Group 1

202412001 Aarti Bodani

202412039 Bhakti Khokhani

Sustainable Agriculture Resource Management: -

Management of Sustainable Agriculture Resources: ->Sustainable agriculture: what is it?

The goal of sustainable agriculture is to satisfy the demands of the current society without endangering the ability of future generations to satisfy their own needs.

The following are some benefits of the sustainable agriculture model: • It allows us to track ownership, size, and crop production.

• Farmers may make better judgments by saving critical data including crop schedules, weather information, and soil conditions. Farmers would use less time because this model calculates farming inputs and produces efficient outputs.

1.Introduction

1.1 Purpose:

The primary aim of the database is to assist farmers in farm management by monitoring essential aspects such as crops, soil conditions, weather and resource utilization. Therefore, it will facilitate better decision making by farmers aimed at increasing productivity and sustainable farming practice.

1.2 Document Conventions

This document was created based on IEEE template for Sustainable Agriculture Resource Management.

1.3 Intended Audience and Reading Suggestions

- Farmers: The database is mainly designed for farmers of all sizes to help them manage their farms better, track crop growth, and make better decisions.
- Agricultural Managers: Those who oversee larger farming operations can use the system to optimize resources like water, fertilizer, and energy.

- Agriculture Researchers: Researchers can use the data to study farming trends, soil conditions, and crop performance.

- Government Agencies: The system can assist in monitoring and ensuring farms meet environmental standards and sustainability practices.

Other tools include the Sustainable Agriculture Resource Management information management system where farmers store key farm data including location, crop calendar among others as well as the soil health data bank. It uses weather and other data and controls the resources like the water and fertilizers to increase the productivity and the results. Predictor values of yields; management of resources to enable efficiency in the farming process may be other advanced features.

1.4 Product Scope:

It would be a tool through which farmers could be able to manage their farms by tracking information and improving farming even further in terms of efficiency as well as sustainability.

Key Features:

1. Farm Information:

It record's details of the farm land including its location, size and ownership. 2. Crop Tracking:

- The following must be recorded; what crop is planted, at what period in the year, and the amount that is produced.

3. Soil and Nutrients:

- Soil Conditions: Maintaining, Soil Health & nutrient., Optimum growing conditions- Ph.

4. Weather Data:

- Past and Current weather data with which to determine the varying conditions. 5. Resource Management:

- Using of tools for tracking and measurement of water usage and fertilizer and energy for better utilization.

6. Future Predictions:

- Budgeting or forecasting of what could be available in future so as to determine how resources can be utilized.

Objectives:

- Allow the farmers to have a clear view of everything that hampers or contributes towards growth of the crops.

- Help in making right decisions for enhancing productivity.
- Improvement in land use for production and sustainable agriculture. - Sustainability and corporate environmental responsibility: an empirical analysis.

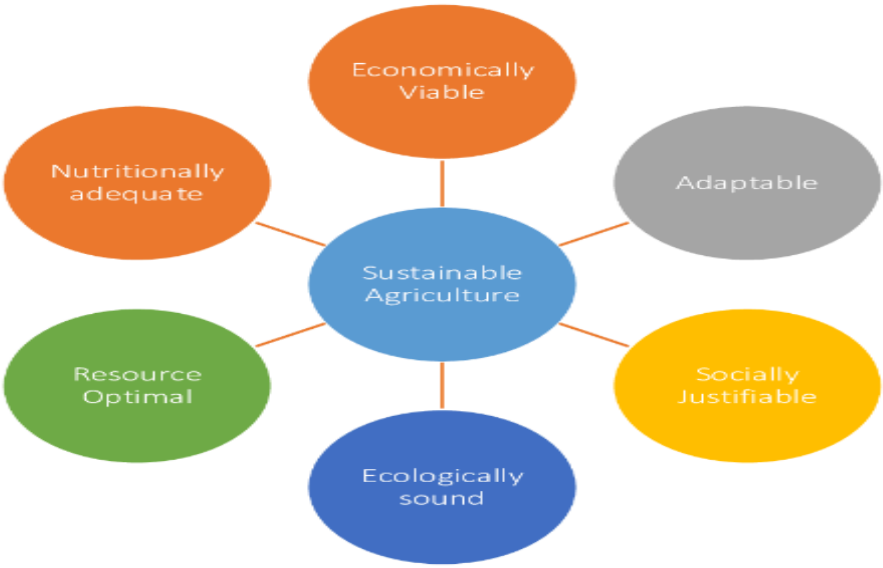
1. 5 Description

To promote sustainable agriculture and resource management, the FAO has developed the ‘Sustainable Agriculture Resource Management Database.’ This application provides farmers with a robust platform to store critical information about their farms, including details on location, size, and ownership. It also records essential data related to crops, such as planting schedules, harvest times, and yield results. Additionally, it monitors vital factors like soil health, nutrient content, and acidity levels to ensure crops grow in optimal conditions.

For instance, a farmer can input data about soil moisture levels and crop types. The system then processes this data, along with real-time weather updates, to offer suggestions such as drip irrigation to conserve water during drought periods. This allows farmers to prepare their land for weather changes by utilizing both current and historical weather data.

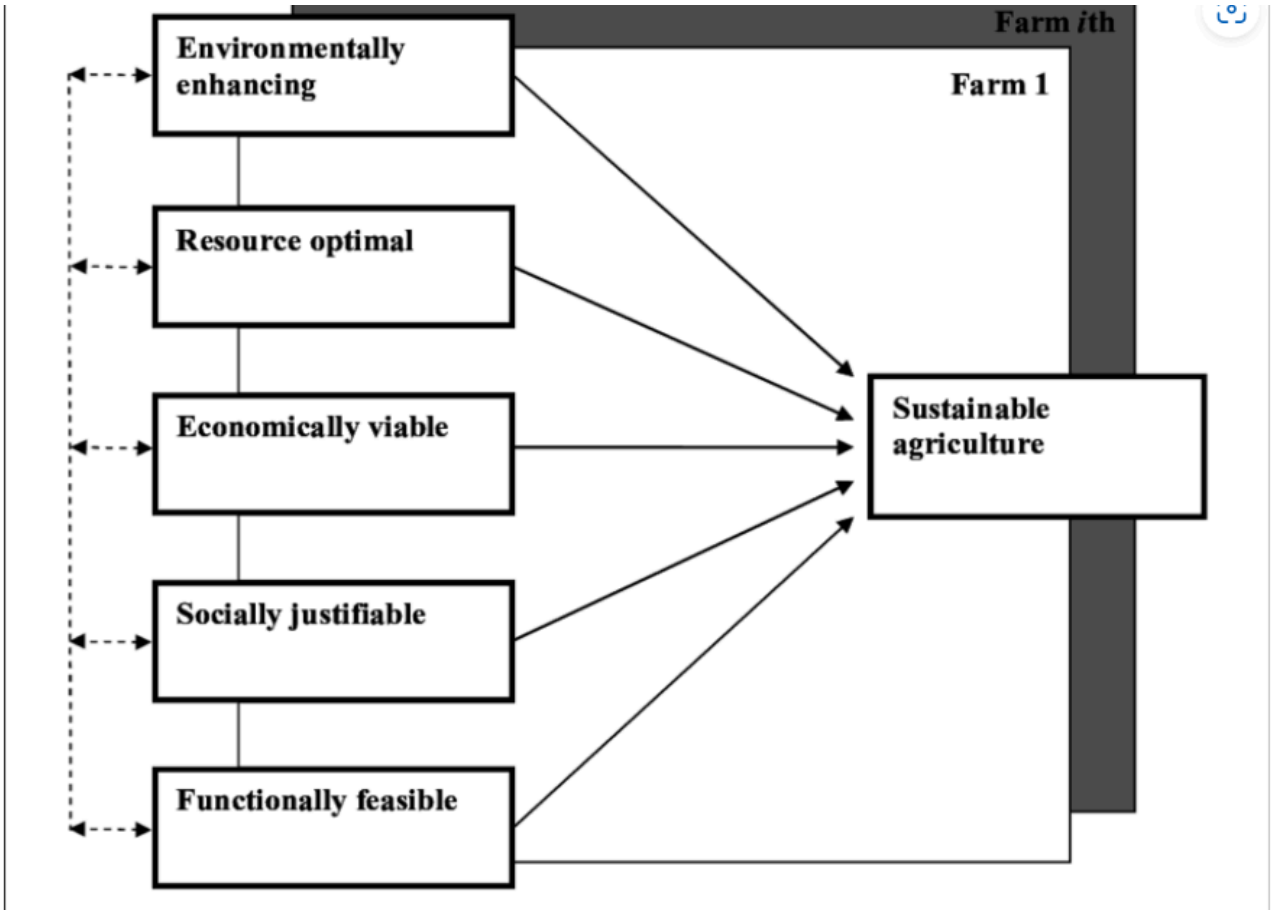
The system also tracks resource inputs such as water and fertilizers, optimizing their use to promote eco-friendly farming. It can even monitor carbon emissions by tracking fertilizer usage, machinery operations, and energy consumption on the farm. If emissions exceed acceptable levels, the system recommends alternatives, such as adopting organic fertilizers or renewable energy to reduce the farm's carbon footprint.

Farmers benefit from predictive insights, including future crop yield forecasts, helping them plan their operations more effectively. Moreover, the system tracks compliance with agricultural policies that encourage sustainability. For instance, when a policy offers incentives for reducing water usage or lowering emissions, the system monitors farms' compliance and notifies farmers when they qualify for financial benefits.



Key Advantages:

- **Increase Food Production**: By optimizing farm resources and practices, the system helps boost food production per unit of land, addressing the growing demand for food.
- **Environmental Protection**: The system integrates sustainable farming methods focused on conserving soil, water, and air, ensuring long-term environmental health.
- **Economic Growth and Wellbeing**: By improving farm productivity and efficiency, the system enhances farmers' livelihoods, promotes economic growth, and supports new agricultural business opportunities.
- **Stronger Ecosystems and Communities**: The system encourages farming practices that strengthen ecosystems, making communities more resilient to environmental and economic challenges.
- **Government Policy Support**: The system is designed to align with governmental policies, ensuring that farming practices comply with regulations aimed at sustainable agricultural production.



Innovation(USP):

Real-time Data Integration with IoT: The system uses Internet of Things (IoT) sensors to provide farmers with real-time information on soil health, weather conditions, and resource usage, enabling them to make immediate and informed decisions for better crop management and sustainability.

Users and Privileges:

- Farmers: Can input and manage farm data, access weather reports, submit pest control strategies, review historical logs, and receive alerts.
- Agricultural Managers: Oversee multiple farms, access aggregated reports, manage user accounts, and implement resource strategies.
- Agriculture Researchers: Access data for research, contribute insights, and share findings with stakeholders.
- Government Agencies: Monitor compliance, access support program data, and generate sustainability reports.
- System Administrators: Have full access for system management, user support, and maintenance.

1.6 Key Aspects

1. Recording Crop Information:

• This records various crops that grow in various part of the farm.

• Other information about the specific variety of crops and their genetic can also be captured to help in recording performance over periods of time.

• It will also be possible for specific planting dates to be made for each crop, which will also aid farmers in estimating the different growth stages as well as the expected time of harvest.

2. Soil and Nutrient Management

• It can also follow the amount and type of fertilizers used so that adequate nutrient inputs in growing crops are met can be monitored.

• This sees the system incorporating data of soil tests through which farmers are able to check nutrient status and ph. This helps in making sure that crops on farms are supplied with the right nutrients that will help in growth.

3. Weather and Environmental Monitoring

• Weather Data Integration: It incorporates historical and present climate history to enable the farmers to change the care of crops depending on rainfall, temperatures, and even drought.

• Environmental Conditions: This helps the farmers to enhance on irrigation and defend their yields by tracking climate circumstances such as humidity rainfall and temperature.

4. Harvesting and Yield Tracking

• Yield Monitoring: The system is integrated in a way that shows how much is harvested and quality of crops harvested to enable farmers compare yields of different crops under different environment.
• Yield Prediction: By converting previous information together with forecasts, yield is predicted and this enhances the planning part of the farmers regarding

the best time to harvest and utilize resources

.

5. Pest and Disease Management

• Pest Monitoring: The system tracks pest incidences so farmers can identify and correct them before they cause loss of crops.

• Disease Outbreaks: In areas, it tracks crop diseases in real-time to assist farmers in preventing them when they recur in the next seasons.

6. Resource Usage Optimization

• Irrigation Tracking: It is used to monitor the water uses to supply crops with the appropriate amount of water not too much or too little.

• Energy and Input Tracking: It measures the usage of fertilizers, pesticide, and energy utilised to enable farmers make wise use of the inputs to avoid wastage.

3. Analytics and Reports

• Data Analysis: The use of the system helps in the analysis of the past crop data in order to identify trends and enhance farming techniques.

• Custom Reports: It is important that farmers prepare plans that they can use to generate different reports, for instance, crop yields and resource utilization, and environmental status of a farmer's farm.

7. Sustainability and Environmental Impact

• Sustainable Practices: It promotes farming practices most of which include rotation of crops and subjection of the farm to organic manure that ensures the health of the land and the environment.

• Carbon Footprint Tracking: This makes input resources tracker and enables the farm to track in the carbon footprint conservation of environmental resources.

1.7 Background reading

The main goal of sustainable agriculture is to meet the world's food requirements without depleting the earth's natural resources.

It addresses all three major components:

1.Economic

The sustainable farming system should be profitable. Farmers can have a good living for themselves and also for their families.

2.Environment

Sustainable agriculture for maintaining the environment, conservation of all natural resources is made like water bodies systems, healthy soil, quality of air etc.

3. Neighbourhood

Sustainable agriculture improves the quality of life for farming and ranching communities and contributes to a more productive countryside with wealthy open countryside and fair treatment of farm workers along with good employment.

➔ https://www.agrivi.com/blog/sustainable-agriculture/

It is based on the three pillars of the sustainable agriculture in the economic, social, and environmental dimensions.

The agri-ecological scale ensures environmental consideration and friendliness in farming, hence assuring the least pollution, and use of non-renewable resources.

The social, or social-territorial scale, addresses how people can appropriately feed the population of our planet and provide fair employment and development.

For local communities.

It is here that the economic scale secures the viability, efficiency, and profitability of the farming business.

➔ https://eos.com/blog/sustainable-agriculture/

According to Anibaldi et al. (2021), various factors across disciplines influence farmers' decisions to adopt sustainable agriculture. While many studies were conducted on the subject, several believe that the progress of sustainable agriculture is at a standstill. In practice, too, many farmers face an intention behavior gap in conducting sustainable agriculture (Nguyen et al. 2019). Further investigation into this issue should be necessary in the interest of policy recommendations.

➔ https://www.researchgate.net/publication/359211371_Sustainable_agricultural_practices_adoption

The growth in the adoption of smart farming technologies increased the level of data creation and consumption for agricultural purposes and automatically attracted questions about the management of such important data. A study of the responses from federal agencies showed that better practices in data management should be encouraged. The DART project, standing for Data Management Plans as a Research Tool, is on its quest to bring about more transparency and efficiency in the usage of data but still faces challenges due to the inconsistency of discipline-specific repositories.

➔ https://acsess.onlinelibrary.wiley.com/doi/10.1002/agj2.20639

Smallholder farmers produce 70% of the world's food but face challenges with sustainable digital services. Improved data management and sharing among agricultural stakeholders can help address these issues. This paper proposes a comprehensive digital framework for managing agricultural data to support smallholder farmers in Tanzania and beyond. The framework's effectiveness is demonstrated through case studies in Tanzania.

➔ https://www.researchgate.net/publication/371173421_Data_management_system_for_sustainable_agriculture_among_smallholder_farmers_in_Tanzania_research-in progress

It is different from conventional farming because it is practiced without harmful methods such as excessive pesticides, superfluous irrigation, or monoculture plantations.
Industrialized farming demands extensive use of chemicals and fossil fuels, thereby reducing natural resources, increasing CO2 emissions, and threatening biodiversity through replacement of traditional crops with fast-growing varieties. Sustainable farming, on its part, strives to reduce these environmental pressures.

➔ https://study.com/learn/lesson/what-is-sustainable-agriculture.html

In order to practice agriculture successfully and ensure its effectiveness in various locations and changing conditions a mix of expertise technical know how and a competent workforce is necessary Scientific research and the knowledge gained from local farmers are crucial for attaining sustainability Schools and other social institutions have an important role in educating both farmers and scientists Collaborative efforts between farmers researchers are vital, for enhancing productivity and upholding sustainable farming methods

➔ .https://www.nature.com/scitable/knowledge/library/sustainable-agriculture 23562787/

By 2050 the world population is projected to reach 9. With a 70 percent increase in food demand ahead. Agriculture faces challenges such as pesticide use, Fertilizer runoff and monoculture farming complicating the task at hand. Concerns arise over farmers depleting resources, Which could impact future farming practices negatively.

Agroecology presents an approach by balancing food security and environmental conservation. Modern farming practices often strain soils But adopting renewable methods, like crop rotation and reducing chemical usage can help alleviate these issues. Embracing knowledge and technology will propel us towards more efficient and environmentally friendly agricultural techniques.

➔ https://youtu.be/X4DZLtdSeCM?si=u1Jx4FsR3S8eZKfg

Developing practices that improve farm sustainability — profitability, quality of life and environmental care. Sustainable agriculture seek to meet the present food necessities without compromising on future resources.

Key points include:

>Productivity & Profitability

>Whole-Farm Approach: Using practices such as rotational grazing and disc reduction to lessen their impact.

>Marketing Mix: Customer-added value and social contract.

>People and Future Generations: Promote farmer health and encourage good farming practices for present needs as well as future generations.

>Resilience It means bringing people together and learning as a collaborative effort to build robust systems.

➔ https://www.youtube.com/watch?v=iloAQmroRK0&t=61s

Technological Innovations: Precision agriculture, remote sensing, and data analytics are enhancing farming by optimizing resource use, boosting yields, and reducing environmental impact
Sustainable Practices: These technologies promote sustainability through efficient resource use, reduced chemical inputs, and improved farm management.

Future Prospects: The technologies have potential to tackle global challenges like food security and environmental sustainability, with a call
for ongoing research and development.

➔ https://www.igi-global.com/chapter/emerging-technological-model-to-sustainable agriculture/268031

Requirements

1. Profitable Farms:
- Help farmers make good money through smart farming.
- Grow different crops and add value to products.
- Provide financial help for new ideas and growth.

2. Healthy Environment:
- Reduce pollution and save resources with methods like organic farming.
- Use less water and keep soil healthy with practices like cover cropping.

3. Thriving Communities:
- Ensure fair pay and good working conditions for farmworkers. - Support local businesses and provide access to healthy food through farmers' markets.

4. Biodiversity Enhancement:
- Create diverse ecosystems by planting cover crops and making habitats for wildlife.
- Improve pest control and pollination to help crops grow better.

5. Education and Training:
- Offer workshops and resources for farmers to learn sustainable practices.
- Encourage partnerships with schools and agricultural groups to share knowledge.

6. Technological Integration:
- Use smart farming tools to manage resources wisely.
- Set up systems to track farm performance and environmental effects.

7. Resilience to Climate Change:
- Grow different crops and focus on soil health to handle climate issues. - Build flexibility to ensure food security and productivity despite changes.

Interview Plan:

System : Sustainable Agriculture

Project Reference : Group 1

Participants :Aarti Bodani
Bhakti Khokhani

Date: 10/9/2024 **Time**: 15:14

Duration: 45 minutes **Place**: Farm

Purpose of Interview:
Preliminary meeting to gain knowledge of the current various agriculture scenarios from the farmers

Agenda:
Current farming practices Resource
management by farmers Problems
faced by the farmers
Future sustainable agricultural plans/goals

Interview Summary: **System** :

Sustainable Agriculture **Project**

Reference : Group 1

Participants :Aarti Bodani
Bhakti Khokhani

Date: 10/9/2024 **Time**: 15:14
Duration: 45 minutes **Place**: Farm

Purpose of Interview:

Preliminary meeting to gain knowledge of the current various agriculture scenarios from the farmers

Questions to discuss:

1. What are the different farming practices currently on board?
2. What is the profit of farmers and how the current technique affects the environment?
3. What tools and technology do you currently use?
4. What future plans do you have regarding the sustainability of the agriculture?
5. How frequently the tools are used for the farming?
6. How and in how much quantity are the resources used?
   (resources eg. water ,land ,seeds ,waste management)
7. Which government policy/schemes do you think will affect or improve your farming?
8. What are the current major problems are you facing now?
9. With which method will you go if you face the minor or major problems?

Summary of the given questions solution:

- Combining traditional methods and modern methods.
- Profits are stable but fluctuate;depends on the crops.
- Use tractors, automated irrigation, pesticides tools. Use limited technology which stops the growth.
- Plans include expanding organic practices and investing in solar energy.
- Tools like tractors and irrigation systems are used frequently; drones and sensors are used periodically.
- Efficient use of water with drip irrigation, land managed with crop rotation, optimized seed usage, and composting for waste management.
- Have less knowledge about the government schemes and policies. And if have the information then dont know how to implement it.
- Issues include fluctuating market prices, pest management, unpredictable weather, soil degradation, and water scarcity.

- Minor issues are handled with practice adjustments; major issues involve seeking expert advice, investing in technology, and exploring government support.So sometimes it takes time to solve and face the major problems.

Combined Requirements:

- 1. Farming Practices
  - A list of traditional and modern farming methods.
  - Information connecting specific methods to different crops and farming conditions.
  - Details on how effective each method is and how often it's used.

- 2. Farmer Profitability and Environmental Impact
  - Records of profit, costs, and earnings for each crop.
  - Data on how farming affects the environment, such as soil health, water use, and pollution.

- 3. Tools and Technology Usage
  - A list of farming tools and technologies like tractors, irrigation systems, drones, and sensors.
  - Information on how often tools are used, how they are maintained, and how they impact farming efficiency.

- 4. Sustainability Plans
  - Plans for future sustainability efforts like organic farming and using solar energy.
  - Progress updates on sustainability goals and the steps taken to reach them.

- 5. Resource Management
  - Information on how water, land, seeds, and waste are used.
  - Historical data to help improve resource usage and reduce waste.

- 6. Government Policies and Schemes
  - Details on government policies and schemes, including eligibility and how to apply.
  - Tracking farmers' knowledge and use of these policies.
- 7. Market Trends and Environmental Challenges
  - Information on changing market prices, pest problems, unpredictable weather, soil issues, and water shortages.
  - Suggestions for handling these challenges based on past data.

- 8. Problem-Solving Methods
  - Ways to solve both minor and major farming problems, including advice from experts and new technology.

- Information on how long it takes to fix issues and what resources are used

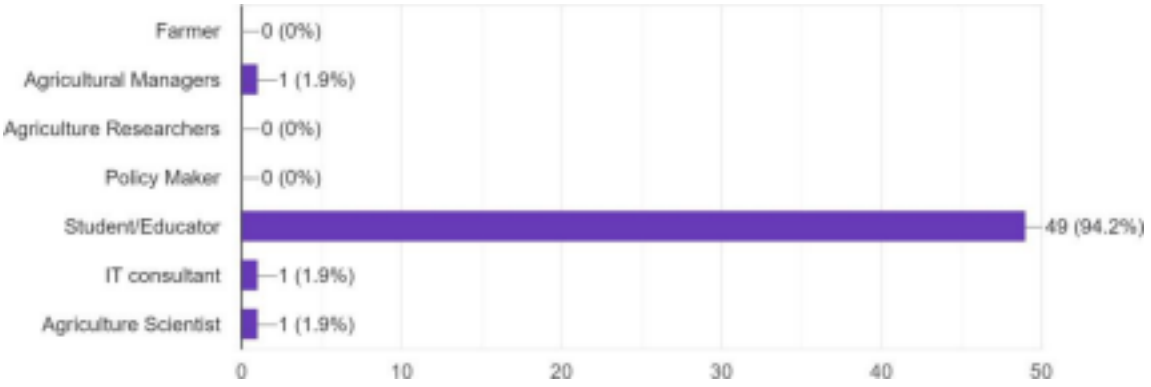
2.3 Questionnaire

-> Questionnaire

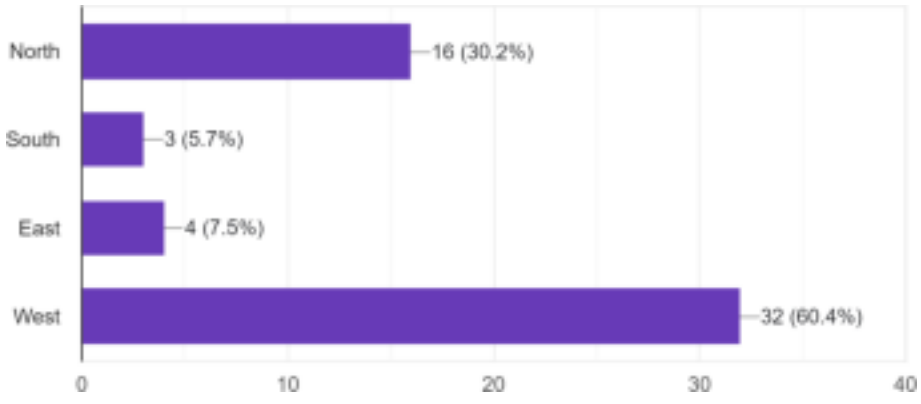
https://docs.google.com/forms/d/e/1FAIpQLSdpNFNwV3GmexRQFilUt7kcJtTt9NluulRf DxMFRBPHX8cyTA/viewform?usp=sf_link

Summary:-

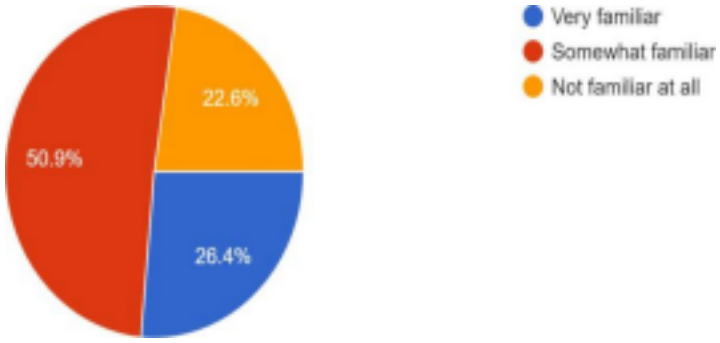
1. Role:-



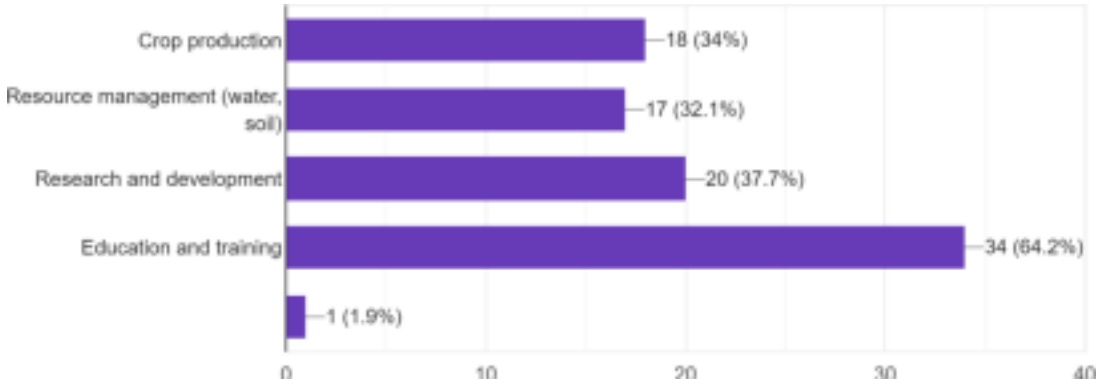
2. Region of Agriculture



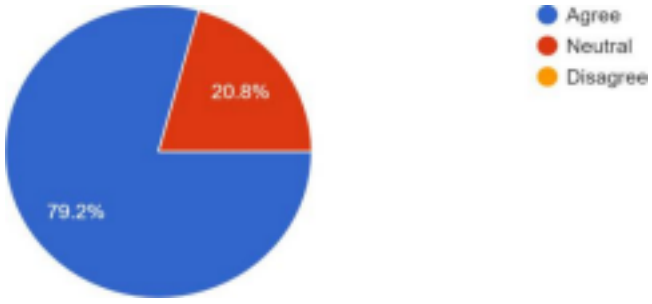
3. How familiar are you with sustainable agriculture?



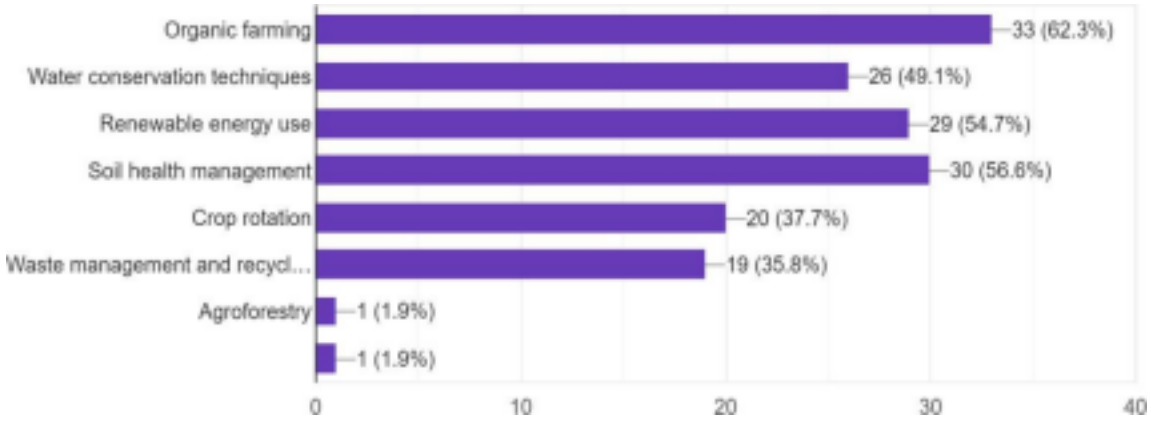
4.What type of agricultural practices are you most involved in or have knowledge about



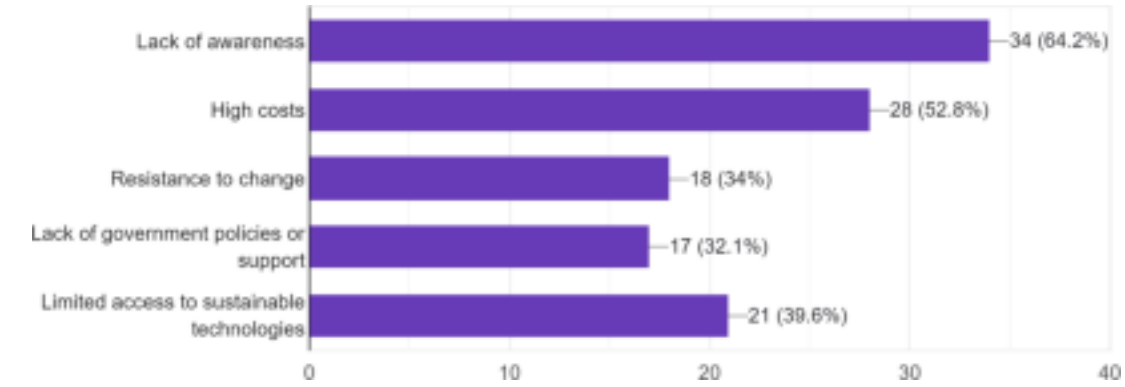
5.Do you believe that sustainable agriculture practices are important for long-term food security?



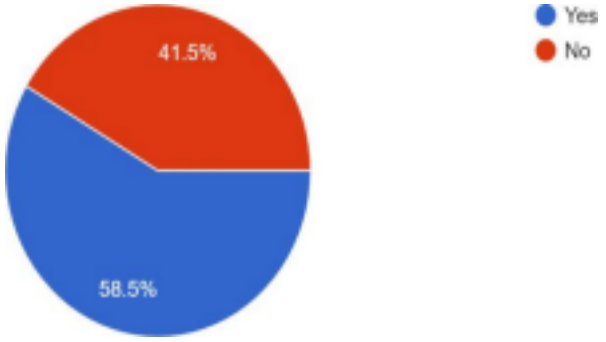
6.What sustainability practices do you think are most important for agriculture?



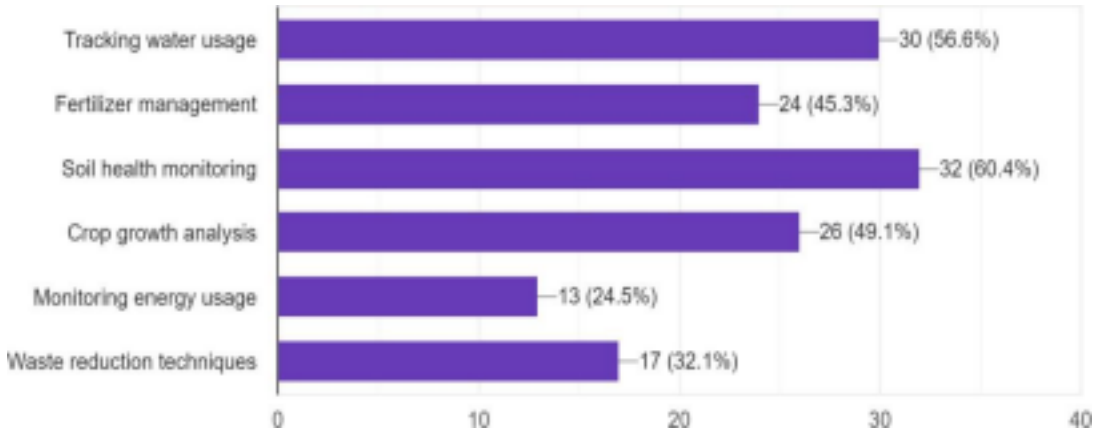
7.According to you what could be the key problems in implementing sustainable agriculture practices?



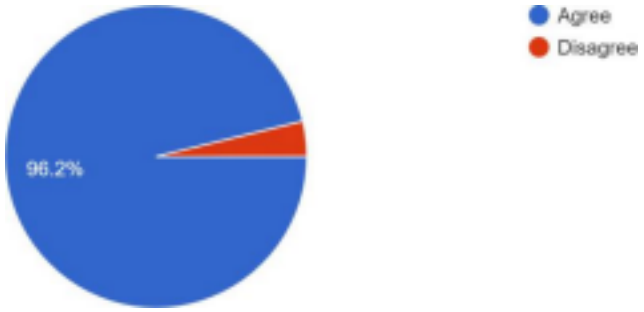
8.Do you know about the use of tools for managing agricultural resources (i.e, databases ,etc)?



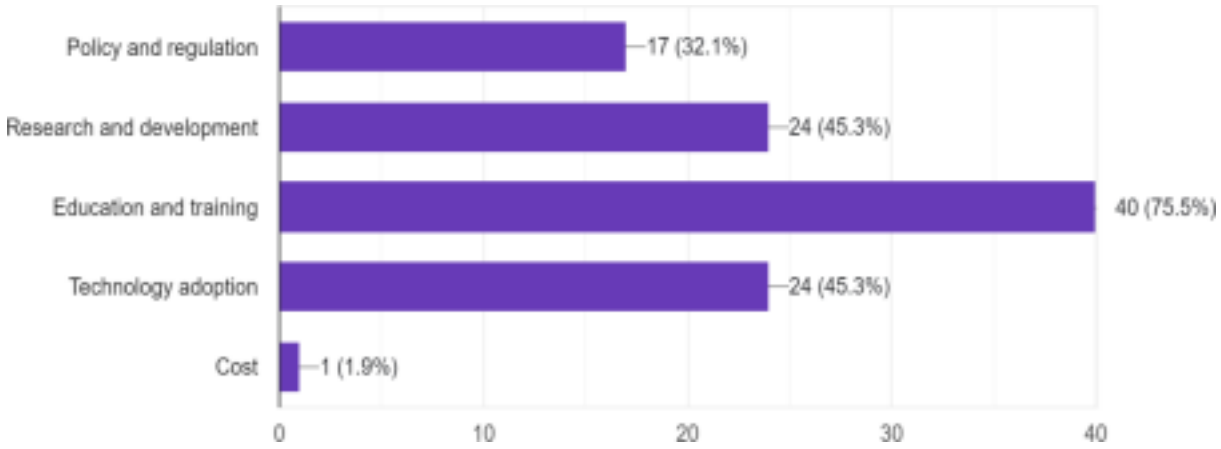
9.Which resource management techniques do you think are most effective in improving sustainability



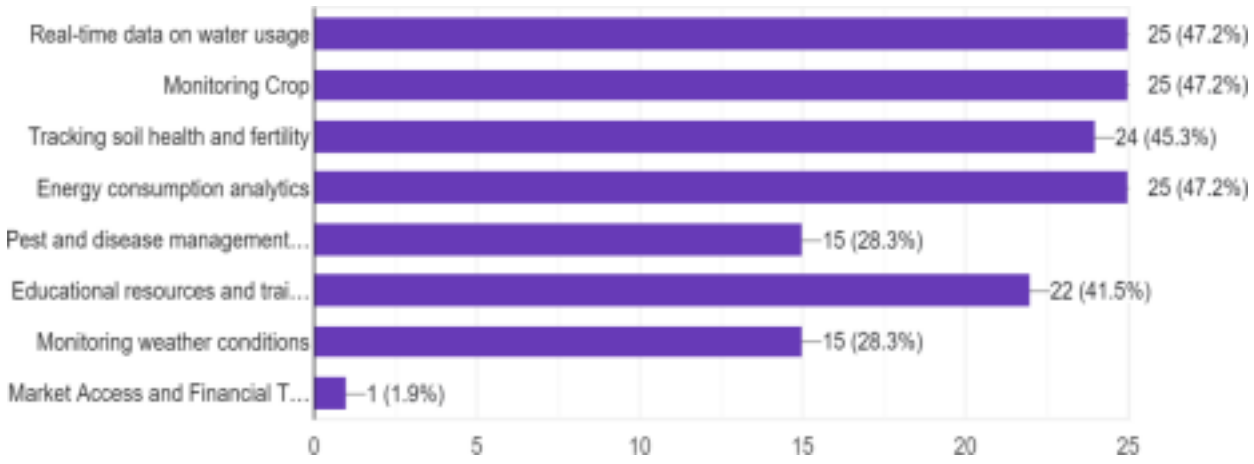
10. Do you believe that technology can play an important role in advancing sustainable agriculture?



11. According to you what should be the key areas for improving sustainable agriculture?



12. What features would you like to see in a sustainable agriculture resource management system?



-> List the combined Requirements gathered from Response/s

- Water Usage : Monitor water use by designating an exact quantity employed, practicing more efficient methods such as drip irrigation, and tracking changes made over time. Strive to minimize wastage.
- Land: Track land registration along with the area used, crops grown and crop rotation strategies. Evaluate it, calibrate and adjust to increase efficiency. • Soil Data: This should be documenting soil health, including information on particulars of fertility (phosphorus and potassium levels), pH, current levels of nutrients.
- Energy Usage: Track energy use by equipment as time passes. • Pest management:- Manage pest control efforts by tracking type, crop, and methods.
- Policies:-Store updates on relevant agricultural policies and regulations .

2.4 Fact Finding Chart

Objective	**Technique**	**Time commitment**
Defining primary goal of the database	Background reading	1 Day
For understanding current agricultural challenges	Interviews, background reading	2 Days
for identifying data source and requirement for the system	Interview	1 Day

for identifying scope for improvement in resource usage	Interview	1 Day
To get the opinions from farmers,managers,students,researchers	Interview Questionnaire survey	4-5 hours
To understand the preference of users of database	Questionnaire survey	4-5 hours
To establish key features and functionalities for the system	Interview Questionnaire	4-5 hours

List of Requirements.

1. Farm Information Management

- The system should store **detailed records of each farm**, including its location, size, soil type, and ownership details.
- It should also capture **specific farming practices** (organic, conventional, etc.) and their relationship to different crops.
- The system must track **resources on each farm**, such as water sources, crop histories, and land usage.

2. Crop Data Management

- The system should store **detailed information on each crop**, such as crop type, variety, planting date, and expected harvest period.
- It should monitor **multiple crop cycles**, including seasonal variations and rotation schedules.

- The database should track **crop yield data** and post-harvest quality metrics.

3. Weather and Environmental Data

- The system must capture **current and historical weather data** including rainfall, temperature, and humidity levels.
- It should integrate **weather forecasts** to assist farmers in planning activities.
- The database should allow users to analyze **weather trends** to enhance decision-making.

4. Pest and Disease Management

- The system should store **details of pest and disease occurrences**, such as types, severity, and affected crops.
- It should track **pest control methods** (e.g., chemical or organic) and assess their effectiveness.
- The system should monitor **patterns of recurring issues** and help predict future outbreaks.

5. Sustainability Tracking

- The database should track **sustainability efforts**, such as water conservation, crop rotation, and the use of renewable energy.
- It must monitor the **adoption of environmentally friendly practices** and their impact on farm productivity.
- The system should track **progress towards sustainability certifications** and provide updates on efforts made by farmers.

6. Farm Activity Log

- The system should log **day-to-day farming activities**, including planting, irrigation, pest control, harvesting, and fertilization.
- It should track **use of labor, machinery, and equipment**, along with their maintenance schedules.
- The database should allow users to **review historical activities** and ensure accuracy in reporting.

7. Resource Usage and Management

- The system must track the **use of essential resources**, such as water, seeds, land, and fertilizers.
- It should keep **historical data** to help optimize future resource use and minimize waste.
- The system should also track **waste management practices**, including recycling and composting.

8. Research Data and Experiment Tracking

- The system should store **data from agricultural experiments**, including trial results on specific farms and crops.
- It should track the outcomes of **field experiments** on new techniques, tools, or crop varieties.
- The system must support **comparisons of research results** across different farm conditions.

9. Policy and Regulation Management

- The system should store **government regulations and agricultural policies** that apply to specific crops and farms.
- It should monitor farmers' participation in **government support programs** and their eligibility for subsidies.
- The database should support **policy updates** to keep information current with new regulations.

10. Market Trends and Challenges

- The system should store **market data** such as crop prices, demand shifts, and market conditions.
- It must also track **environmental challenges**, including soil erosion, water scarcity, pest issues, and weather unpredictability.
- The system should offer **insights and recommendations** for farmers on how to respond to market fluctuations and environmental threats.

11. Problem-Solving and Knowledge Base

- The system should store **information on solutions** for common agricultural challenges like pest infestations and resource shortages.
- It should include **expert advice on modern farming technologies** and tools to solve specific problems.
- The system should track how long it takes to **resolve these issues** and what resources were used to address them.

12. Farmer Contributions and Feedback

- Farmers should be able to **submit data** on their practices, yields, and pest control strategies.
- The system must have a **moderation process** to review and verify submissions from farmers for accuracy.
- The database should allow for **real-time updates**, reflecting farmers' feedback immediately.

13. Data Maintenance and Version Control

- The system should have processes in place for **regular updates and revisions** of farming data, crop records, and environmental information.
- It should support **version control** to ensure data integrity and track changes over time.
- The system must include **backup and maintenance** procedures to avoid data loss and ensure reliability.