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Smart Agronomy

A futuristic way to do farming

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Background:

Farming is done from ancient times. In olden times, farming was a total labour-intensive technique that involved huge amounts of time and effort. As time changes, labour intensive techniques turn into capital intensive that provide high production with less effort. Agriculture is a unique economic activity, act as both a source and sink of GHGs and hence to the global climate change, affecting phenology of crops.

Globally, agriculture sector accounts for 24% of total anthropogenic emissions of GHGs, mainly CH_4 and N_2O, which is mainly through livestock, irrigated rice fields and application of nitrogenous fertilizer (Pathak *et al*., 2014). Furthermore, India is facing crises in terms of input (water, nutrients, labour) and these inputs are also expensive especially for small and marginal farmers which are contributing nearly 85 % population in India, hence there is a need to optimize the use of resources of our country in order to feed the burgeoning population of country in sustainable manner without affecting the production levels.

Definition:

The term **smart agriculture** refers to a farm management concept that uses modern technology with the aim to increase the quality and quantity of agricultural products **while optimizing the human labour used**. This approach includes aspects such as Internet of Things, sensors, location systems, robots and artificial intelligence on farm.

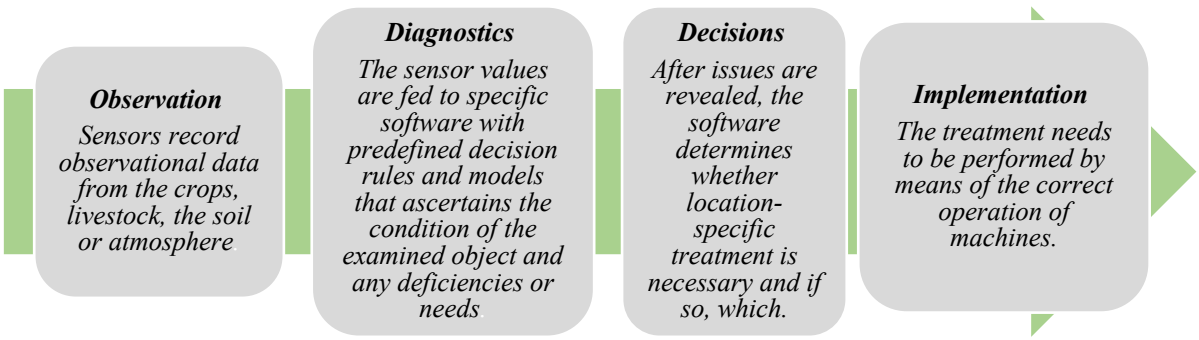
Objectives of Smart Agronomy:

To efficiently cope up with climatic stresses, agricultural systems need a major change - incremental as well as transformational.

To make agricultural systems

- ❑ More productive
- ❑ less variable and more stable production
- ❑ Resilient to risks, shocks and long-term climate variability

Steps Involved in Smart Agriculture



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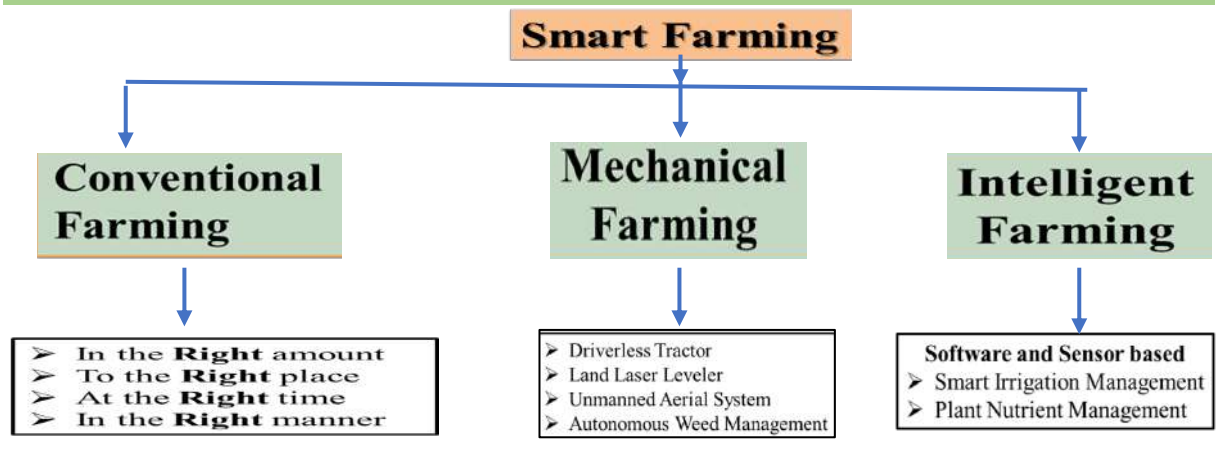

How smart Agriculture can be related to Agronomy

Agronomy is a branch of agriculture that focuses on yielding optimum food production through effective field management is seen as a dynamic discipline.

On the other hand, smart agriculture is also a farm management concept rely upon modern technology in order to increase the quality and quantity of agricultural products while optimizing the human labour used.

In today's scenario, yield enhancement can't be achieved without smart agriculture because of failure of earlier established traditional and conventional systems.

Hence, both the terms are inter-related.

Evolving Farming Technology

Earlier
Mechanical
Hardware oriented
Manual and on-site control
Simple machines
Unpredictable quality and quantity

Now
Information
Software oriented
Automatic and remote control
Networked smart machines
Predictable in quality and quantity

Difference between Ordinary Agronomical Practices and Smart agronomical practices

Ordinary agronomical practices	Smart agronomical practices
Ordinary Agronomic practices means agricultural practices generally associated with field crop production, including soil management, cultivation and row cropping.	The term smart agriculture refers to a farm management concept that uses modern technology with the aim to increase the quality and quantity of agricultural products
Labour intensive methods are adopted	Labour intensive methods are not adopted
These practices are input intensive	These practices are input intensive
It does not include such approaches	This approach includes aspects such as Internet of Things, sensors, location systems, robots and artificial intelligence on farm.
Major aim of these practices is only to enhance production levels for burgeoning population.	Major aim of these practices is only to enhance production levels for burgeoning population in sustainable manner.

These practices does not include Resource Conservation Technologies.	These practices include Resource Conservation Technologies.
These practices may or may not be eco-friendly.	These practices are essentially eco-friendly.

Smart Agronomical methods:

Precision Farming:

Precision agriculture (PA) is an approach to farm management that uses information technology (IT) to ensure that crops and soil receive exactly what they need for optimum health and productivity. The goal of PA is to ensure profitability, sustainability and protection of the environment. PA is also known as satellite agriculture, as-needed farming and site-specific crop management (SSCM).

Robotics:

Farming is a labour-intensive activity that demands plenty of time and effort. Usually, these jobs are repetitious and monotonous. Farmers may subcontract these labour-intensive jobs to robots and automation-based solutions. Such systems have the power to conduct operations that range from sowing and watering through harvesting and sorting. Eventually, this technological integration would result in increased production with minimum resource loss. Robotic Machines also aids in supporting farm machinery. It is important for planting, harvesting and other activities and assists in avoiding human mistakes. Farms can deploy robotic systems for pesticide spraying, harvesting, growing and other such chores.

Seeding and Planting:

With the rise of driverless tractors and other IoT-enabled devices, agricultural chores such as sowing and planting are becoming more adaptable and simpler. Initially, it was a laborious procedure that required a great deal of effort from farmers and farmhands. However, with the use of machine learning and IoT sensors/devices, farmers can now tackle issues like as planting seeds at the correct depth and spacing them at the proper distance for optimal plant development, etc. In addition to mapping and sensor data, farmers may assess soil texture, quality, density, moisture, and nutrient levels to optimise the process of seeding. It will maximise the expansion of the seeding process and boost the crop's total harvest probability.

Irrigation and Crop Management

When rainfall is insufficient or to preserve landscapes, farmers may utilise irrigation for their crops. With the use of automated irrigation, they may achieve a balance between the soil's water and moisture content. Various techniques for installing irrigation systems include –

1. an automated watering system fueled by the sun
2. Automatic irrigation that senses the moisture content of the soil
3. Subterranean Drip Irrigation (SDI)
4. automated watering system based on GSM
5. Enabling the use of these methods with IoT devices and sensors could help in soil sustainability as well.

For crops, **crop analysis and weed management** are vital. A large harvest

depends on a high crop output. Therefore, farmers must install equipment that eradicate weeds and do other duties without human involvement, so that crop development is unaffected. With the aid of sensors and equipment, farmers are able to remotely monitor and evaluate field conditions and make strategic decisions for the entire farm or a single plant.

Drones and Sensors

Remote monitoring and analysis of fields is one of the most beneficial agricultural activities that drones might perform. Drones may travel at a specific height and visually inspect the status of the crop. It saves time and labour that would otherwise be required for manual checking. Additionally, farm-monitoring drones may collect farm-related data to aid in the study of crops and fields. Drones may also be equipped with many sensors to collect data on the various agricultural conditions. These will aid in the generation of data and directional maps that will aid in guiding agribots and other devices to guarantee optimal agricultural care. Using data analytics and data management, farm owners may also generate reports with insights into crop health, soil, climate, and field patterns, among others. Such information generated from several farms might help scientists examine and improve agricultural techniques. Other forms of farming, such as animal husbandry (livestock farming), greenhouse setups, horticulture, and many more, might be significantly influenced by the application of technology. It is just a matter of time before farmers throughout the nation adopt contemporary technologies and permanently boost their output and income.

Benefits of Smart Agronomy

1. Increase in Efficiency
2. With the use of smart farming technologies, expansion in farming takes place
3. Proper Use of Resources
4. It is a cleaner process that can save energy, water and make framing greener
5. Uncertain weather changes, air quality, humidity, soil in the fields and health of crops monitored by the smart farming technologies. That provides real time monitoring that can predict the condition of the crop.
6. Improved product quality

Challenges

1. Expensive Technology
2. Lack of research and development in this technology
3. Lack of expertise
4. Poor Internet connectivity in rural areas
5. Making sense from big data in agriculture
6. Lack of scalability and configuration problems
7. Technical failures and resultant damages
8. Loss of manual employment
9. Benefits not immediately apparent
10. Poor infrastructure also limits economic gains from currently

available precision farming technology

11. Socio-economic conditions of the farmers

A few of possible solutions may be

1. Identifying ways and means of reducing the cost of RS, GIS and precision farming technologies and time gap in collection, interpretation and dissemination of data to enable their usage on a large scale.
2. Providing convincing evidence to prove the utility and economic viability of these technologies so as to mobilize support for R & D work
3. Human resource development to hasten the process of large-scale use of unexplained and cutting-edge technologies that have tremendous scope and potential
4. Improving the internet connectivity and speed in rural areas
5. Use of Artificial intelligence for handling and analyzing big data
6. Farmer's co-operatives and Farmer Producer Organizations
7. Pilot projects.
8. Combined effort of Researchers and Government
9. Entry of Private players in this sector

Conclusion:

Overall, it can be concluded that Smart farming provides great opportunity for accuracy and efficiency in every agricultural operation right from sowing, fertilizing, irrigation, protection till harvesting. It also shows immense potential environmental prospects like reduction in nitrate leaching, emission of greenhouse gases and agrochemicals like fertilizer, herbicide, pesticides etc. which may help in achieving sustainable agriculture of future. Smart farming technology looks promising as a future farming tool, however its effective use in Indian agriculture is yet to be realized and research on smart practices is at infancy stage in our country but it may help farmers to harvest fruits of frontier technologies by achieving more profitability with increase in productivity, availability of cost-effective technology and decrease in cost of cultivation with better management of inputs.

References:

Pathak, H., Bhatia, A. and Jain, N. (2014). Greenhouse gas emission from Indian agriculture: trends, mitigation and policy needs. *Indian Agricultural Research Institute, New Delhi*, **39**.