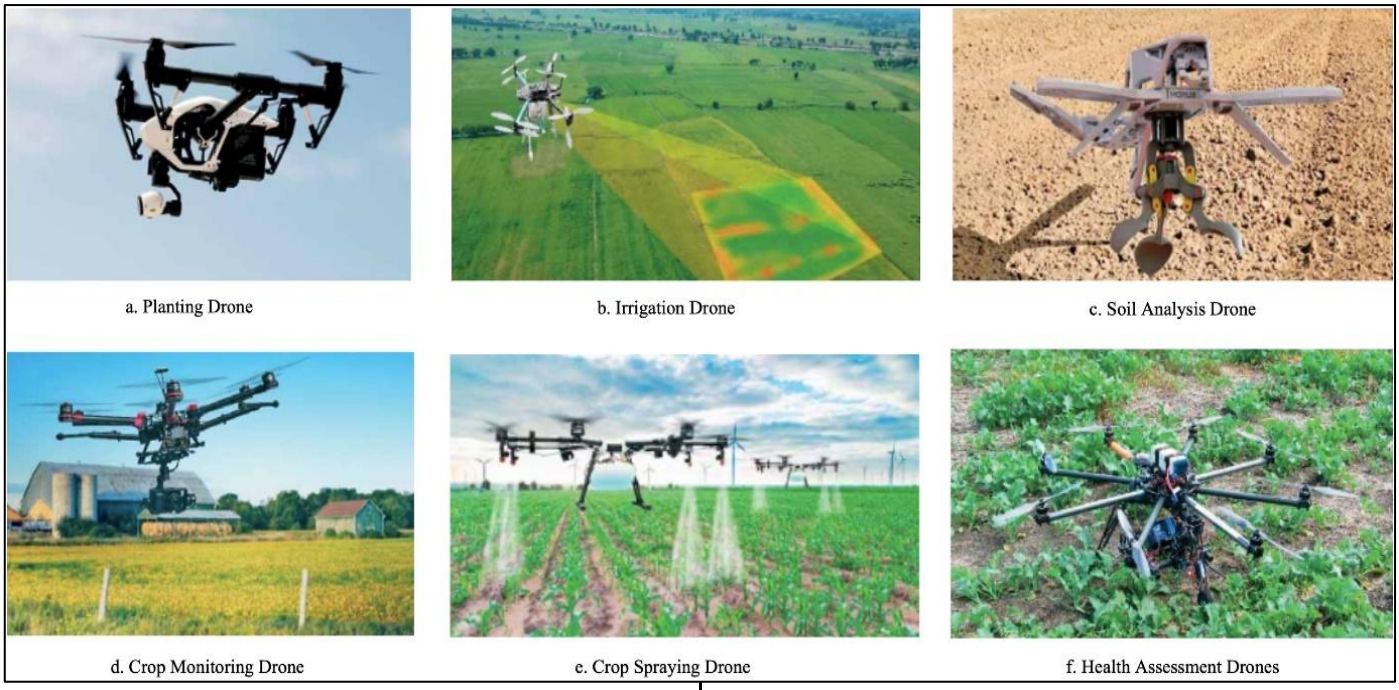
Advancements in Precision Agriculture: Harnessing the Power of Artificial Intelligence and Drones in Indian Agriculture

Abhishek Patel, Aman Mahore, Rohit Dilip Nalawade, Abhishek Upadhyay and Vishal Choudhary



(Source: Unpaprom et al., 2018)

In recent years, the field of precision agriculture has witnessed remarkable advancements with the integration of cutting-edge technologies such as artificial intelligence (AI) and robotics in farm machinery. This article explores the revolutionary impact of AI and robotics on agricultural practices, highlighting their potential to optimize resource utilization, enhance productivity, and promote sustainable farming methods.

The Rise of Precision Agriculture

Precision agriculture is a data-driven approach that utilizes advanced technologies to make informed decisions and maximize agricultural efficiency. Traditional farming methods often rely on generalized practices, but precision agriculture offers a more targeted and customized approach. By combining AI and robotics with farm machinery, farmers can achieve unprecedented levels of precision, accuracy, and productivity.

Artificial Intelligence in Farm Machinery

AI algorithms, coupled with sophisticated sensors and imaging technologies, empower farm machinery to gather and analyze real-time data on crop health, soil conditions, and weather patterns. This wealth of information enables farmers to make data-driven decisions regarding irrigation, fertilization, pest management, and harvesting. AI also helps in predicting crop yield, optimizing resource allocation, and reducing environmental impact by minimizing chemical usage.

Robotics Revolutionizing Agricultural Practices

The integration of robotics in farm machinery has revolutionized labour-intensive tasks and increased operational efficiency. Autonomous robots equipped with advanced sensors and algorithms can perform various tasks, such as precision seeding, spraying, harvesting, and weed control. These robots operate with exceptional precision, adaptability, and

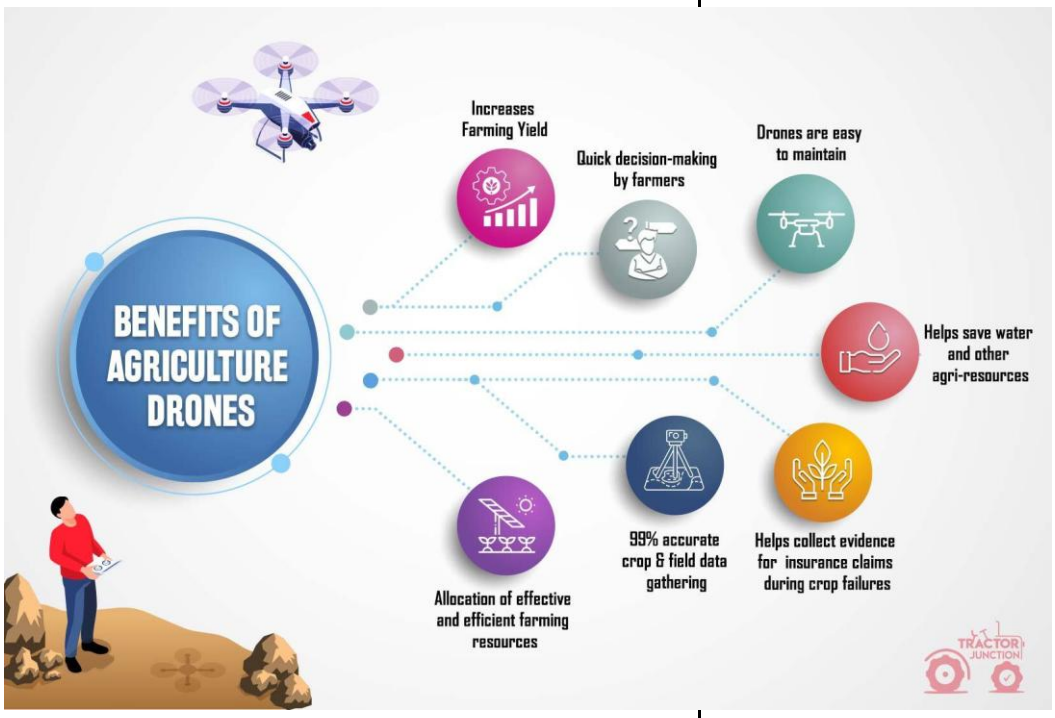
ICAR - Central Institute of Agricultural Engineering, Bhopal
abhishekpatel2910@gmail.com

speed, significantly reducing human labour requirements and increasing productivity on the farm.

Benefits of AI and Robotics in Farm Machinery

The utilization of AI and robotics in farm machinery brings several notable benefits to agricultural practices.

Increased Efficiency: Precision agriculture enables farmers to optimize resource utilization by applying inputs (such as water, fertilizers, and pesticides) precisely where and when needed, minimizing waste and reducing costs.



(Source: Tractor junction., 2023)

Enhanced Crop Health: AI-powered farm machinery can monitor and detect early signs of plant diseases, nutrient deficiencies, and pest infestations. This enables prompt intervention, leading to improved crop health and higher yields.

Sustainable Farming: By using AI and robotics, farmers can adopt more sustainable farming practices, including reduced chemical usage, minimized environmental impact, and improved resource management.

Labour Savings: The automation of tasks through robotics reduces labour requirements, allowing farmers to focus on higher-level decision-making and farm management activities.

Data-Driven Decision Making: The abundance of real-time data collected by AI-powered farm machinery provides valuable insights for optimizing farm operations, improving yield predictions, and ensuring more efficient use of resources.

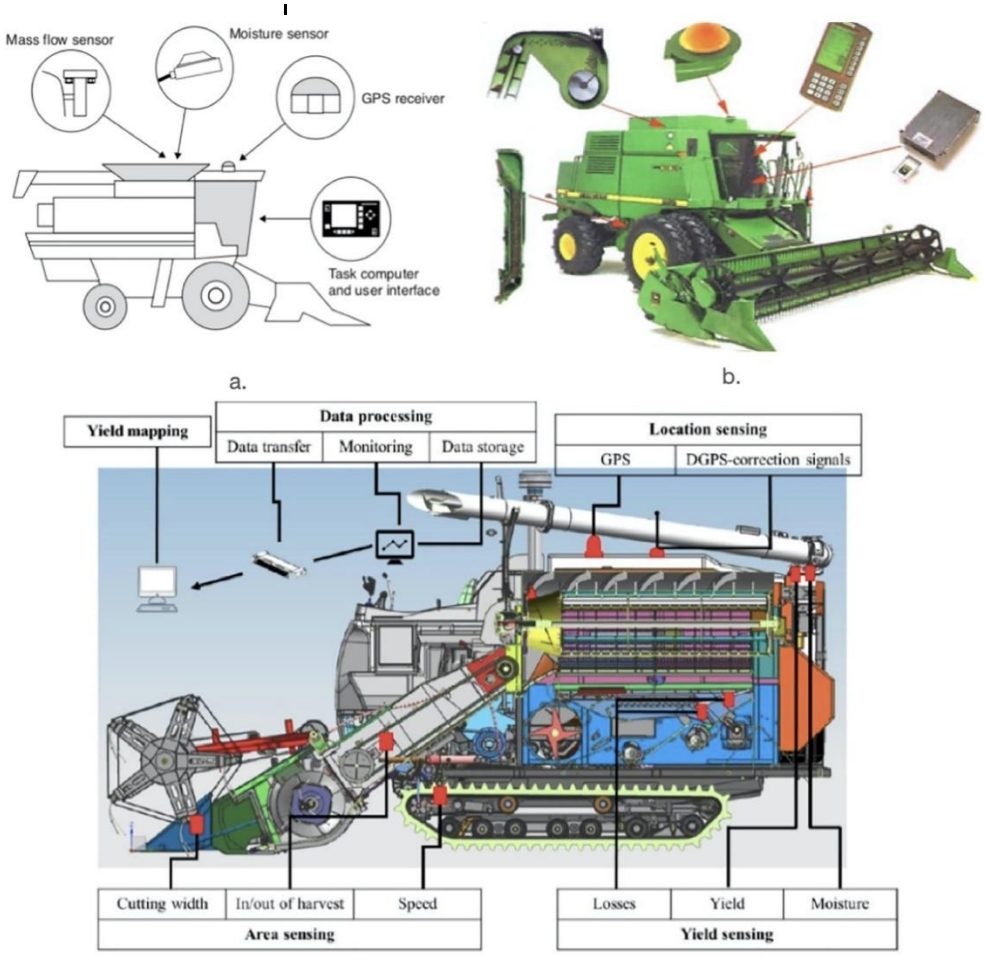
Yield mapping and monitoring

One of the key segments of the unprecedent progressions in exactness cultivating frameworks, yield mapping, enables the farmer to see spatial variety over the field perceiving zone for future activities and outcome of the past sessions, management. It alludes for the most part to the way toward gathering geo-referenced information on harvest yield and qualities, for example, showing in-field fluctuation, and the soil moisture content of the yield giving a benchmarking apparatus, when the yield is being harvested. In combination with soil examining data, yield maps empower the arrangement of variable compost maps which considers soil supplement levels just as the supplement which was expelled in the collected harvest. Last result of yield mapping is typically a tonal or shaded guide showing scopes of yield inside a field. Fundamental segments of grain yield mapping framework incorporate grain fow sensor (determines grain volume gathered), grain moisture content sensor (remunerates for grain moisture variability), GPS antenna (receives satellite sign), Yield screen show with a GPS receiver (geo-reference and records information), header position

sensor (distinguishes estimations logged during turns), travel speed sensor (determines the separation the join goes during a specific logging interim.

Challenges and Future Directions

While the advancements in AI and robotics in farm machinery hold immense potential, certain challenges must be addressed. These include the initial investment costs, compatibility with existing machinery, data privacy concerns, and the need for skilled personnel to operate and maintain these complex systems. Efforts should be made to make these technologies more accessible and affordable for small-scale farmers, enabling them to reap the benefits of precision agriculture.



Yield mapping devices - (a) Schematic diagram (b) Location sensing devices (Plant et al., 2000) (c) yield mapping harvester equipped to do both tasks (Kormann et al., 1998)

Government Schemes & Financial Support for Drones in Indian Agriculture

The Union Ministry of Agriculture and Farmers Welfare has issued guidelines to facilitate farmers and stakeholders in the agriculture sector to have better access to and affordability of drones for agricultural purposes. Furthermore, the Government of India promotes the use of drones in agriculture by providing financial support through its sub-mission on agriculture mechanization. Additionally, agricultural institutes in India can receive a grant of up to Rs. 10 lakhs for the purchase of drones. To assist with the purchase of agricultural drones, custom hiring centers established by cooperative societies of farmers, rural entrepreneurs, and Farmers Producers Organizations (FPOs) offer financial aid and support. FPOs are eligible to receive grants of up to 75% of the cost of agriculture drones for use in farmers' fields.

Under the "sub-mission on Agricultural Mechanization" (SMAM), grants of 100% on agriculture drones or up to Rs. 10 lakhs (whichever is less) are provided. The government also allows a contingency expenditure of Rs. 6000 per hectare for agencies that prefer to hire drones for demonstrations from custom hiring centers, hi-tech hubs, startups, and drone manufacturers. However, the contingent expenditure for implementing agencies is limited to

Rs. 3000 per hectare. Moreover, to support agricultural services through drone applications, financial assistance is available for the purchase of drones by existing custom hiring centers. This assistance covers 40% of the basic cost of the drone and its attachments, or up to Rs. 4 lakhs (whichever is less).

Conclusion

The integration of AI and robotics in farm machinery represents a transformative shift in the field of precision agriculture. By harnessing the power of these technologies, farmers can achieve higher levels of productivity, profitability, and sustainability. The continued advancements in AI and robotics hold promise for the future of farming, ensuring a more efficient, precise, and environmentally conscious approach to agricultural practices. As we embrace these advancements, it is crucial to promote knowledge sharing, investment in research and development, and collaborations between industry stakeholders and agricultural professionals to unlock the full potential of precision agriculture.

References

Kormann, G., Demmel, M., & Auernhammer, H. (1998). Testing stands for yield measurement systems in combine harvesters. In ASAE International Conference.

Plant, R., Pettygrove, G., & Reinert, W. (2000). Precision agriculture can increase profits and limit environmental impacts. California Agriculture, 54(4), 66-71.

Unpaprom, Y., Dussadeeb, N., & Ramaraj, R. (2018). Modern Agriculture Drones: The Development of Smart Farmers 2018. Maejo University, 7, 13-19.

Tractor junction. (2023). Agriculture Drones – Uses, Benefits & Govt. Subsidies Explained, India.

* * * * * * * *