Emerging Technologies in The Field of Agriculture for Vidarbha Region

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Abstract- ***The Vidarbha region, located in eastern Maharashtra, India, is characterized by its predominantly agrarian economy, with agriculture serving as the primary livelihood source for a significant portion of its population. The region faces various challenges, including water scarcity, soil degradation, climate variability and socio-economic constraints, which affect agricultural productivity, livelihood security and rural development. This paper explores the role of emerging agriculture technology in addressing the unique challenges and opportunities of the Vidarbha region's agricultural sector. The study highlights key emerging technologies and innovations, such as precision agriculture, remote sensing, vertical farming, biotechnology, sustainable farming practices and market linkages. Furthermore, the benefits, challenges and implications for Vidarbha's farming communities, ecosystems and economy. It also builds capacity and engage stakeholders.***

Indexed Terms– ***biotechnology, economy, sustainable farming, precision agriculture, stakeholders, etc.***

I. INTRODUCTION

The fast improvements in technology are driving a revolutionary phase in the agriculture sector. Emerging technologies have the potential to transform conventional farming methods, improve efficiency and tackle major issues confronting the agricultural industry worldwide.

The Department of Agriculture in Maharashtra launched the MahaAgriTech project, a novel initiative that envisions the cooperative application of several technologies to enhance the state's agricultural conditions. Beginning in June 2018, MRSAC and NRSC-ISRO are implementing the MahaAgriTech project throughout the state of Maharashtra on behalf of the Department of Agriculture, Government of Maharashtra.

Precision agriculture is a contemporary farming method that emphasizes all of the resources like soil, water, and nutrients that are needed for growing. However, the practices for water-use efficiency (WUE) and nutrient-use efficiency (NUE) have just recently been created in India. In the Indian context, Precision agriculture has not yet been included in widely used farming practices. The practice is still in its early stages in India, according to the literature and stakeholder engagements.

Few farmers use precision farming, frequently on a single field, in experiments, or on commercial farms that cultivate high-value crops.

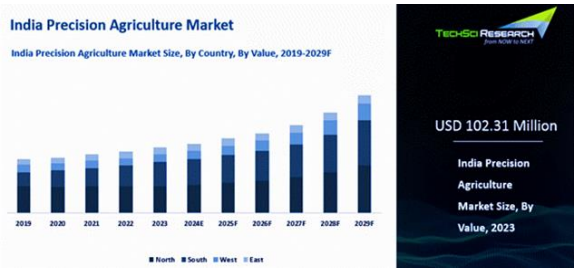

Fig 01: Indian Precision Agriculture Market

II. OBJECTIVES

1) To understand the existing research and studies on the role of emerging technologies in agriculture.
2) To understand the current agricultural practices, challenges and needs of farmers in the Vidarbha region.
3) To evaluate the effectiveness and benefits of precision agriculture technologies for farmers in Vidarbha.
4) To engage stakeholders and build capacity for technology adoption among farmers.

5) To formulate design guidelines for Agricultural Training Centre using research on emerging technologies.

III. LITERATURE REVIEW

3.1 Role of Emerging technology in Agriculture.

Given the region's prominence in agriculture and the difficulties it encounters, the Vidarbha region of Maharashtra, India, stands to benefit greatly from the application of developing technologies in agriculture. In the agricultural sector of Vidarbha, emerging technologies hold great promise for improving sustainability, productivity and economic growth while addressing a range of concerns.

To achieve the goal of a prosperous, resilient and sustainable agricultural sector that improves the lives and well-being of farming communities in Vidarbha. To protect and revitalize the natural resources and support the region's overall socioeconomic development and prosperity. These technologies must be embraced and fully utilized through strategic planning, investment, collaboration, capacity building and empowerment.

3.2 Agriculture Practices

1	Crop cultivation – cotton, soybean, pulses, oilseed.
2	Irrigation practices
3	Soil management and fertilization
4	Pest and disease management
5	Traditional and mechanized farming
6	Agroforestry and horticulture

Table 01: Vidarbha Farmers

1	Precision agriculture
2	Remote sensing and satellite imagery
3	Automation and robotics
4	Biotechnology
5	Vertical farming
6	Sustainable and conservation practices
7	Market linkage and Agri-tech platform

Table 02: Emerging Technology

3.3 Need and Challenges

3.3.1 Need of farmers in Vidarbha

1) Access to Credit and Finance
2) Access to quality Inputs and Technology
3) Water Management and Irrigation
4) Soil Health and Fertility
5) Access to Market and Value Chain Integration
6) Training and Extension Services.

3.3.2 Challenges of farmers

1) Water Scarcity and Drought
2) Climate Variability and Extreme
3) Pests, Disease and Losses.
4) Soil and Land Degradation
5) Input Costs and Market Risks
6) Policy Constraints and Regulatory Burdens.
7) Institutional challenges

IV. EMERGING TECHNOLOGY

4.1 Precision Agriculture

Precision agriculture, which can also be referred to as satellite farming or precision farming. Which is a sophisticated farming method that employs technology and data analytics. To manage and monitor different aspects of agricultural practices precisely. Farmers can make well-informed decisions and customize management practices to specific field conditions, which maximizes yields, minimizes inputs and reduces environmental impacts. Precision agriculture includes a wide range of technologies, techniques and tools.

4.1.1 Global Positioning System (GPS)

Precision machinery navigation, precise field mapping and pinpoint location identification are all made possible by GPS technology for farmers. Proper planting, seeding, fertilizing and spraying may be accomplished with less overlap and input loss due to GPS-guided tractors and equipment.

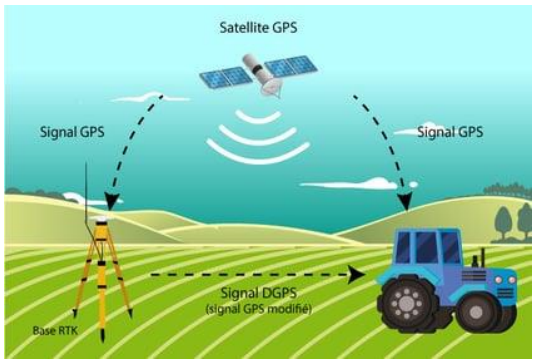

Fig 02: GPS Guide

4.1.2 *Geographic Information System* (GIS)

Soil samples, drainage planning, variable rate input application and other site-specific management methods are made easier by GIS-based mapping. It also combines GPS data, satellite imaging and other spatial data. To analyze and visualize field variability and trends.

An assessment of the health of plants in the United States is conducted by satellite using VegScape.

Areas with significant plant vigour are shown by a bright green colour. Parts in yellow, brown and grey indicate areas with worse plant conditions.

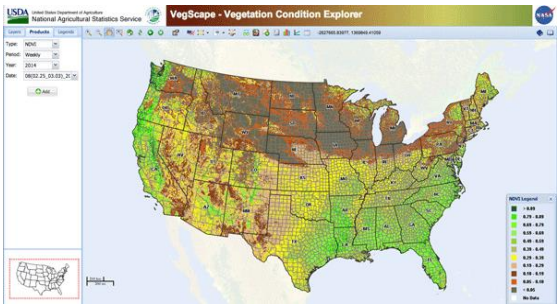

Fig 03: Vegetation Condition Explorer

4.1.3 Soil and Crop Sensors

Precision agriculture technology relies heavily on soil and crop sensors, which offer vital information on crop health, nutrient content, moisture content and soil conditions. Farmers can monitor and manage their fields more efficiently, make data-driven decisions to increase production, sustainability and maximize resource use with the help of these sensors.

4.1.4 Variable Rate Technology

Instead of applying inputs (such as fertilizers, pesticides and irrigation) uniformly throughout a field, as is the case with traditional farming methods. Variable rate technology (VRT) enables farmers to apply inputs at different rates across a field, based on the unique needs of different areas.

4.1.5 Data Analytic and Farm Management Software

Precision agriculture relies heavily on data analytics and farm management software, which provide farmers with data-driven insights, tools and skills to manage their farms more efficiently. It helps to make wise decisions, meet their sustainability, financial and production targets.

4.1.6 Animal Monitoring System

The health, behavior and productivity of livestock (dairy cows, poultry, etc.) are tracked in real time using wearable technology, sensors and cameras. By identifying early disease symptoms, these technologies assist farmers in improving animal welfare and performance, as well as feeding and breeding techniques.

4.2 Remote Sensing and Imaging

To monitor crop health, detect pests and diseases, assess soil conditions and evaluate crop yield potential, remote sensing technologies such as drones, satellites and aerial imagery are used to gather high-resolution images and data of fields. Multispectral and thermal imaging techniques offer important insights into plant health, nutrient deficiencies, water stress and environmental stressors, enabling timely interventions and targeted management practices.

Fig 04: Remote Sensing and Imaging

4.3 Automation and Robotics

Modern farming equipment is frequently fitted with sensors and GPS-guided systems to enable highly precise performance of operations like planting, harvesting and spraying. Robots and autonomous tractors are also being created to carry out monotonous

jobs. Which keeps an eye on crops and gathers data without the need for human interaction.

4.4 Biotechnology

Applications of biotechnology, like biopesticides, biofertilizers and genetically modified crops, which are starting to show promise as ways to improve crop resilience, pest resistance and nutritional value. To solve particular agricultural problems and raise overall productivity, Agri-biotech solutions are being researched and used more frequently in Vidarbha.

4.5 Vertical Farming

Crops are grown vertically using soilless growing methods, hydroponics, aeroponics, aquaponics, LED lighting, climate control systems, automation, sensors and data analytics in frequently controlled indoor or urban environments. Crops are stacked vertically or oriented vertically on surfaces.

4.6 Sustainable And Conservation Practices

Sustainable development and prosperity in Vidarbha, improve environmental health, biodiversity and ecosystems. Also, manage and conserve the energy. To promote sustainable food systems and livelihoods in the area. The sustainable and conservation practices must be incorporated into agriculture technology.

4.7 Market Linkage and Agri – Tech Platform

Embracing and using the potential of Agri-tech platforms and market linkage through investment, cooperation, innovation, empowerment and capacity building. It involves collaboration between agribusinesses, tech firms, lawmakers, researchers and farmers.

V. BENEFITS

1) Farmers can find chances for greater crop quality, more marketable crops and increased efficiency by using data-driven decision-making.
2) Precision agriculture may raise the profitability of farms by increasing yields and lowering input expenses.
3) Precision agriculture practices, such as variable rate application, controlled irrigation and soil conservation techniques. It helps to conserve water, reduce soil erosion and minimize the use of agrochemicals. Therefore, it protects the natural resources and ecosystems.
4) Modern scheduling, planning and management systems support farmers in resource allocation.
5) Farmers can optimize crop growth and output by making well-informed decisions and implementing focused interventions with the use of up-to-date data on soil conditions, crop health, weather forecasts, and market trends.

VI. CHALLENGES

The adoption and application of precision agriculture on a larger scale for the benefit of farmers, consumers and the environment can only be advanced by cooperation, innovation, investment, education, policy support and stakeholder involvement

1) Technological challenges
2) Operational and practical challenge
3) Environmental and societal challenges

VII. IMPACT

1) In Vidarbha, where soil degradation and water constraints are prevalent, precision agriculture provides farmers with targeted irrigation, fertilization and pest management strategies based on real-time data and analysis.
2) This aids in increasing agricultural yields, enhancing soil health and optimizing water use by farmers.

VIII. ENGAGE STAKEHOLDER

1) Precision farming gives several advantages and chances to enhance farming methods. But to reach its full potential, farmers, researchers and technology companies need to overcome some obstacles.
2) For farmers to make well-informed decisions, implement best practices and effectively manage risks, they need access to extensive training, education, extension services and agricultural advisory support. These resources will help them to improve their knowledge, skills, technical capacity and understanding of contemporary farming practices, innovations, technologies, market trends and regulatory requirements.

3) To address shared challenges, spur innovation and expedite the adoption and implementation of precision agriculture on a larger scale. It is important to engage industry stakeholders, researchers, policymakers and communities. This fosters collaboration, knowledge sharing, best practices exchange and collective action.

CONCLUSION

1) The Vidarbha region of Maharashtra, India, could see a dramatic change in its agricultural environment with the adoption of modern agricultural technologies. For farmers in Vidarbha, these technologies range from drones and precision agriculture to biotechnology. These offer many advantages, such as higher output, better crop quality, water efficiency and lower input costs.

2) In addition, these technologies can improve farmer's access to markets. Get information and value chain integration while reducing risks brought on by pests, illnesses and unexpected weather patterns. Enhancing the resilience, profitability and sustainability of farming systems in the region can be achieved through the implementation of sustainable farming techniques, capacity-building programs and community development opportunities.

8.1 Incorporating Agricultural Technology into An Agricultural Training Center.

8.1.1 Needs assessment:
Determine the specific skills and knowledge that trainees need to acquire.

Understand the existing technological infrastructure and determine where improvements or additions are needed.

8.1.2 Infrastructure and facility planning:
Smart boards, projectors, and internet access in the classroom to facilitate interactive teaching and learning.

Provide equipment-filled labs for practical instruction in agricultural technology.

Create areas where trainees can apply learned techniques on actual agricultural land.

8.1.3 Training and skill development:
Organize workshops and training sessions on how to use agricultural technologies effectively.

Offer certification programs to validate the skills and knowledge acquired by trainees.

8.1.4 Promotion and outreach:
Promote the training center and its programs through various channels to attract trainees and stakeholders.

Engage with the local community and agricultural organizations to raise awareness about the training center and its offerings.

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