IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

# REVIEW ON APPLICATIONS OF INDUSTRY 4.0 IN AGRICULTURE SECTOR

[1]Neha Sharma,[2] Sadhana Tiwari,[3]Anil Khandekar

[1]Assistant Professor,[2] Assistant Professor,[3]Associate Professor
[1]Electronics and Communication Engineering department
[1]Prestige Institute of Engineering, Management and Research, Indore, India

***Abstract:*** The presented review the steps of the industrial and agriculture revolution that have taken place in recent years, giving future prospects also. This paper gives an overview of industrial revolution and the specific technologies that can be applied to various agricultural applications. The implementation of Industry 4.0 improvises the outcome of agricultural sector. However, industry is progressing and implementation of industry 4.0 is also started but there are some challenges faced by agriculture sector to cope up with agriculture 4.0. Presented review can give oversights that how the technological development affects different sectors and aspects of agriculture in different ways.

***Index Terms*** **- agriculture 4.0; industry 4.0.**

## I. INTRODUCTION

The rapid use of technologies in agriculture help in increasing productivity, and it is the need hour. The main income source in India is an agriculture sectors, most of the population depend on farming and related works. Agriculture is the backbone for Indian Economy. So, it is required to improve our traditional farming into precision or smart farming. Industrial development reaches to fourth level and its use make revolution in agricultural sectors on large scales, to improve the farming yield effectively.

Agriculture provides humans with food and raw materials. Precision farming under agriculture 4.0 is a promising way to increase the sustainability of farming by increasing farm profitability, reducing manual labors and reducing environmental impact.
These innovations affect small and medium farms, which must invest in advanced technology to cope up with the evolution [1, 2]. The objective of presented work is to review fundamentals of Industry 4.0 revolution and explore the potential of fourth industrial revolution for sustainable growth in agriculture.

## II. AGRICULTURAL REVOLUTION

Green revolution made lots of changes in agriculture sector but growing crops and maintaining livestock remained the same; methodologies changed and influenced the results. Emerging technology Industry 4.0 brings a technological revolution in agriculture sector. Due to increasing demands of population, more intensive farming practices must be adopted. Technological innervations in agriculture practices can yield sustainable growth.
Industry 4.0 is cited from 2014, while Agriculture 4.0 is recently quoted. The industry 4.0 covers the details of production methods [3, 4], combination of firms, suppliers, and customers, logistics processes, lean production qualified workers and new managerial practices [5, 6].
Adoption of the Internet of Things (IoT) for agriculture can boost the volume and quality of items in the industry by enhancing the quality of crops and fertility of the land. IoT Systems basically consist of smart sensors, device connectivity, data processing, cloud and user interface. With the application of Artificial intelligence (AI), computer and machine vision have made remote monitoring of farms and data analysis.
Innovation and technology uses in farming can provide accurate and efficient approach results in a more productive and sustainable farming." The farming industry has only just begun to make use of digitalization," says Dr Jan Regtmeier, director product management, HARTING IT Software Development.
Smart farming involves the replacement of Regular machines to self-aware and self-learning machines and this is supported by Industry 4.0 which enhances overall performance and maintenance including surrounding interaction. Industry 4.0 can felicitate an open smart platform for real time monitoring and tracking the status farming processes and delivery of control instruction.

## III. INDUSTRY 4.0

The Industry 4.0 is transforming traditional practices combined with the use of latest smart technology. It is based on use of machine to machine communication (M2M) and Internet of Things (IoT) in order to increase automation, real time and self-monitoring [7]. There is also provision of smart machines that can analyze real time issues and diagnose it, without the need for human intervention. The Industry 4.0 consists of many components such as Mobile devices internet of Things (IoT) platforms Location detection technologies, Advanced human-machine interface, Smart sensors, Augmented reality/ wearable's etc, Fog, Edge and on-demand availability of computer system resources. All the components can be categorized into four segments: Physical systems, IoT and Computer system resources

The Industry 4.0 trend is a transforming force that depend on disruptive technologies such as Internet of Things, Big Data, Artificial Intelligence, and of digital practices: cooperation, mobility, open innovation [8]. They imply a transformation on connected farms, production equipment, connected transportation systems and machines. This as a result enables increased productivity, quality and environmental protection. In addition to this, it will update value chain and business models with more knowledge gathering, analysis and exchange

With the advent of Industry 4.0 the new term Agriculture 4.0 is also introduced and defined as the next big trends facing the industry, including a greater focus on precision agriculture, the internet of things (IoT) and the use of big data to drive greater business efficiencies in the face of rising populations and climate change.
In 2018, the World Government Summit published their report called Agriculture 4.0 and addresses four main features: Demographics, Scarcity of natural resources, Climate change, and Food waste.
Industrial Revolutions
The First Industrial Revolution began in the 18th century with the mechanization of production. What before produced threads on simple spinning wheels, the mechanized version are eight times more efficient the simple spinning wheels. Steam power was already known. The use steam power for industrial purposes increased the human productivity. Steam powered locomotive brought massive changes and humans and goods could move to more distance in shorter span.
In the 19th century with the invention of electricity and assembly line production second Industrial Revolution began. Henry Ford (1863-1947) introduced the concept of mass production in automobiles, where vehicles were produced in partial steps on the conveyor belt - significantly faster and at lower cost.

| Industrial Revolution | Development | Outcome |
|---|---|---|
| Industry 1.0 | Mechanized Production | Steam Engine |
| Industry 2.0 | Mass Production | Assembly lines and electricity |
| Industry 3.0 | Automation | IT & Electronics |
| Industry 4.0 | Connectivity | Smart technologies, cloud computing, big data, networked machines and processes |

Table 1.1

3rd Industrial Revolution began in the 20th century through partial automation by programmable controls and computers. Introduction of these technologies had automated the production process - without human assistance. Currently we are on transformation phase of industry 4.0 the fourth industrial revolution. It involves the application of information and connectivity. It rots are Third Industrial Revolution. Production systems, computer technology, network connection. This is the next step in production automation [9, 10].

## IV. AGRICULTURE 4.0

Real-time weather data collected through weather stations or by different sensors includes information about various parameters like humidity, rainfall, temperature and more. Alerts are sent if weather conditions are unsuitable. One US-based company that gives smart climate insights using machine learning algorithms to farmers, crop consultants and retailers.
Soil parameters measured using sensors are texture, salinity levels, nutrient status, organic content, etc. Trace Genomics has developed an analytics engine to map the living soil and protect it.
It allows farmers to make better decisions about the crops that can be grown, their harvesting and future-planning for that land. By optimizing planting of seeds, better seed-spacing and depth-control are guaranteed. Based on the amount of light reflected back to the optical crop sensors, sensing the correct amount of fertilizers needed by the crops is done in real time to prevent runoff of excess chemicals into nearby water bodies.
Variable-rate applications (VRA) are centered on understanding the relative productivity of different areas based on data obtained from sensors. Automated equipment and machinery can then be used to optimally apply herbicides, fertilizers and the like at variable rates and prevent overlapping. Maps and GPS ensure that machinery navigation and positioning are accurate. Nano materials-based Pesticides and insecticides further improve precision [10].

Drones, both ground and aerial, are being used for crop planting and monitoring, field analysis, etc these days. With thermal or multispectral sensors, irrigation patterns essential for various fields can be identified. Irrigation can be controlled remotely through a PC or mobile. Companies like Drone Seed, Agribotix, Skycision and HiveUAV have been providing drones for agricultural applications [11, 12].

Utilizing optical sensors, drones and satellite imagery, it is also possible to assess the health of various crops. Using mobiles and tablets, any pest population or weed activity on the farm can be checked, and then effectiveness of pest- and disease-control procedures can be evaluated. One of the most common methods is Normalized Difference Vegetation Index (NDVI). It uses wavelengths of infrared (IR) and visible light to detect crop variability and different crop stages.

Many companies are also building farm robots. These are commonly used for automation of agricultural processes like planting, irrigation, weed management, harvesting crops, fruit picking, plugging, soil maintenance and so on. For instance, Ecorobotix and Blue River have come up with robots that can identify weeds in real time using cameras and communicate the information to another piece of machinery through telematics to decide on the appropriate action that needs to be taken for dealing with them.

## V. UTILITY OF INDUSTRY 4.0 IN AGRICULTURE SECTOR

### 1. Livestock monitoring

The IoT based systems are able to gather information about the location and health of cattle by installing cameras around barns and pastures for remote monitoring of animals from anywhere. RFID at various frequencies, GPS and biometrics can automatically identify and provide important data about the livestock. This data can be interfaced to boards such as Arduino, Resberrypi [11]. It will be published to server for real time monitoring of related parameters Apps like Connecterra IDA is used for getting updates about the animals. This way each animal gets special attention and a database of their history can be maintained. This also assists in easily locating and separating sick animals from the rest to prevent spreading of disease. For example, Cow Manager by Agis Automatisering is a cattle-tracking sensor and software solution [10].

### 2. Software and platforms for data management

The IoT sensors collect a huge amount of data that cannot be stored on a conventional database system. Cloud-based data storage and end-to-end IoT platforms ensure that data related to weather, livestock and crop get analyzed using tools for predictive analytics.

Many apps available in the market can be used for real-time data collection by field teams and to send updates. Software platforms like Cropio pile data from different hardware devices used in precision agriculture on a central platform for processing and analyzing, which is crucial for making effective choices for managing farm operations. Data platforms provide aggregated data to farmers at a single location as a resource. Task management tools can easily create budgets and operation strategies for production, and compare yields against standard values [10].

Cloud-based apps can guide farmers on how to adjust their production based on market demand and how to improve their yield and profitability. Today, a farmer can micromanage farming and all its accompanying activities — even before planting crops, it's feasible to estimate the results by tweaking the variables involved.

### 3. Precision farming

Indian Farming has been largely dependent on favorable natural forces, but not with the recent technologies such as IoT big data and cloud computing together felicitate the collection of sufficient data points to make good decisions related to farming.

Now it is possible to create knowledge repositories that help in vehicle tracking, field observation, and inventory monitoring. The goal of this is to analyze the data, generated via sensors, to react accordingly.

Precision Agriculture practices are becoming more popular and efficient using smart farming applications such as livestock monitoring, irrigation monitoring, database collection and vehicle tracking, now it is possible to generate data through sensors and analyze that information to take intelligent and quick decisions. Analysis of soil parameters, moisture and nutrient level is also possible using sensors and real time monitoring of all theses is possible using IoT. These IoT based systems help to increase the operational efficiency of farming [13].

### 4. Smart Greenhouse

IOT based greenhouse system helping the farmers to carry out the work automatically. It protects the plants from extreme weather conditions like wind, hailstorm, ultraviolet radiations, insect and pest. Temperature, humidity, light intensity and soil moisture can be easily monitored in greenhouse. It involves the data collection, processing and publish the same on internet server so that information can be monitored remotely.

Smart Greenhouse is more efficient over conventional farming by producing insecticide and pesticide free crops and creating a climate for the proper growth of plants. Moreover, this system can be installed by any individual in his house (Rooftop greenhouse), who doesn't have knowledge about farming. it is possible to cultivate any type of crop using this controlled environment. Also all the necessary parameters such as humidity, soil moisture and light intensity are kept in mind according to the species of the plants. These parameters of all the sensors can be controlled by the user itself, making it much easier to cultivate various species and types of plants [16].

### 5. Data analytics and decision making

Large scales data is collected by IoT systems and it needs cloud based data storage which can be further analyzed and transformed into meaningful information using big data analytics. The data analytics helps in the analysis of weather conditions, livestock conditions, and crop conditions. Collected data can be used further for better decision making. With the help of the IoT devices, you can know the real-time status of the crops by capturing the data from sensors. Using predictive analytics, you can get
an insight to make better decisions related to harvesting.

**6. Agricultural Drones**

Technological advancements have almost revolutionized the agricultural operations and the introduction of agricultural drones is the trending disruption. Assessment of crop health, crop monitoring, planting, crop spraying, and field analysis will be more efficient and safe using agricultural drone. With proper strategy and planning based on real-time data, drone technology has given a high rise and makeover to the agriculture industry [15].

**7. Customization and urban Farming**

3D printing supports customization. If a farmer needs a specialized tool to perform a specific job, they can have one 3D printed one in as little as a day. This ease of customization allows farmers to accomplish even the most unusual tasks with greater ease and comfort. 3D printing wax or resin casts or patterns is the most affordable process for making tools but binder jetting with ExOne could also be used for this application. Urban farming is becoming more common as the population is growing but available land shrinks. Indoor farms may have specific equipment needs. Due to their need to fit in the buildings that house them and make optimal use of available resources a lot of the parts can be custom parts. In this scenario 3D printing can provide cost-effective solutions by creating parts for things such as autonomous farming processes. Urban agriculturists can print infrastructure such mounting brackets and light fixtures [17].

A growing farm will need new buildings, when planning structures like grain facilities, farmers need to design them carefully so construction goes smoothly and stays within budget. By 3D printing scale models of the structures they wish to build, they can make the planning process more comprehensive.

Farmers can use prototypes for more than construction. Using technology like LiDar, they can scan and create 3D models of their farmland to understand the area's terrain better. These representations can highlight issues like erosion or catchment spots, which are zones where water collects from the surrounding land [15].

**8. Challenges in adoption of Industry 4.0:**

Although integration of the Industry 4.0 technologies, practices and mindset in the agricultural domain produces good results but still adoption will take time. As standardization requires the ability to invest for equipment's and supporting infrastructures. Standardization in the field is mainly achieved by the AEF and the AgGateway, each focusing on different aspects of interoperability. The investment in new technologies faces important disparities with the risk of creating gaps in production abilities between regions and exploitations.

Another important challenge in the adoption of the industry 4.0 in agriculture is the development of communication infrastructures in rural areas. Deployment of wireless communication networks is required for smooth exchange and data analysis. Updated infrastructure and equipment's required skilled employees so there will be urgent need of educating and training the manpower. This also leads to rethinking on the organization and its processes to maximize new outcomes

An industry 4.0 process has led to major environmental issues, e.g., soil degradation, erosion, compaction, and pollution [115,116]. This also deteriorate the soil quality and of the eco-systemic services [16, 17]. Therefore, technology adoption must be done in accordance with sustainability factors.

Along with this there is not much clarity for data security and the legal issues and security relate issues become more prominent. The IT controlled and automatic processes can be cause for loss of jobs for lower educated part of the society.

**VI .CONCLUSION:**

Industrial revolution always supporting the human life and in continuation Industry 4.0 has also huge possibility to make agriculture sector more efficient and productive. Some of the technological solutions are already in use by some established enterprises but still there is long way to go for actual implementation on ground level. Skilled manpower, resource allocation and supply chain management is still a challenge.

But with time, added benefits like the real time monitoring, intelligent operations and improved business process give motivation for implementation of industry 4.0. With this end to end intelligent operations and improved business process execution, produce gets processed faster and reaches supermarkets in fastest time possible.

**REFERENCES**


1. Lee, J.; Bagheri, B.; Kao, H.-A. A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. Manuf. Lett. 2015, 3, 18–23.
2. https://www.techrepublic.com/article/agriculture-4-0-how-digital-farming-is-revolutionizing-the-future-of-food/
3. Saucedo-Martínez, J.A.; Pérez-Lara, M.; Marmolejo-Saucedo, J.A.; Salais-Fierro, T.E.; Vasant, P. Industry 4.0 framework for management and operations: A review. J. Ambient. Intell. Humaniz. Comput. 2018, 9, 789.
4. Yin, Y.; Stecke, K.E.; Li, D. The evolution of production systems from Industry 2.0 through Industry 4.0. Int. J. Prod. Res. 2018, 56, 848–861.
5. Calitz, A.P.; Poisat, P.; Cullen, M. The future African workplace: The use of collaborative robots in manufacturing. SA J. Hum. Resour. Manag. 2017, 15, 1–11.
6. Kolberg, D.; Knobloch, J.; Zühlke, D. Towards a lean automation interface for workstations. Int. J. Prod. Res. 2017, 55, 2845–2856.
7. http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach__WIndianworkshop/India_01_13_Industrie40_m2m_Ackermann_SAP.pdf. Available on August 28, 2017.
8. Wang, G.; Gunasekaran, A.; Ngai, E.W.; Papadopoulos, T. Big data analytics in logistics and supply chain management: Certain investigations for research and applications. Int. J. Prod. Econ. 2016, 176, 98–110. [CrossRef].
9. http://ijamtes.org/gallery/185-jan19.pdf
10. Jehoon Sung, "The Fourth Industrial Revolution and Precision Agriculture", Automation in Agriculture - Securing Food Supplies for Future Generations, (2018), pp. 1-15.
11. https://iot.electronicsforu.com/content/tech-trends/industry-4-driving-agricultural-revolution/
12. https://medium.com/iot-security-review/agriculture-4-0-what-is-it-9bb654b7fca5
13. 12.Phil Hogan and Dr Bernd Schere, "Agriculture 4.0 – Ensuring Connectivity of Agricultural Equipment", White Paper (2017), pp. 1-12.
14. https://www.cropin.com/precision-farming/
15. Bucci, G.; Bentivoglio, D.; Finco, A. Precision Agriculture as A Driver for Sustainable Farming Systems: State of Art in Litteratureand Research. Calitatea 2018, 19, 114–121.
16. https://www.techrepublic.com/article/agriculture-4-0-how-digital-farming-is-revolutionizing-the-future-of-food/
17. GREENHOUSE MONITERING USING INTERNET OF THINGS,S.Muthupavithran, S.Akash, P.Ranjithkumar,nternational Journal of Innovative Research in Computer Science and Engineering (IJIRCSE) ISSN: 2394-6364, Volume – 2, Issue – 3. March 2016
18. Keesstra, S.; Mol, G.; de Leeuw, J.; Okx, J.; de Cleen, M.; Visser, S. Soil-Related Sustainable Development Goals: Four Concepts to Make Land Degradation Neutrality and Restoration Work. Land 2018, 7, 133.