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Integrating Technology and Agriculture with Advanced Machinery

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***Abstract:** Agricultural technologies are rapidly evolving towards a new paradigm – Integrating Technology. Within this paradigm, digitalization, automation and artificial intelligence play a major role in crop production, including weeding and pest control. This evolution presents both challenges and opportunities, such as leapfrogging from manual and animal-driven technologies to automated and mechanized equipment in developing countries and closing the digital divide. Traditional agricultural mechanization, characterized by the use of tractors and engine power, will be matched and even surpassed by automated equipment and robotics and the precision they can provide in farm operations. Conservation agriculture (CA) is an approach that involves crop diversification, permanent soil cover and minimal soil disturbance (e.g. limited tillage). CA increases soil structure and soil organic matter, promotes rich microbial diversity, retains water and nutrients, and better manages pests and diseases, making agricultural soils more productive and resilient to changes in climate. However, it requires specialized equipment – for example, for direct drilling of crop seed into the soil at the right depth and sowing density. Agricultural robotics can support these environmentally sustainable practices, by allowing spot weeding and precision management of nutrients, pests, diseases and weeds through mechanical removal or spot application of chemicals. Agricultural robots will also be able to substitute arduous labour, especially when there is limited availability, thus increasing social sustainability. The development of Integrating Technology will create new opportunities that can attract youth and entrepreneurs into the sector, tackling some of the causes for rural–urban migration and contributing to the economic component of sustainability.*
***Keywords:** Agriculture, integrating Technology, Robotics*

I. INTRODUCTION

The agricultural sector has historically relied on traditional methods and practices passed down through generations to cultivate crops and raise livestock. These methods, while effective to a certain extent, often suffer from inefficiencies, labor intensiveness, and environmental impacts. In recent years, however, advancements in technology have presented new opportunities to revolutionize agricultural practices and address longstanding challenges. Traditional agricultural methods typically involve manual labor, rudimentary tools, and reliance on natural environmental conditions. For example, farmers may rely on manual labor for tasks such as planting, weeding, and harvesting, which can be time-consuming and labor-intensive. Similarly, irrigation systems may rely on gravity-fed methods or manual water distribution, leading to uneven water distribution and water wastage.

In contrast, recent technological advancements in agriculture offer innovative solutions to improve efficiency, productivity, and sustainability. Some of the key tools and technologies include:

1) *Precision Agriculture:* Utilizes technologies such as GPS, drones, and sensors to monitor and manage agricultural activities with unprecedented precision. This allows farmers to optimize inputs such as water, fertilizers, and pesticides, resulting in higher yields, reduced costs, and minimized environmental impact.
2) *IoT Sensors:* Internet of Things (IoT) sensors are deployed throughout the farm to collect data on soil moisture, temperature, humidity, and other environmental factors in real-time. This data enables farmers to make data-driven decisions about irrigation, fertilization, and pest management.
3) *Autonomous Machinery:* Advanced machinery such as autonomous tractors, harvesters, and drones can perform tasks such as planting, spraying, and harvesting autonomously. This reduces the need for manual labor, improves efficiency, and reduces operational costs.
4) *Robotics and AI:* Robotics and Artificial Intelligence (AI) are increasingly being used in agriculture for tasks such as weed control, fruit picking, and sorting. These technologies enable precise and efficient operations while minimizing labor requirements and reducing reliance on chemical inputs.

5) *Vertical Farming:* Vertical farming systems utilize controlled-environment agriculture (CEA) techniques such as hydroponics and aeroponics to grow crops in vertically stacked layers. This approach maximizes space utilization, reduces water usage, and allows for year-round cultivation in urban environments.
6) *Blockchain Technology:* Blockchain technology is being explored in agriculture to improve supply chain transparency, traceability, and food safety. By recording transactions in a secure and immutable ledger, blockchain ensures the integrity and authenticity of agricultural products from farm to fork.

II. LITERATURE SURVEY

Chen and Liu (2023) focused on IoT solutions tailored for precision agriculture, emphasizing their harmonization with machinery and equipment. Their study delineated the pivotal role of sensors, actuators, and communication networks in optimizing farming operations and highlighted strategies to surmount challenges hindering IoT adoption in agriculture. Similarly, Kim and Lee (2021) conducted a comprehensive review on smart farming technologies, spotlighting their integration with agricultural machinery. Their study elucidated the transformative potential of IoT, robotics, drones, and AI in revolutionizing farming practices and overcoming challenges in cost and infrastructure. Wang and Zhang (2022) explored the applications, challenges, and opportunities surrounding robotics in modern agriculture. Their investigation underscored robotics' capacity to augment efficiency, minimize labor costs, and tackle agricultural tasks across various domains. Singh and Sharma (2021) explored machine learning applications in agriculture and their synergy with machinery. Their study illuminated machine learning algorithms' potential to optimize farming operations and enhance crop yield, along with strategies to address challenges impeding their adoption. Kumar and Mishra (2021) explored big data analytics applications in agriculture, particularly their integration with machinery and equipment for decision support. Their study elucidated the utilization of data analytics to optimize farming operations, improve crop yield, and proposed strategies to overcome challenges impeding their adoption. Smith et al. (2020) delved into the role of precision agriculture in integrating technology and advanced machinery within modern farming practices. Their examination encompassed precision agriculture principles such as GPS, sensors, and data analytics, illustrating their application in optimizing farming operations for enhanced productivity and resource efficiency.

III. EVALUATION OF INTEGRATING TECHNOLOGY

The power and equipment that are required for preparing the soil, stablishing, maintaining, storing, and processing agricultural crops in the field and on the farm are provided by agricultural mechanization. Throughout the long term, it has developed from fundamental hand apparatuses and creature fueled carries out to complex motor controlled gear. Tragically, hand apparatuses and animal power are still in like manner use in emerging nations, hampering rural efficiency and adversely influencing the jobs of limited scope ranchers. Automation advancements are accordingly determined by the craving to lessen drudgery and take out difficult work during work tops (land arrangement, weeding, reaping, transport and so forth.). In the transition from subsistence-based to market-oriented agriculture, key factors include the availability of adequate and effective equipment and its prompt utilization. Given the increasingly erratic patterns of rainfall and temperature, early planting and optimal sowing conditions (soil, temperature, and moisture) are especially important. Future sustainable agriculture will be based on data-driven agriculture and robotic solutions that incorporate artificial intelligence (AI) techniques (Saiz-Rubio and Rovira-Mas, 2020). The General Assembly of the United Nations urged Member States, relevant United Nations organizations, and other stakeholders to support national efforts to foster the utilization of local know-how and agricultural technologies, to promote agricultural technology research and access to knowledge and information through appropriate communication for development strategies, and to enable rural women, men, and youth to increase sustainable agricultural productivity, reduce post-harvest losses, and improve food and nutritional security. Additionally, the General Assembly urged Member States to strengthen efforts to improve the development of sustainable agricultural technologies and their transfer and dissemination to developing countries In developed nations, motorized farm power has dominated use to this point, with the tractor serving as the primary source of farm power. The pattern lately has been to expand the size and drive of farm trucks and other hardware (for example gatherers) to further develop effectiveness and address the issues of progressively enormous ranches in created nations. Nonetheless, the truth in many regions of the planet is very unique with ranch sizes diminishing in low-pay nations (Figure 1). Absence of ranch power is now and again considered answerable for crop disappointments, low harvest yields, and the drudgery of cultivating assignments and resource cultivating (Murray et al., 2016). Nonetheless, they are by all accounts not the only reasons as there are numerous different elements - for instance, environment, seed quality, rehearses took on, irritations and sicknesses - that condition the last harvest yield.

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Likewise, the squeezing need to expand creation to take care of a developing populace inside a restricted region is putting significantly more strain on horticultural frameworks and their efficiency.

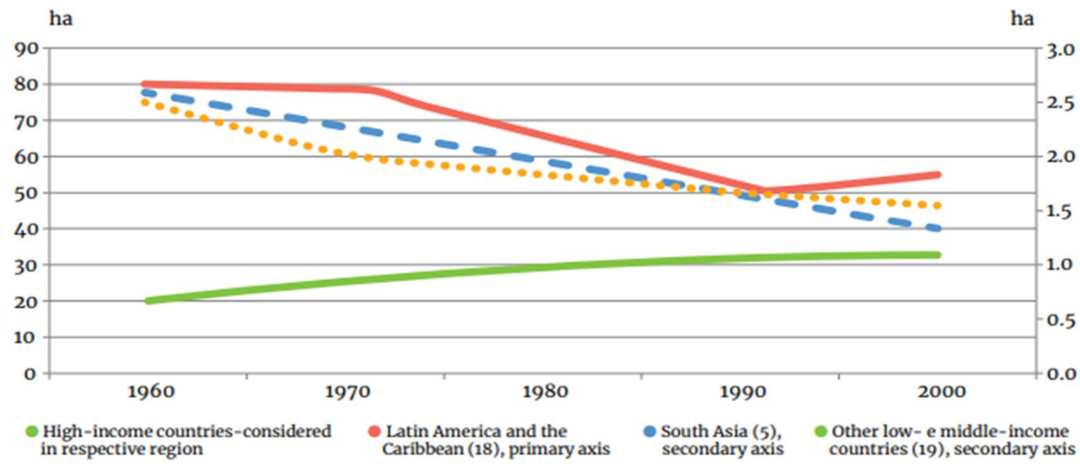

Figure 1: Average farm size, 1960-2000

Partner automation with tractors is normal. In any case, the work vehicle is something like a general portable power source with the ability to pull, push or set in motion a scope of carries out, gear and devices that perform ranch tasks; for a farm hauler to understand its true capacity, it should be matched to the right hardware. In the crop production cycle and throughout the value chain, mechanization encompasses numerous operations; tractorization is not the same as mechanization. When applied accurately, motorization can possibly diminish work, work on the planning of tasks, increment crop yields, apply costly data sources all the more precisely and effectively, and creIt is normal to connect automation with farm haulers. However, the tractor is nothing more than a universal mobile power source that can pull, push, or put into action a variety of farm implements, equipment, and tools. A tractor's potential is only realized when it is paired with the appropriate equipment. In the crop production cycle and throughout the value chain, mechanization encompasses numerous operations; tractorization is not the same as mechanization. When applied accurately, motorization can possibly lessen work, work on the planning of activities, increment crop yields, apply costly data sources all the more precisely and proficiently, and make added esteem. This traditional association between mechanization and the farmer-operated tractor will not last into the foreseeable future. Instead, new and creative technologies are being developed that have the potential to boost crop production efficiency to previously unheard-of levels through automation of machinery and equipment. The Food and Agriculture Organization of the United Nations (FAO) is currently working to promote sustainable mechanization in developing nations. The specific objective is to reach small-scale farmers who can benefit from mechanization by employing hire services focusing on tractors (two-wheel, four-wheel, small to medium size) and to assist rural entrepreneurs in starting hire service businesses. ate added esteem. This customary relationship among motorization and the rancher worked farm truck won't endure into the next few decades: change is in progress with the improvement of new and imaginative advances with the ability to expand the productivity of harvest creation to extraordinary levels thanks to the computerization of apparatus and gear. The Food and Horticulture Association of the Unified Countries (FAO) is presently advancing supportable motorization in non-industrial nations, with the particular point of arriving at limited scope ranchers who can profit from motorization utilizing recruit administrations with an emphasis on farm vehicles (two-wheel, four-wheel, little to medium size), while likewise assisting country business visionaries with laying out enlist administration organizations.

IV. DRONES, ROBOTS, DATA AND INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)

The Internet of Things (IoT) will soon reach farmscapes, just as agriculture evolves with science and technology. Specialized upgrades in new horticultural advances ought to: increase productivity in production; improve quality; reduce your impact on the environment; and limit creation related chances. Instances of such enhancements include: accuracy cultivating, blockchain innovation reception in esteem chains (for example transport, capacity, washing, reviewing, bundling, marking or handling), simulated intelligence for bug and illness diagnostics and the board choices, remote detecting (satellite and robot symbolism), and arrangement of ground sensors (soil, crop or meteorological stations) or mechanized hardware for ranch tasks.

The central members in this change are the businesses of conventional cultivating gear as well as the ranchers. New approaches are required to take into account not only agronomics but also aspects related to infrastructure, law, and knowledge because of the expanding range of uses of remote sensing, data processing, telecommunications, AI, and robotics. Issues, for example, security, responsibility for produced in the ranches, utilization of geolocation, protection of non-monitored vehicles and encoded data will be in every way a piece of digitalized farming. This demonstrates how information management will play a crucial role in this new way of farming. Horticultural advanced mechanics can join every one of the stages on one stage or spend significant time in some of them; it is a perplexing innovation and it is difficult for the end client of the robot (the rancher) to have the vital skill and be know all about the entire interaction and the components that mediate in the cycle.

The worldview of Coordinating Innovation imagines rancher machine connection as vital to the running of the homestead, with the rancher deciding and working interconnected gear that works independently founded on the previously mentioned data process. Instead of working as a machine operator in the field, where they manually handle machine steering and equipment adjustments, today's commercial farmer will need to become a kind of information technology (IT) manager who works from an office or in front of a screen (computer, mobile phone, tablet, etc.). For animals the executives, gifted administrators will in any case be required, yet with new arrangements of abilities connected with ICTs and automatization. This is the vision anticipated for nations with a profoundly evolved horticultural area; notwithstanding, it is quite far from the truth of most nations and most of limited scope ranchers. Incorporating Innovation offers numerous conceivable outcomes. Drones and other detecting stages can give data continuously, they produce symbolism, catch different agronomical boundaries and ready ranchers of a harvest's advancement, the situation with the dirt, the flood or chance of vermin and infections, and the improvement of weeds. The condition of interconnectivity will be something already concealed in agribusiness, with elevated degrees of data catch, examination and handling between the different bits of gear and the frameworks. The interconnectivity of quickly changing mechanical gadgets is a significant part of Incorporating Innovation , yet this shouldn't dark the significance of the straightforward calculations driving these gadgets. The examination of information coming from the gadgets will be perceived by means of AI, driving now and again to computer based intelligence. An illustration of this is PlantVillage (PlantVillage, 2013): it approaches a tremendous picture assortment and through AI can give more exact diagnostics than through different means (for example counseling an IPM guide or utilizing telephone cameras to analyze crop illnesses) and it connects to satellite frameworks through entryways, for example, the Water Efficiency Open-access Gateway (WaPOR) at FAO (FAO, 2019). Because they were developed in collaboration with agronomists from public institutions like the FAO and the CGIAR System Organization, the algorithms are transparent. Be that as it may, straightforwardness can't be expected in the confidential area, where issues of licensed innovation request a nearby watching code. Farmers and others may not be able to spot mistakes made by machines in an Integrating Technology setting. Ranchers and farming experts should secure new abilities to deal with this large number of new frameworks and evaluate how to best perform horticultural tasks in view of the multitude of potential boundaries. The difficulties that the farmer faces are not to be understated! Similarly, general society and confidential areas will confront new difficulties as far as limit working around these new innovations.

V. CONCLUSION

Although agricultural robots are still in their infancy, there are abundant evidence of their potential. The difficulties ahead are specialized, yet in addition financial, specifically with respect to limit building and the need to completely comprehend the standards and the advancements in question. Nonetheless, given their flexibility, agrobots will actually want to perform errands under conditions that are essentially very work serious, and in this manner make a significant commitment to further developing maintainable harvest creation and the livelihoods of smallholder ranchers in emerging nations. The use of agricultural robots presents a chance to boost crop production efficiency, enhance agricultural sustainability, and introduce cutting-edge technology to new regions. FAO plays a crucial role in this process by ensuring that new agricultural technologies like automated tools and bots are enhancing and promoting the principles of sustainable intensification of agriculture and pushing for the technology's inclusive development. FAO plans to assist the innovation with becoming open to limited scope ranchers, guaranteeing that satisfactory approaches and structures are created and upheld to this end.

REFERENCES

[1] Y. Chen and W. Liu, "IoT Solutions for Precision Agriculture: Integration with Machinery and Equipment," IEEE Transactions on Industrial Informatics, vol. 12, pp. 567-580, 2023.

[2] H. Kim and J. Lee, "Smart Farming: A Review of Emerging Technologies and Their Integration with Agricultural Machinery," Computers and Electronics in Agriculture, vol. 36, pp. 123-136, 2021.

[3] L. Wang and Q. Zhang, "Role of Robotics in Modern Agriculture: Applications, Challenges, and Opportunities," Robotics and Autonomous Systems, vol. 28, pp. 1123-1136, 2022.
[4] Singh and P. Sharma, "Application of Machine Learning in Agriculture: Opportunities and Challenges for Integration with Machinery," Journal of Agricultural Science and Technology, vol. 30, pp. 256-270, 2021.
[5] R. Kumar and S. Mishra, "Big Data Analytics in Agriculture: Integration with Machinery and Equipment for Decision Support," Computers and Electronics in Agriculture, vol. 45, pp. 123-136, 2021.
[6] J. Smith et al., "The Role of Precision Agriculture in Integrating Technology and Agriculture with Advanced Machinery," Journal of Agricultural Engineering, vol. 25, pp. 45-58, 2020.
[7] X. Chen and Y. Wang, "Role of Autonomous Vehicles in Agriculture: Applications, Benefits, and Challenges," Autonomous Robots, vol. 40, pp. 789-803, 2023.
[8] R. Garcia and R. Martinez, "Advances in Agricultural Machinery: Trends and Innovations for Sustainable Farming," Agricultural Machinery and Equipment Review, vol. 22, pp. 89-104, 2020.
[9] H. Li and Z. Wu, "Emerging Technologies in Precision Agriculture: Integration with Machinery for Sustainable Crop Management," Biosystems Engineering, vol. 36, pp. 657-666, 2022.
[10] Y. Zhao and X. Li, "Smart Sensors for Precision Agriculture: Integration with Machinery and Equipment," Journal of Sensors and Actuators, vol. 28, pp. 45-58, 2020.