AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine

Article Id
AL04124

SMART FARMING: IS THE FUTURE OF INDIAN AGRICULTURE?

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Agriculture is the backbone of the Indian economy; the whole of India depends on agriculture for survival and it serves as a source of the basic needs of humans. The demand for agricultural produce has risen throughout time as the country's population has grown and the need for food security has increased. With the rising challenge of biotic and abiotic stresses faced by crops, the use of modern technology in Indian agriculture is unavoidable in order to fulfill the massive food grain demand of 480 million tonnes (Mt) by 2050. Like other industries, agriculture has made enter to knowledge based era rather than to resource based and future agriculture become more competitive and market driven. The WTO agreement and agricultural trade liberalization have opened up many new opportunities for agriculture, but they have also brought with them some new challenges to developing country agriculture. Inspite of the fact that India produces a huge amount of food grain, high production costs and low productivity will force farmers out of the free market's economic competitive arena. Increasing the productivity of small-scale farms is an integral part of addressing the problem of food insecurity. To meet all of these new problems, a pollution-free, high-productivity solution is required. It can be possible through the implementation of modern, environmentally friendly technologies that can effectively handle and distribute all resources for sustainable agricultural production. Smart farming, however, offers a better future with the introduction of modern technologies that seek to reduce prices, increase productivity and produce high quality products. Advances in space technology and the IT revolution in India have changed the climate and made wide room for farms in the agricultural sector.

Smart farming is a kind of farm management that incorporates modern technology in order to improve the quality and quantity of agricultural products. The Internet of Things (IoT), data processing, soil sampling, and other smart technology, such as GPS access, are all part of this strategy. Smart farming has been valuable to all farmers, large and small, throughout time because it exposes them to technology and tools that help them enhance the quality and quantity of their products while lowering agricultural expenses.

Benefits of Smart Farming

Some of the benefits of using smart farming in agriculture include:

a) **High crop productivity:** Using better and improved farming technologies after smart farming ensures increased efficiency, as the emphasis is on optimizing inputs productivity and reducing waste.
b) **Reduced usage of pesticides, fertilizers, and water:** Farmers have traditionally utilized water, fertilizers, and pesticides despite knowing where those are needed on the land. For smart, however, you apply water and other chemicals whenever and wherever you need them, and in the right amounts which reduce the use of water and chemicals results in agricultural costs decline.
c) **Reduce environmental impact:** Nowadays, smart farming employs improved methods for increasing efficiency while decreasing the loss of pesticides, water, and other inputs to the crop.The idea is that if you can use them sparingly and where they are strongly needed you don't have to flood the world with unnecessarily harmful chemicals.
d) **Improved safety for farmers and workers:** Smart farming allows for the use of machinery and better technologies that restrict worker engagement in the field, removing the need for farmers and workers to be concerned about their safety.
e) **Low chemical deposition into groundwater and rivers:** Smart farming promotes the use of pesticides as little as possible and the use of ecologically friendly agricultural techniques. This means that little or no contaminants can be released in rivers and in general on the climate.

Smart Farming Technologies

Smart farming technologies involve the use of the following technologies:

1. Sensors for soil scanning and water, light, and temperature management
2. Telecommunications technologies include advanced networking and GPS
3. Hardware and Software for enabling the Internet of Things (IoT) based solution, robotics, automation, and specialized application.

4. Data analytics tools for decision making and forecasting.
5. Satellites and drones for gathering data.

Among the technologies that are obtainable for present day farmers:

1. Sensing technologies such as soil scanning, light, water, temperature management
2. Communication technologies such as cellular communication technology
3. Positioning technologies such as GPS, GIS
4. Hardware and software which enable IoT based solutions, robotics, automation, and specialized software solution
5. Data analytics that account for decision making and forecasting process.

Present Scenario

Though smart farming is very much talked about in developed countries, the application of smart farming technologies is presently at the nascent stage in India. Several discrete steps towards the implementation of this technology have been initiated. India's Working Groups (WGs) have recognized smart farming as one of the country's primary emphasis areas. ISRO's Space Application Center has begun a project with the Central Potato Research Institute in Shimla to explore the function of remote sensing in smart farming. The Tamil Nadu State Government has launched the "Tamil Nadu Precision Farming Project," which would first cover 400 hectares in the districts of Dharmapuri and Krishnagiriafter that it would be expanded to six additional districts (Mondal &Basu, 2009). Indian Agricultural Research Institute has made a plan to do smart farming experiments on the institutes' farms. In collaboration with the Central Institute of Agricultural Engineering (CIAE), Bhopal, the Project Directorate for Cropping Systems Research (PDCSR) in Modipuram and Meerut (Uttar Pradesh) started variable rate technology in various cropping systems. The Ahmedabad Spatial Application Center (ISRO) has begun studies to examine the effect of remote sensing in mapping space and temporal variability at the Central Potato Research Station fields in Jalandhar, Punjab. In collaboration with NABARD, the M S Swaminathan Research Foundation, a non-profit organization based in Kannivadi, Tamil Nadu, has adopted a village in the Dindigul district of Tamil Nadu for variable rate input application.

To explore the potential of the application of IT in the agro sector, Tata Chemicals Ltd., a private sector, provided extension services about the use of remote-sensing technology to analyze soil and inform about crop health, pest attacks, etc. Private sectors such as the Indian

Tobacco Company (ITC) have set up 'e-choupals,' which are village internet kiosks providing weather information, disease forecasting, modern farming practices, market prices and expert crop advice systems. LCC is becoming an effective low-technology smart farming tool for the need-based N management of rice grown in small farms of India. Laser land levelling was used as one of the tools of smart farming to increase the input-use efficiency and it achieved the average application efficiency of 65%, storage efficiency of 70%, and water distribution efficiency of 80% after laser levelling. The yield of the rice crop is increased by about 15–20% in laser-levelled fields (Rajput & Patel, 2006).

Future Prospects

In India, the major problem is farmers are poor, farming mainly subsistence and small size landholding. In India, more than 57.8% of farmers' land holdings size is less than 1ha. However, in major agricultural states like Punjab, Haryana, Uttar Pradesh, and Gujarat, more than a quarter of the population has an operating holding size of more than 4 hectares (Shanwad et. al. 2004). Although these are individual landholdings, the field sizes are considerable when considering contiguous fields with the same crop. According to aerial data, more than half of contiguous field sizes in Punjab's Patiala district are bigger than 15 hectares. For the sake of implementing smart farming, these contiguous fields can be regarded as one field. Smart farming has the potential to be used for important food-grain crops such as rice and wheat, particularly in Punjab and Haryana. In India, however, several horticultural crops with high profits have a significant potential for smart farming.

There is a scope for implementation of smart farming for major food-grain crops such as rice, wheat, especially in the states of Punjab and Haryana. However, many horticultural crops in India, which are high profit making crops, have wide scope for smart farming.

Conclusion

Smart farming has the potential to make a significant contribution to changing agricultural practices to increase efficiency and reduce the effect of agrochemical waste on the ecosystem. It lays out a road to sustainable agriculture that includes technological diversity, crop and livestock production systems, and networks including all agri-food stakeholders. There is no one policy solution that can achieve that aim of supporting and facilitating appropriate ICT use. The digital era's capabilities may lead to new types of farm diversification, as well as contribute to diversification through technological improvements.

While the "Internet of Things," such as agricultural machinery, may be utilized to handle routine farming situations, the farmer must still function as both a scientist and a watchdog, keeping an eye out for unexpected events. Farmers' free time that arises for digitalization can be spent more individually in disease control or in monitoring and handling livestock. When crop pests and diseases reach critical levels, new ICT applications are required to tackle them. Nevertheless, such a deliberate increase in diversity needs consumers, farmers, and decision-makers to be convinced of the advantages of such technological benefits. ICTs facilitate to exchange of information, cooperation, and peer review among farmers. ICT and data management allows for new ways of growing a profitable, widely acceptable agriculture that supports the diversity of environmental species and farmers. However, this can only be achievable if proactive policy development supports the appropriate legal and market structure for smart farming.

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