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Agriculture 4.0: Smarter way of Farming with Data rather Guesswork

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INTRODUCTION

Experiences and instincts were the valuable tools since time immoral for a farmer where he 'felt' the soil and 'looked' at the sky for rain. Today, a small sensor in the rhizosphere, an overhead drone and an application on our smartphone could be the answer to the same question with number of gateways. This drift, commonly figured the emergence of 'smart agriculture' altering the way food is grown, served and fed with India investing and making policies for the same at national scale.

What makes agriculture "smart"?

Agriculture 4.0 aka smart farming or Smart agriculture indicates the basic implementations of information and communication technologies under the radar of farm management conveniently convincing the farmers for observing the field, deciding what to do, and acting on it. It grows out of precision agriculture, which was accountable for variation within a field. Smart farming moves a step ahead by taking decisions not only on location but also on data from several sources and on real-time events basis (Wolfert et al., 2017). The journey starting from GPS-guided machinery and yield monitors till now, systems that combine the Internet of Things (IoT), big data analytics and artificial intelligence (AI) is described by Karunathilake et al. (2023).

The toolkit of a smart farmer

- **Sensors and IoT.** Soil Probes and weather observatories in the field record moisture content, temperature and other soil and plant conditions, and send them wirelessly to a phone or dashboard, so that irrigation can follow the crop's actual need rather than the calendar.
- **Drones and robots.** Drones hunt for pests, nutrient and moisture stress, map the fields and spray liquid inputs precisely, reducing chemicals exposures and human labours.

- **AI and big data.** Several models of Machine-learning turn streams of sensor, satellite and weather data into a single advice. It is used widely across crop, livestock, water and soil handling and regulating, as reviewed by Liakos et al. (2018).

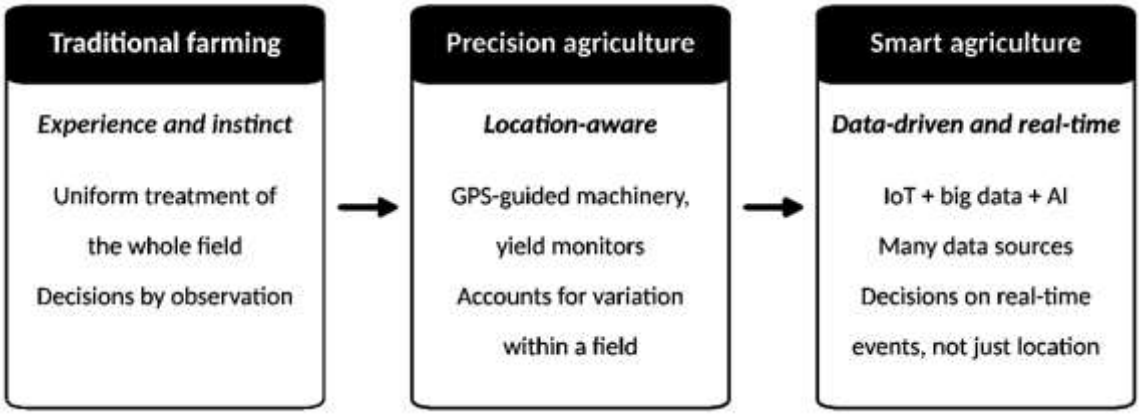


Figure 1: From instinct to data. Smart farming builds on precision agriculture by adding many data sources and real-time decisions

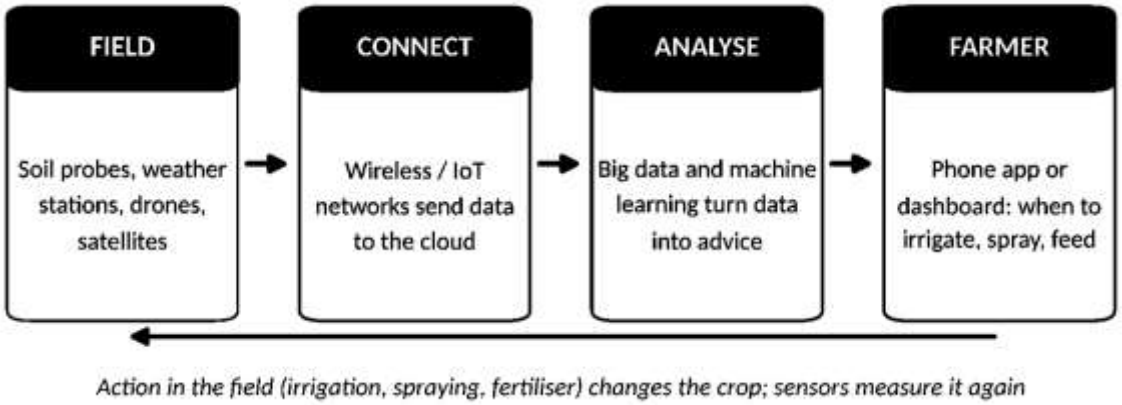


Figure 2: How the toolkit fits together.
Schematic of the data flow from field to farmer and back.

Does it actually work?

The evidences are motivating, though not magical. A review found that site-specific application of fertilisers, water and pesticides can curb greenhouse gas emissions while giving equal or higher yields at lower cost of production than with uniform practices (Balafoutis et al., 2017). In India, a field trial on sweet corn was conducted where irrigation was scheduled by IoT soil-moisture sensors gaving about 12% higher yield and used about 11% less water than a conventional evapotranspiration-based schedule (Vinod Kumar et al., 2023). Walter et al. (2017) went further, arguing in *PNAS* that smart farming is the key to developing sustainable agriculture. However the results depend on the crop, soil, climate and the quality of the system, so benefits should be tested locally rather than assumed.

India's digital push

Recent government initiative investing in crores, showcases interest of policy makers in agricultural advanced technologies. The **NaMo**

Drone Didi scheme budgeting ₹1,261 crore of which 80% central assistance up to ₹8 lakh per drone, along with 15 days of pilot and agricultural training (Press Information Bureau, 2023) was approved for implementation during 2024-2026 to give drones to 14,500 women SHGs with advanced agricultural technologies, who could rent out spraying services for liquid fertilisers and pesticides. In September 2024, the Union Cabinet approved the **Digital Agriculture Mission** of ₹2,817 crore with central government share of ₹1,940 crore. It relies on digital public infrastructure, chiefly AgriStack, the Krishi Decision Support System and soil profile mapping (Press Information Bureau, 2024). Together, they signal that digital tools are being treated as shared public infrastructure rather than luxuries.

The hurdles on the way

Adoption of Technologies is not guaranteed just because of its technicality. Listing challenges such as data management, adoption and cost-effectiveness among the main concern (Karunathilake et al., 2023), and field studies documentations holds barrier to acceptance of IoT-based precision practices (Hundal et al., 2023). Many Indian villages have limited network connectivity, low digital literacy, weak technological infrastructure, unaffordability and gender disparities which are genuine constraints remaining unresolved. Reviews shows power, ownership, privacy and ethics in digitalised agriculture (Klerkx et al., 2019), and Wolfert et al. (2017) warning that data governance and business models deciding whether farmers or large firms capture the profits.

Making smart farming work for everyone with a sensor worthy only when it answers to question of the farmer with practical accuracy. Rental costs and service models, as in the drone scheme, let small farmers use costly equipment without owning it. Training in digital skills, especially for women and young farmers, matters as much as hardware. Clear rules on ownership and privacy build the trust that adoption depends on. Data can show what is happening in a field; understanding soil, crops and nutrients explain why, and what to do next.

Smart agriculture or farming is not about substituting the farmer's wisdom or skill. It is about giving that wisdom better information, so that every drop of water, every gram of fertiliser and every hour of labour counts for better output.

REFERENCES

Balafoutis, A., Beck, B., Fountas, S., Vangeyte, J., Van der Wal, T., Soto, I., Gómez-Barbero, M., Barnes, A., & Eory, V. (2017). Precision agriculture technologies positively contributing to GHG emissions mitigation, farm productivity and economics. *Sustainability, 9*(8), 1339. https://doi.org/10.3390/su9081339

Hundal, G. S., Laux, C. M., Buckmaster, D., Sutton, M. J., & Langemeier, M. (2023). Exploring barriers to the adoption of Internet of Things-based precision agriculture practices. *Agriculture, 13*(1), 163. https://doi.org/10.3390/agriculture13010163

Karunathilake, E. M. B. M., Le, A. T., Heo, S., Chung, Y. S., & Mansoor, S. (2023). The path to smart farming: Innovations and opportunities in precision agriculture. *Agriculture, 13*(8), 1593. https://doi.org/10.3390/agriculture13081593

Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS: Wageningen Journal of Life Sciences, 90–91*, 100315. https://doi.org/10.1016/j.njas.2019.100315

Liakos, K. G., Busato, P., Moshou, D., Pearson, S., & Bochtis, D. (2018). Machine learning in agriculture: A review. *Sensors, 18*(8), 2674. https://doi.org/10.3390/s18082674

Press Information Bureau. (2023, November 29). *Cabinet approves Central Sector Scheme for providing drones to the Women Self Help Groups*. Ministry of Agriculture & Farmers Welfare, Government of India. https://pib.gov.in

Press Information Bureau. (2024, September 2). *Cabinet approves seven major schemes for improving farmers' lives and livelihoods with total outlay of Rs 13,966 crore*. Government of India. https://pib.gov.in

Vinod Kumar, S., Singh, C. D., Ramana Rao, K. V., Kumar, M., Rajwade, Y. A., Babu, B., & Singh, K. (2023). Evaluation of IoT based smart drip irrigation and ETc based system for sweet corn. *Smart Agricultural Technology, 5*, 100248.

Walter, A., Finger, R., Huber, R., & Buchmann, N. (2017). Opinion: Smart farming is key to developing sustainable agriculture. *Proceedings of the National Academy of Sciences, 114*, 6148–6150. https://doi.org/10.1073/pnas.1707462114

Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M.-J. (2017). Big data in smart farming: A review. *Agricultural Systems, 153*, 69–80. https://doi.org/10.1016/j.agsy.2017.01.023