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AI IN PRECISION FARMING TECHNIQUE

*** Hitesh Mahadev Bhagat**

**Research Student, Dept. of Management Studies, Swayam Siddhi Mitra Sangh Degree College, Bhiwandi (Maharashtra)*

Abstract:

The world agriculture sector is facing several problems due to increasing population growth, changes in climate, and demand for food due to increasing growth. These all required innovative solutions for sustainability. Transformative technology Artificial intelligence (AI) is a that changes the agriculture level in the whole world. The solution for precision farming, crop monitoring, disease detection, resource management and smart irrigation. In this study, we explore the impact of AI in modern technology, like framing practices, enhancing crop yield, resource efficiency, and reducing environmental impact. The research finds the investigation of AI-driven tools like drones, autonomous machinery, and AI-based irrigation systems. There are several effective farm productivity and sustainability. Data collected from a survey of agricultural farms highlight that AI technologies are gaining traction among farmers, but challenges include high upfront costs, lack of technical expertise, and lower internet connectivity. Despite these, the a growing interest in adopting AI technologies. The study concludes that AI can revolve around agricultural sources like crop enhancement and quality improvement, but the overall adaption of the overcoming AI technologies, finance and infrastructural challenges. AI ensures the security of the food for consumption and promotes sustainability in farming practices. The technology, which was based on AI technology, improved framing productivity and simplified all agriculture-based technology.

Introduction:

The world population are growing unprecedentedly, creating immense pressure on the farming sectors to meet increasing food demands while maintaining environmental sustainability in farming. The submission of modern technology, practices, and science to improve and enhance the agricultural output. It is the cultivation of crops, plants, domestic animals, fish, birds, and other items for food, fabric, and other amenities of life. Farming is critical to the advancement of human civilisation. Before the Industrial Revolution, most people depended on the agriculture sectors like farming for daily needs such as food, clothes, and shelter. One of the largest 1% of farms are worldwide over 50 hectares (120 acres), and 70 % of more than farmland are operated. More than 40 % of agricultural land is found on larger farms than 1,000 hectares (2,500 acres). There are five out of six farmland in the world consist of fewer than 2 hectares (4.9 acres), and 12 % of the farmlands are taken of as all agricultural land. Agriculture refers to human activity, but certain ants, termites and beetles have been cultivating crops since from the decade of 60 million years. Precision farming is a farm management concept that revolves around the process of measuring, observing and responding to various inter and intra-field variability for modern agriculture. Precision farming (PF) is the term for technology in farming management. Precision AI-based farming can be traced to the 1990s and 60s, at the time the first GPS (Global Positioning System)

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satellites were launched. The upcoming assumption for the growth trends may be expected to reach at 8.7 billion by 2030, and 9.7 billion by 2050 will show the food strain worldwide. So at it will not been able to keep pace. Currently, about 37.7 % of the area of the total land is used for the cultivation of crops. AI-based equipment and machines have taken today's agriculture system to a different level. This technology has enhanced crop production and improved real-time monitoring, harvesting, processing and marketing. The latest technologies of automated systems using agricultural robots and drones have made a tremendous contribution to the agriculture- based sectors. It also uses various well-certified and professional computer-based systems designed to determine various important parameters like weed detection, yield detection, and quality of the crop, as well as other techniques. Implementation of the latest automated technology like wedding techniques as used in the drones technology Also, there are various types of sprayers utilised on UAVs. Robotics and Autonomous Systems (RAS) were introduced in the highly large sectors of the economy, which are relatively low productivity as Agri-food. The sectors of the agriculture field use 85 % of the world's freshwater resources. Due to the high increase in the population, the consumption of food demand is also increasing.

Review of Literature:

A) Srinivasan et al. (2020) developed an AI-based system to detect plant disease in rice while using the deep learning method. They used image capture drones and smartphones to train convolutional neural networks (CNNs), which identify diseases like bacteria and rice blasts with high accuracy. The study demonstrated that AI could perform traditional methods of plant disease detection, which are time-consuming and less accurate.

B) Kumar et al. (2020) developed a hybrid AI model using a combination of neural networks and genetic findings to identify the crop yield of various crops in different climatic conditions. The research introducing the AI model could forecast yields the accuracy of these is highly shown, allowing farmers to take early action for resource management.

C) Chauhan et al. (2021) proposed an AI-based smart irrigation system for Indian agriculture. The system used machine-learning algorithms to predict irrigation requirements based on soil moisture data, weather forecasts, and crop types. The study found that AI-driven irrigation systems could reduce water usage by up to 30%, leading to cost savings and higher crop yields.

D) Patel et al. (2020) explored how AI techniques can be used to monitor soil health in real time. Their research used sensor data to assess parameters like pH, temperature, and moisture levels. The AI system analysed the data that were collected, assumed to be soil fertility and recommended necessary interventions like fertilisation or pH adjustment. This approach helps farmers make timely decisions, improving sustainability and soil productivity.

E) Chaudhary et al. (2020) explored AI in role of managing water resources for agriculture, focusing on precision irrigation. They showed how AI models, combined with Internet of Things (IoT) sensors, could monitor soil moisture levels in real time and automate irrigation schedules, ensuring that the amount of water which were provided at the right time and accurately. This reduces water wastage and optimises crop growth.

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Objectives of Study:

a) Optimize Resource Use.
b) Enhance Crop Yields.
c) Improve Sustainability.
d) Reduce Environmental Impact.
e) Enhance Crop Quality.
f) Reduce Labour Intensity.

Figure no 1: Classification of UAV drones.

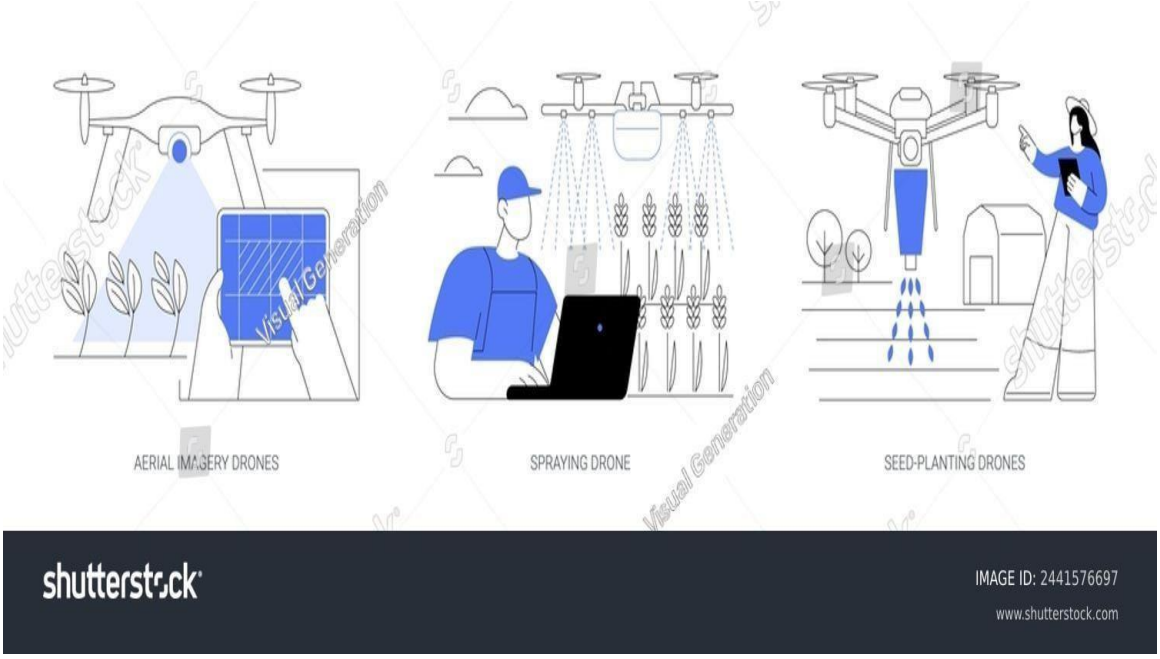

Figure no 2: Use of drones in precision farming.

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Hypothesis:

1) H1: when using precision farming according to AI, fertilisers and pesticides are reduced as compared to traditional farming.
2) H0: when using precision farming according to AI, fertilisers and pesticides are not significantly reduced as compared to traditional farming.
3) H1: AI technique significantly integrates precision farming and leads to improvement in soil health as compared to traditional farming.
   H0: AI technique significantly does not integrate precision farming and leads to improvement in soil health as compared to traditional farming.
4) H1: Crop yield techniques are improving due to the use of AI-driven technology compared to traditional farming.
   H0: Crop yield techniques are not improving due to the use of AI-driven technology compared to traditional farming.
5) H1: AI technology is a method where the use of water usage in farming is reduced compared to traditional farming.
   H0: AI technology is a method where the use of water usage in farming is not reduced compared to traditional farming.
6) H1: Traditional farming techniques are less profitable than AI use in precision farming. It improves the overall economic profit of farming.
   H0: Traditional farming techniques are less profitable than AI use in precision farming. It does not improve the overall economic profit of farming.

Research Methodology:

The research is exploratory. The nature is a descriptive study based on secondary data. The collected data is primarily from economic surveys of various issues and various articles published by both national and international journals etc. Annual statistical data was used for analysis purposes. The data collected from various publications, which are reliable, Authentic and regularly used, is also taken into consideration. The study investigates these effects through surveys, interviews, and Secondary data analysis. The data collected from the surveys is qualitative and Quantitative in Nature.

The Sample:

Data were collected from agricultural farms in the neighbouring area of the city.

Tool for Data Collection:

A self-structured questionnaire was used for collecting the data.

Research Design:

This study is based on Qualitative and Quantitative research.

Sampling Technique:

A convenient sampling technique is used for this research study.

Statistical Tool:

The statistical tools used in analysing the data are in the pie chart and pole bar form.

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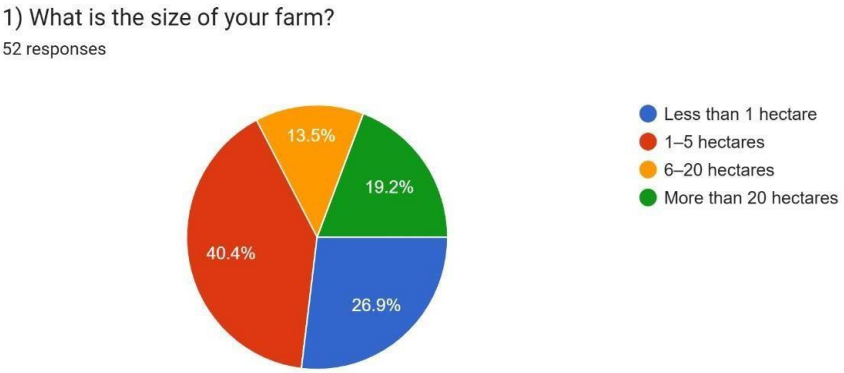
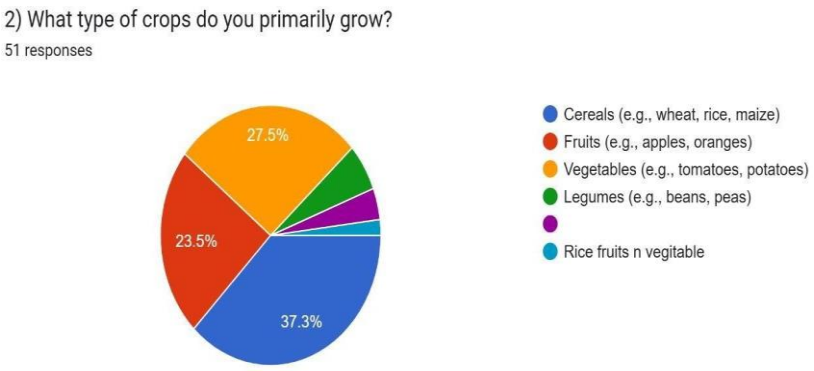
Figure no 3: AI technique in precision farming.

Findings, Analysis & Interpretation:



It was observed that among 58 respondents:

- 26.9% of Respondents have less than 1 hectare.
- 40.4% of Respondents have 1-5 hectare.
- 13.5% of Respondents have 6-20 hectare.
- 19.2% of Respondents have more than 20 hectares.



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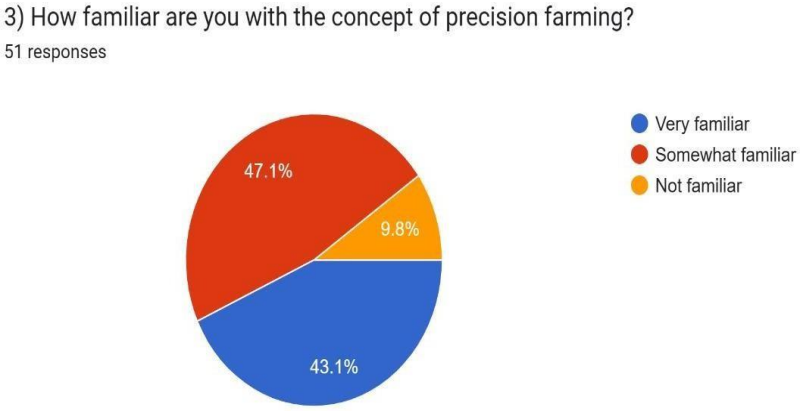
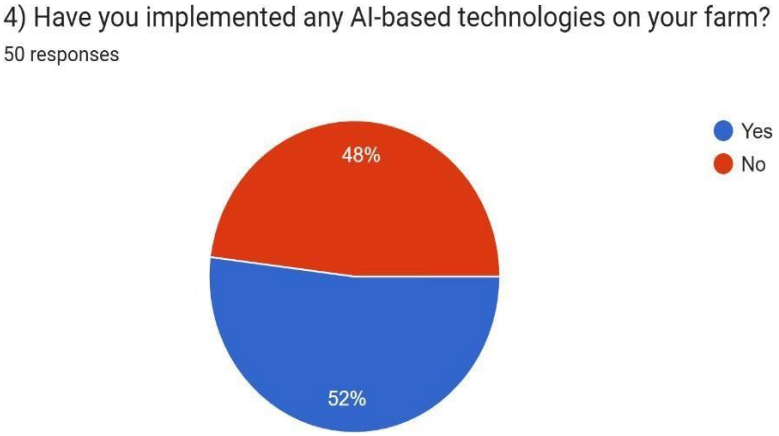
It was observed that among 58 respondents:

- 37.3% of Respondents have Cereals (e.g., wheat, rice, maise).
- 23.5% of Respondents have Fruits (e.g., apples, oranges)
- 27.5% of Respondents have Vegetables (e.g., tomatoes, potatoes)
- 5.9% of Respondents have Legumes (e.g., beans, peas)
- 3.9% of Respondents have others.



It was observed that among 58 respondents:

- 43.1% of the Respondents are very familiar.
- 47.1% of Respondents are somewhat familiar.
- 9.8% of Respondents are not familiar.



It was observed that among 58 respondents:

- 52% of the Respondents have implemented AI-based technology.
- 48% of Respondents have not implemented AI-based technology.

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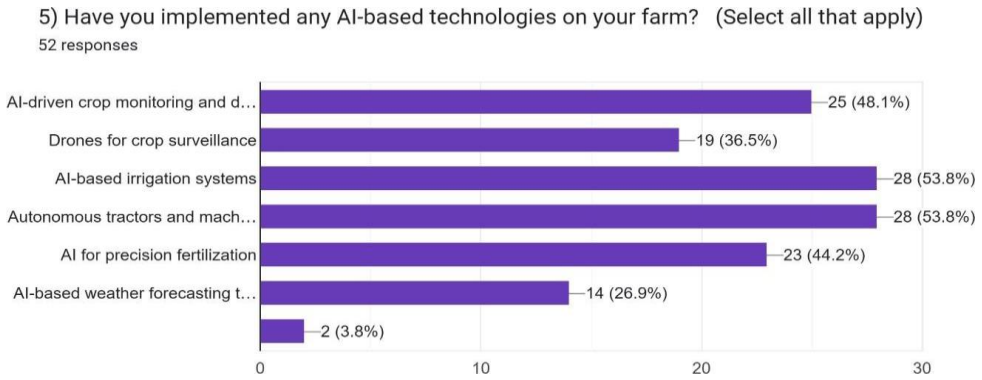
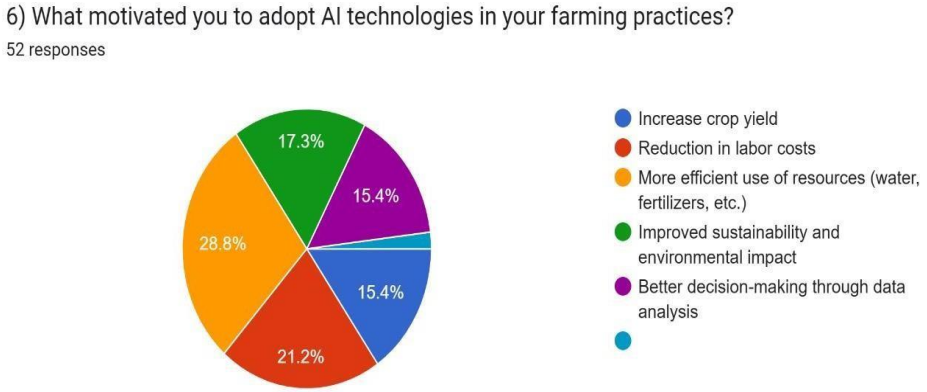


It was observed that among 58 respondents:

- 48.1% utilize AI-driven crop monitoring and disease detection.
- 36.5% employ drones for crop surveillance.
- 53.8% have implemented AI-based irrigation systems.
- 53.8% make use of autonomous tractors and machinery.
- 44.2% utilize AI for precision fertilization.
- 26.9% utilize AI-based weather forecasting tools.
- 3.8% have incorporated other AI-based technologies.



It was observed that among 58 respondents:

- 15.4% of respondents are motivated to adopt strategies for increased crop yield.
- 21.2% of respondents are motivated to adopt measures for the reduction of labour costs.
- - 28.8% of respondents are motivated to adopt practices for more efficient use of resources (such as water, fertilizers, etc.).
- 17.3% of Respondents are motivated and adopted improved sustainability and environmental impact.

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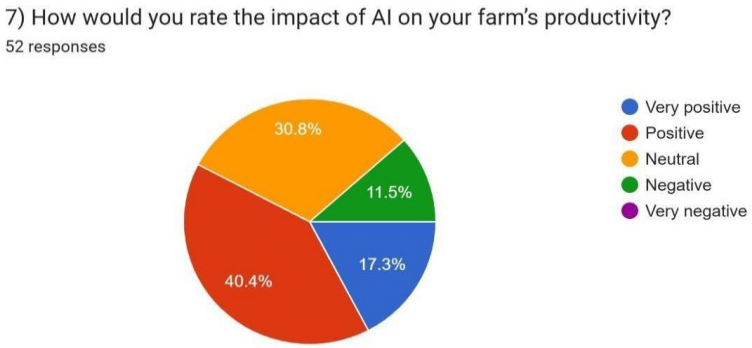
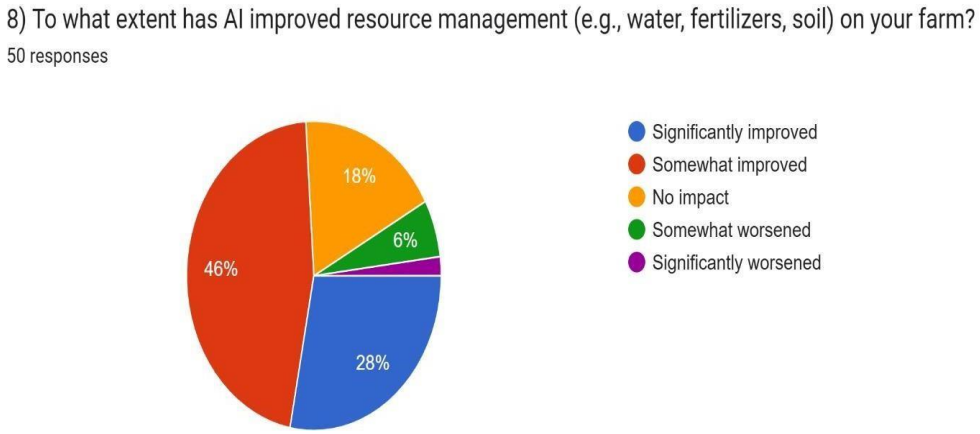
- 15.4% of Respondents are motivated and adopted Better decision- making through data Analysis.
- 1.9% of Respondents are motivated by other AI-based technology.



It was observed that among 58 respondents:

- 17.3% of respondents reported a very positive impact from AI.
- 40.4% of respondents experienced a positive impact from AI.
- 30.8% of respondents felt a neutral impact from AI.
- 11.5% of respondents indicated a very negative impact from AI.



It was observed that among 58 respondents:

- 28% of respondents reported a significant improvement.
- 46% of respondents experienced some improvement.
- 18% of respondents indicated no impact.
- 6% of respondents reported a minor deterioration.
- 2% of respondents experienced a significant deterioration.

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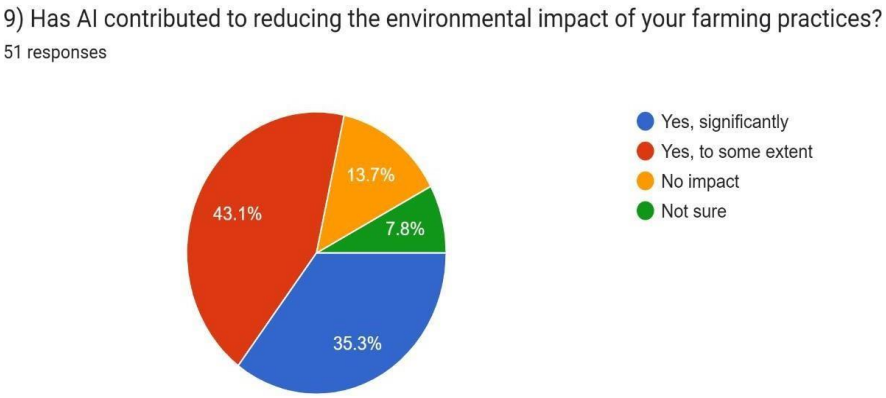
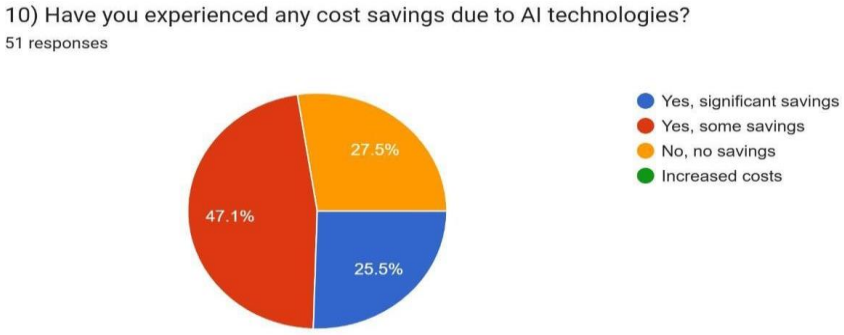


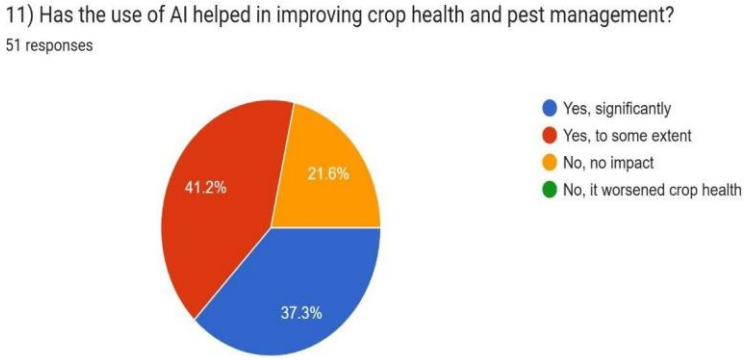
It was observed that among 58 respondents:

- 35.3% of respondents indicated a significant positive impact.
- 43.1% of respondents noted a positive impact to some extent.
- 13.7% of respondents reported no impact.
- 7.8% of respondents selected "not sure."



It was observed that among 58 respondents:

- 25.5% of respondents indicated that there are significant savings.
- 47.1% of respondents reported some savings.
- 27.5% of respondents stated that there are no savings.



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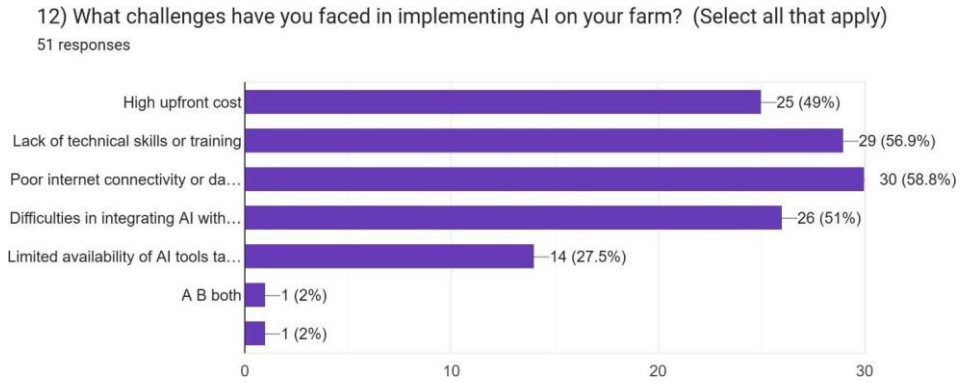
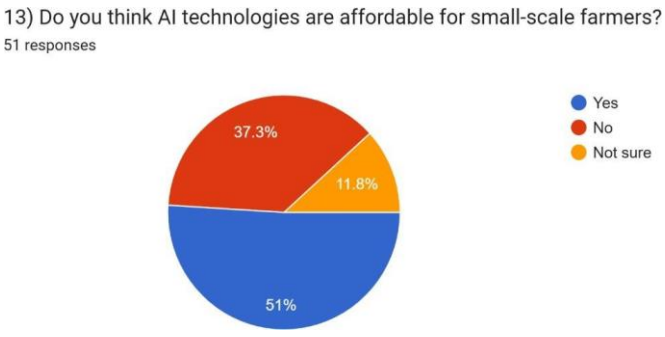
It was observed that among 58 respondents:

- 37.3% of respondents indicated a significant positive impact.
- 41.2% of respondents reported a positive impact to some extent.
- 21.6% of respondents stated that there was no impact.



It was observed that among 58 respondents:

- 49% of respondents reported facing high upfront costs.
- 56.9% of respondents indicated a lack of technical skills or training.
- 58.8% of respondents experienced poor internet connectivity or data access.
- 51% of respondents encountered difficulties in integrating AI with existing systems.
- 27.5% of respondents noted limited availability of AI tools tailored to their farming needs.
- 2% of respondents selected options A and B.
- 2% of respondents provided other responses.



It was observed that among 58 respondents:

- 51% of respondents indicated that AI technologies are affordable for small-scale farmers.
- 37.3% of respondents said that AI technologies are not affordable for small-scale farmers.
- 11.8% of respondents expressed uncertainty about the affordability of AI technologies for small-scale farmers.

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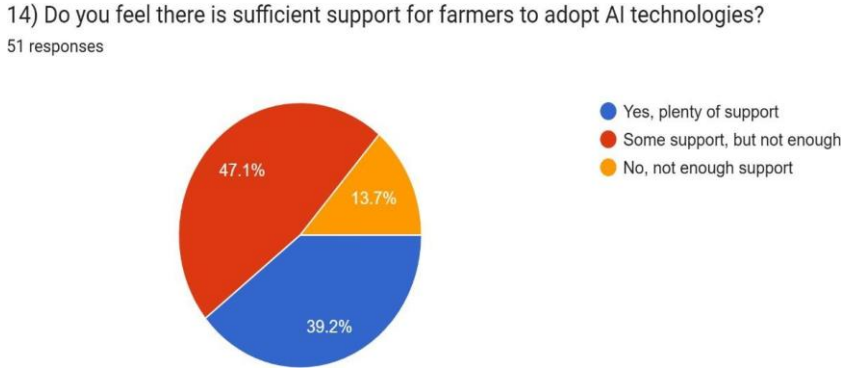
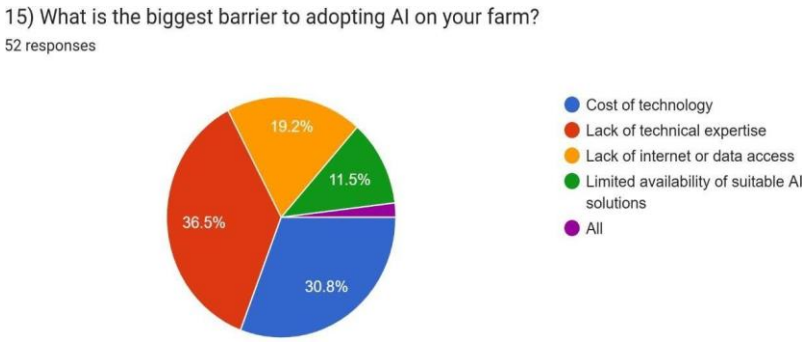


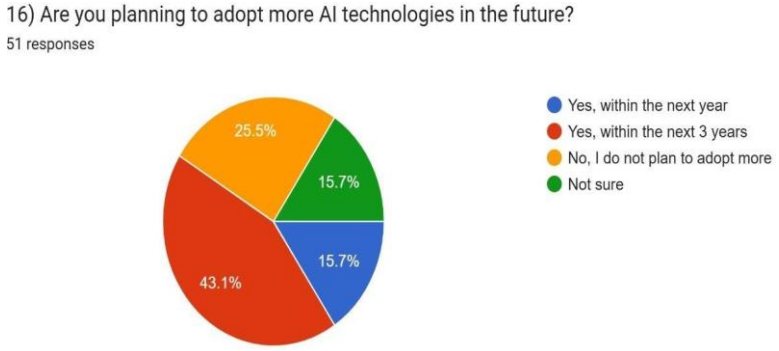
It was observed that among 58 respondents:

- 38.2% of respondents indicated that there is ample support for farmers to adopt AI technologies.
- 47.1% of respondents noted that there is some support, but it is not sufficient for farmers to adopt AI technologies.
- 13.7% of respondents stated that there is no adequate support for farmers to adopt AI technologies.



It was observed that among 58 respondents:

- 30.8% of respondents identified the cost of technology as a barrier.
- 36.5% of respondents reported a lack of technical expertise as a challenge.
- 19.2% of respondents experienced a lack of internet or data access.
- 11.5% of respondents noted limited availability of suitable AI solutions.
- 1.9% of respondents indicated that they face all barriers to adopting AI on their farm.



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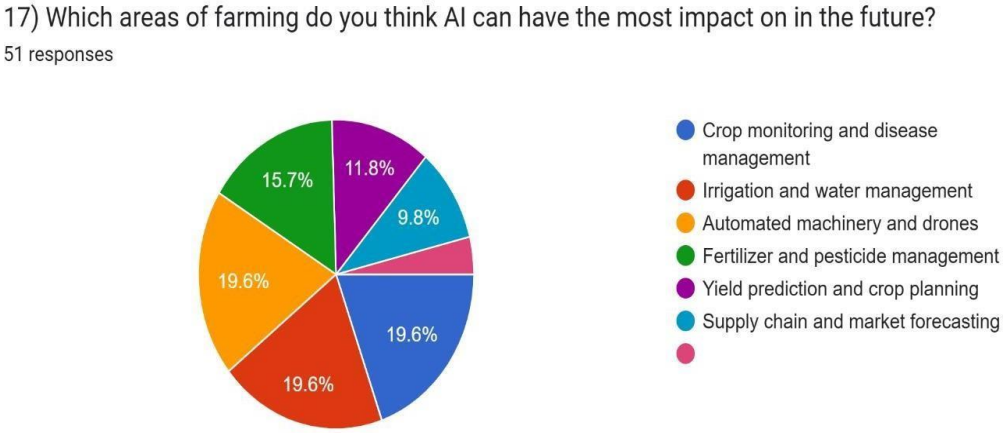
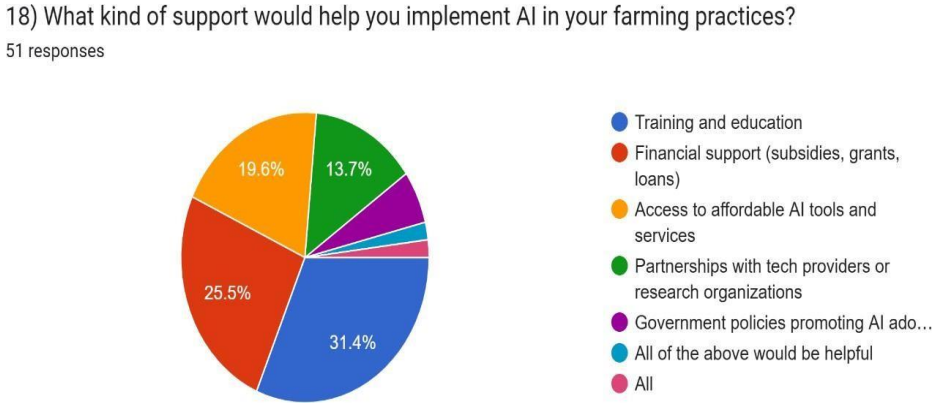
It was observed that among 58 respondents:

- 15.7% of respondents indicated that they plan to adopt more AI technologies within the next year.
- 43.1% of respondents expressed that they intend to adopt more AI technologies within the next three years.
- 25.5% of respondents stated that they do not plan to adopt more AI technologies in the future.
- 15.7% of respondents indicated that they are not sure about their plans to adopt more AI technologies in the future.



It was observed that among 58 respondents:

- 19.6% of respondents utilise crop monitoring and disease management.
- 19.6% of respondents employ irrigation and water management techniques.
- 19.6% of respondents utilise automated machinery and drones.
- 15.7% of respondents implement fertiliser and pesticide management.
- 11.8% of respondents engage in yield prediction and crop planning.
- 9.8% of respondents use supply chain and market forecasting methods.
- 3.9% of respondents identified other applications.



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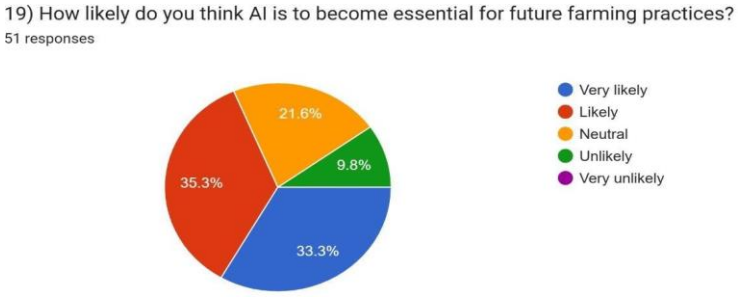
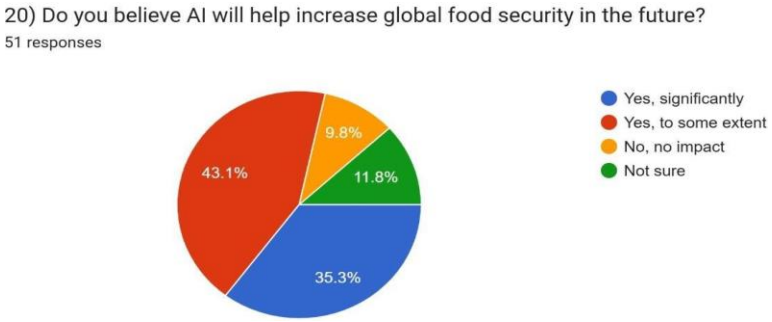
It was observed that among 58 respondents:

- 31.4% of Respondents have Training and education.
- 25.5% of Respondents have financial support (subsidies, grants, loans).
- 19.6% of Respondents have Access to affordable AI tools and services.
- 13.7% of Respondents have Partnerships with tech providers or research organisations.
- 5.9% of Respondents have Government policies promoting AI adoption.
- 2% of Respondents have A and B.
- 2% of Respondents have others



It was observed that among 58 respondents:

- 33.3% of Respondents think it is very likely AI is essential for future farming practices.
- 35.3% of Respondents think AI is likely to become essential for future farming practices.
- 21.6% of Respondents think Neutral that AI is essential for future farming practices.
- 9.8% of Respondents think Unlikely AI is to become essential for future farming practices.



It was observed that among 58 respondents:

- 35.3% of Respondents have said yes, significantly.
- 43.1% of Respondents have said yes, to some extent.
- 9.8% of Respondents have said No, no Impact.
- 11.8% of Respondents said they were not sure.

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Suggestion:

- Data-driven decision technique helps to track the data of the planting, irrigation and harvesting through particular the sensor, drone and satellite
- AI implementation helps the prediction of crop yield, pest infestation, and the pattern of the weather take proactive measures.
- Deploying a robotics system for tasks like planting, weeding, and harvesting helps to reduce labour costs and increase precision.
- AI precision irrigation technique for optimising the usage of water by analysing soil moisture levels and weather forecast, ensuring that the amount of water which were provided at the right time.
- Implementing crop monitoring AI-driven imaging tools to identify the monitoring crop health, detect diseases early and apply target treatment.

Conclusion:

AI is the best agriculture technology for the future technology. It enhanced productivity and credibility, as well as sustainability. They develop the whole agriculture industry at an advanced level. These advancements are very critical in the agricultural industry. These face the pressure of a growing global population and minimising environmental print.

This research indicates that farmers are improving crop yield, resource management in an efficient way and cost reduction. Adopting AI-based tools like drones, automated machines, and AI-driven irrigation systems. However, several challenges are faced, like high initial cost, limited technical expertise and poor internet connectivity. Especially for the small- scale.

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