s.m.a.r.t. greenhouse

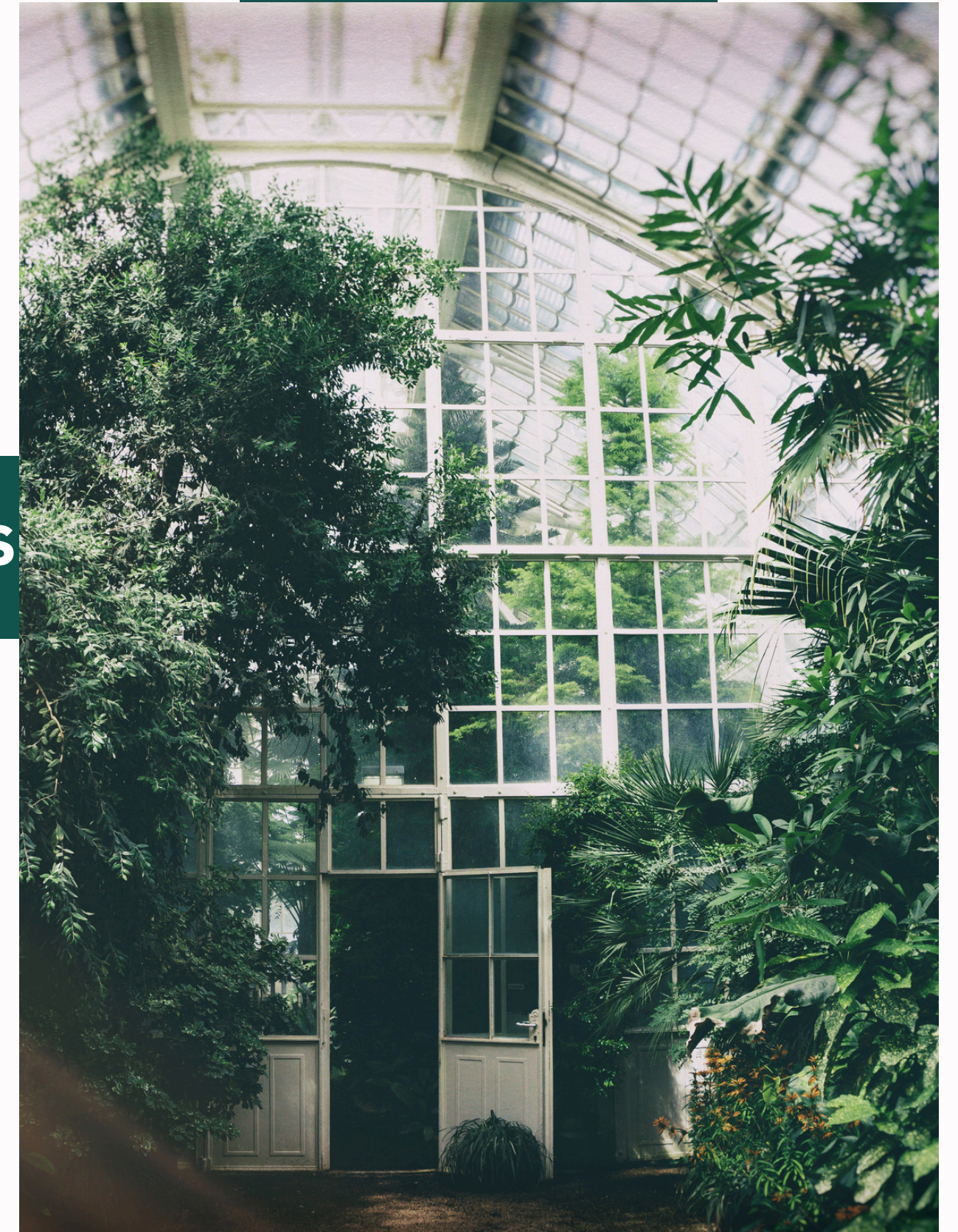## Topic 4: Self-Reliant Systems and Procedures

4.4. Agriculture 4.0 - Smart and precision agriculture

Developed By:

NOVATEX SOLUTIONS.EU

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Objectives

Objective 01

Understanding the definition and principles of Agriculture 4.0 and Smart and Precition Agriculture techniques.

Objective 02

Introduce the significance and the benefits of Agro-Tech sensors in Smart Greenhouses.

Objective 03

Learn the benefits of using Sensors in Smart Greenhouse systems.

Objective 04

Describe the integration of Sensor Data for Informed Decision-Making.

Objective 05

Develop strategies to prevent, monitor, and manage pests and diseases.

s.m.a.r.t.
greenhouse

What is Agriculture 4.0?

- Agriculture 4.0 represents a paradigm shift in farming practices, integrating advanced technologies to optimize productivity while minimizing resource usage.

- Harnesses the power of data analytics, robotics, and artificial intelligence (AI) to revolutionize traditional farming methods.

- Data-driven decisions, leading to enhanced efficiency and sustainability throughout the agricultural value chain.

Evolution of Agriculture 4.0

- The evolution of Agriculture 4.0 is propelled by the increasing demand for food security, environmental sustainability, and economic viability.

- By leveraging technologies such as precision agriculture and Internet of Things (IoT) devices, farmers can monitor crop health, soil conditions, and weather patterns in real time.

- This proactive approach allows for timely interventions, optimizing resource allocation and minimizing waste.

Evolution of Agriculture 4.0

Smart and Precision Agriculture Techniques

Smart and precision agriculture techniques are central to the principles of Agriculture 4.0.

Smart Farming

- Smart farming involves the integration of sensor technologies, drones, and autonomous machinery to collect and analyze data for informed decision-making.

- These technologies enable farmers to monitor crop growth, detect pests and diseases, and manage irrigation systems with precision.

Precision Agriculture

- Precision Agriculture focuses on targeted interventions to maximize resource efficiency

- Use of GPS-guided machinery and variable rate application techniques

- Farmers can apply inputs such as fertilizers and pesticides only where and when needed

- Reduces input costs and minimizes environmental impact by preventing overuse of agrochemicals

Precision Agriculture

- The adoption of smart and precision agriculture techniques aligns with the Sustainable Development Goals (SDGs) set forth by the United Nations.
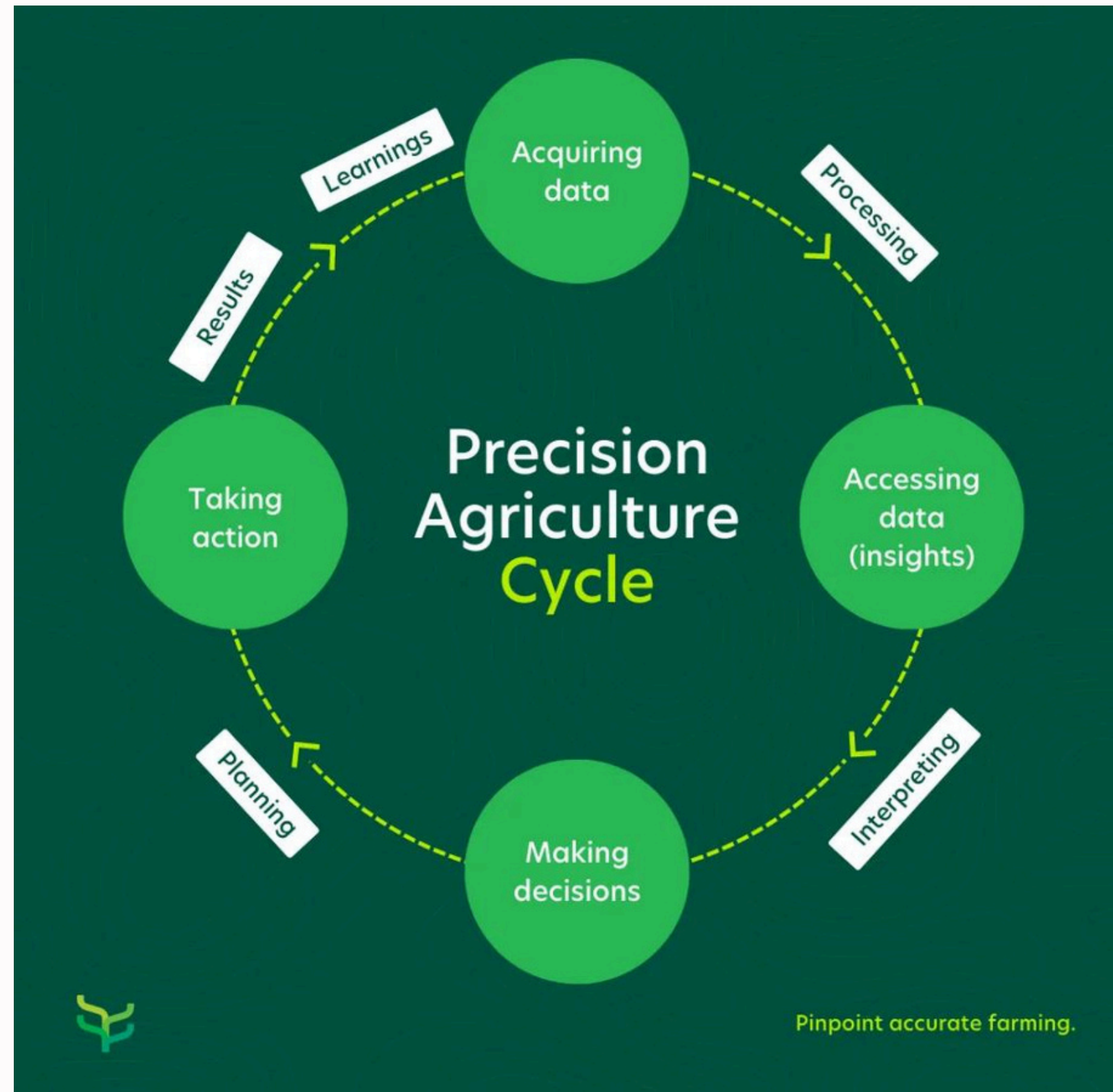
By promoting:
- Resource efficiency
- Environmental stewardship
- Economic prosperity

Agriculture 4.0 contributes to the achievement of multiple SDGs, including zero hunger, clean water and sanitation, and sustainable cities and communities

Smart and Precision Agriculture Techniques

Significance of Smart Greenhouses

- Smart greenhouses represent a foundation of modern agriculture, offering controlled environment conditions for year-round crop production.

These facilities utilize advanced technologies such as:

- Climate control systems

- LED lighting

- Automated irrigation

Optimize growing conditions and maximize yields. By creating a stable and tailored environment, smart greenhouses enable farmers to overcome challenges such as **adverse weather, pests,** and **diseases.**

Agro-Tech Sensors in Smart Greenhouses

Significance of Smart Greenhouses

- The significance of smart greenhouses extends beyond basic productivity gains.

- These facilities play a crucial role in promoting sustainable agriculture practices by reducing **water consumption, minimizing pesticide usage,** and **mitigating greenhouse gas emissions**.

- By harnessing renewable energy sources and recycling water and nutrients, smart greenhouses illustrate the principles of circular economy and environmental stewardship
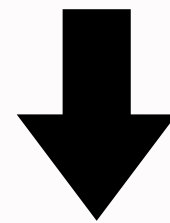
Role of Agro-Tech Sensors

Agro-tech sensors are essential components of smart greenhouse systems, providing:

- Real-time data on environmental parameters crucial for crop growth.

- Monitor factors such as temperature, humidity, light intensity, and soil moisture levels.

Allowing farmers to fine-tune growing conditions and optimize plant health.

Agro-Tech Sensors in Smart Greenhouses

Lets take a look into the specific roles and benefits of Agro-tech sensors in Smart Greenhouse operations

Role of Agro-Tech Sensors

Real-Time Monitoring:

- Enable continuous monitoring of environmental conditions within the greenhouse.

- This enables immediate adjustment, ensuring optimal growing conditions.

Precision Control:

- Agro-tech sensors collect precise data to enable precision control of greenhouse systems.

- Farmers can precisely adjust temperature, humidity, and irrigation minimizing resource and maximizing productivity.

Agro-Tech Sensors in Smart Greenhouses

Role of Agro-Tech Sensors

Optimized Resourse Use:

- Agro-tech sensors optimize resource use in smart greenhouse.

- Monitoring soil moisture allows precise irrigation, reducing water use and ensuring adequate plant moisture.

Early Detection of Issues:

- Agro-tech sensors can detect pest infestations or disease outbreaks early.

- Continuous crop health monitoring helps farmers promptly address issues and minimize losses.

Agro-Tech Sensors in Smart Greenhouses

Role of Agro-Tech Sensors

Data-Driven Decision Making:

- Data from agro-tech sensors underpins data-driven decisions in smart greenhouse management.

- Farmers use data to optimize crop management, boosting yields and resource efficiency.

Remote Monitoring and Management:

- Agro-tech sensors allow remote greenhouse monitoring and management.

- Farmers can remotely manage greenhouse systems using mobile devices, ensuring control from anywhere.
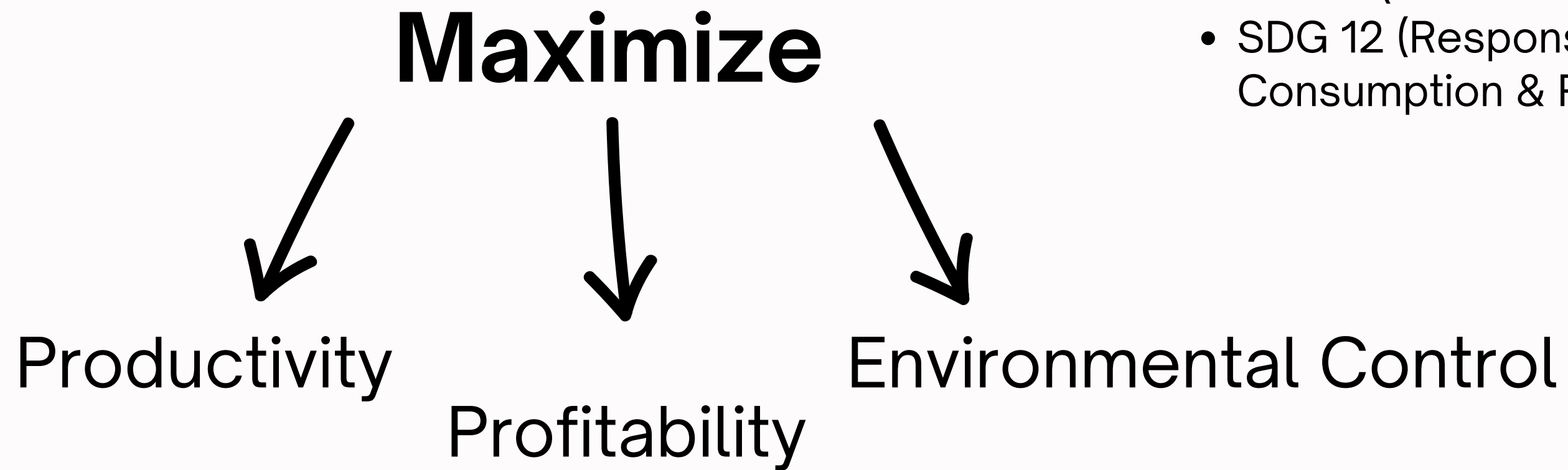
Agro-Tech Sensors in Smart Greenhouses

The incorporation of agro-tech sensors in smart greenhouses represents a pivotal advancement in agriculture, enabling:

- Precise control

- Efficient resource utilization

- Proactive management for sustainable crop production

Benefits of Agro-Tech Sensors

Enhanced Environmental Monitoring:

Sensors continuously measure parameters such as:

- Temperature
- Humidity
- Light intensity
- CO2 levels

This real-time data allows for precise control of the greenhouse environment, ensuring optimal conditions for plant growth and reducing the need for manual monitoring.

Using Sensors in Smart Greenhouse Systems

Benefits of Agro-Tech Sensors

Resource Efficiency:

- Using sensors to monitor soil moisture and nutrient levels
  ➡ irrigation and fertilization can be improved.

- This reduces water and fertilizer usage, contributing to water conservation (SDG 6) and minimizing environmental impact (SDG 12).

6 CLEAN WATER AND SANITATION

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Using Sensors in Smart Greenhouse Systems

Benefits of Agro-Tech Sensors

Increased Productivity and Profitability:

- Accurate environmental control leads to healthier plants and higher yields.

- Sensors can detect and address issues before they affect the crop, ensuring consistent production and reducing losses.

- This results in higher profitability for growers (SDG 8: Decent Work and Economic Growth).
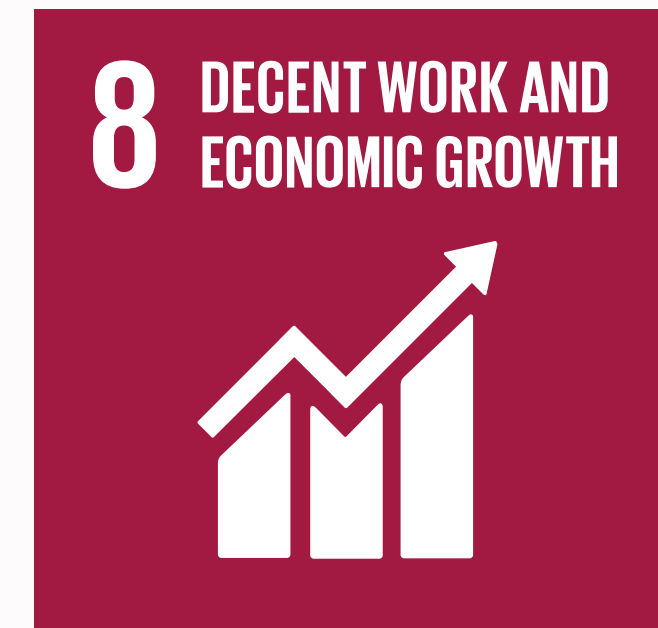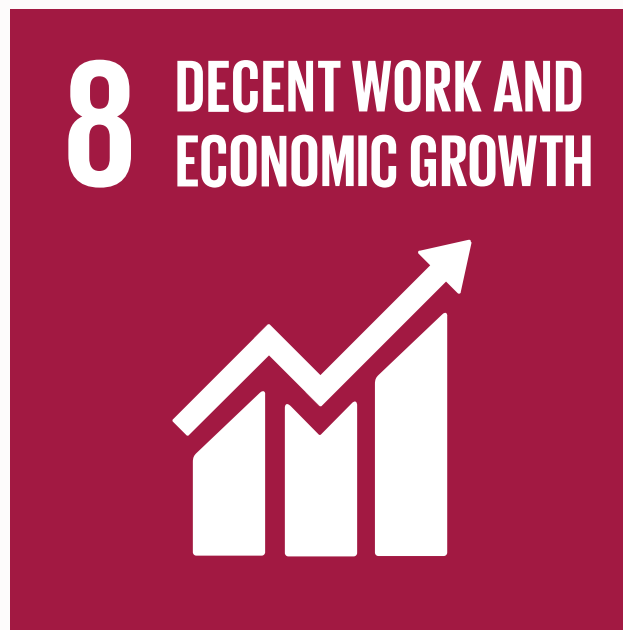
Benefits of Agro-Tech Sensors

Sustainable Practices:

- The use of sensors supports sustainable farming practices by reducing resource waste, minimizing chemical use, and promoting more efficient energy usage.

- This aligns with SDG 12 by fostering responsible production processes.

Integration of Sensor Data for Informed Decision-Making

- Enables growers to make informed decisions by identifying trends, patterns, and correlations.

- This data-driven approach optimizes production processes, maximizes yields, and improves overall profitability while supporting SDG 2, SDG 8, and SDG 12.

Steps For Integration

1. Data Collection: Sensors gather environmental, soil, and plant data, processed using advanced analytics and machine learning.

2. Data Analysis: Growers identify seasonal changes, pest issues, and nutrient deficiencies, enabling proactive management through clear patterns.

Steps For Integration

3. Predictive Modeling: Historical data predicts future conditions and crop performance, aiding resource allocation and scheduling while anticipating issues.

4. Decision Support Systems: Integrated systems provide insights and recommendations, suggesting optimal irrigation, pest control, or climate adjustments in greenhouses.
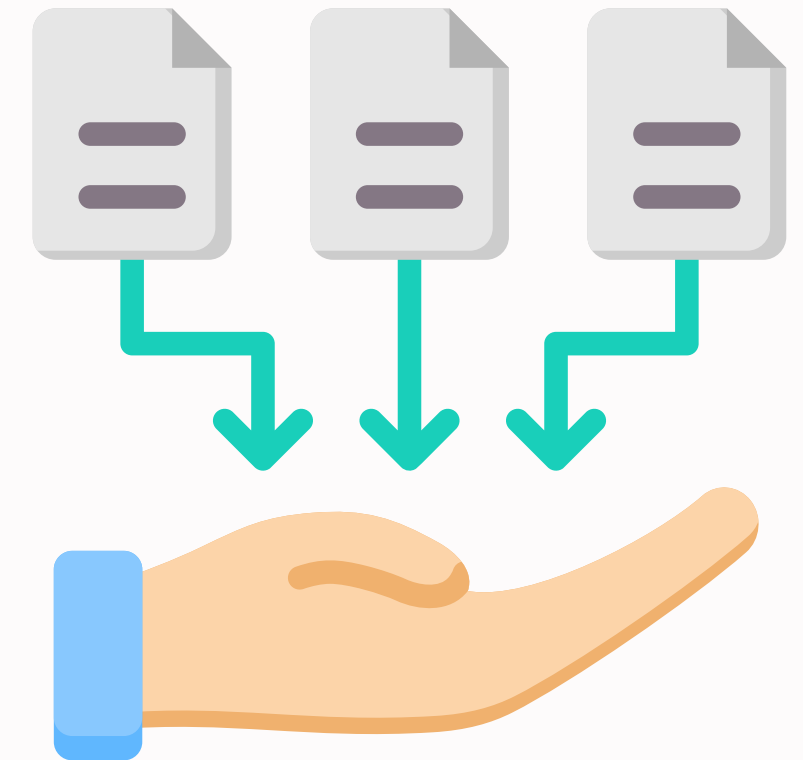
Integration of Sensor Data for Informed Decision-Making

Steps For Integration

5. Continuous Improvement:

- Regular review of sensor data

- Refining strategies for improved productivity and sustainability

- Continuous enhancement over time

- Supports SDG 9 by promoting agricultural innovation

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Pest and Disease Management

- Effective pest and disease management in smart greenhouses involves integrating biological control methods

- Integrated Pest Management (IPM) approaches, companion planting, beneficial insects, and monitoring systems for early detection and prevention

- These strategies support SDG 2 and SDG 15 (Life on Land)

Pest and Disease Management

Biological Control Methods for Pest Management

1. Natural Predators and Parasites:
- Introducing natural predators such as ladybugs, lacewings, or parasitic wasps can control pest populations without the need for chemical pesticides.

2. Microbial Inoculants:
- Beneficial microbes can outcompete harmful pathogens, promoting plant health and reducing disease incidence.

Pest and Disease Management

Integrated Pest Management (IPM) Approaches:

1. Cultural Practices:
- Crop rotation, sanitation, and proper spacing can prevent pest outbreaks and reduce disease pressure.

2. Mechanical Controls:
- Physical barriers, traps, and manual removal of pests can be effective in managing populations.

3. Chemical Controls:
- When necessary, use targeted, environmentally-friendly pesticides as a last resort, minimizing impact on non-target organisms and the environment.

Companion Planting and Beneficial Insects:

1. Plant Diversity:
- Growing a variety of plants can attract beneficial insects and deter pests. For example, marigolds can repel nematodes, while herbs like basil can deter aphids.

2. Habitat Enhancement:
- Creating habitats for beneficial insects, such as installing insect hotels or maintaining wildflower strips, supports biological control agents.

Pest and Disease Management

Monitoring Systems for Early Pest Detection and Prevention:

1. Regular Inspections:
- Routine checks of plants and the greenhouse environment help detect early signs of pest infestations or disease.

2. Sensor Technology:
- Advanced sensors and cameras can detect changes in plant health, signaling the presence of pests or disease. This allows for timely interventions before problems escalate.

3. Data Integration:
- Combining sensor data with historical records helps predict pest and disease outbreaks, enabling preventive measures.

➤ By implementing these strategies, smart greenhouse systems not only improve pest and disease management but also contribute to sustainable agriculture and environmental conservation, aligning with multiple SDGs.