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Учебно-методическое пособие для бакалавров,
магистрантов и аспирантов



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Составители: ст. преподаватель **Е.Ю. Сементовская**,
зав. кафедрой, канд. филол. н., доц. **Е.Г. Коротких**,

Рецензент: канд. филол. наук, доц. каф. теории языка и межкультурной коммуникации НГПУ **Н.В. Носенко**

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Учебно-методическое пособие предназначено для аудиторной и самостоятельной работы с учебным материалом профессиональной направленности на английском языке. Разделы пособия содержат текстовый материал профессионально-ориентированного характера. Издание призвано помочь студентам сформировать необходимые знания, умения и навыки: умение читать и анализировать тексты на английском языке с целью не только извлечения информации, но и приобретения навыков устной и письменной специализированной коммуникации. Учебный материал пособия может быть использован для самостоятельной работы студентов и в качестве заданий для промежуточной и итоговой аттестации по дисциплинам блока «Иностранный язык (английский)».

Пособие может быть использовано в качестве основной или дополнительной литературы для всего набора дисциплин блока «Иностранный язык» инженерных направлений подготовки бакалавриата, специалитета, магистратуры, аспирантуры очной и заочной форм обучения.

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ПОЯСНИТЕЛЬНАЯ ЗАПИСКА

Данное учебное пособие предназначено, прежде всего, для бакалавров и магистрантов таких направлений подготовки Инженерного института, как «Агроинженерия» (профили: «Технические системы в агробизнесе», «Машины и оборудование для хранения и переработки сельскохозяйственной продукции», «Технический сервис в агропромышленном комплексе», «Электрооборудование и электротехнологии», «Сервис технических систем», «Технические системы и цифровизация производства», «Технические системы и роботизация пищевых производств», «Технологии и средства механизации в агробизнесе», «IT менеджмент в агроинженерии», «Управление электроэнергетическими системами в АПК»). Пособие может быть использовано в качестве дополнительной учебной литературы по всем направлениям подготовки Инженерного института очной и заочной форм обучения.

Пособие рассчитано на 60-70 уч. часов аудиторных занятий и 100-120 часов самостоятельной работы, что соответствует базовым стандартам ФГОС. Издание может быть использовано в научно-исследовательской работе магистрантов и при подготовке к сдаче кандидатского экзамена по английскому языку.

В основных разделах пособия представлены:

- 1) работа с текстовым материалом профессиональной направленности;
- 2) банк текстов профессиональной направленности для изучающего, ознакомительного чтения, подготовки презентаций, рефератов и научных докладов;
- 3) рекомендации и справочный материал для эффективной подготовки профессиональной и научной презентации;
- 4) методические указания по организации самостоятельной работы.

Раздел «Работа с текстовым материалом профессиональной направленности» представлен в 6 учебно-тематических блоках (Units), которые соответствуют уровню языковой подготовки A2-B1. Учебный блок открывается обширным тематическим вокабуляром и заданиями на его освоение. Текст для изучающего чтения каждого блока максимально насыщен профессиональной лексикой и представляет собой современный контент, отражающий специфику определённой инженерной отрасли. Текст для изучающего чтения сопровождается послетекстовыми заданиями на понимание содержания и закрепление специальной лексики (Comprehension Check). Завершающая часть блока – это упражнение на подготовку презентации и доклада к ней по тематике юнита. В каждом из блоков предусмотрены задания на самостоятельную работу – упражнения, ориентирующие студента на аналитическую работу с профессиональной лексикой, на поиск дополнительного материала в интернете и создание презентаций на его основе.

Раздел пособия «Банк текстов профессиональной направленности» представляет собой обширную подборку аутентичных текстов профессиональной тематики. Текстовый банк делится на пять тематических частей:

- 1) Professional Agricultural Machinery (66 текстов),
- 2) Working Safely with Mobile and Stationary Agricultural Machinery (7 текстов),
- 3) Equipment and Systems for Dairy, Poultry and Pig Farms (15 текстов),
- 4) Processing Equipment (10 текстов),
- 5) Digital Technologies in Agriculture (19 текстов).

Представленная в пособии первая тематическая подборка Professional Agricultural Machinery включает в себя 4 подраздела:

- Grain Harvesting Combines and Adapters (17 текстов),
- Hay and Forage-harvesting Machines (20 текстов),

- Tractors (14 текстов),
- Tractor Attachments and Implements (15 текстов).

Первая и вторая подборки текстов профессиональной направленности Professional Agricultural Machinery, Working Safely with Mobile and Stationary Agricultural Machinery – это современный профессиональный контент, связанный с работой инженера-механика, специалиста в области организации эффективного использования сельскохозяйственной техники и технологического оборудования на предприятиях агропромышленного комплекса; поддержания работоспособности машин; монтажа, наладки и поддержания режимов работы электрифицированных и автоматизированных технологических процессов и установок; охраны труда и экологической безопасности производства.

Третья и четвертая подборки текстов Equipment and Systems for Dairy, Poultry and Pig Farms и Processing Equipment позволяют подробно изучить довольно обширный пласт специальной лексики, связанной с обеспечением эффективного использования и надежной работы сложных технических систем в животноводстве; а также с монтажом, наладкой и эксплуатацией машин и оборудования для хранения и переработки продукции животноводства и растениеводства.

Пятая подборка текстов Digital Technologies in Agriculture знакомит с современными технологиями в области цифровизации и роботизации производств АПК, предприятий по переработке сельскохозяйственной продукции и пищевых производств.

Раздел пособия «Банк текстов профессиональной направленности» содержит большое количество рисунков и иллюстраций, которые помогают наглядно представить ряд сложных содержательных аспектов специализированного текстового материала.

Раздел «Инструкция для подготовки устной презентации текстового материала на английском языке» содержит методические рекомендации по общему алгоритму создания устных презентаций. Презентации могут выполняться студентами по текстам, представленным в текстовом банке. В разделе также содержится подробный справочный материал по компьютерным технологиям подготовки докладов и презентаций.

Раздел «Методические рекомендации по организации самостоятельной работы» ставит целью методическое обеспечение процесса самостоятельной работы и самоподготовки студентов. Как правило, самостоятельная работа студентов – это подготовка пересказа, реферата, аннотации, проекта. Подробные рекомендации по подготовке данных видов самостоятельной учебной деятельности представлены в разделе.

Основные навыки, освоение которых является первоочередной задачей данного пособия:

- навык корректного перевода текстов профессиональной направленности;
- навык академически правильного устного представления/презентации контента профессиональной направленности.
- формирование навыков устной и письменной профессиональной коммуникации.

Таким образом, каждый блок, через тексты и систему упражнений стимулирует интерес обучающихся к научной коммуникации на иностранном языке, повышает мотивацию к процессу обучения, способствует формированию основных и профессиональных компетенций:

- способность применять иностранный язык в сфере профессиональной деятельности;
- способность к письменной и устной профессиональной коммуникации на иностранном языке;
- способность использовать знание иностранного языка для получения профессиональной информации из иностранных источников.

Пособие может быть использовано в разнообразных условиях учебного процесса для развития базовой коммуникативной компетенции – умения получать, перерабатывать и передавать информацию на иностранном языке.

РАЗДЕЛ 1. РАБОТА С ТЕКСТОВЫМ МАТЕРИАЛОМ ПРОФЕССИОНАЛЬНОЙ НАПРАВЛЕННОСТИ

Тексты профессиональной направленности с практическими заданиями

Unit 1. Agricultural Engineering

Exercise 1. Read and memorize the words and word combinations.

1. agroengineering /agricultural engineering агроинженерия
2. challenge вызов, сложная задача, проблема
3. feeding питание
4. environmental impact воздействие на окружающую среду
5. intersection пересечение, стык
6. agriculture сельское хозяйство
7. technology техника; технические и прикладные науки; технология
8. engineering инженерия; техника
9. sustainable (экологически) устойчивый (не наносящий ущерба окружающей среде)
10. farming practices агротехника
11. equipment оборудование; аппаратура; техника
12. machinery машины; машинное оборудование; механизмы
13. irrigation system оросительная система
14. building здание, постройка, сооружение, строение
15. soil erosion почвенная эрозия, эрозия почв
16. farm structure сельскохозяйственная постройка
17. soil management управление использованием почв; система ухода за почвой
18. erosion control борьба с эрозией
19. water supply водоснабжение; подача воды
20. processing переработка
21. environmentally friendly не наносящий ущерба окружающей среде, не загрязняющий окружающую среду
22. evaluate оценивать, давать оценку; составлять мнение
23. solve решать, разрешать (проблему и т. п.); находить выход; выяснять
24. pollution control меры по охране окружающей среды; контроль за загрязнением окружающей среды; борьба с загрязнением
25. natural resources природные богатства
26. agricultural product сельскохозяйственная продукция
27. agricultural infrastructure аграрная инфраструктура
28. warehouse склад; амбар; хранилище
29. water reservoir водохранилище; водоём
30. dam дамба, плотина, насыпь; запруда
31. artificial intelligence искусственный интеллект
32. mechanical engineering инженерное обеспечение механического оборудования; разработка механического оборудования; механическая инженерия
33. civil engineering гражданское строительство; искусство / техника строительства
34. electrical engineering электротехническая инженерия; проектирование электрических устройств; электрическая инженерия; электронная инженерия
35. chemical engineering химическая технология; химическое машиностроение; химическая инженерия

36. broad field широкая область деятельности, широкая сфера деятельности
37. area of specialization область специализации
38. subfield подобласть (науки)
39. power энергетическое хозяйство
40. power unit энергетический блок; блок питания; силовой агрегат; силовая установка
41. soil conservation охрана почвенных ресурсов
42. water conservation охрана водных ресурсов; гидромелиорация
43. water wastage потери воды
44. conservation strategy природоохранная стратегия
45. storage хранение; складирование
46. post-harvest handling послеуборочная обработка
47. structural engineering проектирование зданий и сооружений, проектирование промышленных сооружений
48. environmental engineering инженерные средства и методы охраны окружающей среды, техника моделирования эксплуатационных условий с учётом их влияния на окружающую среду
49. area of expertise область знаний (в экспертной системе)
50. designing конструирование, проектирование
51. testing испытание, исследование, опробование, тестирование
52. improving улучшение
53. agricultural machinery сельскохозяйственные машины
54. developing разработка; создание
55. conservation measures меры по охране
56. environmental impact воздействие на окружающую среду
57. agricultural development развитие сельского хозяйства
58. collaborating сотрудничество, совместная работа
59. implement реализовать; осуществлять; выполнять; внедрять; претворять; воплощать
60. conducting проведение
61. research and development projects научно-исследовательские проекты
62. agricultural productivity продуктивность сельского хозяйства
63. advantage преимущество
64. drawback недостаток, отрицательная сторона
65. pro аргумент «за»
66. job satisfaction удовлетворение от работы, удовлетворенность работой
67. growing demand растущий спрос
68. job security гарантия занятости, обеспеченность работой
69. diverse разнообразный; различный; разный; многообразный
70. challenging побуждающий, побудительный, стимулирующий; перспективный
71. con аргумент «против»
72. long hours сверхурочная работа
73. planting season время посадки
74. harvest season сезон сбора урожая
75. physically demanding требующий много физических сил, трудный
76. on-site inspection and testing контроль и испытания на месте
77. weather conditions погодные условия; метеоусловия; метеорологические условия

78. pressure давление; стресс, затруднительные обстоятельства; тяжёлое положение, бремя (каких-л. обстоятельств)
79. demand потребность; спрос
80. commitment приверженность, политика
81. competitive основанный на конкуренции
82. salary жалованье, заработная плата; оклад
83. farm ферма, фермерское хозяйство
84. research laboratory (research lab) научно-исследовательская лаборатория
85. equipment manufacturer изготовитель оборудования
86. governmental agency государственное учреждение
87. increase увеличивать; повышать
88. reduce сокращать; уменьшать; снижать
89. environmental footprint экологический след, техногенная нагрузка, негативное воздействие на экологию, отрицательные последствия воздействия на окружающую среду
90. qualities качества
91. analytical skills аналитические способности
92. problem-solving skills умение решать проблемы
93. devise разрабатывать, продумывать (планы, идеи); выдумывать, изобретать
94. physical stamina физическая выносливость
95. outdoors на улице; на открытом воздухе, вне помещения
96. communication skills навыки общения
97. communicate формулировать; общаться
98. scientist учёный; научный работник
99. policymaker автор политики; лицо, определяющее политику
100. career path продвижение по службе, карьерный рост
101. bachelor's degree степень бакалавра
102. practical experience практический опыт; практические навыки
103. internship стажировка, учебная практика
104. cooperative-education program комбинированная программа работы и учёбы, учёба без отрыва от производства, производственное обучение
105. master's degree степень магистра (учёная степень, промежуточная между бакалавром и доктором)
106. Ph.D. (Doctor of Philosophy) доктор философии (учёная степень; примерно соответствует степени кандидата наук в РФ)
107. Professional Engineering (PE) license разрешение заниматься деятельностью инженера-консультанта
108. responsibility ответственность, обязанность
109. advancement прогресс; достижение
110. ongoing непрерывный, постоянный
111. professional development повышение квалификации
112. agricultural sciences сельскохозяйственные науки
113. fundamentals основы, основные положения
114. fruitful успешный
115. agriculturist агроном; земледелец, фермер
116. GNSS (Global Navigation Satellite Systems) глобальная навигационная спутниковая система
117. GPS (Global Positioning System) глобальная система навигации и определения положения

118. human factors engineering эргономика и психотехника, инженерная психология
119. carbon dioxide sink поглотитель углекислого газа
120. agriculture inputs средства производства в сельском хозяйстве

Exercise 2. Read the international words and guess their meanings.

Agroengineering, population, minimize, role, technology, engineering, engineers, know-how, optimize, farm, practice, design, machinery, irrigation, critical, climate, erosion, planning, structure, drainage, management, control, electrification, natural, effect, intensive, focus, infrastructures, reservoir, integrate, element, mechanical, electrical, chemical, principle, ecological crises, specialization, focus, specialists, effective, strategy, optimization, product, structural, system, expertise, project, productivity, profession, real, problem, interesting, season, physical, inspection, testing, global, stressful, balance, Canada, Britain, Australia, economy, location, idea, laboratory, manufacturer, agency, innovation, analytical, analyze complex systems, identify, potential, innovative, communication, audience, policy, career, practical, program, master, specialize, professional, license, typically, exam, university, mechanical, biological, cultivate.

Exercise 3. Read and translate Text 1.

Text 1. How to Become an Agroengineer

Sources: <https://au.indeed.com/career-advice/finding-a-job/what-is-agricultural-engineering>, <https://www.profguide.io/en/professions/agroengineer.html>

The world is facing an unprecedented challenge: feeding its ever-growing population while minimizing the environmental impact. That's where the role of the agroengineer comes in. At the intersection of agriculture, technology, and engineering, agroengineers are tasked with developing sustainable and efficient solutions to agricultural challenges. They apply their engineering know-how to optimize farming practices, designing and improving farming equipment and machinery, irrigation systems, and agricultural buildings. The work of agroengineers is critical in our ongoing battle against climate change, soil erosion, and other ecological crises.

Agricultural engineering is the branch of engineering that deals with designing, developing and improving farm machinery, equipment and technology to improve a farm's efficiency, the location and planning of farm structures, farm drainage, soil management and erosion control, water supply and irrigation, rural electrification, and the processing of farm products. The primary goal is to ensure farms are sustainable and environmentally friendly. The agricultural engineers use their engineering skills and knowledge to evaluate and solve issues like pollution control, natural resources management, sustainable agricultural production, the environmental effects of intensive agriculture and how farms handle agricultural products following harvests. While they primarily focus on agricultural land and equipment, they may also design and build different agricultural infrastructures, like warehouses, water reservoirs and dams. Agricultural engineering is a multifaceted career that integrates innovative technology like artificial intelligence with farming. It combines elements of mechanical, civil, electrical and chemical engineering with agricultural principles.

Agroengineering is a broad field, with several areas of specialization available. Agroengineers can choose to focus on various subfields, including:

– Farm Power and Machinery: This specialization emphasizes the design, development, and application of machinery and power units in agriculture.

- Soil and Water Conservation Engineering: These specialists aim to prevent soil erosion and water wastage through effective conservation strategies.
 - Processing and Storage Engineering: Agroengineers in this field focus on the development and optimization of post-harvest handling, storage, and processing technologies for agricultural products.
 - Structural and Environmental Engineering: These agroengineers design environmentally friendly and efficient agricultural buildings and systems.
- Depending on the area of expertise, an agroengineer's tasks may include:
- Designing, testing, and improving agricultural machinery and equipment.
 - Developing soil conservation measures and efficient irrigation systems.
 - Analyzing environmental impact reports in relation to agricultural developments.
 - Collaborating with agricultural scientists to design and implement sustainable farming practices.
 - Conducting research and development projects focused on improving agricultural productivity and sustainability.

Like any profession, being an agroengineer comes with its own set of advantages and drawbacks.

The main pros are:

- Job satisfaction: Solving real-world problems and contributing to sustainability efforts can provide a high level of job satisfaction.
- Growing demand: The need for more sustainable and efficient agricultural practices is growing, providing job security.
- Diverse work: The varied tasks and specializations can keep the work interesting and challenging.

The key cons are:

- Long hours: Agroengineers often have to work long hours, especially during the planting and harvesting seasons.
- Physical demand: The job can be physically demanding, involving on-site inspections and testing in all weather conditions.
- Pressure: The pressure of finding solutions to global agricultural challenges can be stressful.
- Demand: The demand for agroengineers is on the rise globally, driven by an increasing need to balance productivity with sustainability. In countries like the USA, Canada, Great Britain, and Australia, the need for these professionals is especially high due to the importance of agriculture in these economies and their commitment to environmental sustainability.

Salary for agroengineers varies depending on location and specialization. Here's a rough idea: the USA: \$55,000 - \$105,000; Canada: CAD 50,000 - CAD 95,000; Great Britain: £25,000 - £50,000; Australia: AUD 60,000 - AUD 110,000.

Agroengineers work wherever agriculture intersects with technology. This could be on farms, in research labs, for equipment manufacturers, or within governmental agencies. Their skills are needed anywhere that innovation and efficiency can help increase agricultural production while reducing the environmental footprint.

There are some important qualities of a successful agroengineer. They are:

- Analytical skills: The ability to analyze complex systems and identify potential improvements is crucial.
- Problem-solving skills: Agroengineers often need to devise innovative solutions to agricultural challenges.

- Physical stamina: The work can be physically demanding, with a lot of time spent outdoors.
 - Communication skills: They must effectively communicate their ideas and findings to a diverse audience, including farmers, scientists, and policymakers.
- Step-by-step career path includes the following stages:
- Obtain a bachelor’s degree in Agricultural Engineering or a related field.
 - Gain practical experience through internships or cooperative-education engineering programs.
 - Consider obtaining a master’s degree or Ph.D. for specialized roles or roles in research.
 - Obtain a Professional Engineering (PE) license for increased job opportunities and responsibilities.
 - Continue learning and stay updated with the latest advancements in the field through ongoing professional development.

To become an agroengineer in the USA, you typically need a bachelor’s degree in agricultural engineering or a related engineering field, which takes about four years. Some jobs may require a state-issued Professional Engineering (PE) license, which usually requires an engineering degree, work experience, and passing an exam. If you’re interested in studying Agroengineering, you must enter a university offering Agroengineering programs. You can become an agroengineer even if your degree isn’t specifically in agricultural engineering. Many agroengineers have degrees in civil, mechanical, or environmental engineering. What’s most important is a strong understanding of biological and agricultural sciences, as well as solid engineering fundamentals. If you’ve got that, you can cultivate a fruitful career in Agroengineering!

Exercise 4. Answer the questions.

1. What do agroengineers deal with?
2. What is Agroengineering?
3. What subfields can agroengineers choose to focus on?
4. Which tasks do agroengineers perform?
5. What are the advantages of this job?
6. What are the main drawbacks?
7. What does a salary depend on? How high is it in different countries?
8. Where do agroengineers work?
9. What personal qualities should a successful agroengineer have?
10. Which steps should be taken to make a brilliant career in Agricultural Engineering?
11. Where can one get an education to be an agroengineer in the USA?

Exercise 5. Match the terms (1-7) to their definitions (a-g).

1. Agriculture	a. the work involved in designing and constructing engines and machinery, or structures such as roads and bridges. It is also the subject studied by people who want to do this work.
2. Processing	b. a fixed regular payment, typically paid on a monthly basis but often expressed as an annual sum, made by an employer to an employee, especially a professional worker
3. Machinery	c. the science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products

4. Storage	d. the upper layer of earth in which plants grow, a black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles
5. Salary	e. performing a series of mechanical or chemical operations on something in order to change or preserve it
6. Engineering	f. the action or method of storing something for future use
7. Soil	g. machines in general, or machines that are used in a factory or on a farm

Exercise 6. Read about Agricultural engineering and agricultural engineers and complete the gaps (1-5) with the words given in the box.

Engineers, new, manufacturers, repairs, deals, efficiency, interpret, process

Information sources: https://en.wikipedia.org/wiki/Agricultural_engineering, <https://bakai.uma.ac.id/2020/06/14/how-important-is-agribusiness-engineering/>

Agricultural engineering, also known as agricultural and biosystems engineering, is the field of study and application of engineering science and design principles for agriculture purposes, combining the various disciplines of mechanical, civil, electrical, food science, environmental, software and chemical engineering to improve the 1) ... of farms and agribusiness enterprises as well as to ensure sustainability of natural and renewable resources.

The science of agricultural engineering primarily 2) ... with the improvement of agricultural productivity by applying scientific and technological knowledge into the production and management of agricultural crops. There are three main components in agricultural engineering, and these include crop production technology, agribusiness infrastructure, and agriculture inputs. One major component of crop production technology involves genetic engineering, which is responsible for creating 3) ... crops from existing crops. As to other agribusiness technologies, they deal with agricultural marketing systems and strategies. A number of new technologies have been developed. Some of them have been able to significantly improve the quality of agricultural produce. Other technologies have made the processing of agricultural food easier and cheaper. The second component of agricultural engineering is agribusiness infrastructure which refers to the agricultural machinery and equipment used to harvest, 4) ..., and pack agricultural products. The third component is agribusiness equipment, which is used to deliver the finished crop to the market.

An agricultural engineer is an engineer with an agriculture background. Agricultural 5) ... make the engineering designs and plans in an agricultural project, usually in partnership with an agriculturist who is more proficient in farming and agricultural science.

Agricultural engineers may perform tasks such as planning, supervising and managing the building of dairy effluent schemes, irrigation, drainage, flood water control systems, performing environmental impact assessments, agricultural product processing and 6) ... research results and implement relevant practices. A large percentage of agricultural engineers work in academia or for government agencies. Some are consultants, employed by private engineering firms, while others work in industry, for 7) ... of agricultural machinery, equipment, processing technology, and structures for housing livestock and storing crops. Agricultural engineers work in production, sales, management, research and development, or applied science. In the United Kingdom the term agricultural engineer is often also used to describe a person that 8) ... or modifies agricultural equipment.

Exercise 7. Match the sub-disciplines in Agricultural engineering (1-7) with their definitions (a-g).

Information sources: https://en.wikipedia.org/wiki/Agricultural_engineering#Sub-Disciplines, https://en.wikipedia.org/wiki/Agricultural_machinery, <https://en.wikipedia.org/wiki/Irrigation>, https://en.wikipedia.org/wiki/Soil_management, https://en.wikipedia.org/wiki/Precision_agriculture, https://en.wikipedia.org/wiki/Human_factors_and_ergonomics, <https://en.wikipedia.org/wiki/Aquaculture>, <https://en.wikipedia.org/wiki/Forestry>

1. Agricultural Machinery	a. This sub-discipline deals with the application of operations, practices, and treatments to protect soil and enhance its performance (such as soil fertility or soil mechanics). It includes soil conservation, soil amendment, and optimal soil health. In agriculture, it is needed both in nonorganic and organic types to prevent agricultural land from becoming poorly productive over decades.
2. Irrigation	b. This type of agriculture is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability. It is used in both crop and livestock production. It often employs technologies to automate agricultural operations, improving their diagnosis, decision-making or performing. It is also an application of breakthrough digital farming technologies. The practice of this agriculture has been enabled by the advent of GPS and GNSS.
3. Human Factors and Ergonomics	c. This sub-discipline relates to the mechanical structures and devices used in farming or other agriculture. There are many types of such equipment, from hand tools and power tools to tractors and the countless kinds of farm implements that they tow or operate. It can be regarded as part of wider agricultural automation technologies, which includes the more advanced digital equipment and robotics.
4. Precision Agriculture	d. This sub-discipline, also known as aquafarming, is the controlled cultivation ("farming") of aquatic organisms such as fish, crustaceans, mollusks, algae and aquatic plants (e.g., lotus). Aquaculture involves cultivating freshwater, brackish water and saltwater populations under controlled or semi-natural conditions.
5. Soil Management	e. This sub-discipline, also referred to as watering, is the practice of applying controlled amounts of water to land to help grow crops, maintain landscape plants and lawns, revegetate disturbed soils in dry areas and during times of below-average rainfall. It is also used to protect crops from frost, suppress weed growth in grain fields, prevent soil consolidation, cool livestock, reduce dust, dispose of sewage, and support mining operations. Drainage, which involves the removal of surface and sub-surface water from a given location, is often studied in conjunction with watering.
6. Aquaculture	f. It is the science and craft of creating, managing, planting, using, conserving and repairing forests and woodlands for associated resources for human and environmental benefits. It embraces a broad range of concerns: the provision of timber, fuel wood, wildlife habitat, natural water quality management, recreation, landscape and community protection, employment, aesthetically appealing landscapes, biodiversity

	management, watershed management, erosion control, and preserving forests as carbon dioxide sinks.
7. Forestry	g. This sub-discipline commonly referred to as human factors engineering (HFE) is the application of psychological and physiological principles to the engineering and design of products, processes, and systems. Primary goals of HFE are to reduce human error, increase productivity and system availability, and enhance safety, health and comfort with a specific focus on the interaction between the human and equipment.

Exercise 8. Discuss the following points.

1. How to become an agricultural engineer in Russia?
2. What do agricultural engineers do?
3. Where can agricultural engineers work?

Exercise 9. Search the Web for Agricultural engineering in Russia. Make a presentation.

Exercise 10. Look through Unit 1 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 2. Mechanization in Agriculture

Exercise 1. Read and memorize the words and word combinations.

1. mechanization механизация, механизирование
2. mechanized farming механизированное сельскохозяйственное производство
3. agricultural industry сельскохозяйственная промышленность, агропромышленность
4. benefit выгода; польза; прибыль; преимущество
5. advancement улучшение; развитие, прогресс
6. delve делать изыскания, изучать
7. outcome результат
8. improved techniques усовершенствованные методы; более передовая техника; технические усовершенствования
9. commercialization коммерциализация; промышленное внедрение
10. nullification аннулирование, нуллификация
11. labor shortages дефицит рабочей силы, нехватка рабочей силы
12. crop production производство сельскохозяйственных культур
13. farm income доход сельскохозяйственного предприятия
14. power supply мощности
15. timely completion своевременное выполнение/ завершение
16. cultivation возделывание (почвы), культивация
17. crop yield урожайность
18. conserve беречь, охранять; сберегать, сохранять
19. natural resources природные ресурсы
20. environmentally friendly technology экологически благоприятная технология, экологически безопасная технология
21. efficiently эффективно, рационально
22. reduced power consumption уменьшенная мощность потребления

23. sustainable экологически устойчивый (не наносящий ущерба окружающей среде); отвечающий принципам устойчивого развития
24. value chain производственно-сбытовая цепь
25. food system продовольственная система
26. post-harvest послеурожайный; послеуборочный
27. processing переработка
28. marketing activity деятельность в сфере маркетинга, маркетинговая деятельность
29. efficient эффективный; производительный; продуктивный; рациональный, целесообразный
30. effective действенный, результативный, эффективный
31. meet the needs удовлетворять требования, отвечать потребностям
32. farming community производители сельскохозяйственной продукции; фермеры; сельское население
33. burden тяжесть
34. livelihood средства к существованию, заработок
35. land reclamation мелиорирование, улучшение почвы; освоение земли; рекультивация земель
36. soil erosion почвенная эрозия, эрозия почв
37. irrigation system оросительная система; система полива
38. cultivator культиватор; рыхлитель
39. smoothing out разравнивание
40. ditch канава, ров; канал; выемка
41. weed сорная трава, сорняк
42. usable пригодный к использованию
43. plant root корень растения
44. water wastage непроизводительный расход воды
45. overall efficiency общая эффективность, общая производительность, общий коэффициент полезного действия
46. advent наступление (эпохи, события)
47. subsistence farming натуральное сельское хозяйство
48. commercial agriculture товарное сельскохозяйственное производство
49. domestic consumption внутреннее потребление, потребление внутри страны
50. economic benefits экономические преимущества, экономические выгоды
51. food security продовольственная безопасность
52. nullify аннулировать; сводить к нулю; сводить на нет
53. rural area сельская местность; сельскохозяйственный район
54. manual labor ручной труд, физический труд
55. make operational обеспечить функционирование; приводить в рабочее состояние
56. land utilization использование земельных ресурсов; землепользование
57. pave the way прокладывать путь, подготавливать почву
58. challenging требующий особого подхода
59. arable пахотный; пашня, пахотная земля
60. difficult terrain труднопроходимая местность; местность со сложным рельефом
61. unusable неподходящий, непригодный для использования
62. farming practices методы производства сельскохозяйственных работ

63. growth рост; развитие; выращивание
64. income доход; прибыль; заработок
65. extended period длительный период
66. paid labor оплаченный труд
67. profitability прибыльность, рентабельность, доходность
68. poverty бедность, нищета, нужда
69. machine машина; агрегат; установка; аппарат; механизм; устройство
70. hand tool ручной инструмент
71. draught тяга
72. efficiency эффективность, производительность
73. productivity урожайность, продуктивность
74. tilling обработка почвы, пахота, культивация
75. planting посадка; сев
76. harvesting уборка урожая; уборочные работы
77. transporting транспортирование, транспортировка
78. livestock скот; поголовье скота
79. crop сельскохозяйственная культура, продукция
80. soil conditions почвенно-грунтовые условия, состояние почвы
81. agricultural machinery сельскохозяйственные машины
82. farm worker сельскохозяйственный рабочий
83. timeliness of operation своевременное выполнение работ
84. good quality высокое качество
85. costly дорогой; дорогостоящий
86. time-consuming отнимающий много времени, связанный с тратой времени; трудоёмкий
87. combine комбайн
88. harvester уборочная машина
89. mower косилка; сенокосилка; травокосилка
90. back shovel экскаватор типа обратная лопата
91. excavate копать, рыть; вынимать грунт; производить земляные работы
92. harrow борона
93. breaking up дробление, процесс боронения
94. rake грабли
95. pull тянуть, тащить
96. plow/plough плуг; вспахивать, пахать; прокладывать борозду
97. combine harvester зерноуборочный комбайн
98. sprayer разбрызгивающее устройство; распылитель; разбрызгиватель; опрыскиватель; агропультверизатор
99. water pump водяной насос

Exercise 2. Read the international words and guess their meanings.

Mechanized farming, revolutionize, industry, farmer, mechanization, technique, commercialization, nullification, production, start, role, cultivation, natural, technology, system, marketing, effective, practice, erosion, irrigation, optimize, cultivator, tractor, commercialization, commercial, export, economic, nullify, effect, migration, urban centers, problematic, machines, potential, period, result, global, evolve, innovation, sector, typically, mechanical, basic, process, transporting, monitoring, automation, operator, information, instruction, muscle, business, organization, investment, dramatic, tractor, combine, trend, specialized, specific, excavate, material, sprayer, chemical.

Exercise 3. Read and translate Text 1.

Text 1. Mechanized Farming

Source: <https://www.xcubelabs.com/blog/all-you-need-to-know-about-mechanized-farming/>

Mechanized farming has revolutionized the agricultural industry, bringing numerous benefits and advancements to farmers around the world. This article will delve into the importance of mechanization in agriculture, and the various advantages it offers. We will explore such outcomes of mechanized farming as improved techniques, commercialization, nullification of labor shortages, increased crop production, and higher farm income. So, let's discover all you need to know about mechanized farming.

To start with, let's consider the importance of mechanization in agriculture. Mechanization plays a crucial role in agricultural crop production. By increasing the power supply to agriculture, mechanization allows for the timely completion of tasks, cultivation of larger areas, and higher crop yields, all while conserving natural resources. Moreover, the use of environmentally friendly technologies enables farmers to produce crops more efficiently with reduced power consumption.

Sustainable mechanization in agriculture also contributes significantly to the development of value chains and food systems. It enhances post-harvest, processing, and marketing activities, making them more efficient, effective, and environmentally friendly. By adopting mechanization practices that meet the needs of farmers, including women who contribute significantly to farming communities, the burden of labor can be reduced, thereby improving their livelihoods.

Now let's move onto advantages of mechanized farming.

1. **Improved Techniques:** Mechanization has brought about significant improvements in agricultural techniques. Land reclamation has become more efficient, soil erosion has been reduced, and irrigation systems have been optimized. Cultivators attached to tractors help in smoothing out the soil, filling in ditches, and removing weeds, thereby increasing the amount of usable land and preventing soil erosion. Additionally, mechanized irrigation systems enable targeted watering of plant roots, reducing water wastage and improving overall efficiency.

2. **Commercialization:** The advent of mechanization has led to a shift from subsistence farming to commercial agriculture. The increased productivity and crop yields offered by mechanization have made it possible to produce more food on a larger scale, allowing for both domestic consumption and export. Commercial agriculture brings economic benefits to farmers and contributes to overall food security.

3. **Nullifies Effects of Labor Shortages:** Labor shortages in rural areas, caused by migration to urban centers, have become less problematic due to agricultural mechanization. Machines can now perform a wide range of tasks that previously required manual labor. This handles not only the labor shortage but also reduces the amount of time and effort needed to make farms operational.

4. **Increased Crop Production and Land Utilization:** Mechanization has paved the way for increased crop production by making the challenging lands arable and improving land utilization. Difficult terrains that were once considered unusable can now be cultivated with the help of machines. This expansion of usable land, combined with the efficiency of mechanized farming practices, allows for the growth of a larger variety of crops and significantly higher yields.

5. **Higher Farm Income:** One of the most significant advantages of mechanized farming is the potential to increase farm income. Mechanization saves time and reduces

the need for extended periods of paid labor. Additionally, the higher crop yields achieved through mechanized practices result in increased income. This, in turn, allows farms to operate on a larger scale, reaching global markets and expanding their profitability.

Summing up, it is important to say that mechanized farming has revolutionized the agricultural industry, bringing about numerous advantages and advancements. Improved techniques, commercialization, nullification of labor shortages, increased crop production, and higher farm income are just a few of the benefits that mechanization offers. As we move forward into the 21st century, the role of mechanized farming will continue to evolve, driving further innovations and improvements in the agriculture sector. Embracing sustainable mechanization practices will be crucial for achieving food security, reducing poverty, and improving the livelihoods of farmers worldwide.

Exercise 4. Answer the questions.

1. Which outcomes of mechanized farming are explored in the article?
2. Why is mechanization in agriculture very significant?
3. What does sustainable mechanization in agriculture improve?
4. What are the main advantages of mechanized farming?
5. How can improved techniques optimize agriculture?
6. What benefits does commercial agriculture bring?
7. Why have labor shortages in rural areas become less problematic?
8. How can mechanization improve land utilization?
9. How does mechanized farming increase farm income?

Exercise 5. Match the terms (1-15) to their definitions (a-g).

1. To mechanize	a. an amount of a produced agricultural product
2. To cultivate	b. not harmful to the environment
3. Marketing	c. money received or earned, especially on a regular basis, for work or through investments
4. Environmentally friendly	d. to introduce machines or automatic devices into a process or place
5. Income	e. a thing that makes something better
6. Yield	f. to prepare and use land for crops or gardening
7. Improvement	g. the action or business of promoting and selling products or services, including market research and advertising
8. Tractor	h. a mechanical implement, a tool or machine which is used to break up the earth or to remove weeds, for example, in a garden or field
9. Mower	i. a powerful motor vehicle with large rear wheels, used chiefly on farms to pull farm machinery and to provide the energy needed for the machinery to work
10. Plough/plow	j. a piece of equipment used for spraying liquid somewhere
11. Cultivator	k. a garden tool consisting of a row of metal or wooden teeth attached to a long handle and is used to make the earth smooth and level before putting plants in, or to gather leaves together
12. Combine harvester	l. a machine that has sharp blades for cutting something such as grass, corn or wheat
13. Rake	m. a piece of farm equipment or an implement consisting of a heavy frame set with teeth or tines which is dragged over ploughed land to break up large lumps of soil, remove weeds, and cover seeds

14. Harrow	n. a large farming tool with sharp blades which is pulled across the soil to turn it over, usually before seeds are planted
15. Sprayer	o. an agricultural machine that reaps, threshes, and cleans a cereal crop in one operation; it is normally used on farms to cut, sort, and clean grain

Exercise 6. Read about Mechanization in Agriculture and complete the gaps (1-5) with the words given in the box.

Combines, efficiency, reduce, process, mechanization
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Information source: <https://www.agriculturelore.com/what-is-mechanization-in-agriculture/>

The mechanization of any industry or activity typically leads to increased efficiency and productivity. In many cases, it can also help to reduce the cost of production. In agriculture, for example, the use of machines can help to 1) ... the amount of labor required to grow and harvest crops. There are three main power sources for technology: human, animal and mechanical. Each one of these power sources has different technology levels associated with it. Hand-tool technology refers to the simplest and most basic level of agricultural mechanization, which is powered by human labor. Animal draught technology is slightly more advanced, and is powered by animals such as oxen or horses. Mechanical power technology is the most advanced level, and is powered by machines such as tractors. Thus, hand-tool technology is the most basic level, followed by animal draught technology, and finally mechanical power technology.

Mechanization in agriculture is the use of machines, either wholly or in part, to replace human or animal labour and to perform agricultural tasks. Mechanization can make these tasks faster and easier, and can allow farmers to produce more crops in a shorter amount of time. The process of 2) ... in agriculture generally refers to the use of machines and technology to improve farming efficiency and productivity. This can include the use of machines for such tasks as tilling the soil, planting, harvesting, transporting crops and livestock, as well as using technology for such tasks as monitoring soil conditions and crop growth. Unlike automation, which may not depend at all on a human operator, mechanization requires human participation to provide information or instruction. There are different levels of mechanization, from hand/muscle power to powered hand-tools, powered tools, and program controlled powered tools. The level of mechanization determines the speed, accuracy, and efficiency of the production 3) The process of mechanization is an important one for any business or organization that relies on machines and technology to do work. This process can be a costly and time-consuming one, but the benefits of mechanization are typically worth the investment. When done correctly, mechanization can lead to increased 4) ..., productivity, and profitability.

Mechanized agriculture is the process of using agricultural machinery to mechanize the work of agriculture; it greatly increases farm workers' productivity. The effective mechanization contributes to increase production in two major ways: firstly, the timeliness of operation and, secondly, the good quality of work.

The mechanization of farming during the 20th century led to a dramatic increase in agricultural productivity. Tractors, 5) ..., harvesters, and other farm machines helped farms produce more food with less labor. Consequently, the trend since the early part of the 1900s is that fewer people can farm more land. This trend has continued into the 21st century, as farms have become increasingly specialized and efficient.

Exercise 7. Match the question about agricultural mechanization (1-6) with the appropriate answers (a-f).

Information sources: <https://www.agriculturelore.com/what-is-mechanization-in-agriculture/>, <https://www.agriculturelore.com/what-is-mechanization-of-agriculture/>

1. Why is sustainable agricultural mechanization important in agriculture?	a. First, farm mechanization has its limitations, primarily due to economic and poverty factors. In some countries farm machines are not readily available. In others farm machines are rather expensive and most farmers are poor and cannot afford to buy or own them. Second, land tenure systems, such as land fragmentation and communal ownership, limit the use of farm machines. Third, mechanised agriculture can cause environmental degradation. This can include pollution, deforestation, and soil erosion, which can all contribute to greenhouse gas emissions.
2. What are examples of agricultural mechanization?	b. The debate regarding the mechanization of agriculture is ongoing, with pros and cons to be considered on both sides. As to positive impacts, mechanization can lead to increased production efficiency, encouraging large scale production and improving the quality of farm produce. Also, current mechanised agriculture includes the use of tractors, trucks, combine harvesters, countless types of farm implements, aeroplanes and helicopters (for aerial application), and other vehicles. This has made farming much easier and efficient, allowing farmers to produce more food with less labor. However, there are some negative impacts as well. For instance, it can displace unskilled farm labor, cause environmental pollution, deforestation and erosion.
3. What are the problems of mechanization in agriculture?	c. The mechanization of farming during the 20th century has led to many changes in the agriculture industry. The use of tractors, combines, harvesters, and other farm machines has helped farms to become more productive. Consequently, the trend since the early part of the 1900s is that fewer people can farm more land. This trend has helped to increase the overall efficiency of the agriculture industry, and has made it possible for more people to be fed with less labor.
4. What are the benefits of mechanization?	d. There is no doubt it plays a significant role in the development of value chains and food systems. By making postharvest, processing and marketing activities and functions more efficient, effective and environmentally friendly, it helps to improve the overall efficiency of the food system and make it more resilient to shocks and stresses. In addition, it creates employment opportunities and improves the incomes of small-scale farmers and other actors along the value chain.
5. What are the positive and negative impacts of agricultural mechanization?	e. As to examples, there are many different types of agricultural machinery, each with a specific purpose. Mowers are used to cut grass, back shovels are utilized for excavating, harrows are applied for breaking up the ground, cultivators – for tilling soil, rakes – for gathering materials, tractors – for pulling or plowing, combine harvesters – for harvesting crops, sprayers – for applying chemicals, and irrigation systems and water pumps are needed for irrigation.
6. How has mechanization changed	f. Agricultural mechanization has a number of benefits that can help increase productivity, timeliness of operations, improve the preci-

agriculture?	sion, work environment, safety, and drudgery of labor, reduce crop and food losses, health hazards, and encourage large scale farming. Additionally, agricultural mechanization can promote specialization of available manpower and create employment opportunities for the youth.
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Exercise 8. Discuss the following points.

1. Why does mechanization play a significant role in agriculture?
2. What are examples of agricultural mechanization in Russia?
3. What are the problems of farm mechanization in our country?
4. What are the benefits of agricultural mechanization in Russia?

Exercise 9. Search the Web for mechanization of agriculture in Russia. Make a presentation.

Exercise 10. Look through Unit 2 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 3. Agricultural Machinery

Exercise 1. Read and memorize the words and word combinations.

1. agricultural machinery сельскохозяйственные машины
2. grow выращивать, культивировать
3. harvest собирать урожай
4. crop сельскохозяйственная культура
5. plow/ plough плуг
6. precision agriculture точное земледелие; соответствующее местным условиям сельское хозяйство; прецизионное сельское хозяйство
7. agriculture industry сельскохозяйственная отрасль
8. advancement продвижение, улучшение; развитие, прогресс
9. has seen significant advancements in technology over the years.
10. agricultural tech сельскохозяйственные технологии
11. tool инструмент; орудие труда; оборудование; приспособление; механизм, средство; способ
12. agricultural production сельскохозяйственное производство; сельхозпродукция
13. equipment оборудование; приспособление; установка; устройство, (технические) средства; техника; приборы; оснащение
14. device устройство; аппарат; прибор; приспособление; установка; механизм
15. activities деятельность
16. plowing вспашка; пропахивание; плужная обработка почвы; пахота
17. planting посадка; посев
18. livestock скот; поголовье скота
19. harvester жатка, жнейка; уборочная машина
20. feed mixer кормосмеситель; кормомешалка
21. field-wide по всему полю
22. weed remover удалитель сорняков
23. steam-powered на паровой тяге
24. cultivate возделывать, обрабатывать (почву); культивировать

25. farming equipment агротехника; сельскохозяйственное оборудование; сельхозтехника
26. rake грабли
27. shovel лопата; экскаватор
28. multiple разнообразный
29. automated sorting line автоматизированная сортировальная линия
30. conveyor system конвейер; транспортная система
31. self-driving беспилотный; оборудованный системой автоматического управления; самоуправляемый
32. vehicle транспортное средство
33. plant process производственный процесс; технологический процесс
34. sensing technology технология очувствления (роботов); сенсорная техника; сенсорная технология; технология распознавания
35. ripeness спелость, зрелость; готовность
36. soil fertility плодородие почвы
37. manual inspection проверку вручную
38. effectively действенно; эффективно
39. efficiently рационально; разумно
40. plot of land земельный участок, надел; небольшой участок земли
41. manageable лёгкий в обращении; поддающийся обработке
42. unprecedented success небывалый успех
43. techniques техническое оснащение или оборудование
44. agricultural mechanization механизация сельского хозяйства
45. practice технология; метод; способ
46. land reclamation мелиорирование, улучшение почвы; освоение земли; рекультивация земель
47. soil erosion почвенная эрозия, эрозия почв
48. irrigation system оросительная система; система орошения
49. cultivator культиватор
50. smooth out сглаживать; выравнивать
51. ditch канава, ров, выемка, углубление
52. erode разрушаться; выветриваться; размываться; подвергаться эрозии
53. boost увеличивать; ускорять; стимулировать
54. commercialization коммерциализация; извлечение прибыли
55. subsistence farming натуральное сельское хозяйство
56. manual labor ручной труд, физический труд
57. nullify сводить к нулю; сводить на нет
58. labor shortage нехватка рабочей силы
59. space пространство; место; площадь
60. arable пахотный; пашня, пахотная земля, пахота
61. farm income фермерский доход
62. monetary gain прибыль по чистой денежной позиции; доход по денежной статье
63. laborer рабочий низкой квалификации; разнорабочий; подсобный рабочий
64. crop yield урожайность
65. profit прибыль, доход
66. level of sophistication уровень совершенства
67. local businesses местные предприятия; местный бизнес

68. on a global scale в мировом масштабе
69. farming practices методы производства сельскохозяйственных работ
70. pest вредитель, паразит
71. upfront costs первоначальные затраты; стоимость начальных капиталовложений
72. maintenance-and-repair costs затраты на техническое обслуживание и текущий ремонт; расходы на поддержание оборудования в работоспособном состоянии
73. dependence зависимость
74. environmental damage ущерб, наносимый окружающей среде; экологический ущерб
75. specific purpose конкретная цель, специальная цель
76. tilling обработка почвы, пахота, культивация
77. size размер, величина; габариты
78. capacity производительная мощность
79. pulverize дробить, измельчать
80. cultipacker ребристый каток
81. squash раздавливать; расплющивать
82. clod комок, крупный кусок (земли или глины)
83. air pockets заполненные почвенным воздухом пустоты и поры
84. small stone камушек
85. implement инструмент, прибор; орудие, средство
86. top layer верхний пласт; поверхностный слой
87. nutrient питательное вещество; питательный элемент
88. subsoil plow плантажный плуг; почвоуглубитель; подпочвенный рыхлитель
89. seedbed почва, подготовленная для посева
90. debris растительный мусор; остатки растений
91. rotary tiller почвенная фреза; роторный культиватор; мотоблок; вращающаяся ножевая борона
92. hard soil твёрдый грунт
93. strip-till полосное вспахивание
94. conventional обычный; традиционный; общепринятый; стандартный
95. no-till нулевая обработка почвы; беспашотный
96. tillage system система обработки почвы
97. harrow борона
98. level равнять, выравнивать
99. loosen рыхлить, разрыхлять
100. seed drill (зерновая) рядовая сеялка; высевательный аппарат
101. sow сеять, высевать
102. furrow борозда, колея
103. even точный; равномерный; одинаковый
104. depth глубина
105. rate распределение
106. broadcast seeder разбросная сеялка; сеялка разбрасыватель
107. spreader разбрасыватель; разбрызгиватель; распылитель
108. seeds семена; посевной материал
109. lime известь
110. fertilizer удобрение; удобрительный тук
111. seed-cum-fertilizer drill зернотуковая сеялка

112. irrigation equipment оборудование для орошения; ирригационное оборудование
113. pump насос; помпа
114. sprinkler разбрызгиватель; дождевальная машина; спринклер; автоматическая водораспыляющая насадка; дождевальный аппарат, дождеватель; ороситель
115. watering полив, орошение
116. fire sprinkler system спринклерная система пожаротушения; спринклерная установка пожаротушения
117. water supply водопровод, водоснабжение; подача воды
118. control fire локализовать пожар
119. centre irrigation центральное круговое орошение
120. fertilizing внесение удобрений
121. pest control борьба с вредителями; защита растений от вредителей
122. manure spreader/ muck spreader разбрасыватель навоза; навозоразбрасыватель; жиже-разбрызгиватель
123. honey wagon ассенизационная машина; навозоразбрасыватель
124. slurry tank резервуар для навозной жижи; жижесборник
125. tank бак, резервуар, цистерна
126. sprayer распылитель; разбрызгиватель
127. harvesting equipment уборочная техника
128. threshing equipment молотильный агрегат
129. combine harvester комбайн; зерновой комбайн
130. shake the grain off the stalk выбивать из колосков зёрна
131. clean очищать
132. store хранить, собирать (в бункере комбайна)
133. wheat пшеница
134. corn кукуруза, маис
135. soybean соя; соевый боб
136. cut срезать
137. thresh молотить, производить обмолот
138. sickle серп; режущий аппарат
139. grass трава
140. hay сено
141. mower косилка; сенокосилка; травокосилка
142. motor двигатель; мотор
143. reaper жатвенная машина, жатка
144. cereal crop зерновая культура; крупяная культура
145. power tiller моторная почвофреза; мотокультиватор
146. conveyor belt ленточный конвейер; ленточный транспортёр
147. crop harvesting сбор урожая
148. forage crop фуражная культура; кормовая культура
149. bale тюк, рулон
150. grain harvesting хлебоуборочный; зерноуборочный
151. edible seeds съедобные/ годные в пищу зерна
152. root crop корнеплодная культура; корнеплод
153. harvesting machine уборочная машина
154. potatoes картофель
155. carrot морковь
156. onion лук

157. beet свёкла
 158. thresher молотилка
 159. stalk стебель
 160. husk шелуха; мякина; полова
 161. vegetable овощ
 162. hauling перевозка; транспортировка; буксировка
 163. tract полоса, участок (земли)
 164. oat овёс
 165. barley ячмень
 166. header жатка, хедер (комбайна)
 167. forage harvesters кормоуборочный комбайн, силосоуборный комбайн, ко-силка-измельчитель
 168. forage еда, корм (для животных), фураж
 169. self-propelled самоходный
 170. towed буксируемый; прицепной
 171. alfalfa люцерна
 172. clover клевер
 173. forage wagon высокобортный прицеп для кормов
 174. attachment приспособление; устройство
 175. baler пресс-подборщик (сена, соломы); упаковочный пресс
 176. straw солома
 177. subsoil подпочва; подпахотный слой
 178. disk harrow дисковая борона
 179. chisel plow глубокорыхлитель; чизель; чизельный культиватор
 180. drag harrow лапчатая борона; волокуша
 181. level out выравнивать, делать ровным
 182. seed hopper семенной ящик сеялки; баночный высеивающий аппарат
 183. fertilizer spreader разбрасыватель удобрений; разбросная туковая сеялка; тукоразбрасыватель
 184. drop-type spreader разбросная сеялка с нижним высевом
 185. pneumatic spreader сеялка с пневматическим выбрасывателем
 186. insecticide инсектицид, средство от насекомых
 187. fungicides фунгициды
 188. disease заболевание, болезнь; поражение
 189. grain dryer зерносушилка
 190. moisture влага; влажность
 191. mold плесень; плесенный грибок
 192. storage хранение
 193. milling помол; дробление; измельчение; размол
 194. flour мука
 195. natural gas природный газ (propane пропан)

Exercise 2. Read the international words and guess their meanings.

History, machinery, aspect, modern farming, revolutionize, accuracy, industry, technology, production, farmer, device, transporting, tractor, mixer, date, era, cultivate, traditional, function, automated, sorting, conveyor systems, monitor, optimize, process, model, sensing technology, detect, accurately, inspection, technological, effectively, unprecedented, investing, technique, mechanization, practice, erosion, irrigation, eroding,

commercialization, productivity, commercial, effect, transforming, local business, organization, global, control, potential, type, designed, specific, cultivation, cultivator, mix, pulverize, press, rotary, combine, minimal, control, centre, operation, trailer, sprayer, herbicides, pesticides, soy, motor, material, location, form, component, header, elevator, operator, forage, manner, collect, disk, chisel, compacted, platform, line, pneumatic, insecticides, fungicides, typically, electricity, propane, natural gas.

Exercise 3. Read and translate Text 1.

Text 1. Agricultural Machinery

Sources: <https://www.collegenp.com/article/agricultural-machinery-future-of-farming-equipment/>, <https://safetyculture.com/topics/agricultural-machinery/>

Definition and History of Agricultural Machinery

Agricultural machinery has been a critical aspect of modern farming for centuries. The development of these machines has revolutionized the way we grow and harvest crops, making it possible to produce more food with greater efficiency and accuracy. From the invention of the plow to the introduction of precision agriculture machinery, the agriculture industry has seen significant advancements in technology over the years.

Agricultural machinery, also known as agricultural tech, is an essential tool for improving agricultural production. It helps farmers to grow more crops in less time and with greater efficiency. It refers to any kind of equipment or device used in farming activities, such as plowing, planting, harvesting, or transporting crops and livestock. It can include anything from tractors and harvesters to animal feed mixers or field-wide weed removers. The use of farm machinery dates back to the 19th century when the first steam-powered tractors were invented. This marked the beginning of a new era in farming, as farmers could now cultivate more land and produce more crops. Over the years, agricultural machinery has continued to evolve and improve, leading to the development of modern farming equipment and precision agricultural machinery.

Aside from traditional tools like rakes and shovels, modern farm machines have multiple functions that make harvesting fields easier. They range from automated sorting lines and conveyor systems to self-driving vehicles that monitor and optimize plant processes. Furthermore, some cutting-edge models feature advanced sensing technology that lets farmers detect crop ripeness and soil fertility levels much more accurately than through manual inspection. Ultimately, these technological advancements have given farmers worldwide the power to cultivate their land more effectively and efficiently than ever before. Using suitable agricultural machines can make even a tiny plot of land manageable with unprecedented success.

Advantages and Disadvantages of Agricultural Machinery in Farming

The use of agricultural machinery has several advantages and disadvantages. Here are the most significant advantages of investing in agricultural machinery:

- Improves Existing Techniques: Agricultural mechanization practices have improved land reclamation, reduced soil erosion, and made irrigation systems more efficient. The cultivators attached to tractors help to smooth out the soil, fill in ditches and remove weeds, which all help to increase the amount of land used and prevent soil from eroding.

- Boosts Farm Efficiency and Productivity for Commercialization: Agricultural mechanization has primarily replaced subsistence farming increasing productivity and crop yields. In subsistence farming, farmers produce only enough food to feed themselves or their families. Meanwhile, mechanization has enabled commercial farmers to produce far more food for profit.

– Reduces Manual Labor and Nullifies Effects of Labor Shortages: In recent years, many people in rural areas have moved to cities because of more jobs. But this has left farms without enough workers. Farm workers are no longer required to work as hard because machines are doing some of their work.

– Makes More Space for Crops: Using the mechanization process, we can use land more efficiently. Machines can make land arable that might have been unused before. It allows us to grow a wider variety of crops.

– Increases Farm Income: Agricultural mechanization provides more monetary gain for large and small farms and reduces the time needed to pay laborers. Crop yields are higher with machinery, thus increasing farm profits. Lastly, it adds a level of sophistication to farms transforming them from local businesses to organizations that can compete on a global scale.

– More precise and accurate farming practices.

– Better control of weeds and pests.

The main disadvantages include:

– High upfront costs.

– Maintenance-and-repair costs.

– Dependence on technology.

– Potential environmental damage.

Types of Agricultural Machinery According to Use

A diverse range of machines is available, each designed for specific purposes.

1. Machinery Used for Soil Cultivation

– Tractors: Tractors are one of the most essential pieces of agricultural machinery. They are used for a variety of tasks, including plowing, tilling, planting, and transporting crops and livestock. Tractors come in a range of sizes and capacities, making them suitable for both small and large farms.

– Cultivator: A machine used to mix and pulverize soil before planting.

– Cultipacker: A tool that farmers use to squash clods of dirt, get rid of air pockets, and press small stones down into the ground.

– Plough/Plow: A large farming implement used to turn over the top layer of soil, bring fresh nutrients to the surface, and prepare the soil for planting. Plows, including subsoil plows, are essential for creating a well-prepared seedbed that is free of weeds and debris.

– Rotary tiller: A machine that breaks up hard soil and creates a smooth and even seedbed.

– Strip-till: It combines the advantages of conventional tillage and no-till practices in a minimal tillage system.

– Harrows: Tools that are used to level, smooth, or loosen the soil.

2. Machinery Used for Planting

– Seed drill: A machine that allows you to sow seeds in furrows at an even depth and rate. Soil is not required for it to work.

– Broadcast seeder: Otherwise known as a spreader or fertilizer spreader, is commonly used for agricultural purposes such as spreading seeds, lime, or fertilizer.

– Seed-cum-fertilizer drill: It distributes the fertilizer uniformly on the ground.

3. Farm Machinery Types Used for Irrigation

– Irrigation equipment: It includes pumps, sprinklers, and other automated systems for watering crops.

– Fire sprinkler system: It is made of pipes connected to a water supply and used to control fires.

– Centre irrigation: It is used for large-scale farming operations, delivers water from the center of a field.

4. Machinery Used for Fertilizing and Pest Control

– Manure spreader: Also known as a muck spreader or honey wagon, this agricultural machine spreads manure over a field to fertilize it.

– Slurry tank: A trailer with a pump and tank that can mix manure and water, creating an efficient fertilizer for fields.

– Sprayer: A tool that applies herbicides, pesticides, and fertilizers to crops.

5. Harvesting and Threshing Equipment

– Combine harvester: A machine that shakes the grain off the stalk, cleans it, and stores it. Harvesters, also known as combine harvesters, are machines used for harvesting crops such as wheat, corn, and soybeans. They have the ability to cut and thresh the crops in one operation, making the process of harvesting much quicker and more efficient.

– Sickle: An agricultural tool used for harvesting grain crops or cutting grass for hay.

– Mower: A machine used to cut crops or grasses, operated manually by animal power or motor.

– Reaper: A machine used to harvest cereal crops near the ground. These machines are either operated by a power tiller or tractor.

– Conveyor belt: A device that transports materials from one location to another. The agricultural industry uses it frequently to transport grain.

– Crop harvesting machine: The machine that can harvest forage crops and form them into bales simultaneously.

– Grain harvesting machine: It is used to harvest grains and edible seeds from different cereal crops.

– Root crop harvesting machine: It is used to harvest crops such as potatoes, carrots, onions, and beets.

– Threshers: they are used to separate the grain from stalks and husks.

– Vegetable harvesting machine: It is used to harvest vegetables from the ground.

Exercise 4. Answer the questions.

1. What is the definition of agricultural machinery?
2. How does agricultural machinery help farmers?
3. What is agricultural machinery used for?
4. When were the first steam-powered tractors invented?
5. What functions do modern farm machines have?
6. What are the main advantages of agricultural machinery?
7. What disadvantage of agricultural machinery can you name?
8. What machinery is used for soil cultivation?
9. What machinery is utilized for planting?
10. What equipment is applied for irrigation?
11. What types of machinery help to fertilize and control pests?
12. What does harvesting and threshing equipment include?

Exercise 5. Match the terms (1-7) to their definitions (a-g).

1. Tractor	a. плуг
2. Cultivator	b. борона
3. Cultipacker	c. ирригационное оборудование

4. Plough/Plow	d. ребристый каток
5. Rotary tiller	e. разбрасыватель навоза
6. Harrow	f. уборочная машина для корнеплодов
7. Seed drill	g. трактор
8. Broadcast seeder	h. молотилка
9. Seed-cum-fertilizer drill	i. распылитель; разбрызгиватель
10. Irrigation equipment	j. жатка
11. Fire sprinkler system	к. уборочная машина для овощей
12. Manure spreader	l. культиватор
13. Slurry tank	м. почвенная фреза; роторный культиватор
14. Sprayer	п. зерноуборочная машина
15. Combine harvester	о. разбрасыватель удобрений
16. Forage harvester	р. спринклерная установка пожаротушения
17. Mower	q. косилка
18. Reaper	г. резервуар для навозной жижи
19. Fertilizer spreader	s. кормоуборочный комбайн
20. Root crop harvesting machine	t. пресс-подборщик (сена)
21. Thresher	u. комбайн
22. Vegetable harvesting machine	v. зерносушилка
23. Baler	w. разбросная сеялка
24. Grain harvesting machine	x. рядовая сеялка
25. Grain dryer	y. зернотуковая сеялка

Exercise 6. Read about Farm equipment and complete the gaps (1-7) with the words given in the box.

Combine, sprinklers, equipment, planting, harrows, herbicides, increase

Information source: <https://www.agmachineryaustralia.com.au/2022/06/27/the-common-types-of-agricultural-machinery-and-their-uses/>

Farm Equipment

Farm equipment is a broad category of tools and machines used on farms for farming purposes. Farm 1) ... includes everything from tractors and tillers to planting and harvesting equipment. While some farm equipment is designed for a specific task, such as plowing or 2) ..., other farm equipment can be used for multiple tasks.

The most common type of farm equipment is agricultural machinery. Agricultural machinery is one of the most important tools that farmers use in order to 3) ... their productivity. There are many different types of agricultural machinery available on the market, each with its own unique set of features and benefits.

Agricultural machinery includes tractors, 4) ... harvesters, balers, and other machines used in farming. Agricultural machinery can be used for a variety of tasks, such as plowing, planting, harvesting, and transporting crops and livestock.

Other types of farm equipment include irrigation equipment, soil preparation equipment, and crop protection equipment. Irrigation equipment includes pumps, pipes, and 5) ... used to water crops. Soil preparation equipment includes plows, 6) ..., and rotary tillers used to prepare the soil for planting. Crop protection equipment includes sprayers for pesticides, 7) ..., and fungicides used to protect crops from pests and diseases.

Exercise 7. Match the most common agricultural machinery and (1-10) with the description of their use (a-j).

Information source: <https://www.agmachineryaustralia.com.au/2022/06/27/the-common-types-of-agricultural-machinery-and-their-uses/>

1. Tractors	a. Forage harvesters are agricultural machines used to harvest forage, which is a type of animal feed. There are two main types of forage harvesters: self-propelled and towed. Self-propelled forage harvesters are powered by an engine and can operate independently, while towed forage harvesters are pulled by a tractor. Forage harvesters are used to harvest a variety of forage crops, including grass, alfalfa, clover, and corn. The forage crop is cut and then gathered into a chamber, where it is chopped into smaller pieces and blown into a forage wagon or trailer. They can harvest both dry and wet forage, and they can be equipped with a range of attachments to suit different crops and conditions.
2. Combine harvesters	b. A plough or plow is a tool or farm implement used for initial cultivation to loosen, turn, or invert the soil in preparation for sowing. The primary purpose of the plough is to turn over the top layer of the soil and bring fresh nutrients to the surface while burying weeds and the remains of previous crops and exposing the subsoil. This action also aerates the soil, which is important in maintaining soil fertility.
3. Forage harvesters	c. Harrows are a common tool used in agriculture to break up and level out the ground. This helps to prepare the soil for planting. There are many different types of harrows, each with its own specific purpose. The most common type of harrow is the disk harrow, which is used to break up clumps of soil and level out the ground. Other types of harrows include the chisel plow, which is used to loosen up compacted soil, and the drag harrow, which is used to level out fields.
4. Balers	d. A seed drill is a type of agricultural machinery used to sow seeds. It is usually pulled by a tractor or another vehicle and consists of a platform with a seed hopper and a row of drills. The row of drills sows the seeds in a straight line as the machine is pulled along the field. They create a furrow in the ground, into which the seeds are dropped.
5. Ploughs	e. The use of agricultural sprayers is essential for the efficient and timely application of a wide range of products, including herbicides, insecticides, fungicides, and fertilizers. This helps to protect them from pests and diseases. There are many different types and models of agricultural sprayers available on the market, each designed for specific needs and applications.
6. Harrows	f. Tractors are perhaps the most essential piece of agricultural machinery. They can be used for a variety of tasks such as plowing, harrowing, planting, and spraying. However, they can also be used for mowing, harvesting, and hauling materials. Today, tractors are an essential piece of machinery on most farms. They allow farmers to work large tracts of land quickly and efficiently.
7. Seed drills	g. Fertilizer spreaders are used to distribute fertilizer evenly over a field. This helps to ensure that crops receive the correct amount of nutrients. There are different types of fertilizer spreaders, including broadcast spreaders, drop-type spreaders, and pneumatic spreaders. Fertilizer

	spreaders are an essential component of keeping a crop healthy. They aid in the delivery of nutrients to the plants, allowing them to grow healthily.
8. Fertilizer spreaders	h. Grain dryers are agricultural machinery that is used to dry crops such as wheat, barley, and oats. Grain dryers are used to eliminate moisture from the grain in order to avoid mold and bacteria growth, as well as to keep the grain viable for storage. This helps to preserve the grain and prevents it from going moldy. Grain dryers are also used to prepare the grain for milling and to improve the quality of the flour. Grain dryers are typically powered by electricity, but some models may be powered by propane or natural gas.
9. Sprayers	i. There are many different types of balers, but they all have one common purpose: to compress loose materials into a bale. This allows them to be stored and transported in an efficient manner. Farmers use balers to collect hay, straw, grass, and other materials that can be used as livestock feed. It is often hard to collect and transport these materials without the use of machinery.
10. Grain dryers	j. A combine harvester is an agricultural machine used to harvest crops such as wheat, oats, and barley. The combine harvester has many components including a header, thresher, and grain elevator. The header cuts the wheat, oats, or barley plants and the thresher separates the grain from the plant. The grain elevator lifts the grain to the combine harvester's cab where the operator can see the grain being collected.

Exercise 8. Discuss the following points.

1. What are the main groups of agricultural machinery?
2. What is the most important farm machine in Siberia?
3. What are advantages of using agricultural machinery in Novosibirsk region?
4. Which agriculture machine is best from your point of view?

Exercise 9. Search the Web for Agricultural machinery used in Russia or Siberia. Make a presentation.

Exercise 10. Look through Unit 3 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 4. Agricultural Machinery and Farm Equipment Maintenance

Exercise 1. Read and memorize the words and word combinations.

1. agricultural machinery сельскохозяйственные машины
2. farm equipment сельскохозяйственное оборудование
3. maintenance техническое обслуживание, ремонт; содержание; уход
4. physical assets реальные активы, материальные активы
5. machinery оборудование, машинное оборудование; машины; механизмы
6. mobile equipment передвижное оборудование; самоходное оборудование
7. buildings здания и сооружения
8. vital (жизненно) важный, насущный; основной; необходимый
9. seeding посев

10. harvesting уборка урожая; уборочные работы
11. timelines (оговорённые) сроки
12. in the long and short run в долгосрочной и краткосрочной перспективе
13. unplanned maintenance незапланированный ремонт
14. planned maintenance планово-предупредительное техническое обслуживание и ремонт
15. maintenance worker рабочий по ремонту и обслуживанию
16. safe безопасный, не представляющий опасности; не связанный с риском
17. operational функционирующий; в исправном состоянии; рабочий; действующий
18. significant losses значительные убытки
19. facilities оборудование; сооружения; средства; устройства; производственные мощности
20. process перерабатывать; подвергать обработке
21. store хранить, складировать
22. foodstuff / food products продовольствие, продукты питания; продовольственные товары; корм
23. clean чистый
24. structurally sound конструктивно прочный; без повреждений; герметичный
25. consumption потребление
26. preventing предотвращение, предупреждение
27. breakdown сбой в производстве; поломка механизма, машины; авария
28. accident несчастный случай; травма; авария; поломка, выход из строя
29. keep on schedule производить работы строго по графику; выдерживать график
30. planting высадка, посадка
31. fertilizing удобрение, внесение удобрений
32. quality качество; степень качества, кондиционность; сорт
33. end product конечный (промышленный) продукт, готовый продукт (производства, переработки)
34. calibrating калибровка
35. metal detector детектор металла
36. seed drill рядовая сеялка
37. planter сажалка, сеялка
38. baler пресс-подборщик (сена, соломы)
39. plow плуг
40. manure spreader разбрасыватель навоза
41. harvester уборочная машина
42. storehouse склад, хранилище
43. silo силосное хранилище; бункер для хранения
44. dispenser раздатчик; дозатор
45. refrigeration охлаждение; замораживание
46. temperature control system система обеспечения температурного режима; система регулирования температуры
47. extensive экстенсивный (о характере развития, способе производстве)
48. mobile мобильный; передвигающийся; передвижной; переносной
49. permanent стационарный; постоянный
50. conveyor belt лента конвейера; транспортёрная лента
51. pasteurizer пастеризатор, автоклав для пастеризации
52. preventive maintenance check проверка при профилактическом обслуживании

53. winterizing подготовка к зимней эксплуатации
54. winterize подготовить к зиме; утеплить; законсервировать
55. long-term storage длительное хранение; долгосрочное хранение
56. diesel fuel дизельное топливо
57. battery батарея; аккумулятор
58. heavy equipment тяжёлое оборудование; тяжёлая техника
59. draining слив; спускание (жидкостей)
60. application equipment оборудование для внесения
61. hydraulic fluid рабочая жидкость; тормозная жидкость; жидкость для гидравлической системы
62. diesel exhaust fluid жидкость для очистки дизельных выхлопных газов
63. tank бак
64. oil масло; жидкая смазка
65. outstanding неоконченный
66. snowfall снегопад; количество выпавшего снега
67. sub-zero temperature температура ниже нуля
68. degrade ухудшаться; терять качество
69. pollutant загрязняющее вещество, загрязнитель; примеси
70. engine oil моторное масло; машинное масло
71. transmission fluid масло для коробок передач
72. coolant охлаждающая жидкость; охладитель; хладагент
73. daily checking ежедневная проверка; ежедневный технический осмотр
74. annual ежегодный
75. lubricating смазывание
76. moving parts подвижные части
77. operator's manual руководство по эксплуатации
78. guidelines рекомендации; нормативы; указания
79. air filter воздушный фильтр
80. oil filter масляный фильтр
81. fuel filter топливный фильтр
82. clogged забитый; засоренный
83. replace заменять
84. bearing подшипник
85. rotating parts вращающиеся элементы; подвижные части
86. routine maintenance регламентное обслуживание, плановое (техническое) обслуживание; регулярное обслуживание
87. wheel колесо
88. pulley ролик; шкив
89. shaft вал; ось; шток
90. wear out изнашиваться, истираться
91. damaged повреждённый, испорченный
92. calibration interval срок проверки прибора
93. impair нанести ущерб; уменьшать; снижать; нарушать
94. performance работа; рабочие характеристики; функционирование; эксплуатационные качества; производительность
95. wear and tear износ; амортизация; изнашивание; истирание
96. rust коррозия; ржавчина
97. leak течь, протечка; утечка
98. corrosion коррозия; ржавление; разъедание; окисление, ржавчина

99. routine upkeep текущее техническое обслуживание
100. tidying up уборка
101. comprehensive тщательный, полный, генеральный
102. fixed assets долгосрочные активы; фиксированные фонды; недвижимое имущество
103. surface поверхность
104. nontoxic нетоксичный
105. nonabsorbent неабсорбирующий; негигроскопичный; непитывающий
106. lead-based paint краска на свинцовой основе
107. crack трещина; щель
108. breakage поломка; повреждение, разрыв
109. patch up отремонтировать; починить
110. sanitation улучшение санитарных условий
111. HVAC (heating, ventilation and air conditioning) system система обогрева вентиляции и кондиционирования
112. dust пыль
113. vapor пар; испарение
114. fume дым, газы, испарение; резкий, сильный запах
115. remove удалять, устранять
116. semiannual полугодовой, полугодовой, происходящий раз в полгода
117. floor пол; настил
118. drainage system система дренажа; водосток; дренажная система
119. downspout водосточная труба; сливная труба; спускная труба
120. outdoor находящийся вне помещения, на открытом воздухе; внешний
121. gutter водосточный жёлоб, канава; водоотвод
122. debris мусор
123. flooding затопление; подтопление
124. structural damage повреждение конструкций; разрушение сооружений
125. structural integrity конструктивная целостность; целостность сооружения; прочность конструкции
126. mold плесень; плесенный грибок
127. water damage ущерб, нанесенный водной стихией; залив
128. good condition исправное состояние
129. roof truss висячая стропильная конструкция; ферма стропильная; стропила
130. truss plate подферменная плита
131. bracing крепление
132. reinforcement усиление; упрочнение; армирование
133. lighting fixture осветительный прибор; светильник; осветительная техника
134. bulb лампочка; лампа
135. health hazard вред для здоровья; опасность для здоровья; фактор риска
136. shatterproof безосколочный; небьющийся (о стекле)
137. shielded защищённый, экранированный; закрытый щитком/экраном
138. broken piece осколок
139. lighting conditions условия освещения; освещённость
140. property upkeep обслуживание и содержание объектов недвижимости
141. mowing покос, сенокос; кошение
142. pull weeds выдёргивать сорняки
143. general improvement and landscaping благоустройство и озеленение
144. snow removal уборка снега; вывоз снега; сброс снега; очистка от снега

145. janitorial services услуги по уборке и поддержанию чистоты; обслуживание зданий и сооружений
146. wastes removal уборка мусора
147. contamination загрязнение; заражение, инфицирование
148. spoiling повреждение; порча
149. safely безопасно; надёжно; без риска
150. owner's manual руководство пользователя; инструкция для владельца
151. hazard риск, опасность
152. have at hand иметь под рукой; иметь в распоряжении
153. shut down отключить (электричество, питание), остановить (станок, машину и т. п.); глушить (двигатель); выключить (устройство)
154. secure крепить, закреплять
155. power-up включение/ подача питания
156. sustain injuries получить увечья, получить травмы
157. PPE (personal protective equipment) индивидуальные средства защиты, ИСЗ
158. goggles защитные очки
159. gloves перчатки
160. dirt грязь
161. grease смазочное вещество; смазка
162. contaminant загрязнитель, загрязняющее вещество
163. hard hat защитный шлем, шлем-каска
164. structural repairs капитальный ремонт; ремонт несущих конструкций зданий
165. special equipment специальное оборудование; специальное оснащение
166. height высота
167. fall prevention защита от падения с высоты
168. confined area закрытое (невентилируемое) помещение
169. utilize использовать; применять
170. vital (жизненно) важный, насущный, существенный; необходимый
171. hand tools ручные инструменты
172. signage информационные указатели; знаки безопасности; разметка; вывески
173. hazardous area опасная зона; зона повышенного риска; травмоопасная зона
174. warning sign предупреждающий знак; предупреждающая надпись
175. fragile хрупкий; непрочный
176. exercise caution соблюдать осторожность; проявлять осмотрительность
177. broken bone перелом; сломанная кость
178. respiratory diseases заболевания органов дыхания
179. inhaling вдыхание
180. color coding цветная метка; цветовая маркировка
181. cross-contamination перекрёстное загрязнение; взаимное загрязнение
182. hazardous chemicals опасные химические вещества
183. cleaning agent моющее/ чистящее вещество; средство для чистки
184. maintenance training обучение методам технического обслуживания и текущего ремонта
185. best practice передовые практические методы; наработки; наиболее эффективные технологии
186. learning tool обучающее средство; инструмент обучения
187. failure неисправность; отказ; неполадка; повреждение; поломка
188. pre-harvest предуборочный период
189. blade лезвие

190. misalignment смещение / отклонение от заданного положения; несоосность; разрегулировка
191. chain цепь
192. gauge измерительный прибор; датчик
193. warranty гарантия
194. log журнал
195. joint шарнир
196. friction трение; сила трения
197. premature wear преждевременный износ
198. hitch сцепка, сцепное устройство
199. tire шина; покрывка
200. tire pressure внутреннее давление в шине; давление воздуха в шине
201. tread depth глубина рисунка протектора
202. deterioration амортизация, изнашивание, износ
203. sheltered укрытый; защищённый
204. lifespan долговечность; срок службы
205. customization модификация в соответствии с требованиями заказчика; изменение внешнего вида или изготовление продукта по техническим условиям заказчика

Exercise 2. Read the international words and guess their meanings.

Industry, physical, machinery, mobile, process, operation, planned, result, structurally, guarantee, product, calibrating thermometers, metal detector, sensor, tractor, cultivator, irrigation system, silos, sprayer, conveyor system, mixer, temperature control systems, type, specialization, extensive, contrast, function, mobile, permanent, pasteurizer, inspection, preventive, calibration, typically, diesel, battery, cleaning, pesticide, antifreeze, hydraulic, temperature, interval, farmer, transmission, start, inspect, filter, regularly, examining, corrosion, problem, routine, toxic, ventilation, air conditioning, component, recommend, climate control system, drainage, absorbent, structural, serious, services, information, inform, mechanical, special, respirators, respiratory, chemicals, agent, contact, extra, training, practice, person, plan, season, maximize, optimize, testing, specific, detailed, operator, priority, stop, investing, minimize, protocol, document, organized, manufacturer's recommendations, optimal, functionality, potential, modification.

Exercise 3. Read and translate Text 1.

Text 1. Importance of Agricultural Maintenance

Sources: <https://upkeep.com/learning/agricultural-maintenance/>,
<https://safetyculture.com/topics/agricultural-machinery/>

Like many industries, agriculture relies heavily on physical assets, including machinery, mobile equipment, and buildings. It's important to keep everything running properly in order to avoid delays in vital agricultural processes. Seeding, harvesting, and other processes are bound to strict timelines, and the equipment used to carry them out needs to be ready for operation on time. Thus, maintenance is essential to a farm's success, both in the long and short run. Unplanned maintenance can often be more time-consuming than planned one, but both are necessary to keep a farm safe and operational. Maintenance workers in the agricultural industry have an important job: ensuring that machines used on farms operate correctly and are always ready to be used. If these machines aren't available or aren't working correctly, it could result in significant losses for the farm. In addition, facilities meant to process and store foodstuffs must be kept safe, clean, and structurally sound in order to guarantee that the farm's product is safe for consumption.

Agricultural maintenance serves the following tasks: preventing breakdowns and accidents; keeping planting, fertilizing, harvesting, and so forth on schedule; maintaining the quality of end products by calibrating thermometers, metal detectors, sensors, etc.

Some of the assets farmers need to support are: tractors, seed drills, planters, balers, plows, manure spreaders, cultivators, harvesters, irrigation systems, storehouses, silos, sprayers, conveyor systems, mixers, dispensers and refrigeration/temperature control systems. Of course, this is far from a comprehensive list. The types of assets that need to be kept up depend on the farm's size and level of specialization. More extensive farms will have a team to handle maintenance. In contrast, small family-owned farms may only have one person responsible for running the machines (often with help from other relatives). No matter what the farm's size is, a person, who is in charge of repairs, needs to know every machine and how it functions.

Every farming equipment, whether mobile (tractors, harvesters, and plows) or permanent (conveyor belts, mixers, pasteurizers), requires frequent inspections to ensure that it operates properly. Here are some of the most common preventive maintenance checks for equipment maintenance and calibration:

1. **Winterizing Equipment:** Tasks that farmers typically need to perform to winterize their equipment and get it ready for the long-term storage required during colder months include: changing diesel fuel from #2 to #1; keeping batteries charged or disconnecting them during the season; heavy equipment cleaning; draining and cleaning pesticide application equipment; checking and changing antifreeze and hydraulic fluids as needed; draining the diesel exhaust fluid tank (if necessary); preparing oil equipment for storage; making any outstanding repairs; performing other preventive maintenance tasks. If equipment is used in winter, make sure it's ready to operate in the cold weather, especially if you're in an area with high levels of snowfall and sub-zero temperatures.

2. **Checking and Changing Fluids:** It's necessary to ensure that the liquids used in the equipment are clean and safe. These fluids should be exchanged for fresh ones at certain intervals, like when they degrade or gather pollutants. Below are some of the fluids that farmers need to check up on: engine oil (daily checking), transmission fluid (daily checking), coolants (annual checking) and hydraulic fluid (a couple of times per year).

3. **Lubricating Moving Parts:** The operator's manual for each piece of equipment will usually provide general guidelines on lubrication and other preventive maintenance tasks. Use those as a starting point, then inspect and lubricate all the moving parts needed.

4. **Checking and Changing Filters:** Air, oil, and fuel filters should all be changed regularly. Check them regularly to make sure they aren't clogged, and replace them when needed.

5. **Examining the Bearings:** All rotating parts require routine maintenance, including wheels, pulleys, shafts, and bearings. A replacement is necessary if they have worn out too much or become damaged.

6. **Calibrating Equipment:** Ensure that your calibration intervals follow the guidance in the operator's manual for all equipment.

7. **Conducting Damage Inspections:** It's essential to regularly inspect all equipment for any damage that could impair its performance. Look for signs of wear and tear, rust, leaks, corrosion, and any other damage that could affect the machine's performance. If you spot any problems, make sure to get them fixed right away to prevent further damage.

8. **Other Routine Upkeep:** Regular cleaning is necessary to keep the machines working efficiently. You can do simple tasks, such as tidying up, daily, while you can do more comprehensive cleaning on a weekly or monthly basis.

Not only equipment but also fixed assets of any farm such as buildings and land require frequent inspections to ensure that they are clean and safe. Here are some of common preventive maintenance tasks for farm buildings:

1. Walls and Surfaces: Buildings are used either for storing or for processing foods. In either case, the walls and surfaces need to be nontoxic and nonabsorbent to make sure food products are safe. For example, no lead-based paints should be used. If there are any cracks or breakages, they should be patched up in order to facilitate regular sanitation.

2. HVAC Systems: Heating, ventilation, and air conditioning (HVAC) systems are major components of any building where food products are processed or stored. It's important to make sure the right temperature is kept inside the facilities and that any dust, vapors, or fumes are removed out of the building. Semiannual checks are generally recommended for most climate control systems, though some components (e.g., air filters) should be replaced more often.

3. Drainage: Floors should be equipped with drainage and be nonabsorbent. This is especially important in facilities where fluids (milk or water) are handled. Damaged floors should be repaired as quickly as possible. Drainage systems, such as downspouts, should be kept clean and in good working order. In outdoor areas, gutters and downspouts should be kept clear of debris in order to make sure water drains properly in order to prevent flooding and structural damage.

4. Structural Integrity: Every component of a building should be structurally sound, free of mold and water damage, and in overall good condition. Roof trusses, truss-bearing plates, and bracing components should be repaired or replaced if they are damaged. Clean any rust away, and add reinforcement to areas that need it.

5. Lighting Fixtures: Most building maintenance involves making sure all lights are in working order. However, in agriculture and food processing, it's even more important since broken bulbs could pose a serious health hazard. Ensure all bulbs are either shatter-proof or shielded in order to keep foodstuffs from broken pieces. Any time a light goes out, replace the bulb with the appropriate one in order to preserve safe lighting conditions.

6. Property Upkeep: Some activities should be performed daily, while others may be done on a less frequent basis. They include: mowing, pulling weeds, and general improvement and landscaping; snow removal during the winter months; general cleaning work and janitorial services; wastes removal. While dealing with property upkeep, make sure all repairs are handled in a way that keeps foodstuffs safe from contamination or spoiling.

It's also important to make sure the maintenance is handled safely. To perform agricultural maintenance safely, follow these tips:

1. Read the Owner's Manual: The manuals will provide all the information needed to operate and perform maintenance on your farm equipment safely. They give information on which parts are needed and how often to perform routine maintenance tasks, but also inform about the hazards present when working on the equipment. PDFs of user manuals can be stored to have that information at hand during maintenance.

2. Shut Down and Secure Equipment Before Servicing: Before performing any maintenance work, disconnect the equipment, shut off the engine, and remove the keys to avoid accidental power-ups during maintenance and decrease the likelihood to sustain injuries.

3. Use Appropriate PPE: It's always advisable to wear personal protective equipment (PPE) when performing maintenance on farm equipment. Wear appropriate clothing, goggles, and gloves to protect yourself from dust, dirt, grease, oils, and other contaminants that could cause injuries. Gloves and hard hats are advised when working on most mechanical and structural repairs, and special equipment should be used when working at height (fall prevention equipment) or in confined areas with fumes (respirators).

4. Utilize the Correct Tools: Using the appropriate tools for maintenance is vital. Make sure you only use approved hand tools.

5. Add Signage in Hazardous Areas: There should be clear warning signs for hazards on the farm, such as heights, fragile floors, and areas with fumes or dust. It can help workers exercise caution and prevent injuries, such as broken bones from falls or respiratory diseases from inhaling fumes. Also, color coding signs should be used to mark hazards.

6. Avoid Cross-Contamination: Hazardous chemicals, such as pesticides or cleaning agents, are often present on farms. If you're cleaning equipment that has been in contact with these substances, it's necessary to take extra care to avoid cross-contamination with food or other chemicals.

7. Seek Training: Agricultural maintenance training provides crucial information about preventing injuries by implementing best practices. Training can be done in person or using digital learning tools.

8. Plan Maintenance Tasks in Advance: By planning your maintenance tasks and ensuring you have the right tools available; you can help prevent accidents. Additionally, regularly scheduled maintenance may help reduce unplanned repairs due to machinery failure.

Exercise 4. Answer the questions.

1. What physical assets does agriculture rely on?
2. What do maintenance workers do in the agricultural industry?
3. What are the main tasks of agricultural maintenance?
4. What are the most common preventive maintenance checks for equipment maintenance and calibration?
5. What are common preventive maintenance tasks for farm buildings?
6. What recommendations can you give to make sure the maintenance is handled safely?

Exercise 5. Match the terms (1-7) to their definitions (a-g).

1. maintenance	a. машинное оборудование; машины
2. machinery	b. проверка при профилактическом обслуживании
3. planned maintenance	c. оборудование; сооружения; средства; устройства; производственные мощности
4. facilities	d. ежедневная проверка; ежедневный технический осмотр
5. preventive maintenance check	e. техническое обслуживание, ремонт
6. daily checking	f. индивидуальные средства защиты
7. personal protective equipment	g. планово-предупредительное техническое обслуживание и ремонт

Exercise 6. Read tips about maintaining the farm equipment during pre-harvest season and complete the gaps (1-5) with the words given in the box.

Regular, inspect, safety, harvesters, calibrate

Information source: <https://www.fleetio.com/blog/farm-equipment-maintenance-seasonality>

Pre-Harvest Season: Maximizing Yield

Before the harvest season, it's essential to fine-tune your farm equipment to maximize yield and efficiency. Here's a checklist for pre-harvest maintenance and repair:

1. Blade Sharpening and Adjustments: Optimize Crop Harvest

Your harvesting equipment, including combine 1) ... and balers, need sharp blades to ensure a clean cut. Dull blades can damage crops during harvesting and reduce your overall yield for the season. Sharpening and adjusting blades on harvesting equipment will mean cleaner cuts, and if there's too much wear on your blades, replace them. We recommend keeping spare blades on hand so you can quickly swap them out as necessary. You should also make sure your team is trained to perform blade maintenance and replacements correctly to avoid misalignment or injury.

2. Check Belts and Chains: Ensure Smooth Operation

Belts and chains on tractors and combines can wear down overtime. Be sure to 2) ... belts and chains for wear, check for proper tension and alignment, and replace any damaged or weakened components so they don't break on the job. A malfunctioning belt or chain can upend your entire harvesting process, leaving you stranded in the field with a downed piece of equipment. 3) ... checks and replacements will help maintain the efficiency and reliability of your equipment.

3. Calibration and Testing: Optimize Performance

Many pieces of farming equipment require very precise measurements and settings to stay operational, so doing regular checks is vital. 4)... sensors and gauges to reflect accurate measurements during harvesting operations, and always test and adjust the equipment to match the specific crop conditions. Calibration and testing are essential to optimize yield and ensure that your equipment operates efficiently. Keep detailed records of calibration settings for reference in subsequent harvest seasons.

4. Safety Checks: Prioritize Operator Safety

Safety should always be a top priority. Before you begin harvesting, verify that safety features like emergency stops and guards are in proper working order, and ensure all 5) ... signage and warnings are clear and visible to anyone operating the equipment. Investing in safety equipment and practices is crucial to protect yourself and your operators and will minimize accidents on the farm. A quick safety training pre-harvest can go a long way to protecting your team and should always be part of your farm operation protocols.

Exercise 7. Match the essential farm equipment maintenance tips for smooth operations (1-7) with their descriptions (a-g).

Information source: <https://eworkorders.com/cmms-industry-articles-eworkorders/farm-maintenance-tips/>

1. Keep all documents organized	a. Regularly inspect and tighten hitches, and check tire pressure, tread depth, and overall condition to ensure safe and efficient equipment operation.
2. Perform regular oil changes	b. Clean equipment regularly to remove dirt, debris, and crop residue, preventing corrosion and maintaining optimal functionality.
3. Lubricate moving parts	c. Regularly inspect and test lights, replace faulty bulbs, and ensure batteries are in good working condition for proper visibility and functionality.
4. Check all hitches and tires	d. Whenever feasible, store equipment in a sheltered, indoor space to protect it from harsh weather conditions and extend its lifespan.
5. Inspect any lights on the vehicle and the batteries	e. Apply lubricants to bearings, joints, and other moving parts as recommended by the manufacturer to reduce friction and prevent premature wear.

6. Calibrate special equipment	f. Routinely inspect all equipment for signs of damage, such as cracks, dents, or leaks, and address them promptly to prevent further deterioration and potential breakdowns.
7. Keep machinery clean	g. Maintain organized records of equipment manuals, warranties, service logs, and other important documents for easy reference.
8. Inspect for damage	h. Refrain from making unauthorized modifications or customizations to engines, as they can void warranties and potentially harm equipment performance and reliability.
9. Store equipment indoors when possible	i. Follow the manufacturer's recommendations for oil change intervals and ensure proper lubrication for optimal equipment performance.
10. Avoid customizing or modifying engines	j. If you have specialized equipment, regularly calibrate it as per manufacturer guidelines to maintain accuracy and optimize performance.

Exercise 8. Discuss the following points.

1. What is the role of maintenance in Agriculture?
2. When should be agricultural machinery and farm equipment maintenance conducted?
3. Who normally performs farm maintenance?
4. How much does farm maintenance cost?
5. What preventive maintenance checks for agricultural machinery and equipment do you know?
6. What preventive maintenance tasks for farm buildings can you name?
7. What are the safety tips for agricultural machinery and farm equipment maintenance?

Exercise 9. Search the Web for agricultural machinery and farm equipment maintenance in Russia and other countries. Make a presentation.

Exercise 10. Look through Unit 4 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 5. Agritech Innovations

Exercise 1. Read and memorize the words and word combinations.

1. agritech/ agricultural technology/ agtech сельскохозяйственная технология
2. technological revolution научно-техническая революция
3. genetic evolution генетическая эволюция
4. transgenic plants трансгенное растение (растение, геном которого (или геномы отдельных его клеток или тканей) включает чужеродный генетический материал, внесенный с использованием методов генной инженерии)
5. genetically modified генетически модифицированный
6. seeds семена; посевной материал
7. production costs производственные расходы; себестоимость
8. reduction снижение, понижение, сокращение, уменьшение
9. pest control борьба с вредителями
10. weed control борьба с сорняками

11. productivity производительность; продуктивность; урожайность
12. surge подъём, рост; всплеск
13. satellite image изображение, полученное со спутника; снимок со спутника
14. precision точность
15. disease болезнь; заболевание
16. failure авария, повреждение, отказ
17. irrigation system система орошения; оросительная система
18. machinery машинное оборудование; машины; механизмы
19. accurate точный; правильный; достоверный
20. energy-efficient с низким энергопотреблением; энергосберегающий
21. emission эмиссия; дымогазовые выбросы
22. polluting gases вредные газы
23. machine intelligence машинный интеллект, искусственный интеллект
24. autopilot автопилот
25. operator fatigue утомление оператора
26. crop management возделывание культур
27. incorporate включать в; содержать в себе
28. precision farming высокоточная модель ведения сельского хозяйства; точное земледелие; соответствующее местным условиям сельское хозяйство
29. tools средства
30. synergistic синергичный; взаимно усиливающий
31. digital technology цифровые технические средства; цифровые технологии
32. Internet of Things (IoT) Интернет вещей
33. Big Data Большие данные
34. Artificial Intelligence (AI) искусственный интеллект
35. robotics робототехника
36. collection накопление, сбор
37. data данные, факты, сведения; информация
38. third-party source сторонний источник; независимый источник
39. decision-making process процесс принятия решения
40. supply chain цепочка поставок, сеть поставщиков; канал поставок
41. sustainability устойчивость; устойчивое развитие
42. profitability прибыльность, рентабельность, доходность; экономическая эффективность
43. solution метод решения (проблемы)
44. unnecessary waste напрасная трата
45. water requirement оросительная норма; водопотребление; расход воды на полив
46. onset возникновение; появление; начало, наступление; вспышка, проявление (болезни)
47. cultivation возделывание (почвы), почвообработка; культивация
48. sowing сев, посев, засев; засевание
49. harvesting сбор урожая; уборочные работы
50. traceability возможность отслеживания, прослеживаемость; трассируемость
51. high quality food высококачественное продовольствие
52. on a sustainable manner на устойчивой основе
53. margin for error право на ошибку; запас на отклонение; запас на ошибку
54. technological innovation технологическое новшество; новая технология
55. useful way с пользой

56. agribusiness сельскохозяйственный бизнес; агропромышленное производство; агробизнес
57. best times наиболее оптимальные сроки
58. species вид
59. meteorological analysis метеорологический анализ
60. resources ресурсы; средства
61. automation автоматизация, автоматика
62. robotics робототехника
63. rustic деревенский, сельский
64. backward отсталый, отстающий в развитии
65. distant from reality (весьма) далёкий от реальной жизни
66. aerial воздушный; авиационный
67. terrestrial наземный; сухопутный
68. micro robot микроробот
69. genetic improvement улучшение генетических качеств
70. autonomous независимый; автономный, самостоятельный; самоуправляющийся
71. driver's seat сиденье, место для водителя
72. module модуль; функциональный блок
73. stride шаг вперёд, продвижение, прогресс
74. automated автоматизированный
75. irrigation project оросительная система; проект орошения
76. timing выбор, определение времени; расчёт времени
77. drone дрон; беспилотный радиоуправляемый летательный аппарат; беспилотник; коптер
78. multi-camera многокамерный
79. hyperspectral camera гиперспектральная камера
80. diagnose диагностировать; осуществлять диагностический контроль; обнаруживать/ выявлять проблему
81. plant растение
82. secure безопасный, надёжный; верный; заслуживающий доверия, точный
83. environmental impact экологический эффект; воздействие на окружающую среду
84. soil почва, грунт; почвенный слой
85. cultivation процесс возделывания (почвы), обработка почвы
86. concern over обращать внимание на; беспокоиться по поводу
87. sustainability принципы экологически безопасного и рассчитанного на долгосрочную перспективу экономического развития
88. energy consumption энергопотребление, расход энергии
89. scarecrow пугало
90. deter отпугивать
91. satellite mapping картографирование по данным спутниковых наблюдений; съёмка со спутника
92. vertical farming вертикальное сельское хозяйство; вертикальное фермерство
93. soil exposure воздействие грунта; использование почвы
94. all-year-round круглогодичный
95. hydroponics гидропоника
96. aeroponics аэропоника (система выращивания растений, при которой к свободно свисающим в ёмкости корням подаётся питательный раствор)

97. nutrient-laden water раствор с содержанием питательных веществ
98. water waste водные отходы
99. bee пчела
100. vectoring ориентирование; направление по курсу; задание определённого направления
101. biological control биологический контроль; биологические методы борьбы
102. fungi (мн. ч. от fungus) грибы
103. bacteria (мн. ч. от bacterium) бактерии
104. pollination опыление
105. carbon footprint углеродный след; выбросы парниковых газов в атмосферу
106. wastewater сбросная вода, сточные воды; отработанная вода
107. toxic substance токсичное вещество; ядовитое вещество
108. organic matter органическое вещество; органическая примесь
109. closed-loop system система, работающая по замкнутому циклу; система с замкнутым контуром; замкнутая система
110. on-site на месте эксплуатации; локально
111. recycle повторно использовать; возвращать в оборот; рециркулировать
112. freshwater resources науки запасы пресной воды
113. treatment обработка
114. pathogen патогенный фактор; патогенный микроорганизм; возбудитель заболевания; патоген

Exercise 2. Read the international words and guess their meanings.

Industry, technological revolution, genetic evolution, transgenic, genetically modified, producer, production, control, productivity, image, innovation, farmer, identify, seconds, irrigation system, machinery, machine, accurate, energy-efficient, emission, gas, tractor, autopilot, operator, management, strategy, synergistic, technology, Internet, robotics, automatic, integration, analysis, sensor, process, economic, social, calculating, plan, cultivation, manner, innovative technology, information, interpret, sector, business, optimize, operation, expert, specific, based on meteorological analysis, adaptation to the region's climate, guarantee, result, idea, distant from reality, automation, agribusiness, micro robot, focus, module, controlled, automated irrigation projects, meter, drone, monitoring, trend, multi or hyperspectral cameras, diagnose, transforming the industry, revolutionize, farm automation technologies, autonomously, autonomous tractor, laser, effective, traditional, chemicals, focus, herbicides, pesticides, vertical, season, limited, hydroponics, aeroponics, technique, method, erosion, vectoring, popular, process, biological controls, bacteria, organic, problem, manager, interpret, real, diagnose, plan, pathogens, stress.

Exercise 3. Read and translate Text 1.

Text 1. Technological Innovation in Agribusiness

Sources: <https://www.solinftec.com/en-us/blog/technological-innovation-in-agribusiness/>,
<https://www.mccormick.it/as/agriculture-4-0-what-is-it-and-what-are-its-tools-and-benefits/>

The agricultural industry has been developing very fast in recent times. Talking about the technological revolution in the field, it should be mentioned that the genetic evolution which allowed the development of transgenic plants was a big step. The use of genetically modified seeds brings benefits to the producer, such as production costs reduction, ease of pest and weed control and productivity increase. And besides that, the surge

in satellite image usage has brought greater precision to agriculture. This innovation made it possible for farmers to identify in a matter of seconds which areas have the highest productivity and which are being most affected by pests and diseases, or even failures in the irrigation system. On the matter of machinery, machines are much more accurate and energy-efficient now. This means their emission of polluting gases has been much lower. In addition, innovations related to machine intelligence have made it possible to develop tractors with autopilot, which represents a major advantage for the producer in terms of efficiency since it reduces operator fatigue and offers greater precision in crop management.



Both Agriculture 4.0 and Smart Agriculture 5.0 incorporate the evolution of precision farming and refer to the tools and strategies that enable the synergistic use of a range of digital technologies (Internet of Things (IoT), Big Data, Artificial Intelligence (AI), Robotics) allowing the automatic collection, integration and analysis of data collected from the field, sensors, or other third-party sources. The aim of these technologies is to offer the most extensive and precise support to farmers in the decision-making process related to their activity and the relationship with other parties in the supply chain. The ultimate goal is to increase economic, environmental and social sustainability as well as profitability of agricultural processes. Adopting 4.0 and 5.0 solutions in agriculture means:

- Avoiding unnecessary waste by calculating the exact water requirements of the crop or detecting in advance the onset of certain plant diseases or pests.
- Having greater control over cost and being able to plan all stages of cultivation, sowing and harvesting with a great deal of precision, saving both time and money.
- Improving the traceability of the supply chain to make a short supply chain that is capable of producing high quality food on a sustainable manner with little margin for error.

When we talk about technological innovations in agriculture, we are referring in particular to the use of the most innovative technologies, the ability to manage the amount of data and information coming in from the fields and the ability to interpret them in a useful way for the sector. Technological innovations have helped rural producers and businesses to optimize and improve their operations.

The sector's biggest technological innovations in agribusiness include:

1. Artificial Intelligence (AI): Although AI is already being used in the field, this tool still has a lot left to be explored. According to some experts, AI can reach such a high level of efficiency that it can identify the best times to plant a specific species, based on

meteorological analysis, the use of resources and the species' adaptation to the region's climate, which guarantees better results to the producer.

2. Automation and Robotics: The idea of the field as something rustic and backward is an image that will become increasingly distant from reality. Innovations related to automation and robotics are entering everything in agribusiness. Experts believe there will be more and more robots in the field, whether aerial, terrestrial or micro robots with focus on genetic improvements. In the coming years, we will witness further development in the area of autonomous machinery and equipment. Gradually, driver's seats will give way to modules that are controlled by an operator outside the truck or by Artificial Intelligence itself. Another stride in this area will be the automated irrigation projects. In addition to what we already have today, this process will have greater control over the amount of water according to the needs of each square meter of crops, always with correct timing. This can employ precision farming much more efficiently.

3. Drones: They are already present in many crops; they make monitoring the entire farm a lot easier. In the coming years, the trend is to further optimize the use of this technology. For example, a drone equipped with multi- or hyperspectral cameras can diagnose each plant. This will provide huge progress for agribusiness, allowing access to much more complete and secure information. In addition, drones are not dependent on fuel use, which reduces environmental impact and helps preserve soil and cultivation. This is essential for the crops of the future, as we will need more and more concern over sustainability issues.

Exercise 4. Answer the questions.

1. What are the achievements of the past 10-15 years in the agricultural industry?
2. What do Agriculture 4.0 and Smart Agriculture 5.0 imply?
3. What digital technologies are applied in agriculture?
4. What are they aimed at?
5. What does adoption of 4.0 and 5.0 solutions in agriculture mean?
6. What do technological innovations in agriculture refer to?
7. What are the main technological innovations in agribusiness?
8. What are the feasible options for further use of AI in agriculture?
9. What are the innovations in the area of automation and robotics?
10. How can use of drones for agriculture be optimized in the coming years?

Exercise 5. Match the terms (1-7) to their definitions (a-g).

1. agritech	a. снимок со спутника
2. satellite image	b. искусственный интеллект
3. machine intelligence	c. Интернет вещей
4. Internet of Things (IoT)	d. робототехника
5. Big Data	e. машинный интеллект, искусственный интеллект
6. Artificial Intelligence (AI)	f. сельскохозяйственная технология
7. robotics	g. Большие данные

Exercise 6. Read about six most impactful agricultural innovations that will have an impact on the farm management and complete the gaps (1-7) with the words given in the box.

Hydroponics, wastewater, reduce, biological, technologies, artificial, satellite
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Information source: <https://www.millerchemical.com/blog/innovation-in-agriculture-6-innovations-that-will-have-an-impact-on-farm-management/#:~:text=Some%20innova->

tive%20agricultural%20advancements%20include,irrigation%20systems%20for%20water%20conservation.

Agriculture has seen immense innovations in recent years that are transforming the industry to be more efficient and sustainable. Farmers have embraced the advancements and are constantly seeking new ways to manage their farms effectively. Let's consider the most impactful innovations in agriculture that will revolutionize farm management.

– Farm Automation Technologies: These new 1) ..., such as self-driven tractors and equipment that can autonomously detect weeds and pests, save time and money for farmers. John Deere's autonomous tractor is a great example of this innovation. It has efficient energy consumption, operates with precision, and saves time for farmers. Laser scarecrows are also a recent innovation, which uses laser technology to deter birds. This advancement is far more effective than traditional scarecrows because of its coverage and ability to prevent birds from accessing crops.

– Precision Agriculture for Farm Management: It is another essential innovation in agriculture. Precision agriculture uses newer technologies, like 2) ... mapping or drone imagery, and soil sensors to optimize the use of resources and the application of chemicals. This technology allows growers to focus on a specific area of a crop field to target only the required amount of herbicides and pesticides.

– Indoor Vertical Farming: It is an innovative concept that involves growing crops indoors without soil exposure. The concept's objective is to save space, 3) ... water use and promote sustainable agriculture. Farm managers can also control the environment, creating an all-year-round farming season; this technology is highly appreciated in places with harsh weather conditions or limited spaces. 4) ... and aeroponics are additional innovations in the indoor vertical farming technique, which uses nutrient-laden water to grow crops. The method eliminates soil erosion and prevents water waste.

– Bee Vectoring for Agricultural Uses: Bee vectoring is gradually becoming a popular technology among farmers. The process involves using bees to deliver 5) ... controls, fungi, and bacteria directly onto plants at the time of pollination. This innovation allows farmers to protect their crops while improving pollination rates. In addition, it enhances crop quality and quantity and contributes to reducing the carbon footprint in agriculture.

– Wastewater Treatment Innovation: Wastewater is a significant issue in the agricultural industry as it contains toxic substances and high levels of organic matter that can harm crops and soils. To handle this problem, farm managers are looking into the use of closed-loop wastewater treatment systems. This technology can treat 6) ... on-site and recycle it back onto crops. The innovation helps reduce the dependence on freshwater resources and supports sustainable agriculture.



– Drone Use and Artificial Intelligence: Drones and AI are making the monitoring and treatment of crops far more efficient. Drones and precision agriculture are growing hand in hand, and newer technologies are evolving to enable 7) ... intelligence to help gather, interpret and act on real-time data. Science has advanced so much that drones and AI can operate advanced sensors and collect crop imagery that helps diagnose the crop's health. In addition, farmers can use this data to plan their next moves and detect any issues like pests, pathogens, or crop stress.

Exercise 7. Match the latest trends and innovations in Agriculture (1-13) with their descriptions (a-m).

Information source: <https://www.jiva.ag/blog/top-13-innovations-in-agriculture-farming>

1. Farm automation	a. GIS in agriculture relies on technology such as drones and satellites to understand crop position and types, fertilization level, soil status, and related information. With data generated from GIS remote sensing devices and software, farmers can determine the best location for crop planting in the field and make informed decisions on how to improve soil nutrition. In livestock rearing, GIS software monitors the movement of animals. This helps farmers track animals' health, fertility, or nutrition.
2. Blockchain	b. Agricultural forecasting is made easy when farmers deploy AI/ML & data science technology. The use of 3D laser scanning and spectral imaging/spectral analysis, for example, can help farmers predict weather scenarios and optimize the use of resources required for irrigation, fertilization, and pest control. Through AI/ML & data science technology, farmers can analyze their fields for the best locations for planting seeds. They can use computer vision to recognize plants' optimal height, width, and spacing. This data can then be used to optimize their growing methods.
3. IoT in agriculture	c. In 2022, the global market size of agricultural robotics was nearly \$5 billion. Many farming activities performed by humans can now be done by agricultural robots (agribots), maximizing productivity and saving enormous resources. Today, agribots are used in seed planting, crop harvesting, weeding, sorting and packaging, livestock management, etc.
4. Geographic information systems (GIS) in agriculture	d. Automation is already a major part of the farming process, but it will become even more important in the coming years. Farmers are already using drones to monitor their crops, and advanced sensors can tell them exactly when they need to water or fertilize their fields. These devices can also be used to monitor soil quality and ensure that crops aren't affected by drought or other environmental factors.
5. AI/ML & data science in agriculture technology	e. CEA is a method of cultivating plants in a fully regulated environment. It is also known as 'vertical farming or indoor farming'. In this type of cultivation, all the plant's needs are met by artificially providing them with water, nutrients, and light using hydroponic, aquaponic, and aeroponic techniques. CEA greatly reduces water consumption, protects plants from adverse weather conditions and helps maximize the use of space for cultivation.
6. Regenerative agriculture	f. Unmanned Aerial Vehicles or drones are increasingly becoming useful in crop and livestock management. For example, farmers can

	use sensor-equipped drones to monitor the growth of plants, detect disease stress, monitor field temperature, and spray pesticides or fertilizers at desired locations on the field. In animal husbandry, drones are used to observe grasslands and track animal movements on big ranches. Some drones have thermal imaging cameras to detect sick animals with high body temperatures. Drones help farmers acquire comprehensive data to make timely decisions.
7. Controlled environment agriculture (CEA)	g. Precision agriculture is a rapidly evolving farm management system that involves the use of sensor technology, AI, GIS, and IoT to collect and analyze data about the soil, plants, and animals. It allows for more targeted use of inputs such as water, fertilizer, plant nutrients, pesticides, seeds, and labor. Precision agriculture deviates from conventional agriculture practices, where a uniform method is employed over a large area regardless of soil quality or topography variations.
8. Agricultural robotics	h. Although there is a growing concern about the health impact of agricultural biotechnology, the use of genetic engineering to improve plants or animals will remain a trend in modern farming. Agricultural biotechnology can improve the quality of farm produce and help create more climate-resilient crops.
9. Drones	i. Blockchain technologies are used in agriculture to track plant information from the farms to the shelf. Powered by a decentralized database, this technology helps regulate the quality of food and its shelf life. The auditable database allows growers and marketers to monitor farm produce throughout the supply chain.
10. Precision agriculture	j. In today's information-driven world, agriculture production should be based on a knowledge- and data-driven approach. Farmers need to be able to communicate with each other, vendors, and customers to produce more food efficiently. This can be done through connectivity technologies such as mobile devices, satellite technology, and internet-based platforms. They allow farmers to share information to make better decisions about how they grow their crops or raise their livestock; to reach out to potential buyers or sell directly to consumers.
11. Agricultural biotechnology	k. The farm is becoming a data factory, with sensors and other technology collecting thousands of data points about everything from soil quality to humidity and crop yields. Big data & analytics can help farmers decide when to plant and harvest, how much water or fertilizer to use, and how much seed they should sow. Farming operations are subject to weather and environmental changes, which are difficult to access, especially for large farms. Applying big data and analytics in agriculture help farmers predict water cycles or rainfall patterns.
12. Big data & analytics	l. Regenerative agriculture is described as the way forward to decarbonize the food system and make farming resilient to climate shocks. This unconventional farming practice work based on five fundamental principles: promote biodiversity through the integration of animals and plants; improve soil health by adopting all options that will reduce soil disturbance; practice soil conservation by keeping the soil surface covered as much as possible; practice crop diversity by growing varieties of crops on the same field; and maintain living roots by planting perennial crops or cover crops.

13. Connectivity technologies	m. IoT is used as a smart farming solution for monitoring the crop field from anywhere. It involves using sensors to track soil moisture, crop health, livestock conditions, temperature, etc. IoT technologies make it possible to create automated irrigation structures where water resources can be managed efficiently. By collecting crop data such as moisture and temperature, IoT technologies can help determine the right amount of water for crops every season.
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Exercise 8. Match the questions about Innovations in Agriculture (1-5) with the appropriate answers (a-e).

Information sources: <https://www.millerchemical.com/blog/innovation-in-agriculture-6-innovations-that-will-have-an-impact-on-farm-management/#:~:text=Some%20innovative%20agricultural%20advancements%20include,irrigation%20systems%20for%20water%20conservation,https://rujec.org/article/78430/>

1. What are the innovations in agriculture?	a. The technology that has had the biggest impact on agriculture is arguably the development of genetically modified crops. These crops have been engineered to be more resistant to pests and diseases, tolerate to extreme weather conditions, and have higher yields. This allowed using land more efficiently, increasing food production, and improving food security globally.
2. What technology has had the biggest impact on agriculture?	b. Two new agriculture techniques for growing food are aquaponics and aeroponics. Aquaponics involves growing plants in water enriched with nutrients from fish waste, while aeroponics involves growing plants in a mist or air environment with added nutrients. These techniques require less water and land, have higher yields, and can be used in urban areas.
3. What are the technologies used in smart agriculture?	c. Some innovative agricultural advancements include precision farming techniques using drones and satellite imagery, genetically modified crops for higher yields and resistance to pests, vertical farming for efficient use of space, and precision irrigation systems for water conservation. Additionally, advancements in data analytics and artificial intelligence are being applied by growers to improve crop management, sustainability and productivity.
4. What were two new agricultural techniques for growing food?	d. The main trends in agribiotech are now related to the development of breeding: methods of genomic technologies for accelerated creation of varieties/hybrids in crop production. For animal husbandry, these are embryo technologies for livestock reproduction and genomic assessment methods for effective breeding.
5. What are the main trends in agribiotech in Russia?	e. Smart agriculture utilizes technologies like IoT, sensors, big data analytics, drones, robotics, AI, and machine learning for precision farming, soil and water management, crop and livestock monitoring, and supply chain management. These technologies help farmers make data-driven decisions, optimize resource utilization, improve crop yields, reduce costs, and minimize environmental impact.

Exercise 9. Discuss the following points.

1. What are the latest trends and innovations in the agricultural industry?
2. What digital technologies are applied in agriculture?
3. Why are automation and robotics important in agriculture?
4. How can drones be used for agricultural purposes?
5. What role do connectivity technologies play in agriculture?

Exercise 10. Search the Web for agritech innovations in Russia and other countries. Make a presentation.

Exercise 11. Look through Unit 5 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

Unit 6. Cybersecurity in Agriculture

Exercise 1. Read and memorize the words and word combinations.

1. cybersecurity компьютерная безопасность, кибербезопасность
2. measure мера, мероприятие
3. safeguard охранять, предохранять, защищать
4. digital assets цифровые активы (ресурсы, имущество)
5. information systems информационные системы
6. network сеть
7. unauthorised access несанкционированный доступ; незаконное использование
8. data breach утечка данных; уязвимость данных
9. cyber threat киберугроза
10. digital technology цифровые технические средства; цифровые технологии
11. software solution решение, сформированное программным обеспечением
12. protection of sensitive data защита конфиденциальных данных
13. critical infrastructure критическая информационная инфраструктура
14. digital processing цифровая обработка данных
15. confidentiality конфиденциальность, секретность
16. integrity целостность; сохранность
17. digital information цифровая информация; дискретная информация; цифровые данные
18. disruption нарушение, сбой, срыв
19. farming operations сельскохозяйственный бизнес; руководство фермой
20. sustainability устойчивость; устойчивое развитие
21. agricultural industry сельскохозяйственное производство; агропромышленность
22. digitization преобразование в цифровую форму; дискретизация, оцифровывание, оцифровка
23. farming practices методы ведения сельскохозяйственных работ
24. crop yield урожайность
25. financial records финансовая документация; финансовая отчетность
26. supply chain цепочка поставок, сеть поставщиков; канал поставок
27. manipulation манипулирование, манипуляция, управление; обращение
28. compromise компрометировать, дискредитировать (защищенную информацию в результате её несанкционированного раскрытия или утраты)

29. critical information критическая информация, наиболее важная информация
30. preservation сохранение; охрана, защита
31. operational integrity работоспособность; пригодность к эксплуатации
32. malicious activities вредоносная деятельность
33. disrupt нарушать; срывать
34. financial transactions финансовые операции
35. prevention предотвращение, предупреждение
36. financial losses денежные убытки; финансовые потери; материальный ущерб
37. cyberattack кибератака, киберудар, компьютерная атака
38. ransomware вирус-вымогатель; программа-вымогатель; вредоносная программа с требованием выкупа
39. fraud обман, мошенничество; фрод; противозаконная операция с данными кредитных карт
40. theft кража; воровство; хищение
41. financial information финансовые сведения
42. financial viability экономическая целесообразность, экономическая эффективность
43. precision agriculture точное сельское хозяйство
44. GPS-guided с коррекцией по сигналу глобальной спутниковой навигационной системы
45. underscore акцентировать; подчёркивать
46. reliability достоверность, надёжность; безопасность
47. resource use использование ресурсов
48. resilience эластичность; способность (системы) к восстановлению функций; способность системы противостоять ошибкам, устойчивость к ошибкам
49. supply-chain disruptions сбои в цепи поставок
50. digital communication цифровая связь
51. data exchange обмен данными, информационный обмен
52. farm land сельскохозяйственные угодья; поле
53. consumer потребитель, клиент, заказчик, покупатель
54. trust вера, доверие
55. breach дыра, брешь (в системе безопасности)
56. erode trust подрывать доверие
57. stakeholder участник совместного дела; акционер; совладелец; заинтересованное лицо
58. industry partner промышленный партнёр
59. privacy секретность, конфиденциальность; сохранение тайны
60. instil вселять (надежду, уверенность)
61. mitigating уменьшение; снижение
62. environmental risk экологический риск, риск загрязнения окружающей среды
63. sensitive information информация, содержащая важные сведения; информация для ограниченного круга лиц; важная информация; критичная информация
64. soil health качество почвы; состояние почвы
65. authorised user зарегистрированный пользователь; пользователь с санкционированным доступом
66. misuse неправильное применение; ненадлежащее использование; злоупотребление
67. environmental harm экологический вред; причинение вреда окружающей среде
68. security software программные средства защиты данных

69. antivirus software антивирусное программное обеспечение, антивирусные программы
70. malicious software/ malware вредоносные программные средства; вредоносные программы; вредоносное ПО
71. worm "червь" (один из видов вредоносного ПО)
72. Trojan horse вредоносная программа типа Троянский конь
73. farming system система ведения фермерского хозяйства; сельскохозяйственная система
74. firewall software программное обеспечение брандмауэра
75. firewall межсетевой экран, брандмауэр, система защиты доступа; средства сетевой защиты; сетевой заслон
76. trusted internal network доверенная внутренняя сеть
77. untrusted external недоверенная/сомнительная внешняя сеть
78. incoming входящий, поступающий
79. outgoing выходной, исходящий
80. network traffic трафик в сети; сетевой трафик
81. intrusion вторжение, проникновение; вмешательство
82. intrusion detection and prevention systems (IDPS) системы обнаружения и предотвращения вторжений
83. policy violations нарушения политики
84. cyber incident киберинцидент
85. endpoint protection software программное обеспечение для защиты конечных точек
86. solution решение
87. individual device отдельное устройство
88. laptop переносной компьютер; портативный компьютер; ноутбук
89. mobile devices мобильные устройства
90. anti-malware защита от вредоносного ПО, противовредоносное ПО
91. comprehensive комплексный, всеобъемлющий, полный
92. data encryption software криптографическое средство защиты информации
93. encrypt зашифровывать; шифровать
94. unreadable нечитаемый
95. decryption key ключ дешифрования
96. security information and event management (SIEM) управление информацией о безопасности и событиями безопасности
97. log data данные логов; данные журнала
98. application приложение, прикладная программа
99. security incident случай (событие, инцидент) нарушения безопасности
100. unusual activities необычные действия; необычная активность
101. insights into понимание; анализ
102. security event событие, связанное с безопасностью
103. backup and recovery solutions решения резервного копирования и восстановления
104. recovery восстановление, возобновление, исправление
105. data loss потеря данных
106. hardware failure сбой оборудования, аппаратная неисправность
107. identity and access management (IAM) управление доступом и идентификационными данными

108. authentication аутентификация, опознавание, проверка (подтверждение) подлинности
109. authorisation авторизация
110. user provisioning подготовка учётных записей пользователей
111. specific resources конкретные ресурсы, определенные ресурсы
112. network security software программное обеспечение сетевой безопасности
113. network infrastructure сетевая инфраструктура
114. virtual private network (VPN) виртуальная защищённая сеть
115. vulnerability management управление устранением уязвимостей, контроль за устранением уязвимостей
116. vulnerability уязвимость, слабость, слабое место, слабое звено/ дыра системы защиты/ безопасности
117. proactively упреждающе; без промедления
118. address принимать меры (в ответ на), реагировать на
119. security issue проблема безопасности
120. exploitation разведка, поиск
121. cyber attacker кибервзломщик
122. mobile device management software программное обеспечение для управления мобильными устройствами
123. device encryption шифрование устройства
124. remote wipe capabilities возможности удалённого стирания
125. policy enforcement обеспечение соблюдения политики
126. data accessed данные, к которым получен доступ
127. stored хранящийся
128. regulatory compliance соблюдение нормативных требований
129. adhere придерживаться, соблюдать
130. industry-specific regulation отраслевые нормативные требования; специальные отраслевые правила
131. data protection law закон о защите данных; законодательство в области защиты информации
132. legal requirements требования законодательства
133. ag tech сельскохозяйственная технология
134. contingency plan план действий на случай непредвиденных обстоятельств
135. network segmentation сегментирование сети; сетевая сегментация
136. manageable удобный в управлении
137. portion зона; часть; сегмент
138. recovery plan план обеспечения непрерывной работы и восстановления функционирования
139. password пароль
140. credentials имя пользователя и пароль; право доступа; идентификационные данные
141. multifactor authentication многофакторная аутентификация
142. phishing attack фишинговая атака (вид интернет-мошенничества, целью которого является получение доступа к конфиденциальным данным пользователей – логинам и паролям)
143. hyperlink гиперссылка
144. scam афера, жульничество, мошенничество, обман, надувательство
145. messaging app мессенджер; приложение для обмена мгновенными сообщениями

146. warning indicator предупреждающий индикатор
 147. dead giveaway неопровержимая улика; стопроцентное доказательство
 148. legitimate легальный; законный; настоящий
 149. urge заставлять, побуждать, советовать; настаивать
 150. fake несуществующий; ложный
 151. generic greeting универсальное обращение
 152. updated усовершенствованный; обновлённый; модернизированный
 153. firmware программно-аппаратные средства; встроенные программы; "защитные программы" (в ПЗУ)
 154. outdated устаревший; несовременный
 155. intercepted перехваченный
 156. verify проверять, контролировать, верифицировать
 157. roles and responsibilities функции и сфера ответственности; роли и должностные обязанности
 158. security patch обновление для системы безопасности; патч для устранения ошибок защиты
 159. application programming interface интерфейс прикладного программирования
 160. third-party application приложение стороннего разработчика
 161. validate проверять достоверность; подтверждать правильность
 162. intrusion detection обнаружение вторжения
 163. incident response plan реагирование на инциденты; реакция на событие
 164. security audit проверка защиты
 165. training and awareness обучение и ознакомление
 166. ransomware attack атака в целях вымогательства выкупа
 167. vendor разработчик; изготовитель, фирма-поставщик
 168. security assessment оценивание защищённости программного обеспечения
 169. physical security непосредственная защита; физическая безопасность
 170. physical access физический доступ
 171. data storage facilities хранилища данных
 172. surveillance надзор; наблюдение; контроль
 173. legal and regulatory compliance соответствие нормативно-правовым актам
 174. regulations нормативно-правовые акты; регламент

Exercise 2. Read the international words and guess their meanings.

Practice, technology, information system, sector, integrate, critical infrastructure, process, confidentiality, industry, manipulation, financial transactions, logistics, farmer, business, cyberattack, financial information, GPS-guided tractor, drone, sensor, optimize, maximise, communication, product, partner, role, potential risk, associated, pesticide, type, antivirus, designed, viruse, Trojan, scan files, program, system, barrier, control, monitor, policy, real, cyber incident, individual, computer, mobile device, management, analyse, analysis, authorisation, specific, virtual, private, regularly, scanning, standard, online, adequately, practice, invest, potential online attacks, organization, plan, procedure, effect, segmentation, regular, segmented, location, factor, login, official, administration, multifactor authentication, code, phrase, phishing attacks, identify phishing email attack, hyperlink, personal information, indicator, email address, grammatical, legitimate company, emotion, Sir, algorithm, mechanism, protocol, based, role, integration, service, programming, interface, configuration, integrate, unauthorized, normal, audit, training, informed, base, component, automated, effectiveness, provider, physical, server, legal.

Exercise 3. Read and translate Text 1.

Text 1. Farming Software Security: Safeguarding Agricultural Data in the Digital Age

Source: <https://kg2.com.au/farming-software-security-safeguarding-agricultural-data-in-the-digital-age/>

Cybersecurity in agriculture refers to the practices, measures, and technologies implemented to safeguard the digital assets, information systems, and networks within the agricultural sector from unauthorised access, data breaches, and cyber threats. As farms and agricultural operations increasingly integrate digital technologies and software solutions, the protection of sensitive data, critical infrastructure, and digital processes become paramount. The aim of cybersecurity in agriculture is to ensure the confidentiality, integrity, and availability of digital information, preventing disruptions to farming operations and safeguarding the overall sustainability of the agricultural industry.

Cybersecurity in agriculture is used for:

- Protection of Sensitive Data: With the digitization of farming practices, agricultural operations generate and rely on vast amounts of sensitive data, including crop yield data, financial records, and supply chain information. Cybersecurity safeguards this data, preventing unauthorised access or manipulation that could compromise the confidentiality of critical information.

- Preservation of Operational Integrity: Cybersecurity measures are crucial to maintaining the integrity of digital processes within agriculture. This includes ensuring that data remains accurate and unaltered, preventing malicious activities that could disrupt farming operations, financial transactions, or supply chain logistics.

- Prevention of Financial Losses: Cybersecurity safeguards farmers and agricultural businesses from financial losses resulting from cyberattacks. By protecting against ransomware, fraud, or theft of financial information, cybersecurity measures help maintain the financial viability of farming operations.

- Safeguarding Precision Agriculture Technologies: The increasing reliance on precision agriculture technologies, such as GPS-guided tractors, drones, and sensors, underscores the need for cybersecurity. Protecting these technologies ensures the accuracy and reliability of the data used for precision farming, optimising resource use and maximising crop yields.

- Resilience Against Supply-chain Disruptions: As agriculture becomes more interconnected through digital supply chains, cybersecurity becomes instrumental in preventing disruptions. Securing digital communication and data exchange within the supply chain ensures a continuous and reliable flow of agricultural products from farm land to consumers.

- Preserving Trust in the Agricultural Industry: A breach of cybersecurity in agriculture can erode trust among stakeholders, including farmers, consumers, and industry partners. Maintaining the security and privacy of digital assets instils confidence in the reliability of agricultural technologies and practices.

- Mitigating Environmental Risks: Cybersecurity plays a role in mitigating potential environmental risks associated with precision agriculture. Protecting data from unauthorised access ensures that environmentally sensitive information, such as soil health data or pesticide usage, remains in the hands of authorised users, preventing misuse or environmental harm.

There are different types of security software available in farming.

- Antivirus Software: It is designed to detect, prevent, and remove malicious software (malware) such as viruses, worms, and Trojan horses. It scans files and programs to identify and eliminate potential threats, helping to keep farming systems and networks secure.

– Firewall Software: Firewalls act as a barrier between a trusted internal network and untrusted external networks, controlling incoming and outgoing network traffic. They help prevent unauthorised access to farming systems, protecting against cyber threats and potential intrusions.

– Intrusion Detection and Prevention Systems (IDPS): IDPS software monitors network or system activities for malicious activities or policy violations. It can detect and respond to security threats in real-time, helping to prevent unauthorised access, data breaches, and other cyber incidents.

– Endpoint Protection Software: Endpoint protection solutions are designed to secure individual devices (endpoints) such as computers, laptops, and mobile devices. These solutions often include antivirus, anti-malware, and firewall capabilities to ensure comprehensive protection for endpoints.

– Data Encryption Software: It encrypts sensitive data, making it unreadable without the appropriate decryption key. This is crucial for protecting confidential agricultural data, financial records, and other critical information from unauthorised access.

– Security Information and Event Management (SIEM): SIEM software collects and analyses log data from various systems and applications across the farming infrastructure. It helps identify security incidents, monitor for unusual activities, and provide insights into potential threats through correlation and analysis of security events.

– Backup and Recovery Solutions: They are essential for ensuring the availability and integrity of agricultural data. These solutions create regular backups of data, allowing for quick recovery in the event of data loss due to cyber incidents, hardware failures, or other unforeseen circumstances.

– Identity and Access Management (IAM): IAM software manages and controls user access to farming systems and data. It includes features such as authentication, authorisation, and user provisioning to ensure that only authorised individuals have access to specific resources and information.

– Network Security Software: It includes a range of tools to secure the network infrastructure, including firewalls, intrusion detection/prevention systems, and virtual private network (VPN) solutions. These collectively contribute to protecting the farming network from cyber threats.

– Vulnerability Management Software: Vulnerability management solutions assess and identify potential vulnerabilities in farming software and systems. By regularly scanning for weaknesses, farmers can proactively address security issues and reduce the risk of exploitation by cyber attackers.

– Mobile Device Management (MDM) Software: MDM software helps secure and manage mobile devices used in farming operations. It includes features such as device encryption, remote wipe capabilities, and policy enforcement to ensure the security of data accessed or stored on mobile devices.

– Regulatory Compliance Software: It assists farmers in adhering to industry-specific regulations and data protection laws. It helps ensure that farming operations meet legal requirements related to data security, privacy, and overall cybersecurity standards.

Exercise 4. Answer the questions.

1. What does cybersecurity in agriculture refer to?
2. Why is cybersecurity of paramount importance for agricultural sector?
3. What is the aim of cybersecurity in agriculture?
4. What is cybersecurity used for in agriculture?
5. What types of security software are available in farming?

Exercise 5. Match the terms (1-15) to their definitions (a-g).

1. cybersecurity	a. несанкционированный доступ
2. digital assets	b. нарушение, сбой
3. unauthorised access	c. цифровые активы
4. cyber threat	d. вредоносная программа с требованием выкупа
5. disruption	e. кибербезопасность
6. critical information	f. киберугроза
7. ransomware	g. наиболее важная информация
8. security software	h. программное обеспечение брандмауэра
9. malware	i. сетевой трафик
10. firewall software	j. программные средства защиты данных
11. worm	k. криптографическое средство защиты информации
12. network traffic	l. резервное копирование данных
13. data encryption software	m. виртуальная защищённая сеть
14. backup	n. червь
15. virtual private network	o. вредоносное ПО

Exercise 6. Read about some ways farmers can protect themselves from cyberattacks and complete the gaps (1-7) with the words given in the box.

Passwords, threats, unauthorized, newest, send, cyberattack, manageable

Information source: <https://www.globalagtechinitiative.com/digital-farming/why-farmers-should-invest-more-into-cybersecurity/>

Ag tech offers many benefits, but farms must ensure they have measures in place to protect themselves from online threats adequately. Proper cybersecurity practices safeguard farmers against 1) ... access, data breaches, and other cyber 2) ... when they utilize this technology. Farmers, who invest in cybersecurity practices, are prepared for potential online attacks. Here are a few ways which can help organizations defend themselves from online threats.

– Have a Dedicated Contingency Plan: One of the best things farms can do is prepare for the worst. They should have a plan with procedures in place, if a 3) ... occurs. Knowing what procedures to follow and actions to take can greatly reduce the damage from an attack. Taking action quickly is crucial for limiting the effect of a data breach.

– Implement Network Segmentation and Conduct Regular Backups: Network segmentation is when the system is broken down into smaller and more 4) ... portions. Regular backing up of important information and keeping of different copies in segmented and secure locations also increases safety. These two factors are essential for establishing a great recovery plan.

– Protect Login Information: A great way farms can protect themselves from online threats is to educate employees on cybersecurity best practices. They should regularly change 5) ... for accounts and networks. Officials should ensure everyone has their own login information when using farming software. They should also implement policies where administration credentials are required to install applications. Consider using multi-factor authentication with strong codes and phrases.

– Put Measures in Place Against Phishing Attacks: Employees should know how to identify phishing email attack and what procedures to follow if they receive any. A best practice many agriculture businesses can use is to remove hyperlinks from received emails. This can significantly reduce the chance of someone in the organization falling

victim to the scam. Farms should not 6) ... personal and sensitive information through messaging apps. They should also be cautious when receiving messages from accounts they do not recognize. Here are a few warning indicators to look out for with phishing scams: the sender's name does not match the email address; grammatical errors are often a dead giveaway that the sender is not with a legitimate company; messages asking for personal information are a red flag – most companies rarely ask for sensitive data over email; emails that urge immediate action are likely phishing scams – they rely on emotion and create a fake sense of urgency; the message has generic greetings such as “Dear Sir” or “Dear Employee”.

– Install Antivirus Software and Keep It Updated: Antivirus software should be installed on all devices. The firmware will eventually become outdated, so farmers should perform regular updates. This is one of the best ways to protect farms against the 7) ... online threats.

Exercise 7. Match the key measures to enhance farming software security (1-12) with their descriptions (a-l).

Information source: <https://kg2.com.au/farming-software-security-safeguarding-agricultural-data-in-the-digital-age/>

1. Data Encryption	a. Develop a comprehensive incident response plan outlining the steps to be taken in the event of a security incident. This plan should include procedures for reporting incidents, isolating affected systems, and restoring normal operations.
2. User Authentication and Authorisation	b. Conduct regular security audits and assessments to identify and address potential vulnerabilities. This proactive approach helps in uncovering security weaknesses before they can be exploited by malicious actors.
3. Regular Software Updates	c. Implement strong encryption algorithms to protect data both during transmission and when stored. Encryption ensures that even if unauthorised access occurs, the intercepted data remains unreadable without the corresponding decryption key.
4. Secure APIs and Integrations	d. Educate users and employees on cybersecurity best practices, including creating strong passwords, recognising phishing attempts, and understanding the importance of data security. An informed user base is an essential component of a secure environment.
5. Network Security	e. Secure physical access to servers and data storage facilities hosting farming software. Physical security measures, such as restricted access and surveillance, are integral to protecting the infrastructure supporting the software.
6. Incident Response Planning	f. Implement regular and automated data backup procedures to ensure that critical information can be restored in the event of data loss or a ransomware attack. Regularly test data recovery processes to verify their effectiveness.
7. Regular Security Audits and Assessments	g. Enforce strong user authentication mechanisms, such as multi-factor authentication (MFA), to verify the identity of users accessing the farming software. Additionally, implement strict authorisation protocols to control user access based on roles and responsibilities.
8. User Training and Awareness	h. Before selecting farming software, conduct thorough security assessments of vendors. Ensure that the chosen software providers fol-

	low industry best practices and have security measures in place to protect against common cyber threats.
9. Data Backup and Recovery	i. If the farming software integrates with third-party applications or services, ensure that Application Programming Interfaces (APIs) and data exchanges are secure. Regularly assess and validate the security of integrations to prevent potential vulnerabilities.
10. Vendor Security Assessment	j. Stay informed about relevant data protection regulations and industry standards. Ensure that the farming software complies with legal requirements to protect user privacy and adhere to security standards.
11. Physical Security	k. Keep farming software up-to-date by applying regular security patches and updates. Software developers often release updates to address vulnerabilities and enhance security, so staying current is essential for maintaining a secure system.
12. Legal and Regulatory Compliance	l. Employ firewalls, intrusion detection and prevention systems, and secure network configurations to protect against unauthorised access. Regularly monitor network activity for unusual patterns that may indicate a security breach.

Exercise 8. Discuss the following points.

1. Why is cybersecurity important for agricultural sector?
2. What are the main cyber threats farmers may face?
3. What types of security software are available in farming?
4. What measures can be used to enhance farming software security?

Exercise 9. Search the Web for cybersecurity in agriculture in Russia and other countries. Make a presentation.

Exercise 10. Look through Unit 6 again. Make a list of the words and word combinations you consider to be the terms. Translate them into Russian.

РАЗДЕЛ 2. БАНК ТЕКСТОВ ПРОФЕССИОНАЛЬНОЙ НАПРАВЛЕННОСТИ

2.1. Professional Agricultural Machinery

2.1.1. Grain Harvesting Combines

Text 1. A Combine Harvester

Sources: <https://www.countryfile.com/farming/how-does-a-combine-harvester-work>, <https://www.britannica.com/technology/combine>, <https://www.holtags.com/types-of-farm-equipment-and-their-uses#tractors>

The sight of a massive combine harvester sweeping through acres of ripe, golden wheat is one of the most impressive things you can see in the fields of Britain. It doesn't matter how many times you witness these monster machines at work, the way they slice through the crop still makes you stop and stare.

Definition: Although commonly called combine harvesters, farmers refer to them purely as combines. The name comes from the simple fact that the machine 'combines' three different tasks; reaping, threshing and winnowing. Reaping is the cutting and collecting of the crops; threshing loosens the grain from the dry casing around the seed; winnowing then divides the grain that's needed from the scaly plant material that isn't, so it literally separates the wheat from the chaff.

Combine is complex farm machine that both cuts and threshes grains and certain other crops. Combines are used in the harvesting and cleaning of cereals such as wheat, barley, corn (maize), oats, rice, rye, and sorghum, as well as a number of non-grain crops, including flax, rapeseed, soybeans, and sunflower seeds.

History: An early primitive combine was a horse-drawn "combination of a harvester-thresher" introduced in Michigan in 1836 and later used in California. Combines were not generally adopted until the 1930s, when tractor-drawn models became available. Self-propelled machines, capable of cutting swaths 2.5 to 5.5 metres (8 to 18 feet) wide, appeared a decade later. Originally designed to harvest wheat, they came to be used to harvest many other crops.

You could argue that the combine is the most important labour-saving device ever invented. It has revolutionised the gathering of crops worldwide, making harvest simpler, swifter and more cost-effective. It has also changed the face of farming forever – economically and socially. No longer are large teams of workers employed in the fields in the late spring and summer. Our farming forebears would be familiar with entire villages working for days on end with several generations of the same family helping to bring home the harvest.

Today we don't need an army of reapers, rakers and threshers and the number of employees has shrunk dramatically; at the same time mechanisation has eliminated the poor working conditions and child labour that were commonplace.

Before combines, crops were cut by hand when they were half ripe. The seed head was kept intact on a long stem which meant that they could be bound together into sheaves and stacked in the field to ripen off. But since the 1830s when the first rudimentary horse-drawn combines appeared, things have gradually changed.

Three primary processes: There is a vast array of combines and combine attachments to meet the needs of any farm. Many newer combines can even track yield data, showing which areas of the field did well and which did poorly so that these issues can be addressed the following year. Combines use a complex system of gears, blades, belts and wheels to turn cereal crops into grain. Combines accomplish this through three primary processes:

1. Reaping: Reaping is cutting the plant, accomplished by the header, reel and cutter bar on the combine. The header gathers the crops while the reel pushes them toward the cutter bar, which cuts the crops at their base.

2. Threshing: Threshing is the process of separating the edible parts of the crop from the nonedible parts. This is accomplished by the threshing drum, which beats the cut crops to separate the grains from their stalks. Threshers can also be individual attachments that you can use on a tractor. Some threshers can come with a bagger, while others discharge grains using conveyors.

3. Winnowing: Winnowing separates light chaff from the grain, usually accomplished while the grain is in the threshing drum. Chaff is generally separated from the grain through the use of sieves.

Mechanism: In design, the combine is essentially a binder-type cutting device that cuts and delivers the grain or seed crop to a threshing machine modified to work as it moves across the field. The cutting-gathering component, designed to take the grain with a minimum of straw, is sometimes called the header. A threshing cylinder rubs grain out of the heads against a concave surface. Some grain and chaff go with the straw to the straw deck, on which grain is shaken out and delivered to the cleaning shoe. Some of the grain and chaff goes directly to the cleaning shoe, on which sieves and a blast of air are used to separate and clean the grain. After passing through the air blast, the grain drops into a clean-grain auger that conveys it to an elevator and into a storage tank. Straw drops out of the back of the combine in a windrow for baling or is scattered over the ground by a fan-like spreader. Some combines for use on steeply rolling land have a body supported in a frame by hydraulic cylinders that automatically adjust to keep the body level.

Price: Perhaps it's no surprise that the most up-to-date models come with a hefty price tag. A new one could set you back £250,000 or more and even second-hand combines cost in excess of £100,000.

Text 2. TORUM 7853

Source: <https://en.rostselmash.com/products/models-zuk/torum-785/>

TORUM 785 produced by Rostselmash is designed for harvesting all traditional grain crops, such as spiked cereals, legumes, oil crops, cereal and arable crops. It is an efficient machine with an output of up to 45 tons of grain crops per hour (basic time), capable of cutting crops in an area of up to 2000 ha per season.



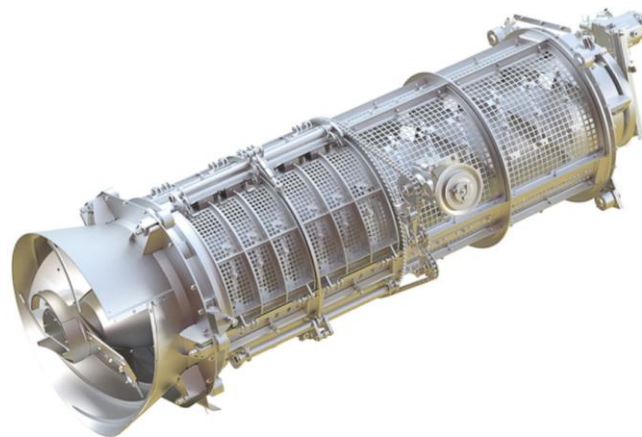
The key features of this combine are:

1. High performance

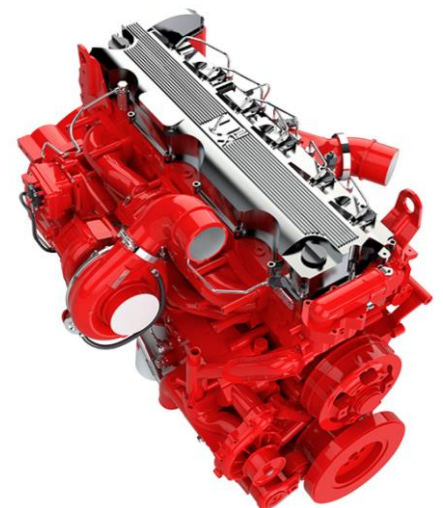
– **A unique threshing system Advanced Rotor System (ARS)** – rotor with a rotating concave. The concave area on the rotary combines with a fixed concave is not used to its full extent, reducing the potential performance. In addition, when harvesting damp crops or rice, the top of concave becomes plugged (the so-called dead zone). The rotating concave allows using 360° of the concave surface and avoiding dead zones and the rotor plugging.



– **Large threshing and separation area:** The rotor, 3200 mm long and 762 mm in diameter, provides a threshing and separation area of 360 degrees – as much as 5.4 sq.m. The concave forms three threshing sections, allowing to set the clearance in one cross section. So, in one rotor revolution the heap is threshed not once, but three times. In addition, the concave design allows setting increased clearances. No additional adjustment of concave is required depending on crop harvesting conditions: for crops from barley to wheat, the threshing clearance is set between 16 and 25 mm.



– **A high-power and fuel-efficient engine 520 h.p.:** TORUM 785 comes with inline 6-cylinder Cummins engines. Powerful and compact, these engines have good fuel consumption and torque reserve. The air cleaning system uses an air intake screen with forced rotation (by a hydraulic motor), which significantly reduces the maintenance effort. A special rotating vane between the coolers provides their self-cleaning, increasing the useful operating time.



2. Comfort in use

– **Luxury Cab featuring Adviser IV information system:** TORUM 785 combines come with a new second-generation Luxury Cab. The major difference between the new Luxury Cab and the proven Comfort Cab II is the size: the new one is more than 1.5 times bigger, with more than 4 cu.m of volume, more than 2 m. wide, and a window area greater than 5 sq.m. Additional benefits include climate control, improved noise insulation and suspension for the cab, a large air-suspended operator's seat, an additional larger seat, electrically adjusted and heated rear-view mirrors. The beverage cooler also has a larger capacity. Adviser IV voice information system and Agrotronic Agromanagement platform come in basic configuration. For the operator's comfort, TORUM 785 is equipped with bright LED lights, this is a new configuration standard for high-performance machines.



3. Important details, opportunities and options

– **High-capacity feeder house:** A new generation feeder house significantly increases the combine functionality and operational comfort for different crops. The basic configuration features a single-point hydraulic multicoupler, adjustable for/aft tilt for higher performance and ease of work with all crops without the need to convert, with quick connection of adaptors (for the headers weighing up to 4500 kg). The power to the header drive was almost doubled to properly handle 12-row corn headers.

– **Quick unloading:** The clean grain goes into a 12,000 l grain tank. This capacity increases the performance by reducing the unloading cycles. The unload rate is 120 l/s, the full grain tank is discharged within 2 minutes. The unloading auger length is now increased to 7.5 m, the unload height is 5.4 m, the reach angle is 105 degrees. This allows an easy unloading of grain into any truck or trailer, even when a 14 m header is used. When harvesting rice, unloading can be done without leaving the bay. An unloading and rear-view video monitoring system is available as an option (e.g., for unloading on the move).

– **CVT rotor drive:** The rotor is driven by a hydraulically controlled planetary CVT (continuously variable transmission) – a unique hydromechanical device that combines the advantages of both types of drives: smooth and accurate speed control, high bearing force, and reliable beltless transmission. All this produces a very high torque (up to 1500 Nm) for an effective work in harsh conditions.

– **RSM tailing elevator crop flow sensor:** Depending on the version, the basic package includes an optical tailing elevator crop flow sensor (monitoring the flow through the tailings elevator). This offers a convenient way for the operator to monitor the operation of threshing and cleaning systems. The amount of incoming material is displayed in Adviser IV as absolute and relative values.

– **RSM adaptive cruise control:** The system automatically controls the machine ground speed depending on crop yield, engine load, thresher and shoe losses, and rethreshing percentage, based on the settings made by the operator, in either of two modes:

- ✓ constant preset speed;
- ✓ constant preset feeder house load, with ground speed adjusted automatically for consistent thresher loading in varying field conditions;
- ✓ constant preset speed;
- ✓ constant preset feeder house load, with ground speed adjusted automatically for consistent thresher loading in varying field conditions.

– **4D longitudinal slope compensation system:** The system provides automatic change of the cleaning fan speed and the gaps between the combs of the upper sieve and extension to compensate for the longitudinal slope of the field:

- ✓ when moving uphill, the fan speed is automatically reduced, and the gaps of the sieves increase;
- ✓ when going downhill, the fan speed is automatically increased, and the sieve gaps are reduced.

Text 3. NOVA

Source: <https://en.rostselmash.com/products/models-zuk/nova/>

NOVA is an excellent combination of performance, affordability, and low operating costs.

An ideal solution for farmers and small farms. Compactness and manoeuvrability make this combine indispensable for efficient operation in small fields with complex contours. The modern design and rational configuration of the machine provide the required performance and ensure good value for money.



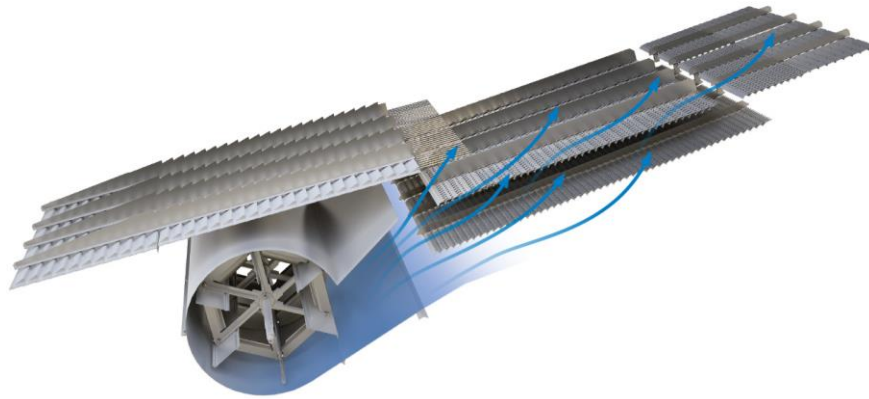
The key features of this combine are:

1. High performance

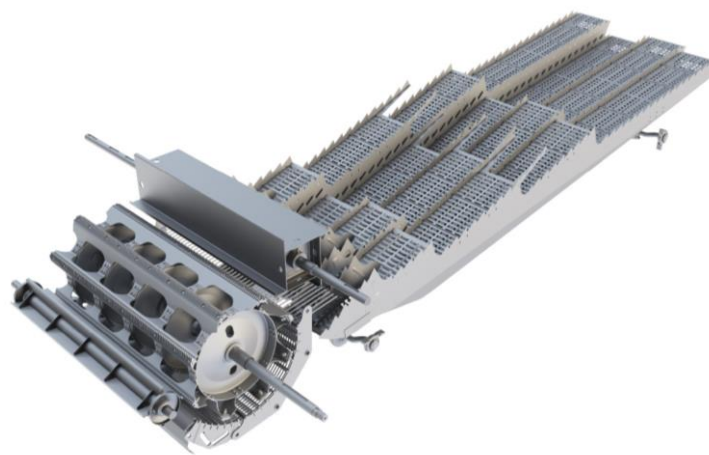
– **Unique threshing/separating system:** The traditional thresher with a single 600 mm threshing cylinder provides a very gentle threshing including thin layer threshing,

but is quite simple in design. A unique double-section concave design along with a large coverage ensures a concave area of 0.93 sq.m (which is unachievable for other combines in this class), and ultimately a high performance of the machine.

- **Efficient cleaning system:** The threshed tailings are cleaned by a double-sieve cleaning system. A large drop height and a finger rake on the precleaner significantly improve the cleaning performance. The true total area of sieves is 3.59 sq m., which is one of the best for this class of combines. The cleaning system uses a 6-vane fan; the fan speed is easily controlled from the cab and displayed on the control panel. Tall dividers can be optionally fitted to the chaffer to minimise losses when the harvesting is done on hillsides. Practice shows that losses are decreased by more than 1%, and the greater the angle to horizon, the greater the effect.



- **A high-performance straw walker with a large separation area:** The straw leaving the threshing cylinder with some grains in it is directed by the rear beater to the straw walker. Four straw walkers with 5 steps does an easy job of separating the remaining grains. A tailings elevator feeds crop material to the rear beater for rethreshing. As a result – good balance of simple design and productivity is achieved.



2. Comfort in use

- **Comfort Cab with Adviser II information system:** NOVA is equipped with a two-seater Comfort Cab with air conditioning and heating systems, beverage cooler, and

Adviser II voice information system. There is an option to install Agrotronic Agromanagement platform. Adviser II voice information system continuously monitors the threshing process and the functioning of combine mechanisms, and allows monitoring the process stability and preventing the failure of units.



3. Important details, opportunities and options

– Feeder house for various conditions: A conveyor-type feeder house feeds crop material to the threshing cylinder quickly and evenly. It has hatches for inspection of its condition and easy maintenance. A stone trap before the threshing cylinder prevents stones from entering the threshing area. The reverse function (for hydraulically driven NOVA 340 4WD and NOVA 330) will help in difficult operation conditions. The terrain following is both lengthwise and crosswise, thanks to balancing springs.

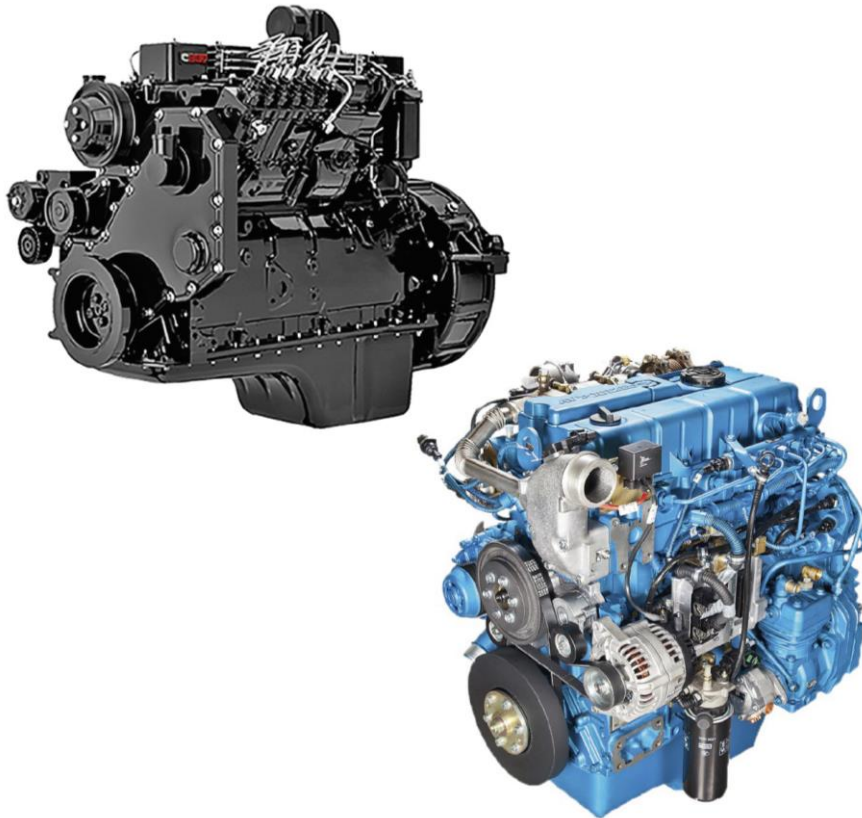
– Large 4900 l grain tank: The grain tank capacity is the most optimal for this class of machines. A high-speed unloader enables the unloading within 2 minutes. Adjustable fins inside the grain tank adjust the unloading speed depending on the harvested crop type and moisture content. The grain tank walls are inclined so as to reduce the probability of sticking even when wet grain is unloaded. The quality of grain can be easily checked by means of the sampler located on the operator's cab platform. The unload height is 4 m, which allows unloading grain into any vehicles. The hydraulic extension of unloading auger can be activated from the cab. Unloading is autonomous, i.e., the thresher drive can be disengaged to save fuel.

– New opportunities: A good road clearance is required to operate on rough terrain (e.g., with irrigation ditches), to drive over ramps or furrows. NOVA with a 50 cm road clearance is perfect for these conditions. The all-wheel drive version is available for high moisture conditions. To reduce the ground pressure, larger tires may be installed. The compact combine base ensures high maneuverability on small fields. The large size of



adapters and accessories enables the maximum operating efficiency.

– **Several engines for various conditions:** NOVA 320 uses an in-line 6-cylinder Cummins engine (model 6BTA, 123 kW, 5.9 l, Stage II). A simple design with manually adjustable fuel supply is undemanding in terms of diesel fuel quality, allowing a high content of sulphur in fuel, and has a high maintainability. NOVA 330 uses an in-line 4-cylinder Cummins QSB/B4.5, 4.5 l, Stage IV/V) with 129kW (175hp) power. NOVA 340 uses an in-line 4-cylinder YaMZ engine (model 53 425, 132 kW, 4.43 l, Stage IIIa). The Common Rail fuel system with electronically controlled fuel supply provides a high injection pressure up to 180 MPa. This reduces the fuel consumption (by 10%) and increases the specific power. The fuel efficiency indicators are displayed by Adviser information system. In general, the achieved fuel consumption is less than 2 kg per 1 ton of grain threshed in normal harvesting conditions.



– **Easy maintenance:** All maintainable assemblies and lubrication points are grouped and readily accessible, so the shift maintenance can be done in less than 10 minutes. Side panels open wider and do not interfere with any service tasks. An air compressor with a 110 l receiver (included in the basic four-wheel drive package) saves a lot of time during daily maintenance and is especially helpful in field conditions if there is no support vehicle nearby.

– **Versatile straw treatment:** The traditional threshing and separating system in NOVA causes little to no damage to the straw. Depending on the intended use, straw may be chopped and spread or windrowed. The chopping rotor drive can be disengaged within seconds. For hard stalk crops, a speed reducer is available to lower the speed to 1700 rpm. The farms that conserve large amounts of straw may purchase the combine version with a 9 cub.m stacker. It can gather straw in stacks and unload them automatically on the move. The most cost-effective solution for the farms that gather all material other than grain is to order a custom combine with a hood and without a chopper. That way, all straw from the walkers and all chaff from the sieves is laid in a single windrow that can then be baled, rolled, or gathered into carts.

Text 4. T500

Source: <https://en.rostselmash.com/products/models-zuk/t500/>

T500 is designed for harvesting all traditional grain crops, such as spiked cereals, legumes, oil crops, cereal and arable crops. It is an efficient machine with an output of up to 30 tons per hour (basic time), capable of cutting crops in an area of up to 1300 ha per season. It is adapted to hardest operating conditions. The grain group does not limit the capabilities of the combine at harvest corn. T500 is characterized by high performance, minimal losses, a new separator with increased separating capacity and updated lighting equipment at the rear of the combine.



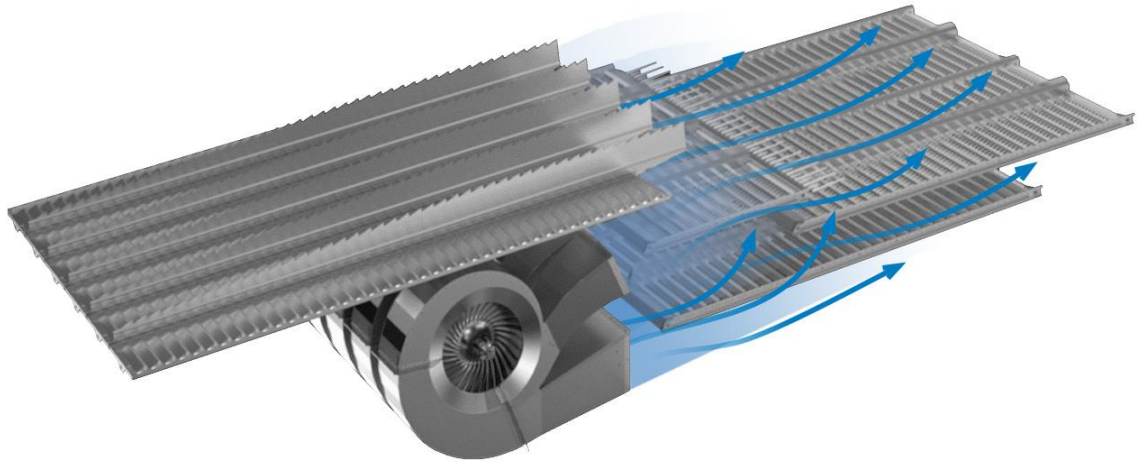
The key features of this combine are:

1. High performance

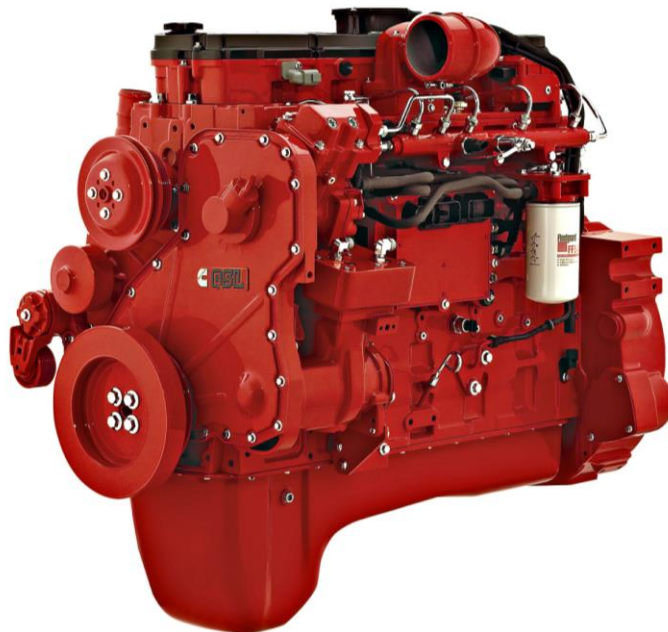
– **TETRA Processor threshing system:** The Tetra Processor features a flexible concave with electronically adjustable clearances along the entire length. An impressive threshing area of 3.0 sq. m and separation area (8.3 sq. m in total) provide a thorough separation with minimum grain and straw damage, also in the toughest field conditions. Tetra Processor threshing system is built using a 800 mm-dia. cylinder which provides consistent and delicate threshing without losses. A 750 mm-dia. separator creates a smooth path for the crop material. The width of the unit – 1,500 mm – allows the machine to achieve an output up to 30 t/h.



– **High-performance OptiFlow cleaning system:** The 2-stage OptiFlow cleaning system with a proprietary sieve suspension with an area of 5.85 sq. m is used to clean the material. A strong optimized air flow, a large drop height, and the tine grid on the grain pan and additional sieve improve the cleaning process significantly. The cleaning system uses a double-flow 5-section turbofan, with its speed controlled in the cab and displayed on the control panel. Sieves and components are easy to clean, and the sieves can be quickly adjusted by the operator from the cab.



– **Powerful and efficient cummins engine, 360 h.p.:** The T500 uses a powerful and efficient 360 hp L6 Cummins QSL 8.9. A large torque reserve (25%), simple design, low maintenance costs coupled with high fuel efficiency.



2. Comfort in use

– **Luxury Cab with Adviser IV information system:** T500 come with a new 2-gen Luxury Cab. The major difference between the new Luxury Cab and the proven Comfort Cab II is the size: the new cab is more than 1.5 times bigger, with more than 4 cu. m of volume, more than 2m wide, and a glazing area greater than 5 sq. m. Additional benefits include climate control, improved noise insulation and suspension for the cab, a large air-suspended operator's seat, an additional larger seat, electrically adjusted and heated rear-view mirrors. The beverage cooler also has a larger capacity. Adviser IV voice information system and Agrotronic agrimanagement platform come standard.



3. Important details, opportunities and options

– **Confident operation in difficult conditions:** A high ground clearance of 50 cm is required for operation in hilly areas or with uneven terrain. In wet conditions, an all-wheel drive package is suitable. Larger tires can be fitted to reduce ground pressure.

– **Fast unloading:** A large capacity grain tank with an advanced system for unloading into vehicles with side height over 4m, and with vibrators. The grain tank capacity – 10,000 litres – increases the performance due to fewer unloading cycles. The unload rate is 120 L/s; it takes 2 minutes to empty the full grain tank. Grain can be easily unloaded into any trucks or trailers, while using headers up to 10m wide. The thresher drive can be disengaged during unloading to save fuel.

Text 5. LEXION Models: Cab and Comfort, Digitalisation

Source: <https://www.claas.co.uk/products/combines/lexion-8900-7400>

The optimised LEXION models produced by CLAAS are the most productive machines on the market – measured in terms of harvested area or tonnes per year. Even when operating in unfavourable conditions, they can be counted on to bring their strengths to bear precisely when you really need maximum performance. So, you can save time and fuel while operating more productively than ever before.

With every harvest bringing new challenges every working day, it is reassuring to know that you can count on process technology that is able to cope, whatever the requirements may be. The LEXION has everything it takes to deliver top campaign performance. The feeder housing, APS SYNFLOW threshing unit, ROTO PLUS secondary separation and the straw management system work together precisely and ensure the success of your harvest.

Whichever LEXION you decide on, it will become a key player in your harvesting chain. The LEXION 8000 model series with the APS SYNFLOW HYBRID threshing system offers you a choice of four models with high throughput for an extremely wide range of conditions. The LEXION 8900 is the flagship of the model series. With the LEXION 8700 and 8800 models, increased engine output and optimised process technology guarantee even higher performance reserves than the predecessor models. The new LEXION 8600 completes the line-up and impresses with its cost-effectiveness and solid throughput under all harvesting conditions.



1. Cab and comfort

– **Comfortable cab:** When we are refining one of our combine harvester models, we always include the cab concept in our design considerations. We are supported in this by combine harvester operators all over the world. Together with them, we take the important decisions relating to the comfort and control aspects of our machines. Proven approaches are continued, good solutions are improved, new ideas are put to the test.



We are certain that you will welcome the new cab of the LEXION, especially the air conditioning concept with its more efficient airflow, the extra space at head and leg level, the actively cooled 30 l cool box for your drinks or the bright, high-resolution CEBIS display. Of course, the fundamentals remain unchanged: the incomparable CLAAS comfort, for example, or the intelligent control concept which gives you easy access to all machine functions.

– **Operating concept:** The system called CEBIS operates intuitively. Thus, operation is possible without previous knowledge. This means that even new operators are able to use the LEXION in a short time. CEBIS plays a decisive role in this. The system is an information supplier, performance optimiser and problem solver all rolled into one.

CEBIS offers immediate assistance. Stored in CEBIS is a library of measures – based on the experience of countless CLAAS combine harvester operators – for resolving various problem scenarios. Covering all the parameters which could contribute to solving the problem, they represent a comprehensive resource which supports you in making full use of the installed capacity of the machine. CEBIS simplifies the menu.



Beginner, normal or expert: you define your user type and CEBIS adjusts the menu system to your level of experience. This ensures that new operators are not overwhelmed by complex menus. The operator assistance system is also integrated in CEBIS. You operate CEMOS DIALOG and CEMOS AUTOMATIC via the user-friendly touchscreen. Using the four sliders, you program the system's automatic functions with the strategies you wish them to follow.

– **Lighting:** Bright LED front area lighting allows turning night into day. Up to 26 work lights flood the entire working area in light as bright as day. The long-range work light provides illumination over a particularly long distance. The front attachment is illuminated as brightly as the front area, sides and stubble. All the important machine components are equipped with maintenance lighting.

2. Digitalisation

– **Operator assistance systems:** Operators can configure CEMOS AUTOMATIC for their specific requirements. CEMOS AUTOMATIC is a self-learning operator assistance system which provides you and your operators with continuous, active support throughout the entire work process. On the basis of harvesting parameters, such as grain quality, threshing quality, standard of cleaning, straw quality and throughput, the system checks sensors and settings. It optimises your LEXION to its technical performance limits while it is at work.



The operator makes decisions. You tell the system your requirements concerning the grain quality and loss level. During harvesting, CEMOS AUTOMATIC optimises the performance of your machine to meet your criteria precisely.

It is possible to assemble your own CEMOS solution. Whether you choose the entry level or full version, you configure your CEMOS AUTOMATIC system to meet your specific requirements on the basis of the functions that will make sense in your fields and optimise your work.

– **Steering systems:** They allow harvesting with pinpoint precision and keeping the number of passes to a minimum. Steering systems are an essential tool in your everyday work. The LEXION can be equipped with three automatic steering systems, which you can choose between on the basis of the task in question: the digital AUTO PILOT, the satellite-based GPS PILOT CEMIS 1200 and the electro-optical LASER PILOT, which we can also equip with the FIELD SCANNER for you as an option.

– **Data management:** A connected LEXION is more productive. Digitalisation puts your farm ahead. With TELEMATICS you transmit data from the machine straight to the cloud. With FLEET VIEW you coordinate your transport teams with a degree of precision measured in seconds. With CEMIS 1200 you create and manage all jobs on the spot in the machine. With DataConnect you process the data from your machines, regardless of manufacturer. With Remote Service you simplify maintenance and service activities.

Text 6. LEXION 8000/7000: Crop Flow

Source: <https://www.claas.co.uk/products/combindes/lexion-8900-7400>

The crop flow includes the following characteristics.

– **Feeder housing:** The feeder housing is equal to any challenge.

As to the HP feeder housing, using the multifunction lever in the cab, you can perform continuous hydraulic adjustment of the cutting angle of the HP feeder housing from -8° to $+11^{\circ}$ – when running at full speed with the front attachment fitted. You can store a separate cutting angle for each of four cutting heights in CEBIS. In this way, you can respond quickly and conveniently to different crop stands, crops or terrain conditions.

The V feeder housing allows you to carry out fast, mechanical adjustment of the cutting angle. This means that you can harvest laid crops, soybeans and grass-seed with greater ease and with reduced losses as the tendency for the crop to build up is reduced. You can order the V feeder housing ex factory with chain or belt conveyors as well as with an open or closed guide roller.



– **APS HYBRID threshing unit:**

An even crop flow saves fuel. The 450 mm accelerator drum in the APS SYN-FLOW HYBRID starts an extremely efficient threshing process which allows you to achieve outstanding throughput rates.



It accelerates the crop flow smoothly to as much as 20 m/s. In so doing, it generates a high centrifugal force which enables maximum separation performance across all concave areas.

Large drum diameters and small contact angles enable particularly flat transitions between the threshing and feeder drums as well as the rotors. This means that there is a straight, fuel-saving crop flow through the combine harvester. What's more, there are no unnecessary changes of speed or direction of flow. This makes for gentle straw handling and saves fuel.

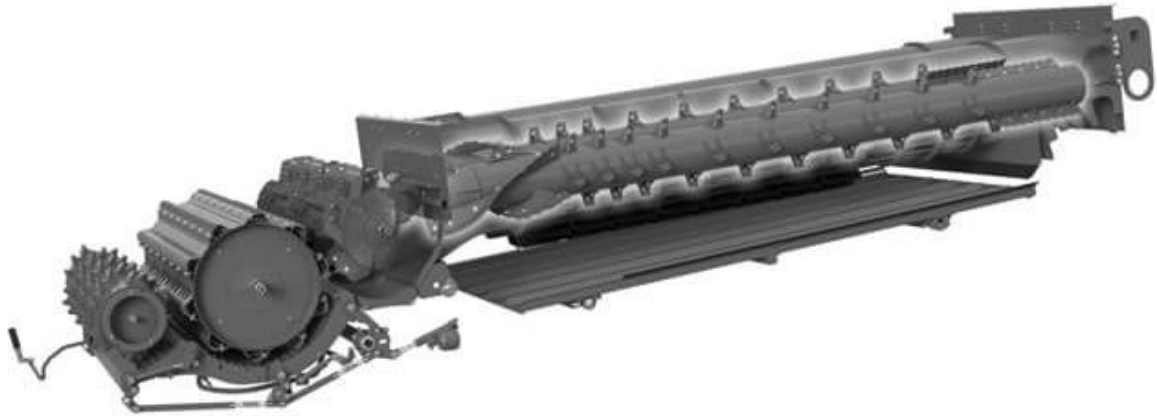
- Crop type change:

Change quickly from one crop to another. In developing the threshing system, we have drawn on our many years of experience. The combination of the tangential APS SYNFLOW threshing unit and the axial ROTO PLUS secondary separation makes the APS SYNFLOW HYBRID threshing unit the trendsetter for its class. Whichever crop you are harvesting, you can look forward to high throughput – with extremely low fuel consumption and top-quality chopping.



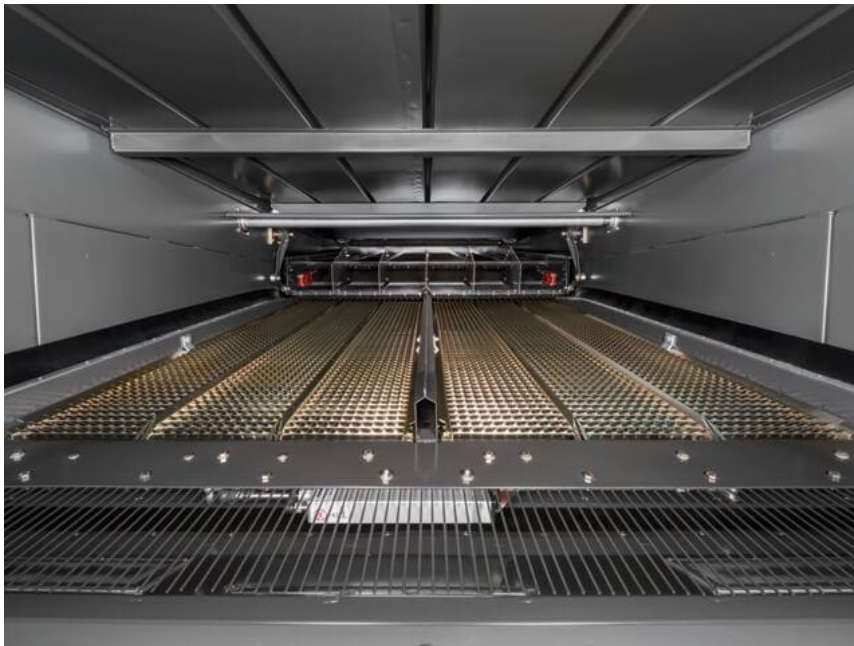
Change concave segments quickly. Changeover times from one crop type to another are getting ever shorter. When a changeover is carried out, the main components of the threshing concave remain in the machine. You can quickly change the preconconcave segments through the stone trap simply by pulling the threshing concave segment out to the side. The numerous combination options are the key to the unique MULTICROP capability of the LEXION.

- **ROTO PLUS:** It makes the most of your crop. Every grain counts. The eccentrically mounted ROTO PLUS high-performance rotors generate tremendous centrifugal force to separate the remaining grains from the straw. With a diameter of 445 mm and a length of 4,200 mm each, they provide a huge separation area.



The mixture of grain, straw and chaff first reaches the preparation floor via the separate returns pan before passing over the straw walker steps to the sieve pan. This significantly reduces the load on the sieve pan.

- **JET STREAM:** Clean grain is worth real money. The JET STREAM cleaning system with its hydraulic fan speed variator and high-performance returns is specially matched to the ROTO PLUS secondary separation. A dual-ventilated step enables intensive pre-cleaning. JET STREAM is controlled conveniently from the cab.



You no longer have to adjust anything manually. As an option, you can put the JET STREAM cleaning function under the fully automatic control of CEMOS AUTO CLEANING.

- **Pivoting spout:** Collect your grain quickly and reliably. Grain tank unloading tube with pivoting spout. The pivot angle of 105° allows you an excellent view of the grain tank unloading tube. You can select the length of the tube in accordance with the width of the front attachment. The diameter depends on the desired unloading rate: 420 mm for 180 l/s or 330 mm for 80 to 130 l/s.

The stream of material is concentrated by a pivoting spout at the end of the tube. This can be adjusted via the CMOTION multifunction lever and makes it easier to load the transfer vehicles precisely.



– **Chaff and straw spreading:** Its straw management is excellent. Top performance with all crops. In addition to two straw chopper drives with manually adjustable chopper speed, there is also a version with hydraulic speed adjustment which can be controlled conveniently from the operator's seat. This option comes into its own when you have to work frequently in changing crop types. During swathing, a neutral setting saves fuel and reduces wear.

Precise straw spreading. Even when the machine is operating in strong crosswinds, handling high straw volumes or negotiating side slopes, the power spreader always deposits the straw precisely. Comprising two discharge rotors turning in opposite directions at a constant speed, it takes both the chopped material and the chaff straight from the cleaning section, accelerates it further and spreads it evenly across the entire working width.

Discharge direction is optimised automatically. You can equip your LEXION with two sensors which automatically adjust the discharge direction of the chopped material to the terrain conditions. The sensors are fitted on the light brackets at the rear of the machine and ensure that the power spreader and deflector spread the chopped material evenly on slopes or in the event of crosswind. You set the sensitivity of this system in CEBIS.

Targeted chaff spreading. During swathing, the chaff blower automatically turns outwards. Swaths of long straw and chaff/broken straw mixture are laid separately. For straw spreading, however, the chaff blower forces the sieve pan discharge straight into the power spreader for active distribution. The chopped straw and the sieve pan discharge are spread across the entire working width.

Text 7. LEXION 8000/7000: Engine and Running Gear

Source: <https://www.claas.co.uk/products/combines/lexion-8900-7400>

The key aspects of engine and running gear include the following characteristics.

– **GLAAS power systems:** You have many possibilities for optimising the LEXION to meet the characteristics of your farm and your fields so precisely that your campaign performance increases to a significant degree.

You benefit from higher engine output. The LEXION 8800 can call on 700 hp instead of 653 hp, the LEXION 8700 has an output of 626 hp instead of 585.

DYNAMIC POWER adjusts the engine output to the power requirement. This allows you to achieve fuel savings of up to 10%.

DYNAMIC COOLING reduces your diesel costs. The variable fan drive adjusts its speed automatically in line with the degree of cooling required.



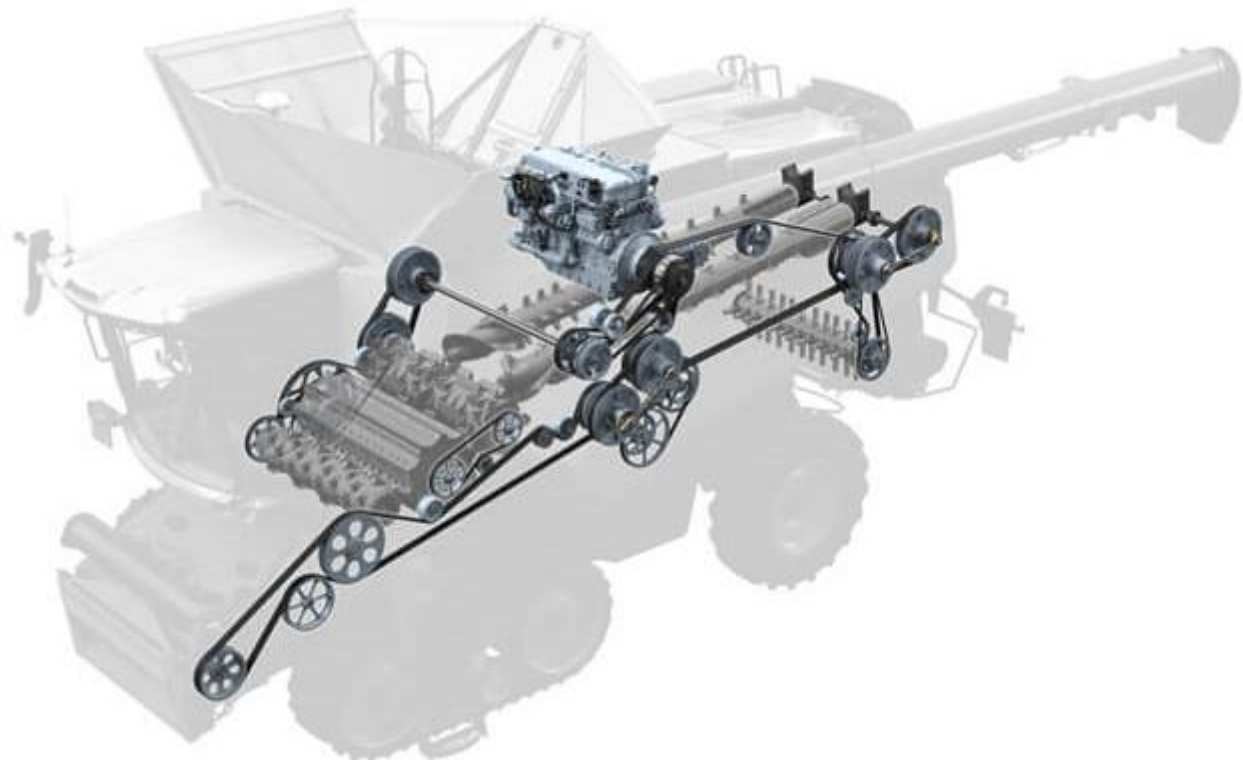
TERRA TRAC reduces soil compaction. The crawler track units offer a high level of driving comfort and are narrow enough for road travel.

You can harvest on slopes as effectively as on level ground. The LEXION 7700 is also available as a MONTANA version.

The differential lock on the front axle allows you to continue to operate reliably in difficult terrain.

For greater tractive power in difficult terrain, you can equip your machine with a POWER TRAC 4-wheel drive.

– **Drive concept:** The intelligent drive concept of the LEXION is one of the many factors which keep maintenance requirements low and operating reliability high.



The main characteristics are a hydraulically actuated dry clutch, hydraulically tensioned main belts, standardized belt tensioners, an improved power transmission and lower maintenance costs.

– **Hydrostatic ground drive:** 40 km/h for fast transfers. All LEXION models are equipped with a 2-speed hydrostatic ground drive with convenient gear selection via the buttons on the armrest. The high efficiency of the hydrostatic motor saves power which is available to the rest of the machine. Both the wheeled machines and the TERRA TRAC

models can travel at up to 40 km/h.

– **DYNAMIC COOLING:** It is a smart solution. What makes dynamic cooling so unique?

- ✓ Variable fan drive provides cooling when required
- ✓ Provides effective and reliable cooling
- ✓ Uses full fan speed only under full load
- ✓ Minimises extent to which dust is able to rise
- ✓ Reduces soiling of the radiator and engine compartment
- ✓ With grain tank unloading tube extended, automatically increases speed to actively blow dust away from engine compartment
- ✓ Extends the air filter maintenance intervals

– **TERRA TRAC:** Third-generation crawler unit protects your soil. The soil is the most important basis for production available to you. As it is impossible to create more of it, you need to be able to obtain ever greater yields from the existing land. The key to this is more productive machines which, thanks to TERRA TRAC, are extremely gentle on the soil.



The third generation of TERRA TRAC crawler tracks impresses with the large diameter of the land wheels, hydropneumatic suspension, improved track tensioning and automatic level compensation from 2 km/h. The TERRA TRAC system increases traction drastically and leaves hardly any trail behind it when operating in the wet, on soft ground or on side slopes. This makes the work of the transport vehicles considerably easier.

TERRA TRAC on the road.

- ✓ 40 km/h top speed possible
- ✓ Fully suited to road travel at 20, 25, 30 and 40 km/h
- ✓ High driving safety and directional stability
- ✓ More driving comfort compared with a wheeled machine

TERRA TRAC in the field.

- ✓ Up to 66% less ground pressure than wheeled machines
- ✓ Better traction in maize, in the wet and on slopes
- ✓ Less slip and greater stability on side slopes
- ✓ Lower drive resistance and fuel consumption

TERRA TRAC in rice.

- ✓ Special rice track, 890 mm wide
- ✓ Greater spacing of tread lugs for self-cleaning
- ✓ High traction and load-bearing capacity
- ✓ Will not sink in when operating in wet field conditions

Text 8. GOMSELMASH GS2124: Uni Cab, Feeder Housing and Dust Control

Source: <https://eng.gomselmash.by/produksiya/grain-harvesters/grain-harvesting-combine-gs2124/>

Grain harvesting combine GOMSELMASH GS2124 is the perfect combination of efficiency, comfort and customer wishes.



The HYBRID-FLOW threshing and separation system provides increased productivity and threshing quality even under extremely harvesting conditions. The high level of automation of the running processes provides the stable operation of the combine on any agricultural background, excluding the possibility of a combine operator error. Choosing this combine model, you can be sure that you will get the best harvest performance with maximum comfort.

1. Uni Cab: The new modern UNI CAB is equipped with everything necessary for comfortable operation of the combine, and a bonus is excellent visibility from the workplace.

Ergonomic joystick, video monitoring of work areas, audio system, heated refrigerator, beverage cooler, climate control, USB port for connecting external devices, 12V socket, organizers for storing documents and small items, steering column and air suspension seat with adjustments allow you to customize your favorite seat individually and comfortably.

The ergonomic U-PAD combine control panel with logically grouped controls helps you to carry out work operations in an intuitive way without unnecessary difficulties.

The information system of HARVEST OFFICE on-board computer with a color touch screen makes the work of the combine operator as efficient and comfortable as possible. The HARVEST OFFICE system helps to manage and provide real-time monitoring of the state of the main combine functional units, control the working parts, engine, transmission, the progress of work and service operations, and also informs about the presence of warning and emergency situations.





The modern multifunctional joystick MULTI GRIP, integrated into the armrest, allows you to easily control the harvesting process. Also, to facilitate and increase the efficiency of your work, the combine has the CROP PRESET system that allows you to automatically tune the working parts of the combine (threshing drum speed, concave clearance, fan speed, upper and lower sieve gaps) when changing crops.

The powerful lighting system of working area LED VISION with ten headlights contributes to comfortable and efficient harvesting even at night.

For the convenience of the operator, the CAM VISION system is installed in the cab, which provides a video overview of the grain unloading areas, the grain tank and the back area of the combine, which allows you to monitor these important processes without leaving the cab.

2. Feeder Housing: Powerful start with minimal power consumption

Thanks to one of the widest feeder housing with a working angle of 35°, you get a powerful and steady start of the grain mass. The ideal trajectory of the mass feed significantly reduces the power consumption of the combine without compromising its performance.

Throughput and high working speed are integral components of the high productivity of your combine, and therefore your work. Working at high speeds up to 10 km/h, at night, on slopes and rocky fields requires a lot of attention, but thanks to the SELF-CONTOUR electro-hydraulic relief copying system, losses behind the header are noticeably reduced and the operator can focus its attention on other important things, without worrying about possible losses. SELF-CONTOUR provides in a fully automatic mode the maintaining set cutting height, soil pressure and position of the header relative to the ground in both longitudinal and transverse directions. These advantages of GS2124 allow you to efficiently load your combine and get the maximum economic benefit from its use.



To work with the minimum downtime, and therefore with the maximum profit for you, in the most difficult period of harvesting, a chain-and-slat conveyor using high-quality IWIS alloy steel chains helps. Reversing the feeder housing conveyor is a must-

have operation, especially in difficult harvesting conditions. The use of a hydraulic motor in the feeder housing design allows the conveyor to be reversed stepless, helping you to harvest in a short time, saving time on cleaning the feeder housing and adapter.

3. Dust Control: The DUST CONTROL is a dust removal system that improves observability and visibility of the header from the cab, allowing you to load the full length of the header with greater accuracy and unlock the full power potential of GS2124.



For even more increasing productivity in the workplace, the GS2124 combine has the multi-functional coupling for adapters that reduces aggregation time, saves your efforts and promotes a quick start of harvesting.

Text 9. GOMSELMASH GS2124: Hybrid-flow System, Air Fan, Grain Tank, Straw Chopper, Innovative Systems, Electronic Systems and Adapters

Source: <https://eng.gomselmash.by/produksiya/grain-harvesters/grain-harvesting-combine-gs2124/>

1. Hybrid-flow system: The HYBRID-FLOW system provides effective separation in all conditions. The basis of the GS2124 combine is a double-drum threshing system and rotary separation, which has repeatedly proven its effectiveness on any agricultural background and harvested crops, which significantly increase the productivity of your combine without damaging the grain and increasing energy consumption.



The perfect combination of tangential threshing and axial separation is the secret of the success of the HYBRID-FLOW system.

The HYBRID-FLOW system is a proven double-drum threshing scheme with a uniform acceleration of the flow of the grain mass before it enters on the threshing drum, which ensures a quick and gentle threshing of your grain. Drum speeds can be easily adapted to different crops and harvesting conditions. The rotational speed is infinitely adjustable in the range from 518 to 1152 rpm.



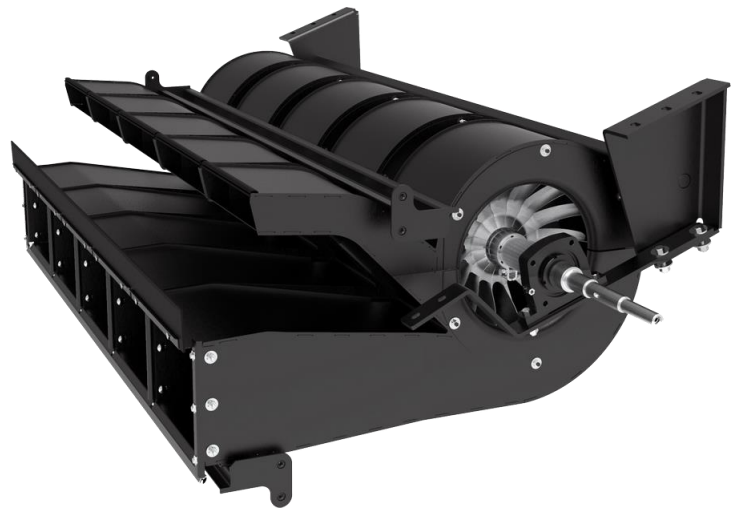
As well as two high-performance straw separator rotors with the diameter of 450 mm and the length of 4200 mm, which rotate in opposite directions, thereby creating a large centrifugal force, provide efficient, fast and gentle separation of residual grain so that you can get the maximum yield.



A three-stage cleaning system with increased productivity with the area of 5.8 m² with the powerful five-section cleaning fan 5D AIR FAN with an equable spreading of air flow over the sieves will satisfy your highest requirements for the purity of the obtained grain.

2. Air fan: Due to the high productivity of the combine, the complexity of cleaning the grain mass also increases. Thanks to 5D AIR FAN, cleaning a large flow of grain mass becomes a simple and effective process.

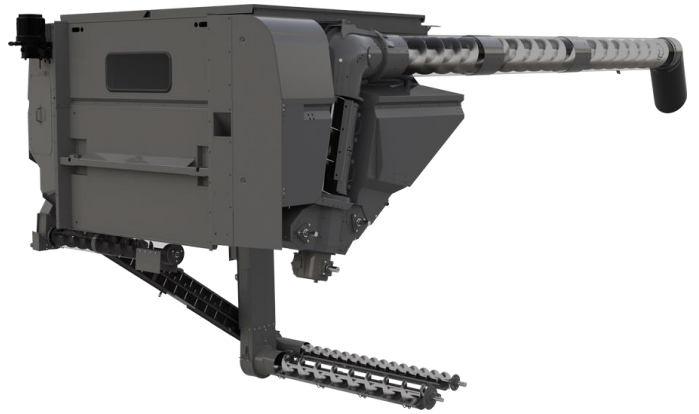
In the 5D AIR FAN cleaning system the air flow is directed through two separate channels: the upper flow blows through the step between the shaking board and the upper sieve, already at this stage removing a significant part of the light fractions. The lower flow is evenly distributed between the sieves, completing the cleaning of the grain. This cleaning principle significantly increases the intensity and equability of blowing, and you get absolutely clean grain and increase the economic benefit from harvesting. The intensity of the air flow and the opening of the cleaning shutters are regulated from the cabin, which saves you a lot of time.



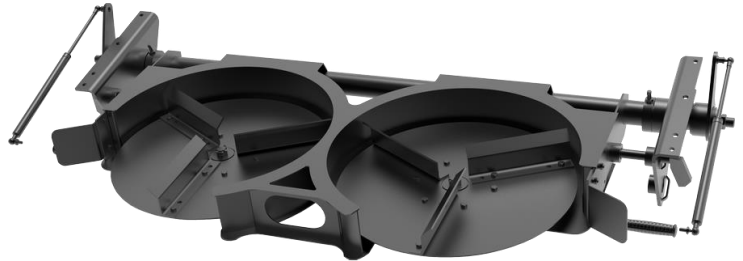
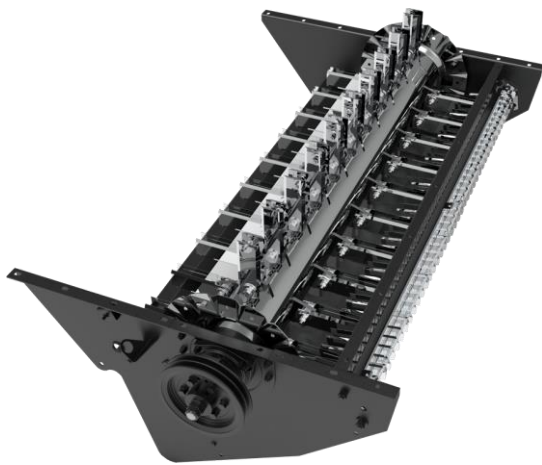
3. Grain tank: It provides excellent unloading.

Grain tank unloading is an essential part of harvesting. This process occurs on average up to 30 times during the day, which can take a lot of your time. The optimal ratio of the characteristics of the GS2124 grain tank with a volume of 10 500 liters and an unloading speed of at least 100 l/s contributes to unloading in the shortest possible time, saving your precious time. In order to save your money, the combine harvester is equipped with the PART-UNLOAD and OPTI-UNLOAD systems. The PART-UNLOAD system, if

necessary, allows you to immediately stop the unloading process, which minimizes grain losses in an unforeseen situation. The OPTI-UNLOAD system makes it possible to unload grain with the powered down drive of the thresher. During the harvesting season, this function saves a large amount of your fuel and prolongs the life of the threshing and separating device of the combine.



4. Straw chopper: The GS2124 combine is provided with an OPTI-CUT 92 straw chopper. 92 knives are installed on the straw chopper, which carry out high-quality and fine chopping, and then spread the non-grain part of the crop. The obtained material easily decomposes and gives nutritional properties to the soil, thereby increasing the yield of your fields in the following seasons.



To maximize crop remains utilization, GS2124 is equipped with the double disc chaff spreader called UNI-SPREADER. Adjusting the speed of the double disc chaff spreader from 400 to 800 rpm helps to successfully spread the chaff of any cereal crop without affecting the air flow of the cleaning. And the optimal location of UNI-SPREADER above the field makes it possible to dispense with additional functions under the influence of the wind.

5. Innovative systems for comfortable and effective work



Reduction gear

Automatic centralized lubrication system

ARC-SYSTEM

– **Reduction gear:** When you need to harvest crops that are easily damaged, such as corn, sunflower and others, use the reduction gear, which is included in basic configuration on the GS2124 combine.

– **Automatic centralized lubrication system:** The automatic centralized lubrication system installed on the GS2124 combine allows you to make efficient use of your working time, reducing downtime and maintenance time.

– **ARC-SYSTEM (Active Radiator Cleaning System):** Also, in order to save your precious time, the GS2124 combine has an innovative active radiator cleaning system called ARC-SYSTEM. The radiator is cleaned by reverse airflow generated by a reversible fan that blows out all the dirt from an air inlet zone, which increases the performance of your combine and simplifies its maintenance.

6. Electronic precision farming systems: The GS2124 combine is equipped with electronic precision farming systems to produce more grain at a lower cost.

The main goals of precision farming are:

- ✓ saving means of production
- ✓ saving of working time of equipment and personnel
- ✓ full use of yield potential
- ✓ product quality improvement
- ✓ increase in profits of agricultural organizations due to increased yields and reduced manufacturing costs.

Each field has a different type of soil, a different nutrient composition and a different amount of moisture. Yield maps are used to interpret these data to analyze high and low yield zones in each field. Yield data is the foundation of precision farming and allows you to make informed decisions for future seasons.

The combines also have the AUTOPILOT function, with which you achieve the maximum accuracy of automatic control, depending on the type of differentiated amendments.

Obtained result:

- ✓ performance improvement up to 10-30%
- ✓ increase of production by reducing overlaps
- ✓ automatic full turn
- ✓ saving fuel and lubricants.

7. Versatility when working on different crops: Whatever crop you grow, you can harvest it with the GS2124 combine using the adapters.



The GS2124 half-track combine is suitable for working in difficult conditions: with steady rains, poor flotation and low soil bearing capacity.

Text 10. John Deere's New S7 Combine Built with Tech for the Future of Farming

Source: <https://www.deere.com/en/harvesting/s-series-combines/s7-700/>,
<https://www.agriculture.com/john-deere-s-new-s7-combine-built-with-tech-for-the-future-of-farming-8600130>

John Deere is launching a new S series of combines with the S7, focusing on increased efficiency and an enhanced operator experience, as well as setting the groundwork for future autonomy systems. The four new S7 models ranged from 333 to 543 rated engine hp. The new engines are behind some of the biggest efficiency gains for the series with a JD9 9-liter engine on the S7 600 and 700, and the JD14 13.6-liter engine powers the

S7 800 and 900 combines, says Bergen Nelson, go-to market manager for combines, cotton, and sugar harvesting equipment for John Deere. Both engines provide a 10% fuel efficiency gain when compared to the S700 series these new models are replacing in Deere's lineup. The new S7 600 and 700 models have a 250-gallon fuel capacity, and the S7 800 and 900 have 330 gallons. The choppers on the combine are now straight-blade knives rather than paddle blades. These slice through material easier and create less drag on the machine, enabling a 15-hp reduction in power. The S7 600 and 700 have a grain tank capacity of 300 bushels, and the S7 800 and 900 can hold up to 400 bushels. All models but the 600 have a peak unload rate of 4.2 bushels per second. The new combines have cross auger shutoff so operators can stop feeding the vertical auger and unload auger to ensure the auger is empty every time the operator goes to unload. An angled spout has an electronic actuator on the tip of the spout for more accuracy, reducing spillage as it unloads into a grain cart. An additional air vent has been included to increase ventilation of the cleaning system.

1. Technology: The S7 series is part of John Deere's preparation for the future of autonomy in agriculture, with electrical architecture built in laying the groundwork for the technology when it arrives. "We're enabling this combine to be future-proof, essentially, as far as electronic architecture goes," says Blake McOllough, combine product marketing manager for John Deere. For now, the S7 makes use of Deere's model year 2025 technology with predictive ground speed automation, and harvesting settings automation. Predictive ground speed automation uses six settings to understand how to harvest in the field, comparable to adaptive cruise control in the field, says Nelson. This system factors in engine power, threshing load, terrain, loss levels, coverage, and predictive input. New stereo cameras on the combine look at the field ahead to see crop volume and height to help predict how fast the machine needs to be before getting into the crop.

"Instead of our technology in the marketplace today as being reactive, this is looking in front of the machine so we can be proactive in how we automate this machine," says Nelson. Harvest setting automations will instantly adjust the combine's concave clearance, sieve, chaffer, fan speed, and rotor speed, based on the operator's set outcomes such as grain loss, foreign material, and broken grain.

"In the past, a customer would have to set a performance target with our harvest settings automation technology and it could take up to 20 minutes for the combine to start making a change — so it's a huge gain for the customer," says Nelson. "They set their acceptance limits and the machine automatically starts changing and optimizing for them." Improved loss sensing capabilities on the combine's rear tailboard provide farmers with better real-time feedback on the cab's display.



S7 700 combine has the following key characteristics:

✓ John Deere 9L Engine delivers more horsepower and faster unload than previous models

- ✓ All new from top to bottom, with larger¹, more comfortable X9 cab
- ✓ Integrated G5Plus CommandCenter™ Display, StarFire™ Receiver and JDLink™ modem
- ✓ Improved Grain Loss Sensing with 2X1 more sensors for more accurate loss sensing
- ✓ Available Predictive Ground Speed and Harvest Settings Automation

1. Features

– **Corn heads refresh:** John Deere is also introducing new CR (rigid) and CF (flexible) corn heads with the S7 combines, updating previous models with increased efficiency, and grain retention technology. “Slip clutch detection monitors the drive shaft of the corn head,” says McOllough. “By doing that, we can tell if there's a slip within one of the gearboxes on the corn head and we can stop, ensure that we don't slip that clutch even more, which can create wear and reduce the reliability of your head.” The new models have short pointed snouts on the end to allow for tighter turns in the field. Active end fenders on the head help with ear loss protection to keep them from flying off to the side – all adjustable from the cab.

– **High-capacity harvesting in corn and beans:** Designed for performance in coarse grain crops, the TriStream™ rotor and Dyna-Flo™ Plus cleaning shoe efficiently thresh and clean grain in tough harvesting conditions. The TriStream rotor helps maximize fuel efficiency with technology that reduces the force required to move material through the combine by as much as 20 percent. High capacity starts at the feeder house, where the S Series provides large areas of clearance for high volumes of crop to flow uninterrupted.

✓ TriStream rotor delivers performance – A slightly tapered front nose dramatically reduces the growling that often comes with thick crops and heavy rotor loads. Spiral vanes around the rotor guide the crop material through the feeding and threshing area, reducing hesitation and improving productivity. Meanwhile, rifling grooves on the elements allow the bullet-shaped rotors to move large volumes of crop material through the rotor more efficiently. Rifled elements grip crop material, providing a pulling action that helps even the crop flow, allowing the rotor to deliver better threshing performance.

✓ Dyna-Flo Plus delivers clean grain – Consider your capacity needs met. In fact, in shoe-limited conditions, you get 10 percent more capacity in corn than previous models, which equates to another 0.6 ha/hr (1.5 acre/hr). The key is uniform distribution and a unique two-stage pre-cleaning design. Four conveyor augers move material onto the shoe steadily and evenly, even on hillsides. A fixed front chaffer helps thin the crop mat; about 30 percent of the air goes to the front chaffer at high speed, allowing it to clean up to 40 percent of the free grain before it reaches the main chaffer. A huge rear chaffer and larger sieve (12 percent larger than previous models) are specially designed to handle the threshing and separating performance of the S7.

– **Raise your capacity in tough small grains or rice:** Truly tough conditions demand more than simple solutions. Rather than slightly improve performance in rice, canola, wheat, barley, oats, or other tough small grains, John Deere S7 Combines set new capacity standards with four crucial components: Active Concave Isolation, a high-performance feeder house, heavy-duty interrupter grates with integrated interrupters, and the variable-stream rotor. When you're looking at a storm on the radar and you don't have time to spare, you can run full throttle and still put your toughest crop into the machine without any issues.

✓ Better material handling – The industry-exclusive variable-stream rotor features a longer, more tapered front cone design that excels in wet, green rice or small grains where the straw is especially tough. The variable-stream rotor with adjustable top cover transport vanes is recommended for rice producers and those facing tough threshing conditions. The

vane angle can be adjusted to reduce the stress on straw material as it flows around the rotor, increasing the quality of the straw while using less fuel. Along with the tough material handling capabilities of the variable-stream rotor configuration, the straw quality and length can be improved due to the electrically adjustable top cover transport vanes.

✓ Dyna-Flo™ Plus cleaning shoe provides more cleaning capacity – In shoe-limited conditions, you'll see a 14 percent capacity boost in wheat and canola compared to previous John Deere designs, raising your productivity and improving grain quality. Simply put, this is a cleaning system that does it all.

✓ Harvest through the toughest conditions – Active Concave Isolation (only available on S7 800 and S7 900 Combines) has been improved by applying hydraulic pressure to better secure the concave, providing extra stability when harvesting really tough crops. This increases the machine capacity by 10 percent, so you can harvest outside the optimal harvest windrow or crop conditions when necessary.

✓ Better feeding in tough conditions – The S7 Combine feeder house design features an exclusive pivoting mid-frame design to provide the highest level of material handling and feeding capacity, especially in high-volume, tough crop conditions. The front feed drum provides you with 5.1 cm (2 in.) of additional movement for greater flexibility in challenging crop.

– **Spend more time harvesting in tough conditions:** The faster you can get to – and into – your fields, the more productive you are. John Deere S7 Series Combines make it easy. Tracks help you get into the field sooner and finish faster. The ProDrive™ system lets you smoothly shift between two speed ranges (field and transport) with the push of a button; you'll no longer have to stop to shift when going up or down hills or when you're exiting a field.

✓ Get your harvest on track – Your ability to get into your fields sooner is easier than ever. Reach a road transport speed of almost 40 km/h (25 mph) with the John Deere tracks. The suspended track system provides a smoother ride with better ground following. This makes for more comfortable harvesting days and lets you finish faster. Available with 76.2- or 91.4-cm (30- or 36-in.) wide belts, these tracks deliver better ride quality and ground following, improved flotation, and less compaction. In addition, there's no daily maintenance.



Harvester with tracks

✓ ProDrive ground drive system – This lets you switch between two infinitely variable speed ranges with the push of a button. Using the CommandARM™ armrest console,

you can set the first range for typical harvesting speeds and the second for transport. This reduces your combine's engine rpms during transport while still maintaining a productive ground speed, improving fuel economy. An electrohydraulic differential lock with a four-pinion differential delivers greater traction in muddy conditions.



In-cab adjustments with CommandARM console

Two-speed, four-wheel drive (4WD) is perfect for demanding conditions – This lets you switch between torque ranges. In slow-speed mode, the high-torque rear assist is ideal for tough conditions. Use high-speed mode for low-torque performance and faster ground speeds.

– **New cab:** The S7 series is receiving a cab update to bring its technology and creature comforts in line with Deere's X series of combines. The cab has an integrated G5 Plus display, with a wider screen than the previous generation. A new primary display on the corner post has higher resolution to provide optimal viewing to all the new technology and automation updates. The 2025 combines also have an integrated StarFire 7500 receiver with SF RTK capability. New lighting on the front of the cab has been added to help operators in low-light conditions. The seat swivels to allow operators a better look at their surroundings. Heated ventilation is now available at the feet of the operator. The cab radio has Apple CarPlay and Android Auto features for connecting mobile devices.

Text 11. John Deere's New T6 800 Walker Combine

Source: <https://www.agriculture.com/john-deere-s-new-t6-800-walker-combine-8657594>

The new T6 800 has a larger grain bin and faster unload rate, capable of unloading 10 tons of grain in just 90 seconds. John Deere's new T6 800 walker combine includes features from its X9 and S7 Series of combines, and new integrated precision ag technology.

"The T6 800 combine provides farmers a significant step forward in harvesting technology," says Bergen Nelson, go-to-market manager for harvesters at John Deere. "With these combines, farmers will have the tools they need to enhance productivity and efficiency in the field."

– **Specifications:** The T6 800 walker combine runs on John Deere's 9-liter Power-Tech PSS engine, rated for 392 hp. It features a power boost at the rated speed, for an additional 34 hp. It has a 211-gallon fuel capacity.



– **Harvesting features:** The feeder house on the T6 800 has the same width as the rest of the crop channel to eliminate flow restrictions throughout the whole combine. The combine has a 300-bushel grain tank – 23% larger compared to previous models.

The spout is adjustable to add control while unloading grain. It also features a 20% faster unloading rate compared to previous models, reaching peak performance at 150 liters per second, capable of unloading 10 tons of grain in 90 seconds. The included Hill-Master leveling technology can compensate for inclines up to 22% for consistent performance while on slopes.

– **Precision technology:** The T6 800 walker combine comes standard with a suite of John Deere’s precision ag technology, including a StarFire 7500 receiver, a 12.8-inch G5 Plus CommandCenter display, and JDLink modem. In addition to the main display, a new corner post display can be customized with different functions and operating information.

Operators can equip an optional G5 Plus extended monitor to control more functions at the same time, like viewing vehicle control functions on one display, and applications such as AutoPath, Machine Sync, or Grain Sensing on the other.

– **Optional automation:** Farmers can equip the combine with additional precision features to increase ease of use while operating.

“The technology added to this combine gives the farmer the power to execute, monitor, and analyze every stage of their harvesting operation,” Nelson says. “In addition, the technology solutions pave the way for the new automation features and functionality.”

Ground speed automation can continuously evaluate inputs and maintain a consistent feed rate by automatically adjusting the combine’s speed based on the operator’s defined parameters. This takes into account grain loss, engine power, rotor pressure, and more. Terrain settings automation enables stable cleaning shoe performance in varying terrain. This function automatically adjusts cleaning fan speed, and chaffer and sieve openings based on the combine’s fore and aft pitch. This function is intended to help reduce losses, and increase machine performance while operating in hilly terrain.

– **Cab updates:** The new cab on the T6 800 has more storage space and cupholders, more heat for the operator’s feet, a redesigned seat, and higher visibility compared to previous models.

“The new cab with the improved creature comforts serve an important purpose,” Nelson says. “The comfort and convenience updates help reduce distractions that can take the operator’s attention away from the task at hand. This is a win for farmers, custom harvesters and their operators. Combined with the X9 and S7 Series combines, we now have a combine for any harvesting need for farmers of all scales.”

Text 12. Power Stream Header

Source: <https://en.rostselmash.com/products/combine/#adapters>,
<https://en.rostselmash.com/products/adapters/zhatka-power-stream/>

Power Stream ensures higher performance due to reduction of loss and optimal crop feed. Practice has proved that the use of this header with the original cutterbar (driven by a planetary gearbox) minimizes shattering losses and ensures consistent uniform feed in any harvesting conditions. A hydraulic reel drive with a synchrodrive function automatically adjusts the reel speed to match the ground speed.



The key features are:

1. Wide opportunities

– **The hydraulic reel drive:** It ensures continuously variable speed of rotation to achieve optimal and uniform supply of crop material for improved performance. A simple and reliable mechanism with minimal adjustments.



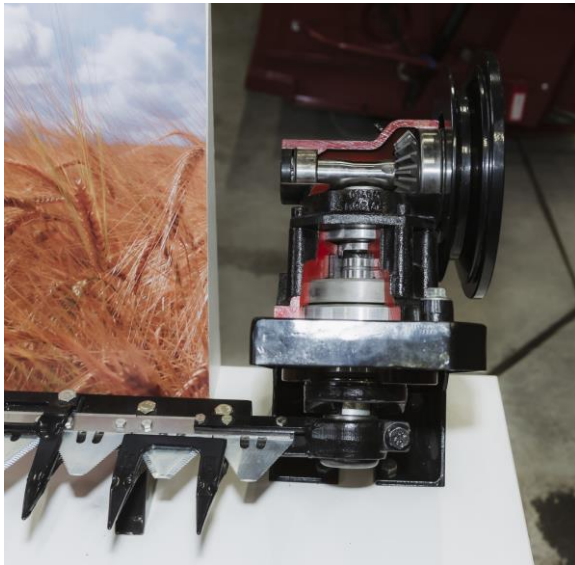
The hydraulic reel drive



Intake auger

– **Intake auger:** A large diameter auger prevents the tall crops from being wrapped. Pins between the turns of the auger across the cutting width allow moving the mass even when harvesting peas and very low barley (for headers with electrohydraulic following). Pins have a groove for safe work when stones get in the header.

– **Cutterbar:** It operates smoothly, accurately, and without wear. High cutting speed and increased knife strokes improve the cutting quality and, as a result, the harvesting efficiency, especially in unfavourable conditions. Knives are bolted, which significantly reduces the replacement time. For cleaning of laid crops on uneven soils, crop lifters are used, which pre-lift stalks off the ground to reduce losses.



Cutterbar



Speed synchronization system

– **Speed synchronization system:** The system of synchronisation of the reel rotation speed and a combine speed makes the operator work easier and lowers the requirements for his/her qualifications. This results in improved harvesting efficiency and decreased losses. The joints of beams of the reel and tines are protected from wrapping of long-stalk plants.

2. Important details

– **The electrohydraulic terrain following system:** This system (included as standard) improves the harvesting performance due to a higher harvesting speed and reduces header losses. Three modes of operation, automatic transition of the adapter into the transport position, and programmable settings of terrain following simplify the harvesting process (electronics will take care of the challenging terrain).

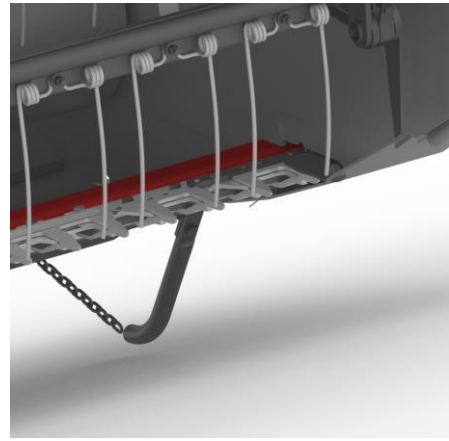


– **Single-point hydraulic coupler:** Designed separately with an electric connector to improve reliability of the header operation. Makes the connection of hydraulic system several times faster.

– **Stone trap bar:** An optional bar fitted behind the header cutter stops up to 90% of stones.



Single-point hydraulic coupler



Stone trap bar

Text 13. Float Stream Close-cutting Header

Source: <https://en.rostselmash.com/products/adapters/zhatka-float-stream/>

The universal Float Stream close-cutting headers enable mowing of different types of cereals, grain legume crops and flax. The minimum distance from the surface of the field to the harvester's cutting elements enable to particularly effectively remove lodged plants, as well as soybeans or chickpeas with a low position of the first pods.



The "floating knife" of the header mows at 30 mm height and adapts to the relief of any complexity in the longitudinal and transverse directions.

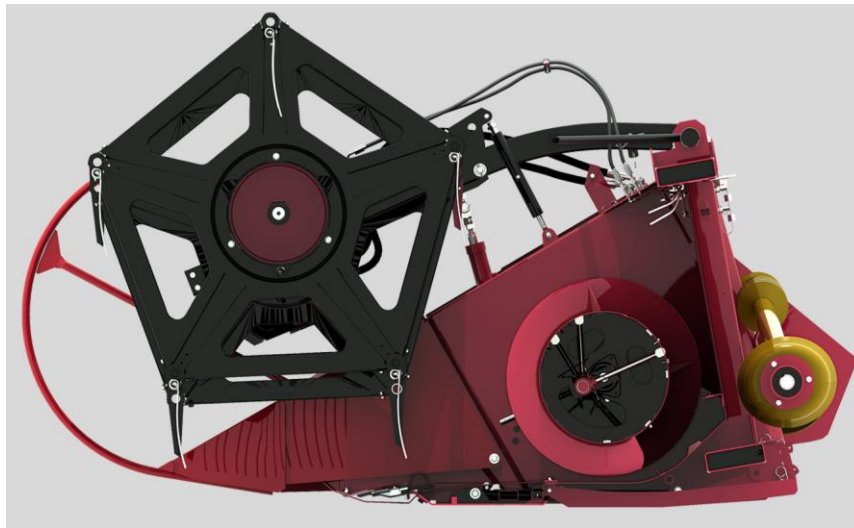
The key features are:

1. Great capabilities

– **Operation on various reliefs:** In the flexible (floating) knife mode, the cutter bar mounted on spring-loaded levers can copy the field relief with an accuracy of 100 mm, repeating all its bumps and thus minimizing losses.

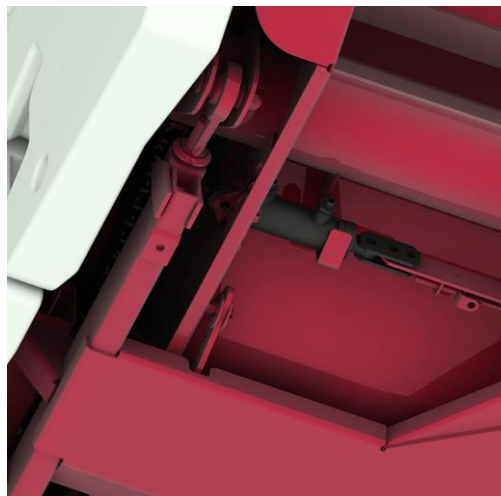


- **Versatility:** The requirements for harvesting grain crops differ from those for grain legumes because of their biological differences. Two operation modes, Floating and Rigid, allow the header to adapt to various harvesting conditions and crop peculiarities.

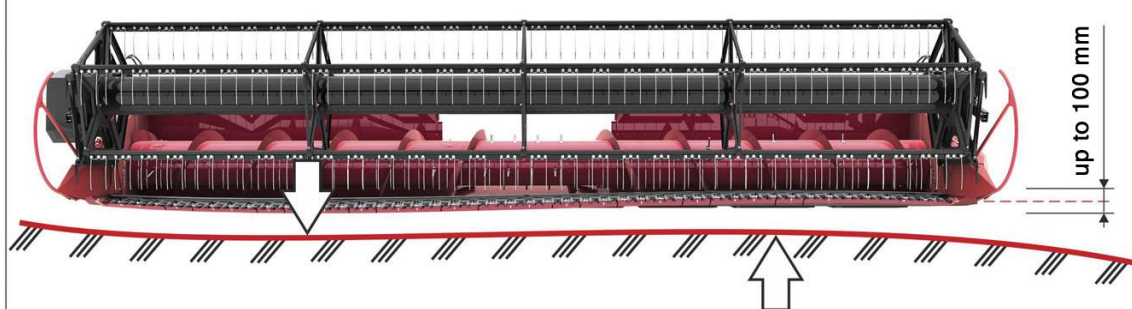


2. Effective operation

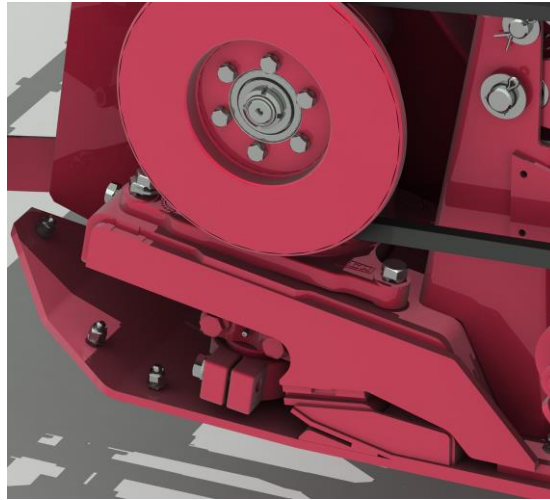
- **Easy operation:** Hydraulic cylinders for remote switching the operation mode from "floating" to "rigid" and vice versa are installed on the sides of the header. The work of hydraulic cylinders is controlled from the operator's cab, which makes the operation easier and reduces the time required to switch from one mode to another.



- **Quality contour following:** Flexible cutter bar allows copying the soil relief in both longitudinal and transverse directions in the range of 10 cm, which reduces the loss of low-lying beans.



- **High quality of cutting:** The Schumacher cutter bar with a frequency of 1,120 double strokes per minute ensures a constant cutting height at maximum operating speeds of combine harvesters.

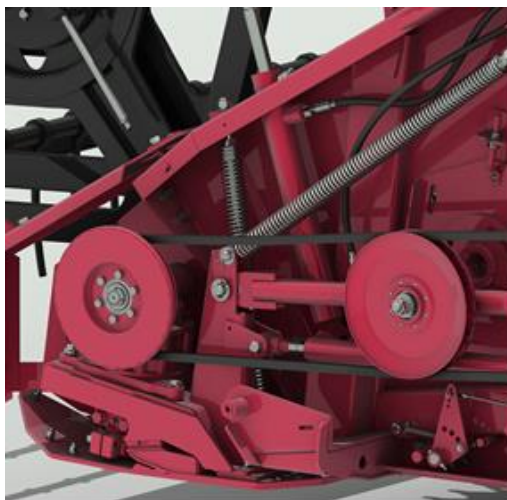


3. Perfection of mechanisms

– **Durability:** Plastic fingers installed on the reel rakes reduce the chance of the cutter bar breakdown during the header operation in the floating knife mode.



– **Cutting bar drive:** The drive of the cutting bar is formed by a belt loop with a swinging drive shaft. This simple and reliable construction reduces the load on the blade drive gearbox and increases the service life of the belt and gearbox.



Cutting bar drive



Stone deflectors

– **Damage protection:** The distinct shape of the stone deflectors facilitates the movement of the mowing and improves relief contour following, thus preventing clogging and damage to the cutter bar segments and the following bottom.

Text 14. Corn Stream Header

Source: <https://en.rostselmash.com/products/adapters/zhatki-corn-stream/>

Corn stream is a series of new-generation corn headers for high-performance harvesters. Any header of this series is notable for a number of technical solutions that allow it to be used for harvesting various types of corn regardless of soil fertility.

The header's performance was almost doubled due to gearboxes with integrated rolls that do not require any additional adjustments. The header can be equipped with cut quick-release rollers featuring eight cutting edges or pull rollers having eight additional working ribs depending on harvesting conditions.

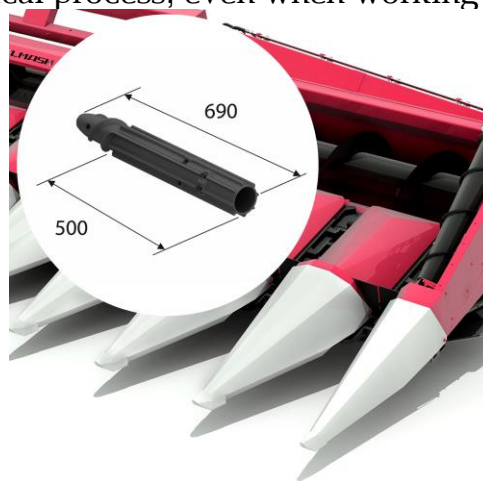


The key features are:

1. Effective operation

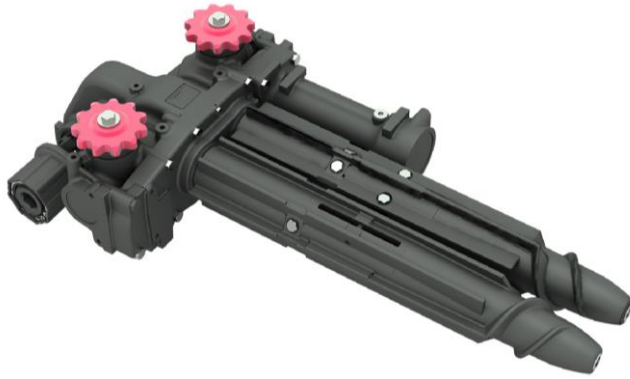
– **High performance:** The feeding auger with an increased diameter of 460 mm and a turn step of 585 mm ensures high performance. These parameters allow to feed huge masses easily to the feeder house of the harvester.

– **Process stability:** The total length of the rollers is 690 mm, their active part is 500 mm, and the diameter is 115 mm. These parameters improve the header performance and ensure the stability of the technical process, even when working in weedy crops.



– **Reduced maintenance effort:** Having no front supports on the pulling rollers virtually eliminates the weeds winding (no downtime for cleaning) and reduces maintenance time (no need for bearing lubrication).

If the knives are damaged during operation, you do not need to remove the chopper. All you need is to lower the bolt, take out the sleeve and replace the cutting element.



2. Perfection of mechanisms

– **High-end chopper:** The CORN STREAM features a reinforced chopper featuring an increased knife speed and a labyrinth seal of the gearbox bearing. The cutting elements have a tungsten carbide surfacing, which considerably increases the wear resistance of the blades.

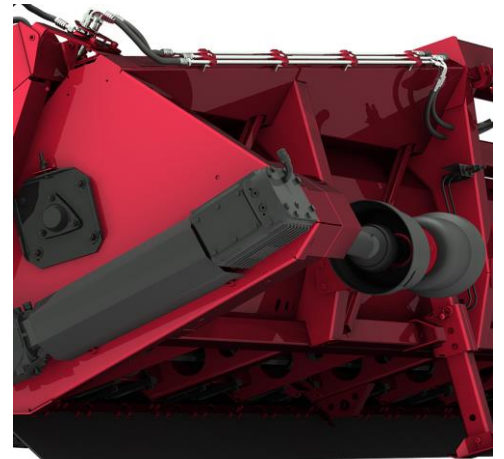
– **Loss reduction:** Additional side shields and active dividers (option) reduce losses when harvesting tall-growing corn.



– **Reliable protection:** The reliable protection of the powered elements under extreme conditions and severe overloads is ensured by safety devices installed on the driveshafts, auger drive, and each gearbox of the snapping unit.

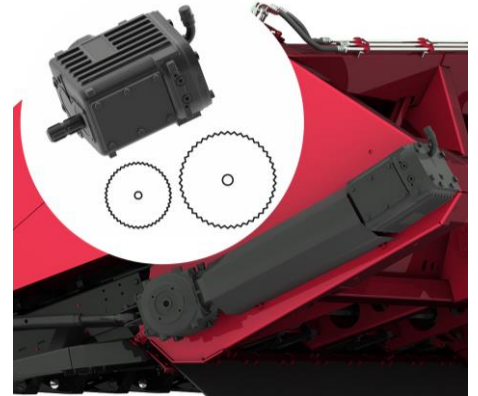
3. Great capabilities

– **Operation with low-growing crops:** The header approach angle (tilt) of 18 degrees, together with the chopper in the center of the pull rollers, allows you to harvest the cobs at a height of 30 cm with the simultaneous chopping of the stalks. It allows you to use the adapter in fields with lodged and low-growing corn.



– **Operation on soils with different fertility:** Depending on harvesting conditions, the header can be equipped with quick-release “cut/pull” or “pull” rollers. This allows harvesting tall, wet, and weed-infested corn with virtually no reduction in operating speed.

– **Versatility:** The original side gearbox with interchangeable gears allows adjusting the speed of the snapping units depending on the soil fertility, which extends the operational versatility.



Text 15. Pick-up Platform Swa Pick

Source: <https://en.rostselmash.com/products/adapters/platforma-podborshchik-swa-pick/>

The Swa Pick pick-up platform with operating widths of 3 and 4 meters is used for swathing cereals, pulses, groats, and rice. It is aggregated with all combine models. Clean mowed crop pick-up, high output, and effective damage protection systems guarantee high operational stability. Robust design and ease of maintenance ensure a long service life. Modifications with plastic fingers are available on request.



The key features are:

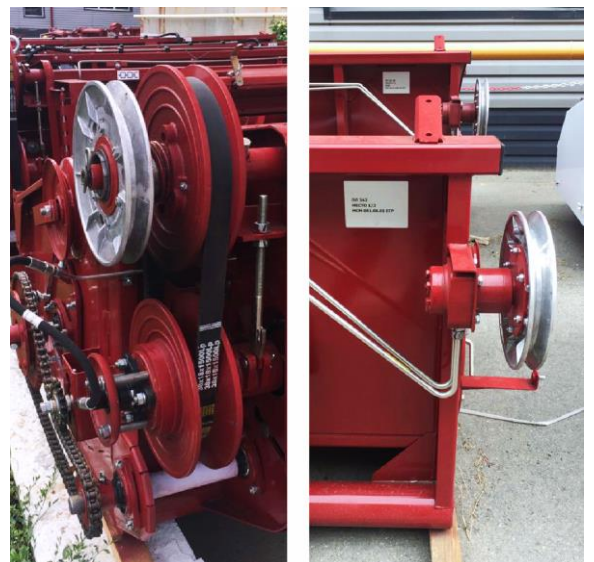
1. Great capabilities

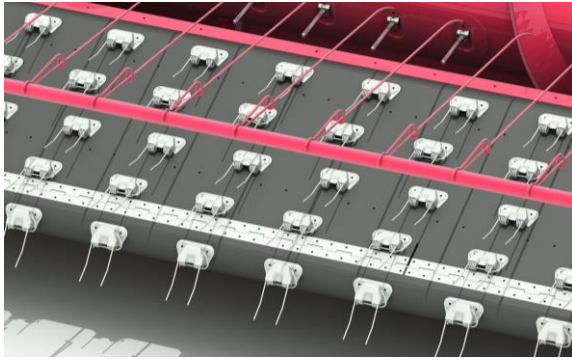
– **Versatility:** Depending on the combine harvester modification, you can choose one of the baler drive types: by V-belt drive from the harvester driveshaft or by a hydraulic motor.

2. Effective operation

– **Steel fingers:** The special pendulum mounting system of the baler counter drive protects the mechanisms from overloading.

– **Plastic fingers:** Plastic fingers allow clean pick-up in fields contaminated with stones or small woody debris. For example, during the treatment of the field perimeter near the plantings, the plastic fingers bend back and simply do not pick up foreign objects.



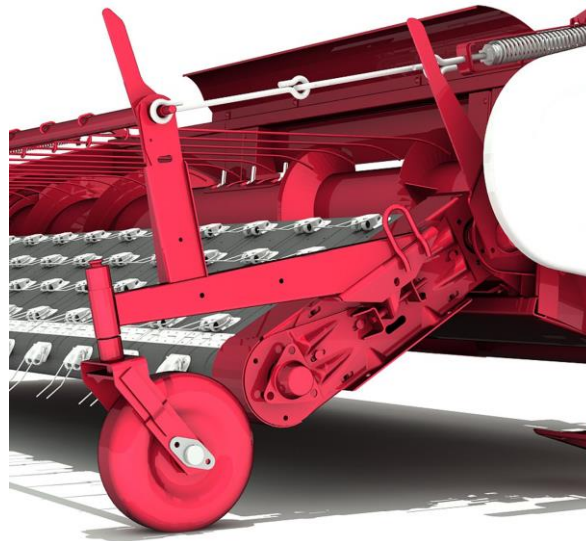


Steel fingers



Plastic fingers

– **Relief contour following:** Suspension of the conveyor to the platform by an articulated hinge provides relief contour following in longitudinal and transverse directions.



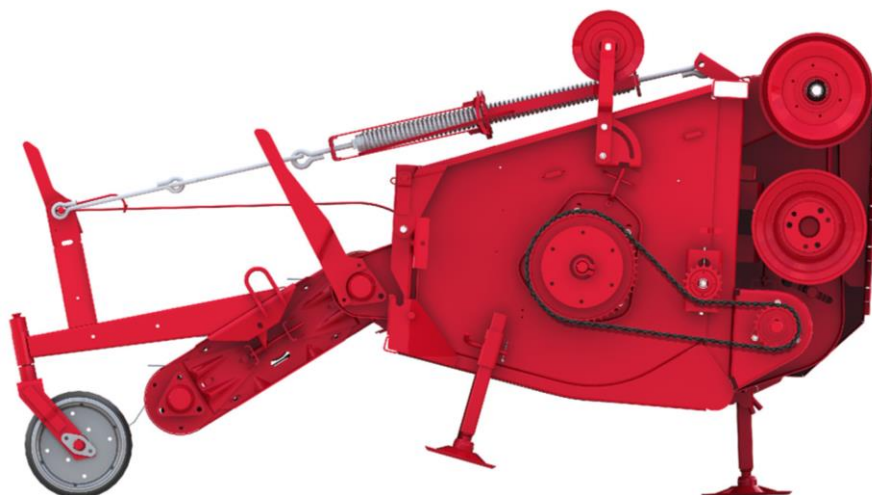
– **Quality harvesting:** More than 200 conveyor fingers ensure quality harvesting with virtually no losses.

3. Perfection of mechanisms

– **Loss reduction:** The use of a single wide belt on the baler reduces the loss of grain from shattering during swath pick-up.

This is especially relevant in the case of drying out or periodic wetting of swaths due to unstable weather conditions in the region.

– **Anti-overstress system:** The special pendulum mounting system of the baler counter drive protects the mechanisms from overloading.



– **Optimal combination of mechanisms:** The pick-up includes a rubberized canvas conveyor, a mechanically controlled normalizer, and a field contour following system. The simultaneous operation of all these elements ensures a high-quality technological process of harvesting various crops.

Text 16. Uni Carts

Source: <https://en.rostselmash.com/products/adapters/telezhka-transportnaya-odnoosnaya-uni-cart-3000/>

Multifunctional carts, in particular, the Uni Cart 3000 single axle cart is used to transport headers and other attachments with an operating width of 5 to 12 m, as well as seed drills, on public roads, farms, and fields.



The key features are:

1. Great capabilities

– **Multifunctionality:** In addition to its original purpose of transporting cutter bars, the carts can be used at the parking lot as auxiliary equipment for unloading, loading, attaching cutter bars, or attachments to the harvester or power unit.



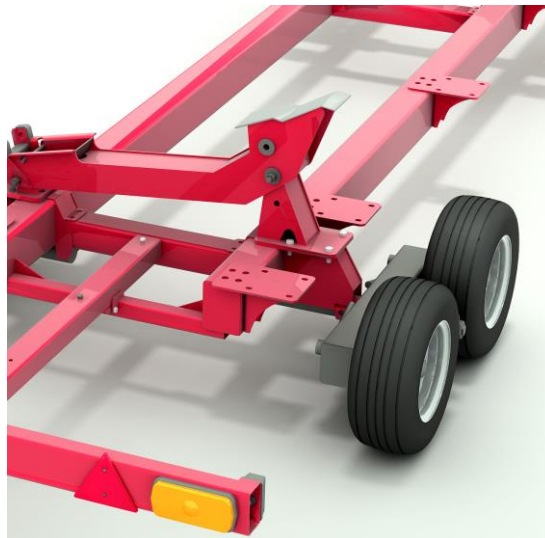
– **Suitable for transportation of both headers and seed drills:** You can use the carts for transportation of not only headers and attachments but also seed drills of various modifications.

2. Effective operation

– **Easy operation:** The front rotary hitch tongue on UNI CART 2700 and 4000 is spring-loaded, which eliminates the need to use a jack to adjust the height when aggregating with harvester tow bar; only one worker is needed.



– **Transportation versatility:** The wide center distance between the support wheels removes a significant load from the tow bar, thus allowing UNI CART 2700 and 4000 to be transported with a tractive vehicle of a low load on the tow unit.



– **Safe operation:** When driving on public roads, carts duplicate the light signals of the vehicle electrical equipment. This ensures convenient and safe operation.



– **Inertia brakes (optional):** Inertia braking system significantly improves the cart operation with a load in emergency situations, which reduces the risk of accidents.

– **Additional spare wheel (optional):** In case of a puncture or tire breakage, the spare tire will ensure that you will reach your destination.

3. Perfection of mechanisms

– **Two-axle frame:** UNI CART 2700 transport cart features a two-axle frame that allows to transport equipment weighing up to 4.000 kg.

Text 17. Tips to Prepare Your Combine for Winter

Source: <https://www.agriculture.com/machinery/harvesting/3-tips-to-prepare-your-combine-for-winter>

Before you put your combine in storage for the year, take a look at some of these tips from experts about how to prepare it for the winter months. With the harvest season behind us, it's never too early to start thinking about next year. Before you put your combine in storage – and out of mind – for the year, take a look at some of these tips from experts about how to prepare it for the winter months.

1. Start it up: Start up your combine and let it run while you do a walkaround inspection, says James Franceschetti, product marketing manager at CNH Industrial. He recommends looking, listening, and smelling for anything that may be off with your machine.

"Letting it run for a little bit will let you simulate what it was like during harvest," says Franceschetti. "As it's running, use an infrared thermometer, and see if any bearings are hotter than they should be."

Once it's in storage, check the operator's manual to see how often you should run your machine.

According to Tyler Rumbold, product manager at John Deere, Deere's operating manual recommends turning your machine on every 60 to 90 days. He says to let the engine warm up, and cycle the air conditioning. When you've finished the cycle, he says to disconnect the battery while it's sitting idle for a long period of time.

2. Clean your machine: Some of the most common damages found when pulling a combine out of storage are caused by mice and rats that like to burrow and sleep in the machine's wiring and harnesses.

"The best way to prevent that is to: clean your machine, clean your machine, clean your machine," says Rumbold. "And just when you think it's clean enough, probably clean it again."

Rumbold says he encounters damage when augers aren't 100% cleaned out. Checking that your machine's augers are clear of grain and dust eliminates a source of food for rodents over the winter.

After a dry harvest season, it's important to use an air compressor to clear out any of the dry material which can pose a serious fire hazard to your combine.

"Check for any scratches or dents, and apply some touch up paint," says Franceschetti. "You certainly don't wanna leave anything bare because it could rust over the season."

3. Don't put off maintenance: Take a look at the operator's manual and do your recommended service interval. This means changing oil, cleaning radiators, draining or changing coolant, changing hydraulic oil, changing filters, and topping off fluids on your machine, according to Rumbold.

"Setting yourself up for success when you've pulled that machine out of the shed in the next fall or next summer is pivotal prior to going into winter storage," says Rumbold.

If you need further assistance with repairs, parts replacement, or maintenance, both recommend getting an appointment scheduled with your local dealer sooner rather than later.

"You don't want to wait until you pull the combine outta storage," says Franceschetti. "You might find out your dealership's service bay is filled up, and you might not be able to get it in there for an inspection."

2.1.2. Hay and Forage Equipment

Text 1. Forage Harvesters

Sources: <https://www.ammachinery.nl/what-is-a-forage-harvester>,
<https://www.ammachinery.nl/the-benefits-of-forage-harvesters>

A forage harvester, also known as a silage harvester or chopper, serves a crucial role in agriculture by efficiently harvesting and processing forage crops. Designed to cut, chop, and collect crops such as corn and grass, forage harvesters play a pivotal role in producing silage – an essential feed for livestock.



At the heart of the forage harvester's purpose lies the production of silage, a nutritionally rich feed that holds immense significance in livestock farming. Silage serves as a staple diet for cattle and other ruminants, providing essential nutrients year-round. The forage harvester's meticulous processing of crops contributes to the creation of silage that is not only abundant but also preserves the nutritional integrity of the forage, ensuring the well-being and health of the livestock.

One notable aspect of forage harvesters is their versatility in handling a wide range of crops. While their primary focus is on traditional forage crops like corn, these machines are adept at efficiently processing various grasses and other green fodder. This adaptability makes forage harvesters indispensable across diverse agricultural environments, catering to the unique demands of different crops and farming conditions.

Distinguishing between a general harvester and a forage harvester is crucial. While a harvester typically refers to a machine that gathers and processes crops, a forage harvester specifically focuses on cutting and processing forage crops like grass and corn. The specificity of forage harvesters makes them indispensable for farmers dealing with silage production.

Forage harvesters offer a myriad of advantages in modern agriculture. Their precision cutting mechanisms ensure optimal crop length for silage, contributing to the overall nutritional quality. These machines not only boost efficiency and productivity but also play a vital role in sustainable farming practices, positively impacting crop yield. The key benefits are:

1. Forage Harvesters are Super-Efficient: Forage harvesters excel in efficiency, swiftly and effectively processing crops such as maize/corn, grass, and various other crops

crucial for livestock feed and silage production. Unlike traditional harvesting methods, which can be time-consuming and labor-intensive, forage harvesters streamline the process, allowing farmers to accomplish more in less time. By leveraging advanced technologies and precision engineering, these machines empower farmers to achieve unprecedented levels of productivity in significantly reduced timeframes. This efficiency not only enhances operational effectiveness but also enables farmers to optimize resource allocation and ultimately increase their overall output and profitability.

2. Forage Harvester are responsible for High-Quality Feed Production: Forage harvesters incorporate advanced technology packages to optimize silage quality and efficiency. These packages include innovative components such as insulated inoculant tanks that meter inoculants based on tonnage or moisture levels. Additionally, NIR moisture sensors provide highly accurate moisture measurements, while automatic chop length adjustment ensures optimal cut lengths based on moisture content. Integration with industry-leading GPS systems enables precise yield mapping and steering, further enhancing the quality and efficiency of feed production.

3. Forage Harvesters are versatile in Crop Handling: Forage harvesters are incredibly versatile machines that can handle a wide range of crops, whether they're standing tall or lying flat in the field. Whether it's maize/corn, grass, or other type of crops, these machines are adept at efficiently harvesting and processing the crop. They can easily adapt to different field conditions and crop types, making them invaluable tools for farmers working with diverse agricultural landscapes.

4. Forage Harvesters Enhance Nutrient Preservation: Compared to traditional harvesting methods, which may result in nutrient loss due to prolonged exposure to air and weather conditions, forage harvesters excel in preserving the nutritional content of the forage. By quickly chopping the crop and ensiling it promptly, these machines help lock in essential nutrients, ensuring that the feed maintains its quality over time.

The superior quality of feed produced by forage harvesters translates into improved animal health and performance. Cattle fed with high-quality forage experience better digestion, nutrient absorption, and overall well-being, leading to higher milk yields and enhanced profitability for dairy farmers.

While a forage harvester focuses on forage crops, a general crop harvester is a broader term encompassing machines designed to harvest a wide range of crops. The functioning of a crop harvester involves cutting, gathering, and processing crops for various purposes, depending on the crop type. These machines have different configurations to suit the specific requirements of different crops.

In addition, forage harvesters are well-equipped to cut grass effectively. Their specialized cutting attachments and configurations allow them to handle various types of crops, including grass. This versatility makes forage harvesters invaluable tools for farmers dealing with diverse forage crops in their fields.

When it comes to processing grass, forage harvesters showcase their versatility. These machines are equipped with cutting mechanisms designed to efficiently handle grass crops. The intricate workings of a forage harvester ensure that grass is cut with precision, catering to the specific needs of livestock feed and silage production.

To sum up, it should be noted that forage harvesters emerge as specialized and indispensable tools in the realm of agriculture. Whether cutting grass or harvesting other forage materials, these machines contribute significantly to the agricultural landscape, ensuring a sustainable and productive future for farmers worldwide.

Text 2. DON 680M

Source: <https://en.rostselmash.com/products/models-kmk/don-680m/>

DON 680M forage harvester is the best option for medium to small livestock farms with a herd of up to 500 heads, or for large livestock farms using the machines of this class for daily feeds.

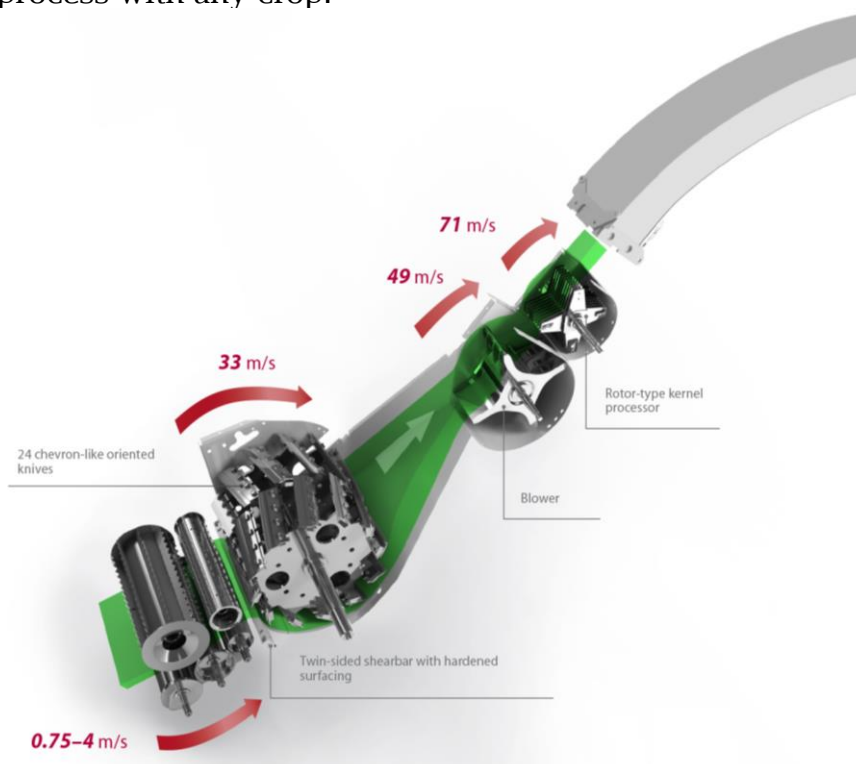
The key features are:

1. High performance

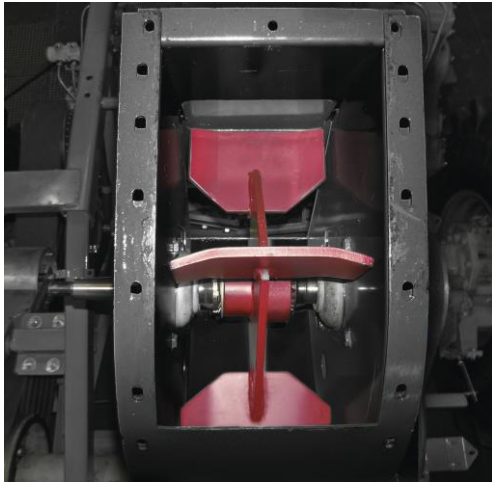
– **Engine:** DON 680M is equipped with a turbocharged 8-cylinder engine with an integrated heat exchanger. V8 compact arrangement allows for transverse engine mounting. It is an optimum configuration in terms of power transmission to the combine tools. Power is taken directly off the engine crankshaft, which significantly simplifies the power transmission. The applied solutions made it possible to reduce fuel consumption to 430 g per ton of silage. The fuel tank capacity is sufficient for 11 hours of operation.



– **Process path:** Flat flow path of forage. The crop material goes through the process path with increase in linear speed from the feeder to the kernel processor. Each subsequent acceleration is almost twice as high as the previous one. This ensures the stability of technological process with any crop.



– **Unloading accelerator:** The accelerator in the combine unloading system makes it possible to unload the chopped material at a high speed, allowing to compact the silage when loading a vehicle, so it is loaded to the maximum capacity.



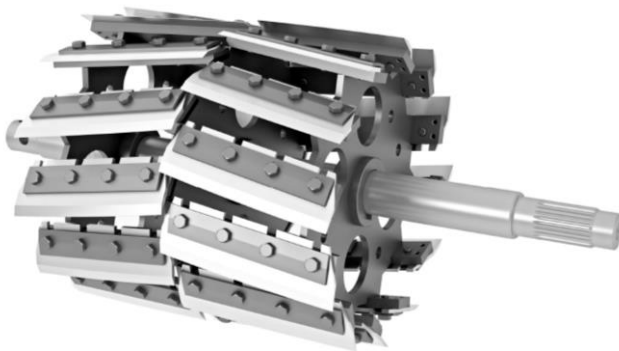
Unloading accelerator



Kernel processor

– **Kernel processor:** The standard configuration includes a kernel processor, which is necessary for a high-quality corn silage.

– **Cutterhead (chopping rotor):** DON 680M forage combine cutterhead is equipped with V-arranged knives. As one of the knives is always engaged with the shear bar, the process of forage material chopping is continuous. For the farms working mostly with grass, heavy-duty knives are provided.



Cutterhead (chopping rotor)



Metal detector

– **Metal detector:** When ferromagnetic sensors trip, material feeding into the chopper stops instantly. A foreign object can be removed by reversing.

2. Comfort

– **Cab:** DON 680M is equipped with Comfort Cab. The standard cab configuration features an air conditioner, a heater, a refrigerator, and an audio system. When in the seat, the operator has a perfect all-around view.

The steering column and the operator seat can be easily adjusted to any operator's anatomy. The main controls of the machine are located on the control panel to the right of the seat. A joystick with control keys provides simplicity of operation. Actual process parameters are displayed on the information system monitor.

– **Information panel:** An information panel with an automatic harvest monitoring system.



3. Important details

- **Spout cap extension:** The spout flap extension allows unloading into low-sided vehicle containers and in windy weather, with minimum loss.
- **Preservative application system:** Keeping too much moisture out of ensiled material, applying preservatives as early as possible, and distributing them throughout the material are key to high quality silage. The advanced preservative applicator mounted on DON 680M forage harvester solves these three problems simultaneously. The system helps spray a bacterial concentrate mist via a pneumatic nozzle without additional water. With a 5 l reservoir, the system can run non-stop for 10 hours.
- **Unloading height:** The spout height allows unloading the grain into vehicles with the sides up to 4.5 m.



Text 3. RSM F 2000

Source: <https://en.rostselmash.com/products/models-kmk/seriya-f-2000/>

RSM F 2000 is the most advanced family of Rostselmash forage harvesters. The new chopper provides a high (up to 85%) consistency of length of cut for better feed intake, and the shortest path in the class allows reaching the performance of 200 t/h.



The key features are:

1. High quality of forage

– **Feederhouse:** An increased feed rolls diameter provides a higher throughput of the combine, providing an even material flow to the chopper. Four springs with a compacting force of 3500 kg ensure a high density of material flow and even cut. The hydraulic roll damper absorbs impact loads, improves the performance of stone detector, prevents damage to the rolls and feederhouse frame, and provides additional pressing of crop material.



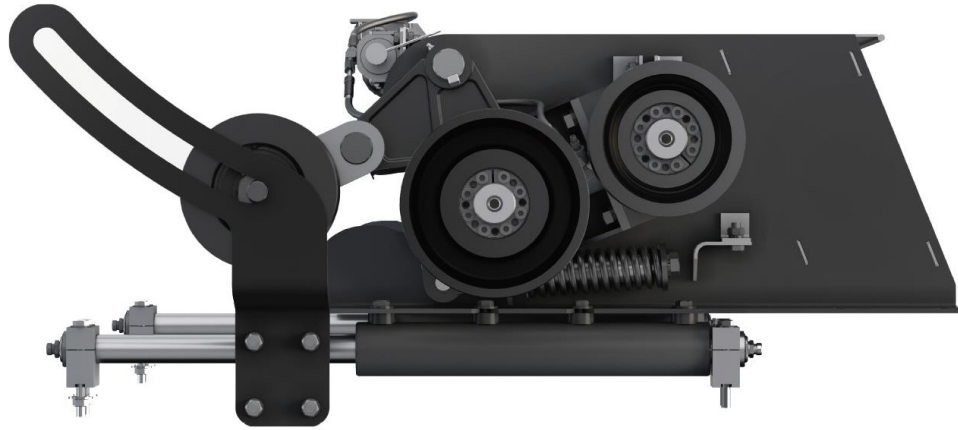
Feederhouse



Cutter head

– **Cutter head:** Thanks to a new cutting drum with four rows of knives arranged in a chevron pattern, crop material alignment and clean cut are ensured. Such design prevents any displacement of the knives, protecting the cutting drum from damage, and reduces the knife replacement costs. Automatic adjustment of the drum floor prevents the crop material from recutting and allows obtaining the length of cut uniformity >85%. New sharpening device increases the knife sharpening speed twice — the highest cutting quality with no time lost.

– **Kernel processor:** Two rolls 190 mm in diameter with saw-like teeth and a 20% difference in rotational speed ensure 99.9% grain cracking. For a more aggressive cracking, kits are available to order that can increase the difference between roll speeds to 30% or 40%. The kernel processor is engaged by a hydraulic drive. The new slider design of the kernel processor does not require uninstallation when switching to grass harvesting.

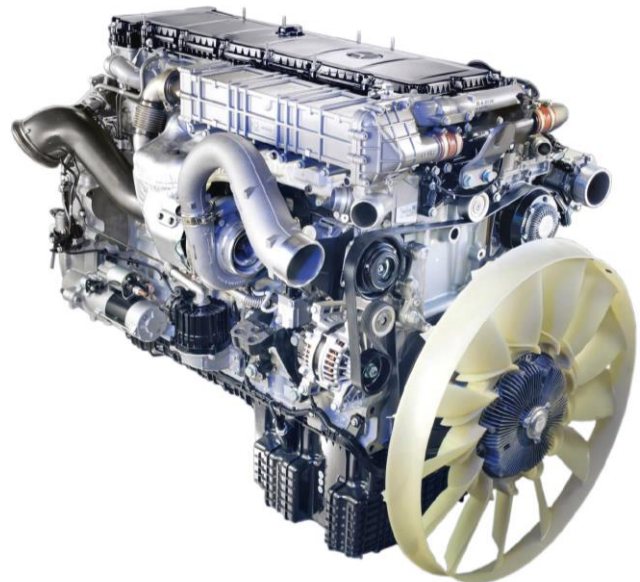


2. High performance

– **Path:** Increased feed roller diameter to increase throughput capacity. The lowest angle path possible ensures the minimum resistance to material flow. The accurately engineered crop material accelerator helps to increase the linear velocity of material and contributes to a 10% tighter filling of the combine body.



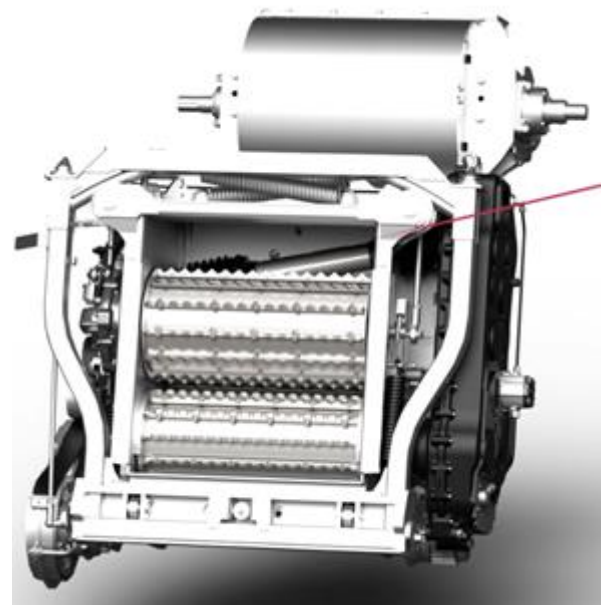
Path



Engine

– **Engine:** Engines up to 611 hp with a torque reserve of 28% ensure stable operation, even under high variable loads. Transverse engine mounting provides direct power take-off for the crop material drive accelerator and the cutterhead from the engine crankshaft, providing maximum energy efficiency. The new engine range is 8% more cost-effective, the fuel consumption is 0.69 l per ton of crop material.

– **Electronic assistants:** Optionally, the machines can be equipped with electronic assistants: Synchronization of the header speed and the machine ground speed.



3. Versatility

– Adaptation to any conditions:

- ✓ the wear plates installed on feed rolls allow changing the feed aggressiveness, preventing the material from wrapping around the rolls;
- ✓ with knives arranged in four rows, half of the knives can be removed to double the range of cutting lengths;
- ✓ special knives for corn (optional) increase the evenness of cut lengths for a better forage compaction in the pit, ensuring its integrity. Reduced number of fine particles also increases the forage intake by animals;
- ✓ the recutter floor (optional) helps prevent any unchopped dry leaves, preventing forage spoiling in the silo;
- ✓ kernel processors with 190 mm (basic package) or 250 mm roll diameters (optional) and a 20% (basic package), 30% or 40% (optional) difference in rpm allow choosing the required configuration depending on the crop features and harvesting technologies.

– All harvesting technologies:

- ✓ small grain silage – 2 versions of headers are available for small grain silage – with a segmented knives cutterbar and a rotary cutterbar. Kernel processor with 190 mm rolls cracks the grain perfectly, improving forage digestibility;
- ✓ grass – two pickup sizes, two versions of direct-cut headers, synchronization of the pickup speed and the machine ground speed, grass knives (as standard) guarantee easy grass harvest on fields of any yield;
- ✓ corn – 3 sizes of corn headers are provided – a header can be selected to suit the yield in your field and the optimal machine load. Corn knives (optional) increase the evenness of cut lengths, improving the forage preservation and its intake by animals. Thanks to wide selection of kernel processor configurations, it can be adapted to your conditions and harvesting techniques;
- ✓ cornage – a special header that allows separating corn ears from stalks. Then the ear is chopped, and the grain is crushed by the kernel processor. In such a manner cornage is prepared – a high nutrient forage / feed additive.

Text 4. JAGUAR 900: Features

Source: <https://www.claas.co.uk/products/forage-harvesters/jaguar900>

Claas is regarded as the top-selling manufacturer of self-propelled forage harvesters around the globe. With its unique overall concept for high throughput with low diesel consumption, excellent operator assistance systems and a wide range of corncracker rollers including patented SHREDLAGE technology, the JAGUAR 900-series forage harvester will help you safely bring in your harvest.

In addition to providing excellent silage quality, high reliability and easy accessibility for optimal maintenance, the JAGUAR 900 series impresses with its cab designed for maximum comfort and convenience and the user-friendly CEBIS control system.

The CEMOS intelligent operator assistance system and the CEBIS control system assist your operators in running the JAGUAR as efficiently as possible throughout the campaign. CEMOS sets up the machine automatically while the CEBIS touchscreen makes control inputs easier. All JAGUAR models comply with the relevant emission standards for their markets up to Stage V.

A pioneer yesterday, the market leader today: CLAAS has been making history with its forage harvesters since the 1970s. From the legendary JAGUAR 60 SF to the JAGUAR 900-series, the machines' performance, efficiency and driving comfort have increased continuously. Today's foragers are more productive than ever.



The secret of its success is in the fact that improvements are made where they have the greatest impact. The JAGUAR allows you to keep operating costs down. Its strengths lie in its economical fuel consumption, its many operator assistance systems, the outstanding forage quality it produces and its high reliability. It all adds up to an investment that pays.

1. Key features

– Cab comfort:

- ✓ DAB + radio.
- ✓ Gooseneck microphone.
- ✓ USB-C charging socket.
- ✓ Cup holder.
- ✓ Compressed air hose for cleaning cab integrated in cab.

– Extended functionality:

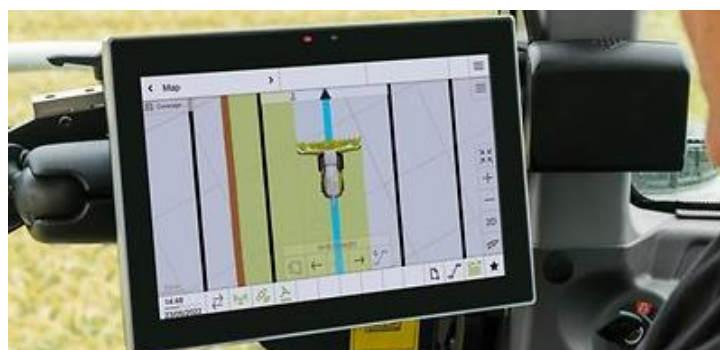
✓ CEMOS AUTO CROP FLOW: overload protection which stops the crop feed automatically if the engine revs are too low.

✓ ACTISILER 37 tank refillable from large 375-litre tank.

✓ 15 m compressed air cleaning hose with automatic retraction.

– **Terminal with intuitive operation (CEMIS 1200):** With CEMIS 1200 you have an entirely new steering terminal in the cab of your JAGUAR. You can count on its support for precision GPS tracking.

– **Guidance by GPS PILOT:** The GPS PILOT uses satellite signals to steer the JAGUAR reliably and with unbeatable precision along parallel tracks, curved contours at the crop edge, or reference lines defined by the operator. It is possible for the operator to make use of the full working width and to reduce overlaps to a significant degree. Unaffected by light conditions, it works at night or in low visibility just as precisely as it does in full daylight. You receive correction signals for whichever degree of accuracy you require. Existing GPS track lines in ISO XML format – produced by a swather during grass harvesting or generated during maize sowing, for example – can be used with the GPS steering system of the JAGUAR.

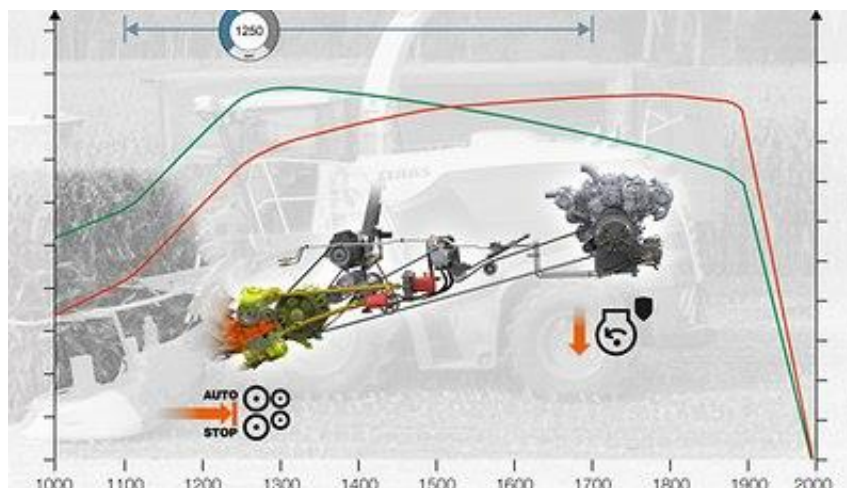


- ✓ The brilliant 12" display is easy to read by day or night.
- ✓ All the relevant functions can be accessed quickly via the touchscreen.
- ✓ You can adapt the working areas in line with your requirements and configure them freely.



Antenna and receiver are housed together in the roof unit. The SAT 900 GNSS receiver is provided with SATCOR 15 by Trimble RTX as standard.

- ✓ 5-year licence for use of SATCOR 15 by Trimble RTX.
- ✓ Pass-to-pass accuracy +/-15 cm.
- ✓ Pass-to-pass accuracy as high as 2 cm is available as an option.
- **CEMOS AUTO CROP FLOW:** The crop feed can be stopped automatically when detection of a preset engine speed causes the feeder unit and front attachment to be switched off. In this way, it is possible to avoid downtime in critical harvesting conditions.



- **Front attachment drive:** Drive power is tailored to the requirements of each front attachment. All the front attachment drives are integrated in the main drive train. In this way, the front attachment drive, feeder drive, chopping cylinder speed, accelerator and corncracker are able to react equally to engine speed variations. The advantage for you is that a constant length of cut is always maintained.

1. Mechanical drive suitable for all front attachments.

- ✓ For conventional use where there is no requirement for automated speed adjustment in constant harvesting conditions.

- ✓ Driven by the chopping cylinder shaft, all-mechanical with constant speed.

- ✓ Engaged via a belt clutch to the quick-release coupler.



2. Split-power front attachment drive.

✓ Front attachment driven mechanically via the chopping cylinder shaft with additional hydrostatic support and maximum power transmission at constant revs.

✓ Suitable for direct mechanical drive of DIRECT DISC and maize pickers.

✓ Removing the right-hand drive belt enables the hydraulic front attachment drive with variable speed adjustment for the PICK UP and ORBIS.

✓ Variable speed adjustment which can be automated enables an even crop flow for top-quality chopped material.

3. Variable front attachment drive for ORBIS maize front attachments and PICK UP.

✓ All-hydrostatic drive.

✓ Manual or automatic speed adjustment to the preset length of cut with low power requirement.

Two independent variable front attachment drives.

✓ Suitable for PICK UP with two variable drives, which are independent of each other, for intake auger and pick-up reel.

✓ Variable drive for intake auger via quick release coupler with speed adjusted automatically in accordance with the length of cut and driving speed.

✓ Hydraulic drive for pick-up reel with automatic speed adjustment in accordance with the driving speed.

Text 5. JAGUAR 900: Assistants for Extremely Precise Steering During Harvesting

Source: <https://www.claas.co.uk/products/forage-harvesters/jaguar900>

The CEMOS intelligent operator assistance system allows you to harvest more efficiently – an improvement in the area/hour (ha/h) rate of up to 7% with a 12% fuel saving is possible. In order to increase efficiency and reduce fuel consumption, the JAGUAR maintains the engine speed set by the operator and adjusts the engine output and ground speed in accordance with the volume harvested. When the volume harvested increases, the ground speed is reduced. A reduction in the volume harvested results in the automatic reduction of the engine output. The advantages are:

✓ A steady engine speed for a steady harvesting process.

✓ Even crop flow for highly reliable operation.

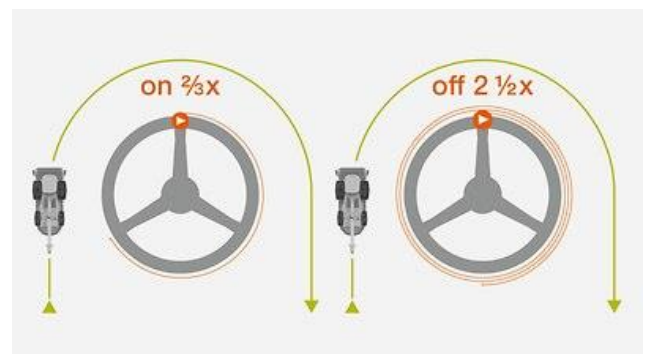
✓ Lower fuel consumption as a result of operating in an efficient engine speed range.

✓ Pleasant driving characteristics thanks to absence of sudden load changes.

✓ Operator's workload is reduced in demanding harvesting situations.

In addition, there are four assistants for extremely precise steering during harvesting.

– **Dynamic steering for the JAGUAR:** As the machine takes about five steering wheel turns to go from lock to lock, many operators prefer a reduced steering effort when they have to turn at the end of the field. The dynamic steering system makes it possible to go from straight-ahead running to full lock in only $\frac{2}{3}$ of a steering wheel turn when travelling below 10 km/h. The intensity of the dynamic steering response can be adjusted as required in CEBIS. This means that individual-



ised settings can be programmed, with different responses possible on the basis of whether the front attachment is in the working position or not.

– **Seeing with CAM PILOT:** The CAM PILOT assumes control of steering the JAGUAR in combination with the PICK UP. The swath is detected as a three-dimensional image by a twin-lens camera. Corresponding signals are transmitted to the steering mechanism in the event of deviations in the swath shape or direction. The steering axle then responds to these steering commands. This makes for reduced operator workload at speeds up to 15 km/h.



– **Sensor-based with AUTO PILOT:** Even row-independent maize front attachments usually follow maize in rows - a task in which they are assisted by the AUTO PILOT. Two sensor arms each scan a row of maize. The signals they generate are translated into corrective steering impulses. Twin-row sensing allows automatic steering in row widths from 37.5 cm up to 80 cm.



– **Guidance by GPS PILOT:** The GPS PILOT uses satellite signals to steer the JAGUAR reliably and with unbeatable precision along parallel tracks, curved contours at the crop edge, or reference lines defined by the operator. It is possible for the operator to make use of the full working width and to reduce overlaps to a significant degree. You start the GPS PILOT via the multifunction lever. It actively controls the steering hydraulics and guides you across the field precisely at all speeds, regardless of the light conditions. It works at night or in low visibility just as precisely as it does in full daylight. You receive correction signals for whichever degree of accuracy you require. Existing GPS track lines in ISO XML format – produced by a swather during grass harvesting or generated during maize sowing, for example – can be used with the GPS steering system of the JAGUAR.

Text 6. JAGUAR 900: Operation, Silage Quality and Fuel Consumption

Source: <https://www.claas.co.uk/products/forage-harvesters/jaguar900>

1. Operation: The JAGUAR can be operated without previous knowledge. This means that even new operators can quickly handle the machine safely and reliably and make use of its performance capacity.

– **CEBIS:** The touchscreen CEBIS gives you fast access to all the machine functions. The most important adjustments can even be made directly by means of switches on the armrest. Precise operation is ensured under all conditions, whether it's a question of a bumpy ride across a field or an operator who is just getting used to the system. You can adjust and operate the JAGUAR in four ways, as required.

– **Cab:** A cab that's a pleasure to work in. The clear and intuitive controls make for easier harvesting, even on long working days. The choice of user-friendly entertainment and communication systems makes work seem almost like a hobby.

Hands-free functionality, navigation, playing music – in combination with Apple CarPlay / Android Auto, the sound and entertainment package makes work more enjoyable. The subwoofer gives the sound the right depth and forceful bass delivery. CLAAS offers preparation for installation of these items as an additional equipment option. It is then simplicity itself for your CLAAS distributor to retrofit the cab with a radio with a 6-inch touchscreen.



Everything you need for easy, high-quality communication and entertainment is provided.

- ✓ The DAB+ radio guarantees clear reception of national stations.
- ✓ The gooseneck microphone ensures that you are heard loud and clear.
- ✓ No need to plug your phone in to recharge thanks to the inductive charger.
- ✓ Charging is also possible via the additional USB-C ports.
- ✓ Large cupholders are on hand for your drinks.
- ✓ Any sand or dust that gets into the cab can be cleaned out quickly with the integrated compressed-air gun.



2. Silage quality: Available in five variants, V-MAX chopping cylinders are ideally matched to your requirements. With 42 knives and a cutting frequency increased to 25,200 cuts per minute, the V-MAX 42 chopping cylinder is able to deliver particularly high throughput. Using the full engine output, it is able to deliver short lengths of cut from 3.5 to 12.5 mm with precision. Greater lengths can be produced by using one third of the number of knives. The V-MAX 42 is available as an option for the JAGUAR 990, 980 and 970.



The V-MAX chopping cylinders extend your length-of-cut range. Harvesting up to a length of cut of 30 mm is also possible with a corncracker. With the V-MAX 36 / 28 / 24, you simply adjust the position of the knife carriers and halve the number of knives. Through the symmetrical crop delivery, you benefit from high operating reliability and achieve very uniform crop processing by the corncracker.

- ✓ Extremely smooth, power-saving action: the curved shape of the knives makes for an optimum crop flow.
- ✓ High strength: chopping forces are taken up directly by the star-shaped cylinder structure.
- ✓ Easy to fit: just two bolts per knife, no need for adjustment/readjustment.
- ✓ Symmetrical crop discharge: with half the full number of knives through repositioning of knife carriers; also enables use with corncracker up to lengths of cut of 30 mm.

– **Water to prevent crop flow issues:** If you are harvesting crops with a high sugar content, the programmed injection of water at specific points in the crop flow path – such as the feeder unit, guide plate, accelerator and upper discharge chute – reduces the build-up of sticky material.

Whenever the crop flow ceases, at the headland, for example, or during forage trailer changeovers, water can be injected automatically. The water from the 375-litre tank moistens the sticky material in the crop flow path. When the crop starts flowing again, the harvested material cleans the crop flow path. It is then possible for silage additive to be injected using the ACTISILER 37 tank.



3. Fuel consumption: The JAGUAR 970 is equipped with a MAN 6-cylinder in-line engine with 790 hp and a displacement of 16.15 litres. The displacement of almost 3 litres per cylinder promises a stable power curve with sustained torque. This means that you can make your way through the densest maize crop without any difficulty while benefiting from fuel consumption per tonne of harvested crop that is impressively low for this performance class.

- ✓ Common rail, high-pressure injection technology (up to 2,500 bar).
 - ✓ Torque is consistent over a wide engine speed range.
 - ✓ Low weight thanks to high power density.
 - ✓ Very low fuel consumption.
 - ✓ Emission standard Stage V.
 - ✓ DYNAMIC COOLING variable fan drive.
- **Sustainability:** For the first time, the machine is supplied ex-factory filled with HVO fuel (DIN EN 15940). Hydrotreated Vegetable Oil is a synthetic diesel fuel whose

pollutant emissions are lower than those of fossil-based diesel as it is free of various pollutants, such as aromatics and sulphur compounds.

Characteristics:

- ✓ Fuel consumption is unchanged.
- ✓ HVO and diesel are fully miscible.
- ✓ Engine noise is reduced by smoother combustion.
- ✓ CO₂ emissions are reduced.

Text 7. Hay Harvest Equipment: A Complete Guide

Source: <https://www.agriteer.ag/equipment-to-harvest-hay/>

Innovations in the field of hay farming are constant. Just the last few years have seen some incredible ingenuity in haying equipment inventions: Vermeer debuted a zero-turn radius baler, McHale created a bale wrapper that bales 120 bales an hour (that's two per minute!), Anderson Group put out a self-loading bale trailer, and Peerbuilt made a net-wrap remover.

With all the new technology and options out there, what is right for your farm? Whether you're just getting started, or you're ready to update your existing equipment, we've got you covered. From mowers and balers to hay tractors, we're going to look at each one and find out what kind will fit your farming style.

So what equipment is needed for hay farming?

– **Cutting:** You've grown your hay, and now it's time to cut it down. What do you use to cut hay? What hay cutting equipment is right for you and your farm?

✓ Swather/Windrower: A swather cuts down the hay and lays it in neat lines (or windrows) for the baler to come along. You can get one of these hay cutting machines that is self-propelled (meaning you drive it), or one that attaches to your tractor. Farmers opt for swathers over mowers because swathers eliminate the need to rake the hay into rows after it has been cut.

✓ Mower: Hay mowers are usually towed by tractors, and they come in three forms:

1. Sickle bar: lightweight, good for subcompact and compact tractors. A sickle bar mower can mow in angled lines, making them the most versatile of your three mower options.

2. Disc: can easily handle thick hay at high speeds. A disc mower may require large tractors to tow it, due to its size.

3. Drum: can handle thick hay and high speeds, and is the most durable of your three mower options. A drum mower comes in shaft-driven and belt-driven options.

✓ Rake: If you opt to go the mower route, you will also need a hay rake, as mowers don't collect the hay into conveniently-baled windrows like swathers do. The three most common types of tractor rakes are:

1. Wheel: least expensive, easy to use, easy to repair.

2. Rotary: gentle on crops, can be used on wet crop.

3. Belt: lightweight, can be used on almost any type of tractor, can be converted to a tedder.

– **Tedding:** Once you've cut your hay, and it's lying there on the ground, you need to make sure it's dry before the next step. Of course, you can leave it lying in the field to dry out, and sometimes that's all it takes. For certain crops in certain climates, though, it's a good idea to use a hay tedder, which "stirs" up the hay on the ground and brings the not-dry-yet crop to the top to expose it to the sun. There are two kinds of tedders:

1. Heavy-duty: if you're doing a lot of tedding frequently, go ahead and opt for a heavy-duty tedder.

2. Light-duty: if you have a small farm or ted infrequently, a light-duty tedder is probably right for you.

Normally, tedders are towed behind tractors, so be sure your tractor can support whichever tedder you choose. In some cases, a rake can be used as a tedder, eliminating the need for an extra piece of equipment.

– **Baling:** Once your hay is cut and dry, it's time to put it into bales. It helps to think through your needs, which will help you figure out what baler is right for you.

✓ Square bales: these are the rectangular bales you see on hay bale rides and in horse troughs. They are popular for feeding horses and other cattle, and they are not terribly difficult for an able-bodied person to lift. They are easy to stack onto trailers/trucks, easy to store, and easy to use for many purposes.

✓ Round bales: these are the giant round bales you see sitting in fields after harvest. They can be stored in the field even in rainy weather; they are heavy (hundreds of pounds) and need to be moved with a large tractor or other equipment; but they last a lot longer than square bales and can feed a lot more cattle. More and more recently, round bales can be made with a small hay baler, giving farmers options on sizes.

– **Transporting:** So, you have bales. Now what? How do you get the bales where you need them to be? You have two options:

✓ Bale accumulators: This is a piece of equipment that you can drag behind your tractor or baler, that will do just what the name suggests – accumulate bales. Once it is full, simply drive it to the barn, unload the bales, and start over.

✓ Stack Wagons (or Bale Wagons): These are the manual labor version of bale accumulators; you pull a wagon behind a tractor or sturdy truck, and people load the bales into it.

Text 8. John Deere Hay and Forage Harvesting Equipment

Sources: <https://www.deere.com/en/hay-forage/harvesting/>

– **John Deere Self-Propelled Forage Harvesters:** No one brings more experience to the harvesting business than John Deere. Since 1837, they've been making innovative solutions for farming. And they've used those years of field experience to create field equipment that works quickly, yet gently.

Let's consider the Self-Propelled Forage Harvesters of 9000 Series. Their main features are:

✓ Powerful John Deere JD18X engine: This engine with 18L (1098-cu in.) displacement delivers unmatched performance and characteristics. The unique engine characteristic and efficiency brings the John Deere self-propelled forage harvesters (SPFH) into another performance league in the 700- to 800-PS (690.4- to 789-hp) power class. With the JD18X engine comes unique features and high comfort on the 9500, 9600, and 9700 SPFH models. It has a long engine oil service interval (750 hours).



✓ Efficient, powerful, and reliable HarvestMotion Plus concept: A state-of-the-art engine with ideal performance characteristics and low specific fuel consumption perfectly aligns and synchronizes with a superior crop flow. This is the John Deere HarvestMotion Plus concept. The “Plus” stands for unique torque rise and more power at low engine rpm – an experience of pure performance and efficiency without any compromise. Additionally, there is no diesel exhaust fluid (DEF) required. The HarvestMotion Plus advantages are 13 percent less fluid consumption (diesel plus DEF), 48 kW (64.4 hp) of extra power at low engine rpm to easily digest peak loads. In addition, reliable power delivered by modern robust engine technology ensures harvesting capacity.

✓ High-capacity feeding supports high silage quality: John Deere rotary harvesting units are built for reliable and powerful feeding of high-capacity forage harvesters. Two fundamental designs are available to match all producer needs. The 600plus Series Headers are the universal solution for different crops up to 4-m (13.1-ft) tall. The 700plus Series Headers are the perfect solution for high-yielding crops. The 6X9 Series Pickups with the patented endless flight vortex auger design and optional dual header drive enable high-capacity feeding of John Deere SPFH. Key advantages are the throughput boost in high-yielding crops but also the easy handling of uneven windrows.

✓ Improve silage quality with two kernel processing options

✓ High forage quality with HarvestLab™ 3000 and AutoLoc™ system: The HarvestLab 3000 sensor mounts to the top of the discharge spout and takes accurate dry matter and ingredient readings (more than 4000 measurements per second) of the crop through the sapphire glass lens as crop passes through the spout. This is the same technology forage labs use to measure dry matter. HarvestLab 3000 with John Deere Constituent Sensing measures dry matter and constituents like sugar, starch, acid detergent fiber (ADF), neutral detergent fiber (NDF), crude fiber, crude ash, crude protein, crude fat, Metabolic Energy and ELOS depending on the crop. In addition, the HarvestLab 3000 sensor can also be used as a stationary unit.

AutoLoc, a feature exclusive to John Deere and unique to the market, brings added value to the HarvestLab sensor and John Deere SPFH. AutoLoc works in conjunction with the HarvestLab 3000 sensor and IVLOC transmission to automatically adjust the length of cut (LOC) based on crop moisture levels to improve bunk density and reduce long particles in dry corn. Nutritionists, herdsman, and SPFH operators will all benefit from this innovation.

✓ Dura Line™ wear parts: Due to increased machine usage (chopping more tons per hour), standard high-quality steel parts need to be replaced more frequently. Since 2010, John Deere has been meeting the challenge and exceeding expectations with Dura Line wear parts. Dura Line components are installed in high wear spots on the self-propelled forage harvesters, mainly in the crop flow. The technology is normally used for heavy-duty environments such as mining and machine tooling. It is the highest material quality in the industry that is installed on an SPFH. The benefits of such parts are:

1. The coating is extremely wear-resistant with an extraordinarily smooth surface due to the special heat treatment and a proprietary tungsten carbide composition.
2. Dura Line™ provides a permanent fast-chopping process with low crop friction on the components while fuel consumption remains low.
3. Tests show that when chopping in the same crop conditions and chopping the same tonnage, Dura Line parts last four times as long as, or longer than, standard parts. Time and money associated with replacing parts are significantly reduced.

– **Rotary Harvesting Heads:** As John Deere has a complete line of row-independent headers, there's a match for every operation. Count on a large-drum cutter-head for high performance in dense, high-tonnage crops.



– **Self-Propelled Forage Harvester Pickups:** Available in single- and double-windrow widths, John Deere hay pickups feature a low-profile design to help you harvest all the crop in the windrow. It is possible to choose between one of the proven 6x9 series pickups or go with the new 46R pickup to increase speed while still maintaining a smooth crop flow.



– **Flail Chopper:** The 972 Flail Chopper has a cutting width of 1.8 m (6 ft) for good productivity. It handles a variety of jobs: makes excellent grass silage, shreds and spreads corn and cotton stalks, chops light brush, makes silage of beet tops and clips pastures.

The rotor design has two rows of knives that allow a uniform cut of the forage. The rotor speed is 1366 rpm. The cutting width is 1.8 m (6 ft). The cutting height can be adjusted to obtain a minimum of 6.4 cm (2.5 in.) or a maximum of 18.4 cm (7.25 in.) with a lever or an optional hydraulic cylinder. The mounting system of the knives allows them to swing back when they hit stones or other obstacles and to automatically return to their normal position without interrupting the chopping operation. The rotor has 42 heat-treated knives. They are double edged so they can be reversed, increasing their longevity.

The discharge spout mechanism allows the operator to easily adjust the direction in which the forage is thrown and, at the same time, adjust the speed at which the material is being ejected. The spout mechanism is heat-treated, which ensures a longer life of its components. The spout rotation is done through a lever, within reach of the operator from the tractor. A steel wear sleeve (attachment) extends the life of the spout. The vertical and horizontal extensions (attachments) evenly fill the larger or taller wagons.

Auger and cutterhead provides better delivery of material. The speed of the auger is 300 rpm, which provides better delivery of material into the cutterhead. The design of the door allows easy access to the auger. There are three reinforced hinges to prevent breakage.

The slip clutch is designed to protect the components of the drive system of the chopper. Gauge wheels are very easy to change. A tractor hookup is fast and easy.

Text 9. The W200 Series Windrowers

Sources: <https://www.agriculture.com/new-high-horsepower-w260m-windrower-from-john-deere-8605334>, <https://www.deere.com/en/hay-forage/mowing/windrowers-platforms/w260r-windrower/>

John Deere is expanding its windrower series with the new W260M with higher horsepower for cutting through dense crop. The W260M is launching with Deere's new mounted-merger option, enabling the windrower to combine up to 48 feet in a single windrow. This option will also be available on the W235M, W235R, and W260R.



The W260M has a maximum 260 hp, which combined with the new mounted-merger option, is intended to boost productivity and efficiency for farmers, with less crop damage. The transport speed is up to 24 mph.

“Dairy feed producers are looking for ways to improve profitability that doesn't increase labor hours,” says Kaylene Ballesteros, hay and forage go-to-market manager for John Deere. The new W260M and mounted-merger solution set helps accomplish just that. Our customers need to do more with less to combat rising costs within the industry. A solution that offers time savings with less passes allows them more time and money to focus on other areas of their operation.”

The W260M is also compatible with Deere's telematics technology like AutoTrac guidance, TouchSet windrow shape and conditioning adjustments, and John Deere Operations Center mowing documentation.

The key features are:

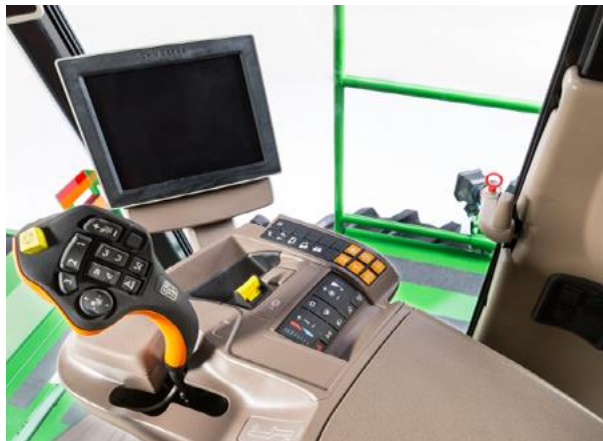
– **Comfort and productivity with M- and R-spec cab features:** The Self-Propelled Windrowers come with a cab that offers a comfortable and quiet working environment with plenty of visibility, storage, and features.

– **Precise control of the machine with the CommandARM™ console:** The CommandARM console provides the operator with unmatched control of the windrower and platform. Controls are designed and positioned to enhance ergonomics and are easy to locate and use. Operators will appreciate the look and feel of the control console in the windrowers, which are similar to the design used in John Deere tractors and combines. Adjustment of the CommandARM console meets the needs of every operator. It adjusts at an angle, fore/aft, and up and down for precise operator comfort. The CommandARM console provides access to the most frequently used windrower controls. The controls vital to the operation of the W200 Series Windrowers are conveniently located on the multi-

function lever.

– **Quickly see important information on the cornerpost display:** The cornerpost display features electronic instrumentation and blends well with the narrow, right-hand cab post, providing excellent visibility to the header. The cornerpost display is divided into an upper and lower region. The upper region provides traction unit information, and the lower region provides platform-specific information.

– **Control engine oil and temperatures with efficient cooling packages:** The W200 Series Windrowers are tested in tough conditions of over 37.8° C (100° F) to ensure that the drives stay properly cooled for maximum life and reliability. The 94.6-L (25-gal.) oil reservoir supplies oil to the pumps.



CommandARM console in the W200M Windrowers



Oil cooler and air conditioner assembly

Oil is cooled as it passes through the combination oil cooler and air conditioner condenser assembly at the rear of the machine. Live monitoring of the hydraulic oil temperature at the left and right drive motors and reservoir limit switch protects against overheating during drive motor stall or high-grade terrain conditions. The eight-blade cooling fan incorporates a viscous drive system that provides precise control over fan speed during operation. Optimization of the viscous fan speed leads to significant reductions in parasitic losses in certain operating conditions. The fan speed is controlled by various factors such as engine coolant temperature, intake manifold air temperature, or hydraulic oil temperature. This level of control allows the fan to operate only at the required speed to keep the engine and cooling package at optimal operating temperature and reduces engine noise levels.

– **Easily fuel the windrower from the ground:** The diesel fuel and diesel exhaust fluid (DEF) fill locations on the W200 Series Self-Propelled Windrowers provide convenient filling from the ground level.

The DEF sight gauge keeps operators from overfilling the tank, preventing spills and damage from freezing and expansion in cold weather. A remote battery terminal, conveniently located on the left-hand platform near the fluid fill, provides power for the 12-V fuel pumps on refueling tanks.



Fuel and diesel exhaust fluid tanks

Text 10. Mower Conditioners

Sources: <https://blog.machinefinder.com/33478/mower-conditioners-what-are-they-how-are-they-operated>, <https://www.deere.com/en/hay-forage/mowing/mower-conditioners/>

Cutting hay isn't always a quick and simple task, especially when you have a large amount of it to tackle in a single workday. Luckily, John Deere has several mower conditioners that customers can choose from to boost their efficiency and overall productivity. With a mower conditioner from Deere, agricultural professionals can cover more acres in a short amount of time. Deere's latest mower conditioners are also lighter in weight and give users the ability to customize their windrow. Maneuverability and durability are also guaranteed with a mower conditioner from John Deere.

– **What is a Mower Conditioner Used For?** Mower conditioners have become a must-have for hay crop producers who value quality. This piece of equipment is designed to crimp and crush newly cut hay with the goal of promoting faster, even drying.

Mowers typically come as one of three types: sickle bar, disc, or drum. Sickle bar mowers use a reciprocating blade to cut grass and often have a reel to fold grass over the knife. Disc mowers use several hubs across the cutting width, and each hub has a small rotating disc with knives. Drum mowers come equipped with two or three large plates known as drums; these ride over the ground while spinning.

Conditioners also come in three main types: rubber-roller, steel-roller, and flail. Roller conditioners have two opposing rolls with a raised, interlocking pattern; these crimp the crop between the rollers. Flail conditioners have an arrangement of steel Vs on their main shaft, which beat the crop against the top of the mower conditioner.



– **How to Set Up & Operate a Mower Conditioner:** Once you purchase a mower conditioner and you're ready to use it out in your field, there are a few steps you can take to prepare for the task at hand.

1. Start by reading your Operator's Manual to familiarize yourself with all of the safety measures that need to be taken into consideration. It will also let you know how to attach your mower conditioner according to the hitch system you are using.

2. Make sure the top of your drawbar is 13 to 20 inches above the ground surface.

3. Verify that the distance from the top of the drawbar to the tractor's PTO shaft centerline is 6 to 12 inches.

4. Measure the distance from the end of the tractor's PTO shaft to the drawbar pin-hole centerline. The distance should be 14 inches for 540 rpm or 16 inches for 1000 rpm.

5. Attach the PTO, secure the safety chain, attach the hydraulic hoses, and remove the jack stand.

6. Return to the tractor cab to set the depth stop on the three-point control. After these steps have been completed, you will only need to make minor adjustments in the future, assuming the conditions remain consistent.

7. Adjust the cutting height by adjusting the gauge shoes. Release the swing lock, then swing the mower conditioner out into the operating position.
 8. Verify that the lock cylinders are locked in place by moving the locking lever to the horizontal position.
 9. Remove the locking pins to raise or lower the gauge shoe on one side. Then, replace the locking pins to set the gauge shoe at the desired height.
 10. Adjust the cutterbar tilt using the turnbuckle to angle the cutterbar up or down.
 11. Adjust the float to keep the machine's weight off of the cutterbar and on the float springs. This will allow the mower conditioner to follow the contour of the field.
 12. Adjust the windrow forming shields by loosening the two handles, adjusting the shields, and re-tightening the handles.
 13. Adjust the swath board by moving the adjustment handle forward to lower the board, or backward to raise it.
 14. Once you are out in the field, set the mower conditioner to operate off-center from the tractor. This will allow it to cut the standing hay while the tractor moves over the previously cut hay.
 15. Review the Operator's Manual before you store the mower conditioner after use.
- The new John Deere C500 Mower Conditioner allows getting more done in a day. The 16 ft. 4 in. (5 m) cutting width of the new C500 lets you cover up to 10% more acres per hour compared to previous models.



The key features of C500 Center-Pivot Mower-Conditioners are:

- **Maximize productivity with the C500 Center-Pivot Mower-Conditioner:** The C500 Center-Pivot Mower-Conditioner from John Deere offers you the widest cut in the lineup. The 5-m (16.4-ft) wide platform is the center-pivot equivalent of the commercial-grade 500R Windrower Platform. The C500 is built to withstand the needs of custom operators and producers covering high acres in a season.

- **Protect your crop with conditioner options to fit your needs:** Achieving the right conditioning action can significantly reduce dry down time. That means less time needed to cure, maintaining optimum feed values, and preventing leaf loss in legumes. Hay and forage producers have a wide variety of crops and conditions. That's why John Deere mower-conditioners offer four different conditioners.

- **Reduced maintenance and proven cutterbar reliability with 5-year coverage:** John Deere's patented design cutterbar is made from individual, diagonal-cut modules, making serviceability easy. Each module can be removed for service individually, leaving the remaining cutterbar modules attached to the frame. Every mower conditioner includes a 5-year warranty on cutterbar components.



– **Save time with quick-change knives:** Having sharp knives on your machine is critical to harvesting all your crop and leaving a clean-cut field. Changing dull or bent knives is no longer a time-consuming job with the John Deere quick-change knife (QCK) system. There are no worries about having an impact or air compressor to change out the bolts. Simply insert the QCK tool into the disk and press down. The knives can be swapped out in seconds.



Reduce time to change knives by more than 50 percent over the bolted system compared to standard bolted knives of previous models.

– **Quickly prepare the mower-conditioner for transport:** An advantage John Deere has over most competitors is that the mower-conditioners transport directly behind the tractor at nearly the same width as its cut. Operators can transition from road to field configuration and back again quickly and easily.

Text 11. Self-propelled Mower KSU 2

Source: <https://en.rostselmash.com/products/models-shk3055/ksu-2/>

New-generation versatile self-propelled mower can be used to fulfil several tasks simultaneously. It can do a quick job of cutting and swathing spiked cereals, grain legumes and cereal crops, cutting and conditioning forage grass. Being powerful, manoeuvrable and multifunction machine, it is ideal for the farms that widely use the windrowing method and grow livestock.



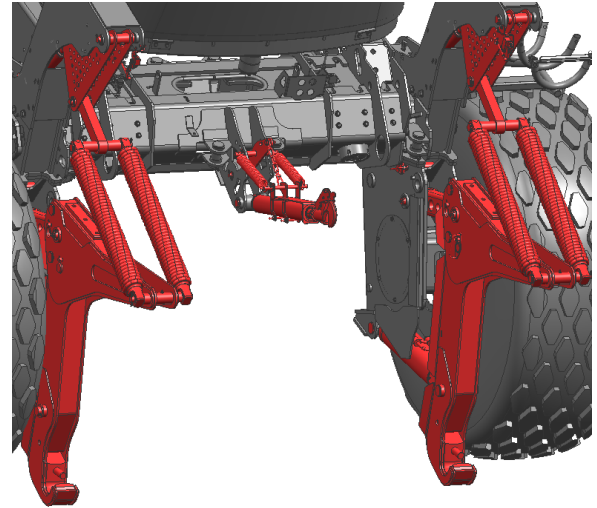
The key features are:

1. High Performance

– **High-power and fuel-efficient engine:** The self-propelled mower is equipped with a 6.7 litre 264 h.p. CUMMINS diesel engine (194 kW @ 2,200 rpm). The engine electronics fully monitors its operation and feeds the exact amount of fuel required under the current load. This ensures the minimal fuel consumption.



Diesel engine



Versatile 3-point hitch

– **Simplified hitch:** With this versatile 3-point hitch, attaching headers to the self-propelled chassis has become even easier and faster like never before. But as before, the mower forward tilt angle can still be adjusted from the operator's station. When changing table position or replacing an attachment, the attachment now can be balanced remotely, from the operator's station.

– **Axes and Tires:** The front axle is an extendable drive axle; wheel tread width adjustment range is 2,700 mm to 3,356 mm. Front axle wheels are 23.1-26. The rear axle is a steering one, wheel tread width adjustment range is 2,820 mm to 3,820 mm. Rear axle wheels are 13.6-20.

2. Comfortable in Use

– **Comfort Cab II with Adviser IV information system:** The versatile self-propelled mower is equipped with the Comfort Cab II. The air conditioning and heating system is included in the basic package. You will enjoy the comfort that will really allow you to work efficiently, with less strain and fatigue all throughout the shift.

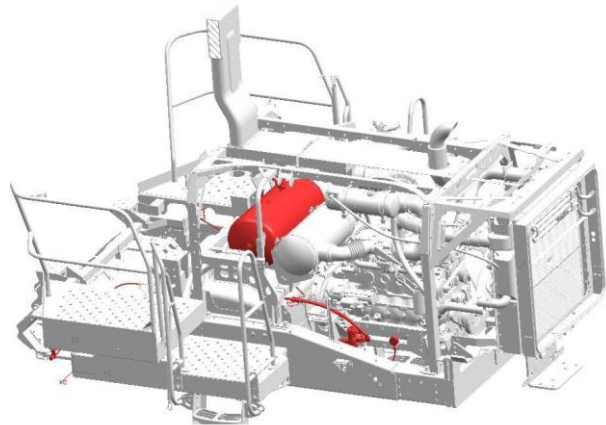
The Adviser IV voice information system continuously monitors operation of the mower components making it possible to control process stability and prevent damage to components, and the multi-function joystick adds to the ease of operation.

– **Adviser IV System:** The new Adviser IV onboard computer system is installed on the mower. The system interface is completely upgraded. New features available in the system are radio, reading data from flash drives. Video from the rear-view camera is also displayed in the system monitor.





Adviser IV onboard computer system

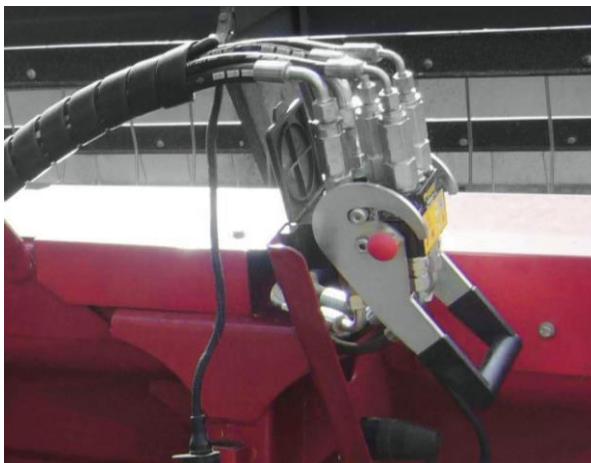


Pneumatic system

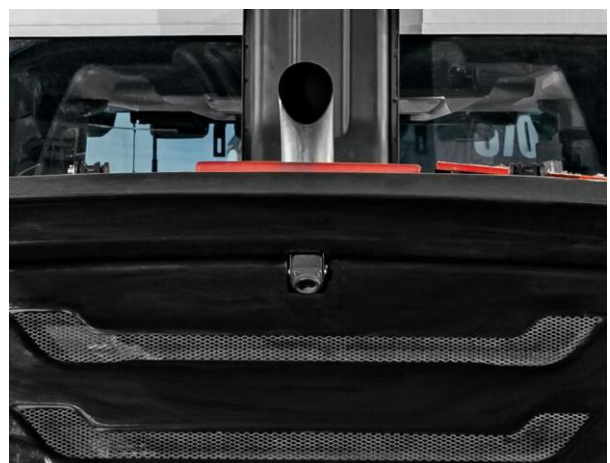
– **Special Standard Equipment:** A pneumatic system is added to the basic package of machines to enhance their self-containment. It consists of a 100L receiver and a compressor which automatically maintains pressure at 4 to 8 bars, convenient pneumatic tools and a quick-release coupling for ease of mower maintenance. With the engine stopped the system holds enough air to operate for 5 minutes, you will have enough time to carry out routine maintenance.

3. Attention to Details

– **DF Universal Hydraulic Connectors:** Universal hydraulic connectors significantly save time when connecting DF 1050 / 1250 / 1400 attachments, they make operation convenient and prevent ingress of dirt.



Universal hydraulic connectors



Rear-view camera

– **Rear-view camera:** The camera improves vision when travelling in reverse direction and can be used to monitor cutting quality behind the mower.

Text 12. Maize Header 450/600/750

Source: <https://en.rostselmash.com/products/adapters-kmk/zhatka-maize-header/>

The header is designed to mow and deliver the cut material to the feeder of corn or other hard stalk crops. The headers are attached to RSM F 1300, RSM F 2450, RSM F 2550, and RSM F 2650 forage harvesters.



The key features are:

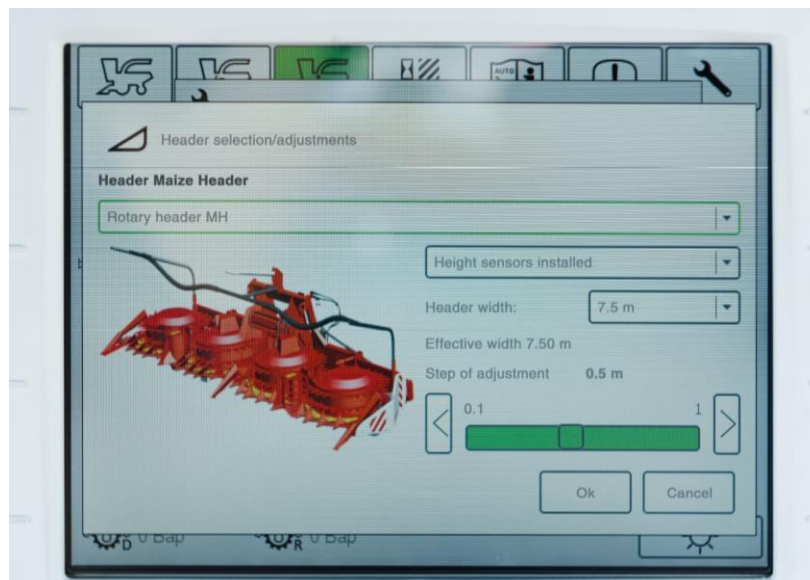
1. Wide opportunities

– **Efficiency:** The use of rotary knives with high rotor rpm allows clean and fast cutting, including thin-stemmed and thick-stemmed crops. Both in high and in low yield conditions.

– **Minimum cutting height:** Thanks to the precise design, the minimum cutting height of the header is 60 mm, allowing to harvest with minimum loss of vegetative crop. Useful, for example, for sorghum and some other crops.

2. Comfort operation

– **Easy to operate:** "Maize Headers" are operated from the operator's seat when hitching up to F 2000 series harvesters. Or by switching gears in the gear case, depending on the cutting length when hitching up to a F 1000 series harvester.



– **Height adjustment:** Two ways of adjusting the header cutting height when hitching up to F 2000 series harvesters: by height or by pressure. This is controlled by height sensors.



– **Transport width:** In transport position, the header is folded up to 3 m in width. So, the harvester may drive on public roads with an adapter mounted.

3. Perfection in detail

– **Each side has its own clutch:**

In case of peak loads on cutting rotors, the protective clutches mounted for the left and right sides of headers are activated. The clutches prevent the rotors gearboxes from possible failures.



– **Scrapers:** The headers are equipped with two types of scrapers. Some scrapers prevent accumulation of leaves and stalks along the path of cut plants into the feeder, and some help clean the divider blocks and break up the stalks.

– **Operation in case of varied plant height:** Telescopic guides allow the headers to handle high stalk crops. After the cutting, the plants are supported by the guides as they slide towards the feederhouse.

Text 13. Adapters to Forage-harvesting Combines: Grass Header 500/600

Source: <https://en.rostselmash.com/products/adapters-kmk/zhatka-grass-header-600/>

High performance rotary header "Grass Header 600" is designed for cutting grass used as cattle forage. It is used in all plain land zones in fields with levelled terrain. One distinctive feature of the header is a cutterbar with rotary knives. The rotor speed is up to 3100 rpm. This high speed delivers a clean, proper cut, with no damage to plant roots. So, the following hay cuttings will be productive as well.

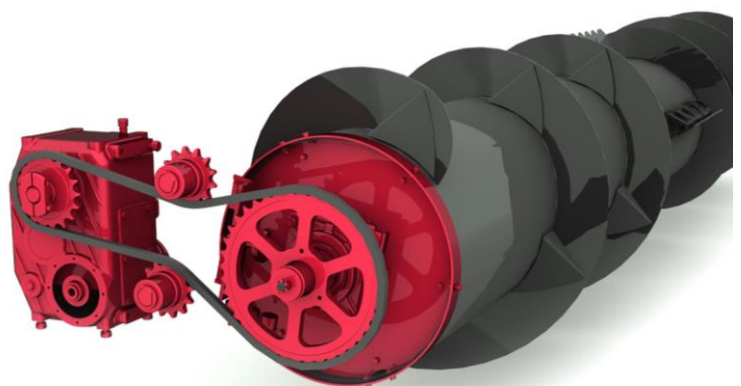


The key features are:

1. Wide opportunities

– **Efficiency:** The use of cutterbar with rotary knives with a high rotor speed up to 3100 rpm delivers a clean, fast cut, including thin-stemmed and thick-stemmed crops – this relies heavily on the header cutterbar operation.

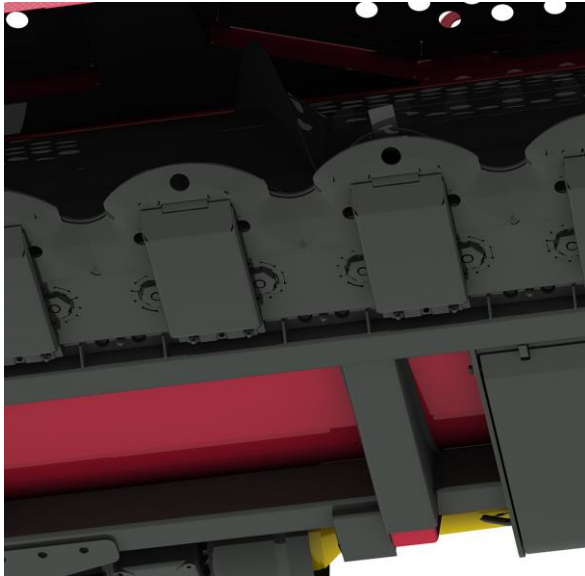
– **Adaptivity as quality assurance:** Due to adjustable auger rotation speed, the header can be easily and quickly adjusted to various operation conditions: changes in yield, composition of harvested crop, etc.



2. Comfort operation

– **Operation with high driving speed:** Special design of the shear bar rotor plates and bent knives provides a high capacity of a header. This prevents plugging with material and increases the operating speed.

– **Stable terrain following:** Uniform ground pressure is ensured by a special balancing system allowing smooth and stable terrain following. As a result, the risk of material contamination and the header damage in contact with the ground are almost fully eliminated.



Special balancing system

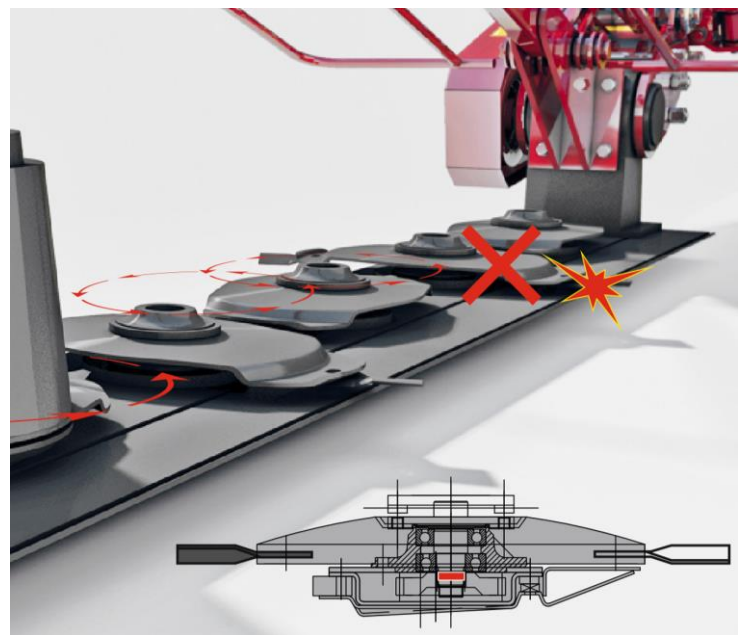


Easy access

– **Ease of maintenance:** Quick and easy access to the header components and units, as well as to lubrication points, allows reducing the time and effort required for maintenance, and requires no special equipment or tools.

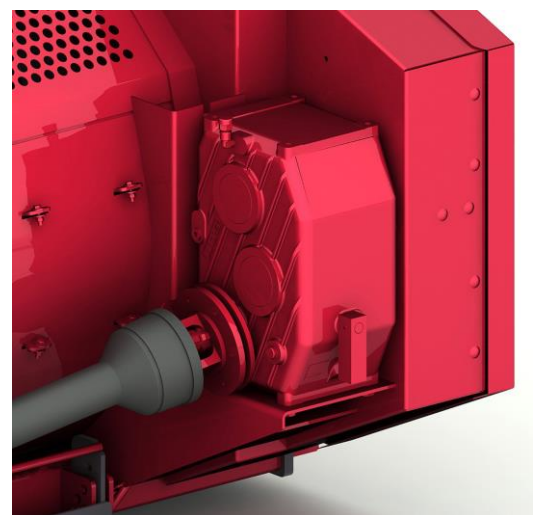
3. Perfection in detail

– **Each rotor has overload protection:** In case the cutting rotor contacts a large obstacle, and this is not noticed during operation, the cutterbar gears are protected against damage by the safety element installed in each rotor drive. So, there is no need of dismantling the cutterbar and replacing the damaged gears: it is sufficient to replace the actuated breakaway support with a new one and continue the operation. That means substantial time and cost saving.



– **Perfect quality of hay:** The knives of special crooked design throw the cut grain material up and back along the cutterbar path, preventing any jamming in front of the cutterbar. The rotor speed 3100 rpm minimizes damage to grass roots, so the sustainability of crop material is maintained until the following cut.

– **Reliable operation in case of emergency:** The slip clutch mounted on the drive shaft provides reliable protection under the peak loads.



Text 14. Adapters to Forage-harvesting Combines: Pickup Forage Harvesting Mounted For Up 300/400

Source: <https://en.rostselmash.com/products/adapters-kmk/for-up-300-400/>

Forage pick-up hinge is mounted on the forage harvester and perfectly picks up the swaths of cut crop and feeds them to the forage harvester's feeding device. Outstanding performance and adaptation to the micro-relief of the field and safety in operation are the distinctive features of the FOR UP 300/400 pick-ups.



The key features:

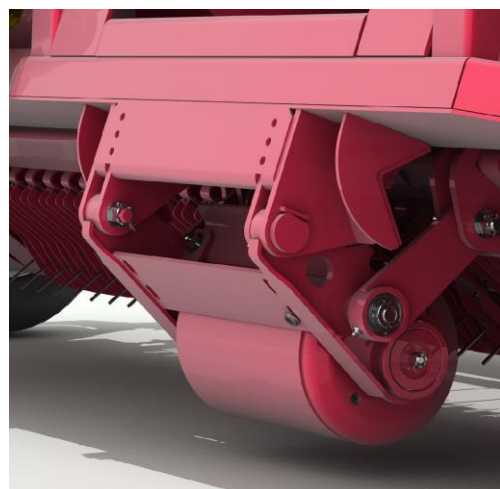
1. Easy operation

– **Working at increased speed:** The well-proven pick-up mechanism combined with the high-performance auger allows picking up crop masses at speeds of up to 15 km/h, which puts your harvester to good use and harvest large areas in the shortest time.

– **Stable Relief Contour Following:** An advanced contour following system is a distinctive feature of pick-ups. Two gauge-wheels in combination with a central roller precisely follow the field contours, and a spring or torsion mechanism ensures that the pick-up unit moves after the forage harvester. All these features allow you to achieve excellent pick-up quality and eliminate contamination of the cut mass.



Pick-up mechanism



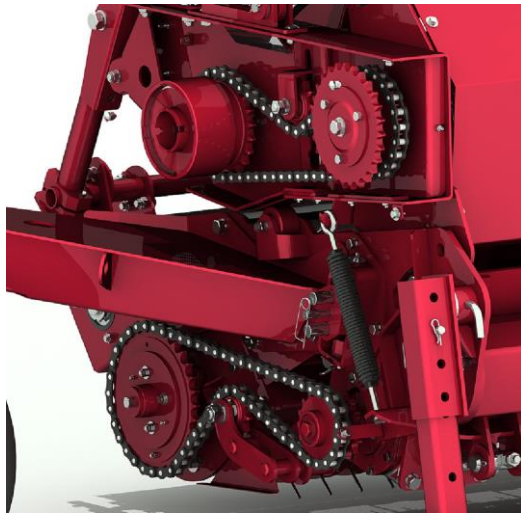
Contour following system

– **Ease of Maintenance:** The minimum number of check and service points ensures quick preparation of the pick-up for the upcoming shift without special tools or much effort.

3. Perfection in details

– **Variability as a guarantee of high performance:** Having the cultivated area is measured in thousands of hectares and different grasses grown on these fields, you will encounter differences in the volume of the swaths you get. To ensure the pick-up is efficient in diverse conditions, the pick-up and auger speeds are variable, and the adjustable auger blades ensure adaptability to short stalks and thick, long-stalked crops. The speeds can be changed by shifting the revolving sprockets.

– **Effective protection:** Efficient mechanism performance is as much important as its reliable operation in field operating conditions. The FOR UP 300R/300/400 pick-ups are now equipped with safety couplings in the pick-up and auger drive. This keeps the pick-up transmission safe in case of any abnormalities during operation and prevents unwanted downtime and, therefore, financial losses.



Safety couplings in the pick-up and auger drive



Normalizer with pressure roller

– **Reliable operation in challenging conditions:** FOR UP 300R/300/400 pickups are equipped as standard with a normalizer with pressure roller. This ensures that irregular, high-yielding or lightly swollen swaths are fed evenly to the operating elements, preventing blocking of cut mass and consequently reducing productivity. The normalizer design involves a dedicated large-area grid, which prevents the crop from escaping from the working area. You can feel confident that the entire crop will reach the combine.

Text 15. New Hay Mowers on the Market

Source: <https://www.agriculture.com/machinery/hay-and-forage-equipment/new-hay-mowers-on-the-market>

Case IH, Claas, and New Holland have all expanded their hay tool lineups by launching new mowers in 2022. Each lineup from the three companies has a variety of models to fit small or large operations.

1. Case IH DC5 series disc mower conditioners

Case IH is now offering new size options for center-pivot DC5 series disc mower conditioners, designed for higher performance in a smaller build. Other changes to the

mowers are designed for better crop flow, faster dry down, and no-tool adjustments to the implement.

The DC105 disc mower conditioner is a new configuration from Case IH with a modular cutterbar that has a width of 10 feet 1 inch. The conditioning system is available in rubber or flail style. A smaller center pivot and overall size is designed for easier road and small-field navigation.

The DC125 has a longer swath gate, with adjustments made to fins and wedges to enhance cutting and windrowing over previous models, and has a cut width of 11 feet 7 inches. The DC135 model is replacing Case IH's DC133 in the company's mower lineup. This model has a cutterbar width of 13 feet 1 inch, with eight discs. Both of these models have the option of rubber, steel rolls, or flail conditioning.



The Case IH DC125 disc mower in tow behind a Case IH tractor

The new DC165 is replacing the DC 163, as well, with an even larger cutterbar at 16 feet 5 inches and ten cutting discs. This model is offered with rubber or steel roll conditioning.

2. CLAAS DISCO 9300 TREND mower

The new Disco 9300 mower from Claas has a large working width available in either 29 feet 2 inches or 29 feet 10 inches configurations. Despite the size, the Disco has a lower profile, with 150 PTO HP power requirement, and doesn't require a monitor for operation.



The Claas Disco 9300 Trend mower pulled behind a Claas tractor in a hay field

The cutterbar is designed to be maintenance free, with a bolted, torsion-resistant build. Each cutterbar has eight contra-rotating mower discs, uniformly spaced for an even cutting pattern. The one-piece base plate is made of 5 mm thick steel and creates a dirt-removing tunnel effect in connection with the skids. The intermediate pieces are shaped differently for converging and diverging mower discs to enable an effective cut as a counter blade and for maximum overlap.

The protective curtains on the mower fold out wide for access to the cutterbar for maintenance, and the build is designed to prevent the turning and attachment points from rusting. The mower bar is equipped with a quick knife change system, with color-coded blades to make changing them out easier, and the replacement blade box is divided into three compartments to keep them sorted.

3. New Holland Discbine PLUS series

With the introduction of the new Discbine Plus series, New Holland focused on enhancing cutting and swath controls for its center-pivot disc mower conditioners. All the models in this series use a newly redesigned cutterbar, similar to the one featured on New Holland's Durabine Plus disc headers on the Speedrower Plus windrowers.



The New Holland Discbine Plus mower pulled in the field by a New Holland Tractor

The cutterbar has longer knives for a faster tip speed, designed for improved cut quality. The models have a 30% lower cutting height than previous models, to leave less behind in down and tangled crops. Reshaped rock guards help with crop-to-knife engagement.

The Discbine Plus' conditioning system is sized for each model for uniform conditioning and fast drydown across the entire series. Conditioning options include intermeshing rubber or steel rolls. A flail tine conditioning system is also available.

The swath gate is 5 inches longer, with adjustable crop spreading wedges to break up crop streams. These also have adjustable crop fins to make windrows as 3- to 8-foot wide. The forming shields are also 5 inches taller than previous models and work with the swath gate to make a tunnel effect designed for more windrow control and neater swaths.

The Discbine 310 Plus has a six-disc cutterbar with a cut width of 10 feet 1 inch. This model can be equipped with a 540- or 1,000- rpm drive, and requires as little as 80 hp to operate. The 312 Plus has a 11 feet 7 inches wide cut, with a 1,000-rpm drive. The 313 Plus has a wider cut than the 312 with an additional 1 foot 4 inches to its width. The 316 Plus has the widest cut in the series at 16 feet 5 inches.

Text 16. Round and Square Balers

Source: https://bobruiskagromach.com/en/catalog/harvesting_equipment/press_balers/

1. Round baler PR-F-145SH

Round baler is designed for picking up and compressing of hay and straw into round bales with subsequent twine winding. Round baler PR-F-145SH is the next stage of modernization of the round baler PR-F-145 by increasing the working width of the baler and pressing density and by installing of two types of winding machines, which allow winding the bales with twine, as usual, and with a grid.

The round baler is a semi-trailer machine and consists of a constant-volume compression chamber, a drawbar with a coupling loop, a base of a two-wheel chamber, a pick-up mechanism, mechanical and hydraulic drives of the working tools, compression

mechanism and electrical equipment. The mechanism for winding the bale with twine tilts up while working with the grid. The baler is equipped with an alarm system and remote control of the mechanisms.

Advantages of round baler PR-F-145SH:

- Due to the increase in the width of the pick-up mechanism to 1.9 m, picking-up of wider windrows is ensured;

- Reducing the distance between the picking tools from 88 mm (PR-F-145) to 54 mm allows to reduce losses during picking-up of hay or straw;

- Reducing the diameter of the picking-up mechanism allows to reduce a load on the picking-up tools and subsequently to increase their durability;

- An additional roller installed behind the picking-up mechanism improves a bale formation;

- An installed compression mechanism with a large number of slats ensures the formation of a denser bale;

- A passive compression roller with a grid installed in front of the baler ensures a steady supply of the mass to the baler and allows to get steadier bale density;

- A possibility to make winding of bales with a twine as well as with a grid;

- Fast switching from one way to winding bales;

- Winding bales with a grid increase the productivity of the baler;

- The bales winded with a grid have the correct cylindrical shape, they are convenient for transportation, they are less susceptible to atmospheric precipitation and are better preserved.

2. Baler PRP-160-1K

PRP-160-1K baler is designed for picking up hay of natural and sown herbs, pre-wilted grass, straw with grinding of the picked-up mass and compressing it into bales with subsequent winding of them with a polymer grid or stretch film. It is possible to use the baler without grinding of picked up mass and without winding the bales with a stretch film. The baler is aggregated with 3 drawbar category tractors with a power of no less than 116 kW, equipped with a hitch, PTO, hydraulic system outlets, a socket for connecting of light signaling electrical equipment and a two-wire pneumatic brake drive. When the baler works without grinding of the picked-up mass and winding the bales with a stretch film (hay, straw), it is allowed to aggregate with 2 drawbar category tractors with a power of no less than 90 kW. PRP-160-1K can be used in all agricultural areas, except mountainous areas.



3. Square baler PPT-160

The machine is designed for picking up windrows of hay, straw and pressing them into square bales. It is aggregated with a tractor of 1,4 drawbar category.



Unlike round bales, the square baler allows adjusting the bale density. Besides, the bale overall dimensions and weight are much smaller, which allows bale unloading and distributing not only with the help of machines but manually. It is convenient at further feeding. The baler PPT-160 is designed for application in small farms with low degree of mechanization.

Text 17. John Deere Square Baler Lineup

Sources: <https://blog.machinefinder.com/37178/8-maintenance-tips-for-your-john-deere-square-baler>, <https://www.agriculture.com/machinery/hay-and-forage-equipment/john-deere-introduces-new-l341r-high-density-large-square-baler>, <https://www.deere.com/en/hay-forage/baling/l341r-baler/>

John Deere offers several types of square balers to meet the needs of all types of agricultural operations, whether you're working at a single farm or a large-scale agricultural enterprise.

1. Square Baler Lineup

The large square baler lineup includes the L331, L341, and L341R High-Density models, all of which boast an impressive minimum of 115 horsepower and are equipped with cutting-edge technologies such as Moisture Sensor and BalerAssist™. The small square baler series is intended for smaller farming operations and comprises the 328, 338, and 348 models, each with a PTO minimum speed of 35 horsepower.



Whether you're tasked with feeding a small herd before sunset or harvesting hundreds of acres of crop, the John Deere balers are known for their durability, precision, and

performance. But to keep your baler in peak condition, it's important to conduct regular inspections and maintenance.

A well-maintained John Deere square baler can quickly and consistently produce high-quality bales without hiccups. The following are just a few of the benefits that come from routine square baler maintenance:

- **Efficiency:** Balers operate at their best when all parts function correctly. When one-part malfunctions, it can have a domino effect on efficiency. For instance, a loose belt could wreak havoc by tangling with other parts, causing stoppages, and speeding up wear. Consistent maintenance boosts reliability, uptime, and performance, which all add up to getting the job done more efficiently.

- **Longevity:** A regular maintenance routine serves as an early warning system, spotting issues before they harm your baler's machinery. Small problems can quickly escalate, accelerating wear and tear and shortening your machine's lifespan. Allocating time and resources to regular maintenance is an investment in prolonging your machine's lifespan for years to come.

- **Cost-Effectiveness:** Proactive maintenance is more than just a smart move – it's a financial win. It spreads out the costs of maintenance over a longer period of time and prevents more costly, avoidable expenses. By ensuring that your baler is operating as it should be, you can also reduce fuel costs and yield more bales in less time.

2. L341R High-Density Large Square Baler

The new balers are designed to produce bales with 30% higher density than previous models. John Deere has introduced the L341R High-Density Large Square Baler to its lineup of balers, capable of producing 3x4 high-density bales.



With higher density bales, there will be fewer bales to pick up and move, leading to less in-field compaction, says Chase Milem, marketing manager at John Deere. With fewer bales to pick up, this baler is designed to help save time, labor, and fuel, and ensure transportation trucks are loaded with as much hay as possible.

The L341R baler has increased plunger force, tension panel pressure, and a bale chamber 18 inches longer than previous models to help provide extra pressure on the bales. This added pressure is applied to the crop as it moves through the baler, and is packed and formed into a bale.

Previous 3x4 baler models were able to produce bales weighing up to 925 pounds. The new L341R can form bales weighing up to 1,200 pounds, around a 30% increase.

This model is equipped with Deere's MegaWide large square baler pickup, which has a low-profile pickup drum with a large-diameter roller baffle. Two options are availa-

ble: The 7.2-foot-wide pickup has the option of standard or premium components, with a tooth-to-tooth width of 76 inches. The 8.1-foot-wide pickup is only available with premium components and has a tooth-to-tooth width of 86 inches.

John Deere is also making new Bale Documentation technology available on large square balers. The Bale Doc application helps farmers track bale weight and moisture, and track that data within the John Deere Operations Center for analysis and permanent record keeping.

"Gathering bale yield data may offer farmers insights into irrigation frequencies and water-volume applied," says Milem. "It also can improve nutrient application plans and provide an estimate on the volume of residue removed from a field. The L341R helps our customers leverage John Deere equipment and technology they may already use, while maintaining the valuable parts and service support they are accustomed to receiving from their local dealer."

Text 18. Tips for Maintaining John Deere Square Baler

Source: <https://blog.machinefinder.com/37178/8-maintenance-tips-for-your-john-deere-square-baler>

John Deere square balers are built to bail hay and other crops while withstanding tough conditions and rigorous use. But just like any other piece of machinery, balers need regular maintenance to run smoothly and efficiently. Proper maintenance not only extends the life of your John Deere square baler but also minimizes breakdowns and downtime to improve your overall productivity. Let's discuss a handful of tips that can keep your baler operating at its best.

Regular square baler maintenance is more than tightening bolts; it's an investment in your machine's efficiency, longevity, and cost-effectiveness. Follow these eight maintenance tips to ensure your baler keeps performing at its best:

1. Maintain and Check Baler Oil: The baler's oil and air filters should be changed regularly, depending on the environment and the baler's level of use. Low oil levels, old oil, incorrect oil, and the presence of contaminants can lead to poor lubrication and compromise the baler's performance. Using the right oil and adhering to the suggested oil change intervals will ensure proper operation and prevent more costly repairs.

2. Observe Proper Cleaning: Cleaning your baler after each use is one of the simplest and most cost-effective ways to protect it. A clean baler is less likely to become contaminated, catch fire, or malfunction. Be sure to clear debris, dust, and crop leftovers, paying special attention to the pickup area and chamber. If you work at a large operation, consider creating a cleaning checklist for your team to follow.

3. Maintain Belts and Chains: Loose or damaged belts and chains can disrupt the baling process and affect bale formation. Check for cracks, tears, proper tension, and alignment. If the belts or chains show any signs of damage, promptly adjust or replace them. By properly maintaining the belts and chains on your baler, you can help to ensure that it operates efficiently.

4. Check Hydraulics and Hoses: Regularly inspect the baler's hydraulic systems, electric cables, and hoses for leaks, cracks, and signs of wear. Hydraulic issues can lead to malfunctions such as knotter system errors and chamber unresponsiveness, which can affect the baler's performance and operator safety. When inspecting the hydraulics and hoses, be sure to check that the auto-lube system is working properly and that the tubes haven't been cut or damaged. Also, regularly change the hydraulic system filters, then run the machine to purge air from the system before use.

5. Make an Inspection Checklist: Daily, weekly, and monthly maintenance is essential for keeping your baler in good condition and preventing serious breakdowns. To stay on top of maintenance needs, create a checklist that specifies the frequency and steps involved in each maintenance task. Your checklist should include tasks related to all key components, such as needles, twine holders, tension springs, and safety shields.

6. Check Chamber Pressure: The correct chamber pressure is vital for bale density and baler performance. Too low and bales are loose; too high and they crumble. Beyond affecting output, improper chamber pressure strains components like belts, chains, and rollers. Regular baler chamber pressure checks and adjustments are essential to safeguard your baler and the bales it produces.

7. Check Knotter System: A malfunctioning knotter system can cause twine jams, misaligned knots, or jammed mechanisms. These problems can disrupt the baling process and require manual intervention, which may not always be possible at the moment while in the field. Proactive maintenance of the knotter system, such as regular inspection, cleaning, lubrication, and knife sharpening, can help prevent these problems and save you from needing a replacement.

8. Observe Proper Storage and Off-Season Maintenance: Properly storing your baler at the end of the season helps prevent deterioration and ensures the baler is ready for use when the next season arrives. Before putting the baler in storage, perform recommended off-season maintenance, clean all baler parts thoroughly, and apply a protective coating. Then, store in a dry, sheltered area to prevent moisture damage.

Text 19. Hay and Forage Raking, Mowing, Tedding, Baling and Handling Equipment for Boosting Efficiency

Sources: <https://blog.machinefinder.com/31409/frontier-hay-and-forage-equipment>,
<https://www.deere.com/en/hay-forage/>

When you're on the hunt for new hay and forage equipment to help you out in the field, you know you can rely on John Deere to provide you with all of the machinery you require. Whether you need a wheel rake or a bale wrapper, Deere has the piece you need to ultimately boost your efficiency. Let's take a look at some pieces of hay equipment you can consider as you shop to suit your needs.

– **Heavy-Duty Wheel Rake:** Rake more hay in less time with this wheel rake, which has large, wind-panel rake wheels to gather hay quicker and more efficiently.



– **High-Capacity Wheel Rakes:** This high-capacity wheel rake can engage nearly any type of terrain. When you're finished, the wheel lift cylinders retract so you can place it in the storage position with ease.



– **Rotary Rakes:** Rotary rakes reduce dry-down time while keeping dirt and debris out of your windrows. In the end, this results in higher-quality bales.

– **Hay Tedders:** You can improve feed quality and dry-down time with a hay tedder, which provides thorough conditioning and an even distribution of all types of hay.



– **High-Capacity Carted Wheel Rakes:** These machines provide a fast raking speed without sacrificing performance to maximize hay quality.



– **Carted Wheel Rakes:** The floating arms of these rakes enable the rake wheels to follow ground contour. Adjustable ground pressure allows each rake beam to adapt to different crops as it works.

– **Disc Mowers:** With a disc mower, you can get a cleaner, even cut over rough ground. In addition, this particular model is iMatch and Quick Hitch compatible, meaning attachments can be connected and disconnected in little to no time.



– **Disc Mower Caddy:** This caddy makes mower hook up easier when it's time to cut the grass. You can level the caddy to fit your tractor, and set the cutting height with a manual turnbuckle.



– **Inline Bale Wrappers:** Inline Bale Wrappers have fully automatic cycling and a film wrap sensor. They can ultimately protect bales from harsh weather.



– **Bale Carriers:** Bale carriers come with adjustable bale arms and only require two hydraulic selective control valves. They also have a 45-degree dumping angle, which makes it quicker and easier to move multiple bales.



– 3-Point Bale Handler and Bale Unroller

The 3-Point Bale Handler simplifies moving round bale hales around the lot. The hydraulic Bale Unroller can also haul and unroll round bales for feeding.



– Bale Spears

Customers can choose from a wide range of single- and triple-tine models to move and stack their bales quickly and more efficiently.



– Sickle Bar Mowers

Sickle Bar Mowers will help you mow up or down hillsides with a blade angle that can be adjusted from -45 degrees to 90 degrees.



– **Small Square-Bale Fork**

This fork has 32 engaging teeth for secure transportation of small square bales. It also has an adjustable guide bar that helps you work with multiple bale sizes.



– **Round-Bale Hugger**

This piece of equipment gently grasps round bales to ensure that they maintain their shape and size. It can handle wrapped bales up to six feet in diameter.



Text 20. Hay Tedders and Tedder Rakes

Sources: <https://blog.machinefinder.com/26047/what-is-a-hay-tedder-and-how-do-you-select-the-right-type>,

https://bobruiskagromach.com/en/catalog/harvesting_equipment/rake_tractor/

To start with, let's have an idea about hay tedders and the hay tedding process.

– **What is a Hay Tedder?** A hay tedder is used to spread and fluff hay in a uniform swath after a windrower, mower-conditioner, rake, or some other type of equipment has created a windrow. Speedy drydown are equivalent to high-quality hay. Hay Tedders allow equal distribution for all different types of conditions, largely thanks to flotation tires that help with smooth operation over irregular land. Tine height adjustments also allow operators to match their implements to crop conditions. If wheel rakes are used to collect hay into windrows, hay tedders exist purely to undo that work.

– **What is a Hay Tedder Used For?** A hay tedder is used to spread the hay out so it can dry more quickly. The hay tedding process allows producers to reduce the dry down time and is especially useful for those that live in wet or humid areas, as it allows them to complete the hay baling process faster.

– **How Does a Hay Tedder Work?** When the hay tedder is in use, it feeds the crop into pairs of spinning rotor teeth. Operators should angle the rotors at an upward angle to lift the crop off the ground and float it to the surface.

– **What factors should be considered before making a purchase?**

1. Acreage: Selecting the right hay tedder for your operation should start with considering the size of the land being worked on. Customers that have a small area of land to work on might want to consider a John Deere TD1010E Hay Tedder, while those working across much larger areas may want to think about a model like the TD3427 Hay Tedder. The size of your operation should dictate the tedder working width that's needed to get the job done.



2. Terrain: Depending on the terrain, some hay tedders are a better fit than others. If you're working on a flat piece of land, a TD1010E can get the job done effectively. However, if the land features irregular ground contours, you may want to consider a model like the TD1316, which has an articulated frame that's supported by flotation tires to follow the contours with ease. You will also want to consider the transport width of the hay tedder if you will be moving the equipment from field to field.



With its quick hitch capabilities, as well as its in-cab transport controls, these hay tedders help to streamline your processes. In addition to its quick hitch abilities, the disc mowers have a park stand, as well as a latch convenience system, a shear hub assembly serviceability, and easy-to-operate transport lock systems. Newer tedders include in-cab controls, used to adjust tine pitch height, which allows for simple adjustments in varied terrains and conditions.

3. Conditions: Lastly, those looking to purchase a hay tedder should consider the conditions that they commonly work in. If you work in a variety of unpredictable condi-

tions, you may want to think about purchasing a model like the TD1316, which is best-suited for those operators that need to take on various conditions from day to day.

Now let's consider some examples of tedder rakes produced by Joint Stock Company "Bobruiskagromash", which is one of the leading manufacturers of agricultural machinery and equipment in Europe. Today, agricultural machines manufactured by "Bobruiskagromash" holding operates in more than 50 countries around the world. Although the main volume of manufactured machinery is supplied to the Republic of Belarus and the Russian Federation, these machines successfully help farmers in Europe, Asia, Africa, North, Central and South America.

– **Rotor tedder rakes GVR-630:** They are designed for raking grass from swaths to rolls, tedding grass in the swaths, wrapping, spreading the rolls. The main advantage of GVR-630 rakes design is the versatility of the machine, the ability to perform several operations – raking, tumbling, wrapping of the rolls, its spreading which creates conditions for greater productivity of harvesting machines in subsequent operations.



– **Rotor tedder rakes GVR-420:** These rakes are designed for raking grass, including withered or freshly cut grass from swath to rolls, tinking it in swaths, wrapping, spreading and doubling of rolls. The rakes can be used on high-yielding sown and natural hayfields with a flat landscape with a slope of up to 9 degrees and also for working in small areas.

– **Rotor rakes GR-700P:** These rakes are designed for raking grass, including withered and freshly cut, from swaths to rolls, tumbling it in swaths, wrapping, spreading and doubling of rolls.



The rakes have the following advantages compared to the GVR-630: effective width is increased to 7,0 m.; formation of one swath with 14 m. for 2 passes by "shuttle"; efficiency is improved while tilling by 18%, raking by 36,5% and double-roll forming by 70%; fuel consumption is reduced in 1,2...1,4 times; it is possible to work only with one rotor on inconveniences; it is possible to rake in one or two swaths in one pass.

– **Wheel rakes GK-630:** The rakes are designed for raking a withered or freshly cut grass from swaths to a roll. Rakes has a simple design, low power consumption, high working speed and aggregated with tractors of drawbar category 0,9-1,4.



2.1.3. Tractors

Text 1. Tractor: Definition, History and Types

Source: <https://www.britannica.com/technology/tractor-vehicle>,
<https://www.holtags.com/types-of-farm-equipment-and-their-uses#tractors>

A tractor is a high-power, low-speed traction vehicle and power unit mechanically similar to an automobile or truck but designed for use off the road. The two main types are wheeled, which is the earliest form, and continuous track. Tractors are used in agriculture, construction, road building, etc., in the form of bulldozers, scrapers, and diggers. A notable feature of tractors in many applications is the power-takeoff accessory, used to operate stationary or drawn machinery and implements.

The first tractors, in the sense of powered traction vehicles, grew out of the stationary and portable steam engines operated on farms in the late 19th century and used to haul plows by the 1890s. In 1892 an Iowa blacksmith, John Froehlich, built the first farm vehicle powered by a gasoline engine. The first commercially successful manufacturers were C.W. Hart and C.H. Parr of Charles City, Iowa. By World War I the tractor was well established, and the U.S. Holt tractor was an inspiration for the tanks built for use in the war by the British and French.

Belt and power takeoffs, incorporated in tractors from the beginning, allow the tractor to power the use of mechanized implements and attachments. They were standardized first in the rear-mounted, transmission-derived power takeoff and later in the independent, or live-power, takeoff, which permitted operation of implements at a constant speed regardless of the vehicular speed. Many modern tractors also have a hydraulic power takeoff system operated by an oil pump, mounted either on the tractor or on a trailer.

There are several types of tractors, including the following:

Compact tractors: Compact tractors are small, high-powered tractors that can assist with all the basic functions needed on a farm or home. They are ideal for material handling and working in tight spaces where traditional tractors can't fit.

Wheeled tractors: Wheeled tractors are general-purpose tractors that help you get the most out of your machinery. These utility tractors can meet various demands and be outfitted for tilling, material handling and equipment pulling. Wheeled tractors come with a range of horsepower, lifting capacity, control and cab-style options, allowing you to choose the best option for your applications.

Track tractors: Track tractors are farming vehicles mounted with tracks instead of tires, allowing them to plow fields with more power while providing a smoother ride for the operator.

Specialty Crop tractors: Specialty crop tractors are designed, or can be specially adapted, with features to work optimally in orchards and vineyards. These slender tractors can more easily fit between lines of trees and vines while still providing the power needed for landscaping and maintenance.

Attachments and implements allow tractors to become universal machines capable of getting anything done.

A large number of tractor implements have been developed for a wide range of uses. In agriculture, key tractor implements include harrows and cultivators for weed control, seed drillers and broadcast seeders for sowing crops, transplanters for transplanting young plants into a field, spreaders for fertilizers and seeds, balers for hay and straw, sprayers for irrigation and pesticide application, and any number of other specialized tools. Some combines, used for cutting and threshing grains, are also tractor-pulled. Additional tractor implements are common in industry, grounds keeping, and construction. A simple box blade attachment is used to dig into the ground and then spread out the material into a flat, level layer, such as for a gravel path; a rear blade attachment is used similarly. Mowers, or cutters, cut grass, weeds, and other vegetation to a manageable height. Front end loaders have moveable arms and a variety of tools for scooping and lifting; pallet forks are common. Other attachments include post-hole diggers, snowblowers, and rotary tillers.

Most modern tractors are powered by internal-combustion engines running on gasoline, kerosene (paraffin), LPG (liquefied petroleum gas), or diesel fuel. Power is transmitted through a propeller shaft to a gearbox having 8 or 10 speeds and through the differential gear to the two large rear-drive wheels. The engine may be from about 12 to 120 horsepower or more. Until 1932, when oversize pneumatic rubber tires with deep treads were introduced, all wheel-type farm tractors had steel tires with high, tapering lugs to engage the ground and provide traction.

Crawler, caterpillar, or tracklaying tractors run on two continuous tracks consisting of a number of plates or pads pivoted together and joined to form a pair of endless chains, each encircling two wheels on either side of the vehicle. These tractors provide better adhesion and lower ground pressure than the wheeled tractors do. Crawler tractors may be used on heavy, sticky soil or on very light soil that provides poor grip for a tire. The main chassis usually consists of a welded steel hull containing the engine and transmission. Tractors used on ground of irregular contours have tracks so mounted that their left and right front ends rise and fall independently of each other.

The tractor is ubiquitous in the farming world and comes in various sizes to fit any farming operation. The primary purpose of a tractor is to pull farm equipment, but modern tractors can be outfitted with multiple attachments to suit just about any farming need. For this reason, tractors are common-sense purchases for small and large-scale farmers alike.

Text 2. Benefits of Tractors in Farming and Agriculture

Source: <https://www.fieldbee.com/blog/benefits-of-tractors-in-modern-farming-and-agriculture>

A tractor is an agricultural machine used for the mechanization of agricultural work such as tillage. However, the tractor has come a long way since its humble launch in the 19th century as a steam engine on wheels. Today tractors for farming are used for plowing, cultivating the soil and planting fields. Modern types of tractors can be used for a variety of tasks including shrubs, landscaping, moving or spreading fertilizer, and lawn maintenance. And with the help of precision farming technologies and digital equipment, the range of tasks and capabilities of modern tractors has become even wider. Whether

you prefer to just work on the lawn and in the garden or on the farm, you will find out that using a tractor makes the job easier. This article discusses the very best benefits of tractors for agricultural mechanization, gardening, or earthmoving.

– **A Wide Range of Types of Tractors:** There is a wide selection of types of tractors, each suitable for a specific business:

- ✓ A hydraulically driven tractor to work in a garden, a wide area or a pasture.
- ✓ A small or compact tractor is suitable for landscaping and digging work.
- ✓ A subcompact tractor is a smaller version of a tractor. It has the power and versatility to do a variety of works such as transporting compost, mowing the field and cultivating the soil. It is a kind of auxiliary tractor and is great for landscaping.
- ✓ An auxiliary tractor for running on a small farm to mechanize agricultural work.

Depending on the purpose, tractors have significant differences in agriculture and are divided into the following types: agricultural; industrial; skidding; and army. We do not consider army vehicles in our article. While other options are highly required in ag. The agricultural tractor itself is a must for a farm. The main requirements for tractors in agriculture, based on seasonality and size of cultivated areas, are as follows:

- ✓ The ability to change attachments or trailed equipment quickly;
- ✓ The ability to work and move at high speeds while maintaining performance with other machines at minimum speeds;
- ✓ The ability to unify connecting devices;
- ✓ The possibility to be serviced and repaired in the field.

Industrial tractors are the basic machines in an earthmoving or construction machine. A skidder is a tractor that is usually built on the basis of an agricultural tractor and differs only in the layout, which allows the platform to be placed on the rear of the frame. The cab and the engine of such a tractor are placed in the front, and behind is a platform that serves for forest skidding. The main characteristic that distinguishes the skidder from other types of tractors is the undercarriage with a large supporting area, which reduces the effect of erosion on the forest floor. General-purpose tractors come in a variety of models. There is also a wide range of agricultural implements that can be connected to auxiliary tractors to help carry out many different tough works on the farm. In particular, these are loaders or rear hoes for a much wider range of performances

– **Modern Equipment Used to Operate the Tractor:** It is worth mentioning the new technologies, which tractors benefit from. First of all, these are GPS and RTK. They allow:

- ✓ Creating routes for the tractor and *возможно* adjusting them to the vehicle.
- ✓ Carrying out automatic steering for accurate row guidance.
- ✓ Controlling the amount of fuel usage and lubricants.
- ✓ Monitoring the tractor's, working hours and idle times tracking its route and deviations.

The reliability and high maneuverability of the tractors, combined with precision farming technologies, make them a versatile farmer's assistants. No matter how the machine-building develops, there is still no replacement for tractors.

Text 3. Uses of Tractor in Agriculture

Source: <https://tractorgyan.com/tractor-industry-news-blogs/865/importance-of-tractors-for-farmers-in-india>

Tractors are an integral part of farming in India. They have revolutionized the way farming is done in the country and have helped farmers in many ways. In this article, we will discuss the importance of tractors in India for farmers, how they can use them and the advantages of the tractors.

– **Role of Tractors for Farmers in India:** Tractors have been the most important asset for agriculture and commercial purposes since their inception. With constant innovation and development, agriculture tractors have helped millions of farmers from manual labour and have also boosted agricultural productivity to a great extent.

Tractors are capable of boosting farming productivity more efficiently and rapidly as compared to manual ploughing. They can plough 12 acres in the same time duration as one acre of manual ploughing. Tractors eliminate the need for human labour and also save the time and cost of farmers. Tractors with the use of the right farming equipment, high-quality seed, and right fertilizers can increase the productivity of farmers to a great extent which increases the importance of tractors in agriculture.

In addition, tractors used with tractor implements like rotavators, power tillers, and combined harvesters can extensively save costs and provide a high-quality yield to farmers. Mechanization of farmland with the right tractor and equipment is a profitable step to grow crops and grains large enough to fulfil the needs of a growing population.

– **Uses of Tractor in Agriculture:** Tractors are one of the most versatile and useful machines for farmers in India. They have a wide range of applications across various sectors and can be used for multipurpose applications. Tractors have revolutionized the way farming is done in India and have helped farmers in many ways which led to the increasing importance of tractor uses in agriculture. Some of the uses of tractors for farmers include:

1. **Ploughing:** Tractors are primarily used for ploughing and preparing the land for cultivation. Tractors with ploughing attachments can easily turn over the soil, removing unwanted vegetation and weeds to provide a clean and fertile surface for sowing.

2. **Tilling:** Tractors can be used for tilling the soil, which is the process of breaking up the soil into small clumps to create an ideal seedbed. Tractors with tillers can break up the soil, remove rocks, and create a smooth surface for planting.

3. **Harrowing:** Tractors can be used for harrowing, which is the process of breaking up clods of soil and creating an even surface. Tractors with harrows can help farmers prepare the land for planting by smoothing out the soil and removing any unwanted debris.

4. **Sowing:** Tractors can be used for sowing, which is the process of planting seeds into the prepared soil. Tractors with planting attachments can easily plant seeds in rows or broadcast them across the field.

5. **Harvesting:** Tractors are also used for harvesting crops. Tractors with harvesting attachments, such as combine harvesters, can easily cut, thresh, and clean the crops, making the harvesting process more efficient.

6. **Hauling:** Tractors can be used for hauling heavy loads, such as crops, fertilizers, and equipment. Tractors with trailers can easily transport these loads, making it easier for farmers to move their products from one place to another.

7. **Landscaping:** Tractors can be used for landscaping tasks, such as levelling land, digging trenches, and removing trees. Tractors with bulldozer blades or backhoes can easily perform these tasks, making it easier for farmers to prepare their land for cultivation.

Hence, tractors are an essential asset for farmers in India, providing them with a range of uses that have revolutionized the farming industry. Tractors can be used for ploughing, tilling, harrowing, sowing, and harvesting. They can also be used for hauling heavy loads, landscaping tasks, and more. With their constant innovation and development, tractors have made farming a more efficient and profitable enterprise for farmers in India. Moreover, tractors' PTO also plays a significant role in operating stationary or drawn machinery and implements.

– **Benefits from Tractors for Farmers:** Tractors are an essential asset for farmers in India and have provided numerous benefits to farmers. Some of the benefits of tractors for farmers in India include:

1. Increased farming Productivity: Tractors are capable of boosting farming productivity much more efficiently and rapidly as compared to manual ploughing. They can plough 12 acres in the same time duration as one acre of manual ploughing. Tractors eliminate the need for human labour and also save the time and cost of farmers. With the right farming equipment, high-quality seeds, and chemical pesticides, tractors can double the productivity of farmers to a great extent.

2. Reduce production costs: Tractors have helped farmers in reducing production costs to a great extent. Tractors can efficiently accomplish tasks in less time when compared to manual labour or hiring human labour, which can cut down the daily cost of farmers.

3. Time-saving: Tractors save a lot of time for farmers by accomplishing their tasks in less time and making them available for other work. For example, a rice plantation takes more time when you plough the land manually, costing you more money and time. A tractor can plough your land faster and more efficiently rather than using manual tools like hoes.

4. Easy to operate: Tractors are one of the most user-friendly machineries that act as the best ploughing tool. A tractor requires you to just start the engine, run through your fields, and direct it accordingly to the soil you want to loosen. It can overcome your most complex farming tasks more seamlessly.

5. Improves soil: Tractors can even help in providing better soil yields. For example, when you use a tractor with equipment, the soil that is loosened is deeper, resulting in better soil structure and better soil yield. Therefore, a crop planted also provides a quality yield. On the other hand, if you use a hoe, the soil loosening process needs to provide the needed results.

6. Versatility: Tractors are versatile machines that can be used for a wide range of applications across various sectors. They can be used for ploughing, tilling, harrowing, sowing, harvesting, hauling, landscaping, and more. This versatility makes tractors a valuable asset for farmers in the agriculture sector.

7. Suitable for Small and Large Farmlands: Tractors can help you work on hectares of land in less time. Moreover, tractors can even efficiently work on smaller lands as well. This is because tractors are available in different sizes and horsepower. Therefore, choosing the right tractor according to your farm is essential when buying a tractor.

Tractors have helped millions of farmers to overcome the laborious and time-consuming manual work involved in agriculture. They have significantly boosted agricultural productivity and efficiency, making farming a more profitable enterprise.

Text 4. Tractor Production in Russia

Sources: <https://russian-farmland.com/tractor-made-in-russia.html>,

https://sar.rostselmash.com/products/tractors/2000_335_375,

<https://dzen.ru/a/XZWUHAzlewCust3x>,

<https://www.volgogradagnosnab.ru/shop/selkhoztekhnika/traktory/kolyosnye/terrion-atm-7360/>,

<https://ru.wikipedia.org/wiki/%D0%9A-744>,

https://ru.m.wikipedia.org/wiki/Файл:Трактор_КАМТЗ_ТТХ_215.jpg,

<https://vgtz-promtraktor.ru/products/traktoryi-dt-75/traktor-dt-75>,

<https://vigma.ru/traktor-t10m/>,

<https://petrazst.ru/catalog/тракторы-сельскохозяйственные/145-трактор-непра-зсм-390-390.html>,

<https://grainboard.ru/brand/k-707-t-baltiec-1360>

Since the times of the Soviet Union, the production of tractors has been established in Russia, Ukraine and Belarus. The most popular tractor in Russia is, of course, “Belarus” (made in Belarus). But today we will talk about our own tractor production in Russia, and we will voice the first ten of such companies, and, of course, we will not forget the foreign manufacturers supplying their products.

1. Rostselmash located in Rostov-on-Don. The leader in the production of agricultural machinery combines, tractors, mowers. Produces a full range for the care of arable land and pastures. And this is a company with a long history, the first rake, plows and seeders were produced by the plant in 1929. The Rostselmash Versatile 2375 is a state-of-the-art tractor with a Cummins engine.



2. Agromash headquarters in the city of Cheboksary. Large tractor brand, part of the concern "Tractor Plants". It was founded in 1972. Cheboksary industrial tractor plant. There are branches at other plants of the holding in Vladimir and Volgograd. The most popular model is the Agromash-180TK universal tractor.

3. Terrion headquarters in St. Petersburg and production in Tambov. The brand of the company "Agrotechmash", which makes combines, special equipment and, of course, a tractor. The company appeared in 1997, started as a dealer of foreign technology, and in 2002 introduced the first own tractor, developed jointly with German partners. One of the main models of the company, Terrion ATM 7360.



Agromash-180TK universal tractor



Terrion ATM 7360

4. "Kirovets" headquarters in St. Petersburg. The legendary Soviet brand, founded as a Kronstadt iron foundry in 1801. Tractors built since 1924, now works under the brand of a subsidiary of JSC Petersburg Tractor Plant. Now the fifth generation of Kirovets tractors has appeared, a model of the K-744R series. This model is produced with engines of Mercedes-Benz, TMZ and YaMZ.



K-744R



KAMTZ TTX-215

5. KAMTZ headquarters and production facilities in the city of Naberezhnye Chelny. The Kama Tractor Plant makes tractors under the brand of TTX, which stands for "Tractors of your farm". The most popular model is the universal tractor KAMTZ TTX-215.

6. VTZ production facilities are located in the city of Volgograd, better known as Stalingrad. Entering the concern "Tractor Plants", founded in 1930, the Volgograd Tractor Plant makes the tractor "Agromash" and various attachments. In the main line, the VTZ DT-75 tractor is produced under its brand.



VTZ DT-75



T10

7. ChTZ main power and headquarters in the city of Chelyabinsk. The Chelyabinsk Tractor Plant was founded in 1933 and mainly produces bulldozers, loaders, pipelayers, and so on. In the line there is one tractor T10.

8. "Altrak" production facilities are located in the city of Rubtsovsk in the Altai. The plant "Altai Tractor" specializes in forestry equipment for various purposes, as well as equipment for various needs of heavy engineering. One of the directions is a tracked tractor for agricultural purposes. The plant was founded in 1941, the main model of the tracked agricultural tractor "Altrak T-501".



9. Petra-ZST headquarters in St. Petersburg. The company, founded in the northern capital in 2003, today produces various road construction equipment, snow plows and several varieties of agricultural and industrial tractors. The main model of the "Peter-ZST 390", a universal tractor.



Peter-ZST 390



Baltiets K-707T

10. Baltiets headquarters in St. Petersburg. The plant and brand appeared in 2000, first produced attachments, and since 2006, and its own tractor. Today Baltiets makes forest, airfield, communal and other equipment of a very wide range. The basic model of the agricultural tractor general purpose "Baltiets" K-707T with engine YMZ.

We should also mention that JOHN DEERE and CLAAS are working in the fields of Russia.

Text 5. Rostselmash Series 3000: High Performance

Source: <https://en.rostselmash.com/products/models-ktk/seriya-3000/>

RSM 3000 tractors are powerful machines for energy-consuming operations. Full-scale production of these tractors started in March 2019 and is represented by four models with output of 440 h.p., 492 h.p., 542 h.p. and 583 h.p. – RSM 3435, 3485, 3535, 3575. Rostselmash is the only manufacturer in Russia and CIS countries which produces tractors with output power more than 430 h.p., and RSM 3575 is the most powerful agricultural tractor manufactured in Russia.

The choice of Series 3000 tractor is economically sound for farms having tilled land area of at least 2,500 ha. It is reliable and well-balanced tractor, and its performance characteristics comply with actual situation in the agricultural sector. High performance results in a reduced number of passes per hectare

(including fuel consumption and labour costs), while the standard dual-tyre configuration reduces the ground pressure, meaning less damage to the most fertile top soil layer.

High performance includes:

- **High power and torque backup:** Thanks to large engine volume, power backup of 26 h.p. to 45 h.p. and torque rise of 35 % Rostselmash tractors can efficiently operate in the most severe conditions.

- **Automatic transmission:** All Series 3000 models come with robust TA22 automatic transmission as standard. The transmission uses power shifting.

- **Large number of gears:** The transmission includes 16 forward gears in the speed range of 2.5 to 40 km/h and 4 reverse gears.

- **Powerful engines:** When designing the full-wheel drive tractors, we chose Cummins QSX engines to optimise power, torque, engine speed to match current field loads. The turbocharge and the charge air cooling ensure as clean and complete fuel combustion as possible. The injection system with pump-injectors and an electronic control unit allows promptly reacting to changes in load and throttle valve position. The electronic control module with the programming function allows to determine the most economical and optimal operation parameters for the engine during the soil tillage or seeding.

- **Axles:** Durable axles equipped with unique outboard planetary gears are designed to withstand high loads. They allow installing dual and even triple wheel systems. The planetary gears transfer all available power through the large precision helical gear. Planetary hubs are suspended on large bearings attached directly to the axle beam. The entire load is supported by the axle beam, rather than the driven components. All axles on Rostselmash tractors have a standard option of forced locking for front and rear differentials.





Cummins QSX engine

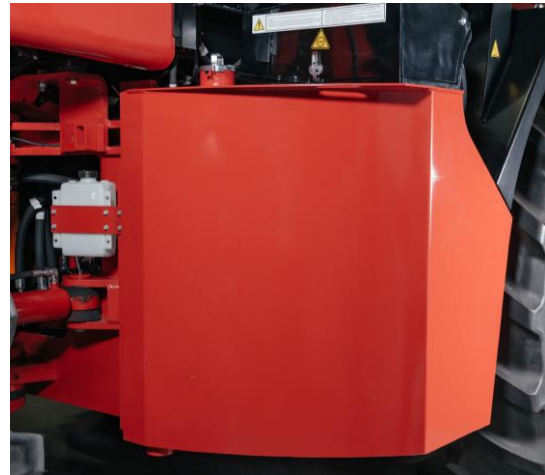


Durable axles

– **Articulation of frame sections:** Articulated tractors have 10-15% higher field operation efficiency as compared with conventional tractors having similar power. This is possible owing to combination of equal wheels for front and rear axles, optimum load distribution and two frames capable to follow terrain in the range of 30° in up and down direction. The design of the articulation joint on Rostselmash tractors has proven its durability and ease of maintenance.



Articulation joint



Fuel tank

– **Fuel tanks:** Large fuel tanks with total capacity of 1,325 litres are designed for 20 hours (2 shifts) of autonomous operation.

– **Wheels:** To achieve maximum performance of ROSTSELMASH Series 3000 4WD tractors, using of dual wheels is recommended. You will benefit from an increased grip, a better floatation in muddy conditions, a ground pressure that is twice as low as with single wheels, and all this has a good effect on the performance and fuel consumption. The tractor with dual wheels will not harm the soil which will pay back in an increasingly more uniform crop emergence from season to season. Dual wheels are included in basic configuration of ROSTSELMASH Series 3000 4WD tractors. Models 3435 and 3485 are offered with 710/70R42 wheels (710 mm tread), and more powerful 3535 and 3575 machines come with 800/70R38 wheel (800 mm tread).

– **Hydraulic system:** The closed centre load sensing hydraulic system provides the required pressure for efficient operation of implements. When there is no demand, the system operates in an economical low-pressure mode, building up a reserve to deliver all power. The RSM 3000 tractor basic configuration includes the hydraulic system with the

capacity of 208 l/min that has four sets of ½” ready-for-use couplers, set of 1” couplers and a 3/8” zero-pressure return line coupler. Such capacity and configuration are sufficient for steady operation during sowing with most of commercially available seeders.



Closed Center Load Sensing



Hydraulic System

– **High-capacity hydraulic system:** For hydraulic-demanding sowing systems we propose versions with improved hydraulic system capability of 303 l/min that includes six sets of 1/2” ready-for-use couplers, 1 set of 1” couplers and 3/8” zero-pressure return line coupler.

– **Rear 3-point hitch (with EHR):** The rear 3-pt hitch is an option that can be installed at the factory. The hitch is designed to accept Category IV implements. Load carrying capacity at 610 mm behind the suspension axis of lower lift links is 6,800 kg. This is an electrohydraulic system with an electronic position control feature (EHR) that is required to maintain the working depth of implements. Basic configuration also includes the slip control function that is responsible for automatic control of the hitch implement depth depending on the slip coefficient of tractor wheels. This feature makes it easy for the operator to operate under difficult soil conditions such as excessively wet soil, uneven rough terrain, deep working depth, etc.



Rear 3-point hitch



Drawbar

– **Drawbar:** The tractor drawbar with the maximum allowable vertical load of 4,082 kg and a 51 mm pin (CAT IV) maximizes efficiency of operation with trailed implements. The drawbar attachment point located close to the tractor’s centre of gravity provides the best distribution of axle load, 50/50. This offers an appreciable saving of fuel. Heavy-duty drawbar with the maximum allowable vertical load of 5,443 kg and a 70 mm pin (CAT V) is available as an option.

Text 6. Rostselmash Series 3000: Comfort Features

Source: <https://en.rostselmash.com/products/models-tkt/seriya-3000/>

As to comfort key features of RSM 3000 tractors, they include:

– **Cab:** RSM 3000 tractor has one of the most spacious cabs in the class.

A comfortable two-seat cab in RSM 3000 with high-quality furnishing, low noise levels, careful ergonomics and practical materials allows for operating the tractor during 10-12 hours per shift without excess fatigue.



- ✓ the steering column can be adjusted by tilt and reach;
- ✓ heater and climate control system;
- ✓ semi-active pneumatic operator's seat;
- ✓ wide variety of seat settings and adjustment options (11);
- ✓ tractor control console with multi-function joystick;
- ✓ 8.7" colour touch screen with integrated dashboard;
- ✓ cooled locker compartment (for 1.5 l bottle);
- ✓ numerous pockets for storing bottles with drinks (0.3 l to 2 l);
- ✓ audio-ready;
- ✓ electrically driven and heated rear-view mirrors;

– **Armrest with integrated control panel:** The armrest also has the buttons of cruise-control, activation of the automatic transmission mode, activation/deactivation of the differential lock, lifting/lowering of the 3-point hitch (option), activation of the PTO shaft (option).



Armrest



Automatic constant ground speed system

– **Cruise control:** The automatic constant ground speed system maintains a preset value of engine speed. This function allows operating at an optimum engine speed mode, irrespective of the position of the throttle control lever.

– **Multi-function control joystick:** The joystick helps shift gears, select the transmission operation modes, control two sections of the hydraulic control valve, rear hitch or headland control.

– **Colour touchscreen:** 8.7" high-resolution colour touchscreen in a dust-proof IP50 housing is easy to read, it displays all information on functioning status of tractor systems and supports the following features:

- ✓ electronic instrument cluster;

- ✓ performance and fuel consumption;
- ✓ engine load;
- ✓ sensor readings, calibration;
- ✓ service intervals;
- ✓ setting hydraulic distributors and rear hitch;
- ✓ headland setting;
- ✓ integrated MP3 media player and radio;
- ✓ integrated GPS tracker.



Joystick



Colour touchscreen



Locker compartment

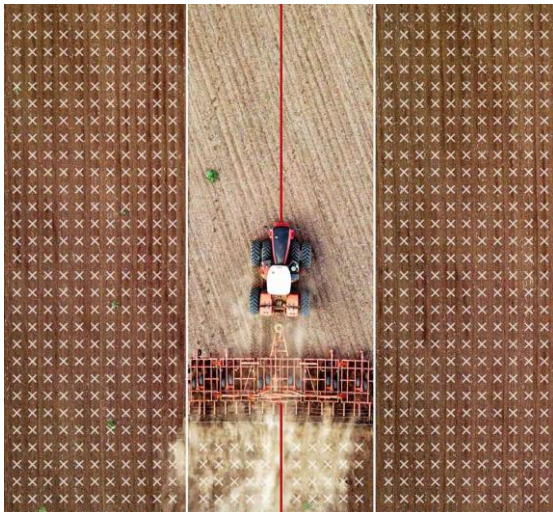
– **Cooled locker compartment:** Now a bottle of water will always be cooled, even during the hottest season.

Text 7. Rostselmash Series 3000: Attention to Details and Options

Source: <https://en.rostselmash.com/products/models-tkt/seriya-3000/>

A lot of attention is paid to details and options in RSM 3000 tractors.

– **Autopilot:** Rostselmash tractors can optionally be fitted with a GPS/GLONASS automatic guidance system. The autopilot will improve tractor's productivity by 10% by minimising gaps and overlaps during tillage operations, and eliminate the risk of overly dense sowing when using seeding systems. The tractor is compatible with both an electric autosteer and a more precise steering system via a hydraulic valve. The last-mentioned option is available for ordering as a factory-installed equipment. Factory pre-installed hydraulic autopilot provides a wide range of precision agriculture functions (including ISO-BUS, support of RTK and RTX, mapping and variable seed/fertiliser application, automatic turning, etc.). These functions are unlocked at the Customer's request.



Autopilot



RSM Agrotronic

– **RSM Agrotronic:** All the RSM Series 3000 tractors are supplied with the proprietary Agrotronic remote satellite monitoring system onboard (the system includes fuel level sensors, a GPS tracker). The features of the system include:

- ✓ tractor travelling and operation monitoring;
- ✓ operation parameter analysis;
- ✓ fuel filling/draining monitoring;
- ✓ error notifications.

All operating parameters can be monitored from the computer or using the application for Android OS / I OS smartphones.

– **Speed radar:** The speed radar is included into basic configuration of RSM Series 3000 tractors. It displays actual ground speed of the tractor so that the operator can check the wheel slip factor in real time.



Speed radar



Fuel filter separator

– **Fuel filter separator:** The auxiliary fuel filter (filter separator) is included into basic configuration of ROSTSELMASH tractors. When the engine runs, the primary fuel filter and the auxiliary on-engine filter separator remove water and solid impurities that can be present in the fuel system, thus reliably protecting the engine against damage to the diesel fuel system and preventing dirt formation. To drain the primary fuel filter, one shall open a small plastic valve on the filter bottom.

– **Reversible fan:** The standard configuration of 3575 model tractors includes a reversing fan to automatically blow off dust and crop remains from the radiators by means of reversing the rotation direction of blades.



Reversible fan



Battery disconnect switch

– **Battery disconnect switch:** The battery disconnect switch can be used for quick isolation of tractor circuits from the batteries.

– **Maintenance:** Among other similar machines, Rostselmash tractors are the best in terms of convenience and ease of maintenance:

- ✓ all lubrication points can be accessed from ground;
- ✓ every reservoir holding any fluid is equipped with sight gauges;
- ✓ filling necks of fuel tanks are located on the both sides of the tractor and can be accessed from ground;
- ✓ air filters can be accessed from ground;
- ✓ side hood panels on the tractor open up easily providing access to belts, alternator, starter and air conditioner compressor;
- ✓ the front grille can be opened outwards providing access to the cooler package that, in its turn, is opened like a book for maintaining the evaporator of the air conditioner condenser, hydraulic oil cooling radiator, engine coolant radiator, fuel cooling radiator and intercooler;
- ✓ you will need minimum time to complete the per-shift service procedure.

– **Power Beyond:** This optional kit is required for ensuring normal operation of certain sowing systems (for example, systems equipped with hydraulic-actuated seed-meter device of the grain tank or automatic steering wheels of the seeder). Power Beyond function ensures maximum hydraulic flow from the hydraulic pump to the seeder by-passing the hydraulic valve. It includes two 1-inch couplers and a coupler for LS line.



Power Beyond kit



Rear power take-off shaft

– **Power take-off shaft (option):** Rear power take-off shaft (option) rated for 1,000 rpm is available as an option. It is supplied with the 20-spline shaft end and shaft diameter of 45 mm.

Text 8. John Deere Updated 7R Tractors

Source: <https://www.agriculture.com/machinery/tractors/john-deere-7r-tractors-updated-for-2020>

The updated model 7R tractors from John Deere include a new, higher horsepower model, more technology, and larger cab. This family of tractors includes seven models ranging from 210 to 330 in horsepower. These machines were designed especially for diversified crop farmers, livestock producers, and commercial hay growers.

"New 7R tractors deliver high-horsepower capabilities in a compact, easy-to-manuever chassis," says Tammy Lee, marketing manager for Deere. "The latest updates strengthen dependability and simplify routine maintenance and service work while adding new technology."

The updated 7R tractors will follow a new naming convention. The three-digit number corresponds to the horsepower of each tractor. A seventh model has been added to the top of the size range of this family.

- ✓ The 7R 330 has been added to this tractor family and is the largest size offered.
- ✓ 7310R is the 7R 310
- ✓ 7290R is the 7R 290
- ✓ 7270R is the 7R 270
- ✓ 7250R is the 7R 250
- ✓ 7230R is the 7R 230
- ✓ 7210R is the 7R 210

Deere designed the new 7R family with increased dependability in mind. The company says hydraulic and electrical routings have been improved over previous models. The 7R tractors have more common parts with other tractors to make parts replacement cheaper and faster. Several components have been relocated for improved access. Deere designed this line of tractors with simplified systems and improved on-board diagnostics for shorter down times.



Deere designed this line of tractors with simplified systems and improved on-board diagnostics for shorter down times.

Lee adds, "The number of hydraulic connections were reduced, decreasing the number of potential leak points. A new decal was placed inside the tractor's hood panel with service and maintenance points clearly identified to make these tasks easier to perform."

The short wheelbase and high maneuverability of these tractors make them an attractive choice for seeding, loader work, or baling. An e23 PowerShift transmission is standard and is designed to handle sudden, high-torque power loads while being responsive, quick, and smooth shifting. This transmission has three modes to automate gear selection and RPMs so the operator can keep up the ground speed they want based on load.

An optional Infinitely Variable Transmission (IVT) is also available. When a tractor is ordered with IVT, it can be upgraded to include CommandPRO. CommandPRO is an ergonomic multi-function lever that includes controls for tractor speed, direction, and implement control. It also includes 11 reconfigurable buttons, that can be assigned appropriate functions for the task at hand.

"The precise speed control of CommandPRO makes implement hookups easy and allows you to accelerate from zero to top speed with the push of a lever – perfect for road transport," says Lee.



John Deere 7R tractor planting

Farmers can be comfortable for longer, thanks to the new, largest ever cab from Deere. The new cab offers two extra inches of headroom and a 24% wider entry path, so it's easier to get in and out of the machine. Inside the cab operators will find many conven-

iences they may be used to in their truck. The company offers three levels of cab packages including Select, Premium, and Ultimate. The Ultimate cab features a new electronically adjusted leather seat. This seat has heating, ventilation, and massage capabilities to keep operators comfortable all day or night. This top-of-the-line cab package also includes a leather-wrapped steering wheel, footrests, and a carpeted floor mat.

As part of the Ultimate cab, operators can connect their smartphone to a 6.5-inch touch screen display and multi-speaker system that puts podcasts, music, and more at their fingertips. The cab suspension system of the 7R tractors has also been changed. The previous hydro-pneumatic cab suspension system has been replaced with a mechanical system. Lee says, "This change was made without sacrificing current comfort and performance levels. For customers who demand an even smoother ride and higher levels of industry-leading comfort, they can add either a new ActiveSeat II or our proven Triple-Link Suspension Plus."

Farmers can also choose from three visibility packages. The Ultimate package was designed for efficient nighttime operation and features 22 work LED and 8 convenience LED lights. This is double the lighting package of previous models. This top-of-the-line lighting package offers 360 degrees of lighting coverage and is especially useful when servicing equipment.

The Ultimate visibility package also includes electric, heated, telescoping mirrors; front, right, and rear wipers and sunshades; and integrated cameras in the front and rear of the tractor.



John Deere 7R tractor lighting package

These updated tractors are compatible with the latest John Deere precision technology. "John Deere made several precision ag technology updates that make it easier for customers to remotely monitor and manage tractor and field operations and to enable more timely transfer of prescriptions and data," says Lee.

All 7R tractors come with an integrated Gen 4 4600 CommandCenter display, StarFire 6000 integrated receiver, and AutoTrac activation. The receiver doesn't require calibration of the Terrain Compensation Module and is more accurate than previous models. The company also designed it to be less vulnerable to theft.

"Coupled with the guidance system enhancements that were made, operators will be up and running with even greater accuracy in less time," Lee says. She adds, "Additional premium or automations are available so customers can upgrade and choose the level of accuracy they prefer. A full suite of John Deere technology is included for the seamless integration of automation, documentation, and connectivity through the John Deere Operations Center. This includes JD Link with five years of service, John Deere Connected Support, Expert Alerts, Remote Display Access and Wireless Data Transfer."

Text 9. The 2025 9RX Series Is John Deere's Biggest Tractor Yet

Source: <https://www.agriculture.com/the-2025-9rx-series-is-john-deere-s-biggest-tractor-yet-8600115>

The new 9RX tractors increase productivity by 100 acres per day compared to previous models, according to John Deere. With a maximum engine power of 830 hp, the Model Year 2025 John Deere 9RX four-track tractor is the company's most powerful yet.

The 2025 9RX is a ground-up redesign of Deere's 9RX series for its higher horsepower capabilities to achieve lower operating costs per acre, says Michael Porter, large tractors go-to market manager for John Deere.

With increased performance, the 9RX series enables farmers to eliminate passes, reducing soil compaction, and increasing productivity by 100 acres each day compared with previous models, Porter says. This is based on John Deere's internal testing, comparing the 2023 9RX 640 tractor pulling a 2680H high-performance disk at 11.9 mph with the new 9RX top-of-the-line 830 tractor pulling the same tool at 13.4 mph, both at maximum power for eight hours a day at 4 inches deep in cornstalks.

– **Performance:** Deere offers the 9RX series in three models: the 710, 770, and 830; each number correlates with the tractor's rated horsepower. The tractors are built with in-line six, 6-cylinder JD18 engines, and 515-gallon fuel tanks. The JD18 is a single-fluid engine (strictly diesel fuel) requiring no diesel exhaust fluid (DEF). Deere estimates this can save a farmer up to 800 gallons of DEF per year.

The 9RX series uses the e21, 21-speed transmission with Efficiency Manager. Farmers select a traveling speed, and the transmission shifts and manages RPMs to maintain the speed. Porter says the transmission is quick to accelerate, for a smooth and responsive ride.



An optional triple pump gives the 9RX series a hydraulic flow up to 168 gallons per minute. For implements with high hydraulic needs, Deere can build the engine with optional Intelligent Power Management, adding a 40-hp bump. The 830 can achieve up to 3,123 pound-feet of torque at 1,400 RPM. The 9RX series has a category 5 drawbar, with a maximum vertical load of 19,000 pounds. The high power means the tractors can pull double the cart load of previous models, while going 1 mph faster on average, Porter says. This can help reduce refilling time, translating to more time in the field.

The new series has a base weight of 74,000 pounds, with a maximum ballast of 84,000 pounds. John Deere has forgone traditional suitcase-style weights, traded out for forklift-ready mono weights to expedite adding or removing the ballast.

– **Handling:** These new four-track 9RX tractors have a 15.2-foot wheelbase, and a 22.3-foot turning radius from the rear axle centerline. The series uses Camso Ag 3500 tracks at 30 inches wide, with 88 inches of tread spacing. Optional Camso Ag 6500 tracks are available at 36 inches wide, with 120 inches of tread spacing.

– **Cab experience:** The 9RX series is built with the new CommandView IV Plus cab, with 15% more floor space compared with previous models, and 20% more visibility on the right side, thanks to the removal of the wheel well.

The new cab suspension system has three degrees of freedom, allowing the cab to pivot independent of the rest of the tractor; the passive air seat provides a smoother ride. The seat in the Select cab package swivels 8° to the left and 40° to the right, while Premium and Ultimate package seats swivel 25° to the left and 40° to the right. Other amenities include a new footrest peg, extra storage for tools, and a cooling box for food and drinks.

Buyers can select from three radio packages, with options including AM/FM radio, auxiliary input jack, USB audio and video inputs, SXM satellite radio, Apple Airplay and Android Auto compatibility, speaker system, Bluetooth microphone, and more. Additionally, farmers can choose from three lighting visibility packages to meet their operational needs.

– **Technology:** The 2025 9RX series employs the same built-in technology as Deere’s model year 2024 tractors. This includes an in-cab G5 Plus display, integrated StarFire 7500 receiver, JDLink modem connectivity, and autonomy-ready features.

“The autonomous-ready package offers all the hardware, software, and safety features that we know today will be required for autonomous operation in the future,” Porter says. “This allows the machine to easily convert to a fully autonomous tractor.”

Text 10. Claas Introduces New Xerion, Arion and Axion Tractor Lines

Sources: <https://www.agriculture.com/claas-introduces-new-xerion-and-arion-tractor-lines-7563007>, <https://www.agriculture.com/machinery/tractors/claas-updates-xerion-tractor-line-for-2023>, <https://www.agriculture.com/machinery/tractors/claas-announces-terra-trac-for-the-axion-tractor>

– **Xerion 4WD tractors updates:** Claas has announced updates to its line of Xerion 4WD tractors for 2023 including powertrain upgrades and improved hydraulic flow. The new updates are designed for compatibility with large implements like wide air seeders. The enhancements for 2023 will be available on the Xerion 5000 and 4500 models in TRAC or TRAC VC configurations.

"We designed the XERION to be our customers' favored choice for true tractor capability," says Frans Reijmers, tractor product manager for Claas. "The enhancements to 2023 models build on its core strengths and provide the power, a better balance in the design, and operator confidence that makes tackling those all-day, tough jobs more convenient than ever."

The Xerion tractors are offered in a range of 435 to 530 hp. The updated models run on the brand new Eccom 5.5 CVT, a 4-range CVT that's designed to better transfer the engine's torque and power to increase efficiency. These tractors can hit a maximum forward speed of 31 mph at a low, fuel-saving rpm.

With the new Eccom 5.5, the tractors also have higher hydraulic flow than previous models. The Xerion has up to six double-acting rear spool valves, and a brand-new pump transfer gearbox. Optional tandem pumps allow oil flow up to 111 gallons per minute, designed to work with high oil flow implements like wide air seeders.



Up to two spool valves, three with the optional tandem pump, can be prioritized in Claas' CEBIS touch display system.

An optional separate 120 hp. Hydraulic system with 66 gallons per minute at 3,770 psi is available for attachments such as manure tanks and front-mounted implements that require high-horsepower hydraulics. A hydraulic dual-circuit trailer brake can also be installed on the Xerion models.

A new base weight plate for the multi-purpose carrier space behind the cab is also available on the 2023 Xerion tractors. With the new system, up to 15,432 pounds of additional ballast weight can be loaded on the tractor. Depending on the application, the Xerion can be balanced for a 50/50 weight distribution.

– **Xerion 12 Series and Arion 600 Series:** Claas' new Xerion 12 Series is built for high-horsepower applications, while the Arion 600 Series is a versatile workhorse. Claas has announced the launch of the Xerion 12 Series and Arion 600 Series, and now offers the Axion 900 Terra Trac in row-crop friendly builds. "With innovative features and a bold design, these tractors will become the go-to choice for farmers looking to take their productivity to the next level," says Frans Reijmers, tractor product manager for Claas North America. "We have taken into account the valuable input our customers have given us, and we are excited to see how these tractors will deliver on their needs."

– **Xerion 12 Series:** The new Xerion 12 Series is launching with two models: the Xerion 12.650 and 12.590, built with high-torque Mercedes-Benz six-cylinder engines with 15.6 l cubic capacity, coming in at 653 and 585 hp, respectively. Its low-engine speed concept brings a maximum power output at 1600 rpm, maximum torque at 1300 rpm, and idling speed at 650 rpm.

These models take inspiration from Claas' original Xerion 5000 and 4000 Series models – bringing back the fixed-frame design, CVT transmission, and quiet cab – but increased in size. This tractor was designed for commercial farms, with up to 3100 Nm torque to pull the largest air seeders, tillage equipment, and grain carts.



Claas Xerion 12 series pulling a planter

The Xerion 12 models have a hydraulic flow rate of 140 gallons per minute, and come standard with a continuously variable transmission. The tractors have a new, heavy-duty axle system to support the higher horsepower and heavier implements.

Farmers can order the Xerion 12 models with 36- or 30-inch Terra Trac units on all four corners to help reduce ground pressure and compaction, lessen vibration, and increase traction. Wheels are also available, using 800/70 R42 duals with a footprint of up to 42 inches.

The cab has also increased in size, with 20% more legroom than previous models. For added comfort, the tractors are built with four-point suspension, and a sound-dampening design.

– **Arion 600 Series:** The ARION 660, 650, and 630 models come in a range of 165 to 205 hp, and are equipped with a continuously variable CMATIC transmission. These

tractors are designed to be versatile work-horses intended for a range of tasks around the farm or ranch.

The Arion series has a maximum transport speed of 31 mph and a lift capacity of 17,600 pounds. The models also have four-point suspension, a front PTO, and three-point hitch. When equipped with the CLAAS FL150 hydraulic loader, the Arion can lift 7,546 pounds up to 15 feet high. The cabs come equipped with standard comfort features familiar to the Claas family of machinery, with the addition of a 12-inch CEBIS touchscreen display for control of essential functions.



– **Axion 900 TT updates:** The Terra Trac option for the Axion 900 is now available on 18-inch belts on 88- and 120-inch centers, in addition to the previous track widths of 25, 29 and 35 inches. The AXION 960TT and 930TT models, have a four-mode, continuously variable CMATIC transmission, come in at 445 and 355 hp, respectively.

Claas has announced the Axion 900TT with its Terra Trac technology. Claas is bringing the Terra Trac friction drive track from its line of combines to the Axion 900 tractor series with the Axion 900 TT, making for the company's first half-track tractor with full suspension.

The new Axion 900 Terra Trac (TT) is designed for better flotation, traction, operator comfort, and soil protection with the use of its drive track.

"We look to our customers to continuously evolve our approach to the design and innovation of new products," says Drew Fletcher, tractor product manager at Claas. "Through extensive testing and discovering numerous advantages with this product compared with other manufacturers, this is technology we're thrilled to bring to market."

The most obvious update to the Axion tractor is the addition of the Terra Trac design used on other Claas machines. The front wheel and rear-track have independent suspension, which helps the 900 TT have less ground pressure and reduced soil disturbance while increasing traction.



Claas Axion 900 TT tractor is pulling an implement



Terra Trac on Axion 900TT

The Terra Trac on the 900 TT also has a larger rear driver wheel that increases the surface area of contact between the plates and inner side of the track. Different from the combines, the wheels on the 900 TT are now spoked instead of solid to assist with clearing debris from the track. The individual tracks are also modular, meaning if the rubber gets chunked from contact with debris, it can be replaced individually.

Combined with the four-point cab suspension and fully suspended tracks, the 900 TT is a smooth ride from Claas. Like other Claas vehicles with the Terra Trac, the wheels in the tracks use hydraulic pistons.

"These rollers can move up and down, and it can 'smile' or 'frown' as it goes over changes in soil, and going through waterways, we can always maintain constant ground contact," says Fletcher.

Taking it on a test ride through Claas' testing facility, I noticed minimal bumps and jolts in the ride compared to a standard-wheeled tractor.

Another feature new to the Axion 900 TT is the height-adjustable drawbar at the push of a button, which can make for easier hook-ups when attaching implements, without the need of using tools to adjust.

The 900 TT is powered by a Cursor 9, 8.7-liter FPT engine, maintaining an efficient, low-speed, high-torque concept at 1,400 RPM. The four mode CVT CMATIC transmission system is designed for fuel savings, never using less than 60% mechanical drive or more than 40% hydraulic drive, according to Fletcher.

Text 11. One in Every Ten Tractors in the World Is from Belarus

Source: <https://www.agriland.ie/farming-news/1-in-every-10-tractors-in-the-world-is-from-belarus/>, <https://www.belarus-tractor.com/en/mtz/company/eksport/>

"One in every 10 tractors in the world is from Belarus." It's a bold claim, but that's the message from Minsk Tractor Works. Its products are best known in this part of the world under the 'Belarus' brand-name. Belarus doesn't just produce big numbers of tractors; it also produces big tractors. Evidence of this was the appearance of a prototype (466hp) 4522 model at the most recent Agritechnica show in Germany.

The 'Belarus' tractor brand-name has a lengthy lineage. Some readers may also be familiar with the associated MTZ badge. MTZ stands for 'Minskiy Traktorniy Zavod'; 'Minsk Tractor Works' is simply the English translation.

That's why you might see either 'MTZ' or 'Belarus' badges adorning what might otherwise be identical tractors. Minsk Tractor Works was founded as far back as 1946, in the aftermath of World War II. Thus far, it has manufactured over 3,883,000 tractors. For the record, the city of Minsk is the capital of the country of Belarus.

– **Historic decree:** Minsk Tractor Works came into existence following a decision by USSR (Union of Soviet Socialist Republics) leader Stalin and the executive officer of the USSR's 'Council of Ministers' to sign a historic decree in 1946. This decree obliged the Ministry of Agricultural Engineering of the USSR to construct a factory with the capacity to produce 50 crawler tractors per day (each with 37hp diesel engines). These crawler tractors were launched in 1948.

Soon after, the factory's first prototype wheeled tractors came into existence. The chief designer of Minsk Tractor Works – Ivan Iosifovich Drong – proposed the name 'Belarus'. Thus, began the legacy of the now-famous brand-name.

By 1958, the 1,000th tractor had rolled off the production line. Fast forward to 1972; that's when the 1,000,000th tractor was built – quite a milestone by any reckoning. 1973 saw the advent of the first "experimental" Belarus MTZ-80 tractors (an example of which is pictured below).

These were considerably more powerful than previous MTZ-50 models. They were destined for a plethora of new markets; one was even tested at the University of Lincoln (Nebraska, US).



Belarus 4522



Belarus MTZ-80

Two years later, in 1975, the USSR's State Committee on Science and Technology named the MTZ-80 as its 'Machine of the Year'.

– **Another milestone:** By 1984, the 2,000,000th 'Belarus' tractor had rolled off the line at Minsk Tractor Works.

The factory continued on into the next decade; 1991 saw USSR President M. S. Gorbachev's visit to the plant. By the mid-1990s, management claimed that every second tractor in the CIS (Commonwealth of Independent States) was a 'Belarus'. All the while, the entity was seeking new outlets. In 1998, for example, Minsk Tractor Works established an assembly operation in Yugoslavia. This was a period when Belarus tractors had started to appear as far away as Mauritania, Yemen and even Sudan.

The rest, as they say, is history. Nowadays, Minsk Tractor Works is still an active, vibrant manufacturer – laying claim to a significant chunk of the world's existing tractor population.

According to the Minsk Tractor Works website, it is among the top 10 largest exporters of tractors in the world: more than 90% of its manufactured products are delivered abroad. BELARUS tractors operate in 125 countries on five continents.

The range of BELARUS machines includes 160 models and more than 220 modifications for operation in any conditions. At the same time, MTW offers to the customer the technology for soil cultivation and harvesting: the tractor as a power tool, equipped with mounted and trailed implements. Special attention is paid to development of innovations, new models, and application of high technology.

A large distribution network has been created to promote BELARUS vehicles on the global market. More than 100 organizations (including about 20 MTW's own entities) are partners of the enterprise in selling the products.

For the last 5 years (from 2018 to 2022) and 6 months of 2023, BELARUS vehicles have been delivered to 80 countries. According to the results of 2022, exports exceeded 900 million dollars, which is almost one third higher than the level of 2021.

The key market for Minsk Tractor Works is the Russian Federation. Amidst the geopolitical and macroeconomic turbulence, the company is ramping up the volume of exports, increasing its share of presence. The dis-



tribution network of MTW has a dealer center in almost every Russian region, which allows to be closer to the consumer, to provide high-quality and timely service, to maintain the operation capacity of vehicles, observing agricultural timelines, which is especially important in ensuring food security.

MTW manages to scale up supplies to other CIS countries: Azerbaijan, Kazakhstan, Kyrgyzstan, Uzbekistan. Exports to the so-called «far arc» countries, including Southeast Asia and Africa, are increasing as well.

Text 12. Minsk Tractor Works

Source: <https://www.belarus-tractor.com/en/mtz/company/manufacture/>

Minsk tractor works is one of the leaders of the world agricultural machinery industry with a powerful technical and technological potential, with many years of experience in creating tractors and special-purpose machinery. The competitive advantage of the enterprise is its full-cycle production.

– **Heart of MTW:** The tractor assembly shop is the «heart» of MTW. This common phrase hides deep meaning of production workflow taking place at the enterprise. All shops – the «organism» – work for the «heart» – the tractor assembly shop – to beat. Just like the tractor assembly shop works for the whole plant to live. Two assembly lines work in the tractor assembly shop. The first one assembles tractors over 100 h.p., the second one assembles tractors up to 100 h.p. The products are made by sub-assembly method.

In addition to the tractor assembly shop, a floor conveyor is located in the areas of mechanical assembly production, five shops of which manufacture parts and units for power-saturated BELARUS tractors with the capacity of more than 350 h.p.

– **The keystone:** Tractor production starts with the blank preparation shops – press, thermal, forging shops, foundries No. 1, 2 and 3, steel foundry and precision steel casting shop, as well as the cab shop. By the way, the foundry shop of Minsk Tractor Works is the largest in the Republic of Belarus.

– **Thousands of part types:** Mechanical shops perform processing of parts. MTW has mechanical shops No.1, 2, 4, 5 and 7, as well as mechanical assembly shop No.3 and small series shop. In mechanical shop No.1 gearboxes are made, mechanical shop No.4 makes coupling clutches, mechanical shop No.3 makes front axles. These parts are sent to mechanical shop No.2, where transmissions are assembled.

At present, mechanical shop No.5 is technically equipped the best, though this does not mean that the other shops are stagnant in development: step-by-step modernization affects all the manufacturing stages.

– **Everything is tested:** When leaving the assembly line, small and medium-sized tractors are run-in at stations No. 4 and No.7 of the tractor assembly shop. Power-saturated vehicles are tested at the Tractor Testing Center of MTW-HOLDING in Obchak village.

The complex of testing sites of the Tractor Testing Center consists of:

✓ four circular strength test sites with a room for remote control of tractors under testing;

✓ roads with different turning circles with radius of 11 and 20 m;

✓ testing site with dynamometer fields;

✓ sites for determining lightening, visibility and turning radius;

✓ slopes with different incline grade;

✓ site with benches for determining protective properties of cabins.

More than 200 design engineers, engineering technicians and workers are involved in the preparation and performance of the tests.

– **Final touch:** After the equipment has been tested for compliance with all the declared specifications, it is delivered to the tractor finishing and painting shop. Here, the tractors are given the «ready-for-sale appearance»: facing, fenders, flaps are mounted, information plates are installed, etc.

Before the tractors are sent to the sales department, the tractors are accepted by the technical control department.

At the final stage, before shipment to the customer, the products are delivered to the preservation and packaging shop, that is, the warehouse of finished products. And then, BELARUS tractors start the way to their destination: under their own power, by rail, or by highways.

– **Tractor as an idea:**

However, no production is possible without the team that «drives» the tractor to the assembly line.

The design department is the starting point for the journey of creating new vehicles and modernizing the existing models. Here, images of future products are created and the corporate identity of the company is formed.

– **Think tank:** Although an idea itself is of great value, it has no meaning without realization. The work of the specialists of the MTW Scientific and Technical Center precedes putting the tractors on the assembly line. Scientific and Technical Center includes two departments of engineering and experimental works – No. 1 and No. 2. The first one designs wheeled tractors, the second one – special-purpose vehicles. But a mere design is not enough. Manufacturing prototypes and small batches of new products is necessary in order to see in practice the product that is planned to be put into serial production. This is the job for pilot production shop No. 1 in DEEW-1, and for pilot shop No. 2 in DEEW-2.

– **Introducing technology in production:** The organization of the production process is the responsibility of the experts at the Chief Production Engineer Department. It is the production engineers who can answer three questions: what do we produce? What materials do we use? What do we need for production? Minsk Tractor Works enjoys dictate of technology.

Text 13. MTW Production: Tractors

Source: <https://www.belarus-tractor.com/en/production/traktory/>

Minsk Tractor Works produces the following tractors:

– **SERIES 300:** The small dimensions of these series tractors make it possible to use them on small-contour fields up to 3 hectares, in industrial premises and greenhouses. Various configurations are adapted to work in different climatic conditions. The tractors can be coupled with a wide range of agricultural and municipal equipment.

– **SERIES 400/600:** Tractors of this series are designed for small-contour fields up to 5 hectares, industrial premises and greenhouses. Various modifications of tractors are adapted to work in different climatic conditions. The tractors can be coupled with a wide range of agricultural, municipal and industrial equipment.

– **SERIES 800:** This model is the most large-scale one in the product line of OJSC “MTW”. These vehicles can be used not only in agriculture and utilities, but also in the construction industry. There are various configurations for any operating conditions and climatic zones. Ideal for cultivation of areas up to 15 hectares.

– **SERIES 900:** Unlike the previous series, these tractors are equipped with more powerful engines. There is a wide choice of synchronized and mechanical transmissions, various types of cabs and hydraulic lift linkages. There are modifications for any operating conditions and climatic zones. Ideal for areas up to 20 hectares.

– SERIES 1000/1200: The 1000 series is equipped with powerful engines and synchronized transmissions. The tractor is designed to perform various agricultural work with mounted, semi-mounted and trailed machines and implements, as well as the transportation work. Ideal for areas up to 25 hectares.

– SERIES 1300: 6-cylinder engine, synchronized gearbox and powerful hydraulic linkage make it possible to efficiently operate the tractor in all types of agricultural work. There are options both with cabins and with canopy frames for work in countries with a tropical climate. Ideal for areas up to 50 hectares.

– SERIES 1500: 6-cylinder engine, synchronized gearbox, electro-hydraulic linkage and comfortable cab with cylindrical panoramic windows. These tractors have different climatic versions and a wide range of additional options. Intended for cultivation of areas up to 60 hectares.

– SERIES 2000: Combination of powerful 6-cylinder engine, electro-hydraulic linkage, comfortable cab and fully-equipped basic configuration with air conditioner and twin rear wheels. Designed for cultivation of large areas with wide-cut and combined units.

– SERIES 3500: Machines of this series are ideally balanced tractors of high power. Modern technical equipment, hydro-mechanical transmission, front and rear lift linkages, front and rear power take-off shafts, creeper gear, twin front and rear wheels. The hydraulic system has a variable displacement pump up to 160 l/min. A comfortable cab with air conditioning. Ideal for cultivation of large areas.



– BELARUS 1502: Crawler tractor equipped with a blade for digging and backfilling trenches, erecting embankments, moving bulk materials, uprooting and moving stumps, as well as performing land reclamation work. It can be used on weak and water-logged soils.

– BELARUS 2103: Agricultural crawler tractor for general-purpose work on water-logged and weak soils. It can accomplish work faster than wheeled tractors do.



Text 14. 6-cylinder Belarus: Strong and Reliable

Source: <https://www.powertraininternationalweb.com/off-highway/6-cylinder-belarus-strong-and-reliable/>, <https://agro-sales.ru/wiki/traktor-belarus-3022-dts-mtz>

1. Tractor Belarus 2022.6: There is a 6-cylinder Belarus under the bonnet of the tractor we tested for you. And the tractor is, obviously, from the Belarus tractor manufacturer. The Belarus 2022.6, strictly speaking. This is basically a captive story from Eastern Europe.



6-cylinder diesel engine



Belarus 2022.6

Undoubtedly one of the strong points of the Belarus 2022.6 is its Diesel engine, which despite its somewhat outdated architecture is reliable and capable of delivering good performance, as we were able to appreciate during the test. With a 7.1 litres displacement and a mighty torque of 905 Newtonmetre at 1,600 rpm, it made a positive impression, always ready to respond to pedal stress at any rpm and in any gear. It's really hard to put it to the test, as it makes up for the impossibility of changing gear on the move by responding promptly to sudden changes in load. Stage IV compliant, the Belarusian six-cylinder is supercharged by a turbocharger with intercooler and uses an electronically controlled common rail injection system. Exhaust gases are treated downstream with a classic Scr system. The power curve peaks at 161.7 kilowatts at 1,900 rpm and then drops to 155.9 kilowatts at 2,100 rpm. Fuel consumption is normal and the 370-litre fuel tank ensures ample autonomy for the entire working day. The engine is mated to the classic mechanical gearbox. As mentioned earlier, there is nothing hydraulic here, so it is always essential to use the clutch to change gear.

The appearance of the 2022.6 is therefore not the most modern, with its 'whale-mouth' bonnet containing two large, square-profile headlights, but it is decidedly functional. One-piece, it can be opened at 45 or 90 degrees, allowing easy access to the engine, the batteries (there are two, one 24-volt for the starter and one 12-volt for the electrical system) and the air filter.

2. Tractor Belarus 3022 DC (MTZ): Agricultural energy-rich wheeled Tractor BELARUS-3022DC.1 with a diesel engine BF06M1013FC (DEUTZ) with a power of 303 hp, certified according to the 2nd stage of Directive 2000/25/EC, traction class 5.0 with a 4x4 wheel arrangement. It is designed to perform various agricultural work with mounted, semi-mounted and trailed machines and implements, in transport, with loading and unloading equipment, harvesting complexes, as well as for driving stationary agricultural machines.

The distinctive features are:

- It is designed for long-term operation in reverse mode and is distinguished by the presence of a reverse control station, which includes an additional steering column,

duplicated controls for the clutch, brakes, fuel supply, as well as a special swivel seat for operation both in forward motion and in reverse.

– Unlike the previous model (Belarus-2022.3), this machine is equipped with a Deutz BF06M1013FC engine (made in Germany).

Hydraulic mounted system – universal, with joystick control, based on an axial plunger adjustable pump from Bosch-Rexroth, providing power, positional and mixed control of tillage depth, having a five-section distributor with electrohydraulic control and the ability to program hydraulic system functions (EHS), electrohydraulic control regulator for front (FNU) and rear (RHL) mounted devices.



2.1.4. Tractor Attachments and Implements

Text 1. Tractor Attachments

Source: <https://www.holtags.com/types-of-farm-equipment-and-their-uses#tractors>

Tractor attachments are attached to tractors or pulled behind them to add a new level of functionality. Their uses range widely from soil management to seeding. The different types of farm machinery attachments are detailed below.

1. Plows: A plow is a large tractor attachment that drags behind the tractor, using long blades to cut furrows in the soil. This process not only loosens and turns the soil, but it also helps kill off any surface vegetation that is not intended to be there. While the soil has to go through several subsequent steps to be ready for planting, plowing is an essential first step.

The concept of a plow may seem simple enough, but there are a variety of different plow types. Each plow type is suited to a specific soil type, soil condition and crop type. Here is a look at the three most common types of plows:

– Moldboard plows: Moldboard plows consist of wing-shaped blades, which are specifically designed to cut into and turn the soil. This is an ideal type of plow for shallow but thorough soil turning, which is often necessary for land that hasn't been used for crop production for several years.

– Disc plows: Disc plows consist of rows of discs that work to turn the soil and cut up weeds. These are less common than moldboard plows as they are less effective at turning the soil, but disc plows may be more useful for soil that is particularly sticky or rocky.

– Chisel plows: Chisel plows consist of exceptionally long shanks. These shanks turn the soil at a depth of a foot or more. This is often necessary for land that has been used for consistent crop production.

Plows can range widely in price from a few hundred to several thousand dollars depending on the type, size, brand and condition of the plow.

2. Harrows: Where plowing primes the soil, harrowing further agitates it in preparation for agricultural work. These attachments break down clumps of soil, make the soil surface level and redistribute crop and weed residue to make it easier for new plants to take root and grow. Harrows can also be used after distributing manure and fertilizer, as they can help break up clumps and distribute the fertilizer more evenly.

Some common types of harrows include:

- Spring harrows: Spring harrows are an older style that isn't commonly found today. These attachments use flexible iron teeth mounted in rows to loosen and agitate the soil.
- Roller harrows: Roller harrows look like large spiked tubes and, as the name suggests, are rolled across the soil to help crush the soil and prepare it for seed planting.
- Chain harrows: Chain harrows look like chain nets with spiked attachments. These are run over the surface of the ground to help aerate and spread soil and fertilizer.
- Disc harrows: Disc harrows are the more modern version of spring harrows, and consist of rows of large discs that break up soil and weeds more thoroughly after plowing.

Often, multiple types of harrows are used for different purposes and may be used multiple times during the soil preparation process. Harrows can be pulled behind tractors or ATVs, depending on their size and complexity. More advanced harrows require a tractor, but they often combine the benefits of multiple types of harrows all into one.

3. Fertilizer spreaders: Fertilizer spreaders function as the name suggests – they spread fertilizer across a field. While there are fertilizer spreaders that can be run separately, most farming operations require a tractor-run fertilizer spreader for quick, evenly distributed fertilization.

There are multiple types of fertilizer spreaders, varying primarily based on the fertilizer used. These are some of the more common types of tractor-mounted fertilizer spreaders:

- Broadcast spreader: The most common fertilizer spreader is the broadcast spreader, which takes fertilizer and disperses it using gravity.
- Manure spreader: Manure spreaders take solid manure from livestock and spread it across a field. This is an easy way of effectively utilizing manure, though the solid manure will often need to be run over with a harrow to break it up and mix it in with the soil.
- Slurry spreader: Liquid manure spreaders are also known as slurry spreaders, which spray a slurry of liquid manure across a field.

Fertilizer spreaders vary widely in size and price, so consider your application closely before deciding which type to buy. It's also worthwhile to note that fertilizer spreader attachments are available for ATVs, UTVs and tractors.

4. Seeders: Seeders are designed to spread seeds across large plots of land quickly and efficiently. While small farms may use small mechanical seeders or even hand-seeding methods, tractor-pulled seeders are most commonly used in large-scale farms today. There are different machines used in agriculture seeding such as the following:

- Broadcast seeders: Broadcast seeders are also known as seeders or rotary spreaders, and they come in all sizes. These seeders work by placing seeds inside a hopper. Inside the hopper, a plate turns, taking seeds in for dispersing across the field. While this method is very effective for planting cover crops and grasses, it is not ideal for garden crops that need more organization, such as being laid out in rows.
- Air seeders: Air seeders are very large, using compressed air to shoot seeds into the ground. Though highly effective, air seeders can only be used on small, round seeds because of the way they operate, which limits their utility.
- Box drill seeders: Box drills are the preferred seeder for most farming operations because they are easy to use and work with a wide variety of seed types. These attachments drill into the soil and drop seeds at a specific depth.
- Planters: Planters are the most accurate seeders, though they tend to be the most expensive. Planters consist of several blades and wheels topped with seed boxes containing the planted seeds. The planter works by cutting into the ground, dropping individual seeds, then closing the ground behind them, all in quick succession.

Like other attachments, seeders vary in price based on the size, type and condition of the seeder. Some seeders can even seed, fertilize or spread salt all at once, depending on the needs of your applications.

5. Balers: They are essential for hay, straw and corn stalk collection. These tractor attachments collect these materials and wrap them into more easily manageable bales. There are three general kinds of hay balers:

- Round balers: Round balers roll hay into round shapes and then wrap it in twine or netting.

- Square balers: Square balers collect hay, straw or stalks into compactors, which help pack and compress the material into a square shape. Once the baler has enough material, it ties it with two lengths of twine or wire and then deposits it in a particular area. Square balers come in multiple sizes to work for a variety of applications. Square balers can tie bales in wire, twine or both, and you can add a bale mower attachment to make it easier to stack bales on your wagon.

- Large square balers: Large square balers function like regular square balers but handle significantly larger volumes for industrial farms. Smaller farms are better off using round or square balers unless you manage hundreds of acres.

Typically, square balers are less expensive than round balers, but the best type of baler for your farm and the wrapping method you use depends on your application. Balers can be used to collect food or bedding for livestock or collect crop yields to make them easier to transport.

6. Wagons or trailers: Farm wagons and trailers are a necessity for any operation. Wagons and trailers are available in a wide range of sizes and materials, and they may be used for a range of purposes, including the following:

- Harvesting: Wagons and trailers may move hay bales and other harvested goods from one farm area to another.

- Material handling: Wagons are often used to move large quantities of materials, including fertilizers and feed, across large areas.

- Equipment transportation: Trailers are often equipped to move farming equipment, smaller vehicles and attachments.

Tractor wagons and trailers vary widely in size, and many operations may need multiple types to handle all the various duties involved in daily farm operations.

7. Other tractor attachments: While the attachments listed above are the most common tractor attachments purchased, many other tractor attachments are commonly used in farming and related applications. Some of these different types of farming machinery attachments include:

- Sprayers: Sprayer attachments can spray pesticides, fertilizers and other substances across large areas. These are a must-have for any farming operation that handles large acreages.

- Mowers: Mowers are necessary for any large plot of land, but tractor owners can benefit from mower attachments. Various mower types meet a range of farm needs, from grass management to harvesting. The specific type of mower you require for your application will depend on your land, and you may need multiple attachments to attend to different areas of your property.

- Transplanters: Tractor-pulled transplanters make transplanting easy by taking large quantities of growing plants, digging holes and depositing them, all using machinery. Even small farms can benefit from transplanters by reducing manual labor and speeding up planting processes.

- Cultivators: Cultivators are used for soil cultivation, specifically in weed control.

These are used for shallow tilling and are often used in smaller farming operations.

- Plastic mulch layers: For large-scale farms that use methods involving plasticiculture, a plastic mulch layer tractor attachment is a necessity. This equipment takes a ream of plastic and lays it flat along the bed using a series of wheels.

- Rakes: If your farm operation involves making hay, raking attachments are essential for your tractor. Several rakes are available as pull-behind attachments, including wheel, parallel-bar, rotary and belt rakes.

You can also find backhoe tractor attachments if your application requires digging holes regularly. These attachments can dig up to 10 feet. However, renting or purchasing a standalone backhoe may be more effective for larger-scale applications.

Front-end loader attachments can also be very versatile for small to mid-size farms. While they are not an option for all tractors, these attachments can dig, move, lift heavy or bulky items, and perform land-grading tasks.

It is important to note that not all farms need all of these attachments – small-scale farms will need fewer types of agricultural equipment than large-scale farms, and a farm's need for specialized equipment will vary based on the local environment and farming methods used

Text 2. Tillage Equipment: DV-1000 Offset Disc Harrows

Source: https://sar.rostselmash.com/products/tillage/DV_1000_Offset_Disc_Harrows

The tillage equipment by RSM is specially designed for severe duty. While providing the highest performance and efficiency, these machines require minimum efforts from machine operators both in the field and during maintenance. The RSM tillage machines are among the most reliable and easy-to-maintain ones in the agricultural machinery market, and cost much less than competitors with comparable specifications.

- **Overview of DV-1000 Offset Disc Harrows:** The DV offset disc harrow is designed for primary tillage, for fields with a large amount of stubble, for cultivation of virgin and disused lands, fallow land, field preparation to fallowing or seeding, placement of fertilizers into soil as well as deep soil tillage with partial plowing up. A robust and simple design, heavy duty bearings, locking steel spools between discs and extended failure-free operation as well as an unrivalled disk gang bolting torque of 5 153 Nm – all these features make the DV offset disk harrows stand out from the crowd.



- **Discs:** Load per disc blade enables easy soil penetration under any conditions. The discs are serrated and smooth. 9mm thick blades ensure extended service life and high wear resistance of the discs. Variable disc gang angles provide the best combination for uniform soil penetration and steady crop residue flow. The offset disc harrow can be attached to tractors with a minimum engine horsepower of 240 HP (wheeled) and 210 HP (tracked).



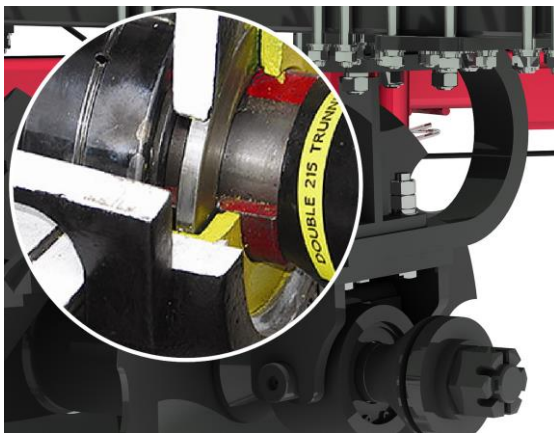
Offset harrow discs



Wear-resistant discs

– **Self-levelling hitch:** The self-levelling hitch ensures smooth and even field tilling as well as protects bearings and discs against shock loads when hitting a stone.

– **Bearings:** Self-orienting bearings installed in T2-215 disc gangs for tough conditions can support radial loads up to 10.5 t per bearing at 33 RPM.



Disc gang bearings



Disc section shafts

– **Disc section shafts:** 50mm disc section shafts maximise disc gang life. You will not have to tighten shaft nuts again and again since they are factory-tightened to 5 153 Nm.

– **Bracket:** STONE-FLEX C-shaped disc gang mounting brackets protect discs and bearings against premature wear and failure, reduce shock loads when hitting stones or other obstacles.



Bracket



Wear-resistant disc scrapers

– **Wear-resistant disc scrapers:** These disc scrapers can efficiently remove any stuck dirt and crop residues minimising disc cleaning time. Bearing protective plates guard the bearings against stones, stubble and dirt extending their service life.

– **Hydraulic system:** A reliable and robust hydraulic lifting system can quickly set the harrow to the operating or transport position.



Offset disc harrow hydraulics



Depth control

- **Tilling depth adjustment:** The tilling depth is very easy to adjust by master cylinder depth control segments, reducing adjusting time before each operation.

- **Harrow rocking shaft:** The rocking shaft mounted on the 14cm diameter main frame adds strength to the frame and ensures its lifting and lowering.



Harrow rocking shaft

Text 3. Tillage Equipment: Precision Seeding

Sources: <https://www.kleverltd.ru/en/catalog/tillage-equipment/seeding/AT/>,
<https://www.kleverltd.ru/en/catalog/tillage-equipment/seeding/SH-SC/>,
<https://rostselmash.com/products/posevnaya-tehnika/>

AT Air Carts as well as SH and SC series drills allow to carry out sowing works in the terms limited by agrotechnology. Sowing complexes of various modifications and capture widths equally contribute to the uniform distribution of seeds and the maintenance of the required sowing depth, regardless of the irregularities of the field.

AT-8, AT-11 Air Carts are an essential part of the drill, which is used for calibration, maintaining a constant seeding rate and fertilizer amount regardless of tractor speed, and delivers seeds and fertilizer through seed pipes to the coulters.

The air seed and fertilizer carts are versatile and are suitable for all RSM drills.



The cart provides good performance (seeding accuracy) for both grain and legumes without changing the seeding roller. Adjustment of airflow moving the seeds in seed tubes ensures stable operation without clogging and minimizes seeds damages.

The AT Air Carts are only available as a part of the SH/SC drills.

The key features of AT Air Carts are:

1. High performance

– **Time-saving:** The large 7,576/11,100 liters cart with a mechanized seed loading system allows you to increase the seeded area between refills, reducing maintenance time.

– **Multitasking:** The cart can have two or three isolated compartments allowing it to simultaneously sow different types of seeds with a seeding rate of 40 to 330 kg/ha.

2. Comfort

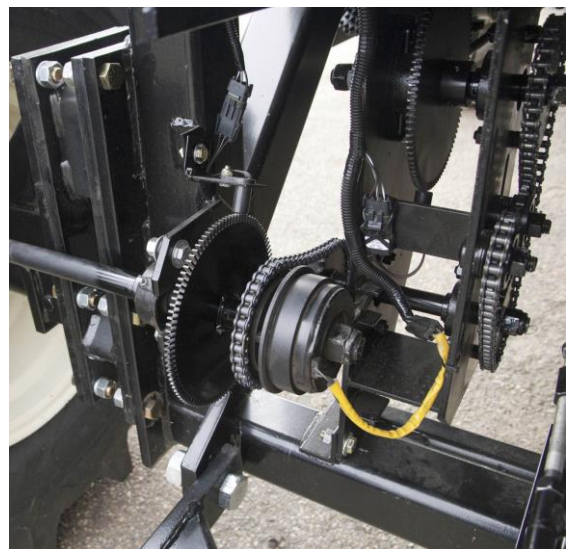
– **Quick loading:** Cart loading takes very little time and effort, a little more than 10 minutes. The auger is mobile and designed for operation by one person, both from the ground and from the upper deck.

– **Efficient airflow distribution:** The use of the direct air mixture supply to the seeding dispenser allows to significantly reduce losses during air delivery and to use a hydraulic motor with a fluid flow rate not exceeding 90 l/min.

– **Automated operation:** The seeding system drive is automatically switched on and off at the beginning and end of the machine travel.



Use of direct air mixture supply



Seeding system drive

– **Easy to set up:** The variator-type gearbox has the ability to steplessly change the rotation of the coils of the seeding devices. The seeding rate can be changed manually or from the tractor cab using actuators.

3. Attention to details

– **Quick change of seeding range:** The tool-less seed rate adjustment for each cart compartment saves time in preparation for work. Changing the crops does not require changing the seeding roller. Instead, you only need to change the drive chain position on the sprockets that are used for seeding range adjustment.

– **Versatility:** The seeding dispenser comes with a universal seeding roller suitable for different crops. Wasting your time retooling the cart when changing crops is already a past.

As to SH and SC series drills, they are used in all cultivation areas, except hill farming areas, and designed for the sowing of cereals, legumes, and subsurface application of artificial fertilizers.



Drills consist of the AT-11 air cart, a cultivating device based on R-series cultivator, and an air-distribution system. The AT-11 air cart provides centralized seed dispensing and delivers it to the drill air-distribution system.

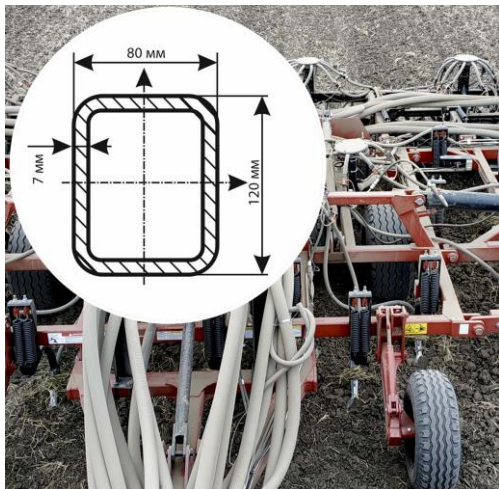
In the SC drill, seeds and artificial fertilizers are directly applied to the under-coulter area of duckfoot tines.

Alternatively, the SH drill applies seeds through double-disk coulters, while artificial fertilizers are applied to the under-coulter area of duckfoot tines across the entire working width. This allows for row seeding of cereals without seedbed preparation.

The key features of SH and SC series drills are:

1. High performance

– **Robust frame:** Seeder frame is tremendously rigid and durable, thanks to the use of shaped tubes with a section of 120x80x7 mm. Tubes are made of structural alloy steel and welded together in inert gases according to a well-proven technology.



Seeder frame



Powerful C-shaped tine

– **Versatile and free from damages:** SH/SC drills can be used for various methods of seeding, field cultivation, as well as soil preparation even in tough conditions. The powerful C-shaped tine can withstand loads up to 250 kg, thus ensuring stable movement of duckfoot tines even in tractor tracks, which is important for seedbed preparation

2. Comfort

– **Working depth adjustment:**

The frame has working depth controls, making it possible to individually adjust the working depth in the drill center and its wings. It ensures an equal working depth across the working width, regardless of the tire deformation degree and wheel sinking.

– **Higher ground clearance:** Decent 680 mm ground clearance under seeder frame and 5-row tines arrangement allows you to farm the fields with lots of crop residues. Forget about seeder clogging and extra stops when sowing.



Frame with working depth controls



Ground clearance under seeder frame and 5-row tines arrangement

3. Attention to details

– **SC drill features:** In the SC drill, seeds and fertilizers are applied to the under-coulter area of duckfoot tines. Sowing is done with a belt up to 250 mm wide. The wide-width seeding significantly increases the individual feeding area of plants, thus creating optimal conditions for their growth. Even distribution of seed over the field area increases the plant performance.

– **SH drill features:** In the SH drill, the duckfoot tines cut weeds, loosen the soil and create an even and compacted seedbed. Artificial fertilizers are applied to the under-coulter area of duckfoot tines across their entire working width, while seeds application is performed through a double-disk coulters. Separate application of seeds and fertilizers at different depth and with different seeding rate positively affects plants growth. Additionally, individual press wheels compact the soil right beneath them.

Text 4. Tillage Equipment: Cultivators

Source: <https://www.kleverltd.ru/en/catalog/tillage-equipment/cultivators/R/>,
<https://rostselmash.com/products/tillage-machinery/tyazhelye-kultivatory-serii-r/>

Cultivators are widely used by farmers all over the world due to a wide range of tasks performed, such as: stubble processing, pre-sowing soil preparation, fertilization, steam care. The use of these aggregates in the complex care of crops or pairs contributes to an increase in soil fertility and agricultural yields.

Series R cultivators are designated for surface and pre-sowing soil processing and fallowing to a depth of 6 to 15 cm.



The presented equipment processes the soil for spring, vegetable and row crops, is perfect for fallow fields, stubble backgrounds, as well as for pre-sowing loosening of the

top layer of soil. Adapted to work in different soil and climatic conditions and have unique technical specifications. The 5 rows of duckfoot tines, optimally spaced on the frame, ensure the unimpeded passage of large amounts of crop and harvested material through the cultivator. The tine arrangement minimizes the buildup of wet soil on the wheels and has a positive effect on the plow uniformity. Three-section models are available with operating coverage width of 8.2/10.2/12.2 m for 210 to 350 hp tractors, and five-section models 14.8 m and 18.3 m for 350 ... 530 hp tractors.

The key features are:

1. High performance

– **Robust frame:** Cultivator frame is tremendously rigid and durable, thanks to the use of shaped tubes with a section of 120x80x7 mm. Tubes are made of alloy steel and welded together in inert gases according to a well-proven technology.

– **Clearance:** High under-frame clearance of 68 cm allows the cultivator to work on fields with a lot of weeds and stubble residues. A road clearance of 38 cm under the duck-foot tine in the transport position provides easy maneuvering on headlands and at crossings.

2. Comfort

– **Reinforced duckfoot tine stand:** The powerful C-shaped tine has a permissible tripping limit of 250 kg, which ensures a stable stroke of the duckfoot tine even in the tractor's tracks, which is important for seedbed preparation.



Floating hitch tongue



Passing wheels

– **Floating hitch tongue:** A floating hitch tongue and front passing wheels ensure ground contour following. In contrast to models with a rigid coupler, the R series cultivators provide a more stable working depth.

– **Passing wheels:** Front passing wheels increase the mobility of the wide-cut implement.

3. Attention to details

– **Processing depth adjustment:** The frame design has individual adjustment in the center and on the wings of the cultivator, which allows an equal working depth across the operating coverage width, regardless of the degree of immersion of the support wheels into the soil.

– **Combined loop:** The cultivator loop, consisting of three rows of spring harrows and a roller with active slats, levels the surface of the field.

– **Surface leveling:** Three-row spring harrows with 495×11 mm tine size, are individually adjustable. Each row of tines operates at a different approach angle: 20°, 25°, 30° and at different depths. This ensures optimal surface leveling.



Frame with individual adjustment



Combined loop



Text 5. Forage Equipment: Berkut 3200, Strige 2100-2800 Series and SapSun 2400 Mowers

Sources: https://sar.rostselmash.com/products/forage_equipment/Berkut_3200,
https://sar.rostselmash.com/products/forage_equipment/Strige_2100_2800,
https://sar.rostselmash.com/products/forage_equipment/SapSun_2400

Rostselmash forage machinery is offered in a variety of capacity ranges and is easy-to-adjust and reliable and has excellent performance. Our forage machinery line ensures that the process is continuous and effective at each phase.

1. Berkut 3200 towed rotary mower: The productive Berkut rotational mounted mower is used even on fields with crop capacity higher than 50 centner/hectare. The operating speed of the machine is gained up to 18km/h, and, at that, thorough mowing of high yield and laid grass is performed, as well as high-quality flattening of mowed mass and laying it into swath. The mower gladdens by its multifunctional ability: the machine with removed flattener can also be used for mowing grass and laying it into swath. The machine is designed for aggregation with tractors of 1,4 drawbar category and very easy in application. The mower is able to work on the fields with small unevenness, and its deformation is excluded due to special protective mechanisms. Careful treatment of your work is the main principle of Berkut.

– **Ideal straw at low expense:** Special design of curved knives and a plate provides effective feeding of mowed mass to the flattening shafts, what enables to get the high-quality straw, to reduce harvesting time and tractor's energy expense.



– **Reducing of time losses and increasing of productivity:** Turning reducer installed on the mover provides excellent maneuverability, reduces turning radius and enables U-turning without PTO deactivation. It substantially reduces time losses and increases productivity.

– **Intensive flattening:** The flattening degree is regulated by adjustment of minimal gap between upper and lower shafts and appropriate spring pressure.

– **High serviceability:** The flattening shafts consist of similar rubber segments with chevron profile. The wear of flattener usually happens in the most loaded area, i.e., the shaft center. It is enough to replace the worn segment with a new one, or transpose the segments, but not the whole shaft.

– **Long-term service life:** The drive of flattening machine is performed by means of four HRA belts providing smooth and silent drive to the flattener shaft. And the completely closed and lubricated chain drive operates longer than open one with any lubrication system.

– **Exclusion of the machine deformation:** Strong structure does not allow deforming the front and side shields at high grass crop capacity.

– **Operation on flat as well as on uneven fields:** On uneven fields with complex relief, the cutting beam bends within the limits of elastic deformation, and, at that, the knives dangerously approach to the flattener. In order not to violate the technological process of harvesting on flat fields and not to cut the flattener by knives, when working on uneven fields, the possibility of cutting beam adjustment relatively to flattening shafts is foreseen.

– **Reliability:** Reinforced mounting of swath formers increases reliability of the structure.

2. Rotary mounted mowers of Strige 2100-2800 series: Strige series rotational mounted mowers are the easiest in their class. It allows to work them with minimal fuel consumption and pressure on soil, as well as to copy the field relief.



At sufficiently high operating speed, reaching 15km/h, the machines ideally mow high-yielder and laid grass, and uniformly lay the cut grass masses into swath. ZhTT-2.8 Strige series mowers, due to especially designed cutting beam comprising three directing conveyors and field divider, allow to mow the mass with laying it into swath of 1.6m in width. Continuous functioning of Strige will nicely surprise even the most requiring agricultural goods producers. The mowers will diligently perform their work, demonstrating excellent results. At PTO rotational speed of 540 rpm, they are aggregated with tractors of 0.9-1.4 t.s. drawbar category.

– **Quality advantages:** Thanks to special design, the knives throw the mowed mass upwards and backwards along the moving of cutting beam. Thus, when mowing high-yielder grass at high speeds, there are no obstructions in front of it, and the mowed mass is not cut twice. As the result, the straw is made of high quality and the energy expenses are reduced.

– **High-quality of mowing without losses and contamination:** Uniform pressure on the soil and dynamic copying are provided by three spiral springs of balancing mechanism. The result is stable and uniform cut, and minimal contamination of the mass.

– **Reliable and continuous operation:** Reliable tension device with soft but strong spring which provides effective tension, continuous and smooth operation of belt drive.

– **Easiness in maintenance:** Maintenance of ZhTT-2.1/2.4/2.8 Strige is extremely easy and does not require special tools and equipment. All 5 lubrication points have very easy access.

– **Minimum time required for aggregation:** Convenient and reliable 3-point hitch reduces the time required for aggregation the mower with tractor.

– **Long-term service life:** When hitting the serious obstacles (e.g., hydrants, poles) unseen in grass, the serious protective elements placed on each rotor are saving the cutting beam from critical damages. Due to this, the cutting beam rest elements are prevented from failures. There is no necessity to disassemble and change toothed gears of the cutting beam; it is enough to replace cutting support, and the mower is ready for operation.

– **Protection from obstacles:** When hitting an obstacle, the towing safety device actuates preventing destruction of cutting beam. In order to continue the work, it is required only move back and replace the cutting element.

3. SapSun 2400 rotary mower with conditioner: SapSun rotary mower with conditioner can obtain the exemplary quality of straw. It is designed for operation with high-yielder and laid grass. At high forward speeds of 9-15km/h, the machine performs clean mowing, without any problem fluffs and lays the mass into uniform swath. Multifunctional ability of the mower will gladden the most exacting customers: the machine can also be used for mowing grass and laying it into swath. Such ability appears when working with removed conditioner. The mower cares of the future crop. And for this purpose, the rotor speed gains 2850 rpm during operation, what not only provides clean cut, but also protects the upper soil layers and grass roots.



– **Exemplary quality of straw:** Thanks to special design, the knives throw the mowed mass upwards and backwards along the moving of cutting beam. Thus, when mowing high-yielder grass at high speeds, there are no obstructions in front of it, and the mowed mass is not cut twice.

– **Protective care of root system:** The mower operates without damaging the roots of the mowed culture the speed of 15km/h. It happens due to high rotor speed – 2850 rpm – what increases productivity and possibility of good crop during next mowing.

– **Fast and easy forage processing:** Conditioner with V-type hinged steel whips provides uniform fluffing of forage mass along the whole width of grip. The result is shorter period of forage drying on the field and uniformity of drying due to which the highest forage quality is obtained.

– **Reliable and continuous operation:** Reliable tension device with soft, but strong spring, which provides effective tension, continuous and smooth operation of belt drive.

– **Reliability of operation and protection from obstacles:** When hitting an obstacle, the towing safety device actuates preventing destruction of the machine.

– **Minimal energy expenses:** Active cylindrical feeding drums installed on the end rotors of the cutting beam direct the mowed mass to the center. Therefore, the mowed mass does not get on to the non-mowed grass at the next running of tractor.

– **Fast aggregation:** Convenient and reliable 3-point hitch reduces the time required for aggregation the mower with tractor.

– **Easiness of maintenance:** Maintenance of SapSun is extremely easy and does not require special tools and equipment.

Text 6. Forage Equipment: Rakes Kolibri 350/470 and Kolibri Duo 810

Sources: https://sar.rostselmash.com/products/forage_equipment/Kolibri_350_470,
https://sar.rostselmash.com/products/forage_equipment/Kolibri_Duo_810

1. Kolibri 350/470 rotary mounted rake: Swath-forming is the important and responsible stage of the whole forage-preparation process. Kolibri 470 mounted rotary rake will ideally suit to farms which prepare forage by themselves for domestic needs. Productivity of Kolibri 470 achieves up to 5.4 hectare/hour at coverage width 4.7m. The rake performs thorough raking the grass into even swaths, light tossing of the mowed mass in swaths, covering, throwing and doubling the straw swaths. Possibility of choosing the swath width allows to adjust for further work of pickup. The rake overcomes obstacles like stones or soil unevenness by means of special tandem-trolley. Kolibri will show the excellent working results with minimal losses.



– **Long-term service life of the machine:** Imported closed gearbox guarantees high-quality and long-term operation.

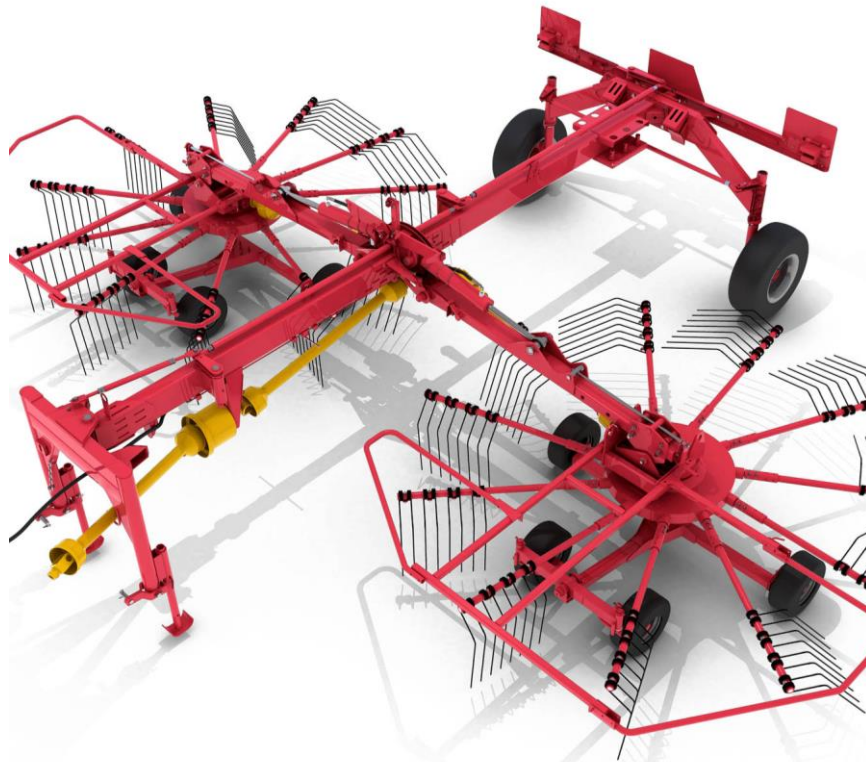
– **Ability to choose a size of swath:** Adjustable reflector forms swath of required width. It provides a possibility to select a swath by aggregates with various width of pickup rake.

– **Reducing the losses when raking:** Availability of tandem-trolley adjusted in height allows to copy the field relief in various planes, and pass the unevenness without losses and “digging” the rakes into soil. Ideal raking without losses and swath contamination with soil is achieved due to very close position of copying carriage wheels to rake pins.

– **Clean raking:** Four doubled rakes on each beam guarantee clean raking and minimal losses. The design provides rapid and convenient rake elements removal during their replacement.

– **Convenience and safety transportation:** Convenience and safety transportation is performed due to installed cassette case for fixing removable rakes and foldable protective arcs. Convenient and reliable three-point hitch allows reducing the aggregation time of the rake with tractor. Maintenance of Kolibri 470 is extremely easy, and does not require special tools and equipment. The machine has only three objects for lubrication.

2. Kolibri Duo 810 double-rotor towed rake: KOLIBRI DUO 810 double-rotor towed rake is required if you want to get the exemplary forage and avoid even minimal losses. It is used for laying in perfectly even double swaths of mowed high-yield sow and natural grass with humidity not higher than 70% on the fields with flattened relief. Two rotors provide higher productivity up to 8 hectare/hour, clean raking, fine formed swaths, as well as careful processing of forage mass. At central raking, double throwing of mass and falling of leaves from forage culture is not happen. You will not worry for your harvest with Kolibri Duo 810.



– **The highest quality of forage with minimal losses:** Imported rotor gearbox give guarantee of long-term high-quality operation of rake. The rotor attachment design allows optimal copying the field relief in lateral and longitudinal directions, and the operating height of raking pins is optimally maintained. This leads to reducing of losses and minimal contamination of forage.

– **Ideal raking:** Clean raking of mass is provided by four doubled rakes installed on each beam.

– **Maneuverability:** The drive-up system of rear support wheels gives the machine the high maneuverability, what provides convenience of the rake operation, as well as reduces the work duration.

Text 7. Fertilization Equipment: Mounted Spreader Grach and RSM AP-3000/4000 Liquid Fertilizer Applicator

Sources: <https://www.kleverltd.ru/en/catalog/fertilization/GRACH/>,
<https://www.kleverltd.ru/en/catalog/fertilization/AP/>

Today, every farmer knows that tillage with mineral fertilizers accelerates the growth and maturation of plants. Rostselmash mineral fertilizer spreaders guarantee an even distribution of chemical elements at each stage of the maturation of agricultural crops, contributing to an increase in the fertile properties of the soil and an increase in yield.

1. Mounted spreader Grach: The PA-900 and PA-1000 Grach mineral fertilizer spreader allows carrying out uniform spreading of dry, granulated, milled, and crystallized fertilizers providing their more efficient application and high yield, respectively. The PA-900 and PA-1000 Grach mineral fertilizer spreader is an ideal spreader for agricultural enterprises and individual businessmen. Operation of one of the sides of spreader is made possible by switching off the mechanism of fertilizer delivery to one of the discs. Due to its open design, the PA-900 and PA-1000 Grach fertilizer spreader does not need any special care, and its robust and almost maintenance-free design provides long-term and trouble-free operation of the equipment. The PA-1000 model spreader has also an option – V-500 tanker extension, which allows increasing the fertilizer tanker capacity by 500 liters.



– Advantages of using the Grach mineral fertilizer spreader:

- ✓ Mechanical drive of tools
- ✓ Maximum payload does not exceed 1800 kg
- ✓ Robust framed design
- ✓ Improved center-of-gravity position relative to tractor due to the tanker shape
- ✓ Low loading height
- ✓ Best control due to the use of the tanker double funnel-shape heads system
- ✓ Trouble-free operation due to folding back and shutting grates
- ✓ Level indication with the use of large sight glasses
- ✓ Distribution mechanism is completely made of stainless steel
- ✓ Convenience and reliability due to a simple and accessible device for setting up distribution rate and operating width
- ✓ Maintenance-free oil-bath lubricated reduction gear box with an integrated overload protection device

- ✓ Excellent design of double sliding gates system being used for setting up application rate and for opening/shutting the gates
- ✓ Crate protecting against foreign matters, distribution rate control device
- **Fertilizer application flexibility:** Operation of one of the sides of spreader is made possible by switching off the mechanism of fertilizer delivery to one of the discs.
- **Reliability:** Due to its open design, the PA-900 and PA-1000 Grach fertilizer spreader does not need any special care, and its robust and almost maintenance-free design provides long-term and trouble-free operation of the fertilizer spreader.
- **Fertilizer smooth feeding:** Feeding fertilizers to the center of the distribution disc is especially efficient, because the peripheral speed of the distribution discs in very low in that sector.
- **Operation uniformity:** The system contains special-shaped scrappers, which allow removing fertilizers out of the tanker in the most convenient way. Consequently, the tanker is discharged uniformly over its surface.

2. RSM AP-3000/4000 Liquid Fertilizer Applicator: The fertilizer applicator is designed for applying liquid mineral fertilizers to the soil of tilled crops such as sunflower, corn, sugar beet (plant-root fertilization), and cereal crops.

When the traditional, or basic, way of fertilizing plants in the fall is used, there is no 100% guarantee that the applied materials will remain until the spring and maintain their nutritional properties. The use of RSM AP applicators guarantees maximum retention in the soil and bioavailability of fertilizers and microelements during the growing season. This is especially important during the period of drought when the surface application of dry mineral fertilizers with a spreader is inefficient, and high daytime temperatures limit the operation of spraying devices due to the risk of leaves burning.



Fertilizers are applied directly to the root zone that ensures their highly effective taking. This type of dressing allows saving up to 30% of fertilizer compared to surface application. Fertilizers are consumed in smaller doses, which eliminates the overdose of PPA and the risk of plant burns.

Advantages of using applicators:

- ✓ Liquid fertilizers easily reach roots intensifying their growth, which improves other nutrients and microelements uptake and makes the plant stalks stronger.
- ✓ Possibility of using other nutrient chemicals such sulfur.
- ✓ Relatively longer period for applying fertilizers; the best result of taking fertilizers by plants in the period of drought.
- ✓ Elimination of the risk of chemical burn even in case of heavy rate of application (in comparison with foliar application), no excess nutrients.
- ✓ Sufficiently lower loss of active ingredients in comparison with surface application, which allows reducing the amount of fertilizer being applied by 15-20%.

✓ Possibility of applying exact amount of fertilizers when applying both small and large amounts.

✓ Reduction of expenses on storage, delivery to the field, and filling.

– **Clearance under the frame:** RSM AF-3800 series applicators provide the flexibility of applying fertilizers and sufficient clearance preventing plants from damage. The large clearance under the frame allows applying fertilizers timely and efficiently, which increases crop yield.

– **Frame and tool bar:** A robust double main frame with dimensions of 4 x 4 and a two-cylinder lifting device increasing the reliability of the machine are used in AF-3800 series. The pressure-exerting hydraulic system provides stable penetration of the applicator ensuring uniform application.

– **Knifed colters:** The 11 colter modification allows treating 6, 8, 10, and 12 rows under 70 sm wide space between the rows. The 17 colter modification allows treating up to 12 rows, when the space between the rows is 70 cm, and up to 16 rows, when the space between the rows is 45 cm.

The colters used in the applicators have the following advantages:

✓ Parallel clutch control lever

✓ Buckled cutting edge, 59 cm

✓ Pressure of 63 kg/cm

✓ Wear-resistant back knife nose

– **Hydraulically powered Ace centrifugal (rotary) pump:** The cast steel pump housing and the silicone-and-ceramic shaft seals provide high resistance to wear and long service life. The absence of a valve unit in the pump makes the pump less sensitive to the quality of the treatment of water filled, which is very important under conditions of water intake from natural sources. The performance of the hydraulic motor-powered pump is up to 511 L/min, and its maximum pressure is 8.3 bar.

– **Control panel:** The application computer designed and manufactured by Raven company is easy-to-use. Several keystrokes are enough for setting necessary rate of liquid fertilizer application. The computer will automatically keep the set value to high precision in a wide range of speed variation. The turbine-type flow meter controlling the electrically powered valve, as well as the additional speed sensors allow providing perfect application precision.

– **Extra tank:** In accordance with the safety requirements regarding any work or manipulation with chemicals, a tank with clean water for washing hands, rinsing eyes and mouth with a capacity of 34 liters is placed on the applicators.

Text 8. Grain Tank Accumulator

Source: <https://sar.rostselmash.com/products/carts/Bunker>

A grain tank accumulator is designed for increasing the harvester efficiency due to reducing of working time losses by 30-40%. Grain tanks-transfers perform grain acceptance from harvester during harvesting of cereals and tilled crops, their transportation to the edge of field and transferring to vehicles. Therefore, the unloading process of grain from harvester does not require it stopping and provides continuous harvesting process. Grain unloading from harvester does not require its stopping. Special design of unloading worm allows transferring the grain not only to deck of grain carriers, but also into input tank of worm transfers to load the granaries. Grain tank accumulators will assist the agricultural goods manufacturers to reduce the time for sowing campaign due to ability to deliver the seed material up to the field. In the base set, the grain tank-transfers are equipped

with high-efficient 6-m unloading worm, turning sleeve of unloading worm and rolling canvas from rain. The Rostselmash grain tank accumulators are made of high-quality components to provide long-term and faultless operation in adverse conditions of harvesting season. Additional plus for agricultural goods manufacturers will be considerable reducing of labor costs.



The key features are:

– **Simplicity of aggregation with tractor:** On the grain tank carrier short tongue there is a jack with turning handle, which allows to aggregate it with tractor without any problem.



– **Direct worm drive from tractor power take-off (PTO):** The worm drive is performed from tractor PTO. Torque moment of tank bottom worm is transferred through belt drive, and in unloading worm – through direct gear from gearbox shaft. It excludes the application of chain drive, and, due to this, the transfer time is reduced, and the efficiency of the tank worm is increased.

– **Low-pressure tires:** Reducing of soil compaction is achieved due to low air pressure in tires of tank-transfer.



Direct worm drive from tractor PTO



Low-pressure tires

– **Adjustable grain unloading speed:** Grain transfer speed adjustment is performed by means of valves arranged inside the grain chamber. The valve position is adjusted from tractor by means of hydraulic cylinders, which change the height of valve elevation relatively to tank bottom worm.



Valves inside the grain chamber



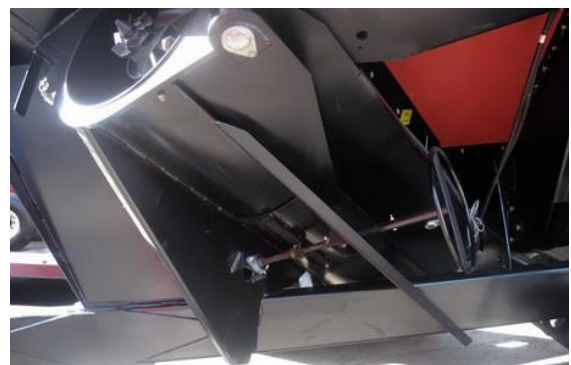
Canvas

– **Providing of grain safekeeping for transportation:** Tank-grain carrier is equipped with canvas, which, in case of transportation to long distances, prevents grain losses, penetration of water, dust, and dirt into grain chamber. Special roller mechanism with a handle allows to cover the grain chamber with canvas just by one operator standing on ground.

– **Grain lower unloading adjustment:** The wheel with toothed gear allows manual adjusting of the grain unloading speed.



Wheel with toothed gear



Grain lower unloading system

– **Grain lower unloading system:** The Rostselmash grain tank accumulators in basic set are equipped with grain lower unloading system. This allows unloading the grain into input devices of worm transfers to provide fast loading of granaries.

Text 9. Trailer Sprayers RSM TS-6200 Sputnik

Source: <https://www.kleverltd.ru/en/catalog/trailer-sprayers/>,
<https://www.kleverltd.ru/en/catalog/trailer-sprayers/SPUTNIK/>,
<https://rostselmash.com/products/models-opr/rsm-ts-6200-sputnik/>

Chemical protection of plants from pests and diseases at the present stage of development of technologies of cultivation of agricultural crops is of particular importance. The cost of the additional harvest received is several times higher than the cost of its production, including the purchase of specialized equipment. For spraying plants, Rostselmash produces trailed machines designed for continuous and tape distribution of chemical solutions.

The trailer sprayers produced by Rostselmash are reliable and high-performance machines designed taking into account all the nuances of the process of spraying agricultural plants for efficient operations in fields all over the world.

These machines are equally efficient in cases of their use in technologies both complete and stripe-type covers. Solution feeding is performed by means of a diaphragm piston pump with a function of self-pumping. Our sprayers are able to apply from 40 to 600 liters of solution per hectare at the speed from 5 up to 18 km/h with the 02 and 04 calibre injection nozzles. The solution rate of application is set by the operator and is automatically maintained at a specified level regardless of the speed of movement, and a computer equipped with a GPS / GLONASS receiver controls automatically (switching on/off) the irrigation sections. The sprayers are able to apply from 60 to 400 liters of solution per hectare at the speed up to 15 km/h. The standard of solution application is set up by an operator and automatically maintained at the specified level without regard to travel speed, and a computer equipped with a GPS-receiver perform automatic control (switching on/off) of watering sections.

Control of any process from adjustment of the boom position to solution spraying is performed by means of remote panels in the tractor cab. The sprayer is driven by the tractor OTP shaft.

Let's consider a trailer sprayer RSM TS-6200 Sputnik.



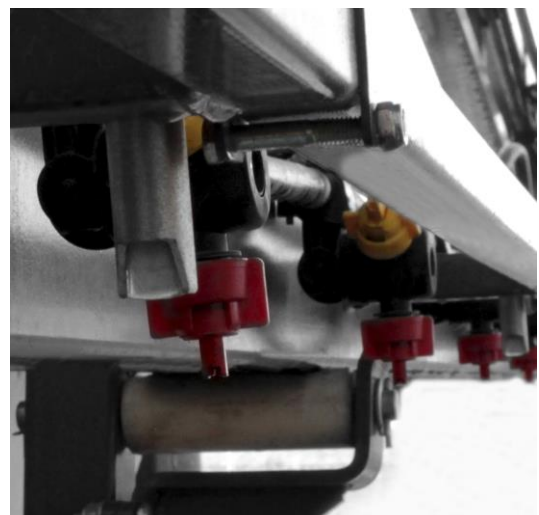
Quality advantages of sprayers RSM TS-6200 Sputnik are:

– **Working on Different Crops:** Track adjusted within the range of 1.8-2.25 m makes it possible to use the sprayer on any crops with different spacing (45/70/75/90 cm). Options: wheels and tires with standard size of 230/95 R48 paired through 45/70 cm spacer for reduction of pressure on soil, sizes of 380/90 R46, 480/80 R46, 520/85 R46, and 620/70 R46.

– **Quality Spraying in Strong Wind Conditions:** Basic configuration includes triple revolving nozzle holders with injection sprinklers having -02, -03, and -04 standard sizes. This allows to ensure efficient work even with the wind speed of up to 8-10 m/s.



Triple revolving nozzle holders



Boom LED Backlight

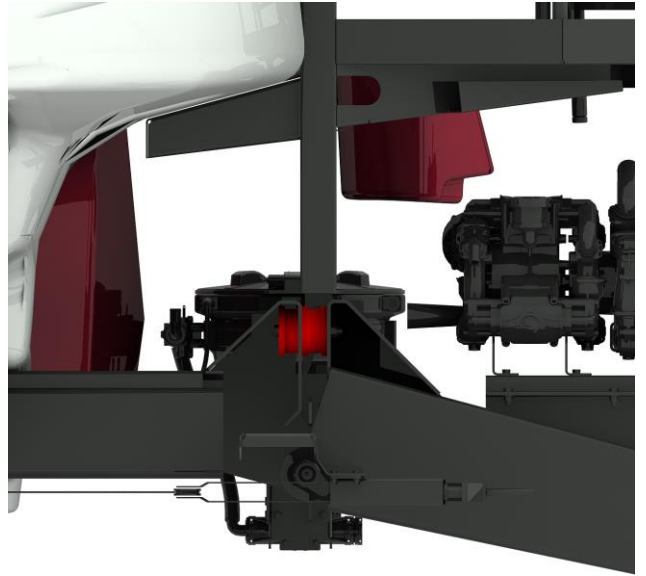
– **Boom LED Backlight:** It provides full control over the plant treatment process. Individual illumination of nozzles allows overall dimensions of the machine to be seen perfectly well and operability of each sprinkler on the boom to be determined with absolute precision.

– **Hitch Tongue Damping:** Hitch tongue includes its own oscillation damping system: 4 dampers placed between the frame and hitch tongue. Dampers flawlessly dampen oscillations generated in the tractor and trailer sprayer hitch which, without doubt, improves agent application quality and prolongs service life of assemblies and units.

– **Absolute Precision:** Control computer with GPS/GLONASS allows for automatic switching on/off of spraying sections and 4 outermost nozzles on the left and right sides, additionally improving treatment quality in case of overlapping with already sprayed areas, and it provides essential cost saving.

– **Uniform Spraying:** Closed-loop system ensures operating liquid circulation. Boom sections are always filled with the operating liquid, and this guarantees simultaneous spraying through nozzles all over the operating width with a precisely set application rate. Because of this, the quality of application and uniformity of agent distribution are improved.

– **Boom Height Control System:** System utilizes ultrasound boom height monitoring sensors automatic calibration of which takes just a couple of minutes. Spraying height can be set and be automatically maintained at the preset level which allows for performance of works on plant protection quicker and with more precision.



Hitch tongue with its own oscillation damping system

Text 10. Trailer Sprayers RSM TS-3200/4500 Satellite

Source: <https://www.kleverltd.ru/en/catalog/trailer-sprayers/>,

<https://www.kleverltd.ru/en/catalog/trailer-sprayers/TS/>,

<https://rostselmash.com/products/models-opr/pritsepnoy-opryskivatel-rsm-ts-3200-4500-satellite/>

RSM TS-3200 Satellite sprayers are the embodiment of reliability, long operational life, and quality. The sprayers are just the machines which will bring you joy due to their high performance, spraying accuracy, and control simplicity. Rostselmash's trailed sprayers are good investment, which will bring profit for many years.

Quality advantages of sprayers RSM TS-3200/4500 Satellite are:

1. Chassis and frame

– **Reliable and durable frame:** The space frame immune to bend and torsion forces provides reliable fixing and protection of the tank. It provides reliability and secure travel of the sprayer over fields having different relief. Due to its low center of gravity the machine has a good stability when running over a field and by a road. To reduce draught resistance the most part of the sprayer total weight is rested on the tractor hitch device.

– **Operation with all cultures:** The versatile wheeltrack of 1.5-1.8-2.1 m allows using the machine for spraying any kind of cultures with different spaces between rows, and

the narrow tires with the width of 270 mm allows spraying beetroot without the risk of root damage.



2. Control unit

– **Absolute accuracy:** Installation of a device for automatic switching on/off of the 4 extreme (right and left) nozzles is optional.

– **Application accuracy:** The sprayer is equipped with a watering control computer having GPS direction indicator function, which allows working according to the technology of accurate farming. The automatic preparations (solutions) flow control unit simplifies the work, enhances the abilities, and increases the sprayer reliability. Besides, the computer allows performing automatic GPS control of watering sections in case of treated areas overlap. The time of the sections switching on/off can be programmed by operators themselves by using overlap percentage ratio.



Watering control computer



Boom height control system

– **Operation convenience:** Boom and its height control system allows changing the height and the angle of treatment promptly.

– **Boom nozzle LED lighting:** It gives full control over the processing of plants. Single-nozzle lighting allows to see the machine dimensions perfectly, and accurately determine the working capacity of each nozzle on the boom.

3. Control pulpit

– **Centralized control pulpit:** The increased focus in the design of sprayers is implemented on elements such as flow control and operation flow control systems, as well as

chemicals feeding system. The centralized control pulpit allows perform all basic operation: tank and sprayers system rinsing, mixer switching on/off system. After the filling and rinsing an operator can wash his/her hands and protective clothes with clean water extracted from a special tank with the capacity of almost 56 liters.

– **High maintainability:** Application of modular approach in the design of watering equipment (taps, fittings, pipes) provide the highest possible maintainability, and the use of simple, robust, and reliable globe taps allows avoiding idle periods, which is especially important for work within short agricultural terms, when every minute is extremely important.

4. Booms and sprayers

– **Smooth operation:** The nozzles spray water solution evenly and strictly in a specified direction. The patented system of boom hitching provides unshocked run and smooth adjustment of the boom height.

– **Damping horizontal oscillations:** The pivot axis of the boom is in its highest point, which provides self-alignment according to the principle of pendulum action. Additional springs and shock-absorbers provide stable position of the boom during operation even on complex agricultural background. High-efficient protection of the extreme section and differently oriented articulated links of the mechanical sections provide high-efficient damping of horizontal oscillations.

– **Reliable damping vertical vibration system:** The trailer sprayers Satellite use a reliable solution for damping vertical vibrations – hydropneumatic accumulator (with nitrogen pumped in under pressure) – which exclude boom oscillations and require minimal maintenance.

– **Protection of the outer boom sections:** The boom is equipped with shockproof links, which when in contact with an obstacle, deflect 60° back and 20° up. The shock-proof links are returned to their original location due to the action of the spring and their own weight.

– **Injector sprayers:** The basic equipment includes triple nozzle holders and revolver-type injector sprayers (-02, -03, -04), which allows operating more efficiently under windy weather conditions even when the speed of wind is up to 8-10 m/sec. Application rate range at the speed of 10 km/g, l/ha:

✓ 67-310 – when using sprayers (-02 yellow, -03 blue, -04 red)

✓ Up to 500 when using sprayers (-06 grey)

✓ Up to 600 when using sprayers (-08 white)



5. Sprayer tank and chemical mixer

– **Improved mixer:** There is an active chemical mixer of increased capacity (40 liters) installed on the sprayer. It allows mixing both liquid and powder preparations efficiently and with a high performance providing high quality preparation of working mixture.



Mixer



Solution tank

– **Solid-cast tank:** The solid-cast solution tank is made of special plastic, and the thickness of its walls is 15 mm. It provides high operation characteristics, and its absolutely smooth inner surface excludes solid particles sedimentation of the wall of the tank. The drain channel along the whole length of the tank having the depth of 10 cm provides high-quality and complete feeding of solution to the pump at different angles of tilt of the sprayer. The channel ends in a water well having the depth of 25 cm, which helps to prevent operation of the pump in dry condition.



Pump



Water intake hose

– **High performance pump:** The high-performance diaphragm piston pump (260 l/min) provides even application of preparations, high-quality preparation of working fluid and active mixing of solution for maintaining stable concentration. The application rate is from 60 to 500 L/ha. Thus, Satellite 3200 can be used for full-volume and low-volume spraying – the most advanced methods of chemicals application. The filters with the function of self-cleaning installed on the intake and pressure lines efficiently remove mechani-

cal impurities providing high-quality filtration of solution, increase the convenience of operation, and reduce the machine maintenance time.

– **Water self-intake:** A 10-meter-long water intake hose with a non-return valve and a filter increases the convenience and the operational independence of the machine and allows using the own pump of the sprayer for self-pumping (self-intake) of water from external sources and water reservoirs.

Text 11. Benefits of Using Tractor Trailers in Agriculture Sector

Source: <https://www.fieldking.com/blogs/use-of-tractor-trailers/>

Tractor trailers are one of the most popular farm implements that are commonly used for transporting goods. Tractor trailers are typically composed of a tractor unit and one or more trailers. The tractor unit is the engine and cab of the vehicle, while the trailer is the large box-like structure that is used to transport goods. The trailer is typically attached to the tractor unit via a fifth wheel, which is a large, circular plate-like device that is connected to the tractor and the trailer.

Tractor trailers have been around for decades, and are used for a variety of purposes. They are also used to transport goods from one location to another or to transport large items such as vehicles or building materials. They are also used in the military to move personnel and equipment over long distances.

Tractor trailers come in a variety of sizes and shapes and can be customized to meet the needs of the customer. They can be equipped with a variety of features, such as additional storage space, refrigeration, and more. Tractor trailers are very helpful agricultural machinery if you use them to transport goods and materials from one location to another.

– The benefits of tractor trailers

1. **Increased Mobility:** Tractor trailers are designed to haul heavy loads over long distances, making them much more mobile than other types of vehicles. This makes them ideal for businesses that require the transportation of goods over long distances.

2. **Increased Capacity:** Tractor trailers can transport large amounts of goods and materials in a single trip, which makes them much more efficient and cost-effective than other types of vehicles.

3. **Cost Savings:** Using tractor-trailers for transporting goods can be significantly cheaper than using multiple smaller vehicles. This is due to the increased capacity and mobility offered by the trailer, as well as the fact that it only needs one driver to operate.

4. **Enhanced Safety:** Tractor trailers are designed to be much safer than other types of vehicles in the event of an accident. The large size and weight of the trailer help to absorb much of the force of an impact and protect the cargo and driver from harm.

– Types of Tractor Trailers



Tipping trailer



Non-tipping trailer



3-way tipping trailer

1. Tipping trailer: A tipping trailer is a type of trailer used for transporting and unloading various materials. It is commonly used for carrying materials such as soil, gravel, sand, mulch, and other materials. The trailer has a bed that can be raised and lowered to allow the materials to be unloaded. The trailer is typically towed by a truck or tractor.

2. Non-tipping trailer: A non-tipping trailer is a trailer that is designed to remain level and stable when loaded. This type of trailer is commonly used to carry large, heavy loads that may be too heavy for a typical tipping trailer. Non-tipping trailers are also often used to transport materials that are sensitive to tipping, such as hazardous materials. Non-tipping trailers are more expensive and require more care than tipping trailers, but they are suitable for safely and securely transporting large, heavy loads.

3. Three-way tipping trailer: A 3-way tipping trailer is a trailer that is designed to tip in three directions. This type of trailer is often used for hauling and transporting heavy materials such as gravel, sand, or soil. It is also used for carrying large items such as logs, rocks, and other debris. It is designed to be able to tip in the direction of the front, the side, or the back, depending on the need and the terrain. This makes it easier to dump the load, and it also allows for easy loading and unloading of materials.

Text 12. Tractor Semi-trailers and Trailers

Source: https://bobruiskagromach.com/en/catalog/tractor_trailers/

Let's turn our attention to different models of tractor semi-trailers and trailers designed for transportation of agricultural goods.

1. Tractor dump semi-trailer PST-3,5:

This semi-trailer is designed for transportation of various building materials, asphalt, ready mixed concrete and transportation of agricultural goods with dumping it back. The trailer is aggregated with wheel tractors of class 0,6-1,4 with trailer hitch, hydraulic output and a socket for connecting electrical equipment. The use of the semi-trailer is possible in all soil-climatic zones except mountainous.



2. Tractor semi-trailer PST-9:

This semi-trailer is designed for transportation of various agricultural goods, grain, root crops, organic fertilizers with back dumping. The back gate opens automatically when the body rolls over. The semitrailer has a balancing trolley with a rigid or spring suspension with the tires 16.5/70-18, which increases ride smoothness and is equipped with a pneumatic brake system.



In accordance to the request of the consumer, the semitrailer can be equipped with additional extension boards of 200 mm. height or 800 mm. height (200 mm. all-metal; 800

mm. mesh.). Semitrailer can be used in all areas of agriculture, except mountainous.

3. Tractor semi-trailer PST-14: Tractor semi-trailers of the new generation PST-14, PST-18 and PST-24 are unified semi-trailers of increased carrying capacity on wide-profile tires for tractors "BELARUS" of traction classes 2-5. The main all-metal body with a tailgate opening with the help of hydraulic cylinders has a capacity designed for transportation of materials of medium density (sand, garbage, manure, ready silo, mineral fertilizers) taking into account the natural bulk cone (cap). By request, for transportation of seeds of various crops, root and field crops, compound feed, semi-trailers are equipped with low added boards, and for lightweight goods with high added boards.



Tractor semi-trailer PST-14



Tractor semi-trailer PST-18



Tractor semi-trailer PST-24

4. Semi-trailer for transportation of corncobs PPK-10: Semi-trailer PPK-10 is designed for working in combination with a corn harvester as a storage tank for corncobs loaded into the body of the semitrailer from the harvester. Unloading of the semitrailer is carried out by turning the body, lifted along the inclined guides, around the horizontal axis and the load is reloaded into a nearby vehicle.



The semitrailer is made with a special telescopic drawbar in order to increase the possibilities of use, which allows with a minimum drawbar length to aggregate the semi-trailer with a tractor and to perform the same functions of a storage-reloader.

The semitrailer is aggregated with a corn harvester based on the Belarus-1523 tractor, it can be aggregated with other wheeled tractors of traction class 2 or 3, equipped with a drawbar device TSU-2 or TSU-3V, outputs for connecting electrical equipment and a brake system.

5. Universal semi-trailer vehicle UPTS-15 "DNEPR": Semi-trailer UPTS-15 is designed for transportation and unloading of silage, as well as various bulk agricultural products. The construction includes 2 spiral vertical spreaders, which with minimal effort ensure an ideal distribution of fertilizers. In fact, you can use two machines in one due to the use of an extremely simple mechanism which also allows an extremely fast feed unloading.



6. Tractor trailer 2PTS-4,5: The dump tractor trailer 2PTS-4,5 is designed for transportation of various agricultural goods, organic fertilizers with a bulk weight up to 1600 kg/m³ (2PTS-4,5A) and up to 400 kg/m³ (2PTS-4,5A-1, 2PTS-4,5A-2) with unloading back and on two lateral sides. The use of the trailer 2PTS-4,5 is possible in all soli-climatic zones, except mountainous. The trailer 2PTS-4,5 is biaxial on tires of type 9.00-16 and equipped with pneumatic brakes. It is possible to use a trailer for transportation of various goods with a small bulk weight up to 0,4 m. (silage, green mass, cotton, etc.). For this, in accordance with the request of consumers, the trailer can be equipped with additional extension boards (1 - mesh boards, 2 - all-metal boards). The trailer 2PTS-4,5 is unloaded using one hydraulic cylinder located in the center of the trailer's cargo platform. The choice of the side of unloading is made by manual unzipping of the corresponding clamps connecting the cargo platform to the trailer frame.



7. Tractor dump trailer 2PTS-6: The dump trailer is designed for transportation of various agricultural goods, grain, root crops, organic fertilizers, building materials and other bulk loads with a volume of 0.8-1.6 t/m³ with unloading back and on two sides.

The use of the trailer is possible in all soil and climatic zones, except mountainous. The trailer is biaxial with four tires of type 13.0/75-16HC10 and equipped with pneumatic brakes.



It is possible to use a trailer for transportation of various goods with a small volume (silage, haylage, green mass, cotton, etc.). For this, in accordance with the request of consumers, the trailer can be equipped with additional extension boards (2PTS-6-1 - mesh boards, 2PTS-6-2 - all-metal boards).

Unloading the trailer is carried out with the help of one hydraulic cylinder located in the center of the trailer loading platform. The selection of the unloading side is made by manually unsticking the corresponding clamps which are connecting the loading platform to the trailer frame.

Text 13. Mineral Fertilizer Spreaders

Sources: https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizers/machines_for_mineral_fertilizers/,
https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizers/

There are different models of mineral fertilizer spreaders. Let's consider some of them.

1. Mineral fertilizer dispersers RU-1000, RU-1600 and RU-3000: These models of mineral fertilizer dispersers are designed for top application of mineral granulated or crystallized fertilizers as well as for feeding winter grain crops (at the early stage of growth), meadows and grass fields.



2. Mineral fertilizer distributor MTT-4U: Mineral fertilizer distributor MTT-4U is designed for surface application of the main doses of solid mineral fertilizers in granulated or crystallized form. It's possible to use the machine for powdered chemicals application (dolomite powder, lime). Both the transporter and spreading discs drive are mechanical from tractor PTO.



RU-1600



RU-3000



3. Mineral fertilizer distributor RU-7000: This distributor is designed for transportation and surface application of mineral fertilizers, limestone materials and chemical ameliorants. The mineral fertilizer distributor has a feed conveyor drive from the machine wheel that provides synchronization of the product feed with the machine speed as well as from the tractor PTO. The machine has a manual adjustment device for changing working product type and required application rate.

RU-7000-1 is provided with the mechanical drive 9 (activated from the tractor PTO shaft) of distributing centrifugal tools (plates) and the hydraulic drive of the feeding conveyor activated from the tractor hydraulic system. The application rate is programmed and monitored by the onboard computer.



4. Pulverized chemicals distributor MSH-9: Pulverized chemicals distributor MSH-9 is designed for transportation and surface application of pulverized chemical reclamants (dolomite powder). The machine can be used in all areas of agriculture, except

of mountainous areas.

The machine is aggregated with wheeled tractors of at least 3 traction class (Belarus-2022), with hydraulic outlets, pneumatic brake actuator, PTO, a socket for connecting light-signal electrical equipment, a drawbar device TSU-3V and a socket for connecting portable electrical equipment (local lighting).



Text 14. Organic Fertilizer Spreaders: Slurry Tankers

Sources: https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizers/machine_for_making_organic_fertilizer/,
https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizers/

Organic fertilizer spreaders include slurry tankers and solid organic fertilizer applicators. Let's consider the models of slurry tankers in more detail.

1. Slurry tankers MJT-3, MJT-F-6, MJT-F-11: These slurry tankers are designed for self-loading, transportation, mixing and overall surface distribution of liquid organic fertilizers as well as for transportation of service water, car washing, fire-fighting, road washing, etc.



In the slurry tanker MJT-3 loading of fertilizers into the tanker is performed by the vacuum system via the intake hose. Spreading of fertilizers is performed by the pump through the rear discharge pipe with a shutter.

As to the slurry tanker MJT-F-6, loading of fertilizers into the tanker is also performed by the vacuum system through the intake hose. Spreading of fertilizers is performed by the centrifugal pump that also mixes fertilizers during their transportation. This tanker is available in three versions: MJT-F-6 – carrying capacity 6 t.; MJT-F-6-A – carrying capacity 7 t.; MJT-F-6-2 – carrying capacity 6t on the low-pressure tires.

The slurry tanker MJT-F-11 is equipped with a vacuum system and a hatch for loading machine by autonomous devices.

2. Slurry tanker MJU-16: The slurry tanker MJU-16 is designed for self-loading, transportation, mixing and overall surface distribution of liquid organic fertilizers as well as for transportation of service water. Upon request, it can be equipped with a device for connecting to a fire hose spout.

Fertilizer distribution is performed by a centrifugal pump and a spreading device. Fertilizer loading is performed by a vacuum system via an intake hose or by autonomous devices via a loading hatch.



3. Slurry tankers MJU-20 and MJU-20A: Both slurry tankers are designed for self-loading, transportation and distribution of liquid organic fertilizers.

The slurry tanker MJU-20 can be equipped with:

- an adapter for surface spread application (MJU-20);
- an adapter for subsoil application (MJU-20-1);
- an adapter for surface tape application using hose spreaders (MJU-20-2);
- a three-axle running system, unified with MTU-24A (MJU-20A);
- a three-axle running system and an adapter for subsoil application (MJU-20A-1).



MJU-20



MJU-20A-1

A distinctive feature of the new slurry tanker MJU-20A is a three-axle running system instead of a two-axle system in order to reduce pressure on the soil and reduce the load to the tractor hitch device. The tank, loading and spreading device, hydraulic drive, brake system and electric lighting equipment are unified with the base machine MJU-20.

Advantages liquid slurry tanker MJU-20A are:

- reduced pressure on the soil;
- improved cross ability of the semi-trailer in the field conditions;
- reduced load to the tractor hitch device;
- reinforced running system is installed;
- increased lateral stability.

4. Slurry tanker for self-loading and feeding of non-food and non-flammable liquids MJT-3P: The slurry tanker MJT-3P is designed for self-loading, transportation and supply of water, non-food and non-flammable liquids in conditions of limited capabilities of the energy means. The MJT-3P machine can be used autonomously, if necessary, to ensure fire-fighting conditions in agriculture or forestry, as well as used in cases of fire elimination, extinguishing open fire in the forest, fields or premises.

Self-loading and supply of water, non-food and non-flammable liquids is carried out using a mud gasoline motor pump, which is driven by a gasoline engine. The machine can

also be equipped with a fireman's trench tool (hook, shovel, axe, cone bucket, etc.).

The MJT-3P machine is aggregated with wheeled tractors of traction class 0.6-0.9, having a TSU-2B, a pneumatic brake actuator and a socket for connecting electrical equipment.



Text 15. Organic Fertilizer Spreaders: Solid Organic Fertilizer Applicators

Sources: https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizers/machine_for_making_organic_fertilizer/,
https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizers/

Organic fertilizer spreaders include slurry tankers and solid organic fertilizer applicators. Let's consider the models of solid organic fertilizer applicators in more detail.

1. Solid organic fertilizer applicator PRT-7A: This applicator is designed for transportation and overall surface application of solid organic fertilizers as well as for transportation different agricultural loads together with a tractor. The new series of machines, retaining all the best technical solutions and the quality of production, ensures the optimal quality of solid organic fertilizers application and the most comfortable working conditions for machine operators. The machines are equipped with one hydraulic reversible conveyor (instead of two conveyors driven by the tractor's PTO in previous models) and modernized spreading device.

2. Solid organic fertilizer applicator MTT-9: This applicator MTT-9 is designed for transportation and overall surface application of solid organic fertilizers. The new series of machines, retaining all the best technical solutions and the quality of production, ensures the optimal quality of solid organic fertilizers application and the most comfortable working conditions for machine operators. The machine is equipped with a reversible hydraulic drive of the conveyor ensuring the smooth, stepless regulation of the dose of fertilizer application.



3. Solid organic fertilizer applicators MTU-15 and MTU-18: Both solid organic fertilizer applicators are designed for transportation and overall surface application of solid organic fertilizers and with the spreading device off they can be used for transportation of different agricultural loads with rear conveyor discharge.

The MTU-15 machines can be made in two versions:

- MTU-15 – machine for solid organic fertilizers application (with a combined spreader (two horizontal grinding drums and two rotors).
- MTU-15-1 – machine for solid organic fertilizers application with spreader with two vertical drums.



MTU-15



MTU-18

The machines MTU-18 can be also made in two versions:

- MTU-18 – machine for solid organic fertilizers application with a spreader with two horizontal grinding drums.
- MTU-18-1 – machine for solid organic fertilizers application with a combined spreader (with two horizontal grinding drums and two rotors).

For transportation of crushed grass and other loads with low volume weight, added boards are provided as an option to both models MTU-15 and MTU-18.

4. Solid organic fertilizer applicator MTU-20: It is designed for transportation and overall surface application of solid organic fertilizers and with the spreading device off it can be used for transportation of different agricultural loads with rear conveyor discharge.

The machines can be made in four versions:

- MTU-20 – machine for solid organic fertilizers application with a combined spreader (two horizontal grinding drums and two rotors).
- MTU-20-1 – machine for solid organic fertilizers application with spreader with two vertical drums.
- MTU-20-2 – machine for solid organic fertilizers application with spreader with four vertical drums.
- MTU-20-3 – machine for solid organic fertilizers application with spreader with two vertical drums and increased body capacity.



MTU-20



MTU-24A-1

5. Solid organic fertilizer applicator MTU-24A-1: It is designed for transportation and overall surface application of solid organic fertilizers with three axis running system and with the spreading device off it can be used for transportation of different agricultural loads with rear conveyor discharge. For transportation of crushed grass and other loads with low volume weight, added boards are provided as an option to both models MTU-20 and MTU-24A-1.

2.2. Working Safely with Mobile and Stationary Agricultural Machinery

Text 1. Hazardous Areas and Control Measures

Source: <https://www.hse.gov.uk/pubns/indg241.htm>

Machinery accidents are caused by a range of factors including: using a machine that is unsuitable for the task; failing to follow a safe system of work; unsafe methods for clearing blockages or making adjustments; failing to follow safe operating or 'Safe Stop' procedures; guards and other safety devices missing or defective; lack of operator training; and poor maintenance.

1. Hazardous areas on agricultural machines: Many agricultural machines have potentially dangerous moving parts, which can cause serious or fatal injuries. For example:

- balers – pick-ups, twine mechanisms and moving rear doors;
- forage harvesters – chopping cylinders;
- combine harvesters – augers in the grain tank and the header unit;
- potato harvesters – rotating rollers and conveyors;
- slurry tankers – power take-off (PTO) shafts;
- bale and straw choppers – chopping mechanisms;
- tractor – hitch mechanisms, PTOs and PTO shafts;
- power harrows – rotating tines;
- feeder wagons – rotating components in the mixing chamber.

These machines and others like them are extremely powerful. Workers using them may become complacent and may not be aware of the forces involved. For example:

- with tractors, a 10 cm diameter fencepost is smashed into matchwood almost instantly when trapped in a rising pick-up hitch;
- leaking hydraulic oil from a burst hose can be projected at 3000 psi and will penetrate the skin as easily as it would if delivered through a hypodermic syringe;
- a PTO shaft will wrap clothes, hair or arms at a rate of about 1.5 metres per second.

2. Control measures

– **Safe Stop:** It is extremely dangerous to carry out any work on a machine while it is under power. The most important safety measure is to follow the Safe Stop procedure before carrying out any maintenance or adjustments, including dealing with a blockage or other problem:

- Put the handbrake on.
- Make sure the controls are in neutral (equipment made safe).
- Stop the engine (or turn off the power).
- Remove the key (or lock-off the power supply).

Many serious and fatal accidents have occurred where operators have tried to clear blockages, tried to correct faults or worked on machines with the engine running or power engaged. So, always make sure you follow the Safe Stop procedure.

Remember that agricultural machines may have several power sources – mechanical, hydraulic and electrical (e.g., a potato harvester with hydraulic-driven components, PTO-driven parts and electrical controls for some systems). All power sources must be isolated during Safe Stop. Usually, stopping the tractor and removing the key does this – but this may not be the case with fixed machinery where it may be necessary to isolate the power supply. Follow Safe Stop: before leaving the driver’s seat/operating position; when anyone else approaches; before anyone carries out maintenance, adjustments or deals with a blockage.

Always make sure the machine has come to rest – remember to allow for any ‘run-down’ time before making any adjustments. Run-down time can vary from a few seconds to several minutes, depending on the machine.

– **Before you start:** Before you start work with a machine there are a few basic checks that can be carried out. Ask yourself:

- Is the machine you intend to use suitable for the job?
- Are all safety devices such as guards in place and working correctly?
- Are you (or the operator) properly trained to do this job/use this machine?
- Has the instruction manual for the machine been provided, read and understood?
- Is the right personal protective equipment (PPE) available and worn?
- Has a risk assessment been carried out?
- Has the work been properly planned and communicated to those who may be at risk?
- If two or more people are involved, has everyone understood what needs to be done and has a system of communication been agreed on?

– **Checking the machine before use:** Before working with any machinery, you should carry out a basic check to make sure that it is in good working order and safe to use. The exact requirements will vary according to the machine but some basic checks could include the following:

– Mechanical defects – pay particular attention to items such as brakes, wheels and tyres.

– Guards and other protective devices should be correctly fitted and maintained in good condition. Check they are in place, securely attached and working – particularly PTO shaft guards. Any damaged or defective guards should be repaired or replaced before the machine is used.

– Check that stopping devices are functioning correctly, e.g., emergency stops.
– All controls should be clearly marked to show what they do.
– If workers are to be carried on the machine ensure they can do so safely, e.g., check for safe means of access and that working platforms have guard rails, etc.

– Hitching and attachment points – for mounted, semi-mounted or trailed machinery, check that it has been safely attached to the towing vehicle such as a tractor. Pay attention to the condition of drawbar/pick-up hitch, and hitch rings, pins, clips, etc.

– Carry out any pre-use checks as specified in the operator’s manual.
– For self-propelled machines, make sure mirrors are clean and properly adjusted. Check any other reversing aids are working.

– **Using the machine:** When you are working with a machine:
– Don’t remove or defeat guards (e.g., by overriding safety devices) in order to allow the machine to work quicker or to avoid blockages or other problems. If guards become damaged or defective, stop work and take action to get them fixed. Don’t leave it until later.

- Don’t run the machine when the guards are removed.
- Replace all guards before making a test run and check the machine before restarting.

- Check for bystanders and warn them before you restart the machine.
- If the machine is to be checked again after the test run, repeat all safety procedures – especially Safe Stop.
- Do not mount or dismount from a moving machine.

Text 2. Dealing with Maintenance and Blockages

Source: <https://www.hse.gov.uk/pubns/indg241.htm>

Let's consider how to work safely with mobile and stationary agricultural machinery when carrying out maintenance and dealing with blockages.

1. The machine operator competence to do the job safely:

Before performing any work with an agricultural machine, including operation, maintenance or repair, consider these questions:

- Are all operators/workers trained to do this job? Relevant training/courses for machines are available from a variety of sources including manufacturers/dealers and through colleges and other training providers. Don't forget that training is needed by casual or seasonal workers. You should also check that any contractors you intend to use are competent to do the job. Workers should not use a machine unless they are properly trained and know how to use it safely.

- Is suitable clothing and footwear available and worn (including any PPE)? Safety boots should usually be worn when using machinery and operators should wear clothes that will not snag on machinery or controls. Any jewellery (including watches and rings) that might snag should be removed and long hair tied back so it does not get caught up in moving parts.

- Have operators been provided with relevant information? The operator should read and understand the instruction manual and keep it handy for quick reference. They should also be provided with any relevant information to enable them to do the work safely, e.g., information from risk assessments. Where workers travel on the machine, e.g., a manned potato harvester, they should also receive adequate instructions and training.

2. Dealing with blockages or other problems:

- Always follow the Safe Stop procedure before carrying out any intervention.
- Secure anything which could fall on you, e.g., by using props or scotches on tail-gates/doors.

- Secure anything which could move or rotate, e.g., by using chocks.

- Remember that energy is stored in springs or hydraulics, for example. Consider how will you stop this energy being released or release it safely.

- Use the right tools for the job. Remember, machine components may suddenly move when a blockage is cleared.

- Follow the manufacturer's instructions/procedures, e.g., as set out in the operator's manual. Adjusting the machine settings can help avoid blockages.

- Use built-in ladders and other purpose-designed access points and platforms where provided. Where such facilities don't exist, you will need to consider alternative safe means of access, e.g., with measures provided to prevent falls.

- When the job is finished, always replace the guards before running the machine.

- Check the machine over before restarting.

3. Maintenance and repairs: Follow Safe Stop and make sure the power source is locked off or the key removed to stop other people restarting the machine while you are working on it. Always follow the safe working procedures set out in the workshop manual. Don't use substandard replacement parts. Additional precautions may be required where

machinery has broken down in the field due to poor weather and/or the operating environment. Also be aware of risks arising from any in-house modifications and homemade machines.

1. Lubricating: If you need to remove the guard to lubricate the machine, never do so while the machine is in motion.

2. Checking hydraulic systems: Remember that hydraulic oil is under high pressure. If checking for leaks, use something (e.g., a piece of card run along the hose) to show where the leak is. Do not use your hands to feel for leaks. Release the pressure before working on the system.

3. Sharpening: When working on a forage harvester, for example, only the actual sharpening should take place with the machine in motion. All activity before and after sharpening (e.g., guard removal) should be done with the machine's components stationary – even if run-down takes a long time. Beware of flying particles when sharpening machinery. Use PPE such as goggles.

4. Working under machines: When working under raised machines, jacks should be used. These should be correctly positioned, and appropriate means of additional support (e.g., axle stands) provided. When working on hydraulically-raised equipment (e.g., trailers) use props. Never rely on the hydraulics alone.

5. Preventing unintended movement: Where possible, take additional precautions to ensure that moving parts remain stationary, e.g., chocking the cutting cylinder of a forage harvester to prevent movement.

6. Hammering: Beware of flying particles. Always use the appropriate PPE, such as goggles.

7. Cleaning: Be aware of the danger of falling off or into machinery, particularly in wet or muddy conditions. Make sure you know how to access machines safely, especially large machines such as combines. Don't clean with machines running and guards removed.

Text 3. Safe Use of Agricultural Mowers

Source: <https://www.hse.gov.uk/pubns/ais25.htm>

Introduction: This information sheet describes typical hazards when using agricultural mowers. It provides guidance on minimising risks to the operator and others during mowing work and is intended to help employers, employees and the self-employed comply with their duties under health and safety legislation. It does not cover the use of these machines at working demonstrations where it is extremely important to assess and control the risks to bystanders.

There are different types of mower commonly used in agriculture. This information sheet covers the typical hazards likely to be found when using most types of drum or disc mower mounted on or trailed behind a tractor, and describes appropriate control measures.

Hazards: The greatest risk of injury comes from contact with the machine's moving parts including: moving blades or flails; moving drive mechanisms; rotating power take-off (PTO) shafts; rapidly moving blades, flails or other attachments ejected from the machine.

Other risks created by mowing work include: contact with moving parts when clearing blockages; being trapped or crushed while moving the mower between the work and transport positions; being crushed below a raised machine while replacing blades or carrying out other maintenance work; being struck or run over by the tractor and mower; overturns when working on slopes or banks; and being struck by objects or debris ejected from the machine.

Control measures: It is extremely dangerous to carry out work on a machine while it is under power. The most important safety measure is to follow the 'safe stop' procedure before carrying out any maintenance or adjustments, including dealing with a blockage or other problem: handbrake on; controls neutral; stop engine; and remove key.

Always allow sufficient run-down time for blades and cutting mechanisms before approaching or working on the machine. Everyone who works for you needs to know how to work safely. You must provide clear instructions, information and adequate training for your employees on: the risks they may face; measures in place to control the risks; how to follow any emergency procedures.

It is particularly important to consider the training needs and supervision of: new recruits and trainees, including young people who are particularly vulnerable to accidents; lone workers; people changing jobs, or taking on new responsibilities; health and safety representatives, who have particular laws relating to them.

Guarding:

- The power take-off shaft must be fully enclosed in a guard along its entire length from the tractor power take-off to the power input connection on the mower.

- Guards should prevent contact with any dangerous part of the machine when it is in motion or use. Stand-off guards should be properly secured, and positioned front and rear to prevent contact with the blades.

- Make sure all guards are in position, correctly fitted and secure before starting work. Do not continue work with the guards missing or damaged.

- Make sure that the protective skirt or other device to stop objects or debris from being ejected is in place and in good condition.

- Remember that other parts of the mower, such as conditioners, need to be guarded to the same standard as the rest of the mower.

General guidance on safe working practice:

- Make sure anyone operating a mower has received adequate instructions and training. Suitable training courses may be available from reputable sources such as local training providers, agricultural colleges, and through machinery dealers and suppliers.

- Follow the instructions and precautions set out in the operator's manual.

- Do not operate a mower if there are bystanders who are likely to be hit by broken blades or ejected debris (these may travel considerable distances).

- Stop work if you see someone approaching you when mowing is taking place.

- Take care when working on steep ground, particularly when turning, and especially with mounted mowers.

- Watch out for potential blockages – avoiding blockages is easier than clearing them.

Maintenance:

- Follow the manufacturer's instructions for replacing blades and flails.

- Ensure replacement parts meet the manufacturer's specifications.

- Always use a purpose-made prop or stand to carry out maintenance work safely beneath a mower. Do not rely on the tractor hydraulics alone.

- Remember that even when working under a supported machine, heavy parts may also need additional support.

- Suitable protective gloves may be needed when changing blades and carrying out similar maintenance.

Text 4. Safe Use of Big Round Balers

Source: <https://www.hse.gov.uk/pubns/ais4.pdf>

Introduction: This information sheet describes typical hazards from the use of big round balers. It provides guidance to minimise risks to the operator and others during baling work. Different types of big round roll-type balers have particular features which should be taken into account when considering the hazards, risks and precautions. This information sheet covers the typical hazards likely to be found when using most types of round baling machine.

Hazards: Many fatal and serious accidents involving amputations occur when operators are pulled into the bale chamber. The greatest risk of injury comes from contact with the machine's moving parts including: being pulled into the chamber at the pickup; being pulled into the powered pressure rollers or other parts of the machine when attempting to rethread the baler – the twine often catching around an operator's arm or wrist; being trapped by the various parts of transmission or moving machinery such as drive belts, pulleys, chains or sprockets; being struck by the rear door/tailgate; being entangled by an inadequately guarded power take-off shaft.

Other risks created by baling work can include: being struck by moving bales ejected from the machine; being struck or run over by the tractor and baler; working on sloping ground.

Control measures: It is extremely dangerous to carry out any work on a machine while it is under power. The most important safety measure is to follow the safe stop procedure before carrying out any maintenance or adjustments, including dealing with a blockage or other problem: handbrake on; controls neutral; stop engine; and remove key.

Many serious and fatal accidents have occurred where operators have tried to clear blockages; tried to rethread twine or correct a twine fault; or worked on the machine with the engine running or power engaged. So always make sure you follow the safe stop procedure.

Dealing with blockages:

- Never reach into the pick-up reel area with an arm or leg, or attempt to clear a blockage unless you follow the safe stop procedure.

- Develop a safe system of work for dealing with any problems that arise with the baler. This may be written down and form part of your written safety policy or risk assessment but should include as a minimum a safe system for clearing any blockages that occur and for rethreading the baler.

- Spread out large clumps of material in a windrow to help avoid a potential blockage. If the windrow is uneven or has been damaged by bad weather, move it or reform it.

- Blockages will occur if there is a mismatch between pick-up and windrow widths. Use a baler with sufficient capacity for the windrow/crop.

- Avoid baling wet or damp hay and straw, or excessively wet silage, as these cause poor core formation and blockages. Some manufacturers supply pick-ups for use on wet hay or silage.

Guarding:

- Guards are there to prevent contact with any dangerous part of the machine when it is in motion or use. Guards should be fitted at the front, sides and rear of the machine to prevent access to chains, sprockets, rollers and other parts that can cause injury.

- The pick-up reel guard should extend in front of the tines. Guarding should also prevent access at the sides and between the pick-up reel guard rail and the top of the bale chamber.

– The power take-off shaft should be fully enclosed in a guard along its entire length from the tractor power take-off to the power input connection on the baler.

– Make sure all guards are in position, correctly fitted and secure before starting work. Do not use it if the guards are missing or damaged.

General guidance on safe working practice:

– Avoid baling light material in windy conditions and when starting to form a fresh bale. This can lead to poor core formation and uneven bales.

– Operators should receive adequate instructions and training.

– Take advantage of relevant training/courses provided by manufacturers/dealers. They will help ensure your safety and that of your staff, and help you get the best performance from your baler.

– Make the instruction manual available to the operator. The manual should give instructions on clearing blockages, rethreading, refilling netting and dealing with poor core forming.

– Keep people clear of the rear of the baler before ejecting a bale and before reversing or moving off. A big round baler is a bulky machine and operator vision to the rear may be poor. Make sure you keep reversing mirrors clean and properly adjusted.

– Use the tailgate ram prop or safety stops at all times when working under the open rear door.

Precautions for work on sloping ground:

– Select a tractor appropriate to the size of baler and conditions likely to be encountered. Insufficient traction on grassy slopes may cause the wheels to slide and a loss of control.

– Large round bales can roll downhill after being ejected from the machine on sloping ground. You should take this into account when assessing safety risks and decide where you can eject bales safely to minimise the risk of them rolling away. If you are using a contractor to carry out the work you should discuss this and agree the system of work to be followed before they begin working.

– Always orientate the baler correctly before ejecting the bale from the bale chamber. You may need to reverse the machine to achieve a position where the bale can be ejected so it comes to rest safely on the hillside.

– It may be safer on steep slopes to transport the bale within the baler to a flat part of the field before ejection. This will also help make bale collection easier.

– Never try to stop a rolling bale, even with a tractor. A round bale may weigh up to 500 kg and will gain momentum as it moves. People have been killed trying to stop a rolling bale.

– Follow any special instructions given in the operator's manual for safe work on slopes.

Text 5. Safe Use of Combine Harvesters

Source: <https://www.hse.gov.uk/pubns/ais6.htm>

Introduction: This information sheet describes typical hazards associated with the use of combine harvesters. It provides guidance on minimising risks to the operator and others during work with combines and is intended to help employers, employees and the self-employed comply with their duties under health and safety legislation. Different types of combine have particular features which should be taken into account when considering the hazards, risks and precautions. This information sheet covers the typical hazards likely to be found when using most types of combine.

Hazards: Many fatal and serious injuries occur when operators are pulled into the machine at the reel/header unit. The greatest risk of injury comes from contact with the machine's moving parts including: being pulled into the cutting mechanism; contacting the knife, reel or stripper rotor; being injured by the drive mechanisms or trapped when automatic sensors operate; becoming entangled with the levelling or discharge augers in the grain tank; contacting the straw chopper or spreader mechanism at the rear.

Other risks created by work with combines include: contacting overhead electricity power lines; being run over; being trapped under the header or injured by the header falling from its transport trailer; falling from the combine, especially during pre/post-season cleaning, maintenance or refueling; fires; and noise.

Control measures: It is extremely dangerous to carry out any work on a machine while it is under power. The most important safety measure is to follow the 'safe stop' procedure before carrying out any maintenance or adjustments, including dealing with a blockage or other problem: handbrake on; controls neutral; stop engine; and remove key.

Many serious and fatal accidents have occurred where operators have tried to clear blockages or worked on the machine with the engine running or power engaged. So always make sure you follow the safe stop procedure.

General guidance on safe working practice: Employers and operators of combines should follow the general precautions set out below to ensure the safe operation of the machine:

- Check all guards are in position and correctly fitted before starting work. Do not run the combine with the guards raised or removed.
- Make sure you, your employees, relief drivers, seasonal workers or contractors are properly trained in how to use the combine safely. Make use of relevant training courses such as those provided by manufacturers/suppliers.
- Never carry passengers on the combine unless seated in a proprietary passenger seat and do not mount or dismount the combine when it is moving.
- Children under 13 years of age must not drive or ride on combines.
- Make sure you keep reversing mirrors clean and properly adjusted.
- Combines are bulky vehicles and operator vision to the rear may be poor so be particularly careful when reversing. Sounding the horn before starting the engine or reversing can help alert others.
- Remember the hazards posed by straw choppers and spreaders – allow adequate rundown time before approaching the rear of the combine.
- Ensure any pedestrians are clear before moving off.
- When unloading the combine on the move you will need to plan and coordinate your movements carefully to match the tractor/trailer combinations working with you.
- Keep the cab door shut to keep out dust and noise.
- Make sure operators are aware of the risks and the safe operating procedures and are provided with the operator's manual.
- Use any grain sampling mechanism provided.
- Take care on slopes and avoid sudden changes of direction. Park on flat ground where you can. If you must park on a slope, park across it. Brake and turn with care on downhill and side slopes.

Dealing with blockages: When attempting to clear blockages the following precautions should be taken:

- Do not reach into the header with an arm or leg, attempt to clear a blockage, or climb or reach into the grain tank unless you follow the safe stop procedure.

- Develop a safe system of work for dealing with any problems that arise with the combine. This may be written down and form part of your written safety policy or risk assessment but should include as a minimum a safe system for clearing any blockages that occur.

- Follow the procedures set out in the operator's manual for safe operation, maintenance, dealing with blockages and other problems.

- Use your instruments and watch and listen for potential blockages – avoiding blockages is easier than clearing them.

- Be patient when working in difficult crop conditions such as in laid crops (lodging), unfamiliar crops or fibrous crops like linseed.

- Reversing drive mechanisms, when fitted, can wind out blockages.

- Do not operate the machine beyond its capacity (i.e., don't overload it).

Precautions for work near overhead power lines (OHPLs): Contact with power lines can be fatal. Assess the risks from OHPLs before starting work and use a safe system of work for harvesting fields where they are present. Factors to consider will include:

- the minimum height and location of the OHPLs in the fields where harvesting will take place;

- the height of the combine to be used measured from the ground to the highest point (including any extensions on the machine);

- remember that radio aerials, grain tank extensions and unloading augers/spouts will increase the overall height of the combine; n safe travel routes between fields/work sites which take into account safety clearance distances.

To work safely:

- Provide operators with instructions and training, including information on the location and heights of OHPLs (farm maps will help).

- Provide operators with information about the risks and the action to take in the event of contact with an OHPL, including emergency contact numbers.

- Use safe operating procedures in the vicinity of OHPLs, e.g., when unloading.

- Never park the combine, carry out maintenance, or extend the discharge auger when under or near OHPLs.

- If you are using a contractor to carry out the work you should discuss and agree the system of work to be followed before they begin working, and provide information about the location of OHPLs on your land.

- Display suitable warning signs as in a prominent position within the cab.

Maintenance: Many serious incidents occur during the maintenance of combines. Employers and operators should:

- Reduce the risk of falls by always using the access ladders, steps and/or standing platforms provided by the manufacturer.

- Provide and use suitable access equipment if it is necessary to work at height during cleaning and maintenance operations.

- Use correct tools and a knife guard to aid safe removal, handling and storage of the cutting knives.

- Follow correct procedures for working under the header (use the supports provided) and when transferring the header on and off the transport trailer.

- Regularly clean straw and chaff deposits from the engine compartment and around belts and pulleys to reduce risk of fire.

- Carry suitable fire extinguishers. These should be regularly checked and properly maintained/serviced.

– Remember that machines fitted with yield measuring meters using an ionising radiation source need additional safety procedures which must be laid down, clearly understood and implemented.

Text 6. Safe Use of Forage Harvesters

Source: <https://www.hse.gov.uk/pubns/ais24.pdf>

Introduction: This information sheet describes typical hazards associated with the use of forage harvesters. It provides guidance on minimising risks to the operator and others during work with both trailed and self-propelled machines and is intended to help employers, employees and the self-employed comply with their duties under health and safety legislation. Different types of forager and their attachments (e.g., a rotary maize header) may have particular features which should be taken into account when considering the hazards, risks and precautions. This information sheet covers the typical hazards likely to be found when using most types of forager.

Hazards: Many serious injuries occur when operators are injured by the chopping mechanism. The greatest risk of injury comes from contact with the machine's moving parts including: the exposed rotating cutter head, e.g., while sharpening; the moving drive mechanisms; being trapped or injured by the header/pick up; clearing blockages from the spout/header while the machine is in motion; contact with the power take-off shaft on trailed machines.

Other risks created by work with foragers include: falling from height while adjusting the chute or mounting/dismounting self-propelled machines; contacting overhead electricity power lines (OHPLs); contact with silage additives; the sharpening stone being ejected or breaking up during sharpening; guards fouling the rotating cutter head; noise and vibration.

Control measures: It is extremely dangerous to carry out any work on a machine while it is under power. The most important safety measure is to follow the 'safe stop' procedure before carrying out any maintenance or adjustments, including dealing with a blockage or other problem: handbrake on; controls neutral; stop engine; and remove key.

General guidance on safe working practice: Employers and operators of foragers should follow the general precautions set out below to ensure the safe operation of the machine:

- Provide operators with the instruction manual. Make sure they have read and understood it.
- Check operators are aware of the hazards, risks and the safe operating procedures.
- Make sure operators are properly trained in how to use the machine safely. Make use of relevant training courses such as those provided by manufacturers/suppliers.
- Check that all guards are in position and correctly fitted before starting work, eg power take-off (PTO) shaft guard.
- Use your instruments. Listen and watch for potential blockages – avoiding blockages is easier than clearing them.
- If it is necessary to clear any blockage, follow the safe stop procedure.
- Use the reversing mechanism (if fitted) to wind out blockages from headers.
- Take extra care when working on steep ground. This is particularly important when using a trailed forager with a towed trailer.
- When blowing grass into a separately towed trailer, consider the other driver and avoid sudden manoeuvres.

- When dropping off loaded trailers from behind a forager on soft ground use a drawbar shoe or jack that has a large ground surface contact area to prevent it sinking.
- Never carry passengers in the forager or tractor cab unless seated in a proprietary passenger seat.
- Do not allow people to jump on or off the tractor or self-propelled forager when it is moving.
- Take into account the run-down time for rotary maize headers before approaching them.

Precautions for work near overhead power lines (OHPLs): Contact with power lines can be fatal. Assess the risks from OHPLs before starting work with a self-propelled forager as these machines can have a working height of 5.6 m or more. The minimum height above the ground is 5.2 m for power lines operating at 11/33 kV. Factors to consider will include:

- the minimum height and location of OHPLs in the fields where work will take place;
- the height of the forager to be used measured from the ground to the highest point such as the top of the chute;
- remember: radio aerials or chute extensions will increase the overall height of the machine;
- safe travel routes between fields/work sites which take into account safe clearance distances;
- plan your work to avoid the spout being raised under OHPLs and use a safe system of work in fields where they are present.

Maintenance: A properly maintained machine will perform better and reduce the likelihood of breakdowns etc. To reduce the risk of injury during maintenance, employers and operators should:

- Follow the manufacturer's recommendations and procedures for sharpening the knives.
- When sharpening the knives on trailed machines, stand in the position recommended by the manufacturer – do not lean over the sharpening mechanism.
- Wear appropriate personal protective equipment, e.g., safety goggles, when sharpening.
- Allow for the run-down time of the cutting mechanism before opening any guards.
- Take suitable precautions before carrying out work on a forager that has been applying additives, e.g., thoroughly wash it down with cold water first.
- Follow the manufacturer's procedures for removing headers and chopping mechanisms.
- Use mechanical handlers or handling aids when placing full additive containers onto the forager. It may be easier to top up the forager-mounted container from a bulk tank using a transfer pump to reduce the risk of sustaining a manual handling injury.

Text 7. Safe Use of Potato Harvesters

Source: <https://www.hse.gov.uk/pubns/ais13.pdf>

Introduction: This information sheet is aimed at operators of potato harvesters. It describes typical hazards from the use of potato harvesters and gives guidance on how to minimise the risks to operators and others during harvesting work. It does not cover other health or safety issues there might be when grading, handling or stacking potatoes. There are particular features of different types of potato harvester, which you should take into

account when considering the hazards, risks and precautions. For example, manned harvesters, with workers stationed at a picking table, may create risks that are different from unmanned machines. This information sheet covers the typical hazards likely to be found when using most types of manned and unmanned potato harvesters.

Hazards: There have been fatal and serious incidents, including crush injuries, and amputations of arms or legs, from contact with harvesters' moving parts. The greatest risk of injury comes from contact with components and, in particular, from: contra-rotating rollers, such as haulm and cleaning rollers; conveyors or elevator chains; drive mechanisms; inadequately guarded power take-off (PTO) shafts.

Other risks created by potato harvesting work include: being struck or run over by the harvester or tractors; falling from access ladders or work platforms.

Control measures It is extremely dangerous to carry out any work on a machine while it is under power. The most important safety measure is to follow the 'safe stop' procedure before carrying out any maintenance or adjustments. There have been many serious and fatal accidents where workers have tried to clear blockages; carry out cleaning; or run the machine with the guards removed; or worked on the machine with the engine running or power engaged. So, always follow the safe stop procedure.

Dealing with blockages:

- Follow the safe stop procedure before trying to deal with a blockage.
- Never reach into the haulm or cleaning rollers with an arm or leg when the machine is running.
- Follow the instructions for clearing blockages set out in the instruction handbook.
- Remember that avoiding blockages is easier than clearing them.
- Take care when working in difficult harvesting conditions or those with weed or haulm problems – take your time and don't overload the machine.
- Use drive reversing mechanisms when fitted and encourage the use of conveyor controls to optimise picking conditions.

Guarding:

- Check that all haulm, clod, stone separator and cleaning rollers are properly guarded. Fit additional guards if anyone can reach the rollers with arms or legs from any position. Manufacturers can help with guard kits.
- Net-type guards for contra-rotating rollers are easily defeated and should not be used. Replace them with securely fixed metal guards.
- The power take-off shaft should be fully enclosed in a guard along its entire length from the tractor power take-off to the power input connection on the harvester. Other drive shafts should be guarded to the same standard.
- Make sure all guards are in position and correctly fitted before starting work and stop work if any guards become broken or defective.

General guidance on safe working practice:

- Make sure everyone working on the harvester understands the safety instructions in the handbook, including the safe way to clean the harvester of haulm, stones, potatoes, etc.
- On a manned harvester, there should be a two-way system for communicating between the workers on the picking/sorting platform and the tractor driver. These machines should also be fitted with an audible warning alarm intended to draw the attention of those on the platform to the starting of the moving parts, e.g., before starting the engine, reversing or engaging drives.
- Machines with a picking/sorting platform require emergency stops accessible from the work position to stop the conveyor to the platform.

- Take particular care when reversing; make sure you can see what is behind the harvester or get help if the view is obscured. People have been killed when they got off a manned harvester or approached a machine on foot and were run over by it.
- Stop the tractor before anyone gets on or off the harvester and do not allow anyone to jump on or off the harvester when it is moving or stationary. Always use the access ladder to mount or dismount from the picking platform and do not climb over the machine.
- Picking/bagging platforms on manned harvesters require guard rails to prevent people falling off the machine.
- Take advantage of relevant training/courses provided by manufacturers/dealers. They will help to ensure the safe and efficient use of your potato harvester.
- Workers on a manned harvester will also require training. Don't forget the training needs of any temporary or casual staff.

Maintenance:

- Do not run the harvester with the guards raised or removed for maintenance or cleaning purposes.
- Always use some form of mechanical support when working below any raised components, e.g., if working under box handling attachments, use the supports provided.
- Remember that putting the power take-off (PTO) out of gear will not cut the power to some hydraulically driven components.
- Avoid parking the harvester or carrying out maintenance on it when under or near overhead electricity power lines.

2.3. Equipment and Systems for Dairy, Poultry and Pig Farms

Text 1. Dairy Farming Equipment

Source: <https://www.jddb.gov.jm/page/dairy-equipment>,
<https://d2xsikgwxxkyoe.cloudfront.net/animal-husbandry/dairy-farming-equipment-small-dairy-machinery-specifications/>

Agricultural equipment used in dairy facilities to obtain milk from the animals and to cultivate pastures, harvest and transport fodder material. The equipment is used to reduce labour, improve the quality and quantity of fodder produced, increases the quality of milk obtained from animals.

There are various factors to consider when selecting equipment for your farm. They include: the size of your farm; the number of animals to be milked; the quality of the equipment to be purchased; the type of milking procedure that will be utilized on the farm; and the land size for planting pasture.

Types of equipment can be divided into several groups.

1. Milking: Milking equipment should be designed, constructed, installed and maintained in a way that will reduce the likelihood of contamination of the milk. When planning to install milking systems, dairy farmers should seek advice from a specialist trained in the planning and installation of such equipment. Milking equipment should be calibrated on a regular basis to be efficient and perform at its optimum. The performance of the milking system can affect the dairy farmer's profit. Milking machines maybe of the following types: pail machines, suspension machines and pipeline milkers.

There are two common types of vacuum pumps, the piston and the rotary pump. The rotary pump is more efficient and smaller in size hence it's more commonly used today. Regardless of which type is used, it must be large enough to provide sufficient vacuum to operate the system properly.

Milk lines are made of stainless steel or glass and carries milk from the barn or parlour to the milk room.

2. Washing: The facility should have areas equipped for washing. There should be sinks for washing hands and sinks for washing milking equipment.

3. Storage: Equipment used for storage should also be designed and constructed and maintained in a way to reduce the introduction of contaminants and also limiting the growth of micro-organisms. A bulk tank is an insulated stainless tank used to cool and store milk. Bulk tanks maybe classified by shape, size, manufacturers and the type of refrigeration system used. The size of the bulk tank must be appropriate to the volume of milk produced. Its size also depends on the frequency with which the milk is picked up and brought to the milk plant. If the milk is picked up every other day the tank should hold about five milkings. It's a good idea however to buy a tank 20 to 50 percent larger than is presently needed, this is to allow for future expansion. A bulk tank size is usually noted in gallons. The bulk tank should be located at least 2 feet from any wall so that it can be easily cleaned. It must be able to cool milk quickly to the required temperature set by milk standard laws. It should not be located over a drain or under light.

4. Feeding: Calf bucket feeders are generally used to feed calves from birth to two weeks old. Colostrum and milk replacers are normally fed to the calves through calf bucket feeders. Bucket feeders should be cleaned after use with soap water and rinsed thoroughly and is dried in a clean environment. Cleaning agent such as hypochlorite should not be used to clean calf buckets as residues may be harmful to the young calf.

Water troughs provide drinking water to the animals on the farm. They are various type of water troughs that can be found on the farm: concrete, plastic and calvinized. Troughs are mostly rectangular in shape and generally fitted along fence lines for easy access for the animals. The length of the trough should allow all cows to drink at the same time. Water troughs should be high above ground level to prevent animals from falling in them.

Total Mixed Ration (TMRs) mixer is used to improve the feeding systems of dairy animals. It ensures that cows consume all the required level of nutrients. The mixed ration should include good quality forages, a balance of grains and proteins, vitamins and minerals. The TMR mixer is used to mix forages, grains and protein in their correct proportions to meet the nutritional needs of the animals. These mixers may be either used in stationary or portable.

5. Pasture land preparation: The most commonly used equipment on any farm operation is the tractor. Tractors are essential tool for preparing the soil to planting the seed to collecting the harvest. Tractors also plays an integral part in fodder conservation and are used to prepare materials for making hay and silage, Tractors are also used to drive and operate other implements on the farm for ploughing, harrowing and planting.

Ploughs are used primarily in soil preparation; it turns over upper layer of the soil bringing fresh nutrients to the surface allowing easier breaking down.

A harrow is suitable for breaking up lumps of soil to provide a finer finish. A good soil structure is ideal when planting seed for pasture establishment. There are three types of harrows: disc, spike and drag ones.

6. Irrigation: Dairy pastures require a large amount of water for irrigation. Irrigation systems are comprised of tubes, pipes and sprays. Some common irrigations used on dairy pastures include:

- Surface irrigation: Water is distributed over and across land by gravity, no mechanical pump involved

- Drip irrigation: A type of localized irrigation in which drops of water are delivered at or near the root of plants. In this type of irrigation, evaporation and runoff are minimized

– Sprinkler irrigation: Water is distributed by overhead high-pressure sprinklers or guns from a central location in the field or from sprinklers on moving platforms.

7. Harvesting and Conservation: Disc Mower helps producers cut hay at higher speeds which paramount when windows are tight, it allows for farmers to mow, rake and bale in one day. It is important to consider the tractor size when purchasing a disc mower.

Mower conditioners are mainly used to cut grasses for hay or silage and are often place the cut materials into rows. These rows of cut materials are referred to as windrows.

A hay baler is a piece of farm machinery generally pulled by a tractor to compress a cut and raked crop into compact bales. Bales are easy to handle, transport and store. Often bales are configured to dry and preserve some of the nutritional value of the plants bundled. There are two types of balers; round and square (large or small).

Silage is made from forages such as corn, grass and legumes which are sored under air tight conditions. A silage packing machine or silo packer is used to compress forage materials.

8. Transportation: Trucks are typical used to transport animals on the farm. Trucks and trailer are also used to transport fodder material around the farm.

9. Dairy Animal Housing Equipment: Shelter, such as a cowshed, is one of the most critical things you can provide for your dairy cows. It is critical not to underestimate the value of a comfortable and hygienic shelter. Your dairy cows will produce a lot of milk for you if they are happy and healthy. To put it another way, happy cows equal happy dairy farmers.

The temperature within the cowshed is another significant aspect of the equipment. A mist cooling system is one of its essential features, which you can witness in several public locations throughout the summer.

You'll need feeding equipment to help feed dairy cows now that they're comfy indoors. A feed grinder is a must-have for dairy producers that utilise grain feed. You may calculate the exact formula of the components you wish to give to your dairy cows using a feed grinder.

Additionally, green fodder cutters can be purchased. Green fodder is a form of dairy cow feed made up of green plants such as beans, grains, grasses, and tree-based crops. You'll need mechanical equipment to chop green fodder into little pieces if you wish to give it to your cows.

A chaff cutter is a fodder-cutting machine. The fodder is fed into the machine and grasped between two toothed rollers, allowing it to be transferred to a share plate, where it is put on a hefty flywheel and turned in short lengths by the knives.

Cutting or crushing is commonly used to minimise the size of farm goods. Some blades are frequently used to cut. The crushing process reduces the product's size to something that can be used. A farmer may prepare cow feed from grain using this sort of agricultural machine known as a fodder grinder.

Text 2. Role of Milking Machines in Modern Dairy Farming

Sources: <https://sites.google.com/site/viveklpm/cattle-and-buffalo-production-management/milking-machine/role-of-milking-machines-in-modern-dairy-farming>,
<https://standartmoloko.com/en/doilnoe-oborudovanie#>,
<https://sites.google.com/site/viveklpm/cattle-and-buffalo-production-management/milking-machine/advantages-of-milking-machines>

Milking management is one of the most important and crucial activities in the milk production chain. The milking machine is unique in the sense that it is one of the few ma-

chines which comes in contact with farm animals on a regular basis. It is therefore very important that these machines are correctly installed, maintained in excellent operating conditions, and used properly.



Early attempts at milking cows involved a variety of methods. Around 380 B.C., Egyptians, along with traditional milking-by-hand, inserted wheat straws into cows' teats. Suction was first used as a basis for the mechanized harvesting of milk in 1851, although the attempts were not altogether successful, drawing too much blood and body fluid and causing congestion within the teat. To encourage further innovations, the Royal Agricultural Society of England offered money for a safe, working milking machine. Around the 1890s, Alexander Shiels of Glasgow, Scotland, developed a pulsator that alternated suction levels to successfully massage the teat and extract milk. That device, along with the development of a double-chambered teat cup in 1892, led to milking machines replacing hand milking. After the 1920s, machine milking became firmly established in the dairy industry. Today, the majority of all milking in organized farms is carried out by machine.

Modern milking machines are capable of milking cows quickly and efficiently, without injuring the udder. The working principle of the milking machine is to imitate the suckling of the calf. The milking machine performs two basic functions:

- It opens the streak canal through the use of a partial vacuum, allowing milk to flow out of the teat cistern through a line to a receiving container.

- It massages the teat, which prevents congestion of blood and lymph in the teat.

The milking unit is the portion of a milking machine for removing milk from an udder. It is made up of a claw, four teat cups, (shells and rubber liners) long milk tube, long pulsation tube, and a pulsator. The claw is an assembly that connects the short pulse tubes and short milk tubes from the teat cups to the long pulse tube and long milk tube (cluster assembly). Claws are commonly made of stainless steel or plastic or both. Teat cups are composed of a rigid outer shell (stainless steel or plastic) that holds a soft inner liner or inflation. Transparent sections in the shell may allow viewing of liner collapse and milk flow. The annular space between the shell and liner is called the pulse chamber.

Milking machines work in a way that is different from hand milking or calf suckling. Continuous vacuum is applied inside the soft liner to massage milk from the teat by creating a pressure difference across the teat canal (or opening at the end of the teat). Vacuum also helps keep the machine attached to the cow. The vacuum applied to the teat causes congestion of teat tissues (accumulation of blood and other fluids). Atmospheric air is admitted into the pulsation chamber about once per second (the pulsation rate) to allow the liner to collapse around the end of teat and relieve congestion in the teat tissue. The ra-

tio of the time that the liner is open (milking phase) and closed (rest phase) is called the pulsation ratio.

The four streams of milk from the teat cups are usually combined in the claw and transported to the milk line, or the collection bucket (usually sized to the output of one cow) in a single milk hose. Milk is then transported (manually in buckets) or with a combination of airflow and mechanical pump to a central storage vat or bulk tank. Milk is refrigerated on the farm in most countries either by passing through a heat-exchanger or in the bulk tank, or both.

Milking machines keep the milk enclosed and safe from external contamination. The interior 'milk contact' surfaces of the machine are kept clean by a manual or automated washing procedures implemented after milking is completed. Milk contact surfaces must comply with regulations requiring food-grade materials (typically stainless steel and special plastics and rubber compounds) and are easily cleaned.

Most milking machines are powered by electricity but, in case of electrical failure, there can be an alternative means of motive power, often an internal combustion engine, for the vacuum and milk pumps. Milk cows cannot tolerate delays in scheduled milking without serious milk production reductions.

Some of the advantages of milking machines are: saving of labour expenses; reduction of dependency on skilled farm workers; enable rearing of larger herd strength; 3-4 times faster than hand milking; increase in the milk yield and quality of milk; reduction of stress throughout the lactation by creating good milking routines.

However, there are some limitations. Some of the older cows which are accustomed to hand milking may not adjust to machine milking. Standby power supply is essential. High initial investment and training of staff is needed. Negligence in following the strict cleaning procedures would lead to severe contamination and higher incidence of mastitis. There is greater water requirement for cleaning of equipment. Prompt service and availability of spares is essential.

Text 3. Types of Milking Machines and Systems

Sources: <https://sites.google.com/site/viveklpm/cattle-and-buffalo-production-management/milking-machine/types-of-milking-machinessystems>

There three types of milking machines and systems. They are:

1. Portable milking machines: These are ideal for small herds (up to 20 cows). Portable milking machines (portable milkers) for cows provide an efficient and convenient way of milking animals in cases when the use of static milking machines is not possible (milking in the field, milking in the barn) or when attending agricultural shows, for small size herd or sick animals in remote pens.

The vacuum required for automated milking of the animal is created by an oil free vacuum pump driven by an electric motor. Should the portable milker be used in the fields with no electricity, a diesel engine may be attached. Each portable milker comes with a vacuum regulator and a gauge to ensure that proper level of vacuum is maintained during milking.

Pulsation in the cluster is created by a pneumatic pulsator fitted on the portable milker. This type of pulsator has been designed to meet simplicity, precision, sturdiness and reliability requirements. Pulsation rate can be adjusted using adjustment screw on the pulsator. Pulsation ratio is user-selectable.

The milk is collected in a sturdy stainless-steel bucket for further transportation. Options with one or two buckets are available.

Portable milkers for cows come with one or two clusters. Complete unit comes with all necessary fixings and tubing for easy assembly. All parts are securely mounted on a lightweight and yet strong and steady trolley which can be easily transported and requires minimal maintenance.

Recommended vacuum level for milking a cow with a portable milker is 48-50 kPa. Pulsation rate is set to 60 ppm and ratio is 60:40.

2. Barn milking systems: These are installed on farms where cows are kept tied in stalls and no separate milking parlour is present (20-100 cows). Barn milking systems are installed on the farms where the cows are kept tied in their cubicles. The milking takes place at the place where the cow is standing. The milking is carried out using a portable milking unit which provides pulsation and delivers vacuum to the teat end. The milking unit is plugged into the milking station fitted on the milk line. One milking station is usually installed for every two cows. The milk then flows to the milk receiving set. The milk receiving set contains a milk receiving vessel with liquid level control, sanitary trap, milk pump and milk filter. From the milk receiving vessel the milk pumped into the milk cooling tank.

The vacuum needed for the equipment operation is created by vacuum pumps and maintained at the desired level by a vacuum regulator.

Cleaning-In-Place automated washing system can be installed for efficient cleaning after milking. It operates in a similar way as in the milking parlour and washes all parts and surfaces of equipment which come in contact with the milk. Good quality washing is achieved using a water slug technique. This water slug is created in the milk line by the air injector valve. The portable milking units are placed on the jetted trays in the utility room for washing.

The system is easily scalable. It is recommended to make a separate milk and vacuum line loop for every 50 cows in the barn. In such case the milk collected in the loop will be pumped to the milk cooling tank from the receiving set installed on each loop.

3. Milking parlours: These are constructed on large farms; they are of various types (more than 100 cows).

– **Herringbone milking parlour:** The most utilised parlour installation is the Herringbone parlour, so named because of the linear layout and angle of the stalls mimicking the shape of the backbone of the herring fish. In herringbone milking sheds, or parlours, cows enter, in single file, and line up almost perpendicular to the central aisle of the milking parlour on both sides of a central pit in which the milker works (you can visualise a fishbone with the ribs representing the cows and the spine being the milker's working area; the cows face outward). After washing the udder and teats the cups of the milking machine are applied to the cows, from the rear of their hind legs, on both sides of the working area. Large herringbone sheds can milk up to 600 cows efficiently with two people. Typical sizes range from a Double 8/8 through 20/20 which means an identical number of stalls on each side of the parlour. There will be one milking control for each stall in a Double parlour and the stall angle ranges from 30 to 90 degrees.

– **Swingover milking parlour:** Swingover parlours are the same as herringbone parlours except they have only one set of milking cups to be shared between the two rows of cows, as one side is being milked the cows on the other side are moved out and replaced with unmilked ones; with the notation 8/16 or 20/40. The swingover style uses half the number of milking controller as one control is used for both sides of the parlour and is therefore mounted down the centre of the pit. The Ram, and the Cluster attached to it, is able to swing from one side of the parlour to the next and hence is a cheaper option to a doubled-up parlour. The advantage of this system is that it is less costly to equip, however it operates at slightly better than half-speed and one would not normally try to milk more

than about 100 cows with one person. However, savings in cost are off-set by animal throughput but the choice of parlour type is usually determined by the size of the herd, the future requirements and the amount the customer has to spend.

– **Rapid Exit milking parlour:** Such milking parlours are growing in popularity as they allow fast throughput by locating the exit gates in front of the cow stall. Also, the building does not need to be long as for herringbone, but needs to be wide. The vacuum operated gate lift allows cows to exit en-masse and aids fast reloading of the stalls.

– **Rotary milking parlour:** With growing herd size the efficiency of the herringbone parlour is put into question when the size goes beyond 20 points per side. Although there are some herringbone parlours with a total of more than 40 points, they number very few due to the length of the parlour.

The most efficient parlour type for the large herd is the Rotary Platform parlour. Rotary milking sheds consist of a turntable with about 12 to 100 individual stalls for cows around the outer edge. A "good" rotary will be operated with 24-32 (~48-50+) stalls by one (two) milker(s). The turntable is turned by an electric-motor drive at a rate that one turn is the time for a cow to be milked completely. As an empty stall passes the entrance a cow steps on, facing the centre, and rotates with the turntable. The next cow moves into the next vacant stall and so on. The operator, or milker, cleans the teats, attaches the cups and does any other feeding or whatever husbanding operations that are necessary. Cows are milked as the platform rotates. The milker, or an automatic device, removes the milking machine cups and the cow backs out and leaves at an exit just before the entrance. The rotary system is capable of milking very large herds – over a thousand cows. It allows for only 2 operators to milk 250 cows per hour on a typical 60-point platform.

– **Automatic milking parlour:** Since the 1970s, much research effort has been expended in investigating methods to alleviate time management constraints in conventional dairy farming, culminating in the development of the automated voluntary milking system (AMS).

Voluntary milking allows the cow to decide its own milking time and interval, rather than being milked as part of a group at set milking times. AMS requires complete automation of the milking process, as the cow may elect to be milked at any time during a 24-hour period.

The milking unit comprises a milking machine, a teat position sensor, a robotic arm for automatic teat-cup application and removal, and a gate system for controlling cow traffic. The cows are permanently housed in a barn, and spend most of their time resting or feeding in the free-stall area.

When the cow elects to enter the milking unit (due to highly palatable feed that she finds in the milking box), a cow ID sensor reads an identification tag on the cow and passes the cow ID to the control system. If the cow has been milked too recently, the automatic gate system sends the cow out the unit. If the cow may be milked, automatic teat cleaning, milking cup application, milking, and teat dipping takes place. As an incentive to attend the milking unit, concentrated feedstuffs need to be fed to the cow in the milking unit.

Text 4. Dairy Housing: Ventilation Options for Free Stall Barns

Source: <https://www.ontario.ca/page/dairy-housing-ventilation-options-free-stall-barns>

The purpose of ventilation in the barn is to provide fresh air in order to:

- control moisture produced by the cows through respiration, water spillage, manure and urine in cold weather;
- control heat produced by the cows in hot weather;

– remove odours and gases produced by cows from manure and urine, and by breathing out CO₂. A ventilation rate that controls moisture and heat will usually remove odours and gases as well, except in extremely cold weather, when it should be maintained at four air changes per hour.

Distribute fresh air evenly throughout the barn to prevent dead spots and avoid drafts in the winter and remove heat in the summer.

Natural ventilation, or mechanical ventilation, works by replacing stale barn air with fresh outside air. In the winter, the barn might be only slightly warmer than outside, but as cold air enters the barn, it expands as it warms up, giving it the ability to hold more moisture. The outside air mixes with the inside air, absorbs the moisture and gases and then has to be removed from the barn.

There are three main components of a natural ventilation system: sidewall inlets, a bird screen and a ridge exhaust.

Large, adjustable sidewall inlets make use of prevailing winds. Build barns with a minimum sidewall height of 4 m (12 ft) and as high as 5 m (16 ft) to make use of natural winds. Cover the inlet opening with an adjustable curtain. Depending on the sidewall height, the curtain may be a single curtain or split in two. With a split curtain, the bottom portion remains closed in the cold weather, and only the top is adjusted. This allows for less wear and tear on the curtain and less strain on the controls. In warm weather, the bottom curtain is rolled up, and the entire sidewall is open.

Cover the top portion of the wall with a bird screen. When the entire wall is open, doors are probably open as well, and birds cannot be prevented from entering. Use a bird screen that is strong enough and fine enough to prevent birds from entering, but not so coarse that it restricts air flow.

The ridge exhaust system can take many forms:

– Open ridge: an open ridge is suitable for cold-environment barns (Figure 4) where no control over the inside temperature is desired. Design the open ridge to provide 2.5-4 cm (1-1.5 in.) of opening for every 3 m (10 ft) of barn width. It should be covered to reduce the entry of rain and snow, and should stop 2.5–3.5 m (8–12 ft) from each end of the barn to reduce down drafting.

– Chimneys: chimneys are a good option when some control over the inside environment is desired. They will reduce the amount of rain or snow entering a barn while still providing good ventilation. Most chimneys are equipped with a damper, which can be used to control the outflow of air. The damper doesn't fit tight and has about a 2.5-cm (1-in.) gap around it, so even when closed it will allow for minimum ventilation. Dampers do not have to be adjusted daily but should be adjusted seasonally. Provide 0.046m² (0.5 ft²) of chimney opening for every 9.3 m² (100 ft²) of floor area. Build chimneys no more than 1.2 m x 1.2 m (4 ft x 4 ft) to prevent down drafting and never more than about 6-7.5 m (20-24 ft) apart.

– Light vents: a number of light ridge options provide a controllable ridge exhaust combined with a translucent ridge cap to allow more natural light to enter the barn.

– Overshot roof: this ridge vent design is constructed by extending the top chord of the truss in the same direction as the prevailing wind. This concept is not new. The difference from previous designs is to install an adjustable curtain to control the outflow of air. The amount of opening should be at least 2.5-4 cm (1-1.5 in.) of ridge opening for every 3 m (10 ft) of barn width but can be more, since the amount of opening can be adjusted. The overshoot roof should stop 2.5-3.5 m (8-12 ft) from each end of the barn to reduce down drafts.

Control systems are necessary to provide a stable environment within the barn:

– Ridge control: the ridge opening only has to be adjusted seasonally, so a manual adjustment system is sufficient.

– Sidewall opening control: the sidewall openings require continual adjustment, using an automatic control system, to maintain a constant temperature within the barn. If the barn is more than 30 m (100 ft) in length, divide the curtain system in two so that the barn can be controlled in zones.

Regarding fan ventilation, the principles are the same for fan ventilation and natural ventilation. With fan ventilation, the fan is providing the power to move and exchange the air. The ventilation rate is based on the size and number of cows. The winter ventilation rate should not drop below four air changes per hour in order to provide a minimum of fresh air. The practical summer maximum should not exceed 1,000 CFM/cow.

Fans provide the power to move and exchange the air. Their air-moving capacity is based on their size and efficiency. Select a range of fan sizes to provide the air flow from winter minimum to summer maximum. Variable-speed fans are not very efficient when they are set to run at one-third to one-half their capacity, so one size does not fit all. Use smaller fans to provide the winter minimum ventilation rate, combined with larger fans to provide the range to the summer maximum.



Fans

As to inlets, there are a variety of inlet types and styles that can be used to provide fresh air. Manually controlled inlets are adjusted using a boat winch, self-adjusting inlets are adjusted using counter weights, and automatically controlled inlets are adjusted with a servo-motor. Adjust inlets to provide enough air speed (800-1,000 feet per minute (FPM)) to mix the air throughout the room. Fan controls work from the temperature. Adjust controllers so that each successive step in ventilation no more than doubles the current ventilation rate.

Text 5. Dairy Housing: Fans and Sprinkler Systems

Source: <https://www.ontario.ca/page/dairy-housing-ventilation-options-free-stall-barns>

Supplemental cooling in the form of fans over the cows and sprinkler systems is needed in order to prevent heat stress. The ideal ambient temperature for a dairy cow is 0°C-20°C. At temperatures above 20°C, cows start to use energy to cool themselves, instead of producing milk. Heat loss from a cow occurs primarily by conduction and convection, as well as by evaporation. As the temperature rises, it becomes increasingly difficult for a cow to dissipate heat. Rising relative humidity also affects a cow's ability to lose heat via evaporation. Since heat loss depends both on temperature and relative humidity, a temperature-humidity index (THI) has been developed to indicate the amount of heat stress experienced by a cow.

Let's consider some options to cool cows. In general, there are two cooling strategies. One is to increase the rate of heat transfer between the cow and her environment, and the other is to modify the environment to reduce the heat stress placed on the cow. Practi-

cally, this means increasing the convective heat transfer rate by increasing the air speed over the cow and increasing the evaporative cooling rate by wetting the cow or the air around the cow.

Fans, sprinkler systems and misting systems help to cool cows.

– **Fans:** There are different types of fans that can be used:

1. Panel or basket fans: This type of fans is usually selected for cooling. Select fans based on their capacity and the air velocity they produce. Select fans that will provide at least 500 CFM/cow, up to 1,000 CFM/cow and air velocities in the range of 220-500 FPM (2.5-5.5 mph). Typically, these fans are 60-120 cm (24-48 in.) in diameter and provide low volumes of air but at a high speed (LVHS). Fans from a reputable supplier effectively maintain adequate airflow to a distance of 10 times the fan diameter.

Mount the fans high enough to provide clearance for any equipment used in the alleys and with about 2.5 m (8 ft) clearance above the free stalls to keep the cows from damaging them. Place fans so they blow air in the direction of the prevailing winds, spaced at a distance of 10 times their diameter. Tilt fans downwards to aim their airflow at a point directly below the next fan in line. In holding areas or when blowing across the width of the barn, install fans 2.5-3.5 m (8-12 ft) apart and use 45-60 cm (18-24 in.) fans.

In summary:

– place fans over the alley next to the feed manger and over the rows of free stalls in a four-row barn;

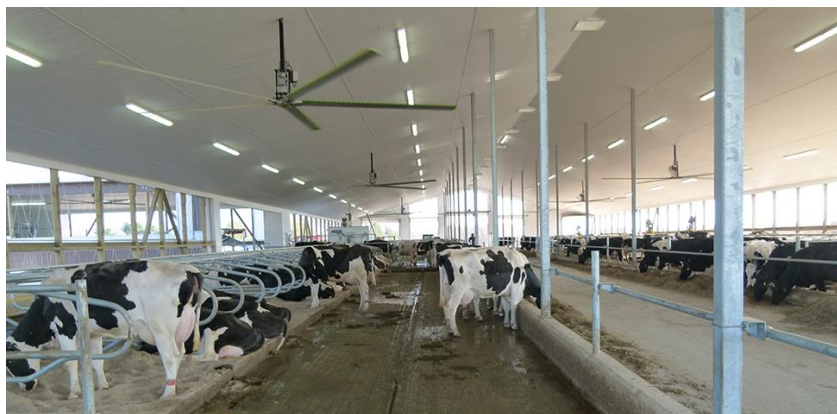
– in a six-row barn, it may be necessary to place a row of fans over the outside row of free stalls;

– space fans according to their diameter;

– start fan operation when the barn temperature reaches 21°C;

– all fans should be running when the barn temperature reaches 27°C.

2. Big ceiling fans: An alternative to the panel fan for hot-weather ventilation is the high-volume, low-speed (HVLS) ceiling fan. Typically, 6-7.5-m (20-24-ft) diameter fans are installed 15-18 m (50-60 ft) apart, along the length of a free-stall barn. Fans run at approximately 50 rpm and will move from 150,000 CFM up to almost 400,000 CFM of air. Air speeds are highest directly under the fan and decrease with increasing distance away from the fan.



HVLS ceiling fan

Guidelines for installing HVLS fans:

– in four-row barns, space 6-7.5-m (20-24-ft) diameter fans 15-18 m (50-60 ft) apart;

– in six-row barns, HVLS fans do not provide good coverage to the outside row of free stalls unless two rows of fans are used;

– a 7.3-m (24-ft) diameter fan should have at least 76 cm (30 in.) clearance at the

blade tips;

– mount fans at least 0.3 m (1 ft) higher than the highest overhead door for safety.

Install variable frequency drive (VFD) controllers properly to reduce radio interference: make sure controllers are grounded properly; use the correct type of shielded cable; locate controllers within 3 m (10 ft) of the fan.

3. Tunnel ventilation: It is another option for increasing air flow to reduce heat stress. With a tunnel ventilation system, large fans, 120-180 cm (48-72 in.) in diameter, are used to move air through a barn at an air speed fast enough to provide convective cooling of the dairy cattle. Air enters the barn at one end and is exhausted at the other. Since the air speed depends on the cross-section of the barn, long, narrow barns tunnel-ventilate more efficiently than short wide ones.



Tunnel ventilation

General recommendations for tunnel ventilations: air speed of 400-600 FPM; air exchange rate of 1,000 CFM/cow; <1 air change/min and inlet air speed of <500 FPM.

To calculate ventilation requirements at different air flow rates, use the formulas $Q = VA$ or $A = (Q/V)$, where: Q = quantity of air (CFM); V = air speed (FPM); A = area of building (ft²).

Fan capacity is directly proportional to the cross-section of the barn – the smaller the cross-section, the fewer fans required to provide the desired air speed. Producers have achieved some success by hanging curtains from the ceiling to reduce the cross-section dimension. Place curtains no more than 12 m (40 ft) apart.

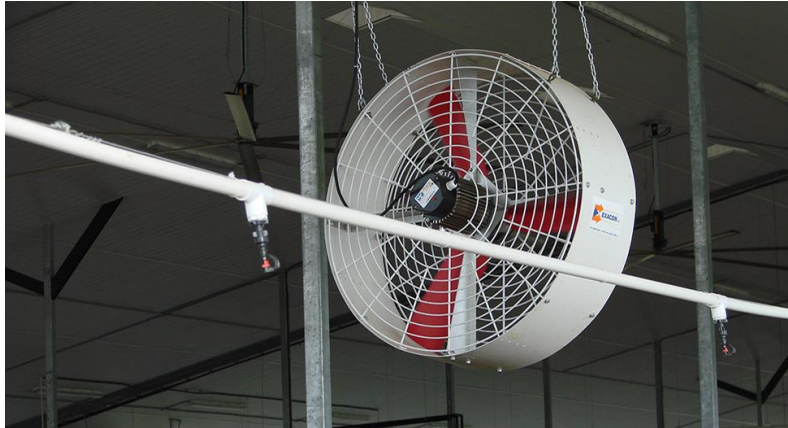
Control fans with a thermostat, but ensure they also have on/off switches for emergency shut-off.

The main recommendations are: start operation of fans at 21°C; run all fans when the barn temperature reaches 27°C; set thermostats to turn fans on at every 1°C interval; and ensure fans no more than double the previous airflow as they turn on. In theory, all wall openings should be closed between the exhaust fans at one end of the barn and the end wall openings at the other. In practice, opening the curtain slightly (about 5 cm (2 in.)) from the bottom provides some fresh air along outside rows of stalls.

Some tunnel ventilation fans are available with two-speed motors. This would allow for some cooler weather operation. This may help with air distribution in the barn during cold weather.

During cold weather when the fans are not operating, it will be necessary to cover them with insulated panels to minimize heat loss and air leakage.

– **Sprinkler systems:** Using sprinkler systems with fans can provide additional cooling. The sprinklers create droplets that wet the cow's hair coat to the skin. Fans force air over the cow's body, causing evaporative cooling to take place on the skin and hair coat. Heat from the cow's body causes the moisture to evaporate. The droplet size should be large enough to wet the skin surface and must be applied intermittently to allow time for the moisture to evaporate from the skin.



Sprinklers with fans

A sprinkler system uses simple, readily available and easily maintained components and should: use a timer to run sprinklers for 1-3 min, every 15-30 min; provide enough water to soak the skin but not wet the udders; turn sprinklers regularly to allow for evaporation; use low-pressure (20-40 psi) nozzles; use solid-cone coarse droplet spray nozzles with flow rates between 0.2-0.5 USGPM (U.S. gal/min); use 180° nozzles (half circle) along feed bunk; use 360° nozzles (full circle) over holding area; start system at temperatures over 25°C-27°C; close-up of sprinklers mounted above cows.

Variable-rate soaker systems are becoming more popular. They increase the sprinkler frequency as the temperature rises as follows: 21°C-27°C every 15 min; 27°C-32°C every 10 min; >32°C every 5 min.

Fans should run continuously when the sprinklers are on. If water is being blown on the feed or on the stalls, the droplet size is too small, or the fans need repositioning.

– **Misting systems:** These fogging systems are also effective for cooling cows. They cool the air around the cows without wetting the cows or the surroundings directly. The amount of cooling achieved depends on the air temperature, relative humidity and the amount of moisture evaporated. Misting systems use high-pressure nozzles (200 psi) to inject moisture directly into the air stream. The nozzles are usually installed in a ring in front of the fan, but they can also be used with tunnel ventilation systems by injecting water vapour close to the inlets.

To sum up, it is important to note that supplemental cooling in the form of fans over the cows and sprinkler systems can be supplied if situation so requires. When natural ventilation alone can no longer look after the heat load, install supplemental fans. Fans over the cows can increase their convective cooling rate significantly. Use sprinkler or fogging systems to increase the evaporative cooling rate when additional cooling is needed.

Text 6. Choosing the Right Heating System for Livestock and Agriculture

Sources: <https://www.pericoli.com/en/mechanical-ventilation-system/heating-systems-agriculture-and-farms/>, <https://www.pericoli.com/en/direct-fired-heating-and-indirect-exchange-heating/>

Heating systems in agriculture, farms and industries constitute specific solutions where temperature drops below an acceptable threshold, negatively affecting plant production and the well-being of animals and workers. Termotecnica Pericoli is able to provide its customers with heating systems in agriculture, horticulture sectors, farms, livestock and industrial sectors capable of satisfying any type of need.

The main requirements of a good professional heating system for industrial use are:

- excellent relationship between performance and fuel consumption;
- versatility to adapt to any system and environment;
- constant and homogeneous temperatures;
- withstand long workloads;
- thermal efficiency and low running costs.

The direct or indirect exchange heaters are able to manage the air inside the warehouse or greenhouse by maintaining parameters suitable for the well-being of people, animals or plants. The efficiency of these heating systems offers low power consumption and great versatility. In the dynamic realm of livestock and agriculture, where precision is paramount, maintaining optimal environmental conditions becomes a strategic imperative. The choice of a heating system plays a pivotal role in achieving this delicate balance. Among the myriad options available, two contenders stand out: direct gas-fired air heaters and indirect exchange heating systems. Each presents a distinct set of advantages and considerations.

In this article, we're going to understand all the nuances differentiating these two heating methods, guiding you toward an informed decision tailored to the unique needs of your agricultural or livestock facility.

– **Direct Gas-Fired Air Heaters:** These heaters are known for their efficiency and immediate heat delivery. These systems work by burning natural gas, diesel, or propane directly to produce hot air, which is then circulated into the designated space. The absence of a heat exchanger in direct-fired systems ensures minimal heat loss, making them apparently highly efficient. Here are two different options related to direct heating.

The main advantages of direct gas-fired air heaters are:

- Highly responsive heating: Direct-fired heaters provide quick and direct heating, making them ideal for situations where immediate warmth is required.
- Cost-effective: These systems are often more cost-effective upfront, as they have fewer components compared to indirect exchange systems.
- Energy efficiency: Direct gas-fired heaters are known for their high energy efficiency, as there is no heat exchanger to absorb and transfer heat. However, this is only an apparent efficiency. The direct flame increases the concentration of CO₂, NO_x in the air, therefore requiring frequent air changes to maintain a healthy environment. The result is a drastic drop in the global efficiency.

The disadvantages of direct gas-fired air heaters are:

- Air quality concerns: Direct-fired heaters release combustion byproducts, such as carbon dioxide and water vapor, directly into the heated air. This can affect air quality and may not be suitable for certain applications.
- Moisture addition: The combustion process can add moisture to the heated air, which may not be desirable in environments where moisture control is crucial.

– Fire danger: The presence of a naked flame increases the risk of fire within an environment.



Direct-fired gas air heater EASYTERM



Direct gas-fired air heater AGRITERM

Our technicians recommend the use of direct heating, especially as an important tool in case of emergency. For example, in the Horti sector, to melt snow on greenhouses that would otherwise collapse from the weight, and/or in applications where it is necessary to artificially increase CO₂ to accelerate plant growth. In livestock, especially in poultry and swine barns, direct-fired heaters are an interesting cost-effective option. As explained before, farmers must take into consideration the air quality levels which will then need to be balanced with greater minimum ventilation resulting in increased operational costs.

– **Indirect Exchange Heating Systems:** Indirect exchange heating systems, on the other hand, use a heat exchanger to transfer heat from a combustion chamber to the air. In these systems, the combustion byproducts are separated from the air that is circulated into the space, addressing air quality concerns associated with direct-fired heaters. Here are the best options for indirect heating in large spaces.



Indirect air heater combiTERM



Direct-driven jet fan F-OTB

The pros of indirect heating systems are:

- Improved air quality: The separation of combustion byproducts ensures that only clean, heated air is released into the environment, contributing to better air quality.
- Moisture control: Indirect exchange systems allow for better control over humidity levels since the combustion byproducts, including moisture, are kept separate from the heated air.

The cons of indirect exchange heating systems include:

- Less responsive heating: Compared to direct-fired heaters, indirect exchange systems may have a slower response time as the heat must be transferred through a heat exchanger.

– Higher initial costs: The additional components, such as the heat exchanger, can result in higher upfront costs for indirect exchange heating systems.

In conclusion, it should be noted that when deciding between direct gas-fired air heaters and indirect exchange heating systems for livestock and agriculture, it's essential to consider factors such as heating speed, air quality, moisture control, and upfront costs. Each system has its own set of advantages and considerations, and the choice ultimately depends on the specific requirements of your facility. By carefully weighing the pros and cons of each option, you can make an informed decision that aligns with the unique needs of your agricultural or livestock operation.

Text 7. Automated Dairy Systems: Enhancing Dairy Processing

Source: <https://www.ifm.com/us/en/us/industries/food-and-beverage/automated-dairy-systems/dairy>

Imagine a dairy farm that's not just more efficient, but also more profitable and humane. Automated dairy systems offer the exact solutions for the challenges every farmer faces, from improving milk quality to optimizing cow health.

Thanks to Artificial Intelligence and Industrial Internet of Things (IIoT) technology, automated dairy systems are creating a smarter, more efficient dairy industry for operations of all sizes. From improving efficiency with scarcer labor resources and reducing manual inefficiencies to improved process control, animal health monitoring, and more informed, data-driven decisions.

Benefits of automated dairy systems include:

1. Increase product quality: Precision instrumentation improves process control for enhanced food quality and safety. New technologies improve animal welfare and supply chain traceability.

– Improved process control: Precision instrumentation ensures tighter control over process parameters during all steps of production. Small deviations in temperature can result in unsafe food quality of dairy products. This makes consistency and reliability of sensor values essential throughout dairy processing. Smart process sensors from IFM provide: increased accuracy with digital values over IO-Link; increased sensor life due to extreme testing and design; product design to meet the enhanced sanitary needs of dairy products.

The higher resolution of a digital signal via IO-Link compared to traditional analog outputs results in consistently higher quality dairy products. Connected sensors provide real time information during batch production, ensuring consistent conditions during each process step. This results in batch-to-batch uniformity and premium-quality products that build consumer trust.



Improved process control



Automated milking system

– Automated milking system: Robotic milking systems can operate around-the-clock, allowing them to milk cows when the animals need it. The automated milking systems are equipped to spray disinfectant and attach the milking mechanisms gently, in order to reduce stress on the cows and help them to stay calm. Milking on-demand instead of predetermined time intervals helps increase the comfort and health of the animal, while also optimizing milk production. All of these factors improve cow health overall. Robotic milking is just one example of what an automated dairy system can do to enhance animal welfare on a dairy farm.

– Improved traceability for food safety: Automated systems can help you implement traceability protocols that enhance recall readiness. Easily maintain and store records to track: raw ingredients; dairy in production; finished goods throughout packaging and shipping.

Increased data from connected pasteurization and homogenization equipment tracks process parameters for the entire cycle duration of each batch. You can use the IIoT port of the IO-Link master to send machine data to ERP software for recordkeeping and analysis. Connected machines increase confidence that these processing steps have eliminated harmful pathogens while preserving the milk's nutritional value. Scanning and recording bar codes for serialization ensures lot traceability of dairy products at the final stages of production.

2. Increase machine availability: With more real-time data, improvements are made immediately, helping to reduce both planned and unplanned stops.

3. Meet sustainability targets: Reducing waste and inefficiency during production helps dairies meet sustainability goals.

Now let's consider key technologies driving automation. Modern dairies incorporate a range of sophisticated technologies to ensure precision and consistency.



IO-Link



Pressure sensors



Flow sensor



Code reader

– IO-Link provides a flexible communication protocol for connecting smart sensors. As part of an open consortium, it is technology agnostic. The purely digital signal provides more accurate resolution compared to traditional analog technology.

– Pressure sensors or level sensors provide high degrees of accuracy and reliability for optimal machine design. Designed to withstand caustic cleaning solutions and wash-down, they are rigorously tested to prevent moisture ingress and other common causes of sensor failures.

– Flow sensors are critical for monitoring flow rate, totalizing functionality, and media temperature in real time. Receive all of these process values from one sensor over IO-Link for real-time monitoring of your batch during production.



Temperature sensors



Conductivity sensors



3D Sensor

- Code readers can identify date codes, barcodes, and other important marks, using OCR technology and transmit the data over IO-Link. This allows for identification and removal of affected products in the case of a quality issue or safety concern.
- Temperature sensors provide real-time monitoring of the media. Designed to withstand caustic cleaning solutions and washdown, they are rigorously tested to prevent moisture ingress and other common causes of sensor failures.
- Conductivity sensors provide real-time measurements that allow you to monitor skid health in a variety of applications. The price performance ratio allows you to implement multiple data points on a machine for increased insight into processes.
- 3D Sensors for sanitary environments can perform tasks like feeding and cleaning along with automated milking systems.

To sum up, it is important to note that in the dairy industry, leveraging smarter process control solutions helps to improve quality control and optimize downtime to enhance operational efficiency. Integration of IIoT solutions can enable real-time monitoring of dairy operations, ensuring optimal conditions for final product quality and optimal equipment performance. To thrive in the future, dairy manufacturers should invest in technology that prioritizes flexibility and helps achieve improved quality, safety, and sustainability.

Text 8. Equipment Needed for Poultry Farming

Source: <https://www.roysfarm.com/poultry-equipments/#:~:text=Incubator%20is%20such%20a%20poultry,most%20popular%20and%20widely%20used,https://www.agrifarming.in/equipment-needed-for-poultry-farming-tools-and-pdf#download-equipment-needed-for-poultry-farming-pdf>, <https://www.agrifarming.in/wp-content/uploads/2022/02/Equipment-Needed-for-Poultry-Farming.pdf>, <https://www.fancom.com/blog/poultry-equipment>

Poultry farming business become very easy and simple thanks to using poultry equipment properly. The term ‘poultry equipment’ refers to various tools, machinery, and supplies designed and used in the poultry industry. These tools are used for the care, management, and production of poultry (such as chickens, ducks, turkeys, and other domesticated birds). This equipment is essential for maintaining a healthy and efficient poultry farming operation. The specific equipment may vary depending on the type and scale of the poultry farm and the species you are raising in your farm.

Choosing the best poultry farming equipment is an important step in setting up a successful poultry farm. Here are some factors to consider when choosing poultry farming equipment:

- Quality: Poultry farming equipment must be durable and able to withstand the harsh conditions of the poultry house. Choose equipment made from high-quality materials that will last a long time. The initial investment may be larger, but the ROI is higher and high-quality equipment can be tuned optimally to your specific situation.
- Ease of use: Your equipment should be easy to use and maintain. Make sure that you and your employees are comfortable using the equipment before you make a purchase. The easier to work with the less chance for mistakes and the shorter the training period of new staff.
- Safety: It is paramount in poultry farming. Choose equipment that is designed with safety in mind and has safety features for both animals and staff such as guards, sensors, and emergency shut offs. Also be aware of the differences in recovery in case of power failures.

– Availability of spare parts: It's important to choose equipment that has readily available spare parts. This will make it easier and faster to replace parts when they wear out or break. Also check for what period spare parts will remain available.

– Future proof capacity: Bear in mind what your (growth) ambition might mean for your equipment. Over capacity is not required when you choose a solution that is flexible in case your farm grows.

– Energy efficiency: Choose equipment that is energy-efficient to save on your energy costs. Check the possibilities for dynamic energy consumption, not just on and off.

– Warranty and support: Look for equipment that comes with a warranty and good customer support. This will give you peace of mind and helps you address any issues that may arise.

Consider the above factors to make an informed decision and invest in equipment that will help you achieve success in your poultry farming business.

Here is a list of the most useful and essential poultry equipment which is mandatory for successful running of a poultry farm.

1. Housing equipment: Housing depends on the type of poultry farming. Layers are kept in battery cages, while broilers are kept in deep litter rooms. Coup boxes are used in the barn free-range system. It requires heating, ventilation, and space.

2. Incubator or Setter: It is used for hatching the bird's egg in artificial ways. Generally, in natural condition, the poultry birds hatch their egg, but they can only maintain and hatch a limited number of eggs. So, when it is necessary to hatch a large number of eggs, you have to use an incubator. This is a device used to maintain a proper temperature around the baby chickens. It helps to provide adequate temperature, equalize the humidity, and turning of chicken eggs for the first 19 days of the cycle. This allows providing a comfortable environment for the baby birds to settle. There are a lot of types of egg incubators available to choose from. You can buy different types of setters from the market depending on your location and price. A diesel and electric incubator is the most popular and widely used in poultry industry.

3. Brooder Machines: A brooder is a device that provides heat and electricity to newly hatched chicks. It is an essential poultry equipment to ensure warmth and comfort for the chicks during the early stages of their life. Charcoal stove brooder/kerosene stove brooder is used where there is no electricity and is preferred by those who use cheap poultry equipment. There is a charcoal stove covered with a lid that provides heat near the stove and the baby chickens to enjoy the heat. Gas brooder is associated with natural gas, methane, and LPG. The brooders are 3-5 feet above the baby chickens, providing them with both warmth and light.

4. Ventilation Systems: A good ventilation system is a must for keeping your birds healthy and active. A ventilation system is designed to regulate airflow and also to maintain optimal conditions within poultry housing.

5. Health Monitoring Tools: Health monitoring equipment is used for checking the health and well-being of poultry. It includes thermometers and diagnostic tools.

6. Feeders: A feeder is used for feeding the poultry birds. You have to keep foods in the feeder and the poultry birds will start eating from there. Plastic or metal feeders are used mostly to feed the chickens. Always try to keep the feeder neat and clean to keep the birds healthy. Keep sufficient number of feeders in the poultry house according to the number of your birds. Generally, one feeder is enough for 10-15 birds. If the number of feeders is less than the number of chickens, birds can't consume enough food and it will affect their health and production. And if the number of feeders is more than the number of chickens, the birds will waste the food and maximize your feeding cost.

7. Waterers: This poultry equipment is essential for supplying water inside the cage. We all know that clean and fresh water is very essential and helpful for poultry bird's health. So, clean the waterer regularly. Poultry waterers can be of various types. You can install either a simple waterer or a pipe line. In the pipe line system, you can put a pipe from one corner to another corner of the house or use a drop water system.

8. Heaters: Heat management is necessary for poultry farming. Infrared bulbs, heaters or other heating equipment can be used to warm up the poultry cage.

8. Laying Nests: They allow poultry birds to lay their eggs. This equipment increases the egg production and will help you to collect eggs from the nest.

9. Egg Handling Cages: Egg handling nests or cages are used for transporting eggs from one place to another places. It reduces the risk of damages of eggs while transporting for marketing purpose.

10. Fencing: In case of free-range poultry farming system, fencing is a must. Because it protects the poultry birds from all types of predators. Almost all poultry farmers use wire for fencing purposes.

11. Flooring: A neat, clean and dry flooring system keeps the birds healthy. So, always try to use a proper floor. In the case of indoor farming methods use wire net in the floor.

12. Coops and Cages: There are many companies available which produce ready-made coops or cages for the poultry. Such coops and cages are very suitable for small scale poultry rearing.

13. Manure Management Equipment: These are essential tools for handling and disposing of poultry waste in an environmentally friendly way.

Text 9. Advanced Poultry Farming Equipment

*Source: <https://www.agrifarming.in/equipment-needed-for-poultry-farming-tools-and-pdf#download-equipment-needed-for-poultry-farming-pdf>,
<https://www.agrifarming.in/wp-content/uploads/2022/02/Equipment-Needed-for-Poultry-Farming.pdf>*

The choice of good equipment is very important for a successful poultry farm. Poultry farming businesses will use different types of equipment depending on the size and type of poultry house. Perches, feed containers, watering gadgets, heaters, foggers, baby chicken guards, laying houses, and brooding hover are important examples of chicken house equipment.

Today, people from different countries are increasingly turning to poultry farming as it is one of the best sources of income. If you are thinking of starting a poultry farm, equipment is also needed for each stage of the cycle. There are a lot of poultry tools available that are essential for successful poultry farming. Having all these tools will help you to run your farm easily. There are some reasons why you need poultry equipment.

- The equipment makes work easier and faster.
- For large-scale farming, the use of agricultural implements will help increase productivity. That means more sales.
- In addition, by using these add-ons, you can reduce labor for you as a farmer. Importance of poultry equipment for raising healthy chickens

High-quality poultry equipment is essential for raising healthy chickens. Investing in poultry equipment is important to run a successful poultry business that can deliver consistently high-quality products. Let's have a look at some types of advanced poultry farming equipment needed for poultry farming dealing with layers, broilers, and baby chickens.

– **Pan feeding systems:** They are innovative systems that weigh as much as gold when considering poultry feeder options and prices. The pan feeding system allows you to be sure that you use the latest design for better animal welfare. It provides best feed conversion; easy feed access from start to finish; clean, fresh feed in required quantity.

– **Adequate poultry drinkers:** First, decide if the nipple or bell poultry drinker will work best for you. The benefits of nipple poultry drinkers are: heavy and healthy birds; improved feed conversion; reduced mortality of birds; fewer condemnations; the dry floor in the poultry house; and significant savings of labor and overall higher profit.

– **Climate controllers:** The temperature in poultry houses can vary according to the weather conditions outside. Climate controllers send data to the farmer's mobile device, which provides him with important data about changes taking place inside the house.

– **CO2 sensors:** High levels of CO2 can damage chickens and slow down their metabolism. The sensor monitors CO2 levels and lowers them to normal ones.

– **Lighting system:** LED lighting is designed specifically for poultry houses. The right amount of light can reduce costs and improve productivity.

– **Weighing scales:** The scales provide farmers with important data on the weight of birds. That way, farmers can follow the chickens, as they become broilers.

– **Feeding Systems:** Automated systems send the right amount of food through feeding scales, so birds are fed on time whether it's restricted feeding or free feeding.

– **Egg counter:** Egg counting has never been easier. Fortunately, the counting tool can accurately count eggs without damaging them.

– **Infrared bulbs:** These are self-reflecting bulbs with unique red lights. This light attracts birds, and they gather beneath it to experience the heat. One of the differences between these bulbs is that they have no reflectors. These infrared bulbs are the most popular these days, not only because of their affordability but also because they are amazingly effective. Industrial chicken factories use large 250-watt bulbs to heat about 200 chickens. But even small ones work to heat the flock.

– **Hatching equipment:** Hatching equipment is essential when you prefer layers for egg production. They are used to care for eggs after hatching. It includes hatching egg trays and hatching transfer machines. A hatching egg tray is a tray that can hold 90-180 eggs at a time. This helps in storing the eggs properly, where they are stored. A hatching transfer machine helps to transfer eggs from the breeder farm to the hatching tray.

– **Watering equipment:** This equipment has a lot of varieties: a pan and jar drinker, a bell waterer, a nipple drinker and a manual drinker.

The pan and jar drinker is a very budget-friendly option and very easy for chickens to drink. All you need to do is put a jug of water on top of a pan, and that's it. The water in the jar should reach the pan. Although it is not the most reliable option, the smallest move or effect can take it down. If you have tons of chickens, you may want to go for an alternative.

A bell waterer is a bell-shaped piece of plastic hanging along the pipeline, water falls on the pan. The great thing about this device is the very low investment. With just a few bucks you can build a self-contained watering system that is reliable and very efficient. You will need a piece of plastic, a spring mount valve, and a plastic drinker. It takes a while to collect, but it's worth the investment.

Nipple drinkers can be used for almost any type of housing, including cages and coops. They are also quite easy to assemble but may require a larger investment than previous options. It's just a nipple that lets water out permanently in small portions throughout the day. This water falls on a cup or jar so that the chickens can drink from it. People use it on all kinds of birds and other animals, but it is most effective in small places like chicken coops.

The manual drinker is very similar to the jar and pan drinker, but it is fully assembled and ready for the baby chickens to drink. All you have to do is keep the drinker in place suitable for the birds to come and drink. The best thing about this piece is that you can choose bright colors like red, blue, or yellow which the hens like nearby. You can also find them in many sizes, so you can get more than one or just one depending on your needs. Above all, giving vitamins and medicine to chickens is a piece of cake with this piece.

– **Poultry feeding equipment:** It is very important to feed the chickens regularly with the right number of gains. There are different types of feeders. Circular feeders are circular and carry 5-7 kg of grain at a time. The unique pop colors attract baby chickens. Automatic feeders are designed in auger type or chains that feed the birds directly into their nests or sites. Linear feeders are linear in shape with a length of 2 meters made of galvanized iron or wood and bamboo material.

Text 10. Areas of a Poultry Farm That Can Be Automated

Source: <https://www.fancom.com/blog/poultry-equipment>

Being successful in modern poultry farming requires automated equipment. Automating a poultry farm can offer several benefits such as increased efficiency, better production, less risks, reduced labour costs, improved animal welfare, and increased profits. By automating certain tasks, you can free up your time to focus on other areas of the farm that require your attention. Let's consider some areas of a poultry farm that can be automated.

1. Feeding: You can use automatic feeding systems to dispense feed to the birds at specific times, reducing the amount of labour required to manually feed the birds. Automated feeding systems give you extremely accurate control of feed rations allowing you to steer towards optimal growth. This saves time and helps you keep the cost price of feed and the production results under control.

Every farm is different, which is why different feeding systems are available:

– A feeding system with silo weighing that dispenses large feed rations in a short time. A silo weighing system ensures accurate control from silo to feeder. As the silo is weighed continuously, you can read out exactly how much feed is left in the silo at all times.

– A feeding system with batch weigher that dispenses small feed rations very accurately.

– The electronic feed weigher is positioned between the silo and the hoppers in the house and controlled by a computer. This enables highly accurate and controlled dosing of feed rations. The high weigher capacity means feed can be dosed very quickly.



2. Ventilation: Automated ventilation systems can maintain good air quality inside the poultry house, which is important for the birds' respiratory health. Good air quality is beneficial to the growth and health of your animals and saves you costs for feed, water and energy. A ventilation system for poultry farms typically includes the following elements:

– Exhaust fans: These fans extract damaging waste substances such as CO₂, NH₃, moisture and dust and introduce oxygen rich air, helping to maintain good air quality and reduce the risk of respiratory diseases.



Exhaust fans



Air inlets

– Air inlets: These are openings in the walls or roof of the poultry house that allow fresh air to enter. They can be adjustable to control the amount of air entering the house. A continuous supply of fresh air without any draughts or rapid air flows contributes to the quality of the air at animal level.

– Cooling pads: These are wetted pads that are installed on the walls of the poultry house, in front of the air inlet. As air passes through the pads, it is cooled by evaporation, helping to keep the birds comfortable during hot weather.

3. Heating system: This can include heaters or brooders to maintain the temperature in the poultry house during cold weather.

4. Thermostats and sensors: These are used to monitor and control temperature, humidity, and other environmental factors in the poultry house. A good living environment is more than just the right temperature and relative humidity. Excessive carbon dioxide and ammonia concentrations are harmful to humans and animals.

5. Watering and monitoring: Automatic watering systems can ensure that the birds have access to fresh water at all times, and also reduce labor costs associated with manually watering the birds. The water consumption is one of the simplest, but above all most accurate tools, that a poultry producer can use to monitor the performance of the birds. A sudden deviation in water consumption usually signals that something is wrong.



6. Lighting: Automated lighting systems can help regulate the lighting conditions in the poultry house, which can affect the birds' growth and egg-laying patterns.

7. Automatic Control System: This can include a computerized control system that manages the ventilation system and ensures that the environment inside the poultry house is optimal for the health and well-being of the birds. The computer offers all the settings necessary to automatically control the processes throughout the rearing cycle, from the first day the animals arrive to the day they leave the farm. Based on pre-set growth curves, the control parameters automatically grow with your animals and adapt to the changing conditions.



8. Alarm: It is vital that any malfunctions on your farm are reported reliably and in time. No matter how well-equipped your houses are, unpredictable situations that cause malfunctions can always occur. This is not necessarily an issue, as long as timely intervention is possible. If you are not alerted to problems, what started as a simple issue could potentially have a disastrous impact on the running of your farm. To prevent the risk of malfunctions not being signaled, instead of physically walk inspection rounds, there is a range of alarm monitoring systems available, please be aware of the differences in redundancy.

Overall, automating a poultry farm can save time, reduce labour costs, and improve animal welfare, leading to increased productivity and profits.

Text 11. Solutions for Complete Poultry Farm Control and Automation

Sources: <https://www.fancom.com/blog/poultry-equipment>,
<https://www.fancom.com/climate-systems>, <https://www.fancom.com/automatic-feeding>, <https://www.fancom.com/monitoring>

Complete farm control in poultry refers to a farming approach where every aspect of the poultry production process is closely monitored and managed by the farmer. A single system that gives you complete control of the climate, feed distribution, bird weighing and the behaviour and health of your broilers.



Here are some potential benefits of complete farm control in poultry farming:

- Improved quality control: With complete farm control, farmers have full control over the conditions in which the birds are raised, including the feed, water, housing,

growth and health management. This level of control can lead to better-quality poultry products, which can translate into higher profits for the farmer.

- Better disease management: By implementing strict biosecurity measures, controlling the environment and monitoring the health of the flock, farmers can reduce the risk of disease outbreaks in their poultry flock. This can help to reduce the likelihood of economic losses due to mortality of birds.

- Increased efficiency: With complete farm control, farmers can monitor and optimize every aspect of the production process, from egg production to hatching, brooding, growing, and processing. This can lead to higher yields, faster growth rates, and reduced production costs. Objectives are met.

- Increased food safety: With complete control over the feed, water, and housing conditions, farmers can ensure that their poultry products meet high standards for food safety. This can help to reduce the risk of foodborne illness and improve consumer confidence in the safety and quality of poultry products.

- Improved animal welfare: By controlling the environment and providing high-quality care, farmers can promote the welfare of their poultry flock. This can help to reduce stress and disease in the birds, leading to healthier and happier animals.

Overall, complete farm control in poultry farming can lead to improved product quality, increased efficiency, better disease management, reduced risk of errors, increased food safety, and improved animal welfare. These benefits can help farmers to improve their profitability and sustainability over the long term.

To get complete control over all processes in your laying hen houses it is necessary to install a total automation system. One integrated tailor-made system takes care of a carefree operation. It puts your animals first and ensure the best possible growing and living conditions. A total automation system consists of:

- Climate systems: A good climate in your farm is one of the building blocks of Smart Farming. Creating superior conditions in livestock houses starts by regulating an optimal climate in the house, regardless of the outdoor conditions. Your animals are your living capital and the environment they live in influences their development and welfare. The right climate is beneficial to the growth and health of your animals and saves you costs for feed, water and energy. Thanks to a good climate control system, extreme weather conditions and sharply fluctuating day and night temperatures will have no influence on the house climate. You, however, can exert an influence on a sustainable and profitable production process. You are in control, not the conditions.

- Automatic feeding systems: The automatic feeding system plays a pivotal role in establishing optimal conditions within the farm environment. Feed constitutes a major expense on your farm, so naturally, controlling feed prices is a priority. Our automatic pig feeder, a product of Fancom's advanced technologies, provides a highly accurate control of feed rations, ensuring your animals get the right feed quantity at the appropriate time. You can conveniently tailor the feed composition to align with your animals' needs, saving time and effectively managing the cost of feed and production results.

- Monitoring systems: Advanced technology is used in the automated climate and feeding processes to ensure the efficiency of these processes. The ventilation method that uses accurate measurement and control of the ventilation flow ensures optimal thermal comfort for the animals with no temperature fluctuations, or even worse, draughts in the house. Feed rations are dispensed precisely according to the settings in the feed curve, while the gradual transition from one feed type to another ensures better animal growth and less susceptibility to disease.



Climate system



Automatic feeding system



Monitoring system

– Data analysis: The process computers in the house, such as the climate, feed and weighing computers are a source of valuable information about the surroundings and the behaviour of the animals. A high volume of data can be collected. Sometimes maybe even too much, which will cloud the overview. Data collection is just part of the story, you have to actually do something with the figures. Data must be converted into insight. Linking the process computers with the management software on your PC allows the data to be easily combined and presented in clear graphs and overviews. This makes it much easier to compare the data with previous cycles, benchmark the results against your goals or compare the results with the industry standard. A management system takes a lot of work out of your hands by automatically generating useful overviews that are geared to meet the needs of various employees. You don't need to leave anything to chance. Based on concrete facts and figures, you can consult with your employees and farm advisors such as feed suppliers or the veterinary practitioner. This gives you perfect control of your entire production process.

All the data you collect and automatically receive about your farm can be turned into a much more powerful tool than simply a retrospective analysis of your performance. Farmers who want to make progress can utilise their data to monitor the situation daily and respond rapidly by making changes if necessary. The ability to steer the processes with greater precision based on up-to-date data from the house is a huge advantage, particularly on larger farms with multiple sites and a large workforce. The data should be presented in a handy and practical format, for example in an app on your cell phone. So, you don't even have to be physically present in the house to access your data or adjust settings.

The more data you collect from the houses and monitor remotely (for example, via the PC or smartphone), the better equipped you can be to anticipate certain abnormalities. You can view the running time of your ventilation system, heating and lighting, plan regular maintenance, check on stocks and update animal mutations from a distance. Your computer or cell phone can alert you about any alarms. And, if necessary, you can easily adjust the settings in the control computers remotely to improve the processes in the house and boost the efficiency of your production. This saves time and makes your daily workload lighter. You will be notified automatically as soon as a value deviates, so there is no need to check your screen continually.

Data is primarily essential to improve your operating results. It also offers a way of demonstrating how the animals are housed and raised thereby guaranteeing the license to supply. Data can, for example, be used to prove that you use little or no antibiotics, that the animals are provided with enrichment material and have permanent access to drinking water. Supermarket chains, food service and consumers are critical and consider transparency into these aspects to be increasingly important. Automatic data collection on your farm gives you an easy way to demonstrate your commitment to animal welfare.

Text 12. Smart Livestock House Technology for Poultry and Pig Producers

Source: <https://www.fancom.com/smart-farming>

Fancom One smart farming is a comprehensive smart house system for layer farmers, broiler producers and pig producers. The scale of farms continues to grow, technology is becoming more complex, and customers are placing increasingly higher demands. And we want to offer everyone a suitable solution that aligns and harmonises the controller and the peripheral equipment perfectly and enables smart communication. The various processes such as climate control, feed and water distribution, animal weighing and egg counting must interact and operate seamlessly. And no matter how sophisticated and complex the systems are, user-friendliness is paramount. Everything is scalable so we can deliver a suitable solution for every type of house, anywhere in the world. Never too much and never too little. And always customised to match the needs of that particular farmer. We call this new approach Fancom One; centralised control of the entire house.

Fancom is the market leader in creating superior conditions in livestock houses for pig and poultry producers as well as for mushroom growers. Our smart house technology manages and controls all the processes in the house from a central location. As far as we are concerned, there is no limit to the total automation solutions for livestock houses with Fancom One. We have in-depth knowledge of the technology and the processes in the house. Our expertise makes us uniquely positioned to blend these aspects seamlessly. That knowledge is based on almost 45 years of experience and our partnerships with the many reliable and trusted partners we collaborate with to develop our products. We help you improve your operating results.

As to advantages of a smart house system, you are sent a clear, daily overview with easy-to-read data reports. This valuable information helps you: boost your performance; lower your production costs; deliver a safer, healthier and more socially acceptable product; prevent errors and save time.

Smart farming technologies also offer you many other advantages:

- Animal friendly production.
- You manage feed costs on your farm smartly.
- Most energy efficient ventilation solution.
- You get the best out of your animals.

One of the features of smart farming is the application of IoT (Internet of Things) solutions in the form of smart sensors. An IoT solution is a system consisting of smart devices and sensors connected to the internet that collect and communicate data to perform tasks. For example, an IoT solution can consist of a network of sensors that measure temperature, humidity and air quality in a house and send this data via the internet to a central management system. This management system can then analyze this data and take actions to determine the ideal environmental conditions for the animals. This can result in better animal welfare and more efficient energy consumption. By using IoT solutions, the ventilation in the house can be controlled automatically based on the environmental conditions. This can help improve air quality and reduce the risk of illness.

There are more examples of IoT applications in farms:

- Feeding automation: By using IoT solutions, pigs and chickens can be fed automatically and at set times. This helps to optimize the feeding process and reduce waste.
- Health and welfare monitoring: Sensors can be used to monitor the health and welfare of animals in the house. This data can be analyzed to detect early signs of illness or stress, allowing veterinarians or farm managers to act more quickly.

– Data analysis: By using IoT solutions, valuable data can be collected about animal performance, energy consumption and other important factors. This data can be analyzed to make better decisions about farm management and animal health.

All in all, IoT solutions can help improve farm management in pig and chicken houses, increasing animal welfare and efficiency while reducing costs.

Data collection in smart farm management is important. This brings us to another important feature of smart farming: data collection. Data plays an important role in modern smart farm management as it enables farmers to make better decisions based on facts and trends, rather than assumptions or intuition. Below are some important reasons why data collection is important in modern data driven smart farm management:

– Animal health monitoring: Keeping records of animal health, such as their weight, feed intake and growth rates, can help farmers detect diseases early and take preventive measures to maintain animal health.

– Feed management: Monitoring the feed and water consumption of the animals can help farmers to better adjust the feed amounts and feed composition to their nutritional needs and to detect and correct any nutritional deficiencies or surpluses.

– Increase efficiency: Gathering data on animal performance can help farmers increase farm productivity and save costs.

– Improved decision making: By analyzing data on farm performance and animal health, farmers can make better decisions about, for example, the use of labour, the purchase of feed and the implementation of new production techniques.

In short, the use of data in modern data driven smart farm management can help farmers to better understand the performance of their farm and base their decisions on facts and trends. This can lead to higher farm productivity, better animal health and lower costs.

Text 13. Pig Farm Equipment

Sources: <https://www.chiangraitimes.com/legal-learning/pig-farm-equipment/>,
<https://osbornelivestockequipment.com/products/heat-mats/>,
<https://osbornelivestockequipment.com/products/feeding-equipment/>,
<https://osbornelivestockequipment.com/products/feeding-equipment/electronic-sow-feeding-weighing/>

Pig farming is a popular branch of animal husbandry. Although pig is not a part of many areas' food habits, they still retain their position as significant livestock farmed globally. The demand for pig meat and other related products has significantly increased the number of pig farmers worldwide. Farmers resort to advanced technologies and sophisticated pig farm equipment to rear pigs effectively.

Pigs are highly sensitive to the environment they live in. So, even minor changes happening to their living conditions can affect their breeding and meat quality. This is why pig farmers worldwide resort to high-quality pig equipments that provide ample stability to the farming environment. Let's turn our attention to the various equipment used actively in the pig farm industry. Some of the most famous pig farm equipment are:

1. Farrowing Crate: Sows are breeding female pigs. Keeping them safe and stable ensures the breeding of a healthy group of piglets. So, specialized pig farm equipment like sow farrowing pen for pigs is widely used in the pig farming industry. It is common for sows to crush the piglets after giving birth. A farrowing crate prevents that from happening. This farrowing crate for farrowing sows is a metal crate with restricting bars that pre-

vent the sows from moving around too much. A farrowing crate helps to keep the sows indoors, consumes less space inside the pen, protects the newborn piglets, decreases piglet mortality rate and increases economic return. A number of versions are available for the farrowing crate, including the hot dip galvanizing farrowing crate and the piggery pig cage. Some pens also have a designated gestation crate area to accommodate gestating pigs. This kind of separation of pens into various crates helps reduce chaos on the farm.

2. Ventilating Equipment: Proper ventilation is crucial for pigs. So, farmers use a dedicated ventilation system for the pig pens. It provides high rates of ventilation, consumes less power, and produces low noise. The large diameter is crucial.

3. Pig Feeding Line System: The pig feeding line system can differ based on the feed supplied to the pigs. Feeds can be both dry and wet. Depending on its texture, different kinds of feeding systems are installed. There are different kinds of pig feeding systems: a traditional dry feeder, a wet-dry feeder, a tube feeder and a gestation feeder.



For example, let's consider Electronic Sow Feeding (ESF) with RFID (Radio Frequency Identification) technology which provides individual animal management without individual confinement. Harnessing radio frequency identification (RFID) technology, Osborne's Total Electronic Animal Management (TEAM) systems provide animals with freedom to exercise, freedom to choose their eating schedule without feeding anxiety or aggression, and improves animal condition.

4. Heating Equipment: Usually, two types of heating equipment are used in pig pens. They are partial heating and central heating. Central heating maintains an ideal temperature throughout the pen. Partial heating is a form of targeted heating using various equipment like heat lamps, heating pads and a piglet incubator. Popular pig farm equipment supplier platforms provide quality heating systems.



For example, Stanfield heat mats provide safe and gentle supplemental heat for newborn and growing livestock animals, pets, and exotic animals like tortoises, lizards, and more. Operating at a steady temperature rise above ambient temperature, these electric heat pads are designed to promote healthy growth, reduce stress, and provide the optimal growing environment to newborn and growing animals.

Although heat mats are the safe and economical alternative to heat lamps, they're not all the same: Osborne's engineered abrasion-resistant, fiberglass-reinforced composites fully encapsulate a low-temperature, double-insulated heating element, making them far superior to cheap and less reliable poly mats. And, Stanfield heat mats have earned more electrical safety certifications than any other brand (including UL, CSA, CE, IEC, and PSE). They are simply the safest, under-body electric heating mats in the world.

Text 14. Ventilation Adaptable to All Livestock Buildings

Sources: <https://osbornelivestockequipment.com/products/ventilation/>,
<https://osbornelivestockequipment.com/products/ventilation/ventilation-controls-accessories/>

Livestock farmers and kennel operators understand how important maintaining their animals' health and comfort. Proper ventilation contributes to profitability by helping maintain good air quality for both animals and those who care for them. Properly ventilated buildings prevent disease and illnesses, reduce animal stress and discomfort, and create a more productive environment.

With an integrated combination of exhaust fans, fresh air inlets, circulation fans, and reliable controls, Osborne-designed ventilation systems can create healthy indoor environments for virtually any kind of animal. Each component is built to provide long-lasting, trouble-free service. Let's consider different types of fans.

1. Exhaust Fans: Properly sized and placed exhaust fans assist in continuous fresh air exchange in animal facilities. Without exhausting indoor air, a toxic build-up of gases is possible that can seriously affect animal performance. Osborne's selection of exhaust fans expels condensation and toxic gases and are available in a full range of sizes and CFM ratings to match nearly all applications.



Exhaust Fans



Circulation Fans

2. Circulation Fans: Stagnant air in animal facilities can cause a life-threatening build-up of gases and moisture. Proper air circulation improves exhaust fan performance by ensuring all indoor air is well-mixed before it is exhausted. Eliminate "dead air" spaces, expel condensation, and keep pens clean and dry with Osborne's line of Super-Jet Circulation Fans.

3. Fresh Air Inlets: Exhaust fans create negative pressure in animal care facilities that requires replenishing the foul indoor air with fresh outdoor air. Osborne's fresh air exchange systems use various inlets, including the line of no-adjust Auto-MAX inlets, to provide the fresh air your animals need to stay healthy and productive.



Air Inlets



Ventilation Controls and Accessories

4. Controls and Accessories: Osborne-designed fresh air exchange systems include fan controls ranging from simple, manual motor speed controls for a single fan to fully-integrated, automatic system controls with multiple ventilation stages and customizable settings. Additionally, a full line of corrosion-resistant accessories to support fan performance are also available to complete a state-of-the-art ventilation system. The main ventilation controls and accessories are:

- Fan Controls: Browse our selection of fan controls and thermostats for the perfect control for your application. Ranging from single-fan, manual motor speed controls to fully integrated system controls for controlling fans, heaters, curtains, and more for an entire barn or animal facility. As always, contact our ventilation experts for more information or assistance in selecting the right control for your system.



View Fan Controls



Wind Diverter 58" Plus

- Wind Diverter Kits: Wind can slow or stall exhaust fans, seriously affecting barn ventilation rates. This wind pressure problem can be especially severe in winter months when small or variable speed fans are operating at low speed. Reduce wind pressure without significant interference to exhaust rates by adding Osborne's Wind Diverter to your system of exhaust fans.

- PVC Shutters: All-plastic PVC shutters are standard on all Osborne Slant-Wall exhaust fans or custom-made to any size needed for your application. With absolutely nothing to corrode or rust, the non-porous surfaces stay clean and last for years. Available in several standard stock sizes, custom-made shutters are also available by special order.



PVC Shutters



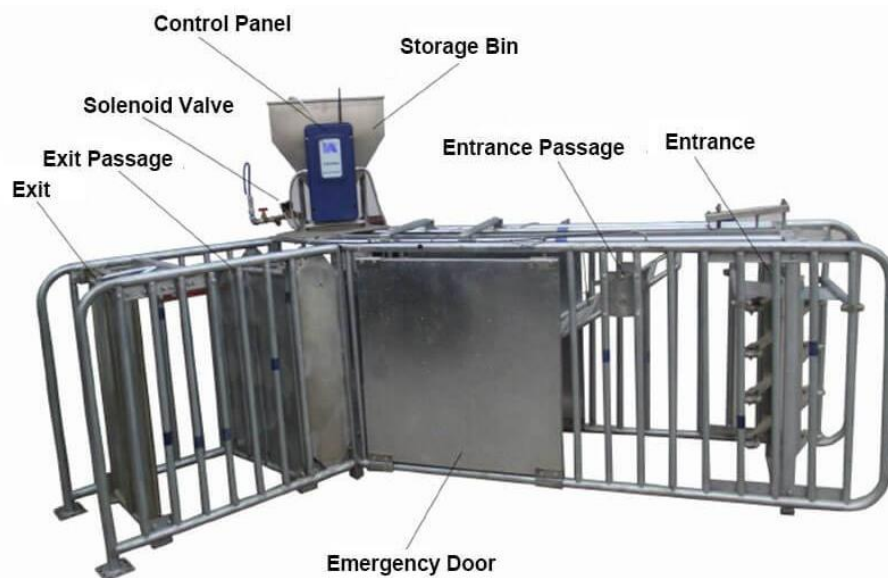
Fiberglass Elbows

– Weather Hoods and Elbows: Adaptable to many fans, Osborne's corrosion-resistant elbows are specially designed to be used as a weather hood or pit fan transition. The non-porous fiberglass-reinforced composite construction prevents dust accumulation, never become brittle in the cold, and holds its shape even in extreme heat, giving you trouble-free years of service.

Text 15. Automatic Feeding System of Sows

Source: <https://www.farming-machine.com/livestock-machinery/pig/automatic-feeding-system/>

The accurate feeding system of sows is controlled by the computer software system. With one or more feeders as the control terminals, and a large number of reading sensors to provide data for the computer. At the same time, according to the scientific formula of sow feeding. The data is processed by computer software system. The mechanical and electrical part of the feeder is instructed to work after processing, so as to achieve the data management and accurate feeding management of sows. This system is also called the intelligent feeding system of sows, the intelligent feeding management system of sows, the automatic feeding management system of sows and the automatic management system of sows.



The advantages of intelligent feeding system are:

- It realizes the highly automatic control of the whole production process: automatic feeding, management, data transmission, alarm.
- It provides high production efficiency. First, it improves efficiency of managers. For instance, for a breeding pig farm with a population of 750 sows, only two people are

needed to manage the pig farm. Second, management is easy – no more than 1 hour per day on average. Third, reproductive efficiency of sows is high. Under the production mode of 26-28 days weaning. The average annual number of births in the sow farm using the system can be increased to 2.40 per year. And finally, it increases overall economic efficiency: 50-120 euro per commodity pig.

– In addition to fully meet the requirements of animal welfare, it is also conducive to reduce the stress on sows in the feeding process.

– It reduces the risk of epidemic as it decreases pollution problems of aggregate feed during transportation and feeding.

Technical Principle: The pig is equipped with an electronic ear tag, which is read by an ear tag reading device to determine the identity of the pig and transmit it to the computer. At the same time, a weighing sensor transmits the weight of the pig to the computer. The manager sets the pig's pregnancy date and other basic information. The system operates according to the data (ear tag number, weight) obtained by the terminal and the data (pregnancy date) set by the computer manager; calculates the amount of food the pig needs on that day. And then transfers the amount of food to the feeding equipment for feeding the pig in time. At the same time, the system obtains other information of pig group for statistical calculation. And it provides accurate data for pig farm managers to carry out company operation and analysis.

Basic Functions of Automatic Feeding System:

- It has a fully automatic function of feeding and data statistics.
- There is an ear mark recognition system for automatic recognition of feeding pigs.
- It automatically calculates the pig's ear mark number, eating time and amount according to the body weight and pregnancy days.
- The daily weight of pigs is measured automatically and the daily gain is calculated.
- The system carries out a comprehensive detection and system alarm for the operation status of the control equipment, the measurement status, and the abnormal situation of pigs.
- The system realizes the function of real-time data backup to display the current status of the pig.

2.4. Processing Equipment

Text 1. Milk Processing Equipment

Source: <https://abltechnology.wordpress.com/2016/06/21/what-do-you-need-to-know-about-milk-processing-equipments/>,
<https://www.britannica.com/technology/pasteurization>,
<https://www.britannica.com/topic/dairy-product/Separation>,
<https://www.ifm.com/us/en/us/industries/food-and-beverage/automated-dairy-systems/dairy>, <https://farmandranchdepot.com/dairy-equipment-and-milking-supplies>

Nowadays, the main section of any milk processing plant is the milk processing equipment. It helps to perform the various operations and working on milk production such as storing milk, cleaning, homogenization, separations, pasteurization and some other operations. In modern days, all milk processing equipment has become more advanced with some latest and unique techniques. These advanced hi-tech machines are very useful for farmers for good quality milk production without more human efforts. The milk processing equipment is designed and developed to consider all farmers' needs. The milk processing machines have a great role to make dairy industry one of the major food industries all over the world. There are various milk processing machines that are helpful in dairy

plants to produce best products like cheese, milk, butter, yogurt, ice cream and much more similar products.

There are several types of milk processing equipment used in dairy farms. Let's consider some of the main processes and operations in dairy plants and the applied milk equipment:

– **Automation:** Automated dairy systems enhance dairy processing. Imagine a dairy farm that's not just more efficient, but also more profitable and humane. Automated dairy systems offer the exact solutions for the challenges every farmer faces, from improving milk quality to optimizing cow health. Thanks to Artificial Intelligence and Industrial Internet of Things (IIoT) technology, automated dairy systems are creating a smarter, more efficient dairy industry for operations of all sizes. From improving efficiency with scarcer labor resources and reducing manual inefficiencies to improved process control, animal health monitoring, and more informed, data-driven decisions. For instance, automated or robotic milking systems can operate around-the-clock in order to milk cows when the animals need it. The automated milking systems are equipped to spray disinfectant and attach the milking mechanisms gently, in order to reduce stress on the cows and help them to stay calm. Milking on-demand instead of predetermined time intervals helps increase the comfort and health of the animal, while also optimizing milk production. All of these factors improve cow health overall. Robotic milking is just one example of what an automated dairy system can do to enhance animal welfare on a dairy farm.

– **Pasteurization:** The pasteurizers are used for a pasteurization process for heat treatment of products to kill bacteria and reduce enzymatic activity. Pasteurization, heat-treatment process that destroys pathogenic microorganisms in certain foods and beverages. Pasteurization of milk, widely practiced in several countries, notably the United States, requires temperatures of about 63 °C (145 °F) maintained for 30 minutes or, alternatively, heating to a higher temperature, 72 °C (162 °F), and holding for 15 seconds (and yet higher temperatures for shorter periods of time). The times and temperatures are those determined to be necessary to destroy *Mycobacterium tuberculosis* and other, more heat-resistant, non-spore-forming, disease-causing microorganisms found in milk. The treatment also destroys most of the microorganisms that cause spoilage and so prolongs the storage time of food. Ultra-high-temperature (UHT) pasteurization involves heating milk or cream to 138–150 °C (280–302 °F) for one or two seconds. Packaged in sterile, hermetically sealed containers, UHT milk may be stored without refrigeration for months. Ultra-pasteurized milk and cream are heated to at least 138 °C for at least two seconds, but, because of less stringent packaging, they must be refrigerated. Shelf life is extended to 60–90 days. After opening, spoilage times for both UHT and ultra-pasteurized products are similar to those of conventionally pasteurized products.

– **Mixing:** Mixing is a high complex operation for emulsifying, dispersing, dissolving the powder and liquid ingredients into a liquid medium. The milk mixers are designed to eliminate labour intensive hand mixing and carrying of milk. For example, the milk powder mixing machine is applied for mixing dry powders or granules in general, as well as liquids and low-viscosity pastes.

– **Separation:** The milk separators are very useful in milk processing plants to ensure the texture and excellent quality of products and elevated performance of skimming milk by preventing intake of destructive air. Most modern plants use a separator to control the fat content of various products. A separator is a high-speed centrifuge that acts on the principle that cream or butterfat is lighter than other components in milk. (The specific gravity of skim milk is 1.0358, specific gravity of heavy cream 1.0083.) The heart of the separator is an airtight bowl with funnellike stainless-steel disks. The bowl is spun at a

high speed (about 6,000 revolutions per minute), producing centrifugal forces of 4,000 to 5,000 times the force of gravity. Centrifugation causes the skim, which is denser than cream, to collect at the outer wall of the bowl. The lighter part (cream) is forced to the centre and piped off for appropriate use.

An additional benefit of the separator is that it also acts as a clarifier. Particles even heavier than the skim, such as sediment, somatic cells, and some bacteria, are thrown to the outside and collected in pockets on the side of the separator. This material, known as "separator sludge," is discharged periodically and sometimes automatically when buildup is sensed.

Most separators are controlled by computers and can produce milk of almost any fat content. Current standards generally set whole milk at 3.25 percent fat, low-fat at 1 or 2 percent, and skim at less than 0.5 percent. Most skim milk is actually less than 0.01 percent fat.

– **Standardization:** The standardization is the main process in milk production whereby the protein, total solids, fat and solids-non-fat have previously separated from a product. Tetra Pak® Standardization unit has a unique ability to standardize not only fat content but also solids-non-fat, total solids and protein, thanks to built-in software which regulates the mass balance.

– **Homogenization:** Milk is homogenized to prevent fat globules from floating to the top and forming a cream layer or cream plug. Homogenizers are simply heavy-duty, high-pressure pumps equipped with a special valve at the discharge end. They are designed to break up fat globules from their normal size of up to 18 micrometres to less than 2 micrometres in diameter (a micrometre is one-millionth of a metre). Hot milk (with the fat in liquid state) is pumped through the valve under high pressure, resulting in a uniform and stable distribution of fat throughout the milk. Two-stage homogenization is sometimes practiced, during which the milk is forced through a second homogenizer valve or a breaker ring. The purpose is to break up fat clusters or clumps and thus produce a more uniform product with a slightly reduced viscosity. Homogenization is considered successful when there is no visible separation of cream and the fat content in the top 100 millilitres of milk in a one-litre bottle does not differ by more than 10 percent from the bottom portion after standing 48 hours. In addition to avoiding a cream layer, other benefits of homogenized milk include a whiter appearance, richer flavour, more uniform viscosity, better "whitening" in coffee, and softer curd tension (making the milk more digestible for humans). Homogenization is also essential for providing improved body and texture in ice cream, as well as numerous other products such as half-and-half, cream cheese, and evaporated milk.

– **Temperature control:** Temperature chart recorders are electric monitors that track and document the temperature of the wash water and milk. Temperature chart recorders have sensors which read the water or milk's temperature. The sensors report to the pen, recording the temperature according to received readings. It's possible to set recorders to set off alarms at certain temperature ranges in order to be notified of unhealthy changes in temperature and incorrect processes of washing. Machines recording and reading the water and milk's temperature are referred to as "circular chart recorders". They may monitor an array of measurements, yet the most important measurement is its temperature. It's important that you have high-quality recorders because they make sure that the milk gets cooled to the necessary temperature then stored at the necessary temperature to be safe for consumption and is of the highest quality. Temperature chart recorders are available with time-period ratings that record for one day at a time or seven days. For 2-day temperature chart recorders, it's possible to pay about \$1,000. For seven-day recorders, you'll pay roughly \$1,500.

– **Processing and storage:** For a micro dairy, you'll have to buy two kinds of tanks – processing tanks and storage tanks. One kind of tank stores milk, and the additional tank

processes it. A 100-gallon tank is priced at approximately \$4,000 and a thirty-gallon mixing tank is priced at about \$3,000. Most often, a 220-gallon cooling tank is priced at about \$7,300, whereby a milk cooling tank is designed of stainless steel and a fourteen-gallon tank is priced at roughly \$2,000.

You'll require pumps that transport your milk, if you have plans on moving milk from station to station. Milk pumps move milk from refrigerated storage tanks to processing tanks, then, as the milk gets processed, it's moved from processing tanks to cooling storage tanks. Like tanks that are utilized in the storing and processing, a milk pump should be designed of stainless steel since it's the most hygienic substance. High-quality milk pumps are as critical as the quality of materials that are used to manufacture them. High-quality means milk pumps gently handle the milk when moving it rapidly so the milk doesn't experience temperature changes which may alter the milk. A milk pump may range in size, range in power, as well as have a multiple-phase or a single-phase pump. Pumps may range so much in capacity, features, and design that it may be difficult to anticipate expense unless you know precisely what you're looking for. Portable pumping stations that have electric transfer pumps may cost approximately \$3,000, whereby a stainless steel, low-volume liquid transfer milk pump is priced at about \$1,100, for example.

– **Packaging:** Until the mid-1880s milk was dipped from large cans into the consumer's own containers. The glass milk bottle was invented in 1884 and became the main container of retail distribution until World War II, when wax-coated paper containers were introduced. Plastic-coated paper followed and became the predominate container. Today more than 75 percent of retail sales are in translucent plastic jugs. Glass bottles make up less than 0.5 percent of the business and are used mostly at dairy stores and for home delivery.

Modern packaging machines are self-cleaning and provide an aseptic environment for milk packaging. Their improved design has allowed milk to remain fresh for at least 14 days and has made it possible for use with ultra-pasteurizing equipment for extended shelf-life applications.

Text 2. Milk Coolers

Source: [https://www.paulmueller.com/hubfs/Dairy-](https://www.paulmueller.com/hubfs/Dairy-Farm/Downloads/Mueller_Milk_Coolers_Brochure_Digital.pdf?hsLang=en)

[Farm/Downloads/Mueller_Milk_Coolers_Brochure_Digital.pdf?hsLang=en](https://www.paulmueller.com/hubfs/Dairy-Farm/Downloads/Mueller_Milk_Coolers_Brochure_Digital.pdf?hsLang=en)

You want quality equipment cooling and storing your source of income, and Mueller® milk coolers set the industry standard. Paul Mueller Company milk coolers are known for dependability and durability, so you can count on years of trouble-free performance. Our coolers also provide low operating costs, precise temperature control, and a wide range of standard features.

Mueller milk coolers protect your milk and your peace of mind. Mueller milk coolers are built of polished stainless steel for durability and ease of cleaning. Our milk coolers feature double-wall construction to maintain temperatures and use our exclusive Mueller TempPlate® heat transfer surface for maximum cooling capacity and low energy costs. Mueller milk coolers are available in sizes from 500 to 8,000 gallons to suit the needs of both large and small dairy operations. Heavy-duty agitators and automatic washing systems are standard features. Our milk cool-



Model OH milk cooler

ers can even be adapted to your operational needs with a broad selection of Mueller refrigeration systems and control panels, providing the most suitable range of features.

Standard components are:

– **Washing System:** The cooler-mounted wash pump, clean-in-place (CIP) piping, and spray dishes work together to provide the cleanest and most durable wash-ready system on the market. These components work in conjunction with the agitator(s) and Mueller control package to quickly prepare your milk cooler for another load.

– **Agitation System:** The agitation system ensures proper blending and even temperature distribution of milk prior to and during milking, as well as during sampling. The agitator assembly consists of a gear drive and a paddle with a milk-sweep design. A single, heavy-duty gear drive is supplied with 2,700-gallon and smaller milk coolers, and two heavy-duty gear drives are standard on 3,000-gallon and larger coolers.

The features and benefits are:

– Highly-polished Type 304 stainless steel construction provides durability and cleanability in an attractive package.

– An inner liner with the exclusive Mueller Temp-Plate® heat transfer surface maximizes refrigeration efficiency.

– Insulated, double-wall construction maintains high thermal storage efficiency.

– Available in sizes from 500 to 8,000 gallons, our options let you choose a unit tailored to your specific storage capacity requirements.

– An automatic cleaning system provides precise, controlled cycles and chemical dispensing.

– Adjustable legs ensure uniform weight distribution on level or uneven surfaces.

– The personnel-access assembly cover swings to the side for easy product inspection and tank maintenance. After servicing, it seals tight to keep milk sanitary.

– A stainless-steel ladder on 800-gallon and larger models allows safe access to the personnel access assembly cover during inspection and service.

– Built to exact specifications, our coolers meet or exceed all milk cooling and storage standards.

– Our milk coolers connect to all Mueller condensing units and control panels, allowing you to choose the right components for your budget and operational needs.

Text 3. Poultry Primary Processing: Chilling Solutions

Sources: <https://poultry.baader.com/chilling>, <https://poultry.baader.com/air-chilling/multi-tier-air-chilling>, <https://poultry.baader.com/air-chilling/clean-air>

The chilling process determines the product appearance, yield performance and shelf life. The ability of chilling to the correct core temperature without freezing extremities will eventually determine the final product value. Local processing practices determine whether cold water or air is used as the preferred chilling method. We offer both methods to best fit your chilling requirements.

1. Air Chilling: Air chilling offers in-line processing and does not change the meat structure. Weight loss is avoided by adding moisture during the process. We offer two air chilling solutions: a multi-tier air chilling tunnel and the single-tier clean air tunnel.

– **Multi-Tier Air Chilling:** Air chilling tunnel with multiple tiers. Offers fast cooling within a reduced footprint. Cold air is an effective way to cool down the carcass temperature while the product stays on the overhead conveyor. In the Multi-tier Air Chilling system, cold air is circulated to cool the meat, resulting in a strong flavour and less chance of contamination compared to immersion chilling.



The benefits of the Multi-tier Air Chilling system are: fast chilling to desired core temperature; automatic, in-line chilling and maturation; preserves meat flavour and texture; moisturizing technology to ensure product quality and keep the weight loss to a minimum; multiple tiers ensure small footprint air-chilling; easy temperature management, alternating tier position to reduce cross-contamination caused by dripping.

Automatic transfer to an in-line air chilling line will reduce product handling and bacterial growth. Using line speed, tunnel length and air flow, the solution will bring products to a predefined deep core temperature. By designing the air chilling solution with several tiers, the overall footprint is reduced to a minimum. The position of the birds in the different tiers alternates to reduce the risk of dripping.

When circulating cold air around the carcasses, the meat temperature is quickly reduced. To avoid drying the surface, a water spray system can be used. When a bird is detected on the line, the system releases a sprinkle of water around the product. The additional humidity will keep the weight loss down.

Air-chilled chickens are cooled individually, which reduces the number of bacteria spreading among products during chilling. Furthermore, as the product is not subject to added water, air chilling is known to preserve the true flavour and meat texture. During cooking, there is no excess water to steam out and the weight loss is minimal.

– Single-tier Clean Air Chilling: It is one layer air chilling tunnel to reduce cross-contamination. Ambient air is filtrated to keep the circulating air inside the tunnel clean.



The chilling process heavily influences the product appearance, yield performance and shelf life. In the Clean Air Chilling tunnel, the birds are conveyed through several chambers, where cold, clean air is circulated to cool the meat. Each chamber has its own temperature and humidity to best control the chilling process and protect the meat quality. The result is a high-quality product with no added moisture and a strong flavour.

The benefits of the Single-tier Clean Air Chilling system are: fast air chilling without freezing the extremities; long shelf life; single-layer design prevents cross-contamination caused by dripping; ambient air is filtrated to keep the circulating air inside the tunnel clean; easy cleaning of chilling room as dripping on structural beams is avoided;

reduced weight loss through fast sealing of the skin's surface; no manual rehangng needed; a vast number of chickens hanging in chilling tunnel.

In the Clean Air Chilling tunnel, the product is cooled to the desired core temperature by clean, cold air as it passes through the tunnel hanging in the overhead conveyor. Rehangng to the chilling line can be done automatically on a transfer machine to avoid manual operations.

Inside the cooling tunnel, the cold airflow is directed through the cavity opening of each bird to achieve a fast cooling from the inside. At the same time, the cold air is distributed over the bird's surface to seal in the meat juices. After exiting the air chill process, the birds remain very pliable and do not have any ice build-up on the extremities of the body. Excellent for cut-up or whole bird pack out.

No cross-contamination caused by dripping occurs as the Clean Air Chilling design is single-layered. Only the maturation area is designed with multiple levels as birds are dry and no longer drip. A single-layer chill room is easier to clean as only the floor needs washing. There is no washdown of structural beams required.

There is also a filtration system that keeps the air clean. Ambient air is filtered and cooled through the evaporators before being directed back through the plenum throughout each zone.

2. Water Chilling: Cold water is a highly efficient way to cool down the carcass temperature. Immersion chilling also has the benefit of allowing for water pick-up in the skin of the carcass, thereby increasing yields. Heavy-duty stainless-steel water chiller equipped with an air agitation system to decrease thermal layering of the carcasses and improve heat exchange. The carcasses are moved forward by the movements of the spiral and the speed of the spiral shaft can be adjusted to fit the specific production need. The spiral chiller is offered in various lengths to best fit your chilling time and volume requirements.

Text 4. Poultry Secondary Processing: Distribution Equipment

*Sources: <https://poultry.baader.com/distribution>,
<https://poultry.baader.com/distribution/trueweigher-707>,
<https://poultry.baader.com/distribution/vision-camera>,
<https://poultry.baader.com/distribution/buffer-transfer-138>*

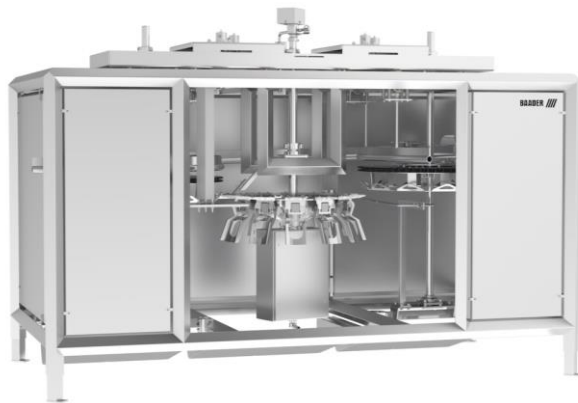
Secondary processing of poultry production includes distribution. There are different distribution solutions that enable intelligent distribution based on individual bird weight and quality. Let's consider some equipment designed for weighing, detecting quality defects on the whole bird and assigning a quality grade, and selective transferring of whole birds from the distribution line to whole bird packaging or cut-up systems.

1. The TrueWeigher 707: This equipment is used for fast and accurate whole product weighing. The benefits of this equipment are:

- ✓ Accurate in-line weight capture after water chilling.
- ✓ High processing speeds up to 15,000 birds per hour.
- ✓ Provides accurate input for best downstream product distribution.
- ✓ Can be installed together with the ClassifEYE® 2.0 vision system to combine weight and quality data for distribution purposes.
- ✓ Allows for +/- 750g flock variation within the same machine set up.
- ✓ Each product is weighed on its own load cell.
- ✓ Very robust and reliable digital load cells – 1000% over-load protection.
- ✓ Products are weighed and distributed in standard two-leg shackles.

It is installed on the distribution line after water chilling and manual rehangng. This in-line weighing machine captures the individual whole product weight in order to optimize downstream distribution – optionally together with individual quality grade and buffer transfer. After weighing, the products can be sorted into whole product drop-off and/or cut-up. The TrueWeigher 707 works together with the BAADER production software that controls the distribution process.

The machine operates with a static weighing principle that allows for an accuracy better than $\pm 0.25\%$, even at high line speeds. The weighing shaft is equipped with several weighing units, each with a digital weigh cell connected to a weighing computer. Every product is weighed on its own load cell without interference from the chain, shackle or trolley. Zero-taring is performed after each weighing cycle to maintain the highest weighing accuracy throughout the production day.



The TrueWeigher 707 is controlled by an office-located weighing computer that provides the operator with performance data for monitoring purposes such as system status, shackle counts, alarm history, etc. It allows the operator to easily set up key parameters and perform various tasks, e.g., calibration. Optionally, a touch screen mounted on the machine (HMI) can give control directly from the plant floor.

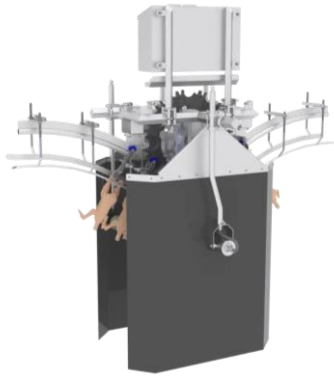
2. The ClassifEYE® 2.0 system: Vision technology has become increasingly important in the poultry processing industry, as it offers numerous advantages over traditional visual inspection methods. With the use of advanced cameras and Artificial Intelligence, vision technology can quickly and accurately inspect poultry products for defects, contaminants, and other quality issues.

The ClassifEYE® 2.0 system uses the most advanced AI technology to adapt to the local production environment and to ensure the highest detection quality at all times. The system computes macro-grades for all parts of the bird and then combines them into a weighted bird grade, which can be used for further best-suited distribution to the downstream processes: whole bird packing, cut-up, deboning, retail and Food Service. The benefits of this equipment are:

- ✓ Advanced AI-based vision technology to accurately determine quality.
- ✓ Real-time classification system that can detect and classify all parts of each bird.
- ✓ Capable of learning from previous inspections, adapting to the local production environment, and improving accuracy over time.
- ✓ Individual quality detections are merged into an overall quality grade for each bird used to determine further distribution.
- ✓ Real-time defect monitoring to immediately correct upstream processing.
- ✓ Captures a wide variety of quality issues.
- ✓ Quality reporting offering easy configuration options to meet specific user requirements.

✓ The grade setup is as simple as moving a slider between photos showing different degrees of quality damages.

✓ ClassifEYE® 2.0 seamlessly integrates with other data capturing equipment and transfer solutions from BAADER.



ClassifEYE® 2.0 provides accurate defect detection and assistance in identifying the root cause through detailed and easy-to-understand detection widgets. The system's dashboard is accessible within the local ClassifEYE® 2.0 network and allows immediate upstream corrections once a value-reducing threshold is reached. Immediate adjustments of processing parameters result in a rapid decrease in carcass damage and fewer down-grades, ultimately leading to the optimal value of every part of the bird.

For the highest detection details, the camera features a 1.4-megapixel colour sensor with specifically chosen optical components to imprint all available information in one shot to a digital data frame. The AI of ClassifEYE® 2.0 takes colour, texture and shape variations into account for precise detection. Robust construction and industrial-grade materials make the cameras highly durable, and able to function reliably in a rough production environment.

3. The Buffer Transfer 138: This type of equipment automatically transfers birds from the distribution line to either whole bird packing or cut-up. The birds are selected and transferred based on their individual weight and quality grade or a combination of both.



The benefits are:

✓ Selectively transfers from a high-speed distribution line to cut-up lines running at a lower speed.

✓ Uses individual bird weight and quality as sorting criteria.

✓ Transfer rate over 98% – carrier segments in clip system for better grip.

✓ Easy set-up and machine control on touchscreen.

✓ Option: drop one-leg-hangers before entering the cut-up line.

✓ Low maintenance – first shaft transfer by servo motor.

The buffer principle enables the Buffer Transfer 138 to handle the difference in line speed between the cut-up line and the distribution line, and to provide a constant bird flow to the cut-up line ensuring full line utilization.

When a selected bird arrives at the transfer point on the buffer wheel, a pushing device gently releases the bird from the distribution shackle and transfers it to an empty buffer carrier where birds accumulate on the buffer wheel before being transferred to the outlet wheel. On the outlet wheel, distance and pitch between birds are adjusted to fit the cut-up shackle.

Text 5. Poultry Secondary Processing: Precise and Flexible Cut-up Equipment

Source: <https://poultry.baader.com/cut-up>, <https://poultry.baader.com/multicut-30>

Today's poultry processors need speed, accuracy and flexibility from their cut-up equipment in order to supply multiple markets, meet last-minute order changes and achieve high-yield performances. Increased demands for convenience products worldwide drive needs for further automation in wing cutting and dark meat deboning. Cut-up lines play a significant role in successful poultry processing.

– **A ProFlex cut-up system:** The system can be designed with numerous cut-up modules to fit your exact market needs. Bypassing units on the cut-up allow birds to be sent to specific cut-up units and deboning systems according to weight, quality and sales demands.

The ProFlex cut-up systems offer reliable and precise portioning while running up to 7,500 birds per hour. Anatomical cuts are available, e.g., in wing segmenting and thigh/drumstick cuts to ensure the highest possible yield performance.

The ProFlex cut-up systems is available in two versions:

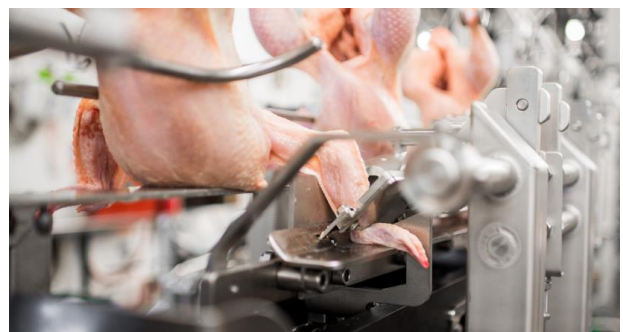
– The ProFlex Classic is a price-competitive system designed in a complete frame structure with all cabling pre-wired. Line speed up to 6,000 birds per hour.

– The ProFlex Premium is an advanced, flexible cut-up system capable of bypassing cutting units and has a flexible design that allows for dropping products wherever required. Line speed up to 7,500 birds per hour.



The numerous cutting modules available for both the Classic and Premium version allow a variety of products to be produced that will fulfill any market needs.

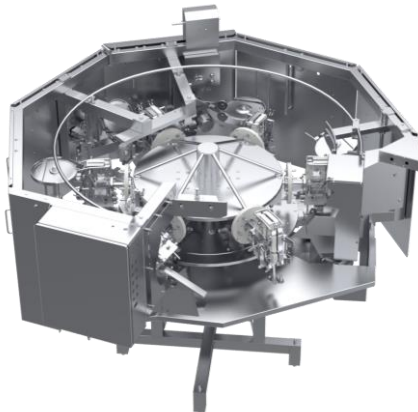
Chicken wings are an increasingly valuable product to global poultry processors. The precision to achieve high quality and yield while maintaining the flexibility to process various wing products are two challenges that poultry



processors face in daily production. The patented BAADER Anatomical Wing Segmenting modules offer the highest quality in wing cuts as well as full flexibility in processing.

The ProFlex Food Service system is capable of providing specialized fast-food cuts consisting of wing cuts, keel cuts, breast quarters, thighs and drumsticks. Due to the modular design of the system, it is easy to add further cutting units such as fat remover and tail cutter. The line can be equipped with a synchronized food-service conveyor to collect all parts from one bird and transport them to a subsequent packing machine.

– **MultiCut 30:** It is a manually loaded compact portioning system for food service cut-up designed to cut up to 1500 birds per hour (ranging from 1050 to 1350 grams) into eight or nine pieces according to machine model. After cut-up, all parts from the same bird are released and can be conveyed away from the machine.



The benefits include:

- ✓ Manual loading, automatic and consistent cutting.
- ✓ Circular, compact system with small footprint.
- ✓ The rotating module ensures correct bird positioning before cutting.
- ✓ Quickly adjustable to ensure precise cutting.
- ✓ Eight- or nine-piece cut-up fit for food service.
- ✓ Easy machine set-up.
- ✓ Approved by the United States Department of Agriculture.

The MultiCut 30 is offered in two models:

– Model 690-000 is designed to cut the whole eviscerated bird into eight pieces: two half breasts with back, two thighs with back, two drumsticks and two whole wings.

– Model 690-100 is designed to cut the whole eviscerated bird into nine pieces: one keel, two quarter breasts with back, two thighs with back, two whole wings and two drumsticks.

The MultiCut 30 performs the following cuts:

– Wing cuts: one wing after the other is separated from the carcass through the shoulder joint. Each wing contains a circular portion of breast meat after cutting (silver dollar).

– Pre-cut and keel cut: cutting off the keel breast piece when performing 9-piece Food Service cut-up.

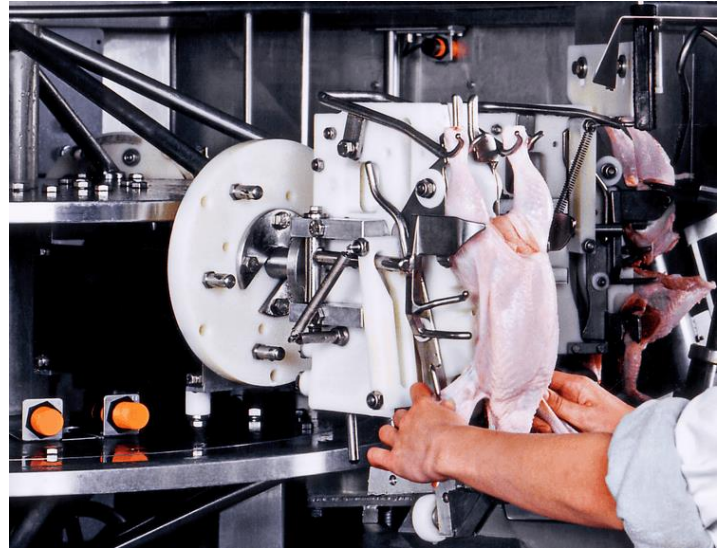
– Split cut: splits the chicken lengthwise into two halves

– Cross cut: cutting off the remaining breast piece (half breasts when 8-piece/breast quarters when 9-piece).

– Drumstick cut: drumsticks are separated from the thighs through the knuckle of the knee joint.

An important feature of this machine is the rotating module. The module locks the bird in such a way that cutting is performed with a high degree of accuracy. As the turn tab-

le revolves along the stationary cutting stations, each module indexes into the right cutting position for the previously mentioned cuts. The bird is thereby correctly positioned before each cut and firmly held by the legs and the wings during the cutting process. To further ensure cutting precision, the leg loop cam and blade heights can be adjusted to fit the bird size being processed.



The machine is equipped with five removable protective covers and the machine will stop immediately if any of the protective covers are removed during production. A safety arm is located before the module closing ramp and is connected to a switch - if pushed, the machine stops. If a motor overload occurs, the "MotorOverload" indicator light will switch on. As a security for correct cutting, a reset indicator will light up if any of the modules do not close properly after loading the birds. For safe cleaning, a lock is provided on each module to prevent the opening of a module.

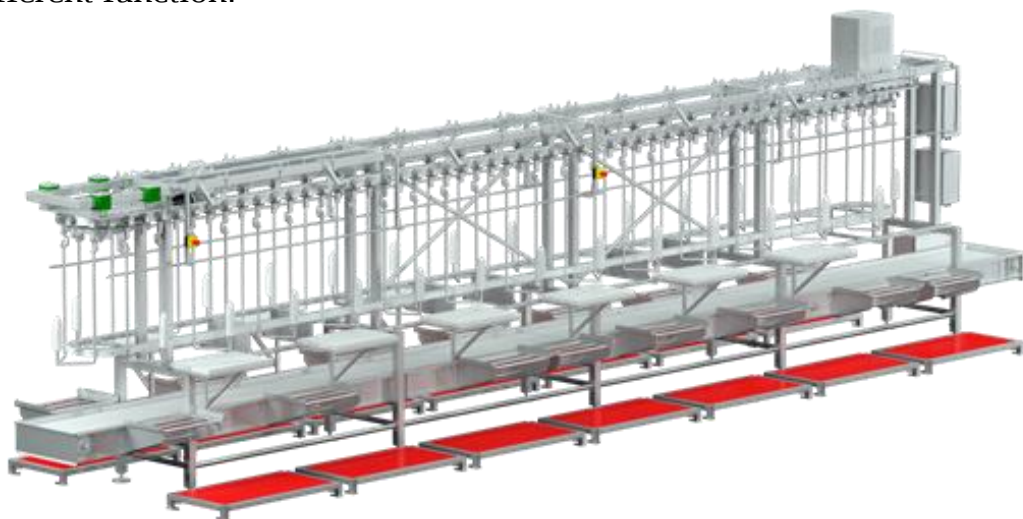
Text 6. Poultry Deboning Line

Source: <https://www.feleti.by/en/katalog/slaughtering-and-primary-cattle-processing/poultry/poultry-deboning-line/>

The cone line for manual cutting of poultry carcasses is a conveyor line with cones for carcasses, a modular conveyor for transporting full boxes and a set of tables on both sides of the line, which serve as workplaces for personnel.

The line is designed for cutting uncalibrated poultry carcasses of different weights and sizes, which allows this type of line to be used in small and medium-sized enterprises.

The operating principle of the line is based on the principle of conveyor production: chicken carcasses move on cones along the conveyor, and each operator sequentially performs a different function.



Sequence of jobs on the line:

- cone loading of chicken carcasses;
- wing separation;
- cut chicken thighs;

- cutting hams into shin and thigh pieces;
- skinning;
- chicken breast cutting;
- carcass removal from the cones.

The capacity of this line at full load is up to 18 tonnes per shift. After cutting the chicken parts are put into crates. When filled the crate is pushed on a roller conveyor to the modular belt conveyor and transported to the palletising place.

The poultry deboning line consists of:

1. Conveyor DF-K: The multi-level conveyor system consists of individual conveyors that fulfil different functions: transporting meat, transporting bones, feeding clean crates, transporting filled crates and stockpiling.



The design features are:

- robust wear-resistant construction;
- robust polymer tape;
- controlled from a common control panel;
- helps to organise workplaces for quality deboning;

The specifications are:

- material: stainless steel AISI 304;
- conveyor belt made of polymer material;
- electrical connection: 400 V / 50 Hz;
- drive power: 4 kW;
- conveyor design is customised and can be of different configurations.

2. Deboning table DF-SG: The table is designed for deboning and sorting poultry.



The design features are:

- simple design for safe and ergonomic work
- the table is equipped with a removable table top
- customised design

The specifications are:

- frame material: stainless steel AISI304
- table top material: polyethylene

3. Platform DF-P: This platform is designed to organise the workplace.



The design features are:

- robust design for safe and ergonomic operation
- the platform is equipped with a removable composite meniscus-shaped anti-slip grid.

The specifications are:

- material: stainless steel AISI 304
- removable composite meniscus-shaped anti-slip grid
- overall dimensions: 1100x575x200 mm.

Text 7. Meat Processing: Angle Meat Grinder

Source: <https://www.feleti.by/en/katalog/meat-processing/angle-meat-grinder/angle-meat-grinder-for-fresh-and-frozen-meat-mp-ga/>

An angle meat grinder for fresh and frozen meat MP-GA is a grinder with corner feeding system MP-GA. It is designed for grinding fresh and frozen meat (up to -20°C) to the required granulation, as well as for performing other technological operations depending on the equipment used.



The angle meat grinder ensures:

- safety during operation due to its sturdy and reliable product body, as well as high-quality stainless-steel blades;
- durability and reliability during daily operation;
- grid diameter: 130 - 200 mm;
- hopper capacity: 220 - 370 l.

The key features are:

- the device is made of high quality AISI 304 stainless steel. External surfaces are shot-blasted; surfaces in contact with the product are ground;
- reliable strong metal-intensive design ensures mechanical strength and convenient equipment maintenance;
- touch screen control panel;
- the meat grinders have a hyperbolic shape of the feeding zone, which prevents the chopped raw materials from getting stuck;

- the throat of the meat grinder has a system for easy installation and disassembly of the cutting kit, the configuration of which depends on the technological needs;
- the cutting system includes high-quality tools (knives, double-sided cutting knives, grids with various hole diameters);
- for safety reasons, the machine is equipped with a protective cover for the throat, which protects the operating personnel and eliminates the risk of splashing minced meat beyond the workspace. The cover also has a lockout system to prevent opening during operation;
- there is a protective frame along the perimeter of the loading hopper for an emergency stop of the machine;
- meat grinder can be equipped with an external device for separating cartilage and films;
- convenient system of access to the feed screw greatly facilitates the sanitary washing of equipment;
- the pressure chamber with a working auger is made of a durable material, which enhances the wear resistance of the components, while the pressure equalization system inside the chamber eliminates the undesirable effect of compressing the raw material;
- adjustable screw rotation speed;
- easy replacement of cutting tools;
- presence of technological holes for CIP-washing of hard-to-reach places in the cavities of the working screw;
- the grinder can be built into the technological line;
- the presence of a trolley for storing cutting tools.

Text 8. Minced Meat Mixers

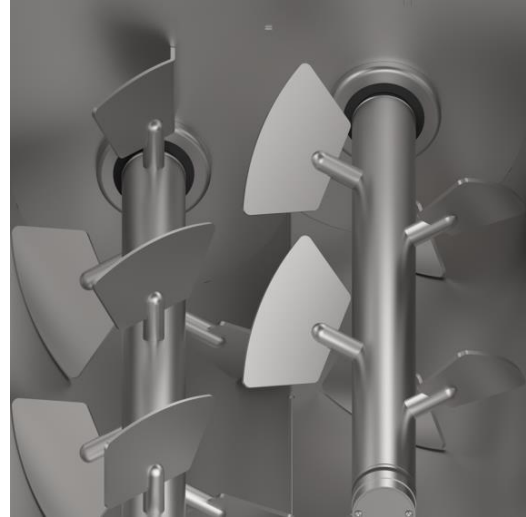
Sources: <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/?branch=317>, <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/kopiya-farshemeshalka-s-lopastnyimi-meshalkami-mp-fp/mp-fpv/>, <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/kopiya-farshemeshalka-s-z-obraznyimi-meshalkami-mp-fzv/>, <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/kopiya-farshemeshalka-so-spiralnyimi-meshalkami-mp-fs/mp-fsv/>

Different models of minced meat mixers are used in meat processing. Let's consider some of them.

1. Meat mixer with blade shafts MP-FP/MP-FPV: This minced meat mixer MP-FP/MP-FPV with two paddle mixers is designed for mixing minced meat and other viscous products until smooth, as well as massaging and salting small pieces of meat (weighing up to 500 g). In the process of mixing, spices, flour, food colorings, brine and other ingredients provided for in the recipe can be added to the products. It provides high-quality and homogeneous mixing of the product; a wide range of productivity from 150 to 2000 liters; individual solutions and it has the possibility of installing a vacuum system.

The key features of the mixer are:

- The equipment is made of high-quality stainless steel. Strong design ensures mechanical strength and convenient equipment maintenance.
- Minced meat mixers equipped with a vacuum system have a durable bowl and a sealed cover, which ensures a creation of vacuum of up to 99% (additional option).
- A vacuum system with a high degree of filtration and with a moisture separator.
- There is the ability to adjust the speed of rotation of the mixers, reverse.



- Due to the profile of the mixing paddles, the product is unloaded almost without residue.
- The inner mixing chamber has rounded corners and polished surfaces.
- Crisscrossing paddle shafts located at different heights, rotating in opposite directions (inward or outward).
- A touch screen control panel with an informative and intuitive clear interface that is very easy to work with. The software allows you to control the operation of the machine in both manual and automatic cycles.

2. Meat mixer with Z-shaped shafts MP-FZV: The minced meat mixer MP-FZV with two Z-shaped mixers is designed for mixing minced meat and other viscous products until smooth, as well as for mixing dough. In the process of mixing through the viewing window, spices, flour, food colorings, brine and other ingredients provided for in the recipe can be added to the products. Unloading is carried out by overturning the mixing chamber. It has a wide range of capacity: 300 - 2000 l; hygienic design and a possibility of installing a vacuum system.

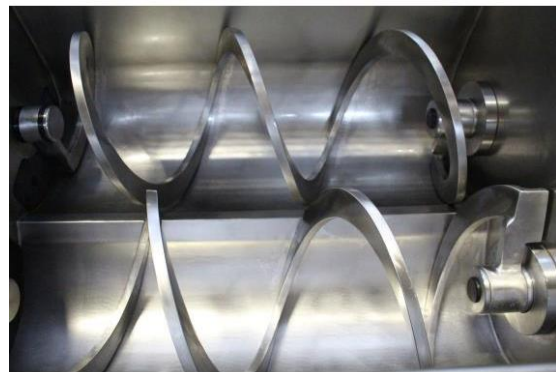


The key features of the mixer are:

- Vacuum provides excellent protein extraction, liquid absorption, distribution and absorption of flavor of spices and additives, allows you to control the density and eliminates the possibility of air bubbles before emulsification, filling or molding.
- The equipment is made of high-quality stainless steel. Strong design ensures mechanical strength and convenient equipment maintenance.

- The working hopper is made of stainless steel with a smooth surface, has no corners, which simplifies its cleaning.
- The presence of a branch pipe for/supplying water / liquid to the mixing chamber.
- A vacuum system with a high degree of filtration and with a moisture separator.
- Unloading of the product is carried out by overturning the mixing chamber.

3. Meat mixer with spiral shafts MP-FS/MP-FSV: This minced meat mixer MP-FS/MP-FSV with two spiral mixers is designed for mixing minced meat and other various products until smooth, as well as for mixing vegetable salads and some types of cheese. In the process of mixing, spices, flour, food colorings, brine and other ingredients provided for in the recipe can be added to the products. The volume of the mixing chamber is 300-450 l. There is a possibility of installing a vacuum system. It is suitable for cheeses and vegetable salads.



stagnant zones are excluded, in which bacterial flora can accumulate, worsening the quality of the finished product and reducing its shelf life

The key features of the mixer are:

- Open type minced meat mixers are equipped with a grid for safe operation during mixing.
- A sensor for the presence of a technological container for unloading, preventing the unloading of the product in case of its absence.
- It is made of stainless steel AISI 304, external surfaces are shot-blasted, and surfaces in contact with the product are ground.
- There is the ability to adjust the speed of rotation of the mixers, reverse.
- Spices and ingredients can be added in the process of mixing through the grid or viewing window.
- The mixer drive is designed in such a way that it completely eliminates the ingress of lubrication into the product and onto the electric motors.
- The minced meat mixer can be equipped with a mast lift and a vacuum system.
- The strong design ensures mechanical strength and convenient equipment maintenance.

Text 9. Meat Injector and Brine Mixer

Sources: <https://www.feleti.by/en/katalog/meat-processing/injector-mp-i/mp-ir/>,
<https://www.feleti.by/en/katalog/meat-processing/brine-mixer-mp-mix/mp-mixc/>

The injector MP-I is designed to inject meat with brine, which is supplied under pressure through needles. Suitable for meat with and without bone, meat elements, chicken carcasses and elements. The needles have small holes that can be located both along the body and at the tip of the needles.



Each meat injector is equipped with several types of needles, the thickness and number of which can be selected depending on the size of the semi-finished product. The injectors are suitable for meat with and without bone, meat elements, chicken carcasses and elements. They have from 20 to 80 needles per block. Needles can be of different diameters and with different number of holes. For pork and beef meat, needles with a diameter of 4 mm are recommended, for chicken 3 mm.

The key features of the meat injector are:

- hygienic design;
- mobile execution;
- adjustable conveyor speed;
- adjustable pump pressure;
- a system for safely hiding the needles in the block when in contact with the bone;
- double brine filtration;
- presence of a tank for brine;
- function of mixing and pumping of a brine from the tank;
- rotary brine cleaning system (additional option);
- easy dismantling of the block of needles and the conveyor for sanitary cleaning;
- the injector can be connected to a brine mixer;
- control and settings from the touch screen panel;
- made of stainless steel AISI 304, external surfaces are shot-blasted, and surfaces in contact with the product are ground;
- all machine parameters are controlled by the controller. The touch screen panel adjusts the conveyor speed and pump pressure, allowing you to select the optimal operating parameters.



The brine mixer MP-MIX/MP-MIXC is an efficient mixer for dissolving salt, dry additives and spices by adding water in a special foam-free process. All ingredients are

easily loaded into the hopper. In a short time, the ingredients are efficiently and mixed until smooth inside the tank by means of a mixer and a pump that recirculates the brine. The resulting brine can be used during injection. It ensures effective mixing without foam formation. It has solution temperature control and provides the ability to work in a single process line with an injector.

The key features of the brine mixer are:

- supply of the required amount of water;
- solution temperature control;
- double mixing system, eliminating the foaming of the brine;
- ability of operation of the brine mixer and the injector in a single technological line;
- strong and efficient mixing and transfer pumps;
- ability to connect the tank to the factory CIP system;
- control and settings from the touch screen panel;
- made of acid-resistant stainless steel, external surfaces are shot-blasted, internal surfaces are polished.

Text 10. Frozen Meat Cutter and Bowl Cutter

Sources: <https://www.feleti.by/en/katalog/meat-processing/frozen-meat-cutters/?branch=316>, <https://www.feleti.by/en/katalog/meat-processing/bowl-cutters/?branch=316>

A number of cutters is used in processing. Let's consider a block cutter for meat and other frozen foods as well as an industrial bowl cutter for meat grinding.

1. Frozen meat cutter MP-KR: This type of cutter is designed for qualitative cutting of frozen blocks of meat, cheese, fish, butter, cottage cheese, hard glazes, chocolate and other products with temperature down to -25°C . Maximum size of blocks for chopping 600x400x250 mm. It ensures gentle and quality product slicing. It has an automatic pusher. Its high productivity can be compared to guillotine type of equipment. It is characterized by easy accessibility for washing and sanitizing.



The key features of the frozen meat cutter are:

- It is made of high quality AISI stainless steel. The outer surfaces are shot blasted, the surfaces in contact with the product are polished.
- A robust metal construction provides mechanical strength and easy maintenance of the equipment.
- Touch control panel is available.
- It provides a gentle and high-quality cutting of the product into small or medium-sized pieces.
- There is an automatic pusher.

- Its high productivity compared to guillotine type machines.
- For safety reasons, a hinged protective cover is provided to protect the operating personnel and prevent injuries to hands in the grinding area.
- It is characterized by easy accessibility for washing and sanitising all machine components.
- The top cover of the machine is lifted with a pneumatic cylinder.
- It is equipped with a secure trolley locking
- It has a convenient access system for dismantling the pneumatic pusher
- It provides comfortable reception desk as a workplace for staff
- An adjustable rotational speed of the working drum and rotor allows for better performance
- It is easy to change blades.
- The block cutter can be integrated into the production line.
- The control panel is hygienic, compact and offers IP54 protection.

2. Bowl cutter MP-CUT: This cutter is designed for grinding meat and other small-scale food products and mixing with various ingredients in the production of sausages, pates, minced meat for various semi-finished products, preparation of protein emulsions, as well as when chopping vegetables, fruits and other products. It provides high-quality grinding of raw materials with minimal production time. It has high-quality knives to ensure a long service life. There is a hygienic design without stagnant zones and convenient access for cleaning the cutter. The warranty service is provided for 12 months.



The key features of the bowl cutter are:

- reliable design ensures mechanical strength and convenient maintenance of the equipment;
- all the outer surfaces of the bowl cutter and the surfaces in contact with the product are made of high-quality AISI stainless steel;
- touch control panel with an intuitively understandable interface;
- built-in vat cart loading device;
- built-in unloading device;
- provides convenient, tool-free access to clean the relevant parts from all sides of the device;
- high speeds of the cutting head (up to 4500 rpm);
- the knives are made of high-quality steel and have a long service life;
- a system of cutting knives that does not require adjusting the distance from the bowl. The gap between the blades and the bowl is up to 1.5mm;
- the bowl is made of stainless steel;
- multi-level security system eliminates personal injury;

- smooth adjustment of the rotation speeds of the bowl and blades due to the installed frequency converters;
- built-in product temperature sensor;
- the presence of the knife reverse function;
- IP66 remote electric cabinet.

2.5. Digital Technologies in Agriculture

Text 1. Benefits and Challenges of Adopting Digital Technologies in Agriculture

Source: <https://www.collegenp.com/article/digital-technologies-in-agriculture/>

Introduction

Agriculture has been an essential part of human civilization since ancient times, providing food and other essential resources. With the advancements in technology, the agricultural sector is now embracing digital technologies to increase efficiency, reduce waste, and improve productivity. The integration of digital technologies in agriculture has revolutionized the way farmers manage their crops and livestock, leading to increased yields, reduced costs, and improved environmental sustainability. In this article, we will explore the benefits and challenges of adopting digital technologies in agriculture, current examples of precision agriculture and smart farming, future trends and innovations in agricultural technology, and the economic and environmental impact of digital technologies in agriculture.

Overview of Digital Technologies Used in Agriculture

Digital technologies are transforming the agriculture industry, enabling farmers to make data-driven decisions and optimize their farming practices. Digital technologies in agriculture include precision agriculture technologies, agricultural IoT, smart farming, and other digital tools that enable farmers to collect and analyze data to make informed decisions. Precision agriculture technologies such as GPS-guided tractors, drones, and sensors, enable farmers to monitor crop growth, soil moisture, and weather patterns, allowing for optimized planting, irrigation, and fertilization. Agricultural IoT enables farmers to connect devices such as sensors, drones, and weather stations, to collect real-time data and monitor their crops and livestock remotely. Smart farming uses artificial intelligence and machine learning to analyze data and optimize farming practices, leading to increased yields and reduced costs.

Benefits and Challenges of Adopting Digital Technologies in Agriculture

The adoption of digital technologies in agriculture offers numerous benefits, including increased efficiency, improved productivity, reduced costs, and improved environmental sustainability. By using precision agriculture technologies, farmers can increase yields while reducing water usage and chemical inputs. According to a report by the World Economic Forum, the adoption of digital technologies in agriculture can lead to an increase in crop yields of up to 30%, while reducing water usage and chemical inputs by up to 90%. Precision agriculture technologies also enable farmers to optimize their use of fertilizers and pesticides, reducing waste and environmental pollution. Agricultural IoT enables farmers to monitor their crops and livestock remotely, leading to improved animal welfare and reduced labor costs. Smart farming uses artificial intelligence and machine learning to analyze data and optimize farming practices, leading to increased yields and reduced costs.

However, the adoption of digital technologies in agriculture also presents several challenges. The initial costs of adopting digital technologies can be high, and some farm-

ers may lack the technical skills required to operate and maintain digital tools. Additionally, data privacy and security concerns can arise when collecting and analyzing data on crops and livestock. The lack of standardized data formats and data-sharing protocols can also limit the interoperability of different digital tools, making it difficult to integrate and analyze data from different sources.

Examples of Digital Technologies Used in Precision Agriculture and Smart Farming

Precision agriculture and smart farming are two examples of digital technologies that are transforming the agriculture industry. Precision agriculture technologies use real-time data and analytics to optimize planting, irrigation, and fertilization, leading to increased yields and reduced waste. Smart farming uses artificial intelligence and machine learning to analyze data and optimize farming practices, leading to improved efficiency and productivity. Here are a few examples of precision agriculture and smart farming technologies:

- GPS-guided tractors: GPS-guided tractors enable farmers to plant crops with precision, reducing waste and increasing yields. The tractors use real-time data on soil moisture, weather patterns, and other factors to optimize planting.
- Drones: Drones are used in precision agriculture to monitor crop growth, identify pests and diseases, and analyze soil moisture. The use of drones in agriculture can lead to increased yields and reduced costs.
- Agricultural IoT: Agricultural IoT enables farmers to monitor their crops and livestock remotely, using sensors and other connected devices. This technology can lead to improved animal health and welfare, as well as optimized crop growth and yield. Agricultural IoT devices can be used to monitor soil moisture levels, temperature, humidity, and other environmental factors that can affect plant growth. By collecting and analyzing data from these sensors, farmers can make informed decisions about when to irrigate, fertilize, or harvest their crops.

One example of Agricultural IoT technology in action is the use of RFID (Radio Frequency Identification) tags to monitor the health of dairy cows. The tags are attached to the cows' ears and record data on their behavior, such as their activity levels, feeding patterns, and milk production. This information is then analyzed to identify any potential health problems, allowing farmers to take action before the issue becomes more serious.

Despite the many benefits of digital technologies in agriculture, there are also some challenges that need to be addressed. One major challenge is the cost of implementing these technologies, which can be prohibitive for smaller farms. Additionally, there is a need for greater education and training for farmers to effectively use these technologies, as well as concerns around data privacy and security.

Future Trends and Innovations in Agricultural Technology

As technology continues to evolve, there are many exciting innovations on the horizon for the agriculture industry. One area of particular interest is the development of autonomous farming equipment, such as tractors and harvesters, which can operate without human intervention. These machines are equipped with sensors, cameras, and other technologies that enable them to navigate fields, avoid obstacles, and make real-time decisions about crop management.

Another emerging technology is blockchain, which has the potential to revolutionize the way that agricultural products are tracked and sold. By using a decentralized ledger system, blockchain can provide greater transparency and traceability throughout the supply chain, from farm to table. This technology could help to reduce food waste, improve food safety, and increase consumer trust in the food they eat.

Economic and Environmental Impact of Digital Technologies in Agriculture

The adoption of digital technologies in agriculture has the potential to not only improve the economic viability of farms, but also to reduce their environmental impact. By optimizing crop growth and reducing the use of water and chemical inputs, digital technologies can help to reduce greenhouse gas emissions and conserve natural resources. Additionally, these technologies can help to reduce food waste and improve the efficiency of the supply chain, leading to more sustainable and resilient food systems.

Conclusion

To sum up, digital technologies such as precision agriculture, agricultural IoT, and smart farming are transforming the agriculture industry, offering many benefits to farmers, businesses, and consumers. These technologies have the potential to increase crop yields, improve animal health and welfare, and reduce the environmental impact of farming. While there are challenges to their adoption, such as cost and education, the future looks bright for the continued development and use of digital technologies in agriculture. As we move forward, it will be important to ensure that these technologies are implemented in a responsible and sustainable way, to ensure a more equitable and prosperous future for all.

Text 2. IoT and Other Technologies in Modern Farming

Source: <https://smarttek.solutions/blog/the-role-of-iot-technology-in-modern-farming/>

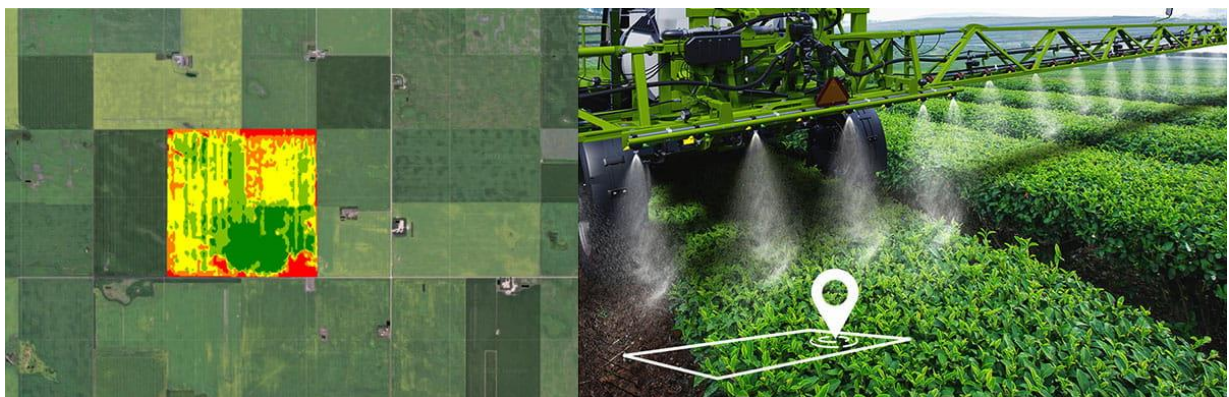
Many technological changes happen not only in the world of AR/VR, cybersecurity, and web development. The agriculture sphere is one of the most notable representatives of innovation use. Indeed, drones, robots, and other great machines implementing in the farming sector, and we can see amazing results of IoT in agriculture.

The agricultural sector since farming is no longer considered a sphere far away from IoT and technology. Studies show that population growth is supposed to increase by another 3 billion more lives by 2050. Therefore, industrialized farming has a necessity to change things for the better.

Let's find out how IoT and other technologies are revolutionizing modern farming and how their application can benefit agribusinesses.

– **GIS-Based Agriculture:** Half the competition battle in farming is choosing a great piece of land. You're the lucky ones if you have a family generation of farmers. But new farmers do not have such a luxury, and, being first-timers, they want to pick the right piece of land without risks and lead IoT farming successfully.

It brings them to GIS software, a geographic information system. It is a modern farming technology that can depict current and future changes in precipitation temperature, soil condition, plant health, and several other pieces of helpful information to have a good harvest.



GIS technology in agriculture

A farmer can also benefit from GPS-based applications along with smart machinery to improve the application of IoT in agriculture to specific field areas to save money and effort.

– **Livestock Farming Technology:** Advanced technologies allow farmers to use sensors, data, and processing algorithms to improve animal raising and care, as well as optimize farm management and overall productivity. The technologies allow livestock businesses to obtain good results even in countries unsuitable for animal husbandry, for example, Israel.

The following list shows several examples of modern farming technologies used to achieve the objectives:

1. Remote health monitoring: Remote monitoring technologies provide more data on animal health and welfare than ever before. For instance, animals are weighed with movable scales installed in the floor covering. Using this tech, farmers do not need to physically contact animals or drive them into pens.

2. Automated feeding systems: Resorting to such feeding systems, farmers can now provide cattle, pigs, and other livestock with premixed feed in amounts specifically developed to meet a particular group's needs. The systems ensure animals' nutritional requirements and reduce overeating to a minimum.

3. Milk meter: The device accurately measures milk yields and estimates the most favorable time for milking device removal to protect the cows' udders. Based on the data received from a milk meter, the software warns farmers about potential mastitis. They can initiate early preventive measures and minimize drug usage.

– **Satellite-Derived Data:** For example, they can predict crop yields or help farmers monitor their fields in real-time. Predictability is crucial when growing seeds in a 'freakish' climate zone. No hardworking farmer wants to surprise himself with dry plants while attending to his crops.



Satellite data in Farming

IoT farming applications help to work across a number of different spectral indices:

- ✓ Normalized Difference Vegetation Index (NDVI).
- ✓ Canopy Chlorophyll Content Index (CCCI).
- ✓ Normalized Difference RedEdge (NDRE).
- ✓ Modified Soil-Adjusted Vegetation Index (MSAVI).

The internet of things in agriculture is applied to help farmers control plant health, vegetation content, nutrient application, nitrogen content, and soil background impact.

– **Data from Drones:** Farmers lose much if they neglect the achievements of IoT in agriculture and see only one perspective of their fields and crops – from their own eyes. It fits if you have small territory, but it becomes hard to control hectares of an industrialized farm just by foot or even a machine.

Benefits of using drones in farming:

- ✓ Define crop biomass;
- ✓ Measure plan height;
- ✓ Observe the presence of weeds;
- ✓ Ensure water saturation;
- ✓ Detect and treat hazard areas;
- ✓ Success in your fields due to more precision as a result.

Additionally, data from drones is supposed to be more accurate with a far greater resolution compared to satellites. If they are locally operated, they also provide any climate or crop valuable information faster.

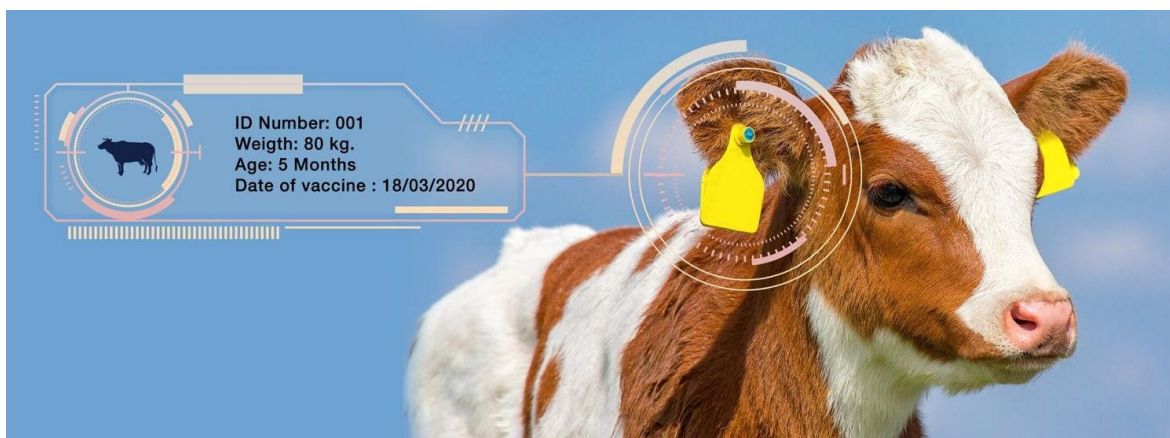
– **EOS Crop Monitoring:** How does it work? The system is supposed to give the farmer as much information as he would obtain, saving time and money due to a simple subscription. The digital platform also ensures that farmers can speed up decision-making and not miss any crucial field treatment points.

Benefits of EOS monitoring in farming and agriculture:

- ✓ Forecast yields at the field, region, or country level.
- ✓ Access field-level crop type classification (wheat, soy, corn, etc.).
- ✓ Monitor crops with scouting applications and assign tasks to them in a few clicks.
- ✓ Take the best steps to combat the problem, from pest activity to weed management.
- ✓ Yield the best number of crops due to weather analytics and plant condition data.

By knowing all satellite-based information due to IoT in Agriculture, farmers can prevent bad scenarios like frost or heat damage, insects, etc., to grow the best harvest without dampers.

– **RFID Technology:** This smart farming technology involves the use of small electronic tags that can be attached to livestock, crops or equipment and transmit data wirelessly to a reader.



Animal Tag (RFID technology)

By attaching electronic tags to each animal, farmers can easily monitor its location, movement and health. This can help farmers identify potential problems, such as illness or injury, and respond quickly to ensure the well-being of their animals.

In addition, RFID technology can help improve the safety and security of farming operations. By attaching electronic tags to equipment, farmers can monitor its location and

ensure it is not stolen or misused. This can help prevent costly losses and keep operations running smoothly.

– **Farm Management Software:** Dedicated farm management software serves farm owners as a platform where they can get a whole picture of all business aspects and factors affecting the successful operations of farms. Using this software, farmers can effectively plan their activities, conduct their real-time monitoring, and make learned decisions. To reach the goals, farmers can use a universal ERP system like Odoo adapted according to the needs and peculiarities of customers engaged in agribusiness.

– **Technologically Innovative Machinery:** Modern industrialized farming is impossible without technologically innovative machinery to get the job done with all field information. This sphere ranges from automatic harvesters to large industrialized sorters. Besides, it covers livestock tracking with ERP systems or mobile/web development for better IoT farming communication.

Farmers can increase versatility significantly using smart machinery and automation approach to save human resources and time to grow harvest. Most of the equipment is multipurpose, so you definitely adjust it to your specific needs.



Robotics in smart farming

In a perfect scenario, combining all these technologies can speed up your farm productivity from scratch and show all the benefits of IoT in agriculture. Farming is indeed a complex process in the era of the technological wave that revolutionizes the efficiency of farms worldwide.

As the population grows, there is a need for more quality food, and farmers must perform double to satisfy the demand. It is where drones, satellites, and GPS come to the fore to optimize farm work and complement human resources.

Text 3. Emerging Agriculture Technologies. Part 1

Source: <https://businessexceed.com/emerging-agriculture-technologies/#agricultural-robots>

The agriculture industry has been going through a gradual transformation in the past 50 years. In recent years, this change has taken a radical turn at the back of new generation technologies. Artificial intelligence, blockchain, analytics, connected sensors, drones, GPS, and robots work at the core of emerging agriculture technologies. The new generation of agricultural technologies allows businesses to be more profitable, efficient, safer, and environmental-friendly.

To start with, let's find out why there is a need for innovation in agriculture and farming. The global population is on track to reach 9.7 billion by 2050. Resulting to re-

quire 70% increase in calories demand. The cost of agriculture production inputs is constantly rising. Global water supply is expected to fall 40% short of meeting global water needs by 2030. Energy, labor, and nutrient costs are already affecting profit margins across the agriculture industry. Need to comply with climate change, ethical and sustainable farming practices, higher standard of animal well-being and reduce chemical and water usage. There are growing consumer preferences for transparency and sustainability. One in seven people is facing starvation on earth.

Now let's turn our attention to the new emerging agriculture technologies.

– **Precision Agriculture:** Precision agriculture is a method to assess and manage soil. It helps to ensure optimum crop health and productivity. It supports identifying variations with heterogeneous fields to allow farmers to utilize resources and increase yield efficiently. Resources include seeds, pesticides, fertilizers, machinery, etc. This technology combines real-time data about local weather, soil, crops, ambient air, labor costs, equipment availability to predict guidance around crop rotation, plantation timelines, harvest cycles, and soil management. It is enabled using apps, IoT sensors, drones, cloud computing, and artificial intelligence.

– **AgDrones (Agricultural Drones):** In recent years, the usage of agricultural drones (also known as Unmanned Ariel Vehicles) is increasing by agronomists, agriengineers, crop insurers, researchers, and farmers. AgDrones aims to streamline operations through effective decision-making using data analysis, optimize agricultural operations, enhance crop production, and monitor effectiveness. Agricultural drones help in a variety of uses: mapping, surveying, crop-dusting, spraying, planting, and irrigation.

– **Vertical Farming:** Vertical Farming is the method of producing food on vertically stacked layers. It aids in maximizing production output in a limited space. These systems are built-in facilities such as a skyscraper, tunnels, shipping containers, old mine shafts, or repurposed warehouse. These facilities function through Controlled Environment Agriculture (CEA) techniques (hydroponics, aeroponics, aquaculture, and aquaponics) to artificially control temperature, light, humidity, pests, and gases. The purposes of vertical farming are:

- ✓ To play a role in meeting future global food production demands
- ✓ To allow crops to grow around the year due to a controlled environment
- ✓ To use significantly less water
- ✓ To allow more organic yields due to low exposure to chemicals and disease-causing agents

– **Closed Ecological Systems:** Closed Ecological Systems are artificial self-sustained ecosystems. In these systems, waste produced by one species is used by one or more species. Carbon dioxide, feces, and urine gets converted into oxygen, food, and water, respectively. These systems also help build life support systems for space travel, space stations, or space habitats.



Closed Ecological System Biosphere 2, Arizona, the USA

Their purpose is to help scientists understand:

- ✓ How plants grow in various scenarios (on Earth and outside)
- ✓ Reduce usage of natural resources (fossil fuels)
- ✓ Convert wild ecosystems for human use

There are three types of closed ecological systems:

- ✓ Ecosphere
- ✓ Man-made closed ecological systems
- ✓ Aquarium and bottle garden ecospheres

– **Cultured Meat:** Traditional methods are not sustainable to meet the growing meat demand of the two-third world population in the next 40 years globally. Cultured meat (also known as in-vitro meat, healthy meat, slaughter-free meat, vat-grown meat, lab-grown meat, cell-based meat, clean meat, cultivated meat, and synthetic meat) is a solution to this problem. In its production process, muscular cells are harvested from living cows and nurtured to help multiply tissues. It is the same muscle tissue that comes from a cow.



In 2013, Mark Post, a professor at Maastricht University introduced a burger patty grown prototype through cell-based research. Since then, it has gained global media attention.

– **Floating Farms:** Floating farms (also known as floating agriculture) are farmlands that follow a method to grow crops in areas flooded for longer periods. The foundational bed is created with rotten vegetation (like hyacinth plants) that acts as compost. The land being able to float over water makes it suitable for agricultural purposes within waterlogged areas. In this method, cropping and harvesting timelines are shorter as compared to traditional dryland farming. The low requirement of pesticides helps produce organic food that can fetch premium prices in the market.

The most interesting example of smart floating farms is a commercially viable offshore farming system developed by Javier F. Ponce (Forward Thinking Architecture) and Jakub Dycha. Smart floating farms feature are:

- ✓ A rooftop housed with solar panels for renewable energy generation
- ✓ A middle level with a hydroponics crop production facility
- ✓ A ground floor with an aquaculture system for fish and other species

According to the creators:

- ✓ Each farm will produce eight tons of vegetables and 1.7 tons of fish every year.
- ✓ Achieve breakeven cost of development in 10 years.
- ✓ It is a replicable modular model that aims to bring sustainable water-bound farms to densely populated cities like New York, Chicago, Karachi, Shenzhen, and Jakarta.

Text 4. Emerging Agriculture Technologies. Part 2

Source: <https://businessexceed.com/emerging-agriculture-technologies/#agricultural-robots>, <https://jv-technoton.com/solutions/agricultural-machinery-telematics/>

Agriculture technology (also known as agtech and agritech) has experienced investment major growth. The smart agriculture market is estimated to grow from USD 13.8 billion in 2020 to USD 22.0 billion by 2025, at a CAGR of 9.8%. There are a lot of new technologies such as a bee vectoring, laser scarecrows, livestock biometrics, synthetic biology, algae feedstock, bioplastics, engineered minichromosomes, etc. Let's continue considering emerging agriculture technologies related to the use of engineering equipment and software.

– **Cattle Tracking:** A system that uses IoT sensors, cloud, and GPS-enabled devices, to help ranchers can track cattle over a large area.



Cattle Tracking

Its benefits include:

- ✓ Precise animal identification.
- ✓ Heat detection to improve conception and insemination.
- ✓ Disease tracking.
- ✓ Track head patterns.
- ✓ Mastitis detection.
- ✓ Manage rations.
- ✓ Animal stress levels.
- ✓ 24×7 monitoring.
- ✓ Long-range.
- ✓ Prevent animal theft.
- ✓ Reduce manual labor.
- ✓ Waterproof and weatherproof technology.
- ✓ Cheap implementation cost.
- ✓ Inactivity detection.
- ✓ Easy connectivity to cloud.
- ✓ Help make informed decisions.

– **Agricultural Robots:** Agricultural robots help improve production efficiency for farmers. Their market share is expected to reach USD 11.5+ billion by 2025. They help automate repetitive tasks that are performed by farmers at a slow pace.

They facilitate higher quality production, reduce production costs, and decrease manual labor. They are used for harvesting, picking, weed control, cloud seeding, seed plantation, monitoring, soil assessment, mowing, pruning, spraying, thinning, phenotyping, sorting, and packaging.



Agricultural Robots

– **Aquaponics:** Aquaponics is the combination of aquaculture (artificially raising aquatic animals like fish, snails, etc.) and hydroponics (soil-less plant production).

In this process, plants are grown in a systematic bed, and fish are kept in tanks. The water that contains aquatic animal waste is infused into the plant growth bed. This helps utilize natural bacteria to reduce ammonia into nitrites and nitrates. Plants absorb these materials to grow while filtering the wastewater. This clean and oxygenated water is sent back to the tanks and repeats the process.

Its benefits include: low water usage, all-season food growth, low weeds usage, faster vegetable growth, inexpensive to set up and maintain, enhanced food security.



Aquaponics

– **Harvest Quality Vision (HQV):** An artificial intelligence-based technology that can identify various factors about a harvested produce within seconds. It collects hundreds of data points for each piece of crop or fruit within seconds.



Harvest Quality Vision (HQV)

Data points are gathered to determine fruit/crop size as per optimal conditions (with 3 mm of accuracy) and provide insights on storage based on crop conditions. It helps in enhancing efficiencies in all levels such as production, transport, receiving, storage, packing, marketing, and sales. It alerts if there are any deficiencies from the acceptable standards.

– **Equipment Telematics:** Agricultural machinery telematics is a solution for fuel monitoring, monitoring of operating parameters, GPS tracking and running time tracking of tractors, harvesters and other agricultural vehicles, that are widely used in agro-industrial complex and agricultural enterprises.

Text 5. Agricultural Machinery Telematics

Source: <https://jv-technoton.com/solutions/agricultural-machinery-telematics/>

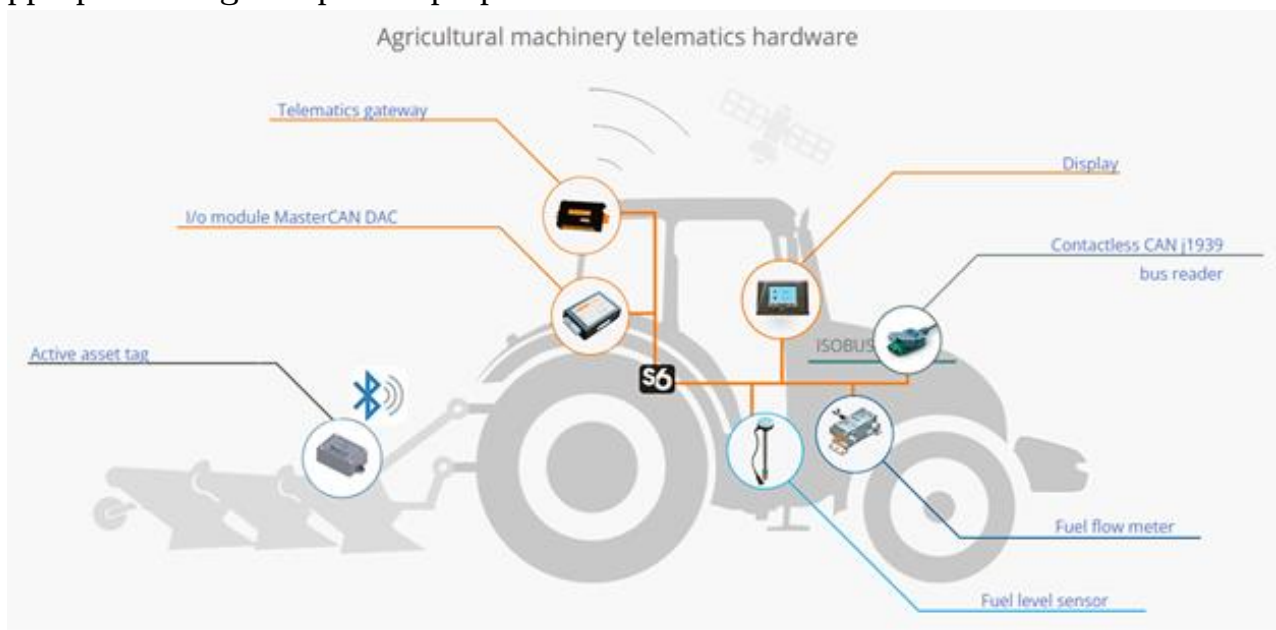
Agricultural machinery telematics by Technoton is an integral telematics solution for fuel monitoring, monitoring of operating parameters, GPS tracking and running time tracking of tractors, harvesters and other agricultural vehicles, that are widely used in agro-industrial complex and agricultural enterprises.

Fuel monitoring of agricultural machinery provides opportunities of detecting fuel over consumption, normalizing fuel consumption quotas for each operation, monitoring fuel tank fill-up and draining volumes and preventing fuel theft, which happens due to adopted excessive fuel consumption quotas or violations of operating procedures.

Operation parameters monitoring of tractors and harvesters allows fleet manager to monitor compliance of operating procedures, check operation of auxiliary and attached equipment, keep an eye on operation modes of machinery (engine RPM, instant fuel consumption, temperature of cooling fluid, oil pressure).

Machine running time tracking helps to adjust time quotas for certain works, precisely record real engine operation hours, also allows introducing employee compensation system based on actual working hours.

GPS tracking of tractors and harvesters provides information on location and route of vehicles, movement direction and route and enables detection of machinery misuse and inappropriate usage for private purposes.



Effects of implementing agricultural machinery monitoring system are:

– Lowering fuel and lubricants costs: fuel consumption optimization (detection of excessive consumption), diesel fuel theft prevention (fuel tank siphoning and theft from

engine return line, underfilling fuel in a tank)

- Reduction of maintenance costs: remote malfunction diagnostics, breakdown prevention, prediction of maintenance date taking into account real operating conditions of the equipment

- Increase fleet performance: reduction of excessive downtime, prevention of inappropriate usage, strengthening labor discipline.

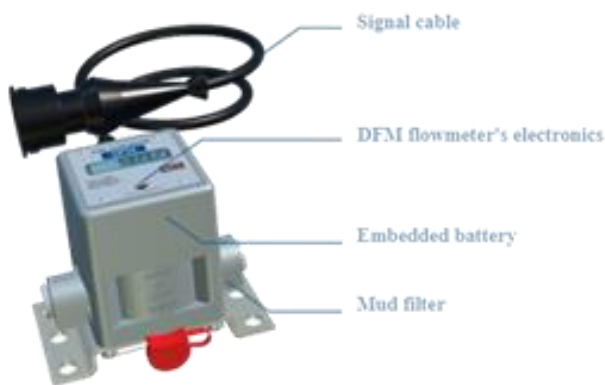
Depending on the current situation in a fleet, telematics system can reduce total fleet expenses for fuel by up to 30% and decrease repair and maintenance costs by up to 20%.

The picture above shows that an agricultural machinery telematics hardware includes: a fuel level sensor; a fuel flow meter; a contactless CAN j1939 bus reader; a display; a telematics gateway; an I/o module MasterCAN DAC; an active asset tag and ISOBUS.

A tractor telematics system is based on DFM fuel flow meter, DUT-E fuel level sensor, Crocodile contactless reader, CAN bus tools and CANUp telematics gateway.

DFM fuel flow meter is installed directly in a fuel line of engine and provides high accuracy of fuel consumption data even in difficult machinery operation conditions: rough terrain, fuel “bounces” inside a tank, mixed engine operating cycles.

DUT-E fuel level sensor is easily mounted and allows highly accurate fuel volume measurement no matter what fuel tank design is. Fuel tanks of agricultural machinery have a complex shape with “pockets”, ledges, steps.



DFM fuel flow meter



DUT-E fuel level sensor

Crocodile contactless reader gathers data from CAN bus with various parameters of vehicle operation: engine operating time, fuel volume & consumption, etc. Data reading occurs without electrical connection and without damaging CAN wires.



Contactless CAN j1939 reader



J1939 i/o module MasterCAN DAC

Digital-to-analog converter MasterCAN DAC is a smart tool for converting digital data and analogue output signals in telematics systems, where analogue on-board equipment is used along with digital CAN/S6 equipment. Data converting is realized simultaneously in both directions.



MasterCAN Display 35



CANUP telematics gateway

MasterCAN Display 35 is mounted in the driver's cabin and provides the possibility of visual monitoring 3500+ operating parameters.

CANUP telematics gateway receives data from monitoring devices – fuel level sensors, fuel flow meters, contactless readers, CAN bus tools and sends it to online web-based telematics service.

Text 6. 3D Printing in Agriculture

Source: <https://arrival3d.com/3d-printing-in-agriculture-a-match-made-in-heaven/>,
<https://miller3dprinting.com/industries/agriculture/>,
<https://www.agritechtomorrow.com/news/2024/01/11/-how-agriculture-is-reaping-the-benefits-of-3d-printing/15190/>

At first glance, agriculture and technology may not go hand-in-hand. Often times, we associate technology to the future, while agriculture reminds us of the past. However, today, agriculture by far the most adaptable industry and ready for 3D printers. Technology plays a major role in agriculture as it simplifies processes including food production, transportation, marketing, etc. As a result, 3D printing applications are on the rise across the industry to optimize the existing workflows.

Here are a few benefits of using 3D technology in farming:

– **Producing replacement parts:** Farming equipment is massive, complex, and expensive. As a result, replacing a part can quickly become expensive; especially if the machine is outdated and replacement parts are no longer available, or difficult to find. By utilizing 3D printing solutions, these replacement parts can be produced quickly to decrease down time, which is important as agricultural applications are often time dependent due to variations of the weather and how the crops need to be processed to keep the fields on a schedule. These machineries are also vital components in food production from tractors and harvesters to seeders and fertilizer spreaders. By increasing cost savings and productivity while decreasing lead times, 3D printing in agriculture solutions innovate multiple aspects of the industry.

– **Making tools:** We have seen enhancements in structural operations, replacement parts on the equipment, and day-to-day tools and fixtures needed by the farmers. 3D Printed tools are regularly used to plant crops as they can improve the process exponentially by increasing efficiency and customizations. These tools are produced quickly, efficiently, and remotely to offer benefits from all sides, including energy and money savings.

– **Solving problems for the irrigation process:** Getting water available to every plant is a challenge and irrigation is a crucial aspect of agriculture. Installing a robust irrigation system is a nightmare for farmers because it's expensive, time consuming as the pipes are transported from a supplier to the agricultural land, leaving no flexibility or scope of how changes in the landscape will affect the irrigation pattern. More than 60% of

water is wasted either due to leakage or evaporation. Furthermore, pipes are transported from a supplier to the agricultural land, leaving no scope of changing the landscape of the irrigation pattern. To solve these issues, companies are utilizing 3D printers to produce polymer pipes on the farming land to form a honeycomb structure, which then allows water to flow out, much like a sponge. These pipes absorb the moisture of the soil and transport it to the plant. Using these pipes, a farmer can easily plant the seeds. In conclusion, additive manufacturing technology is ensuring an efficient and eco-friendly way to deal with common irrigation problems.

– **Monitoring the crops:** The 3D technology is creating ripples in the agriculture industry and empowering the farmers to monitor their crops. To help the farmers, students of Carleton University in Ottawa have come up with a 3D-printed drone which can help the farmers monitor the crops. The 3D-printed drone can be controlled by the farmers using an open-source software and will fly over the agricultural land and take pictures. The photos will provide infrared readings on information concerning how well the plants are facilitating the photosynthesis process. Using this information, farmers can adjust the amount of water and fertilizer to their crop and increase the crop yield. 3D technology in agriculture is touching those areas and providing crucial information, which otherwise was inaccessible to the farmers.

– **Reducing waste:** In the coming years, 3D technology will not be a reason for the ‘death of small farmers’ because farmers can turn the technology in their favor. 3D printing is helping farmers reduce material wastage and decreasing the cost of farming. Furthermore, sensors and drones are keeping the farmers better informed than ever by providing information on soil, pests, and weather. The more informed a farmer is, the higher is the production and the lower is the wastage.

As to the future of 3D printing, it should be noted that while 3D printing is already being utilized in a variety of ways in agriculture, there is great potential for additional uses, including:

- Biodegradable plastics, reducing waste and enhancing agricultural sustainability.
- Sustainable housing for livestock and other animals, boosting comfort and lowering agriculture's environmental effect.
- Customized structures for vertical farming, allowing for crop production in urban locations and minimizing land-intensive agriculture.

Key takeaways of 3D printing in agriculture are:

- Increased efficiency: 3D printing can be used to create customized tools and parts, improving the efficiency and accuracy of agricultural operations.
- Improved sustainability: 3D printing can be used to create biodegradable plastics and other sustainable products, reducing the environmental impact of agriculture.
- Better animal welfare: 3D printing can be used to create customized prosthetics and orthotics for livestock, improving their health and well-being.
- Increased innovation: 3D printing enables new and innovative products and technologies in agriculture, providing new opportunities for sustainable and ethical food production.

The potential for 3D printing in agriculture is extensive and compelling, and as the technology advances, it will undoubtedly play an increasingly crucial part in determining the industry's future. For farmers, it's probably the right time to adapt the agricultural technology because, in the coming years, agriculture is going to rely heavily on 3D printing technology. The 3D printing industry still has a lot to offer to agriculture as the technology continues to be developed, and it's anticipated to grow in popularity as farmers continue to reap the many benefits.

Text 7. Crop Spraying Drones

Source: <https://www.dslrpros.com/dslrpros-blog/the-top-7-crop-spraying-drones-of-2024-guide-and-reviews/>

Now we'll turn our attention to the drones that can be used to apply pesticides and fertilizers to your farm. The criteria for making it onto 2024's ranking included a blend of advanced technology, efficiency, and of course, a little bit of that wow factor. Payload capacity and spraying efficiency were top of our priorities. Then there's the flight stability and precision – no one wants a drone that drifts off course at the first puff of wind. Sustainability and ease of use also come into play, since there's increased emphasis on using agriculture drones that are not only more efficient, but also kinder to our planet.

The best crop spraying drones for the modern farmer are:

1. DJI Agras T40: It was officially introduced to North America in October 12, 2022, during AirWorks 2022, after already being mainstream in China. The AGRAS T40 is a step up from its predecessor, the DJI T30. It comes with increased capacity and that has made it a popular choice for farmers over the year that followed – and it still retains its strong lead into 2024. This drone is designed for a variety of applications, including spraying orchards, crop fields, and fruit trees, featuring a coaxial rotor system that ensures stable flight patterns during these processes, plus enhanced precision due to the integration with DJI Agras Intelligent Cloud. The key features are:

- Spraying and Spreading Capacity: The T40 can carry up to 40 kg of liquid for spraying and has a spreading payload of up to 50 kg, equivalent to a 70-liter capacity.
- Coaxial Twin Rotor Design: Increases payload capacity by 30% and reduces aircraft size by 70% when folded for portability.
- Dual Atomized Spraying System: Ensures even droplets for more efficient pesticide use.
- Magnetic Drive Impeller Pump: Isolates pesticide from the motor, making the aircraft corrosion-proof and ultra-durable.
- Active Phased Array Radar + Binocular Vision: Offers 360-degree horizontal omnidirectional obstacle sensing for enhanced safety.
- Ultra-fast Charging: 9-min charging for the 30000mAh Intelligent Flight Battery with a 12000W Multifunctional Inverter Generator.
- Fully Enhanced Remote Controller: Features an 8-core processor and a 7-inch high-brightness screen for smoother, faster mapping.

The coaxial twin rotor design of the Agras T40 not only boosts the drone's payload capacity significantly but also enhances its operational efficiency by enabling it to carry more spray or spread load per flight. This design, along with its foldable structure, makes the T40 exceptionally portable and easy to deploy in across different settings, be it hilly and uneven terrains, plantations, or orchards and vineyards.

The dual atomized spraying system of the T40 enhances the efficiency of applying liquids. By atomizing the spray twice, it ensures that droplets are fine and uniform, allowing for more ground coverage and reducing the amount of chemicals needed, thereby saving costs and minimizing environmental impact. The magnetic drive impeller pump further contributes to the drone's durability by preventing corrosion, a common issue in agricultural drones exposed to chemicals regularly.

The integration with the DJI Agras Intelligent Cloud allows for variable spraying and spreading operations, which can be precisely tailored according to the farmland's prescription map when used alongside UAVs like the Mavic 3 Multispectral. This integration enables more precise application of inputs like fertilizers, defoliants, and nutrient solutions, based on

the specific needs of different crop areas, thereby reducing waste and increasing crop yields. For instance, the Jiangsu Farming Group reported a 10% reduction in fertilizer consumption and a 5% increase in rice and wheat yield by utilizing variable spraying techniques.

Safety and efficiency in operation are also prioritized, as evidenced by the T40's omnidirectional obstacle sensing capability. The integration of Active Phased Array Radar and Binocular Vision allows the drone to detect and avoid obstacles from all directions, ensuring safe operation even in complex environments like dense orchards or uneven terrain. This feature, coupled with the drone's advanced mapping capabilities, enables farmers to plan flight routes more efficiently and with reduced risk of accidents.

The fully enhanced remote controller, designed with a focus on user experience, features a large, bright screen and an 8-core processor that facilitates quick and efficient mapping of agricultural land. The T40's ultra-fast charging capability is another standout feature, addressing one of the major challenges in drone operations – battery life and re-charge times. The powerful 12000W generator supports rapid charging, significantly reducing downtime and allowing for continuous operation throughout the day.

2. Guardian SC1: This is an exciting one to watch out for this year – to see how farmers take it up. The company behind it – Guardian Agriculture, was founded by an experienced team from Apple, BAE, Tesla, and Uber way back in 2017. Since then, it has focused its efforts on leveraging electric vehicle, AI, and advanced flight dynamics technologies to benefit agricultural practices.

The Guardian SC1 garnered attention for its efforts in sustainable farming, especially after it got green light from the US Federal Aviation Administration (FAA). This was a major milestone, making it the first eVTOL (electric Vertical Take-Off and Landing) to be cleared for commercial operations all over the US. Deliveries of the system are slated to begin in mid-2024, with the starting price set at \$119k. That's quite the hefty price tag though. The key features are:

- Payload Capacity: 200 pounds (approximately 20 gallons or 76 liters), for spraying operations.
- Coverage: Capable of covering up to 60 acres per hour, ensuring rapid and efficient crop treatment.
- Quick Prep Time: Features a combined tank fill and supercharge time of only 1 minute, minimizing downtime between operations.
- Fully Electric: Powered by a 9.1 kWh battery and equipped with four six-foot propellers driven by a 40hp drivetrain, emphasizing its commitment to sustainable farming practices.
- Autonomous Operations: No manual control required, with RTK/GNSS remote control accuracy, intelligent auto-protect, and return-to-home functionality, making it simple to operate and ensuring safety and reliability.

The Guardian SC1's 200-pound payload capacity and the ability to cover 60 acres per hour highlight its efficiency and capability to handle large-scale agricultural needs. The quick preparation time, enabled by its innovative design, ensures that the drone is ready for operation with minimal delay, enhancing productivity on the farm. It also has 100% repeatable and programmable coverage, ensuring precise application across every operation.

The fully electric nature of the Guardian SC1 not only reduces the carbon footprint associated with crop spraying tasks but also ensures quieter operation compared to traditional gas-powered aircraft. The drone's autonomous capabilities, requiring no manual control, allow for precise application of treatments with minimal human intervention. This precision, combined with RTK/GNSS accuracy, ensures that every application is consistent, reducing waste and improving the effectiveness of crop protection measures.

The Guardian SC1's design and operation reflect a deep understanding of the challenges faced by modern agriculture, including the need for operational efficiency, and reliability – while being environmentally conscious.

Text 8. XR Tools to Transform Food Farming

Source: <https://www.forbes.com/sites/forbestechcouncil/2022/02/15/how-xr-tools-are-transforming-food-farming/?sh=2eb4302c2ce7>,
<https://www.agmatix.com/blog/innovation-and-developmemt-in-agritech/>

Is the metaverse really the next big thing in the digital world? Will we really be wearing XR (extended reality) headsets to view the world as part of “enhanced” experiences? I think that reality is struggling to catch up with the hype. Facebook (Oculus), Microsoft (Hololens), Nvidia, Google and Apple are betting big on the metaverse, but what about the essential, though less glamorous, agri-food sector? Is XR ready for food suppliers, restaurants and retail?



Popularized in science fiction, metaverse (“meta” + “universe”) now describes the integration of digital technologies with the physical world: overlaying 3D virtual environments onto physical environments through devices. Remember the *Pokemon Go* craze of 2016, when people used smartphones to “catch” Pokemon around town? *Second Life* and *Fortnite* are metaverses in gaming environments. The metaverse can also integrate virtual, physical spaces and virtual economies. There are challenges, including the technological limitations of programming, hardware (headset) development and the costs of creating and running XR systems. In particular, so far people have not taken to wearing goggles, glasses or headsets for extended periods of time, and some even many find them nausea-inducing.

Most of what you hear about the metaverse is hype at this point, but here are five areas where XR tools are starting to make a real difference in agri-food.

1. Observation/Visualization: XR enables farmers to augment what they see with their (human) eyes to visualize soil fertility, production quality, pests and diseases across an entire farm and use that data to select optimal crops and management practices. For indoor livestock facilities, AR (monitoring ventilation/air quality/temperature), IoT (animal sensors) and AI (camera vision) can be combined to allow farmers to monitor animal health and well-being in real time. Outdoors, AR applications can track and adjust digital boundaries for grazing. Some metaverse-type initiatives in agri-food include:

- Sparkle (EU) demonstrates XR applications for agriculture, including monitoring farms, student and worker training, and tool/equipment assessment.

- CSIRO (Australia) adapts popular gaming platforms with high-tech sensor technologies and data analytics, creating wearable, hands-free technologies for real-time pond-side information on water quality and system monitoring for prawn farmers.

- Bareburger burger chains use Snapchat’s AR technology to show hyper-realistic food images. Hololamp is a hands-free, glasses-free AR projection machine that projects a

menu's food items (with images/video) on a table.

2. Origin of Food/Ingredients: QR codes are increasingly popular. Enhanced by AR, your smartphone can yield information on nutrition, product composition and provenance. AR enhanced QR codes allow shoppers to "visit" source farms, learn cooking techniques and more. Examples include:

- ABP Food Group and ASDA in the U.K. used Aircards to build an interactive, immersive AR experience, demonstrating cooking a perfect steak as part of a larger consumer education campaign.

- Farm VR combines GeoAR, geolocation, 3D modeling, data visualization and virtual farm tours to create an interactive environment to inform consumers about where their food comes from.

- NexTech AR shows consumers how their seafood got from the ocean to their plates through an AR tour of the fishing boat.

- Patrón Tequila's AR-enhanced app experience shows where Patrón comes from and how perfect tequila is made.

- Queppelin AR smart glasses integrate visual observations with virtual information in a hands-free platform for farmers to facilitate decision making and to give consumers "eye-witness" information about their food sources.

3. Staff Training: Immersive e-learning experiences transform staff training, bringing advanced precision methods and techniques to geographically dispersed farms. Examples include:

- Vaderstad has an app that allows farmers to calibrate their machinery from their smartphone while making training and equipment familiarization easy and fast.

- Cornell University's veterinary school uses VR to teach anatomy, allowing students to experience new techniques before trying them on live animals. The University of Liverpool uses interactive fiberglass animal models with VR to teach equine or cattle veterinarian students what to expect when operating.

- A VR system is being developed to enable remote post-mortem pig inspection.

4. Enhance Efficiency and Safety: AR tools can help select optimal tools and equipment for specific tasks. For example, Nedap CowControl uses Microsoft's HoloLens so that farmers can integrate digital information with real-world information. Using actions, hand gestures and voice commands, farmers can interact with the technology naturally, efficiently and successfully. Yeppar utilizes AR, VR and MR for field inspections, weather updates and simulated agricultural training.

XR can also improve farm safety (including dealing with hazardous materials stored on-farm) and can alleviate the challenges of limited emergency response capabilities. The University of Nebraska's AR system identifies on-farm hazards during emergencies and notifies first responders. Georgia Tech is developing AR systems that project instructional graphics onto chickens on a processing line, helping worker safety, improving efficiency and improving food safety.

5. Improving the Consumer Experience: Consumer-focused AR is largely about storytelling. For example, Augmania's AR system combines interactive print, live demos and AR experience to tell consumers their food story and lets customers build their own AR experience (no coding skills needed).

Boursin Sensorium's 360 VR Experience takes customers on a journey through the cheese production process. Innis & Gunn's virtual reality headset transports customers to landscapes "inspired by" their two main brews. Coca-Cola cans have had a variety of polar bear adventures to enjoy while drinking. In a cross-promotion, Nestle cereal boxes had a QR code linked to the movie *Rio*, through which consumers could play an augmented real-

ity game with Blu, the main character of the film.

So, while the hype of the metaverse is entertaining, the agri-food sector is already exploring the practical applications of AR. Agricultural AR is helping farmers better understand and manage land resources, enhance productivity, improve time management, streamline training and improve safety.

Text 9. Digital Technologies for Poultry Producers. Part 1

Source: <https://www.denbow.com/8-digital-technologies-poultry-producers/>

Growth in poultry farming has been relentless. In fact, despite the continued preference for pork in Asia, current growth means that global chicken meat consumption will exceed that of pork by 2022, making it the number one meat globally. Egg consumption continues to grow as well because eggs are inexpensive, mild-tasting and are easy to process and include in other foods. Universal acceptance by almost all cultures and all religions ensures that poultry will continue to prosper.

Although touted as the world's most efficient protein, poultry producers actually manage their flocks with very limited information. Today, it takes 1.4 kilograms of feed to produce 1 kilogram of live-weight meat, and genetics offer the opportunity to reach a 1:1 ratio. Chicken producers know the birds' weights when coming in and going out as well as average feed and water consumption. Egg farms at least have the daily data point of average egg production for a group of birds, but managing for averages makes production inefficiencies inevitable.

In the next 30 years, we will see another 3 billion people inhabit the Earth, and the middle class of urban dwellers will continue to rise. Poultry farming must respond. Farmers must farm data, not just chickens, and in doing so, harness new digital technologies and information to improve efficiencies and respond to the growing requirements of proactively engaged consumers ("prosumers"). These digital technologies provide a useful framework to describe the plethora of novel technologies arriving in the marketplace that can help producers manage their flocks in a more efficient and sustainable way.

– **3D printing prosthetics:** Poultry operations would benefit from the on-site printing of plastic or metal parts when the ones on the farm require replacing. The University of Western Australia's head of mechanical and chemical engineering, Tim Sercombe, has developed a printer that would use a metal powder that represents about 20 percent of the total cost of the part. Smaller part sizes might take a day to complete, but when compared to ordering and waiting for delivery of a part, the potential to save downtime on a farm could be considerable.

One of the more inventive ways in which 3D printing can affect the poultry industry is through life-saving techniques. Reproducing feet, legs and even beaks has already been applied for pet birds. One example includes researchers from the University of Calgary, who created prosthetic feet for Foghorn the rooster after he lost both of his feet, most likely an unfortunate result of severe frostbite. Then there's Dudley the duck, who received an entire prosthetic leg (including the knee joint!) from the combined efforts of a 32-year-old mechanical engineer and architect who worked with Proto3000, a 3D printing company based out of Ontario. Imagine the opportunity for preserving high-value breeding stock such as parents, grandparents or great-grandparents, where continuing the genetic line is critical.

– **Robots doing the dirty work:** One of the most practical applications of digital technology in the poultry industry is that of robots. There are a multitudinous number of repetitive tasks that robots could assist with. Poultry houses require nearly constant attention – cleaning and sanitizing, collecting eggs and checking birds. This is time-consuming, monot-

onous work, but it would not bother a robot. Additionally, robots are more precise, thorough and honest about the work they do compared to their human counterparts. An article by Benjamin Ruiz also points out how robots can help from a human welfare standpoint.

France-based Octopus Robots designs entirely autonomous robots to prevent and control disease and infection in poultry houses. The bots also evaluate environmental factors such as temperature, humidity, carbon dioxide, ammonia, sound and brightness.

Another French robotic company, Tibot, explains that robots can discourage chickens from laying eggs on the floor and also keep the birds moving for an added health benefit. These attributes can result in cost-savings for producers in product and labor while appealing to welfare advocates.

For more specialized tasks, including feeding and monitoring, Metabolic Robots designed robotic feeders that can increase feed efficiencies, lower mortality rates and alert the producer of potential disease concerns. “Nanny robots” are used by Thailand’s Charoen Pokphand Group (CP Group) to maintain healthy flocks of around 3 million laying hens. If the robots detect an ill bird, humans are alerted and the bird is removed immediately. These automations will reduce outbreaks of bird flu and foodborne illnesses, improving the safety of the entire supply chain from producer to consumer. Also, with safety in mind, Tyson recently announced the opening of its high-tech hatchery in Springdale, Arkansas. The operation spans 75,000 square feet (7,500 square miles) and hosts six robotic arms designed to replicate tasks that would otherwise result in worker fatigue.

– **Drones to protect the flock:** The opportunity for drones in chicken houses may seem a little farfetched. There is concern that the drone could make the flock nervous and cause undue stress. To this point, an experiment by Georgia Tech in 2015 showed the birds were not yet ready for this technology, compared to robots, which are probably better suited for indoor tasks anyway.

Free-range or yard-kept chickens and turkeys that roam fields freely would be a better application for drone technology, which could herd, protect and monitor them. Adaptation of avian species to drones would probably require training but will most likely succeed outdoors.

– **Sensors for individualized monitoring:** Sensors probably represent the easiest of the digital technologies to implement. This is partly due to lower implementation costs, but also because the benefits are immediately recognized. Big Dutchman is one of the top names in modern poultry housing. Its DOL 53 is a sensor designed to measure ammonia, a common problem in many hen houses. Both SKOV and Filipino Poultry use sensors to regulate and control the climate in the house, including ventilation and temperature. Rotem’s sensor is designed for carbon dioxide monitoring, which can reduce the negative effects high carbon dioxide concentrations can have on layers and breeders, resulting in significant cost savings. Greengage has a unique lighting system using sensors and LED bulbs to create a consistent lighting environment that stimulates better growth efficiencies in birds and also reduces costs.

From a wearable sensor perspective, researchers – and even farmers – could gain a lot of insight into the health and well-being of broilers, layers, turkeys and ducks. Fitted with RFID tags, poultry could then be observed in a more natural environment, giving researchers the opportunity to learn from the animals. This information could be evaluated to determine everything from natural behaviors to inefficiencies in diet, greatly increasing the opportunity to help with production efficiencies. Studies conducted at the University of Michigan have used sensors to analyze how chickens use space in their pens in order to better understand how to design non-cage systems for the comfort and well-being of the hens.

Text 10. Digital Technologies for Poultry Producers. Part 2

Source: <https://www.denbow.com/8-digital-technologies-poultry-producers/>

Let's continue to consider the available digital technologies for poultry producers.

– **Augmented reality helping the consumer:** Augmented (or enhanced) reality is the ability to see things that the human eye cannot, using the non-visible spectrums of light, or to overlay information, including data interpretation, alongside what the person sees. The possible uses of the technology are wide-ranging, but so far, there are a few examples of real commercial applications.

Georgia Tech had a student project in which it investigated the use of AR in the processing plant. The application of AR allows trimmers in factories to see how to cut the chicken carcass and accurately remove defective parts of the meat. Two methods are being tried. One is using a head-mounted display in which the trimmer could see a graphical overlay on each bird indicating the best location for cutting. Alternatively, the project also tested a laser scanner that was mounted near the processing line and indicated directly onto each bird where to make the cuts. The latter was generally considered more cost-effective, as all workers could use the same equipment.

Apart from the benefits for farmers or processors, consumers may be the key to implementation. Transparency is becoming critical, as is having the ability to know where and how food is produced. Australian-based CHOICE offers all iPhone and Android users a free app that allows consumers to scan a code on the egg carton and download detailed information on where the eggs are from and information relating to their welfare conditions.

– **Virtual reality (VR) training in production:** The most obvious application for VR in the poultry industry is training, particularly processing. It could teach line workers in the processing plant the ideal way to trim meat from birds. Applied to free-range layer houses, it could teach employees how to walk through the house without frightening the birds, find errant eggs and check on hens. An example of VR is how McDonald's has teamed up with The Lakes Free Range Egg Company to give customers an immersive virtual tour of the farm's hen houses, ranges and pack houses. This technology is, however, expensive, and implementation is likely to be slow.

Another eccentric option is to give the virtual reality experience to the chickens. Created by professor Austin Stewart at the University of Iowa, Second Livestock is a conceptual company that allows chickens to enjoy the free-range experience while remaining contained within the safety of the poultry house. The idea is that chickens are equipped with a virtual headset and see through a screen projection using goggles. In this way, chickens can be raised anywhere, even in urban areas, and feel the freedom of their virtual world, free from predators. While this company may not actually be producing these products, it is important to recognize that the technology is there and is on its way to becoming increasingly more affordable.

– **Blockchain in production safety:** Blockchain's opportunity in the poultry industry is its ability to resolve food safety and transparency issues. Walmart, Unilever, Nestlé and other food giants are working with IBM using blockchain technology to secure digital records and monitor supply chain management, ensuring traceability of the poultry products sold in stores. Blockchain can be used to monitor all aspects of the food supply chain, from farmers and producers to processors and distributors. This is Walmart's third experiment with blockchain, and seeing the increasing interest of other large food conglomerates demonstrates the unique capabilities of this technology.

Recently, Cargill announced it would enable customers to trace their Thanksgiving turkey back to its farm of origin. Blockchain technology is what makes this possible. Consumers can enter a code from the package onto the company's website and learn where the turkey was bred and grown. This is a big step toward offering traceability and understanding where food comes from, something that is becoming of increasing concern for consumers.

ZhongAn Technology has launched a technology incubator to develop blockchain technologies, citing that there is an expectation of specific applications within the poultry industry. The Chinese consume about 5 billion chickens a year but prefer dark meat rather than the breast meat favored by American consumers. Recently, the country has been allowed to export cooked chicken to the United States, and blockchain could be a way to alleviate any concerns about sourcing and production methods, eventually opening the way for raw exports.

– **Internet of things (IoT):** The internet of things is listed separately from the other eight technologies because it is the technology that connects all the others. For example, ZhongAn is working to make chicken production safer and will utilize a collaboration with Wopu, a company that specializes in the internet of things. IoT connects many of the sensors in a hen house to a smartphone, iPad or other devices, which is the case with SmartPoultry.

A paper by Rupali Bhagwan Mahale gives detailed insight into the applications of IoT in farm monitoring with a focus on the poultry industry. IoT can be incorporated at a very basic level, despite the complexity of the concept. My Connected Coop is a Kentucky-based venture created by Greg Cullen. The system allows even small home-grown and backyard chicken farmers to utilize this technology to raise their chickens easily and remotely using their mobile phones.

LX IoT Cores and Prognostix both offer technologies for improved efficiencies within the poultry sector through the use of combined sensor applications using cloud-based technologies and smart farming applications. M-TechSystems offers a software package to track and trace all elements of the farm, including information gathered from sensors, but also potentially from various sources, from robots to veterinary activity and upstream supplier information. This overall management of the entire chain offers incredible advancements to traceability, which is becoming increasingly important to all food production worldwide. Cargill's TechBro Flex takes a producer's own data and creates predictive analytic options, allowing the customer to choose their path based on a choice of strategic scenarios.

– **The Big Data advantage:** As we can collect more information on animals including the bacteria in their digestive tract and how they respond to nutrition at the gene level, it becomes clear that farmers are learning how to manage vast amounts of data as much as they previously understood how to manage their animals. 'Farming the data' to predict an individual animal's growth requires the ability to interpret 'Big data'. Alltech has been creating complex algorithms to interpret information they are collecting of the microbiome, nutrigenomics and track pathogens, such as campylobacter or antibiotic resistant bacteria. While nutrigenomics allows us to generate information to feed the animal precisely, and DNA profiling to know exactly what specific bacteria are present. Without powerful data analysis there is no way to take advantage of this.

Text 11. Artificial Intelligence Application in Poultry Industry

Source: <https://www.denbow.com/8-digital-technologies-poultry-producers/>

Artificial Intelligence (AI) technologies have become the backbone of many other technologies. Robots, for example, use AI in the processing plant to improve efficiencies. Through a collaboration of efforts, iPoultry is a high-tech automated processing system first demonstrated at VIV Europe. Automating a procedure such as chicken deboning requires recognition of the shape and size of each chicken and individual adaptation. Artificial intelligence is the perfect technology for this application. Consider that a computer can analyze the difference in density and structure of meat versus bone, thereby making the most precise cut possible. This is a great example of combined technologies: robots perform the work that AI instructs them to do based on the data that sensors collect. The Gribbot by SINTEF is one such robot that can debone a chicken in two to three seconds, replacing up to 30 human operators! When combined with machine vision, companies like Gainco are also creating processors to achieve high productivity.

Companies such as Porphyrio, PMSI, Impex Barneveld and Intelia all use AI to monitor and control the environment of the house. Sensors collect the information, software tracks it and AI adjusts the conditions of the house or alerts the farmer if there is a potential issue, such as an ill bird. All this information can be transferred to the farmer's iPad or smartphone. This is all done in real time and can curb concerns and small issues before they become disastrous to the entire flock. Aside from saving humans from doing these tasks, there are opportunities for cost savings, such as optimized feed consumption and climate control, increased production through healthier flocks because of cleaner water and better systems management. All of this information can be stored and analyzed to increase uniformity in production, which will ultimately increase performance and overall flock health.

Another AI application is chicken translators! Many a poultry producer will attest that the sounds of the flock indicate health, comfort and overall well-being. By listening to and understanding the sounds of a healthy flock, producers can be tuned in to signals of distress and have a better chance of reducing stress or distress early on.

A form of AI, machine vision, has been used to grade eggs as well as determine defects such as cracking or internal blood spots. It can also be used in assessing infertility in incubation by scanning eggs and learning which are fertile and which are not. An algorithm is then created, enabling the machine to determine the accuracy of fertility by over 98 percent by day five of incubation.

A research study in Brazil used AI to better understand hen behavior and the difference in interactions when under thermal stress versus a comfortable environment. Specifically, they tapped into an area of research known as artificial neural networks, which makes it possible to "teach" computers how to do tasks using visual references and understand patterns. This was important because it reduced the chances that a researcher's presence would alter the hen's behavior, removed any subjectivity or misconception from the researcher's standpoint, and allowed for a more precise calculation of the overall well-being of the hens.

This technology has allowed a significant challenge within the layer industry to be overcome. Layers, of course, are designed to produce eggs for consumption. To replace laying hens, farmers have to incubate some eggs, but they cannot tell until they are hatched which are male and which are female. The ability to sex the eggs was the undertaking of Vital Farms which has teamed up with Israeli technology company Novatrans to create OvaBrite. Using terahertz spectroscopy, the system can identify male eggs immediately after laying and sell them as unfertilized eggs for the farmer, allowing for significant cost savings within the layer industry.

Text 12. Digital Technologies Transforming Pig Production

Source: <https://www.thepigsite.com/articles/9-for-19-digital-technology-for-the-pig-industry>

From a technology standpoint, agriculture actually hasn't changed that much since the industrial revolution. Some might say raising pigs hasn't changed much since the first were domesticated 6,000 years ago. And yet it is clear that other industries are being disrupted at a faster and faster rate, supported by billions of dollars from venture capital investors while a new ecosystem of incubators, accelerators and shared workspaces to support startups is kickstarting a faster and faster cycle of innovation.

Digital technologies are on the rise and the winds of change also threaten to transform agriculture. Perhaps we will see producers' transition from farming pigs to farming data. How will the hog production be affected and what technologies are already available?

At the last PIC leadership conference, I outlined nine digital technologies with the potential to transform pig production, also covered in more depth in a blog published on my LinkedIn page. Swine producers and consumers (prosumers!) can both benefit from these technologies that offer the opportunity to improve processes, increasing productivity and efficiencies while making the animal production process safer for both humans and animals alike.

1. Artificial intelligence (AI): Facial recognition of pigs may sound far-fetched, but it is already a reality thanks to AI. AI uses algorithms to mimic human decision making. Often used in conjunction with hardware technologies which collect data, such as robots, sensors and machine vision. Recognition systems track individual pigs in the pen, monitor feed & water intake, movement, etc., identifying and even suggesting the ideal feed programme for pigs. To address smothering sows, several companies have designed technologies to alert producers or even prompt the sow to move (SwineTech) should she be suffocating her babies. Other companies use machine vision and 3D cameras to monitor a pig's tail posture which can indicate potential for increased tail biting, allowing producers to act preventatively.

2. Robots: Robots can improve animal welfare, safety and production in swine production. They don't tire, can do heavy work and do so 24/7. The Boar Bot (Swine Robotics) is designed to help the boar check sows for heat. Robotic cleaning facilities improve conditions and address environmental and societal concerns such as reducing odour, emissions and animal welfare and improve sanitation. From a processing standpoint, robots can vastly improve safety by replacing the more dangerous roles in meat processing and packing and use AI to cut the meat in the most efficient manner increasing profitability.

3. Sensors: Sensors similar to 'Fitbits' in the form of wearables are creating a lot of interest in the pig industry. They can provide one of the primary pieces of the data collection puzzle, allowing farmers to track animals on an individual basis and monitor health in real time. Sensors can alert farmers to illness concerns, heat cycles, food and water intake, anything that is critical to productivity. Aside from wearables, fixed sensors can record house ammonia levels, dust, humidity and temperature.

4. 3D printing: Although progress is somewhat slower than some of the other technologies, 3D printing offers the opportunity for farmers to print parts or pieces for machinery or equipment, allowing the producer to save time which would have been lost waiting for delivery or repair. This technology could be particularly beneficial in rural areas. 3D printing of certain foods such as pizza and chocolate is already a reality.

5. Drones: Drones are greatly beneficial in many agricultural applications, particularly crop production, but there is less occasion for their use in the pig industry at present. The primary opportunities would be with outdoor pig systems, potentially checking herds and relaying status of their location or health.

6. Virtual reality (VR): Several companies and organisations (e. g., McDonalds, North Carolina Pork Council) already use VR to offer consumers virtual tours of their pork producers. These range from grain harvesting, to taking viewers inside of sow or finishing barns. VR can also be used for education and training, particularly in areas of veterinary medicine and production facilities.

7. Augmented reality (AR): AR can add information to what the viewer sees with their eyes and can use light spectra that the human eye cannot. Examples for use include enhanced decision making by production workers, machine repair or for certification and inspection during auditing processes. Allied to AI, errors can be caught faster, reducing processing hazards before they become dangerous. In the processing plant AR allows the opportunity to see potential food borne illness concerns, such as bacteria on food, and avoid food scares.

8. Blockchain: Often discussed, but rarely understood, blockchain is an online documentation system which allows users to hold records of transactions confidentially in distributed ledgers maintaining confidentiality for all of those involved in the transaction. A simple definition, but it becomes increasingly clear to those in the food and agriculture supply chain that blockchain allows: better traceability, increased food safety, improved payment systems, lower costs of production and logistics, and opportunities for new ventures and business growth. It's no wonder Walmart and IBM are already using it with pork and other products in china.

9. Internet of things (IOT): Everyone is talking these days about precision agriculture. We could never get there if it weren't for IOT. It is the technology that connects all others, allowing for robots and sensors to transmit data and machines to alert farmers if there are malfunctions. While much of pig farming is still rural, therein lies the struggle with these technologies. Fortunately, programmes such as the EU's funded project ALL-SMART-PIGS are preparing to use IOT connect the swine industry.

These are the nine digital technologies with the greatest potential to influence pig production in 2019. Technologies that allow pork producers to address the mega trends: our growing global population with an increasing middle class, the continued interest in pork as a healthy protein, the demand from consumers for safer food and the need to demonstrate approved animal welfare practices. Producers must consider how these technologies can best serve them and which to adopt in order to increase efficiencies and profitability, for this is where the future of pig farming is headed.

Text 13. Vertical Farming Technology

Source: <https://smarttek.solutions/blog/vertical-farming/>

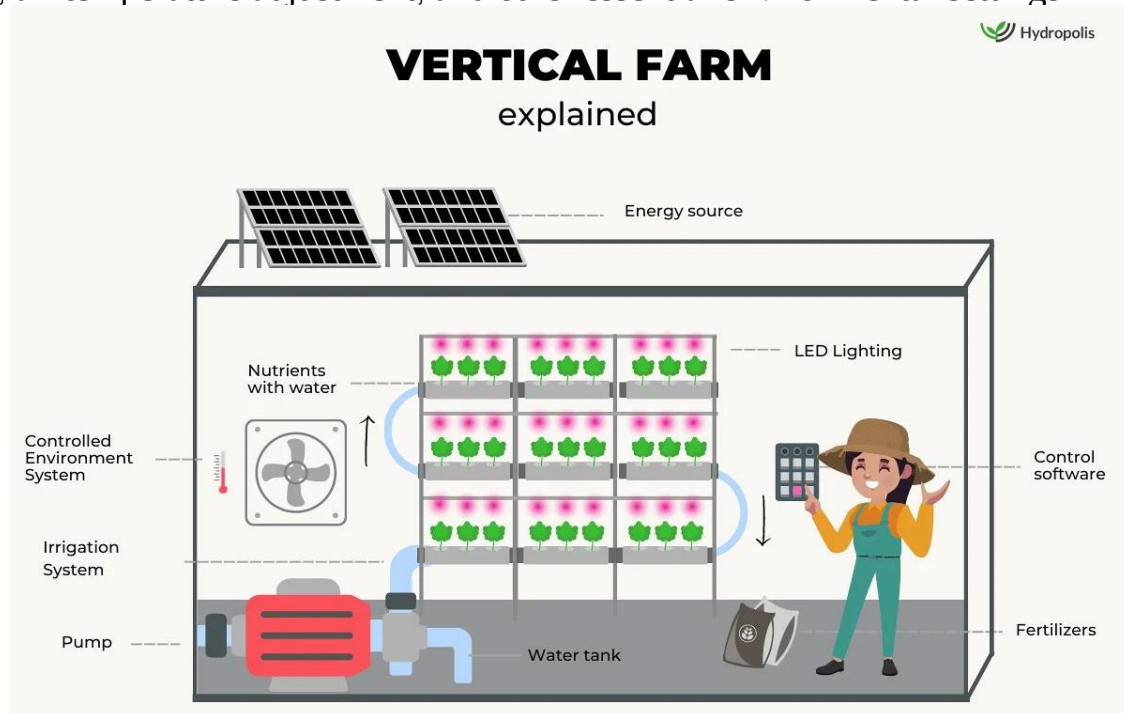
Farmers still depend on nature's vagaries: pests and extreme weather conditions often cause considerable damage to yields. Fertile land is scarce, natural resources are exhausted, and the demand for them is, on the contrary, constantly growing. All these challenges require new approaches to food production, including the dynamic application of various technological solutions. Vertical farming is one of these promising directions.

In this article, we explain what vertical farming is, how this technology works, and the benefits it offers.

What is Vertical Farming and How Does It Work? Vertical farming is a relatively new development in agriculture. It allows growing greens indoors. Plants grow one above the other on several levels, which ensures efficient production area utilization. To grow greens on a vertical farm, particular hydroponic systems (hydroponics, aeroponics, aquaponics) are in use where plants receive the necessary nutrients through water rather

than soil. This approach makes the food production process more straightforward and environmentally friendly.

The farms look like automated multi-level plots with automatic watering, lighting control, air temperature adjustment, and other essential environmental settings.



Vertical farm explained. Source: Hydropolis

Companies around the world conduct experiments with new types of vegetables and fruits to grow them on vertical farms. For instance, drones monitor fruit quality and size, while iFarm even purchases specially trained Dutch bumblebees from the Koppert Company. They pollinate the blooming fruit plants on the farm according to the schedule.

Main Components of Vertical Farming System: Numerous startups have already appeared in the vertical farming market. They conduct experimental work with various combinations of approaches and technologies, trying to grow different products with this farming method. Generally, each of these solutions has specific mutual elements:

1. Multi-level metal structures specifically designed for growing plants using this method. Their outer appearance may differ depending on the target premises and the plants grown.

2. An LED illumination system adjustable for the controlled plant growth and flowering rate. Because closed premises have limited access to natural light, illumination intensity is critical for a rich harvest.

3. Vertical farms can use different environment types to grow plants. The three basic ones used in vertical farming are hydroponic, aeroponic, and aquaponic.

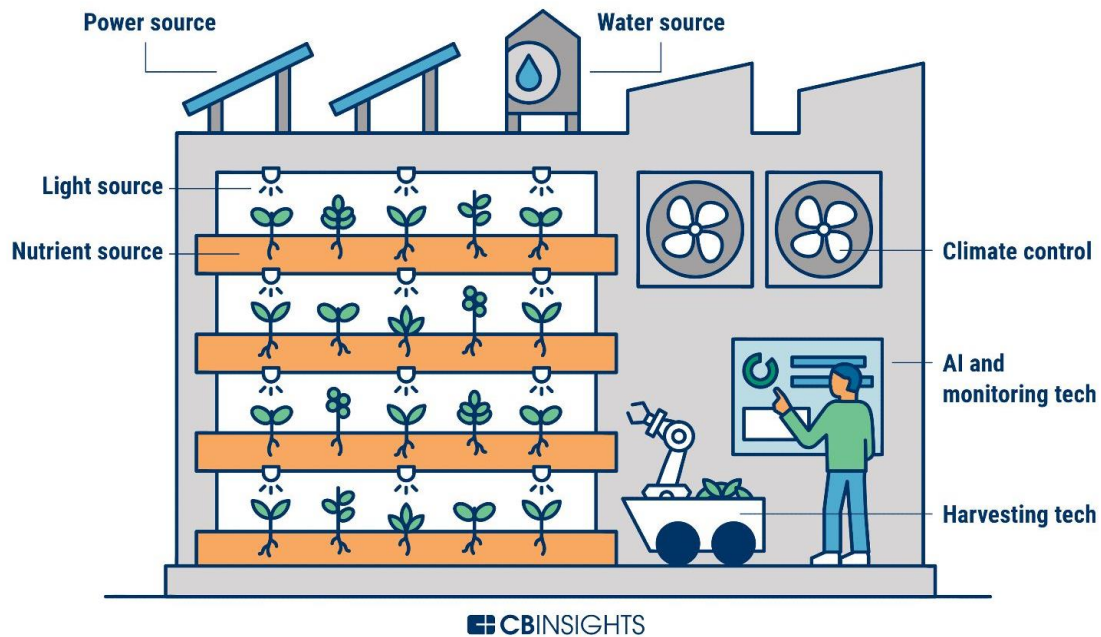
4. A climate control system is an essential element for vertical farming. For optimal plant cultivation conditions, it is necessary to ensure precise control over temperature, humidity, and air circulation.

5. Smart sensors are another important component of a vertical farming technique. The Internet of Things (IoT) is a critical component, as it is impossible to ensure good farm productivity without constant monitoring of the surrounding environment and plant condition.

6. Automation systems for plant cultivation management. They may include planting and harvesting systems controlled by artificial intelligence and may, as well, use robots.

7. Besides all the points above, indoor farms need a reliable energy source to power illumination, climate control systems, and other equipment.

8. Functional and reliable software is another often-unobvious element. It can optimize employees' work, manage specific farm aspects, and control an entire farming complex, data aggregation, interpretation, and visualization.



Main components of a vertical farm, image: CB Insights

Benefits of Vertical Farming: How Technology is Revolutionizing Food Production: Vertical farming solves several problems of classic farms and has many crucial advantages, making this industry a promising direction for new startups.

- Vertical farms occupy less space, allow farmers to grow more plants per area unit without fertile land, save water, and use fewer fertilizers.

- Due to controlled air flows within the premises, pests cannot get inside, and therefore, there is no need to resort to pesticides to fight them.

- Due to minimal dependence on weather conditions, fresh greens are available all year round. This factor puts vertical farming products in demand among restaurants and stores offering vegetables and fruits in a premium segment.

- Vertical farming is possible even in densely populated urban areas with limited available space. Product delivery logistics are less complicated, and corresponding expenses are lower.

- Vertical farms allow entrepreneurs to grow food products in several layers and use the available space to its full extent. This approach ensures high yields per area compared to traditional farming methods.

- Precise control over plant cultivation and shortened supply chains allows entrepreneurs to reduce harvest spoilage and food waste rates significantly.

- All the factors recollected above make this business area a promising investment direction, guaranteeing good returns for the companies engaged in this kind of business.

Summing up, vertical farming offers many advantages and allows successful food growing in places where it was previously difficult and unprofitable. While the variety of plants grown increases, delivery logistics improves, and energy costs get lower, the vertical farm industry will continue to grow. The sector will become even more profitable if such technological advancements as AI, IoT, and machine learning find their use in it, while robotics and automation will free people from routine tasks.

Text 14. Automation in Food Industry

Source: <https://www.appventurez.com/blog/automation-in-food-industry>

Automation in food industry in manufacturing, processing, packaging, maintaining safety standards, and waste management, can help upscale its revenue and boost its capacity. In nearly every sector of the economy, companies have invested in artificial intelligence services in the handling and management of a range of functionalities. In the food industry, the utility of AI is substantial. For instance, the use of pattern recognition in sorting food products, and data science in structuring random data can be advantageous. Deep learning in processing and packaging, and machine learning in revenue prediction can be deployed for better outcomes.

– **Trend Forecasting in the Food Industry:** Trend forecasting is a method that enables decision-makers to take appropriate action based on predictive analysis further promoting automation in food industry. In the industry, ML-based algorithms can render detailed insights into the upcoming ups and downs. This can prove to be an excellent tool for anticipating customer preferences and keeping the trends under inspection.

Integrating trend forecasting in the food industry can provide impetus to companies in achieving their revenue targets. Manufacturers can make informed decisions as per the insights and make adjustments to their functioning to make profits with food data accordingly.

– **New Product Development Using AI:** A remarkable food product is an amalgamation of consumer preferences, healthy character, and a sustainable process of manufacturing. By collecting insights from consumer trends, AI can lead to new product development.

AI-powered programs can form new recipes and design new products while enhancing the role of automation in food industry. It deploys computing, machine learning, and data analytics to make food products tastier and easier to cook. Cognitive abilities to cater to human requirements are also applied by AI chefs. A prominent example is Chef Watson by IBM who can be a great companion to chefs in the kitchen in examining dishes and suggesting recipes.

– **AI in Food Processing and Product Sorting:** Packaging and shipping manufactured goods to the markets are two of the most crucial operations in the food industry. The process, however, is so monotonous and tiresome that the error quotient in the case of human involvement increases to detrimental levels. Thus, automation food industry can provide an effective solution for the packaging problem.

1. AI-based systems to execute packaging operations can reduce the margin of errors to a non-existent level.

2. AI-based food industry solutions can provide impetus to the rate of production to sustain the demand-supply chain.

AI led food processing automation renders intelligent solutions employed through a variety of tools and approaches. These include laser and X-ray technologies, high-resolution infrared cameras, and spectroscopy. These technologies are utilized at the input channel to evaluate food commodities and sort out bad products through in-depth scanning and thorough examination. In comparison, traditional systems could only discriminate between good and bad items based on their appearance.

The deployment of AI-based systems in food packaging and product sorting has also several economic benefits. On one end, the cost of manual labor is cut, and only operational cost remains. On the other end, sanitation of impeccable standards through cleaning food processing equipment is assured. Furthermore, decision-making through predictive analysis and demand-supply chain management are also kept in balance.

– **AI in Food Safety:** AI-based systems and robotics can be sterilized and, therefore, are suitable for the food industry. It is due to this characteristic that the possibility of contamination in food products is reduced to zero. This in turn reduces the risk of foodborne diseases and food poisoning.

In several cases, food grains like wheat and pulses, and oilseeds like mustard and sesame are stored unpackaged in large godowns over longer periods without refrigeration. This is done to maintain a buffer stock to meet demands in extraordinary circumstances. However, these grains do get contaminated in humid conditions and lead to the development of various diseases and symptoms in humans.

The role of AI in food safety is to ensure such instances of errors do not occur. Additionally, as a solution, AI-based automation in food industry can measure and identify the contamination status of a food product efficiently. This is made possible by Next-Generation Sequencing or NGS.

NGS (Next-Generation Sequencing) is a method of sequencing that strengthens food safety and security through data collection, analysis, and extensive testing. It can measure contamination and prevent possible hazardous implications through genome examination.

EN (Electronic Noses) are electronic sensing devices that examine odors to determine food quality and food spoilage. The application of the device also consists of data acquisition and machine learning data analysis to identify degrees of falsification and read the manufacturing process.

– **AI in Food Waste Management:** It is estimated that a total of 17% of the food produced globally is wasted. Out of which, 7% is wasted in retail and services. The economic cost of that percentage is approximately USD 1 trillion per year!

These insights shed light on the inefficient management of food waste. Integration of AI and ML-based systems not only at the stage of manufacturing but at cultivation can enhance decision-making capacity and reduce instances of food waste.

1. AI can monitor the growth of plants and crops and predict or notify when the fruits, vegetables, or grains are ready for harvest.

2. In addition, deep learning can also provide insights into what fertilizers to use to expedite growth.

3. AI-based food analytics and tracking systems can give information on the shelf life of the product and trace the most suitable period of sale.

All these methods would help in the overall reduction of food wastage by helping manufacturers in product management, assuring food safety, and reducing wastage.

– **AI in Supply Chain Management:** Like every major industry vertical, the food industry has its massive supply chain system. The inclusion of AI in the supply chain has wide applicability, such as inventory management, demand forecasting, and more. The AI-led automation in food industry commences at the primary level of food crop cultivation and runs up to packaging and delivery. Let's take a look at these steps in brief in the following section.

1. Smart Farming: AI in the food industry can be used to monitor crop growth, alert against instances of infestation, measure humidity and temperature, soil moisture and nutrient retention, etc., to aid in farming.

2. Healthify Junk Foods: By running deep-learning algorithms, AI can be used to prepare healthier renditions of food labeled as junk by customers. The need to address junk food addiction can also be addressed efficiently through this mechanism. Hoov Foods, a food formulator platform, aims to transform junk and addictive food products into healthier renditions. Their procedure involves matrix analysis of the food product, ingredients mapping, and redesign of constituent elements.

3. Machinery maintenance: AI can be used to generate alerts when a piece of equipment or machinery is due for servicing. This is a cost-efficient practice as maintenance, if delayed, can be costly.

4. Automated Food Packaging: AI can be integrated with robotics to automate food packaging. Food industry automation can also bring design improvements, ensure pinpoint accuracy, detect faulty products, and forward them for removal or renovation.

5. Food Sorting and Quality Control: As previously mentioned, AI-assisted machinery can automate the process of sorting packaged food products. Similarly, equipped with high-end techs like IR spectroscopy, AI can easily detect food spoilage ultimately reducing revenue deficit.

Text 15. Transformative Role of Robotics and AI in Food Industry

Source: <https://www.appventurez.com/blog/automation-in-food-industry>

From the stage of sowing seeds to processing the harvest, cooking, adding the secret ingredients, packaging, and readying the product for delivery, the application of robotics that further leads to automation in food industry is nothing short of transformative. The advancement of technology in food industry can be facilitated through drones, armed bots, and heavy machinery programmed to carry out standard functionalities. The utility widely aims to influence agriculture through smart farming and predictive analysis, and automating food packaging, food sorting, and storing. Let's study these sections in brief.

– **Robotics in Agriculture:** Agriculture is an extensive activity. It includes various sub-sections like horticulture, floriculture, poultry farming, dairy farming, and so on. The indulgence of robotics in agriculture can automate and escalate routine tasks like plowing, soil monitoring, harvesting crops, measuring water levels, collecting milk and eggs, etc. Two-armed robots, drones, and heavy machinery can be programmed to promote automation in food industry and carry out tasks with efficiency. Smart farming promotes the usage of technology to enable scientific methods of cultivation. For instance, drone technology can promote scientific farming by performing spatial analysis, moisture measurement, and field reconnaissance. This is made possible by the high-quality infrared camera setup installed on the drone. Similar is the case with machinery and other types of equipment operated in cultivation. These include tractors, harvesters, combines, planters, sprayers, and many more.

– **Robotics in Food Delivery:** So far, the implications of robotics in food delivery are concerned, drone technology is the major case in point. Drones are already used in the contactless delivery of goods and groceries. This is not only cost-effective on the operational level, but also saves time, reduces cost, and enhances efficiency by bringing automation in food industry. Drones are equipped with sensors and stereo-vision cameras to improve accessibility and avoid instances of accidents. The method is also sustainable as it replaces fuel exhaustion that is there in conventional methods of delivery.

– **Robotics in Cookery:** The introduction of automation in food industry is not something new as the use of robotics is applied to the cookhouse. These are mostly in the form of two-armed robots that imitate human behavior and decision-making skills while cooking. The robots, thereafter, apply deep-learning mechanisms to develop their cookery skills. To enable imitation, the robots are equipped with sensors and optic cameras. Recently, a UK-based company, Moley Robotics, constructed a robot inherently for cooking. The robot can skillfully add and mix ingredients, flip bread and stir meals, and clean utensils effectively.

– **Robotics in Food Manufacturing:** The implementation of food processing robotics has already penetrated the industry. The efficacy applies in sorting, grinding, extrusion, agglomeration, mixing, etc. Another notable type of machinery that also brings automation in food industry includes an armed robot. These can be multi-joined or overhead-picking arm robots called ‘delta robots’. For instance, a US-based startup, Zume, commissioned Vincenzo, a robot to perform smaller tasks in preparing pizzas, such as making the dough and baking the crust thoroughly and properly.

– **Robotics in Food Packaging:** The involvement of robotics in food packaging in the industry, as per a survey conducted by the Association for Packaging and Processing Technologies, is estimated to be 94%. The implementation of automation in food industry has resulted in enhanced productivity with more than 100 products processed and packaged seamlessly. Additionally, the integration of robotics in food packaging can enable a sustainable approach and ensure confirmation of the environmental regulations set by the government. Machinery can be geared with biodegradable and sustainable materials to use in packaging. Outside of these usages, robots can also box, sort, and warehouse products as programmed.

Text 16. Benefits, Challenges and Future of AI-led Automation in Food Industry

Source: <https://www.appventurez.com/blog/automation-in-food-industry>

The yield on investment in robotics and AI in the food industry will be monumental over the next several years. It has been estimated that the market valuation for automation in food processing will reach \$29.4 billion by 2027. The investment would be meant to escalate the rate of manufacturing products, automate packaging, ensure food safety, and manage food wastage. Larger implications of these provisions would be aimed at culminating manual labor and replacing direct human contact with a machine-embraced approach to carrying out tasks.

The benefits of robotics and AI-led automation in food industry would have lasting impacts on the following aspects:

– Facilitating a consumer-centric approach in food manufacturing: Factories with a massive production rate are equipped with AI in food manufacturing. ML algorithms continuously study consumer trends to enhance product quality and devise new recipes.

– Efficient food packaging and sorting: AI in food packaging, sorting, and warehousing can facilitate an increased rate of production and cut costs on shipping.

– In-depth computation to ensure food safety standards: Robotics can be programmed and integrated with AI to guarantee food safety standards and ensure the units are streamlined with the legislation.

– Environmental-friendly food waste management: AI and ML-based programs can effectively ensure a sustainable food waste management cycle by installing checkpoints during the process of food manufacturing, and, in turn, generate an economy of \$127 billion a year by 2030.

– Reduces additional expenses and optimizes costs: Automation in food industry can relay economic advantages as it reduces expenses on human capital, and infrastructure maintenance, and enables an efficient cleaning process.

– Enhances customer experience: Integration of AI led automation in food industry also improves customer experience through neural learning of market trends and consumer preferences.

As to challenges of using AI in the food industry, there is no doubt that food automation, as has been emphasized throughout the article, presents extensive advantages. However, the industry could face financial stress and social adversaries through unemployment. The challenges of bringing automation in food industry are explained below.

1. High Installation and Maintenance Cost— Owing to the ever-increasing business demand for AI incorporation, the cost of installing the automation apparatus has increased. In the food industry, the utility of AI efficiently applies to minimizing the margin of error and streamlining with customer trends.

Powering the food industry with AI can be expensive due to the operational and functional aspects. For operating AI-powered machinery, the need for a dexterous task force is needed. Similarly, the cost can also shoot up depending on the functionalities AI is deployed to carry out. The greater the usage, the more the cost.

2. Job Cuts—Automation in food industry, specifically on the scale of manual labor, would lead to massive job cuts. This contention comes from the question of whether AI would replace human labor.

While it can be said that losses in jobs would occur due to the integration of AI and robotics, alternatively, the demand for highly skilled and high-paying jobs on an operational level would witness a significant rise.

3. Concerns Regarding Unethical Practices— By now it is evident that automation in food industry can improve the standards to excellent levels. However, concerns regarding the manipulative usage of AI to only build profit while ignoring quality have been put forth. At times, companies prefer unethical methods of making addictive products to make a profit. Therefore, AI deployments must be regularly monitored and checked for any breaches.

4. High Dependency on AI: Utmost dependency on AI, from carrying out simple tasks to high-level decision-making, can have disastrous implications. Triggering decisions based entirely on datasets can have downgrading impacts on food quality and resource management.

Talking about the future of AI-led automation in food industry, it should be noted that the food industry is constantly losing value owing to undue dependence on conventional approaches. It has not only led to a widening margin of errors but also held back what the larger potential the industry is capable of accomplishing. With AI-powered machinery and automation in food industry, the future of the industry can become more advanced. Some instances include the following:

1. Smart Kitchen and Robot Chef: Kitchens at homes and restaurants can also be integrated with artificial intelligence to maintain food safety standards and aid in cookery. Additionally, robotics can also be added to the kitchen to aid in manufacturing, checking food quality, and upkeeping the cleanliness of types of equipment. In the preceding sections, we have already discussed Chef Watson by IBM who aids chefs while cooking and suggests recipes.

2. Research Labs for Food Processing: Growing food in a controlled setting as in the case of research labs, can aid in optimizing quality and assuring consistency in the rate of production. Datasets collected from the labs can then be put to use in a wider setting to attain maximum output and efficiency.

3. Equitable to Safe and Quality Food: The advantages of AI led automation in food industry can be used to build strategies to ensure wider access to safe and nutrient-rich food. This use case would have lasting implications in countries grappling with food insecurity.

Text 17. Robotic Applications in Food Manufacturing

Source: <https://blog.robotiq.com/top-6-robotic-applications-in-food-manufacturing>

Robotic food manufacturing is a rising trend in the food industry. The value of the global food automation industry is expected to rise to \$2.5 billion by 2022.

In this article, we introduce six robotic applications in food processing. As we discussed in our previous article on the food industry, food manufacturing can be separated into two stages: primary food processing and secondary food processing.

– **Top 3 Robotic Applications in Primary Food Processing:** Primary processing involves handling raw food products, which are cleaned, sorted, chopped, packaged, etc. Some foods, like raw vegetables, will only undergo primary processing before they are packaged for the consumer. Other foods will undergo secondary processing before packaging.

Up until quite recently, robotic processing at this stage has been limited or non-existent. Raw foods are variable in size, weight and shape. This makes it difficult for robots to handle them. However, recent developments in sensing and soft gripping have made it possible for robots to handle many raw foods.

1. **Robotic Butchery:** Butchery is a very difficult task to automate. Every animal carcass is different. A skilled butcher will adapt each cut to the shape and position of bones and meat. Some butchery tasks are simpler to automate than others. For example, high-volume chicken leg deboning is an established part of the meat processing industry.

Beef butchery has traditionally been very difficult to automate. Recently, beef manufacturer JBS has started looking for ways to introduce robots into their factories. Parts of the process are very dangerous for human workers. Rib cutting, for example, involves operating a high-speed circular saw for several hours. JBS has managed to automate this action using robot manipulators and various vision sensors. The application has improved safety and product consistency.

2. **Fruit and Vegetable Pick and Place:** Fruits and vegetables are challenging to handle with a robot due to their variable sizes and shapes. They also require delicate handling to avoid damage. For these reasons they have traditionally been handled by human workers. However, recent developments in gripping technologies look to change all that.

Soft Robotics Inc has introduced a flexible gripper which can handle very delicate foods, even individual lettuce leaves! Another example is Lacquey's gripper, which uses paddles to lift soft fruits and vegetables.

3. **Robotic Cutting and Slicing:** Some cutting and slicing tasks are easy to automate. For example, even kitchen food processors can slice vegetables into uniform shapes. Robots are not needed for this type of simple automation.

For more advanced cutting and slicing, however, the food industry has relied on human workers but robotics is starting to make its way into the industry. Fish cutting, for example, involves detecting and removing defects from the fish as well as cutting fillets to uniform shapes and sizes.

– **Top 3 Robotic Applications in Secondary Food Processing:** Secondary processing involves handling products which have already undergone primary processing. Robots have been used for several applications for a long time, particularly pick and place. However, recent developments have opened the door to even more advanced applications.

1. **Product Pick and Place:** You may be familiar with the high-speed delta robots which are used to move food products around a production line. Uniform foods are much easier to handle robotically, so this application has been available in the food industry for many years.

2. **Cake Decorating:** One impressive application is robotic cake decoration. This involves using a robotic arm much like a 3D printer to pipe icing onto a cake. The Deco-Bot from Unifiller can pipe hand-drawn decorations onto cakes on a moving conveyor.

Cake cutting can also be done robotically, like the Katana waterjet cutting robot which can cut out intricate shapes in cakes using high pressure water.

3. Pizza Making: Artisan food producers sometimes worry that adding robots their process will make their products less 'hand-made'. However, Silicon Valley pizza producer Zume is showing how robots can be produced to look like they have the human touch. Their pizzeria uses two robots: a delta robot to spread the tomato sauce and an ABB manipulator to tend the pre-baking ovens. While their system is far from fully automated, their goal is to make the pizza delivery industry a labor-free business.

Finally... Washing Up! Contaminated food causes 48 million people in the USA to become sick annually. Robotic food processing has the potential to reduce this, by removing human workers from parts of the process, but this is only possible if the robots themselves do not cause contamination.

One of the more challenging issues for food automation is the fact that every piece of machinery must be thoroughly cleaned to avoid contamination. Robot manufacturers have been working to make their robot casings smoother, with better ingress ratings and no loose wires. This allows them to be thoroughly washed down at the end of each cycle.

Text 18. Robotics in Food Processing

Source: <https://knowhow.distrelec.com/food-and-beverages/the-rise-of-robotics-in-food-processing/>

Food processing has become an important field for robot utilisation to assist in the process of food production, delivery and distribution.

With the rise of robotics in many industries, food and beverages is one of the key markets for automation technologies and the advancement of robotics. As a beacon of innovation, robotic solutions promise to redefine efficiency, safety, and quality in food production as the industry struggles with enduring issues including labour shortages, strict safety standards, and the continued demand for high-quality products.

If you are wondering how robots are taking over the food industry, you are in the right place. Keep reading to learn more about robots and their role in the food industry.

How Are Robots Used in Food Processing?

The food processing industry is undergoing a substantial shift due to the incorporation of advanced robots that possess artificial intelligence (AI), cooperative robots (cobots), industrial robots or industrial robotic arms, as well as specialised equipment meant for various functions such as packaging, sorting, picking, and careful quality checks.

With their sophisticated sensor technologies and machine vision systems, these technical wonders are more than simply machines – they are the future workforce, able to handle even the most delicate food products with care and precision. With the technology behind the rise of robots, the future is here and is also impacting the food sector.

Robotic Solutions in Food Production

Food processing is one of the industries with the widest range of robotic applications. Robotic solutions are becoming more and more prevalent in a variety of fields, including the handling of perishable fruits and vegetables and the labour-intensive operations associated with producing meat and poultry. Robots are not only increasing production speeds in the dairy and baked goods industries, but they are also essential for specialised jobs like cake decoration and artisan cheese packaging that require extreme precision.

Using robot arms in bakeries is one such example; these arms are designed to decorate cakes with elaborate designs that would take a lot of time and effort for human workers to complete. Similarly, robotic butchers that are equipped with very precise cutting tools in the meat processing industry can achieve levels of efficiency that exceed human capabilities by precisely cutting meat while minimising waste.

Top 6 Robotic Applications in Food Processing

Robotic technology is being quickly adopted by the food processing industry in order to improve productivity, security, and food hygiene. Here are the top six robotic applications that are having a big impact on food processing out of all the many applications:

1. Sorting and Grading

– Robotic Vision Systems: With the use of sophisticated vision systems, food items can be sorted by size, colour, ripeness, and quality by robots. Robots with cameras and sensors, for instance, may swiftly and precisely sort goods in the fruit and vegetable business, making sure that only items that fit predetermined standards move on in the food manufacturing line.

– Robotic Arms: Robotic arms are essential to the transformation of food processing processes because they are efficient, precise, and versatile in a wide range of applications. For instance, to sort and grade food products according to size, colour, weight, and quality, robotic arms are incorporated with sensors and image technology. Only items that fulfil certain requirements move forward down the production line thanks to industrial automation of the quality control process.

2. Cutting and Deboning

– Robots with great precision: In the processing of meat and fish, robots perform operations including cutting, deboning, and filleting. These robots can execute jobs that are difficult and dangerous for human workers, making accurate cuts to maximise production and decrease waste.

3. Packaging and Palletising

– Collaborative robots (Cobots): Package food items securely and effectively by collaborating with human operators. They may be simply programmed for various duties and are made to handle a wide range of products, from larger commodities like meat packages to delicate ones like eggs.

– Palletising Robots: These machines automate the process of packing food items into pallets for transport. They greatly expedite the food packaging process and lessen the physical strain on human workers because they can carry high loads and operate nonstop.

4. Cooking and Preparation

– Automated Cooking Systems: The fields of food preparation and cooking are also being affected by robots. Automated systems are capable of precisely and consistently completing operations like mixing, baking, and frying, guaranteeing consistently excellent results. These technologies are very helpful in mass production environments, such as the manufacturing of snacks and prepared meals as well as in the restaurant and hospitality industries – restaurant robotics are becoming more popular.

5. Inspection and Quality Control

– Machine Vision for Inspection: Food products can be inspected for flaws, contamination, and irregularities at different phases of manufacturing by food robotics that are outfitted with machine vision. Only goods that adhere to the strictest food quality requirements are sent to customers thanks to this real-time inspection.

6. Cleaning and Sanitisation

– Robotic Cleaning Systems: It's critical to maintain hygienic conditions in food processing facilities. Deep cleaning activities can be carried out by robots fitted with cleaning and sanitising equipment. These machines can reach locations that are challenging for human personnel to clean efficiently. This lowers the possibility of foodborne infections while also enhancing the facility's general hygiene.

7. Customisation and Decoration

– Decorating Robots: In the bakery and confectionery industries, robots are capable of precisely and artistically decorating cakes, biscuits, and other goods. These robots can

reliably reproduce complex designs, which improves the products' visual attractiveness.

Are Robots the Future of the Food Industry?

AI and machine learning will be more deeply integrated into robotic food processing methods in the future, allowing robots to learn from their surroundings and gradually become more efficient. More flexible and adaptive robotic systems that can do a greater range of activities with less assistance from humans may result from this.

The development of robotic solutions will be essential to the creation of more effective and zero-waste food processing techniques as the world's attention turns increasingly towards sustainability. In doing so, the production processes for food can be made more sustainable overall, minimise product loss, and maximise energy use.

In addition to addressing present industrial issues, the use of robotics in food processing opens the door to a safer, more effective, and sustainable food production system in the future. The potential uses of robotics in the food business are only going to grow as technology develops, drastically altering the way that food is produced.

Text 19. Ways Robotics Is Incorporated into Food Industry: Pros, Cons and Application

Source: <https://www.foodics.com/robotics-in-the-food-industry/>

Introduction: Robotics play an indispensable role in the modern age; it is integrated into all industries and is changing the way things are run, forever. The food industry has been relatively slow to adopt technologies. However, as the demand for food continues to rise with the growth and aging of the global population, food suppliers are urged to find ways to cater to the high demand while maintaining and even improving food quality.

That said, robotics has started to make its way into every aspect of the food industry from agriculture and food processing to packaging and delivery. Not only that, but automation has also found its place in restaurant kitchens!

In this article, we dive into the different ways robotics is incorporated into the food industry as well as their advantages, challenges, and future.

What Is Robotics? Robotics is a division of science and engineering that designs, develops, manufactures, and operates robots. These robots are intelligent machines that are designed to perform different kinds of tasks. Robots come in different shapes, forms, and sizes and their level of intelligence and sophistication may vary.

Robotics in Food Industry – Uses and Advantages

1. **Agriculture:** A report published by Fior Markets estimated that the agriculture drone market will grow from 1.5 billion USD in 2019 to a staggering 10.5 billion USD by 2027. The applications of robotics in this sector include planting, weeding, and harvesting as well as monitoring and analyzing crops. As for livestock farming, robotics is used for feeding, milking, egg collection, and sorting, as well as cleaning.

2. **Food Processing:** The use of robots in food processing operations is more effective, efficient, and sanitary than the employment of human labor force. Robots can produce large quantities of products in a short period of time and they ensure product quality and safety.

– **Meat Processing:** The use of robots in meat processing is growing mainly because these operations are not best suited for humans. They include working in freezers, cutting carcasses, processing sausages, and deboning chickens.

– **Dairy Processing:** In addition to automatic milking systems which improve cow health and increase milk production, robots are also used in cheese processing like stirring curds and slicing cheese.

3. **Packaging:** Food packaging is one of the earliest and most common uses for food-handling robots. It has been developed over the years to handle the whole packaging pro-

cess. It can be split into 3 stages:

- ✓ Primary packaging: food is packed into a wrapper, a container, or a vacuum-sealed bag.

- ✓ Secondary packaging: individual packages are grouped in a larger container.

- ✓ Palletizing: Secondary packages are stacked for shipping by palletizing robots.

4. Robotics in The Kitchen: While this technology is still in its infancy stages when it comes to the restaurant industry, it is clear that it is growing steadily and we will inevitably witness its prosperity in the near future.

Just like self-ordering kiosks, robots are being integrated into the food service to provide more consistency and productivity and reduce labor costs, which can make up around 30% of cost. Although the costs of these automation technologies are high, it has been proven to be cost-effective in the long run. These robots perform a variety of tasks such as mixing, chopping, cooking, and serving customers. More sophisticated robots are made to perform functions like making pancakes, sushi, and noodles. It is worthwhile to look into robotics and find the right kind for your restaurant to help you run it more efficiently.

5. Food Delivery: Starship Technologies developed a robotic delivery service allowing restaurants, bakeries, and other businesses to use robots for delivery. These robots are operated remotely and can carry up to 9 kilos. They are also equipped with alarms and cameras to prevent any theft attempts.

6. Customer Service: In addition to food delivery, restaurant owners are starting to adopt robots in customer service. These robots take care of basic tasks, they save time thanks to their ability to answer multiple questions very quickly and they provide 24/7 support.

Disadvantages and Challenges: Now that we discussed the application of robotics in the food industry and its advantages in each area, let's go through some of its disadvantages.

1. High initial investment: Let's be real, investing in robotics for your business is costly. When you decide on adopting this technology, you should take into consideration all costs of industrial robots including initial price, installation, configuration, and maintenance, as well as costs related to keeping your robots safe from cyber threats.

2. Scarcity of experts: Automation is a fairly new technology in the industry, hence the scarcity of experts in the field. Finding people to take care of maintenance and programming can be challenging. Therefore, you should take into account the investment you need to make to employ such expertise.

3. Layoffs: There is an understandable social concern that robots are stealing jobs from humans. Although robots require humans to operate, they certainly replace a big deal of that working force, forecasting losses of 20 million manufacturing jobs by 2030. Business owners are forced to lay off a substantial number of unneeded workers which can be stressful for both parties.

Future of Robotics in Food Industry: When we look at the big picture, it becomes crystal clear that robots will take over in the future. It's expected that in the next few decades, the food industry will be largely automated and smarter robots will be developed to better communicate with each other and humans. According to the International Journal of Recent Technology and Engineering, the food industry is recorded to be among the industries in which intelligent robotics systems are likely to have substantial effects in the future. Will this pivotal change be beneficial or menacing for humans? Only time will tell.

Conclusion: Robotics comes with a bag full of advantages for commercial industries. They ensure better quality and consistency, maximize productivity and throughput, provide greater safety and reduce labor costs. As for the challenges they pose, it's for you to decide whether or not this technology is worth the hefty initial investment and the moral burden of layoffs.

РАЗДЕЛ 3. ИНСТРУКЦИЯ ДЛЯ ПОДГОТОВКИ УСТНОЙ ПРЕЗЕНТАЦИИ ТЕКСТОВОГО МАТЕРИАЛА НА АНГЛИЙСКОМ ЯЗЫКЕ

3.1. Поэтапная инструкция по подготовке презентации текстового материала

Presentation Preparing Guide – STEPS

Step 1. Know the context of the presentation: Who are the audience, and what are their interests? How big will the audience be? How long is the presentation to be? What facilities are available for visual aids? What about time for questions?

Step 2. Decide on your topic. Think carefully about the main point or points that you want to communicate. You should be able to write these clearly in one or two sentences.

Step 3. Structure the content. Most people begin with an unordered collection of ideas and then put them into sequence. Then decide on the relative weight of each section of the talk.

Step 4. Think of ways of catching the listeners' interest: examples, anecdotes, impressive statistics, and interesting quotations.

Step 5. It is useful to 'rough-draft' visual aids at this stage because they can help you make the sequence of points clearer and more logical. Think about whether some information should be put into handouts.

Step 6. Check overall length, and the relative weight of sections. A little too short is better than even a little too long. As a rough guide, allow about 1 minute for every 100 words, plus time, if necessary, for changing transparencies. One A4 page, double-spaced, takes about 3 minutes of speaking time.

Step 7. Finish preparation of visual aids. If you are using PowerPoint data projection, having slides or transparencies is a useful back-up in case of last-minute technical problems.

Step 8. Prepare handouts, if you want them. Make copies.

Step 9. Plan the exact words you will use for the opening, the transition points, and the conclusion. Practice them again and again. If you are anxious, write on cards the introductory and concluding sentences. Make more notes if you need them.

Step 10. REHEARSE your presentation, as often as necessary. Do not omit this step! You can practice alone, or ask a friend or colleagues to listen to you. With practice, you will become more fluent and at ease. Make sure you speak simply, but in academic not conversational style. Project your voice across the room. You will find this slows your speech. Check the timing carefully and make adjustments if necessary. Mark a time reference at one or two points in the presentation.

Step 11. Think about the questions the audience may want to ask you. Plan how you will answer them.

Step 12. On the day of your presentation, be calm and organized. If you are unfamiliar with the location, go beforehand to plan where you will stand and where you will put your papers and to see how the projection works. Arrive in good time for your presentation. Remember to take all your visual aids, notes and papers.

If you feel nervous, do not worry. That's normal. Breathe slowly and deeply for a few minutes beforehand, and try to relax the muscles of your face, mouth and neck. This will make you look relaxed, and will improve the quality of your voice. Then remind yourself how well prepared you are, and enjoy it. Concentrate not on yourself or your notes, but on the audience and making clear to them what you have to say.

Visual aids: If you are using an **overhead projector**, follow steps 1–4 below.

1. Before your presentation, check that the equipment works. Decide on the best place to stand, so that you do not obscure the view of the audience; decide where to put transparencies before and after use; decide whether you will point at the transparency or at the screen (or not at all).

2. If you point at the transparency, use a pen as a pointer.

3. Detach the transparencies from their backing paper to make things easier during your presentation. Interleave them with plain paper.

4. Number the transparencies in case you drop them.

If you are using **Power Point** data projection, follow steps 1–6 below.

1. Check beforehand whether you should bring your presentation on diskette or CD or DVD. If you are bringing a computer, check on the type of connection required for the data projector.

2. If possible, set up your presentation before your talk. This can take several minutes, even if all goes well.

3. Have a blank slide at the start and end of your presentation. This makes your start and finish smooth.

4. Power Point has an excellent online tutorial and help system. Use it when you are preparing your presentation so that you can make full use of its faculties (such as time monitoring, handouts and notes).

5. Don't be tempted, because of Power Point's capabilities, to make your slides too 'busy'. That will distract the audience's attention.

6. Even if you are giving your presentation in a well-equipped room, technology can go wrong. Print out your PowerPoint slides on to transparencies, so that you have an alternative.

Handouts: Handouts are useful in **three ways**.

1. They show data that are too detailed for a visual aid, such as transcript data from interviews, or mathematical calculations. If there is a lot of detail, the points you want to refer to in your presentation should be clearly highlighted in the handout. The handout is given immediately before the presentation, and then referred to.

2. They provide a 'signposting' framework to guide the audience through your talk. In this case, the handout will be a note-frame, which is given out before the presentation. Don't put too much into it, or the audience will read the handout instead of listening to you.

3. They act as a record of your presentation, which the audience can take away. This could be either a note-frame or a fuller text. For this 'record' type of handout, it's common practice to add your address and email address, so that people working in the same field can contact you later. Some presenters like to give out this type of handout at the end of their talk, so that the audience listens with full attention. Others give it out at the start, as a support to listening.

Keep your handout short – one page if possible.

Notes: Visual aids often provide sufficient support for your presentation. If you feel you need notes as well, remember that they will be more to cope with during the presentation: you will have to deal with the visual aids, the notes, and the audience.

1. Cards or A5 paper are often recommended because they are neater in the hand than big pages. Make sure you number them clearly!

2. A good alternative is to use photocopies of your visual aids, with notes written on them. It is then easier to coordinate your progress through notes and visual aids.

3. Write very large and clear, with plenty of space.

4. Use colour, so that you can quickly locate key points or words.

3.2. Технология создания электронной презентации текстового материала

3.2.1. Облако слов

«Облако слов» представляет собой визуальное представление ключевых слов текста. Это – графическая визуализация текста.

1. Зарегистрироваться на сайте <http://tagul.com/>

2. Нажать клавишу My clouds, затем клавишу CREATE NEW CLOUD и зайти во вкладку Tags source (Теги: источник) → URL (вводим адрес веб-страницы) и текст загружается в буфер.

3. Нажать клавишу Visualize, таким образом, текст появится справа.

4. Придать облаку желаемый вид с помощью меню:

Appearance – внешний вид

Font – шрифт

Color – цвет, раскраска слов в облаке

Background color – цвет фона (на экране)

Animation speed – скорость анимации

Roll over text color – развернуть цвет текста

Roll over box color – развернуть цвет рамки

Roll over stroke color – развернуть цвет шрифта

Grab and share – сохранить и поделиться

Save to local computer – сохранить на своем компьютере

Save graphic image – сохранить графическое изображение

Place on a web-page – разместить на веб-странице

Send link to a friend – отправить ссылку другу

5. Сохранить созданное облако, нажав на клавишу Save graphic image. После нажатия появляется окошко «Сохранить как», и вы выбираете место сохранения.

6. Отправить ссылку своим коллегам.

ИЛИ

1. Используя сайт <http://www.tagxedo.com/>, создать **облако слов** из текста.

2. Придать облаку желаемый вид с помощью меню:

Color – цвет

Theme – тема

Font – шрифт

Orientation – ориентация

Layout – расположение слов в облаке

All – всевозможный вариант

Shape – очертание/форма

Hide History – история выполненных действий

3. Сохранить, нажав клавишу Save, и выбрать необходимые параметры сохранения: размер и расширение. После нажатия клавиши сохранить изображение в любом месте на вашем компьютере.

3.2.2. Диаграмма связей / ассоциативная карта

«Диаграмма связей», известная также как «Интеллект-карта», «Карта мыслей» (англ. Mind map), «Ассоциативная карта», – способ изображения процесса общего системного мышления с помощью схем. Также может рассматриваться как удобная техника альтернативной записи.

1. Зайти на сайт <http://freemind.sourceforge.net/>. В пункте **See Download** нажать на **Download** (загрузка). Вы автоматически попадаете на страницу **Download**, где спускаетесь в пункт **Installing Free Mind**.

2. Если компонент Java уже установлен, то нужно нажать на **You can find a Free Mind installer including java here**. После чего начинается автоматическая загрузка файла Free Mind-Windows на ваш компьютер.

3. Установить программу в обычном режиме на компьютер.

4. На рабочем столе появляется значок, который вы запускаете как программу.

5. В центре поля щелкнуть на **Free Mind** / Новая карта и написать центральное понятие, например: «статья о программе Free Mind».

6. Нажать клавишу **Insert** / Вставка для вставки пункта первого уровня (например, «Введение»).

7. Нажать клавишу **Enter** для вставки второго пункта первого уровня (например, «Установка приложения»).

8. Основное редактирование необходимо производить с помощью клавиш **Insert** / Вставка, **Enter** / Ввод, **Escape** / Выход и **Delete** / Удаление.

9. Для редактирования текста внутри выбранного узла можно воспользоваться клавишей **F2**.

10. Можно перемещать карту целиком в любое место рабочего пространства методом обычного **drag'n'drop** / перетаскивание – нужно зажать мышью рисунок и перетаскивать его, не отпуская, в нужное место.

11. Попробуйте изменить размеры узлов. Все возможные формы работы с узлом вы найдете, щелкнув по узлу правой кнопкой мыши, в пункте «Формат».

12. Нажатием сочетания клавиш **Alt+I** откройте каталог с предустановленными иконками («Выберите пиктограмму»). Вы можете выбрать любую из них для добавления к узлу на вашей карте. Добавление иконок делает ее более читаемой и интуитивно понятной.

3.2.3. Шаги по созданию и работе с узлами ассоциативной карты

1. Щелчок мышью по «**Новой карте**» дает возможность внести ключевое слово. Нажав клавишу **Enter**, вы закрепляете данное ключевое слово.

2. «**Вставка → Новый смежный узел после текущего**» дает возможность создать узел с правой стороны.

3. «**Вставка → Новый смежный узел перед текущим**» дает возможность создать узел с левой стороны.

4. Щелчок **левой** кнопкой мыши по «**Новому смежному узлу**» дает возможность внести название для созданного узла.

5. Выполнение щелчка **правой** кнопкой мыши обычно приводит к отображению **списка доступных действий для работы с узлом:**

Редактировать F2	Изменение названия узла
Изменить текст в редакторе	Форматирование шрифта: цвет, курсив, жирный шрифт, подчеркивание, выравнивание, вставка таблицы, создание списка, создание нумерации
Редактировать атрибуты	Создание таблицы с атрибутами под названием узла
Удалить узел	Удаление узла
Вырезать	Удаление узла из данного места и вставка в другом месте

Копировать	Копирование узла и вставка в другом месте
Копировать только этот узел	Копирование только этого узла и вставка в другом месте
Вставить	Вставка узла
Новый подчиненный узел	Создание нового узла, подчиненного заданному узлу
Новый смежный узел после текущего	Создание нового смежного узла под существующим узлом
Новый смежный узел перед текущим	Создание нового смежного узла над существующим узлом
Развернуть/свернуть	Развёртывание и свёртывание подчиненного узла
Пиктограммы <i>здесь же:</i>	Вставка пиктограмм из предложенного списка
• Удаление последней пиктограммы	Удаление последней пиктограммы в данном узле
• Удаление всех пиктограмм	Удаление всех пиктограмм в данном узле
Экспортировать ветвь как новую карту Alt+Shift+A	Экспорт данной ветви в новую карту, т. е. перенос в новое окно, где с ней можно отдельно работать (в главной карте появляется ссылка на этот элемент ассоциограммы)
Формат	Работа с узлом Тип узла – овал, кривая Увеличить шрифт узла Уменьшить шрифт узла Курсив Жирный Цвет узла Высветлить узел Фоновый цвет узла Убрать фоновый цвет узла Цвет облака (облако создается в вставке) Цвет ребра (прямая, кривая, заостренная прямая, заостренная кривая) Толщина ребра (как у родительского узла, тонкое ребро, 1, 2, 4, 8)
Вставка	Облако Изображение из файла (Alt+K) Ссылка (выбор файла) – вставка файла через ссылку Ссылка (текстовое поле) Создать связь (выделив минимум два узла) / между узлами
Стиль	Изменение стиля текста в рамках узла

6. Если подвести курсор к узлу – появится значок на повороте узла, и **узел** можно **перенести** в другое место, потянув в нужном направлении.

7. Файл – экспортировать – как... (выбираем формат, в нашем случае PDF). Сохранить созданную ассоциативную карту связей.

3.2.4. Ментальная карта

1. Зайти на сайт <http://www.spiderscribe.net/> (предварительно зарегистрировавшись).
 2. Создать новую ментальную карту – **Create New Map**.
 3. Задать имя папки – **Map name**.
 4. Добавить описание данной папки – **Description**.
 5. Кликнуть по иконке «**Текст**» и, удерживая кнопкой мыши, перетащить на поле. Ввести текст.
 6. Отформатировать текст по желанию: справа на экране панель форматирования текста. Изменить фон окна, шрифт, кегль текста (размер шрифта).
 7. Щелкнуть по знаку «+» и создать новую ветвь.
 8. Кликнуть по иконке «**Изображение**» и, удерживая кнопкой мыши, перетащить на поле.
 9. Щелкнуть на кнопку загрузки **Upload image** и загрузить изображение. Отформатировать изображение по желанию: справа на экране панель форматирования изображения.
 10. Прodelать похожие шаги с картой, календарем, документом Word.
 11. Внести дополнительные изменения в работу с ментальной картой: в верхней части экрана находится **Панель инструментов**: отмена последнего действия, центрирование карты, изменение размера, печать, экспортирование карты, удаление карты.
 12. После окончания работы с картой нажать на **Share** (поделиться) – в правом верхнем углу экрана.
Private – Частные (по умолчанию) – карта видна только владельцу и тем, с кем автор поделился (указать электронные адреса).
Public with the link – Общедоступная со ссылкой – карта видна всем, кто имеет ссылку. Вход в аккаунт SpiderScribe.net не требуется.
Public on Internet – Опубликованная в Интернете – карта видна и доступна всем.
- При выборе режима **Private** в левом поле ввести список людей, которым разрешен доступ к карте. Выбрать формат доступа: **readers** – только чтение, **editors** – редактирование. Нажать кнопку **Save** (сохранить). Сохранить. Предоставить доступ одному из участников. **Или:** выбрать режим **Public on Internet**, скопировать адрес карты и сохранить в отдельном документе. Нажать кнопку **Save** (сохранить). Нажать в верхней части экрана на **Export Map** (экспортировать карту) и выбрать формат JPG.

РАЗДЕЛ 4. МЕТОДИЧЕСКИЕ РЕКОМЕНДАЦИИ ПО ОРГАНИЗАЦИИ САМОСТОЯТЕЛЬНОЙ РАБОТЫ INDEPENDENT WORK GUIDE

Рекомендации по организации работы с текстами для чтения

Чтобы научиться понимать и переводить иноязычный текст, необходимо в первую очередь научить студента выделять и понимать содержание на уровне *текста, абзаца и предложения*, а также дифференцировать основную и второстепенную информацию.

Основные признаки текста: 1) *связность*; 2) *тематичность* (все предложения объединены какой-либо одной темой); 3) *цельность* (использование средств связи между предложениями).

Тема текста. Текст представляет собой сложное суждение, в котором есть текстовый субъект (о чем говорится в тексте?) и текстовый предикат (что говорится в тексте?).

Текстовым **субъектом** является тема текста, которая находит словесное выражение чаще всего в заголовке или в самом начале текста.

Текстовый **предикат** представляет собой группу суждений, раскрывающих тему текста, т. е. сам текст.

Главное содержание текста. Понять содержание текста – значит уяснить его тему и идею.

Тема текста – это предмет данного описания, т. е. предмет, явление, событие, о которых идет речь в тексте.

Идея текста – это главная мысль о данном предмете, авторское отношение к описываемому предмету. Идея текста – это вывод, к которому должен прийти читающий после ознакомления с содержанием текста.

Тема часто сообщается в заголовке или в первом предложении текста. Понять идею можно лишь после прочтения всего текста. Иногда она не имеет словесного выражения, тогда читающий должен сам сделать определенные выводы.

Основное содержание текста. Для этой цели выделяются элементы, в которых заключена основная смысловая информация текста. Они называются «ключевыми фрагментами» (слово, словосочетание, предложение, группа предложений). Каждый абзац имеет ключевое предложение – «абзацную фразу», если их объединить, то можно получить основное содержание текста.

Ключевое предложение может находиться: а) в верхней части абзаца (*дедуктивная структура* – изложение мысли от общего к частному); б) в нижней части абзаца (*индуктивная структура* – изложение мысли от частного к общему); в) в верхней и в нижней части (*рамочная логическая структура*).

Другие предложения текста представляют собой способ логического развития мысли в абзаце.

Формы передачи информации. Существуют следующие формы передачи информации: *сообщение, описание, повествование и рассуждение*. Так, ядро самого простого типа информации – сообщения – составляют ответы на следующие вопросы: кто, что, когда, где, как, почему.

В текстах психолого-педагогического профиля преобладает тип информации о ситуации или положении дел, а также комбинированный тип информации (сообщение, передача высказывания, информация о событии или факте, о ситуации или положении дел, рассуждение).

Основные виды текстов для чтения

1) учебный;

2) художественный (*story* – рассказ, *play* – пьеса, *novel* – роман);

3) научный и научно-популярный (*research work* – научный труд, *theses* – диссертация; *monograph* – монография; *reference* – статья из справочной литературы; *article* – журнальная статья; *notes* – сообщение).

Методические рекомендации для студентов

Чтение с полным пониманием прочитанного

Цель – полностью понять содержание текста, выделить главную информацию, передать содержание, оценить его, сравнить с уже известным ранее.

Алгоритм

1. Перед чтением спрогнозируйте по заголовку содержание текста.

2. Читайте текст с полным пониманием, т. е. старайтесь как можно точнее понять содержание и смысл читаемого. При этом догадаться о значении слов вам помогут:

3. Проверьте, насколько хорошо вы поняли содержание и смысл текста.

Для этого необходимо:

– ответить на вопросы к тексту, позволяющие выделить детали;

– самостоятельно поставить вопросы к тексту;

– составить развернутый план прочитанного.

4. Для подготовки *пересказа* текста необходимо:

– найти в тексте и выписать основные ключевые слова и выражения;

– составить последовательность фактов и событий;

– изложить содержание текста с опорой на ключевые слова и выражения.

5. Для *характеристики* какого-либо объекта текста необходимо:

– определить объект характеристики;

– выписать слова и выражения, относящиеся к определяемому объекту;

– описать объект;

– высказать свое мнение о нем.

6. Для подготовки *высказывания* по проблеме текста следует:

– определить исходный тезис;

– определить основной материал для аргументирования;

– выписать ключевые слова и словосочетания;

– аргументировать тезис;

– привести примеры.

7. Для *обсуждения проблемы* текста следует:

– выделить предмет обсуждения;

– выделить информацию о предмете;

– выписать ключевые слова и словосочетания;

– выразить свое отношение к предмету;

– аргументировать свою точку зрения.

8. Для *реферирования* текста необходимо:

– зафиксировать основные опорные пункты;

– распределить информацию по степени важности.

9. Для *аннотирования* текста следует:

– зафиксировать тему и главную мысль;

– выразить свое отношение.

Чтение с пониманием основного содержания

Цель – получить общую информацию о содержании текста, выделить главную мысль, высказать свое отношение к прочитанному.

Алгоритм

1. Перед чтением спрогнозируйте по заголовку содержание текста.
2. Читайте текст с пониманием основного содержания, то есть: сконцентрируйтесь на основных фактах текста, опуская второстепенную информацию;
3. Старайтесь охватить взглядом все предложение или его часть;
4. Старайтесь догадаться о значении незнакомых слов или обратитесь к словарю;
5. Старайтесь догадаться о значении незнакомых слов или обратитесь к словарю;
6. Во время чтения подчеркивайте или выписывайте словосочетания и предложения, несущие основную информацию.
7. Проверьте, поняли ли вы основные факты текста, определите его основную мысль. Для этого необходимо:
 - выбрать заголовок из предлагаемых вариантов или сформулировать самому;
 - разделить текст на смысловые отрезки;
 - ответить на вопросы, выделяющие основную информацию.
8. Для подготовки высказывания следует:
 - сформулировать главную мысль текста;
 - сказать, что вы узнали нового;
 - кратко изложить основные идеи текста;

Рекомендации для написания рефератов, аннотаций

Реферат, составленный по одному источнику, называется *монографическим*. Структура реферата строго установлена. Он состоит из двух частей: *заголовочной* и *собственно реферативной*. В заголовочной части отражается название первоисточника, фамилия автора и библиографические данные (место издания, издательство, год издания).

Текст собственно реферативной части строится на основе выделенных при чтении ключевых слов и ключевых фрагментов, большинство из которых могут быть терминами в данной специальной области.

Реферат, составленный по нескольким работам на одну тему, называется *обзорным*.

Рекомендуемые клише для оформления реферата на английском языке

The Paper is called = The title of the Paper is... – Название реферата...

The theme of the Paper is... – Тема реферата...

It is spoken about... – Говорится о...

It is said in brief that... – Кратко говорится о...

Reader's attention is drawn to... – Внимание читателей привлекает...

The text gives information about... – Текст дает информацию о...

The following facts are stressed in the article... – В статье подчеркиваются следующие факты...

The content of the text includes... – Содержание текста охватывает...

The text is devoted to the problem... – Текст посвящен проблеме...

The articles are taken from... – Статьи взяты из...

In the article it is analyzed... – В статье анализируется...

The author characterises... – Автор характеризует...

The author emphasizes ... – Автор подчеркивает, что...

The author suggests... – Автор предлагает...

The author considers that... – Автор считает, что...

The main (sufficient) part of the research work contains... – Главная часть исследования содержит...

The text contains statistics about... – Текст содержит статистику о...

In the introductory part the author touches upon... – Во вступительной части автор касается...

At first it is depicted that... – Во-первых, изображается...

Secondly it is revealed that... – Во-вторых, обнаруживается, что...

First of all it is stressed that... – Вначале ударение делается на...

The author underlines that... – Автор подчеркивает, что...

In concluding paragraphs it is pointed out... – В заключительных параграфах указывается на...

Summing up the information... – Подводя итог...

Алгоритм составления реферата

1. Оформите заголовочную часть: запишите название первоисточника, фамилию и инициалы автора (авторов) и библиографические данные.
2. Пронумеруйте абзацы текста.
3. Просмотрите текст и определите его главную тему.
4. Внимательно читая текст по абзацам, определите тему и подтемы каждого абзаца и запишите их вместе с номером абзаца в виде ключевых слов и выражений.
5. Таким образом вы составите логический план текста.
6. Обдумайте последовательность расположения пунктов плана.
7. Выберите из каждого абзаца ключевые фрагменты (отдельные слова или словосочетания), которые характеризуют выделенные вами темы и подтемы, запишите их. Так выявляются смысловые ряды.
8. На материале смысловых рядов составьте текст реферата, используя связующие специфические выражения и языковые клише.
9. Прочитайте составленный текст реферата и отредактируйте его.
10. Укажите свою фамилию и инициалы, факультет, курс, номер группы и дату.

Клише для обсуждения реферата

To my mind the Paper is... – По моему мнению, реферат...

From my point of view... – С моей точки зрения...

It seems to me that... – Мне кажется, что...

I would like to express my own opinion on the problem... – Хотелось бы высказать свое мнение по проблеме...

I would like to clarify... – Я хотел бы кое-что прояснить...

I would like to tell something else... – Я хотел бы сказать следующее...

I would like to add... – Я хотел бы добавить...

An example of this would be... – Примером этого будет...

For example... – Например...

The point is that... – Смысл в том, что...

Обсуждение

I disagree with the position of the author. – Я не согласен с позицией автора.

I do not share the author's point of view. – Я не разделяю точку зрения автора.

I have just the opposite idea. – У меня противоположное мнение.

I can't agree with the author's opinion. – Я не могу разделить мнение автора.

Согласие

I do share the author's opinion that... – Я разделяю мнение автора в том, что...

I agree with your point of view that... – Я согласен с вашей точкой зрения, что...

You are definitely right that... – Несомненно, вы правы, что...

I find this Paper interesting / important. – Я нахожу данный реферат интересным / важным.

There is no doubt that... – Нет сомнений в том, что...

It goes without saying... – Без сомнений, ...

Сомнение

I am not quite sure that... – Я не вполне уверен, в том что...

It seems to me doubtless because... – Это кажется мне сомнительным, потому что...

I agree to the point but... – Я согласен с этим, но...

I suppose you are right but... – Предполагаю, что вы правы, но...

I would like to mention that... – Хотелось бы упомянуть, что...

Требование, просьба

I would like to ask a question... – Я хотел бы задать вопрос...

Could you tell me more about... – Не могли бы вы рассказать о...

Do you know anything else about... – Знаете ли вы еще что-нибудь о...

Can you confirm the fact? – Вы можете подтвердить... ?

I would like to ask you to tell your opinion about... – Я хотел бы вас попросить высказать свое мнение о...

Аннотирование текста

Аннотация – короткая справка о печатном произведении, излагающая содержание в виде перечня его основных вопросов. Аннотация дает представление только о характере оригинала (книга, статья и т. д.), о его строении (перечень вопросов), о его назначении (на кого оригинал рассчитан), а также об объеме оригинала (количество страниц). Аннотации пишутся как на языке оригинала, так и на родном языке. При составлении аннотации используются языковые клише. Объем аннотации составляет 0,5 страницы.

Структура аннотации стабильна. Она состоит из заголовочной части (название оригинала, фамилия автора, издательство, место и дата издания и др.). Написание собственно аннотации начинается с чтения текста и нумерации абзацев, определяется ведущая тема текста, темы и подтемы каждого абзаца, составление логического плана текста в виде перечня тем и подтем текста.

Клише, используемые при составлении аннотации:

a) клише, начинающие аннотацию и вводящие в главную тему:

The article (text) is called...

The title of the article (text) is...

The article (text) is published in...

The article is printed in...

The article consists of...

The article is devoted to...

The text touches upon the problem...

In the introductory part the author points out...

в) клише, оформляющие основную мысль произведения:

The author raises the problem of...

The main part of the text informs about...

The article contains statistics about...

с) клише, оформляющие выводы автора оригинала:

In the concluding paragraphs it is pointed out...

Summing up the information it is important to say that...

Generalizing the information, it is necessary to say that...

В конце аннотации указывают фамилию, инициалы составителя, факультет, курс, группу, дату составления.

Например:

Summary

The article is called 'English for Specific Purposes in Russia: a Historical Perspective'. The article is published in Journal 'ESP Russia' in January, 1996. Volume 1. It is written by Tamara Nazarova, Professor of Moscow State University. The article is devoted to historical development of an approach of language teaching which is directed by specific and apparent reasons for learning.

The author raises two problems for identification. The 1st is: What is the meaning of the word ESP? And the 2nd: How to use it?

In the concluding paragraphs it is pointed out that ESP methodology has been consistently applied to intellectual communication at large. Summing up the information it is important to say that as it is shown, terminologies of usage differ in various sciences, but the category of reproduction allows the learner to acquire proficiency in the use of neutral 'prefabricated units'.

Рекомендации для разработки проектов

Проектное обучение представляет собой технологию активной познавательной деятельности студентов, в основе которой лежит разработка в ходе самостоятельной (групповой или индивидуальной) исследовательской деятельности различных типов проектов – перспективных заданий, направленных на решение задач практики.

Участники проектной деятельности должны ответить на вопросы:

1. Что является целью проектной деятельности?
2. В чем актуальность (оригинальность, ценность) идеи проекта?
3. На решение каких задач практики он будет направлен?
4. Каков будет результат (продукт)?
5. Где он может быть применен?
6. Как он может изменить ситуацию?

Типы проектов в вузе:

- *исследовательские* проекты, подчиненные логике исследования и имеющие структуру, приближенную или полностью совпадающую с научным исследованием;
- *информационные* проекты (модуль исследовательского), направленные на поиск, знакомство и представление информации;

– *практикоориентированные* проекты, имеющие профессиональную направленность, результат которых ориентирован на социальные интересы самих студентов.

Процесс работы над проектом многоступенчатый. В таблице представлены этапы и содержание проектной деятельности.

Этапы работы над проектом	Содержание работы	Деятельность студентов
<i>Подготовка</i>	Определение реальной ситуации, ее осмысление, рождение задачи (проблемы) из описания ситуации, постановка вопросов	Анализируют ситуацию, выявляют проблему, рассматривают актуальность ее решения
<i>Прогнозирование и целеполагание</i>	Прогноз изменения ситуации, постановка личностных и коллективных целей, их осознание	Обсуждают. Прогнозируют. Определяют цели
<i>Планирование</i>	Определение источников, способов сбора и анализа информации, форм представления результатов. Установление критериев оценки процесса и результатов. Распределение задач между членами групп	Разрабатывают план действий. Определяют и распределяют задачи. Вырабатывают критерии оценки результатов
<i>Реализация</i>	Сбор информации. Работа над проектом. Решение промежуточных задач. Получение запланированных результатов	Выполняют свою часть проекта. Промежуточное обсуждение хода реализации проекта
<i>Оформление и представление</i>	Формы представления устного и письменного отчета. Оппонирование	Отчитываются, обсуждают, представляют результаты для внедрения в практику
<i>Мониторинг и рефлексия</i>	Интерпретация и анализ процесса и результата. Внешняя оценка. Рефлексия студентов по поводу авторства в проекте. Формулирование выводов. Новое целеполагание	Анализируют, интерпретируют, оценивают в ходе коллективного обсуждения и самооценок

Параметры внешней оценки проекта:

- значимость и актуальность проблемы;
- корректность используемых методов исследования и обработки полученных результатов;
- активность каждого члена проектной группы в соответствии с его индивидуальными возможностями;
- характер принимаемых решений, общения, взаимопомощи;
- глубина проникновения в проблему, привлечение знаний из других областей;
- эстетика оформления результатов проекта;
- умение аргументировать, доказывать, делать выводы и заключения, отвечать на вопросы.

Общие практические рекомендации для изучающих иностранный язык

Владение иностранным языком на современном этапе развития общества играет важную роль в формировании личности человека, свидетельствует о его высоком образовательном и культурном уровне. Изучение иностранного языка, с одной стороны, занятие довольно увлекательное, а с другой – очень непростое. Помимо интереса и желания оно требует больших усилий и терпения, значительных временных затрат, постоянной систематической работы.

Для организации успешной самостоятельной работы по овладению иностранным языком предлагаем вам несколько практических советов:

1. Регулярно занимайтесь языком. Не допускайте длительных перерывов, так как процесс забывания иноязычной информации происходит быстрее, чем в родном языке.

2. Составляйте собственный план работы над языком на день, неделю, месяц и старайтесь его выполнять.

3. Фиксируйте свои достижения в изучении иностранного языка. Помните, язык – беспредметен и безграничен, и каждое усвоенное слово или явление языка обогащает ваши знания.

4. Старайтесь сделать свои занятия разнообразными и интересными, используя различные виды деятельности: работу над произношением, выполнение грамматических упражнений, перевод, чтение вслух, прослушивание аудиокассет, просмотр телепрограмм, видеокассет или дисков с повторением и имитацией диктора, составление небольших ситуаций и рассказов, исполнение песен на иностранном языке и др.

5. Старайтесь больше учить наизусть стихов, песен, считалок, поговорок, диалогов, выражений речевого этикета, фрагментов текстов. Все это тренирует вашу память, расширяет ваши знания иностранного языка.

6. Будьте настойчивы и терпеливы в изучении языка. Здесь, как нигде, действует принцип перехода количественных изменений в качественные. Будьте активны, участвуйте во всех мероприятиях на иностранном языке, настраивайтесь на успех и добивайтесь его.

ЛИТЕРАТУРА

1. Dictionary of Agriculture/ by Alan Stephens. – Finland: Peter Collin Publishing, 1996.
2. Oxford Advanced Learner's Dictionary of Current English / by A.S. Hornby. – Oxford University Press, 1999.
3. Encyclopedia Wikipedia [Электронный ресурс]. – Режим доступа: <https://en.wikipedia.org>.
4. Lingua. CD-ROM, АBBYY 11.
5. Dave Willis, John Wright Basic Grammar // The University of Birmingham// Harper Collins Publishers, 2000.
6. Oxford Living Grammar Intermediate // Norman Coe // Oxford University Press 2009.
7. English for Bachelors and Masters = Английский для бакалавров и магистров: / А.А. Волкова, Е.В. Добровольская, Е.Г. Коротких [и др.]; научный редактор А.А. Волкова; Новосибирский государственный педагогический университет. – 2-е изд. – Новосибирск: Изд-во НГПУ, 2014. – 170 с.
8. *Cummings M.C.* Listen, Speak, Present: A Step-by-step Presenter's Workbook / M.C. Cumming. – Heinle&Heinle Publishers Inc. – Boston, Massachusetts, 1992.
9. *Modern organizations: theory and practice* / edited by Ali Farazmand / - 2nd ed. – Greenwood publishing Group Inc, USA, 2002. – 307 p.
10. Presentations that move audiences [Электронный ресурс]. – Режим доступа: <https://prezi.com/> (дата обращения: 20.01.2024)
11. Презентация по английскому языку [Электронный ресурс]. – Режим доступа: <https://present5.com/prezentaciya-po-anglijskomu/> (дата обращения: 20.01.2024)
12. Indeed. Career Guide [Электронный ресурс]. – Режим доступа: <https://au.indeed.com/career-advice/finding-a-job/what-is-agricultural-engineering> (дата обращения: 22.02.2024)
13. ProfGuide [Электронный ресурс]. – Режим доступа: <https://www.prof-guide.io/en/professions/agroengineer.html> (дата обращения: 20.01.2024)
14. Wikipedia, free encyclopedia. Agricultural engineering [Электронный ресурс]. – Режим доступа: https://en.wikipedia.org/wiki/Agricultural_engineering (дата обращения: 20.01.2024)
15. How Important Is Agribusiness Engineering? Article. [Электронный ресурс]. – Режим доступа: <https://bakai.uma.ac.id/2020/06/14/how-important-is-agribusiness-engineering/> (дата обращения: 20.01.2024)
16. Wikipedia, free encyclopedia. Agricultural machinery [Электронный ресурс]. – Режим доступа: https://en.wikipedia.org/wiki/Agricultural_machinery (дата обращения: 20.01.2024)
17. Wikipedia, free encyclopedia. Irrigation [Электронный ресурс]. – Режим доступа: <https://en.wikipedia.org/wiki/Irrigation> (дата обращения: 20.01.2024)
18. Wikipedia, free encyclopedia. Soil management [Электронный ресурс]. – Режим доступа: https://en.wikipedia.org/wiki/Soil_management (дата обращения: 20.01.2024)
19. Wikipedia, free encyclopedia. Precision agriculture [Электронный ресурс]. – Режим доступа: https://en.wikipedia.org/wiki/Precision_agriculture (дата обращения: 20.01.2024)
20. Wikipedia, free encyclopedia. Ergonomics [Электронный ресурс]. – Режим доступа: https://en.wikipedia.org/wiki/Human_factors_and_ergonomics (дата обращения: 20.01.2024)

ния: 20.01.2024)

21. Wikipedia, free encyclopedia. Aquaculture [Электронный ресурс]. – Режим доступа: <https://en.wikipedia.org/wiki/Aquaculture> (дата обращения: 20.01.2024)

22. Wikipedia, free encyclopedia. Forestry [Электронный ресурс]. – Режим доступа: <https://en.wikipedia.org/wiki/Forestry> (дата обращения: 20.01.2024)

23. All You Need to Know About Mechanized Farming. Agriculture. Blog [Электронный ресурс]. – Режим доступа: <https://www.xcubelabs.com/blog/all-you-need-to-know-about-mechanized-farming/> (дата обращения: 07.02.2024)

24. Agruculture Lore. What is mechanization in agriculture? [Электронный ресурс]. – Режим доступа: <https://www.agriculturelore.com/what-is-mechanization-in-agriculture/> (дата обращения: 07.02.2024)

25. Agruculture Lore. What is mechanization of agriculture? [Электронный ресурс]. – Режим доступа: <https://www.agriculturelore.com/what-is-mechanization-of-agriculture/> (дата обращения: 08.02.2024)

26. Collegenp. Agricultural Machinery - Future of Farming Equipment. Article [Электронный ресурс]. – Режим доступа: <https://www.collegenp.com/article/agricultural-machinery-future-of-farming-equipment/> (дата обращения: 22.02.2024)

27. Agriculture Equipment. Blog. The Common Types of Agricultural Machinery and Their Uses. [Электронный ресурс]. – Режим доступа: <https://www.agmachinery-australia.com.au/2022/06/27/the-common-types-of-agricultural-machinery-and-their-uses/> (дата обращения: 22.02.2024)

28. Safety Culture. The Benefits of Using Agricultural Machinery. Article. [Электронный ресурс]. – Режим доступа: <https://safetyculture.com/topics/agricultural-machinery/> (дата обращения: 23.02.2024)

29. What Is Agricultural Maintenance? UpKeep. [Электронный ресурс]. – Режим доступа: <https://upkeep.com/learning/agricultural-maintenance/> (дата обращения: 23.02.2024)

30. Farm Equipment Maintenance and Repair: A Seasonal Guide to Optimize... Fleet Management Blog. Fleetio. [Электронный ресурс]. – Режим доступа: <https://www.fleetio.com/blog/farm-equipment-maintenance-seasonality> (дата обращения: 23.02.2024)

31. Essential Farm Equipment Maintenance: 10 Key Tips for Smooth Operations. EWorkOrders. [Электронный ресурс]. – Режим доступа: <https://eworkorders.com/cmms-industry-articles-eworkorders/farm-maintenance-tips/> (дата обращения: 23.02.2024)

32. Technological innovation in agribusiness: new ways to optimize crops. SOLINFTEC. [Электронный ресурс]. – Режим доступа: <https://www.solinftec.com/en-us/blog/technological-innovation-in-agribusiness/> (дата обращения: 23.03.2024)

33. Agriculture 4.0: what is it and what are its tools and benefits? McCormick. [Электронный ресурс]. – Режим доступа: <https://www.mccormick.it/as/agriculture-4-0-what-is-it-and-what-are-its-tools-and-benefits/> (дата обращения: 23.03.2024)

34. Innovation in Agriculture: 6 Agricultural Innovations That Will Have an Impact on the Management of Farming. Miller. Blog. [Электронный ресурс]. – Режим доступа: <https://www.millerchemical.com/blog/innovation-in-agriculture-6-innovations-that-will-have-an-impact-on-farm-management/#:~:text=Some%20innovative%20agricultural%20advancements%20include,irrigation%20systems%20for%20water%20conservation.> (дата обращения: 23.03.2024)

35. Top 13 Innovations in Agriculture/Farming in 2023. Jiva. [Электронный ресурс]. – Режим доступа: <https://www.jiva.ag/blog/top-13-innovations-in-agriculture-farming> (дата обращения: 23.03.2024)
36. Innovation in Agriculture: 6 Agricultural Innovations That Will Have an Impact on the Management of Farming. Miller. Blog. [Электронный ресурс]. – Режим доступа: <https://www.millerchemical.com/blog/innovation-in-agriculture-6-innovations-that-will-have-an-impact-on-farm-management/#:~:text=Some%20innovative%20agricultural%20advancements%20include,irrigation%20systems%20for%20water%20conservation> (дата обращения: 23.03.2024)
37. Nadezhda V. Orlova, Dmitry V. Nikolaev. Research Article. Russian agricultural innovations prospects in the context of global challenges: Agriculture 4.0. Russian Journal of Economics 8(1):29-48. [Электронный ресурс]. – Режим доступа: <https://doi.org/10.32609/j.ruje.8.78430>, <https://rujec.org/article/78430/> (дата обращения: 23.03.2024)
38. Webadmin01. Farming Software Security: Safeguarding Agricultural Data in the Digital Age. KG2. [Электронный ресурс]. – Режим доступа: <https://kg2.com.au/farming-software-security-safeguarding-agricultural-data-in-the-digital-age/> (дата обращения: 23.04.2024)
39. Jane Marsh. Why Farmers Should Invest More into Cybersecurity. Globalag-TechInitiative. [Электронный ресурс]. – Режим доступа: <https://www.globalagtechinitiative.com/digital-farming/why-farmers-should-invest-more-into-cybersecurity/> (дата обращения: 23.04.2024)
40. TORUM 785. Combines. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-zuk/torum-785/> (дата обращения: 14.05.2024)
41. NOVA. Combines. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-zuk/nova/> (дата обращения: 14.05.2024)
42. T500. Combines. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-zuk/t500/> (дата обращения: 14.05.2024)
43. LEXION 8000/7000. Combine harvester. CLAAS. [Электронный ресурс]. – Режим доступа: <https://www.claas.co.uk/products/combines/lexion-8900-7400> (дата обращения: 20.05.2024)
44. Grain harvesting combine GS2124. GOMSELMASH. [Электронный ресурс]. – Режим доступа: <https://eng.gomselmash.by/produksiya/grain-harvesters/grain-harvesting-combine-gs2124/> (дата обращения: 21.05.2024)
45. The New S7 Combine. Grain Harvesting. John Deere US. [Электронный ресурс]. – Режим доступа: <https://www.deere.com/en/harvesting/s-series-combines/s7-700/> (дата обращения: 22.05.2024)
46. Combines. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/combine/#adapters> (дата обращения: 22.05.2024)
47. Power Stream. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters/zhatka-power-stream/> (дата обращения: 25.05.2024)
48. Float Stream. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters/zhatka-float-stream/> (дата обращения: 26.05.2024)

49. Corn Stream. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters/zhatki-corn-stream/> (дата обращения: 26.05.2024)
50. Uni Cart 3000. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters/telezhka-transportnaya-odnoosnaya-uni-cart-3000/> (дата обращения: 04.06.2024)
51. Swa Pick. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters/platforma-podborshchik-swa-pick/> (дата обращения: 04.06.2024)
52. Revolutionizing Agriculture. Unleashing the Power of Forage Harvesters. Ammachinery. [Электронный ресурс]. – Режим доступа: <https://www.ammachinery.nl/what-is-a-forage-harvester> (дата обращения: 05.06.2024)
53. The Benefits of Forage Harvesters in Agriculture. Ammachinery. [Электронный ресурс]. – Режим доступа: <https://www.ammachinery.nl/the-benefits-of-forage-harvesters> (дата обращения: 05.06.2024)
54. DON 680. Forage Harvesters. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-kmk/don-680m/> (дата обращения: 22.05.2024)
55. RSM F 2000. Forage Harvesters. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-kmk/seriya-f-2000/> (дата обращения: 22.05.2024)
56. JAGUAR 900 HRC. Forage Harvesters. CLAAS. [Электронный ресурс]. – Режим доступа: <https://www.claas.co.uk/products/forage-harvesters/jaguar900> (дата обращения: 22.05.2024)
57. Adam Henson. What does a combine harvester do? And how does it work? Countryfile. [Электронный ресурс]. – Режим доступа: <https://www.countryfile.com/farming/how-does-a-combine-harvester-work> (дата обращения: 31.05.2024)
58. Combine. Definition, Harvester, Farming, Uses and Facts. Britannica. [Электронный ресурс]. – Режим доступа: <https://www.britannica.com/technology/combine> (дата обращения: 31.05.2024)
59. Hay Harvest Equipment: A Complete Guide. Agriteer. Blog. [Электронный ресурс]. – Режим доступа: <https://www.agriteer.ag/equipment-to-harvest-hay/> (дата обращения: 06.06.2024)
60. Alex Gray. John Deere's New T6 800 Walker Combine. Successful Farming. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/john-deere-s-new-t6-800-walker-combine-8657594> (дата обращения: 06.06.2024)
61. Alex Gray. 3 Tips to prepare your combine for winter. Successful Farming. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/machinery/harvesting/3-tips-to-prepare-your-combine-for-winter> (дата обращения: 06.06.2024)
62. Alex Gray. 3 John Deere's new S7 combine built with tech for the future of farming. Successful Farming. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/john-deere-s-new-s7-combine-built-with-tech-for-the-future-of-farming-8600130> (дата обращения: 06.06.2024)
63. Mowing. W260R Windrower. John Deere US. [Электронный ресурс]. – Режим доступа: <https://www.deere.com/en/hay-forage/mowing/windrowers-platforms/w260r-windrower/> (дата обращения: 07.06.2024)

64. Alex Gray. New high-horsepower W260M windrower from John Deere. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/new-high-horsepower-w260m-windrower-from-john-deere-8605334> (дата обращения: 07.06.2024)
65. Mower Conditioners: What Are They & How Are They Operated? Machinefinder Blog. [Электронный ресурс]. – Режим доступа: <https://blog.machinefinder.com/33478/mower-conditioners-what-are-they-how-are-they-operated> (дата обращения: 07.06.2024)
66. Mower Conditioners and Mounted Mowers. John Deere US. [Электронный ресурс]. – Режим доступа: <https://www.deere.com/en/hay-forage/mowing/mower-conditioners/> (дата обращения: 07.06.2024)
67. Косилка самоходная универсальная KSU 2. Ростсельмаш. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-shk3055/ksu-2/> (дата обращения: 07.06.2024)
68. Maize Header 450/600/750. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters-kmk/zhatka-maize-header/> (дата обращения: 07.06.2024)
69. Grass Header 500/600. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters-kmk/zhatka-grass-header-600/> (дата обращения: 07.06.2024)
70. For Up 300/400. Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/adapters-kmk/for-up-300-400/> (дата обращения: 07.06.2024)
71. Alex Gray. New Hay Mowers on the Market. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/machinery/hay-and-forage-equipment/new-hay-mowers-on-the-market> (дата обращения: 07.06.2024)
72. Round baler PR-F-145SH. BobruiskAgroMach. [Электронный ресурс]. – Режим доступа: https://bobruiskagromach.com/en/catalog/harvesting_equipment/press_balers/pick_up_roller_pr_f_145ssh/ (дата обращения: 07.06.2024)
73. Baler PRP-160-1K. BobruiskAgroMach. [Электронный ресурс]. – Режим доступа: https://bobruiskagromach.com/en/catalog/harvesting_equipment/press_balers/prp_160_1k/ (дата обращения: 07.06.2024)
- а. Square baler PPT-160. BobruiskAgroMach. [Электронный ресурс]. – Режим доступа: https://bobruiskagromach.com/en/catalog/harvesting_equipment/press_balers/ppt_160/ (дата обращения: 07.06.2024)
74. 8 Maintenance Tips for Your John Deere Square Baler. Machinefinder Blog. [Электронный ресурс]. – Режим доступа: <https://blog.machinefinder.com/37178/8-maintenance-tips-for-your-john-deere-square-baler> (дата обращения: 07.06.2024)
75. Alex Gray. John Deere introduces new L341R high-density large square baler. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/machinery/hay-and-forage-equipment/john-deere-introduces-new-l341r-high-density-large-square-baler> (дата обращения: 07.06.2024)
76. 15 Pieces of Frontier Hay Equipment for Boosting Efficiency. Machinefinder Blog. [Электронный ресурс]. – Режим доступа: <https://blog.machinefinder.com/31409/frontier-hay-and-forage-equipment> (дата обращения: 07.06.2024)
77. What Is a Hay Tedder and How Do You Select the Right Type? Machinefinder Blog. [Электронный ресурс]. – Режим доступа: <https://blog.machinefinder.com/26047/what-is-a-hay-tedder-and-how-do-you-select-the-right-type> (дата обращения: 08.06.2024)

78. Tractor rakes. BobruiskAgroMach. [Электронный ресурс]. – Режим доступа: https://bobruiskagromach.com/en/catalog/harvesting_equipment/rake_tractor/ (дата обращения: 08.06.2024)
79. НГАУ. Инженерный институт. Абитуриенту. [Электронный ресурс]. – Режим доступа: <https://nsau.edu.ru/mechfac/abiturientu/> (дата обращения: 08.06.2024)
80. Tractor. Definition, History, Types, Examples and Facts. Britannica. [Электронный ресурс]. – Режим доступа: <https://www.britannica.com/technology/tractor-vehicle> (дата обращения: 08.06.2024)
81. Benefits of Tractors in Modern Farming and Agriculture. FieldBee. [Электронный ресурс]. – Режим доступа: <https://www.fieldbee.com/blog/benefits-of-tractors-in-modern-farming-and-agriculture> (дата обращения: 08.06.2024)
82. 7 Uses of Tractor in Agriculture: Role and Benefits of Tractors for Farmers in India. Tractorgyan. [Электронный ресурс]. – Режим доступа: <https://tractorgyan.com/tractor-industry-news-blogs/865/importance-of-tractors-for-farmers-in-india> (дата обращения: 08.06.2024)
83. Tractor made in Russia! Russian-farmland. [Электронный ресурс]. – Режим доступа: <https://russian-farmland.com/tractor-made-in-russia.html> (дата обращения: 11.06.2024)
84. Series 3000 (440-583 h.p.) Rostselmash. [Электронный ресурс]. – Режим доступа: <https://en.rostselmash.com/products/models-tkt/seriya-3000/> (дата обращения: 11.06.2024)
85. Natalina Sents Bausch. John Deere 7R Tractors Updated for 2020. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/machinery/tractors/john-deere-7r-tractors-updated-for-2020> (дата обращения: 12.06.2024)
86. Alex Gray. The 2025 9RX series is John Deere's biggest tractor yet. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/the-2025-9rx-series-is-john-deere-s-biggest-tractor-yet-8600115> (дата обращения: 12.06.2024)
87. Alex Gray. Claas introduces new Xerion and Arion tractor lines. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/claas-introduces-new-xerion-and-arion-tractor-lines-7563007> (дата обращения: 12.06.2024)
88. Alex Gray. Claas updates Xerion tractor line for 2023. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/machinery/tractors/claas-updates-xerion-tractor-line-for-2023> (дата обращения: 12.06.2024)
89. Alex Gray. Claas announces new tractor and combine for 2023. Agriculture. [Электронный ресурс]. – Режим доступа: <https://www.agriculture.com/machinery/tractors/claas-announces-terra-trac-for-the-axion-tractor> (дата обращения: 12.06.2024)
90. Mower Berkut 3200. Sar.rostselmash.com. [Электронный ресурс]. – Режим доступа: https://sar.rostselmash.com/products/forage_equipment/Berkut_3200 (дата обращения: 12.06.2024)
91. Mower Strige 2100/2400/2800. Sar.rostselmash.com. [Электронный ресурс]. – Режим доступа: https://sar.rostselmash.com/products/forage_equipment/Strige_2100_2800 (дата обращения: 12.06.2024)
92. Mower SapSun 2400. Sar.rostselmash.com. [Электронный ресурс]. – Режим доступа: https://sar.rostselmash.com/products/forage_equipment/SapSun_2400 (дата обращения: 12.06.2024)
93. Rakes Kolibri 350/470. Sar.rostselmash.com. [Электронный ресурс]. – Режим доступа: https://sar.rostselmash.com/products/forage_equipment/Kolibri_350_470 (дата

обращения: 12.06.2024)

94. Rakes Kolibri Duo 810. Sar.rostselmash.com. [Электронный ресурс]. – Режим доступа: https://sar.rostselmash.com/products/forage_equipment/Kolibri_Duo_810 (дата обращения: 12.06.2024)

95. Mounted spreader Grach. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/fertilization/GRACH/> (дата обращения: 12.06.2024)

96. RSM AP-3000/4000 Liquid Fertilizer Applicator. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/fertilization/AP/> (дата обращения: 12.06.2024)

97. AT Air Cart. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/tillage-equipment/seeding/AT/> (дата обращения: 16.06.2024)

98. SH/SC Drill. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/tillage-equipment/seeding/SH-SC/> (дата обращения: 16.06.2024)

99. Посевная техника. Ростсельмаш. [Электронный ресурс]. – Режим доступа: <https://rostselmash.com/products/posevnaya-tekhnika/> (дата обращения: 16.06.2024)

100. Cultivators series R. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/tillage-equipment/cultivators/R/> (дата обращения: 16.06.2024)

101. Культиваторы серии R. Ростсельмаш. [Электронный ресурс]. – Режим доступа: <https://rostselmash.com/products/tillage-machinery/tyazhelye-kultivatory-serii-r/> (дата обращения: 16.06.2024)

102. Grain Cart. Sar.rostselmash.com. [Электронный ресурс]. – Режим доступа: <https://sar.rostselmash.com/products/carts/Bunker> (дата обращения: 16.06.2024)

103. Trailer sprayers. Klever company. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/trailer-sprayers/> (дата обращения: 16.06.2024)

104. Trailer sprayers RSM TS-6200 Sputnik. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/trailer-sprayers/SPUTNIK/> (дата обращения: 16.06.2024)

105. Прицепной опрыскиватель RSM TS-6200 SPUTNIK. Ростсельмаш. [Электронный ресурс]. – Режим доступа: <https://rostselmash.com/products/models-opr/rsm-ts-6200-sputnik/> (дата обращения: 16.06.2024)

106. Trailer Sprayers RSM TS-3200/4500 Satellite. Kleverltd.ru. [Электронный ресурс]. – Режим доступа: <https://www.kleverltd.ru/en/catalog/trailer-sprayers/TS/> (дата обращения: 16.06.2024)

107. Прицепные опрыскиватели RSM TS-3200/4500 Satellite. Ростсельмаш. [Электронный ресурс]. – Режим доступа: <https://rostselmash.com/products/models-opr/pritsepnoy-opryskivatel-rsm-ts-3200-4500-satellite/> (дата обращения: 16.06.2024)

108. How Tractor Trailers Are Beneficial to the Agriculture Sector. Fieldking. [Электронный ресурс]. – Режим доступа: <https://www.fieldking.com/blogs/use-of-tractor-trailers/> (дата обращения: 17.06.2024)

109. Tractors trailers. BobruiskAgroMach. [Электронный ресурс]. – Режим доступа: https://bobruiskagromach.com/en/catalog/tractor_trailers/ (дата обращения: 17.06.2024)

110. Fertilizer Spreaders. BobruiskAgroMach. [Электронный ресурс]. – Режим доступа: https://bobruiskagromach.com/en/catalog/technique_for_application_of_fertilizer_s/ (дата обращения: 17.06.2024)

111. Jim Breen. 1 in every 10 tractors in the world is from Belarus. Agriland. [Электронный ресурс]. – Режим доступа: <https://www.agriland.ie/farming-news/1-in-every-10-tractors-in-the-world-is-from-belarus/> (дата обращения: 18.06.2024)
112. МТЗ. [Электронный ресурс]. – Режим доступа: <https://www.belarus-tractor.com/en/production/tractory/#section0> (дата обращения: 18.06.2024)
113. ТРАКТОР БЕЛАРУС 3022 ДЦ (МТЗ). Агро Портал – Предложения АПК. [Электронный ресурс]. – Режим доступа: <https://agro-sales.ru/wiki/traktor-belarus-3022-dts-mtz> (дата обращения: 18.06.2024)
114. 6-cylinder Belarus: strong and reliable. Powertrain International. Editorial Staff. [Электронный ресурс]. – Режим доступа: <https://www.powertraininternational-web.com/off-highway/6-cylinder-belarus-strong-and-reliable/> (дата обращения: 18.06.2024)
115. МТЗ. [Электронный ресурс]. – Режим доступа: <https://www.belarus-tractor.com/en/mtz/company/eksport/> (дата обращения: 18.06.2024)
116. МТЗ. [Электронный ресурс]. – Режим доступа: <https://www.belarus-tractor.com/en/mtz/company/manufacture/> (дата обращения: 18.06.2024)
117. Types of Farm Equipment and Their Uses. Holt Ag Solutions. [Электронный ресурс]. – Режим доступа: <https://www.holtags.com/types-of-farm-equipment-and-their-uses#tractors> (дата обращения: 19.06.2024)
118. Working safely with agricultural machinery. Health and Safety Executive. [Электронный ресурс]. – Режим доступа: <https://www.hse.gov.uk/pubns/indg241.htm> (дата обращения: 19.06.2024)
119. Agriculture Publications. Free leaflets. Health and Safety Executive. [Электронный ресурс]. – Режим доступа: <https://www.hse.gov.uk/pubns/agindex.htm> (дата обращения: 19.06.2024)
120. Milking equipment on order. LLC “StandardMoloko” – farm equipment. [Электронный ресурс]. – Режим доступа: <https://standartmoloko.com/en/doilnoe-oborudovanie#> (дата обращения: 19.06.2024)
121. [Livestock Production Management](#). – ROLE OF MILKING MACHINES IN MODERN DAIRY FARMING. [Электронный ресурс]. – Режим доступа: <https://sites.google.com/site/viveklpm/cattle-and-buffalo-production-management/milking-machine/role-of-milking-machines-in-modern-dairy-farming> (дата обращения: 19.06.2024)
122. Livestock Production Management. – ADVANTAGES OF MILKING MACHINES. [Электронный ресурс]. – Режим доступа: <https://sites.google.com/site/viveklpm/cattle-and-buffalo-production-management/milking-machine/advantages-of-milking-machines> (дата обращения: 19.06.2024)
123. Livestock Production Management. – TYPES OF MILKING MACHINES/SYSTEMS. [Электронный ресурс]. – Режим доступа: <https://sites.google.com/site/viveklpm/cattle-and-buffalo-production-management/milking-machine/types-of-milking-machinessystems> (дата обращения: 19.06.2024)
124. What do you need to know about milk processing equipments? ABL Technology. [Электронный ресурс]. – Режим доступа: <https://abltechnology.wordpress.com/2016/06/21/what-do-you-need-to-know-about-milk-processing-equipments/> (дата обращения: 20.06.2024)
125. Pasteurization. Definition, Process, Inventor and facts. Britannica. [Электронный ресурс]. – Режим доступа: <https://www.britannica.com/technology/pasteurization> (дата обращения: 20.06.2024)

126. Dairy product. Separation, Processing, Nutrition. Britannica. [Электронный ресурс]. – Режим доступа: <https://www.britannica.com/topic/dairy-product/Separation> (дата обращения: 20.06.2024)
127. Automated dairy systems: enhancing dairy processing. IFM. [Электронный ресурс]. – Режим доступа: <https://www.ifm.com/us/en/us/industries/food-and-beverage/automated-dairy-systems/dairy> (дата обращения: 20.06.2024)
128. Dairy Equipment. Jamaica Dairy Development Board. [Электронный ресурс]. – Режим доступа: <https://www.jddb.gov.jm/page/dairy-equipment> (дата обращения: 20.06.2024)
129. Dairy Farming Equipment: Small Dairy Machinery Specifications. KJkrishi-jagan. [Электронный ресурс]. – Режим доступа: <https://d2xsikgwxxkyoe.cloudfront.net/animal-husbandry/dairy-farming-equipment-small-dairy-machinery-specifications/> (дата обращения: 20.06.2024)
130. Milking Equipment and Dairy Supplies for Your Homestead or Farm. Farm and Ranch Depot. [Электронный ресурс]. – Режим доступа: <https://farmandranchdepot.com/dairy-equipment-and-milking-supplies> (дата обращения: 20.06.2024)
131. Dairy housing: ventilation options for free stall barns. Ontario. [Электронный ресурс]. – Режим доступа: <https://www.ontario.ca/page/dairy-housing-ventilation-options-free-stall-barns> (дата обращения: 20.06.2024)
132. Choosing the Right Heating System for Livestock and Agriculture: the differences between Direct-Fired Heating and Indirect Exchange Heating. Termotecnica Pericoli. [Электронный ресурс]. – Режим доступа: <https://www.pericoli.com/en/direct-fired-heating-and-indirect-exchange-heating/> (дата обращения: 21.06.2024)
133. Heating systems for agricultural and livestock industry. Termotecnica Pericoli. [Электронный ресурс]. – Режим доступа: <https://www.pericoli.com/en/mechanical-ventilation-system/heating-systems-agriculture-and-farms/> (дата обращения: 21.06.2024)
134. Automated Dairy Systems: Enhancing Dairy Processing. IFM. [Электронный ресурс]. – Режим доступа: <https://www.ifm.com/us/en/us/industries/food-and-beverage/automated-dairy-systems/dairy> (дата обращения: 21.06.2024)
135. Poultry Equipment. ROYS FARM. [Электронный ресурс]. – Режим доступа: <https://www.roysfarm.com/poultry-equipments/#:~:text=Incubator%20is%20such%20a%20poultry,most%20popular%20and%20widely%20used> (дата обращения: 21.06.2024)
136. Equipment Needed for Poultry Farming: Tools and Pdf. AgriFarming. Sponsored Post. [Электронный ресурс]. – Режим доступа: <https://www.agrifarming.in/equipment-needed-for-poultry-farming-tools-and-pdf#download-equipment-needed-for-poultry-farming-pdf>, <https://www.agrifarming.in/wp-content/uploads/2022/02/Equipment-Needed-for-Poultry-Farming.pdf> (дата обращения: 21.06.2024)
137. The Digitization of the World from Edge to Core. – URL: <https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-data-age-whitepaper.pdf> (дата обращения: 05.04.2024)
138. How XR Tools Are Transforming Food, Farming. Forbes. – URL: <https://www.forbes.com/sites/forbestechcouncil/2022/02/15/how-xr-tools-are-transforming-food-farming/?sh=2eb4302c2ce7> (дата обращения: 05.04.2024)
139. Poultry equipment for successful farming. Fancom. [Электронный ресурс]. – Режим доступа: <https://www.fancom.com/blog/poultry-equipment> (дата обращения: 22.06.2024)
140. Monitoring Systems for Livestock Buildings. Fancom BV. [Электронный ресурс]. – Режим доступа: <https://www.fancom.com/monitoring> (дата обращения: 22.06.2024)

22.06.2024)

141. Automatic pig feeder and poultry feeder system. Fancom. [Электронный ресурс]. – Режим доступа: <https://www.fancom.com/automatic-feeding> (дата обращения: 22.06.2024)

142. Climate solutions for pig and poultry farmers. Fancom. [Электронный ресурс]. – Режим доступа: <https://www.fancom.com/climate-systems> (дата обращения: 22.06.2024)

143. Smart Farming: a revolutionary system by Fancom farmers. Fancom. [Электронный ресурс]. – Режим доступа: <https://www.fancom.com/smart-farming> (дата обращения: 22.06.2024)

144. Air Chilling. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/chilling> (дата обращения: 22.06.2024)

145. Multi-tier Air Chilling. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/air-chilling/multi-tier-air-chilling> (дата обращения: 22.06.2024)

146. Clean Air Chilling. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/air-chilling/clean-air> (дата обращения: 22.06.2024)

147. Distribution. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/distribution> (дата обращения: 22.06.2024)

148. TrueWeigher 707. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/distribution/truweigher-707> (дата обращения: 22.06.2024)

149. Vision Camera. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/distribution/vision-camera> (дата обращения: 22.06.2024)

150. Buffer Transfer 138. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/distribution/buffer-transfer-138> (дата обращения: 22.06.2024)

151. Cut-up. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/cut-up> (дата обращения: 22.06.2024)

152. MultiCut 30. BAADER Poultry. [Электронный ресурс]. – Режим доступа: <https://poultry.baader.com/multicut-30> (дата обращения: 22.06.2024)

153. Salman Ahmad. Pig Farm Equipment: A Detailed Analysis. CTN News. [Электронный ресурс]. – Режим доступа: <https://www.chiangraitimes.com/legal-learning/pig-farm-equipment/> (дата обращения: 22.06.2024)

154. Stanfield Heat Mats, Controls and Accessories. Osborne. [Электронный ресурс]. – Режим доступа: <https://osbornelivestockequipment.com/products/heat-mats/> (дата обращения: 22.06.2024)

155. Feeding Equipment. Osborne Livestock Equipment. [Электронный ресурс]. – Режим доступа: <https://osbornelivestockequipment.com/products/feeding-equipment/> (дата обращения: 22.06.2024)

156. Electronic Sow Feeding & Weighing. Osborne Livestock Equipment. [Электронный ресурс]. – Режим доступа: <https://osbornelivestockequipment.com/products/feeding-equipment/electronic-sow-feeding-weighing/> (дата обращения: 22.06.2024)

157. Ventilation. Osborne Livestock Equipment. [Электронный ресурс]. – Режим доступа: <https://osbornelivestockequipment.com/products/ventilation/> (дата обращения: 22.06.2024)

158. Ventilation Controls & Accessories. Osborne Livestock Equipment. [Электронный ресурс]. – Режим доступа: <https://osbornelivestockequipment.com/pro>

[ducts/ventilation/ventilation-controls-accessories/](#) (дата обращения: 22.06.2024)

159. Automatic Feeding System of Sows. Intelligent Feeding Management. [Электронный ресурс]. – Режим доступа: <https://www.farming-machine.com/livestock-machinery/pig/automatic-feeding-system/> (дата обращения: 22.06.2024)

160. Buy an angle meat grinder for fresh and frozen meat. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/angle-meat-grinder/angle-meat-grinder-for-fresh-and-frozen-meat-mp-ga/> (дата обращения: 23.06.2024)

161. Poultry deboning equipment, chicken deboning plant. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/slaughtering-and-primary-cattle-processing/poultry/poultry-deboning-line/> (дата обращения: 23.06.2024)

162. Stuffing machine for meat to buy, machine for stirring minced meat. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/?branch=317> (дата обращения: 23.06.2024)

163. Meat mixer with blade shafts to buy. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/kopiya-farshemeshalka-s-lopastnyimi-meshalkami-mp-fp/mp-fpv/> (дата обращения: 23.06.2024)

164. Meat mixer with Z-shaped shafts to buy. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/kopiya-farshemeshalka-s-z-obraznyimi-meshalkami-mp-fzv/> (дата обращения: 23.06.2024)

165. Meat mixer with spiral shafts to buy. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/minced-meat-mixers/kopiya-farshemeshalka-so-spiralnyimi-meshalkami-mp-fs/mp-fsv/> (дата обращения: 23.06.2024)

166. Meat injector МР-І/МР-ІR to buy, automatic for salting syringes. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/injector-mp-i/mp-ir/> (дата обращения: 23.06.2024)

167. Brine mixer, buy a mixer for mixing ingredients. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/brine-mixer-mp-mix/mp-mixc/> (дата обращения: 23.06.2024)

168. Block cutter for meat and frozen foods. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/frozen-meat-cutters/?branch=316> (дата обращения: 23.06.2024)

169. Bowl cutter for meat grinding industrial buy. Feleti. [Электронный ресурс]. – Режим доступа: <https://www.feleti.by/en/katalog/meat-processing/bowl-cutters/?branch=316> (дата обращения: 23.06.2024)

170. Mueller Milk Coolers Brochure Digital. Paul Mueller Company. [Электронный ресурс]. – Режим доступа: https://www.paulmueller.com/hubfs/Dairy-Farm/Downloads/Mueller_Milk_Coolers_Brochure_Digital.pdf?hsLang=en (дата обращения: 23.06.2024)

171. Andrii Sydoruk. Modern Farming Technologies in Agriculture: 8 Great Examples. SmartTek Solutions. [Электронный ресурс]. – Режим доступа: <https://smarttek.solutions/blog/the-role-of-iot-technology-in-modern-farming/> (дата обращения: 23.06.2024)

172. Gaurav Dhiman. 18 Emerging Agriculture Technologies: The Future of Agritech. BusinessExceed. [Электронный ресурс]. – Режим доступа: <https://businessexceed.com/emerging-agriculture-technologies/#agricultural-robots> (дата обращения: 23.06.2024)

173. Agricultural Machinery Telematics. Technoton. [Электронный ресурс]. – Режим доступа: <https://jv-technoton.com/solutions/agricultural-machinery-telematics/> (дата обращения: 24.06.2024)
174. Digital Technologies in Agriculture: Revolutionizing the Future of Farming. Collegenp. [Электронный ресурс]. – Режим доступа: <https://www.collegenp.com/article/digital-technologies-in-agriculture/> (дата обращения: 24.06.2024)
175. 3D PRINTING IN AGRICULTURE – A MATCH MADE IN HEAVEN. Arrival3D. [Электронный ресурс]. – Режим доступа: <https://arrival3d.com/3d-printing-in-agriculture-a-match-made-in-heaven/> (дата обращения: 24.06.2024)
176. How agriculture is reaping the benefits of 3D printing. AgriTech Tomorrow. [Электронный ресурс]. – Режим доступа: <https://www.agritechtomorrow.com/news/2024/01/11/-how-agriculture-is-reaping-the-benefits-of-3d-printing/15190/> (дата обращения: 24.06.2024)
177. Miller 3D Printing. 3D Printing in Agriculture. One Miller. [Электронный ресурс]. – Режим доступа: <https://miller3dprinting.com/industries/agriculture/> (дата обращения: 24.06.2024)
178. Aidan Connolly. 8 Digital Technologies for Poultry Producers. Denbow. [Электронный ресурс]. – Режим доступа: <https://www.denbow.com/8-digital-technologies-poultry-producers/> (дата обращения: 24.06.2024)
179. Aidan Connolly. Nine digital technologies transforming pig production in 2019. The Pig Site. [Электронный ресурс]. – Режим доступа: <https://www.thepigsite.com/articles/9-for-19-digital-technology-for-the-pig-industry> (дата обращения: 24.06.2024)
180. The Top 7 Crop Spraying Drones of 2024: Guide & Reviews. DSLR Pros. [Электронный ресурс]. – Режим доступа: <https://www.dslrpros.com/dslrpros-blog/the-top-7-crop-spraying-drones-of-2024-guide-and-reviews/> (дата обращения: 24.06.2024)
181. Andrii Sydoruk. Vertical Farming Technology: Everything You Need to Know. SmartTek Solutions. [Электронный ресурс]. – Режим доступа: <https://smarttek.solutions/blog/vertical-farming/> (дата обращения: 24.06.2024)
182. Anand Prakash. Role of AI-led Automation in Food Industry. Appventurez. [Электронный ресурс]. – Режим доступа: <https://www.appventurez.com/blog/automation-in-food-industry> (дата обращения: 24.06.2024)
183. Alex Owen-Hill. Top 6 Robotic Applications in Food Manufacturing. Robotiq. [Электронный ресурс]. – Режим доступа: <https://blog.robotiq.com/top-6-robotic-applications-in-food-manufacturing> (дата обращения: 24.06.2024)
184. Justyna Matuszak. The Rise of Robotics in Food Processing. KnowHow. [Электронный ресурс]. – Режим доступа: <https://knowhow.distrelec.com/food-and-beverages/the-rise-of-robotics-in-food-processing/> (дата обращения: 24.06.2024)

Составители: *Сементовская Елена Юрьевна*
Коротких Елена Геннадьевна

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Тел. (383) 267-09-10, e-mail: 2134539@mail.ru