ROLE OF INTERNET OF THINGS IN SUSTAINABLE AGRICULTURE IN INDIA

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Abstract: Contribution of agriculture for the overall development of the nation is always endorsed by its citizen and policymakers. Hence, there is an urgent need to foster sustainable development in India. In the digi-tech world, Internet of Things (IoT) has great role to play in the new facet of agricultural revolution and will play a crucial role in promoting sustainable agriculture too. IoT technology is used in various fields like healthcare, smart cities, traffic, retail, agriculture, and many more, but the usage of IoT application is going to be a game-changer for the agriculture sector and for the humanity. IoT technology helps in providing the solutions to the farmers in various ways such as by reducing the damage gaps by maintaining high yield production, taking care of environmental safety, maintaining climatic conditions, and also helps in increasing the profitability of farming sector. IoT technology also reduces carbon footprints in the farming process and production.

INTRODUCTION

Contribution of agriculture for the overall development of the nation is always endorsed by its citizen and policymakers. It provides much-needed employment and provides livelihood to the masses. Although, India is having highest contribution from service sector, yet more than half of the workforce is engaged in agriculture sector to earn their livelihood. Agriculture remains one of the important occupation even though its contribution has confined to 17.8 per cent of our Gross Value Added (2019-20, at current prices). It contributes directly and indirectly to the well-being of nation, thus agriculture development is very crucial for the attainment of inclusive and sustainable development (Mohapatra, 2015). To meet the rising food requirements on account of growing population and in meeting the demand of industry, not only agricultural productivity should increase but it should be perennial and sustainable in nature. Hence, there is an urgent need to foster sustainable development in India. In the digi-tech world, Internet of Things (IoT) has great role to play in the new facet of agricultural revolution and will play a crucial role in promoting sustainable agriculture too.

The envision of Government of India to become a US $ 5.0 trillion economy by 2024 and US $ 7.0 trillion economy by 2030, can be possible by adopting disruptive approaches in transforming Indian agrarian system. IoT-based solutions in the farming system in India will certainly transform the economy in achieving sustainable development. The third agriculture revolution has given the momentum in the transformation processes by adapting high-end technology and cloud-based solutions in data-driven decision making. Application of IoT has great potential in enhancing agriculture productivity and will laid the foundation for sustainable agriculture in India (Hiremath and Mohapatra, 2020).

IOT TECHNOLOGY & ITS APPLICATION

In today's digi-tech world, IoT technology is used in various fields like healthcare, smart cities, traffic, retail, agriculture, and many more, but the usage of IoT application in

agriculture is going to be a game-changer for the agriculture sector and for the humanity. IoT technology helps in providing the solutions to the farmers in various ways such as by reducing the damage gaps by maintaining high yield production, taking care of environmental safety, maintaining climatic conditions, and also helps in increasing the profitability of farming sector. IoT technology also plays a crucial role in soil inspection, air inspection, temperature inspection, water inspection, decease inspection, and most importantly fertilizer inspection and pest inspection (Farooq *et al.*, 2020).

The continuous increase in global population demands a 70% increase of the world's food production by 2050 (UN Food and Agriculture Organization), but due to the depletion of limited natural resources and shrinking of agricultural lands, there is an urgent needs to augment farm yields (Khan *et al.*, 2021). Finite availability of natural resources such as fertile land and fresh water, leads to slowing down of yield traits in several staple crops. Also, impeding concerns over the farming enterprises include the shifting structure of agricultural team of workers, climate changes, deteriorating soil, drying lands and collapsing ecosystems. Therefore, adoption of IoT-based solutions in farming practices is much required for maximum production at low cost and also to minimize the wastage.

IoT technology facilitates farmers and producers to reduce the use of fertilizers quantity and able to know the exact requirement of water and other resources. With the use of IoT technology, farmers can check the conditions and keep the track on farming areas from anywhere at any time. This technology helps in providing instructions and guidance to the farmers to plan and work further, according to the data, information and facts furnished by the IoT systems. For example, if the moisture of the soil decreases during the crop production process, then sensors with AI-technology notify the farmer and accordingly based on the instructions, it also automatically starts the process of irrigation and stops when water comes at the required level.

IoT technology in farming contains devices like Wi-Fi connectivity, IT-services, etc. Also, BI Intelligence survey forecasts that the adoption of IoT devices in the agriculture sector will attain seventy-five million in 2020, evolving 20% yearly (Horwitz, 2020). And the global agriculture market size is predicted to grow by three times higher by 2025, accomplishing $ 15.3 billion (as compared to $ 5 billion in 2016).

ROLE OF IOT TECHNOLOGY IN SUSTAINABLE AGRICULTURE

Application of IoT technology transforms agriculture sector in various ways. Data collected by smart agricultural technologies like sensors, detectors, control structures, automated hardware help the farmers to maximize their farm yield. These technologies provide information which lead to better farm management. Major role played by IoT technology is in irrigation process in agriculture, which is called as smart irrigation in sustainable farming. It works as a combination of soil sensors and cloud-based analytics where it monitors moisture in the soil that gives accurate analysis and information to farmers. As and when they need to water the land, it automatically start watering the land and also stops the process when water (irrigation) requirement is completed. This not only conserve valuable resources but also helps in preventing over-watering problem.

Smart greenhouse designed with IoT intelligently monitors and controls the climate and weather changes to augment higher production and also helps in promoting energy conservation. All this can be done with the help of solar power based IoT sensors, which not only helps in controlling weather-related problems but also predicts climatic conditions. Sensors in this technology also helps in contributing in conservation of energy by monitoring and controlling temperature, light level and also humidity level of the soil. IoT technology also reduces carbon footprints in the farming process and production.

Drones are also used in agriculture to enhance productivity through minimal use of manpower in irrigation, crop monitoring, fitness evaluation, planting, soil and discipline analysis. With that, predictive analytics in smart farming helps the farmer to determine their

future plan concerning to production of crops, its storage and threat management. Farmers can get correct soil records both with the aid of dashboard or by a customized cell of software (Ayaz *et al.,* 2019).

Broadly, IoT technology is going to be applicable for large-scale producing farmers, however India is a country where good number of small farmers and marginal farmers are there and they contribute a higher percentage to the overall production. Therefore, IoT supporting sustainable technology is not only meant for large farmers but also going to work really well for small farmers, like greener greenhouse and smart irrigation. These technologies are one time investment but work for so many years.

Now a days, the world is going digital and the facts, data and information are considered to be the long-term asset and found very reliable. Data from IoT technology guides farmers' decisions, and supports them to cultivate smartly and more securely and further adapt quickly in ever changing situations. IoT technology helps farmers in various ways:

- It takes less time to check farm conditions and infrastructure, which ultimately leads to saving time and labor cost.
- It helps in improving farmer's decision making via information analytics using IoT technology.
- It provides quicker and faster insights because of real-time statistics throughout the price-chain, and helps farmers to respond what the market desires, depending upon the seasons.
- It helps in less wastage of food crop due to actual facts provided by the technology of what type of food crop to produce and how to produce that.
- It helps in building skills for new and emerging technologies.
- It supports and contributes to the ongoing innovation and enhances productivity which ultimately saves the time and also reduce the cost of farming.

ISSUES AND CHALLENGES

Apart from various benefits of IoT technology, it has some issues and challenges especially in developing countries like India where number of small & marginal farmers are more. These issues and challenges are:

Security: Major problem is of security, and that needs to be addressed which arises at different level of usage the IoT technology. Farmers can face difficulty of loss of data, problems of limited memory and also the issues of low energy consumption level etc. In agricultural field, there is a big problem of physical security as well like attacks of animals on sensors and technologies which are used in soil for monitoring and evaluation purpose.

Cost: While implementing IoT in farming, various cost related issues emerge like introducing and running expenses. This includes metalware costs comprising of IoT gadgets/ sensors, base station foundation, and passages. Also, strolling charges incorporates a continuous membership for the control of tech-devices, exchange of measurements among different administrations etc.

Lack of Knowledge: Lack of expertise among farmers who are living in rural areas faces major hindrances especially in country like India. As most of the farmers are not that educated, hence proper training and counselling of farmers is necessary for successful implementation of IoT in agriculture before deploying large infrastructure.

Reliability: Major challenge IoT devices/ sensors faces is of harsh physical environmental conditions which at times disturbed communication channel and causes failure of data and facts. Thus, it is very important to monitor physical protection and security of those established devices in farm land and also very much required to safeguard them in very good physical conditions for smooth functioning and working.

Reluctancy: Farmers are little hesitant in adopting new like PA/tech-driven-farming and are not well–acquainted with it and with its uses and also shows least interest in IoT technology implementation (Hiremath and Mohapatra, 2020).

CONCLUSION

Considering the future of the green economy, agriculture sector is going to play a major role in the development of nation and thus it is vital for the government, corporates and NGOs to support actively for the use and establishment of IoT technologies in farming sector. Their support and organised effort will increase the production definitely and also helps in attaining food security. IoT technology not only helps the big farmers but also the usage of basic IoT systems will help small and marginal farmers of the country. These farmers can get the benefits in terms of low cost of production, high quality with quantity of production. Therefore, IoT enabled farming can be a solution for the problems like wastage of resources, low productivity, untimely monitoring, demand forecasting, unavailability of man power etc.

For AI-technology in India, government initiated several schemes for agricultural development. Similarly Pradhan Mantri Fasal Bima Yojana (PMFBY) helps in reducing the time consumption in settling claims of the farmers. Government of India also signed MOU with IBM to monitor the agriculture sector with IoT technologies which will surely facilitate sustainability in farming (Kumar and Sharma, 2020). Government is playing a crucial role by putting resources in creating and carrying out those IoT advances or giving endowments, so that producers and farmers can manage the cost of their production effectively and efficiently and that will help in promoting sustainable agriculture. It is crucial for the government to promote IoT technologies by suitable technical support and providing appropriate training to the farmers of all categories. The technical knowhow transfer and timely support by the tech providers should be given more priority in augmenting sustainable agriculture through IoT technology in India.

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