AgriCos e-Newsletter
ISSN: 2582-7049
Volume : 01 Issue : 03 July 2020 Article No: 01

# Smart Farming- Way of Agricultural Development

**Patil R. S.[1], Kadam M. M.[2] and Wandare G. A.[3]**
[1]Assistant Professor, Lokmangal College of Agriculture, Wadala, Solapur, Maharashtra
[2]Manager, Marketing and Communication, CCSNIAM, Jaipur, Rajasthan
[3]Assistant Professor, Lokmangal College of Agriculture Business Management, Wadala, Solapur, Maharashtra

## SUMMARY

Smart farming represents the application of modern Information and Communication Technologies (ICT) into agriculture. Following the plant breeding and genetics revolutions, this Third Green Revolution is taking over the agricultural world based upon the combined application of ICT solutions such as precision equipment, the Internet of Things (IoT), sensors and actuators, geo-positioning systems, Big Data, Unmanned Aerial Vehicles (UAVs, drones), robotics, etc.Smart Farming has a real potential to deliver a more productive and sustainable agricultural production, based on a more precise and resource-efficient approach. The process of applying robotics, automatic control and artificial intelligence techniques at all levels of agricultural production, including farm bots and farm drones. Smart Farming is a farming management concept using modern technology to increase the quantity and quality of agricultural products. Farmers in the 21st century have access to GPS, soil scanning, data management, and Internet of Things technologies. By precisely measuring variations within a field and adapting the strategy accordingly, farmers can greatly increase the effectiveness of pesticides and fertilizers, and use them more selectively. Smart farming is necessary for the overall economic development of farmers. With almost 70% of the Indian population depending on agriculture and its services and around 75% of the population residing in rural areas, agro-based economies like India are typical realm for applicability of smart agriculture. The combined efforts of the Government and industry shall kick-start this journey of rural development and steer the country towards socio-economic equality.

## INTRODUCTION

The farming industry will become arguably more important than ever before in the next few decades. The world will need to produce 70% more food in 2050 than it did in 2006 in order to feed the growing population of the Earth, according to the UN Food and Agriculture Organization. To meet this demand, farmers and agricultural companies are turning to the Internet of Things for analytics and greater production capabilities. Technological innovation in farming is nothing new. Handheld tools were the standards hundreds of years ago, and then the Industrial Revolution brought about the cotton gin. The1800s brought about grain elevators, chemical fertilizers, and the first gas-powered tractor. Fast forward to the late 1900s, when farmers start using satellites to plan their work. Agro-based economies like India are a perfect working ground for smart agriculture and its applicability. A recent study by Statista has shown that smart agriculture is expected to take up $26.76 billion of global market size by 2020 and Asia is expected to hold 40% of the global market share. According to NASSCOM report, India has around 40 startups dealing in smart agriculture. With that said, most of these firms are research and development organizations and only a nominal number of solutions have been actually implemented in the farms.

The use of IoT for digitization of farms has caught the attention of the Government of India and the same has been included in the government's draft policy released in 2015. The focus areas for smart agriculture have been identified as precision farming, data analytics for farmers, alert systems for variance in pest control requirements and storage, and drones for unmanned pest control. Recently, some commercial smart agriculture solutions have been introduced to the market. Besides this, the continuous research in this field by research as well as industrial organizations has steered a staggering growth in product development for this area. Agriculture has been a neglected field as far as technological use and applicability is concerned, which is more so in developing countries like India where funds for technological adoption are limited and technical expertise for using the available technologies is inadequate. The improving accessibility of low-cost IoT sensors and affordable solutions for smart agriculture has mitigated the challenges associated with adoption of IoT-based big data analytics in agriculture, to a large extent.

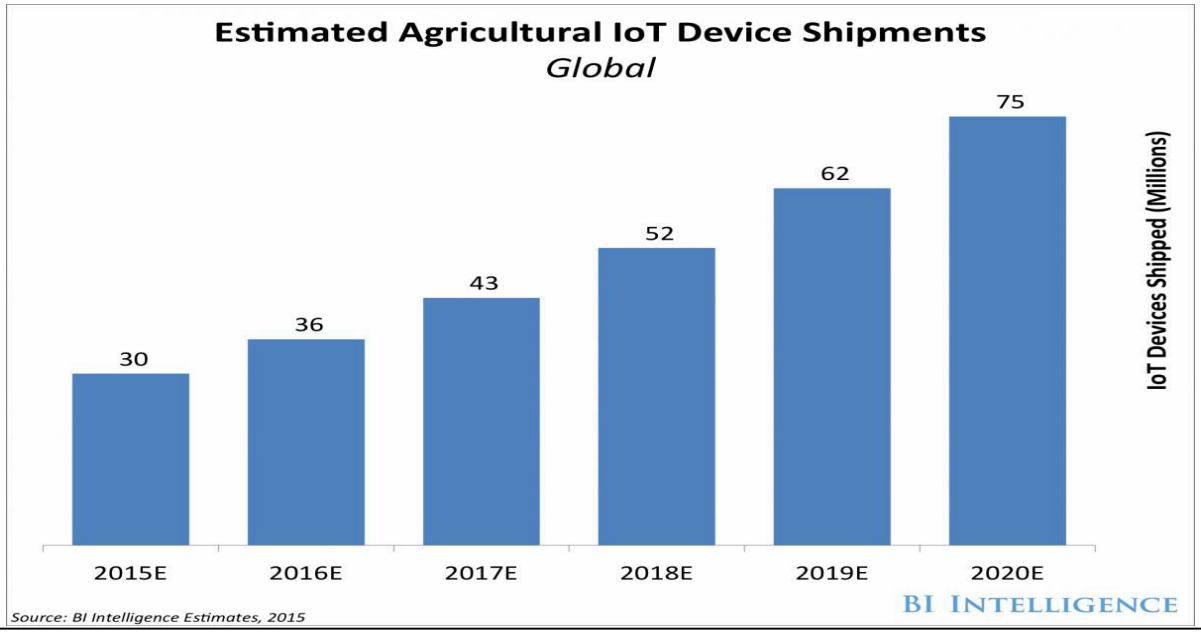


**Figure 1. Agricultural IoT device shipments**

It would not be wrong to state that IoT in agriculture is simply the coming together of information technology, telecommunications and sensor technologies. Some of the best examples of how IoT can be used in agriculture include development of smart irrigation facilities, facilitating check on soil vitals and performing a real time monitoring on crop health. In simple words, the vision is to empower farmers of different educational and cultural backgrounds and help them enhance their crop production with the help of state-of-the-art technologies. This movement can prove to be quite a revolution particularly for agro-based economies like India.

## Use Cases for Smart Agriculture

Smart agriculture encompasses a number of applications. Some of the best -known use cases of this concept are as follows –

### 1. Precision Farming

A practice or process followed for improving the accuracy and control over farming and livestock management is commonly referred to as precision farming. Typically, this practice makes use of automated hardware, sensors, robotics and control systems, in addition to other technologies, to achieve its purpose. Precision farming continues to be the most popular application of smart agriculture. Weather station is another popular smart agriculture gadget. Data collected from farming sensors can be mapped onto weather conditions to determine the best crops for the area. Moreover, this approach can also be used to make interventions for improving the capacity of cultivation and profits generated. Some IoT devices being used in this area include Pycno and Smart Elements.

Precision Farming and other Modern Technologies System of Rice Intensification (SRI), which improves the productivity of rice by 30 to 35% in the conventional varieties and over 50% in hybrids, is another potential source of technological revolution for small and marginal farms. It is a skill intensive technology that cuts the need for inputs such as seeds and fertilizers while raising yields per ha. The area under SRI has increased progressively since 2000-01. The leading states that are practicing this are Tamil Nadu, Bihar and Tripura. The government may consider expanding the scope of the technology through extension programs as a part of its strategy to bring the Green Revolution to eastern India. Similarly, modern machinery such as laser land levellers, self-propelled sprayers, precision seeders and planters, transplanters for rice and vegetable seedlings, multi-crop threshers, harvesters for cereals and sugarcane today allow technically highly efficient farming and resource conservation. The single operation of laser levelling can reduce water application charges by 25 to 30% with greater water use efficiency. Coupled with precision farming, the resources conservation technologies like zero

tillage and residue management can reduce the cost of cultivation by 25 to 30% over conventional farming practices. It is predicted that in the next ten years, Nano-technology led application will play a critical in agriculture.

These applications are related to release and efficient dosage of water and fertilizers and drugs (for livestock) and herbicide delivery. We may also see the emergence of Nano sensors for soil quality, plant health monitoring and pests detection. The Nano-particles for new pesticides, insecticides, and insect repellents may also come to play an important role. Recently, Madhya Pradesh has introduced a programme on raised bed planting of soybean in the State. Planting of soybean on ridges has helped conserve water and raise productivity. Micro irrigation via sprinklers and drips has helped bring dramatic change in several pockets of the country especially in undulating topography and sand dunes areas where no other method of irrigation can work. Hi-tech horticulture like poly house cultivation of vegetables, flowers, medicinal plants and fruits constitutes one of the most technology and skill intensive agricultural practices. Being remunerative and skill oriented it can also attract youth. However, being capital intensive, it requires access to credit and participation of business entrepreneurs. While technology and knowledge intensive agriculture holds enormous promise, it must be remembered that they are also capital intensive and would displace labour. Therefore, while the government may create a facilitating policy framework for private entrepreneurs to engage in these practices, it should resist the temptation to indiscriminately subsidize them and prematurely push farmers towards them. The emphasis should be on informing farmers of the opportunities new technologies offer, improving access to credit and creating an enabling policy environment for their adoption without major direct financial commitments.

### 2. Smart Greenhouses

Smart greenhouse is a step ahead of the regular greenhouses. In these setups, the microclimate is controlled and monitored to ensure optimal plant growth. Some of the smart agriculture solutions that support this capability include Growlink, Farmapp and Green IQ.

### 3. Livestock Management

There are specialized sensors for livestock management that can be attached to every livestock animal on the farm. These sensors collect data about animal health and maintain a log of the performance. Solutions like Cowlar and SCR by Allflex place collar tags on the animal and record data like health, activity, nutritional data and temperature. Insights on the herd can also be provided on the basis of collective data assessment.

### 4. Agriculture Drones

Drones can be put to excellent use in the agricultural industry. Typically, there are two types of drones namely, ground-based and aerial drones. These drones can be incorporated in agricultural systems for applications like soil analysis, field evaluation, planting, irrigation and assessment of crop health.

Some of the characteristic benefits of using drones for this sector comprise –

- Saves time
- Easy to use
- Includes GIS mapping
- Allows imaging of crop health
- Increases yield

The use of drones provides immense control to the farmer in terms of the field, altitude and resolution of ground, the farmer wants to survey. Therefore, drones basically collect data, which can later be used for yield prediction, plant counting, measurement of plant height and health indices, drainage mapping and canopy cover mapping, in addition to many others. Agriculture has been recognised as the core of the Union budget for the year 2019-20. The Government of India has planned to invest widely in agriculture infrastructure to provide assured income to small and marginal farmers. It has made Niti Aayog a national think tank to establish and conduct programmes and research on technologies of the future namely, machine learning and Artificial Intelligence (AI) to facilitate the economic development of our country.

Uzhavan app, Ag mobile, CCMobile app, IFFCO Kisan are some of the applications developed keeping in mind the need of the hour requirements in farming. Several notable initiatives like e-choupal, Agri market, Kisan Suvidha and the more recent e-NAM had long been trying to place agriculture as the forerunner.The current budget has outlined setting up of 20 technology business incubators to develop at least 75,000 skilled entrepreneurs in the agro-rural industry. Further, Rs 805 crore has also been allocated to Pradhan Mantri Matsya Sampada Yojana (PMMSY) to address critical gaps in the value chain including infrastructure, modernization, traceability, production, productivity, post-harvest management and quality control through integration of latest technology.This will eventually pave way to achieving long-term sustainable agriculture goals of environmental health, economic profitability and social and economic equity. In a research, conducted in China in 2013 on agriculture-based on cloud computing and IoT (Internet of Things), the integration of IoT in farming mainly facilitated soilless culture, solution control technology, artificial photosynthesis technology, growing environment control technology (carbon dioxide density, humidity, wind pressure and speed) and intelligent irrigation technology. After several years of intense work, China's industry and information ministry has achieved remarkable success in projects like 'Every village project', 'Golden Agricultural Project', 'The three Dian project (Computer, Television and Telephone network coverage in rural area)'.

However, as more emphasis was laid on hardware than software, there was a lack of communication of right information to the farmers. This led to the development of an agricultural information cloud with integration of IoT and RFID (radio frequency identification) technology. Also, the agriculture sector, has, in recent times visualized the integration of IoT and farming practices in development and conceptualization of plant factory technology. For example, a lighting sensor and a video sensor can show the distribution of the intensity of light in real time and monitor the size of the plant. This would help determine the stage of the plant growth. The health condition of plants, thus, could be obtained in real-time by the spectral analysis of the images of the plant. Data from the global positioning systems (GPS) and wireless sensor nodes (WSN) also served as powerful monitoring tools to supervise parameters and correlate between them. Geo-referencing methods that employed the use of unmanned aerial vehicles and drones were observed to have a positive impact on crop cultivation and pesticide control. Data stored in these sensors and farm equipment and machinery was shared periodically to the farmers through a mobile phone connected to GPRS. The farmers could remotely monitor and control on-field sensors like switching on/off a pump/valve when water level in the field reaches a specific threshold value or take important decisions with the help of deep learning algorithms involving crop management.

In Brazil, a Smart Farming project was studied intensively. It involved digital revolution, AI, mobility with intelligent sensors. It led to the identification of more innovative products, process optimization and managing effective agricultural production. The project was, in 2014, executed as collaboration between Dutch research institutes, Dutch industry and Dutch agricultural businesses. The collaboration led the Smart Farming consortium to investigate the possibility of using remote sensing solutions in the cultivation process. The trend in variables like sunlight, humidity, temperature, rain was obtained from the archives of Royal Netherlands Meteorological Institute to gain prior knowledge on deviations in seasons in comparison with previous years. From the satellite images, the Normalized Difference Vegetation Index (NDVI) values were deduced, which served as an indication of the amount of photo-synthetically active vegetation on the region.Using historical analysis, the variety specific NDVI curve was established and its relationship between the variables was identified. This information was observed to be crucial in formulation of data driven models. In the year 1980-1983, a global study on vegetation types were conducted using satellite images. It was observed that the NDVI highly correlated with vegetation parameters such as green-leaf biomass and green-leaf area.

Incidentally, India was found to have high NDVI values. This could potentially serve as a key driver to increase sustainable farming practices in India. Next On, a South Korean company in 2018, successfully built the country's largest smart farm inside an abandoned road tunnel. The indoor farm provided ideal conditions with a steady temperature and the right amount of artificial light and rest of the factors were controlled by IoT. The company signed an agreement with the South Korea government to develop an indoor vertical farm as an alternate solution to prevent damages to crops due to extreme weather conditions. It successfully cultivated more than 60 different types of fruits and vegetables. Foods produced from the farm were found to be healthier as they had reduced insect infestations being in a closed environment.

In India, the Union Ministry of Earth Sciences and Agricultural Meteorology Division of the India Meteorological Department (IMD) have in their mission 2030, proposed the formation of an integrated unit involving the IMD, Indian Council of Agricultural Research (ICAR) in collaboration with the different institutions like agricultural universities, ICAR Institutes, state department of agriculture, department of information technology, department of space, MS Swaminathan Research Foundation and non-governmental organisations,etc in a phased manner. The inter-institutional collaboration could be further strengthened at national and international level in the field of agro-meteorological activities. The National Mission on Agricultural Extension and Technology (NMAET) as a part of sustainable development group aims to strengthen and restructure mechanisation and plant protection to enable delivery of improved agronomic practices to farmers. This was planned to be achieved through interactive methods, using information and communication technology (ICT), which includes messaging services, web-based applications, capacity building, institutional strengthening, encouragement of public-private partnership and training services to guide farmers. Our government, thus, has acknowledged the role of ICT in agriculture for sustainable intensive farming; and the newly established farmer producer organisations ensure to provide a conducive atmosphere between the central and state government enabling farmers to get fair price for their produce and understand the ease of doing business.

### 5. Farm Management Systems

A number of IoT devices can be installed on the premises for measuring different farm parameters for collecting data. Analytics are performed on this data and reported via a dashboard. These systems are also referred to as farm productivity management systems. Logistics, storage management and vehicle tracking are some of the best examples of this use case. Commercially available solutions belonging to this category include Cropio and Farm Logs.

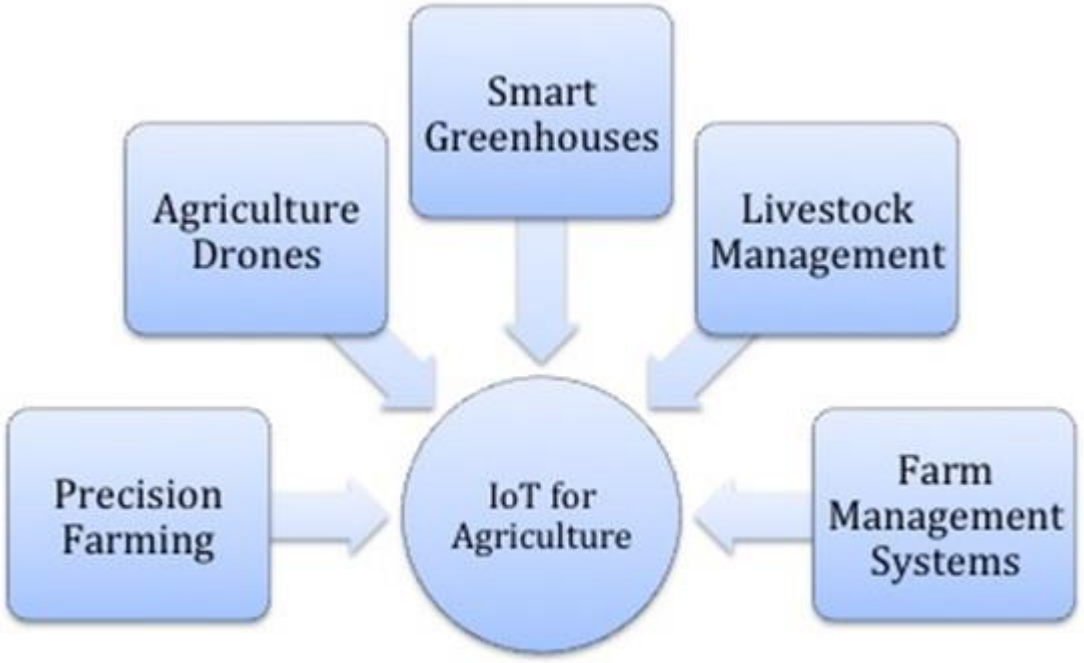


**Figure 2. IoT for Agriculture Use Cases**

Open Cube, a Bengaluru based organization, has been actively involved in the development of an open-source IoT-based agricultural products. They are focused towards development of a handheld, farmer friendly device, based on Raspberry Pi and Arduino, which shall be able to perform livestock management, irrigation management and assess crop and soil health, on real-time basis. A valuation of crop and soil health will allow farmers to make informed decisions about the type and quantity of fertilizers required.

Precision farming is cited as the top agendas of smart agriculture. Ag Next Technologies is a Punjab-based organization that has recently launched satellite combinations and drones for smart agriculture. One of the

their recent solutions uses satellite imagery, IoT, weather forecasting and artificial intelligence – based image processing for evaluating the presence of diseases and pests in large areas. Moreover, predictive analytics related to the same are also provided. However, these failed to address specific farmer-centric issues. While the aforementioned solutions only focus on crop and soil health for analytics, Energy Bots Private Limited, a Gurugram-based organization, has come up with a smart watering system. The developed IoT device, which makes use of GSM and allows farmers to control the switching on and off of the motor pump from their mobile phones, use the humidity and moisture sensors to get data for the microcontroller and controller. They can send a SMS or missed call for switching the pump on/off or schedule the on/off timings. Moreover, whenever an action is performed, the famer is notified via a message.

## Benefits and Challenges

IoT has the capability to modernize agriculture and initiate exponential growth in the sector. It is all set to change the way cultivation and warehousing is done. Moreover, it is expected to reduce wastage and improve profit margins remarkably. In view of the fact that agro-based economies like India heavily depend on agriculture for growth, IoT-based initiatives can contribute to national growth in a massive way.

**The benefits of using IoT in agriculture include –**

- The effective use of inputs helps in reducing wastage and thus, decreases costs incurred.
- Losses due to diseases and infections can be reduced, by continuous and real-time crop monitoring.
- The use of water can be optimized, which in turn shall reduce water wastage.
- The use of IoT-based devices allows better management of farm activities.

With that said, adoption and implementation of IoT-based smart agriculture solutions in countries like India has its own set of unique challenges and limitations. Firstly, there is a lack of awareness in farmers as far as technology-based farming solutions and their applicability are concerned. This, also, stems from the lack of knowledge and fear of upgrading to a technology of higher level. In order to develop commercially viable solutions, it is critical to keep these factors in mind. The solution must function in local languages and have interfaces that are easy to understand for laymen. In addition to the above-mentioned, some technological challenges also act as roadblocks in the widespread usage of IoT. Most of the products available in the market suffer from vendor lock-in; therefore, the customer is completely dependent on the vendor for products as well as services. Any changes desired by the customer require him or her to switch between vendors, which can prove to be costly.

Besides this, developers recommend the use of high quality sensors in view of their better life and durability. Such sensors are expensive and may or may not fit into the budget requirements of farmers. Moreover, solutions offered to the Indian market must be scalable considering the variable size of farms in India. Therefore, organizations must be able to offer solutions that are scalable and cost-effective, both at the same time.

## CONCLUSION

It can best be described as an ecosystem that integrates technologies of different domains to solve specific problems. With almost 70% of the Indian population depending on agriculture and its services and around 75% of the population residing in rural areas, agro-based economies like India are typical realm for applicability of smart agriculture. The combined efforts of the Government and industry shall kick-start this journey of rural development and steer the country towards socio-economic equality.

## REFERENCES

Raising Agricultural Productivity and Making Farming Remunerative for Farmers*, NITI Aayog, Government of India, 16 December 2015

Ravi Gorli, 2017. Future of Smart Farming with Internet of Things, Page 27-38© MANTECH PUBLICATIONS 2017.

Samiya Khan, 2018.Smart Agriculture in India: Possibilities, Benefits and Challenges. Science.

Sriram Rajagopalan and Mathangi Sriram, 2019. How IT, communication can boost sustainable farming in India. Down to Earth magazine.