TITLE: **Smart, Secured, Survivable and Sustainable Agriculture Platform Project Using Solar Energy, IoT, AI and Blockchain Technology**

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Collaboration Universities :


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Background :

- In developing countries, there are lack of strong infrastructure
  - underground cables connection for stable internet connectivity
  - the reach of electricity, especially in rural areas.
- Only mobile phones (via satellite) and solar energy have the potential to reach such areas reliably.
  - E.g., hill-tribe people[1] living over the range of mountains in the rural area of Keng Tung, Eastern Shan State, Myanmar.
- Traditional farming practices are inefficient and cannot reach to qualified market
  - due to lack of resources and information.

Targets:

- This initiative research project aims to develop a smart, secured, survivable and sustainable agriculture platform (4S Agriculture Platform) for rural farmers using solar energy powered Internet of Things (IoT) sensors, artificial intelligence (AI) and blockchain technology.

1. Hill Tribes of Myanmar's Shan State – GlobeRovers , The Local Tribes of Kyaing Tong/Kengtung, Myanmar | Chasing Lenscapes

4S Agriculture Platform Architecture

- The platform will consist of
  - IoT sensor devices,
  - Raspberry Pi controller with GSM SIM for internet connectivity,
  - Private blockchain network,
  - Cloud servers and AI/ML models.
- Sensors will measure factors like temperature, humidity, soil moisture etc.
- The Raspberry Pi will collect and transmit encrypted sensor data to the blockchain network.
- Farmers can access anonymous analysis reports and recommendations on their mobile phones using decentralized cloud applications.

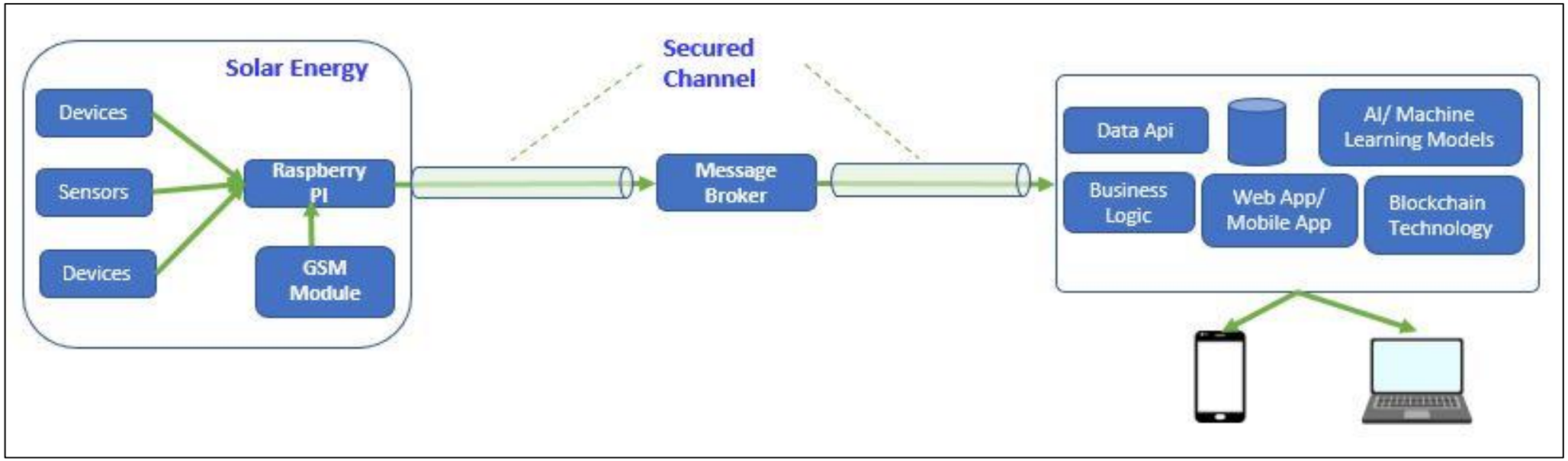


Figure – 4S Agriculture Platform Architecture Overview

4S Agriculture Platform Architecture: Phases of Implementation

1) **Infrastructure Setup**
   - Installation of IoT sensor devices powered by solar energy modules
   - Setting up the internet connectivity using GSM SIM Module on Raspberry Pi controller.
2) **Sensor Networking**
   - Connecting various sensors to the Raspberry Pi.
   - Developing protocols for secure sensor data collection,
   - Encryption and transmission using cipher blockchain technology
3) **Cloud Architecture**
   - Deploying the cloud servers
   - Developing AI/ML models for automated analytics and control system
   - Implementing Web application and mobile application UI for the user accessibility
4) **Pilot Testing:**
   - Practicing in specific crop by using this 4S Agriculture Platform,
   - Implementing the platform on selected crop varieties and farms in University Campus first
5) **Large scale rollout**
   - Based on pilot study results, enhance platform, scale up across different geographies and crop varieties. And then, implement in selected rural area for smart agriculture.

Project Plan : Master Schedule

Phase	Process	Time(Months)						
		0-3	4-6	7-9	10-12	13-15	16-24	...
1	Getting Approval and Forming the Project Team							
2	Initiation and setting up the Infrastructure							
3	Develop Cloud architecture and establish sensor data base-station							
4	Implement the monitoring system and web UI and design/train with AI Models							
5	Pilot Testing for practicing the crop in 4S agriculture platform with auto-irrigation							
6	Deployment: Implement in selected rural areas							
7	Monitoring and evaluation and training continues for AI and ML models							

4S Agriculture Platform Architecture: Phases of Implementation

1) Infrastructure Setup
   I. Installation of IoT sensor devices powered by solar energy modules
   II. Setting up the internet connectivity using GSM SIM Module on Raspberry Pi controller.

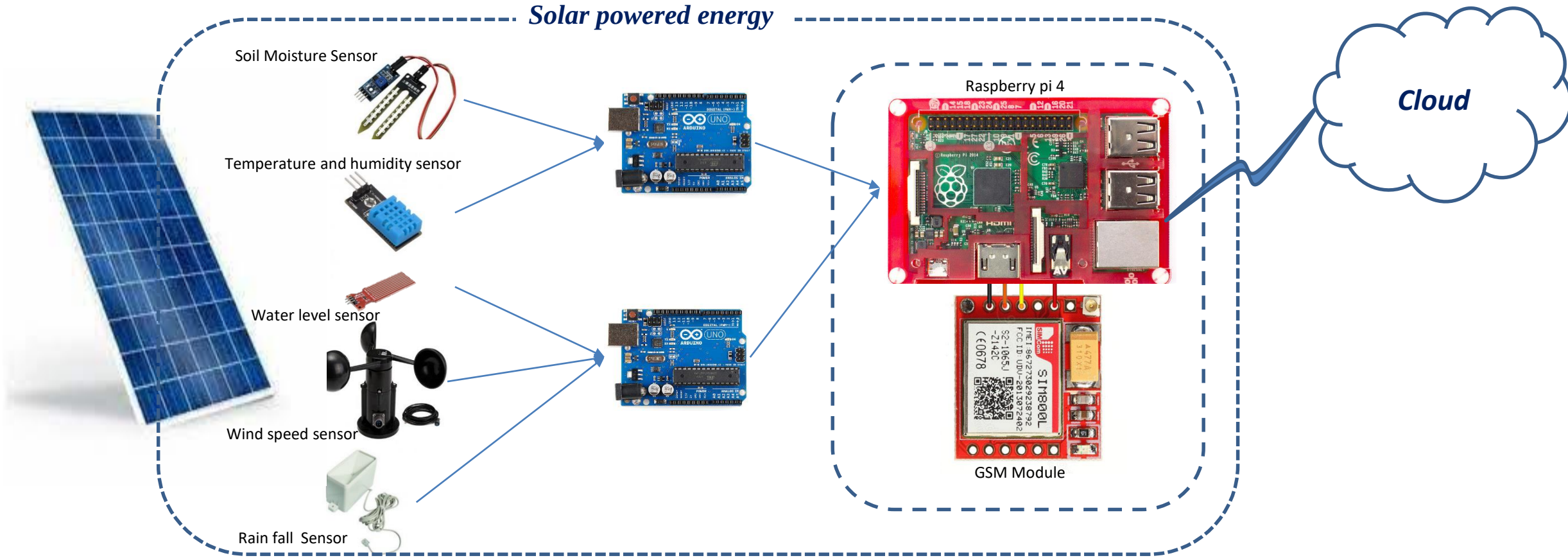


Figure – Infrastructure Design for each node overview

4S Agriculture Platform Architecture: Phases of Implementation

1-1) Required Devices for each node

Description	Specification	Quantity	Est. Unit Price ($)
Solar Panel	~ 50 Watt 12 V	1	129
Battery	~ 24 Ah 12 V	1	75
Solar Charge Controller	~12 V	1	60
Regulator(lm323) with heatsink	3A 5V	1	15
Soil Moisture Sensor		1	10
Temperature and Humidity Sensor		1	10
Water Level Sensor(/Ultrasonic)		1	25
Wind Speed Sensor		1	175
Rainfall Sensor		1	35
Arduino	Uno	2	20
Raspberry Pi	3 or 4	1	85
GSM Module		1	12
General(jumper wire, case, etc.,)			49
Total			**700**

Price Ref: www.alibaba.com

4S Agriculture Platform Architecture: Phases of Implementation

2) Sensor Networking

I. Developing protocols for secure sensor data collection,

II. Encryption and transmission with blockchain technology.

- In order to get the secure data transmission, we will implement the data encryption algorithm using cipher block chain method.

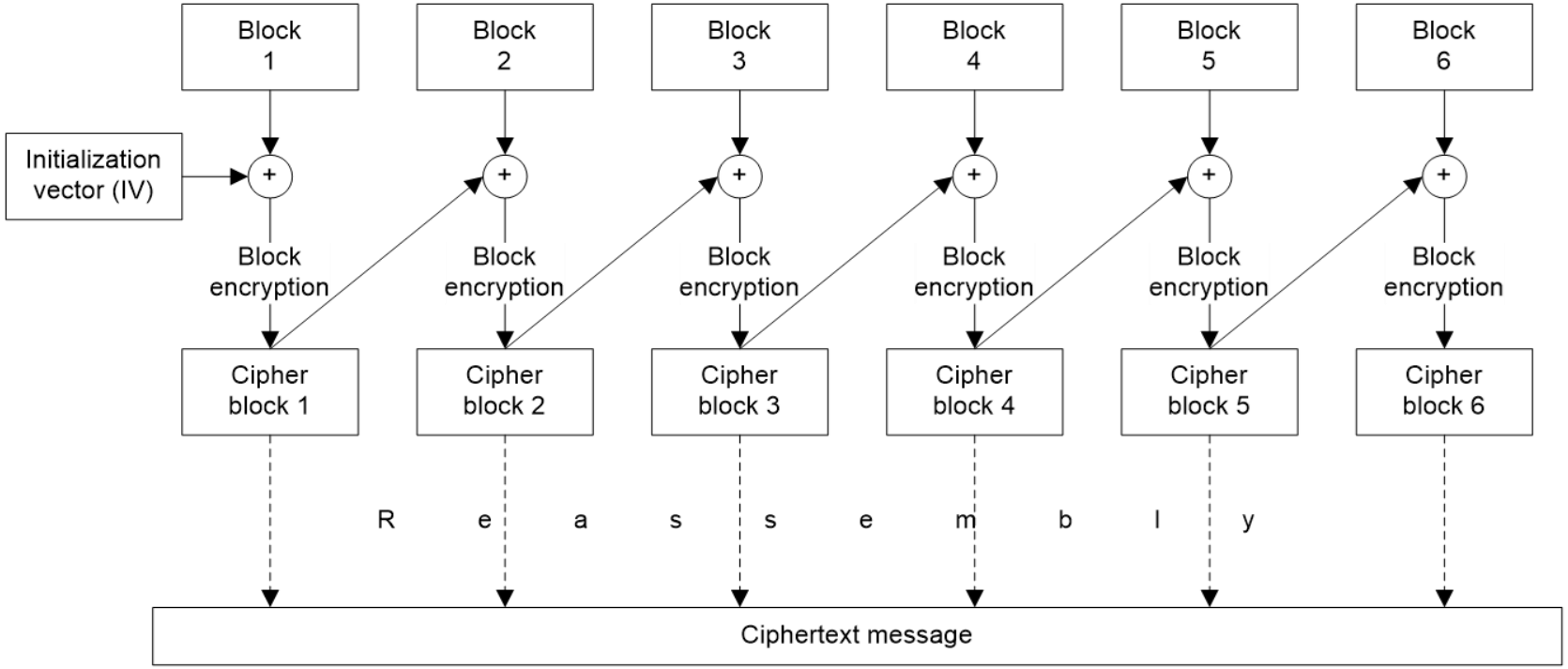
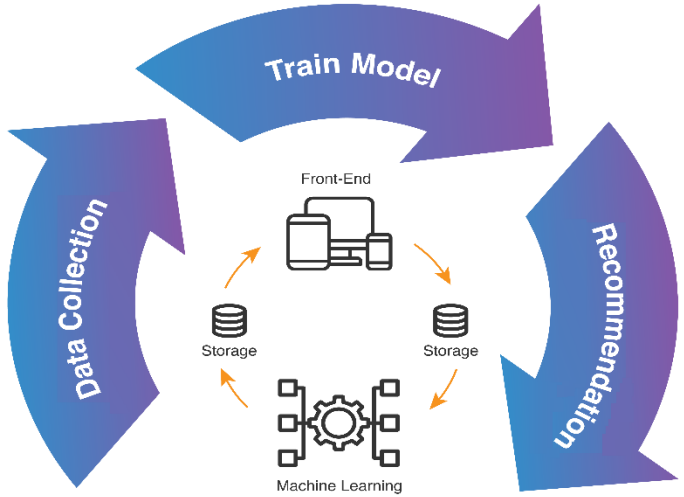


Figure – Cipher Block Chaining

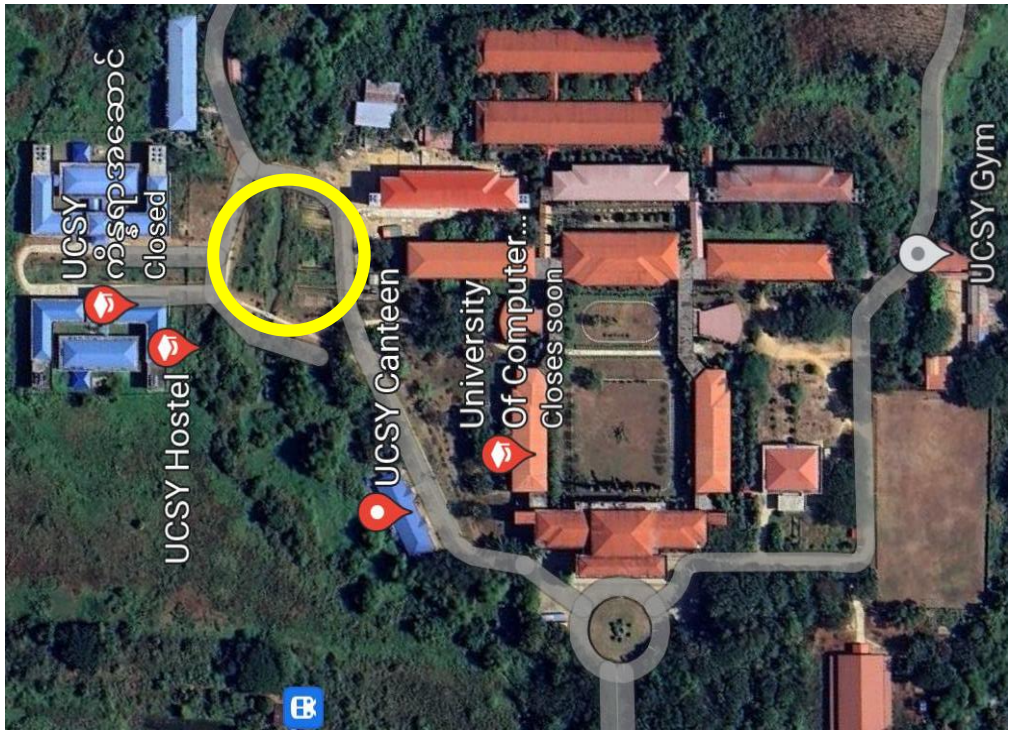
4S Agriculture Platform Architecture: Phases of Implementation

3) Cloud Architecture
   - Deploying the cloud servers and
   - Developing AI/ML models for automated analytics and control system
     - auto-irrigation system
   - Implementing Web application and mobile application UI for the user accessibility
     - Dashboard for data collection from nodes
     - Recommender System
       - Collaborative Filtering: Collaborative filtering is a technique often used in recommendation systems, including crop recommendation. It identifies patterns and similarities between users or fields to make crop recommendations based on what has worked well for similar users or fields.
   - Establishing the connections:
     - between the sensor network and cloud servers
     - send message via message broker among them



4S Agriculture Platform Architecture: Experiments including field testing

- The selected location for the pilot project is the crop fields in the UCSY Campus, Yangon. Myanmar
- When the pilot project is completed in UCSY Campus, then the selected rural areas will be applied to deploy.
  - Evaluating impact on productivity, yield, resource usage.
  - Check and track whether the sensors' collected data are securely send to the cloud-base monitoring centre or not.



[UCSY Map]

Impact:

Scientific and Technological Impact:

- Empower agricultural communities with an IoT sensor network powered by solar energy, aimed at gathering critical environmental data from farms, such as soil properties, weather conditions, and more.
- Establish a secured data ecosystem, ensuring that farmers have easy and transparent access to vital sensor data for informed decision-making.
- Leverage advanced AI/ML models hosted in the cloud to provide actionable insights and recommendations based on sensor data, enabling farmers to enhance productivity and sustainability.
- Create an AI-driven auto-irrigation system that optimizes water usage according to real-time farm conditions, thereby conserving water resources and improving crop yields.
- Implement a pilot program in selected rural areas of developing countries to assess the tangible benefits of the platform, measuring its positive impact on agricultural sustainability, water conservation, and local livelihoods.

Societal and Collaborative Impact:

- By harnessing the capabilities of a resilient, secure, and sustainable agriculture platform, farmers can significantly reduce toxic emissions, thereby contributing to the reduction of air pollution and its associated environmental benefits.
- This platform also facilitates seamless communication between remote farmers, promoting knowledge sharing and collaboration among agricultural communities, leading to improved practices and increased productivity.
- Furthermore, the adoption of this technology empowers rural residents with the tools for smart living and farming, enhancing their overall quality of life while promoting sustainable agricultural practices for long-term community well-being.

Output/Outcome:

Outputs:

- Development of the 4S Agriculture Platform
- Deployment of Solar-Powered IoT Sensors
- AI/ML Models for Data Analysis
- Auto-Irrigation System
- Recommender System

Outcomes:

- Improved Agricultural Practices
- Environmental Impact
- Knowledge Sharing and Collaboration
- Pilot Evaluation

Conclusion:

- While The platform has potential to revolutionize sustainable smart agriculture, challenges of high initial costs, lack of infrastructure and technical skills of farmers need to addressed.
- The 4S Agriculture Platform project introduces innovative technologies, such as IoT sensors and AI-driven recommendations, to improve farming methods, leading to increased crop yields and resource efficiency.
- By collecting and analyzing data on various environmental factors, the project promotes sustainability and potentially contributes to reducing environmental impact, including lower toxic emissions and better resource management.
- The platform's capacity for knowledge sharing and communication among farmers encourages collaboration, fostering a sense of community and collective problem-solving.
- The pilot phase will provide valuable real-world insights into the effectiveness of the platform, serving as a model for smart and sustainable agriculture, water conservation, and rural livelihood improvement.
- Future enhancements could include integration of computer vision, virtual/augmented reality based advisory tools and blockchain supported farmer communities/micro-financing.

4S Agriculture Platform Project

Thank You