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Role of Farm Machinery in Enhancing Agriculture Production

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ABSTRACT: Agricultural machinery or farm machinery 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. Diverse arrays of equipment are used in both organic and nonorganic farming. Especially since the advent of mechanised agriculture, agricultural machinery is an indispensable part of how the world is fed. Agricultural machinery can be regarded as part of wider agricultural automation technologies, which includes the more advanced digital equipment and robotics.[1] While agricultural robots have the potential to automate the three key steps involved in any agricultural operation (diagnosis, decision-making and performing), conventional motorized machinery is used principally to automate only the performing step where diagnosis and decision-making are conducted by humans based on observations and experience

KEYWORDS: agricultural, machinery, equipment, mechanized, robotics, digital equipments, automation technologies, motorized

I.INTRODUCTION

With the coming of the Industrial Revolution and the development of more complicated machines, farming methods took a great leap forward.[2] Instead of harvesting grain by hand with a sharp blade, wheeled machines cut a continuous swath. Instead of threshing the grain by beating it with sticks, threshing machines separated the seeds from the heads and stalks. The first tractors appeared in the late 19th century.[3] Power for agricultural machinery was originally supplied by ox or other domesticated animals. With the invention of steam power came the portable engine, and later the traction engine, a multipurpose, mobile energy source that was the ground-crawling cousin to the steam locomotive. Agricultural steam engines took over the heavy pulling work of oxen, and were also equipped with a pulley that could power stationary machines via the use of a long belt. The steam-powered machines were low-powered by today's standards but because of their size and their low gear ratios, they could provide a large drawbar pull. The slow speed of steam-powered machines led farmers to comment that tractors had two speeds: "slow, and damn slow". The internal combustion engine; first the petrol engine, and later diesel engines; became the main source of power for the next generation of tractors. These engines also contributed to the development of the self-propelled combine harvester and thresher, or the combine harvester (also shortened to 'combine'). Instead of cutting the grain stalks and transporting them to a stationary threshing machine, these combines cut, threshed, and separated the grain while moving continuously throughout the field. Tractors do the majority of work on a modern farm. They are used to push/pull implements—machines that till the ground, plant seed, and perform other tasks. Tillage implements prepare the soil for planting by loosening the soil and killing weeds or competing plants. The best-known is the plow, the ancient implement that was upgraded in 1838 by John Deere. Plows are now used less frequently in the U.S. than formerly, with offset disks used instead to turn over the soil, and chisels used to gain the depth needed to retain moisture. Combine is a machine designed to efficiently harvest a variety of grain crops. The name derives from its combining four separate harvesting operations—reaping, threshing, gathering, and winnowing—into a single process. Among the crops harvested with a combine [1] are wheat, rice, oats, rye, barley, corn (maize), sorghum, soybeans, flax (linseed), sunflowers and rapeseed. The most common type of seeder is called a planter, and spaces seeds out equally in long rows, which are usually two to three feet apart. Some crops are planted by drills,[2] which put out much more seed in rows less than a foot apart, blanketing the field with crops. Transplanters automate the task of transplanting seedlings to the field. With the widespread use of plastic mulch, plastic mulch layers, transplanters, and seeders lay down long rows of plastic, and plant through them automatically. After planting, other agricultural machinery such as self-propelled sprayers can be used to apply fertilizer and pesticides. Agriculture sprayer application is a method to protect crops from weeds by using herbicides, fungicides, and insecticides. Spraying or planting a cover crop are ways to mix weed growth.[4] Planting crop Hay balers can be used to tightly package grass or alfalfa into a storable form for the winter months. Modern irrigation relies on machinery.[28] Engines, pumps and

other specialized gear provide water quickly and in high volumes to large areas of land. Similar types of equipment such as agriculture sprayers can be used to deliver fertilizers and pesticides.[3]

Besides the tractor, other vehicles have been adapted for use in farming, including trucks, airplanes, and helicopters, such as for transporting crops and making equipment mobile, to aerial spraying and livestock herd management.[4]

The basic technology of agricultural machines has changed little in the last century. Though modern harvesters and planters may do a better job or be slightly tweaked from their predecessors, the US$250,000 combine of today still cuts, threshes, and separates grain in the same way it has always been done. However, technology is changing the way that humans operate the machines[27], as computer monitoring systems, GPS locators and self-steer programs allow the most advanced tractors and implements to be more precise and less wasteful in the use of fuel, seed, or fertilizer. In the foreseeable future, there may be mass production of driverless tractors, which use GPS maps and electronic sensors.[5]

II.DISCUSSION

The Food and Agriculture Organization of the United Nations (FAO) defines agricultural automation as the use of machinery and equipment in agricultural operations to improve their diagnosis, decision-making or performing, reducing the drudgery of agricultural work[26] and/or improving the timeliness, and potentially the precision, of agricultural operations.[1][5]

The technological evolution in agriculture can be summarized by a progressive move from manual tools to animal traction, to motorized mechanization, to digital equipment and finally, to robotics with artificial intelligence (AI). Motorized mechanization using engine power automates the performing of agricultural operations such as ploughing, seeding, fertilizing, milking, feeding and irrigating.[6] With digital automation technologies, it also becomes possible to automate diagnosis and decision-making. For example, autonomous crop robots can harvest and seed crops, and drones can collect information to help automate input application.[1][5] Tractors, instead, can be transformed into automated vehicles that can sow fields independently.[1]

Many farmers are upset by their inability to fix the new types of high-tech farm equipment.[7] This is due mostly to companies using intellectual property law [26]to prevent farmers from having the legal right to fix their equipment (or gain access to the information to allow them to do it).[8] In October 2015 an exemption was added to the DMCA to allow inspection and modification of the software in cars and other vehicles including agricultural machinery.[9]

The Open Source Agriculture movement counts different initiatives and organizations such as Farm Labs which is a network in Europe,[10] l'Atelier Paysan which is a cooperative to teach farmers in France how to build and repair their tools,[11][12] and Ekylibre which is an open-source company to provide farmers in France with open source software (SaaS) to manage farming operations.[12][13] In the United States, the MIT Media Lab's Open Agriculture Initiative seeks to foster[25] "the creation of an open-source ecosystem of technologies that enable and promote transparency, networked experimentation, education, and hyper-local production".[14] It develops the Personal Food Computer, an educational project to create a "controlled environment agriculture technology platform that uses robotic systems to control and monitor climate, energy, and plant growth inside of a specialized growing chamber[24]". It includes the development of Open Phenom,[15] an open source library with open data sets for climate recipes which link the phenotype response of plants (taste, nutrition) to environmental variables, biological, genetic and resource-related necessary for cultivation (input).[16] Plants with the same genetics can naturally vary in color, size, texture, growth rate, yield, flavor, and nutrient density according to the environmental conditions in which they are produced.[6]

III.RESULTS

An agricultural robot is a robot deployed for agricultural purposes[23]. The main area of application of robots in agriculture today is at the harvesting stage. Emerging applications of robots or drones in agriculture include weed control,[1][2][3] cloud seeding,[4] planting seeds, harvesting, environmental monitoring and soil analysis.[5][6] Fruit picking robots, driverless tractor / sprayers, and sheep shearing robots are designed to replace human labor. In most cases, a lot of factors have to be considered (e.g., the size and color of the fruit to be picked) before the commencement of a task. Robots can be used for other horticultural tasks such as pruning, weeding, spraying and monitoring. Robots can also be used in livestock applications (livestock robotics) such as automatic milking,[22] washing and castrating. Robots like these have many benefits for the agricultural industry, including a higher quality of fresh produce, lower production costs, and a decreased need for manual labor.[8] They can also be used to automate manual tasks, such as weed or bracken spraying, where the use of tractors and other human-operated vehicles is too dangerous for the operators. Much of the current

research continues to work towards autonomous agricultural vehicles. This research is based on the advancements made in driver-assist systems and self-driving cars.[14]

While robots have already been incorporated in many areas of agricultural farm work, they are still largely missing in the harvest of various crops. This has started to change as companies begin to develop robots that complete more specific tasks on the farm[21]. The biggest concern over robots harvesting crops comes from harvesting soft crops such as strawberries which can easily be damaged or missed entirely.[13][14] Despite these concerns, progress in this area is being made. According to Gary Wishnatzki, the co-founder of Harvest Croo Robotics, one of their strawberry pickers currently being tested in Florida can "pick a 25-acre field in just three days and replace a crew of about 30 farm workers".[14] Similar progress is being made in harvesting apples, grapes, and other crops.[12][14][15] In the case of apple harvesting robots, current developments have been too slow to be commercially viable. Modern robots are able to harvest apples at a rate of one every five to ten seconds while the average human harvests at a rate of one per second.[16]

Another goal being set by agricultural companies involves the collection of data.[15] There are rising concerns over the growing population and the decreasing labor available to feed them.[13][15] Data collection is being developed as a way to increase productivity on farms.[15] AgriData is currently developing new technology to do just this and help farmers better determine the best time to harvest their crops by scanning fruit trees.[15]

Implications

An agricultural drone is an unmanned aerial vehicle used in agriculture operations, mostly in yield optimization and in monitoring crop growth and crop production. [20]Agricultural drones provide information on crop growth stages, crop health, and soil variations. Multispectral sensors are used on agricultural drones to image electromagnetic radiation beyond the visible spectrum, including near-infrared and short-wave infrared. The use of agricultural drones has ethical and social implications. One benefit is that they are able to monitor and control the use of pesticides properly. This allows minimizing the environmental impact of pesticides. However, drones do not require permission to fly over another person's property at altitudes of under 400 feet (120 m). They may have microphones and cameras attached[19], and the resulting concern for potential privacy violation has caused some opposition towards drones. There is a large capacity for growth in the area of agricultural drones. With technology constantly improving, imaging of the crops will need to improve as well. With the data that drones record from the crops the farmers are able to analyze their crops and make educated decisions on how to proceed given the accurate crop information. Software programs for analyzing and correcting crop production have the potential to grow in this market. Farmers will fly a drone over their crops, accurately identify an issue in a specific area,[18] and take the necessary actions to correct the problem.[6] This gives the farmer time to focus on the overall task of production instead of spending time surveying their crops. Additional uses include keeping track of livestock, surveying fences, and monitoring for plant pathogens.[7]

Both the purchase and maintenance costs of modern drones make them too expensive for small farms in developing nations. Pilot programs in Tanzania are focusing on minimizing those costs, producing agricultural drones simple and rugged enough to be repaired locally.[8] Apart from african countries, Asian countries like India is also promoting Dones in agriculture sector by use of Kisan van , which means farmer's vehicle, DGCA i.e Director general of Civil Aviation is taking care of it and has[17] launhed safety guidelines for use of Drones in Agriculture[9]

A research team from Washington State University has developed an automated drone system that deters pests like crows or European starlings from feeding on grapes and other crops. The birds could be scared off by the drone's noise, but researchers also could include distress calls and predatory bird noises.[10]

IV.CONCLUSIONS

Mechanised agriculture or agricultural mechanization is the use of machinery and equipment, ranging from simple and basic hand tools to more sophisticated, motorized equipment [7]and machinery, to perform agricultural operations.[1] In modern times, powered machinery has replaced many farm task formerly carried out by manual labour or by working animals such as oxen, horses and mules.

The entire history of agriculture contains many examples of the use of tools, such as the hoe and the plough. The ongoing integration of machines since the Industrial Revolution has allowed farming to become much less labour-intensive.[8]

Agricultural mechanization is part of this technological evolution of agricultural automation.[2] It can be summarized as a progressive move from manual tools to animal traction, to motorized mechanization, to digital equipment and finally, to robotics [16]with artificial intelligence (AI).[3] These advances can raise productivity and allow for more careful crop,

livestock, aquaculture and forestry management; provide better working conditions; improve incomes; reduce the workload of farming; and generate new rural entrepreneurial opportunities.[3]

Current mechanised agriculture includes the use of tractors, trucks, combine harvesters, countless types of farm implements, aeroplanes [15]and helicopters (for aerial application), and other vehicles. Precision agriculture even uses computers in conjunction with satellite imagery and satellite navigation (GPS guidance) to increase yields. New digital equipment is increasingly complementing, or even superseding, motorized machines to make diagnosis and decision-making automatic.[2]

Mechanisation was one of the large factors responsible for urbanisation and industrial economies. Besides improving production efficiency, mechanisation encourages large scale production and sometimes can improve the quality of farm produce. On the other hand, it can cause environmental degradation (such as pollution, deforestation, and soil erosion), especially if it is applied shortsightedly rather than holistically[9]

Motorized mechanization has substantially expanded at global level, although it has been unevenly and inadequately adopted particularly in sub-Saharan Africa.[2] Mechanization is limited to a range of operations including harvesting and weeding and is rarely used for fruit and vegetable production across the globe.[13]

Extensive adoption started in the United States of America, where tractors replaced about 24 million draught animals between 1910 and 1960 and become the main source of farm power.[14] United Kingdom first started using tractors in the 1930s, but agricultural[14] transformation in Japan and some European countries (Denmark, France, Germany, Spain and former Yugoslavia) did not take place until about 1955. Thereafter, the adoption of motorized mechanization took place very quickly, completely superseding animal traction.[15] Using tractors as farm power enabled, and even triggered, innovations in other agricultural machinery and equipment that greatly eased the toil associated with agriculture and allowed farmers to carry out tasks more quckly.[16] At a later stage, motorized machinery also increased in many Asian and Latin American countries.[13]

Sub-Saharan Africa is the only region where adoption of motorized mechanization has not progressed over the past decades.[17][18] A study in 11 countries proves this low level[13] of mechanization in the region, finding that only 18 percent of the sampled households have access to tractor-powered appliances. The remaining ones make use of either simple hand-held tools (48 percent) or animal-powered equipment (33 percent).[18]

Since at least the early nineteenth century there have been concerns over the possible negative socioeconomic impacts of labour-saving technological change, particularly job displacement resulting in unemployment.[2] However, fears that automation increases labour productivity to the extent that it causes massive unemployment are not supported by historical realities.[2] Instead, innovation and incorporation of labour-saving technologies tends to take long, and automation of one task often spurs increases in the need for workers to perform other jobs.[2] The direct impact of automation on employment will be determined by the factors leading to its adoption.[19]

If rising wages and labour scarcities drive the adoption of automation then it is not likely to create unemployment.[19] Automation can also stimulate agricultural employment. For example, it can enable farms to increase their production following growing food demand. Agricultural automation is part of the structural transformation of societies through which increased agricultural labour[12] productivity gradually releases agricultural workers, giving them the opportunity to take new jobs in other sectors, including industry and services.[2] On the other hand, automation that is forcibly promoted, such as through government subsidies, could cause rising unemployment and falling or stagnant wages.[19]

The Food and Agriculture Organization of the United Nations (FAO) advises against governments implementing distortive subsidies for automation because doing so risks increasing unemployment.[2] FAO also advises against restricting automation on the assumption that this will save jobs and incomes,[3] because it risks making agriculture less competitive and productive.[2] Instead, the recommendation is to concentrate on creating an enabling environment to adopt automation [11]– particularly by small-scale agricultural producers, [10] women and youth – while making social protection available to least skilled workers, who are more likely to lose their jobs during the transition.[3]

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