CANTHO UNIVERSITY

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Education:

1986: BS. Agriculture - Cantho University, Vietnam

1999: MS. Applied Biological Science, Tokyo University of Agriculture & Technology, Japan

2002: Ph.D. Applied Biological Science, Tokyo University of Agriculture & Technology, Japan

2009 - 2010: Post Doctor, Bio-system Engineering, Clemson University & USDA, USA.

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Researches:

- Mechanism action & application of plant growth substances on clonal propagation by cutting & plant tissue culture, plant nutrition, bioactive substances in cultivation, pest and weed management.
- Crop and fruit production: rice, sugarcane, soybean, peanut, lotus, aquatic plants, mango and rose apple.
- Extraction of natural compounds, enzymes and proteins.
- Carbohydrate metabolism and application.
- Rice lodging control.
- Mechanism action and biological activity of enzymes, proteins and natural products.
- The biochemistry and microbiology of biofuel production from lignocellulosic biomass
- Medicinal plants and biochemical reactions involving endocrine diseases.

INTERNATIONAL CONFERENCE
DEVELOPING SCIENTIFIC TECHNOLOGY AND INNOVATION IN THE NEW TIME

APPLIED BIOLOGICAL SCIENCE AND ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE AGRICULTURE

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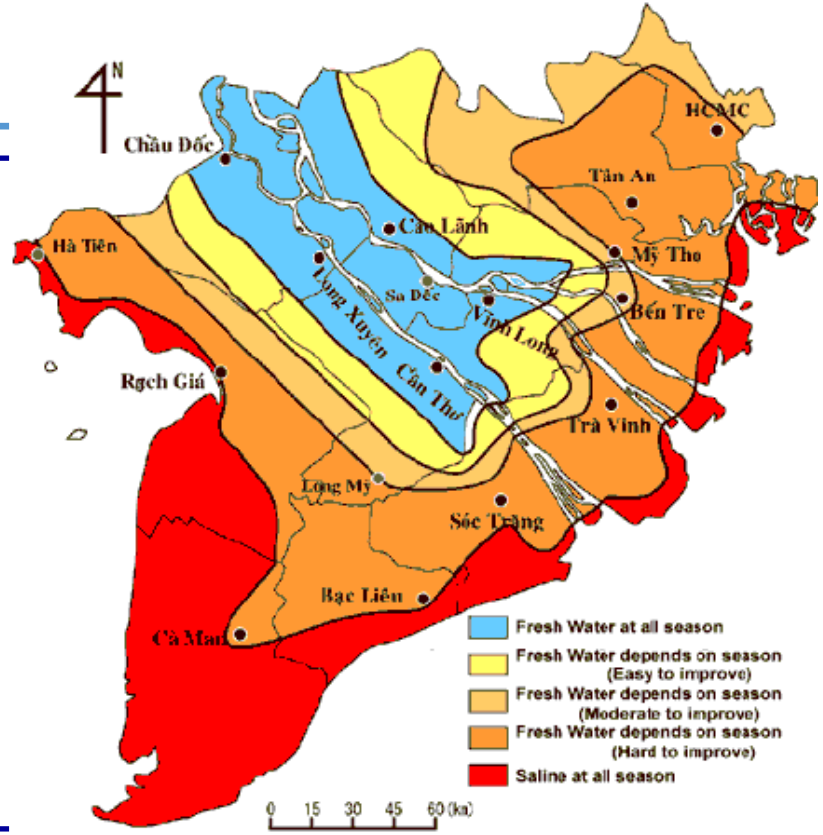
INTRODUCTION

- Sustainable agriculture: strategic priority in the Mekong Delta, Vietnam.
- Mekong Delta: the nation's primary food basket.
- Mekong Delta: increasingly threatened by climate change, salinity intrusion, and overuse of chemical inputs.
- Sustainable Agriculture Problem of the Mekong Delta, Vietnam?



INTRODUCTION

- Key Principles and Practices?
- Core Focus Areas for Sustainable Agriculture?
- AI Platforms & Mobile Applications.
- Applied biological science, combined with advances in artificial intelligence (AI), provides powerful opportunities to redesign agricultural systems that are both productive and ecologically balanced.

CONCEPT OF SUSTAINABLE AGRICULTURE

- Sustainable agriculture is a holistic approach to farming that aims to meet the food and fiber needs of the present generation **without compromising the ability of future generations** to meet their own needs.
- It is an integrated system of plant and animal production practices that is site-specific and designed to work over the long term.

CONCEPT OF SUSTAINABLE AGRICULTURE

The Three Pillars of Sustainable Agriculture

* The concept rests on three interconnected pillars, often referred to as the "three legs of the sustainability stool":

Pillar	Focus	Key Goal
1. Environmental Stewardship (Planet)	Protecting and enhancing the natural resource base.	Health of soil, water, air, and biodiversity. Minimize pollution and efficient use of non-renewable resources.
2. Economic Viability (Profit)	Ensuring farm operations are profitable and financially resilient.	Profitability and long-term economic stability for farmers, allowing for reinvestment in the business.
3. Social Equity (People)	Promoting human well-being, social responsibility, and quality of life.	Quality of life for farmers, farm workers, and society as a whole, including fair working conditions and food security.

PROBLEM OF SUSTAINABLE AGRICULTURE AT MEKONG DELTA

The Mekong Delta, often referred to as Vietnam's "rice bowl" and "fruit basket," faces a complex and worsening array of challenges to its agricultural sustainability. These problems stem from the confluence of environmental changes, upstream human interventions, and unsustainable local practices.

PROBLEM OF SUSTAINABLE AGRICULTURE AT THE MEKONG DELTA

1. Climate Change and Hydrological Pressures (External Threats)

🌊 Salinity Intrusion (Saltwater Intrusion):

- **Problem:** Rising sea levels and reduced freshwater
- **Impact:** Massive crop losses (rice, fruit trees), reduction in cultivated land

🌡 Extreme Weather Events:

- **Problem:** Increased frequency and intensity of prolonged **droughts unpredictable floods**, and **heatwaves**.
- **Impact:** Reduction in crop yields, disruption of planting and harvesting cycles, and increased risk.

↓ Land Subsidence:

- **Problem:** Excessive and unsustainable **groundwater extraction**
- **Impact:** Worsens the impact of sea-level rise and salinity intrusion

🛑 Upstream Damming

- **Problem:** Hydroelectric dams built upstream, reduce the natural flow of water
- **Impact:** Increases coastal and riverbank **erosion**, reduces the land's natural fertility, and diminishes the freshwater barrier against salinity.

PROBLEM OF SUSTAINABLE AGRICULTURE AT MEKONG DELTA

2. Unsustainable Local Practices (Internal Issues)

* Human-induced problems within the Mekong Delta

* 🧪 **Overuse of Chemical Inputs:**

- **Problem:** Intensive, high-yield, 3-rice-crop, **synthetic fertilizers & pesticides**.
- **Impact:** Degradation of soil fertility over time, severe **water pollution, health risks**

🌾 **Intensive Monoculture:**

- **Problem:** Intensive rice production, building high dikes to prevent the natural flood pulse.
- **Impact:** Disrupts the natural hydrological balance, depletes soil nutrients, and restricts the region's ability to naturally absorb floodwaters, making floods more concentrated and damaging elsewhere.

🏘️ **Uncontrolled Land Use Change:**

- **Problem:** Rapid, uncontrolled conversion of coastal land, often including the clearing of protective **mangrove forests**, for **shrimp and intensive aquaculture** ponds.
- **Impact:** Exacerbates coastal erosion, pollutes surface water, and further accelerates land subsidence through groundwater extraction for pond operations.

PROBLEM OF SUSTAINABLE AGRICULTURE AT MEKONG DELTA

3. Socio-Economic and Market Challenges

- These factors hinder the adoption and success of sustainable solutions:

- 💰 **Market Volatility and Low Value-Addition:**

- **Problem:** Heavy reliance on exporting raw commodities (like rice), unstable international market prices. A small percentage of products undergo deep processing.

- **Impact:** Limits farmers' income & reduces motivation to switch to higher-cost, sustainable methods.

- 👦💻 **Limited Technical Capacity and Capital:**

- **Problem:** Lack the **capital** to invest in modern, climate-resilient infrastructure (e.g., smart irrigation) or switch to new crops. Extensive **training** & digital literacy.

📉 **Labor Migration:**

- **Problem: Youth out-migration** to major cities for higher-paying jobs.

- **Impact:** Shortage of young, educated farm labor for new high-tech & sustainable agricultural.

+ The transition (Resolution 120): move from **intensive quantity (rice)** to **sustainable quality (diversification)**, adapting farming to the three hydro-ecological zones.

APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

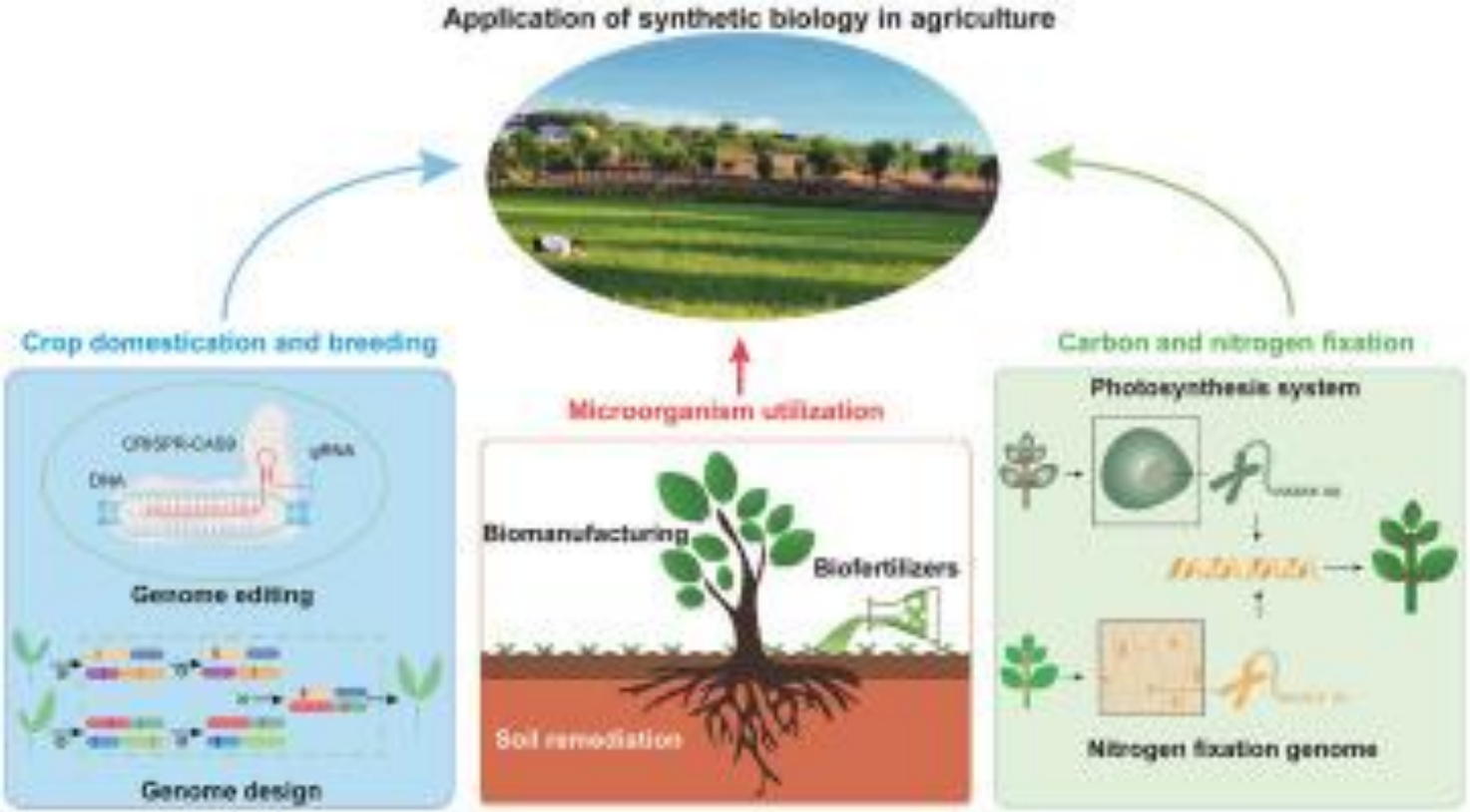
* This is an interdisciplinary field that uses biological knowledge, processes, and technologies in practical ways to develop agricultural systems that are productive, environmentally sound, economically viable, and socially responsible over the long term.

☞ It applies biology to solve real agricultural problems while protecting natural resources and future generations.

APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

- **🔬 Core Definition (Academic Style)**

- Applied Biological Science for Sustainable Agriculture involves the **application of plant biology, microbiology, biochemistry, genetics, ecology, and biotechnology** to improve crop and livestock production **with minimal environmental impact** and enhanced resilience to climate change, pests, and resource limitations.



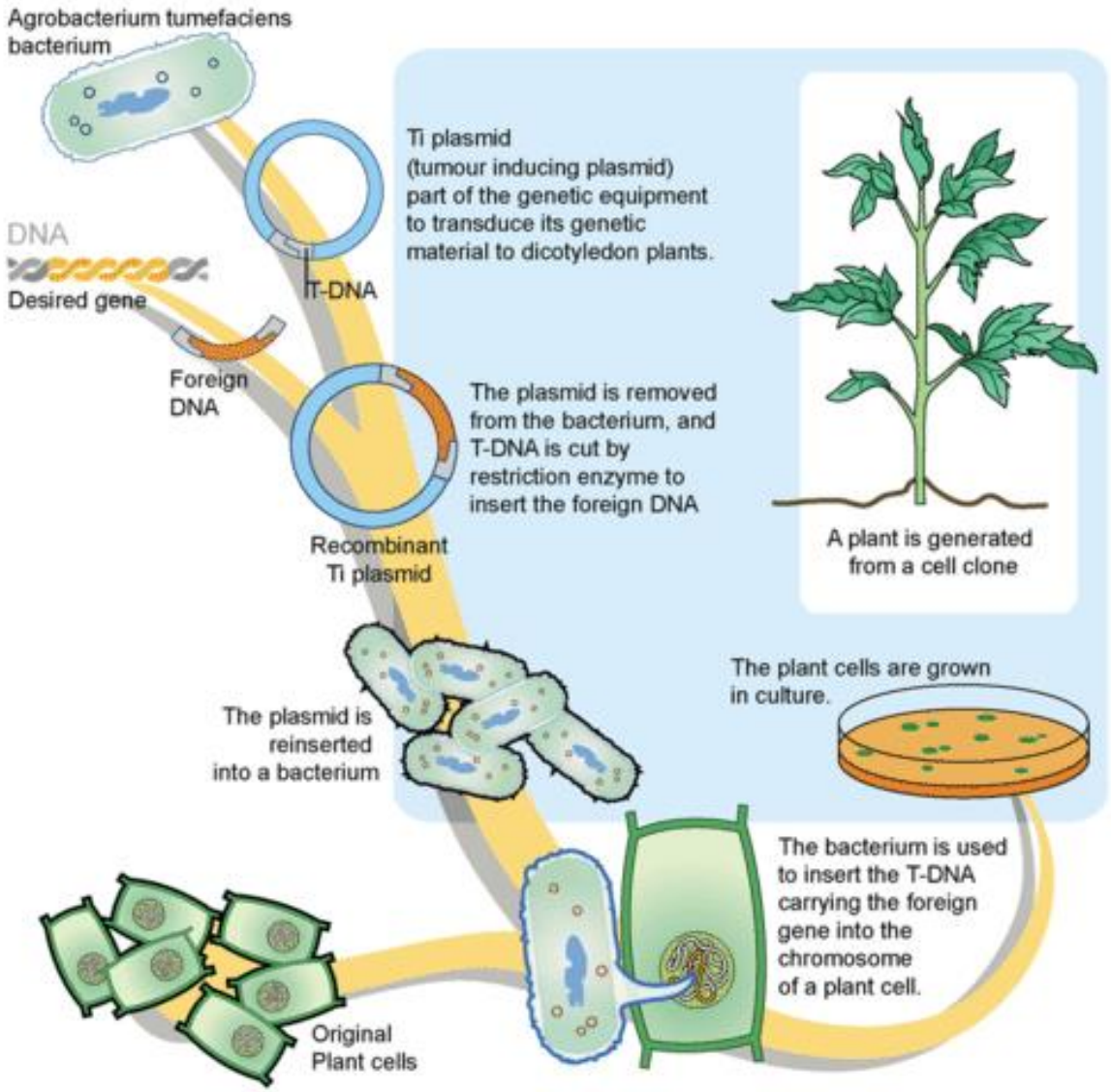
APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

Key Components

1 Plant Biology & Physiology

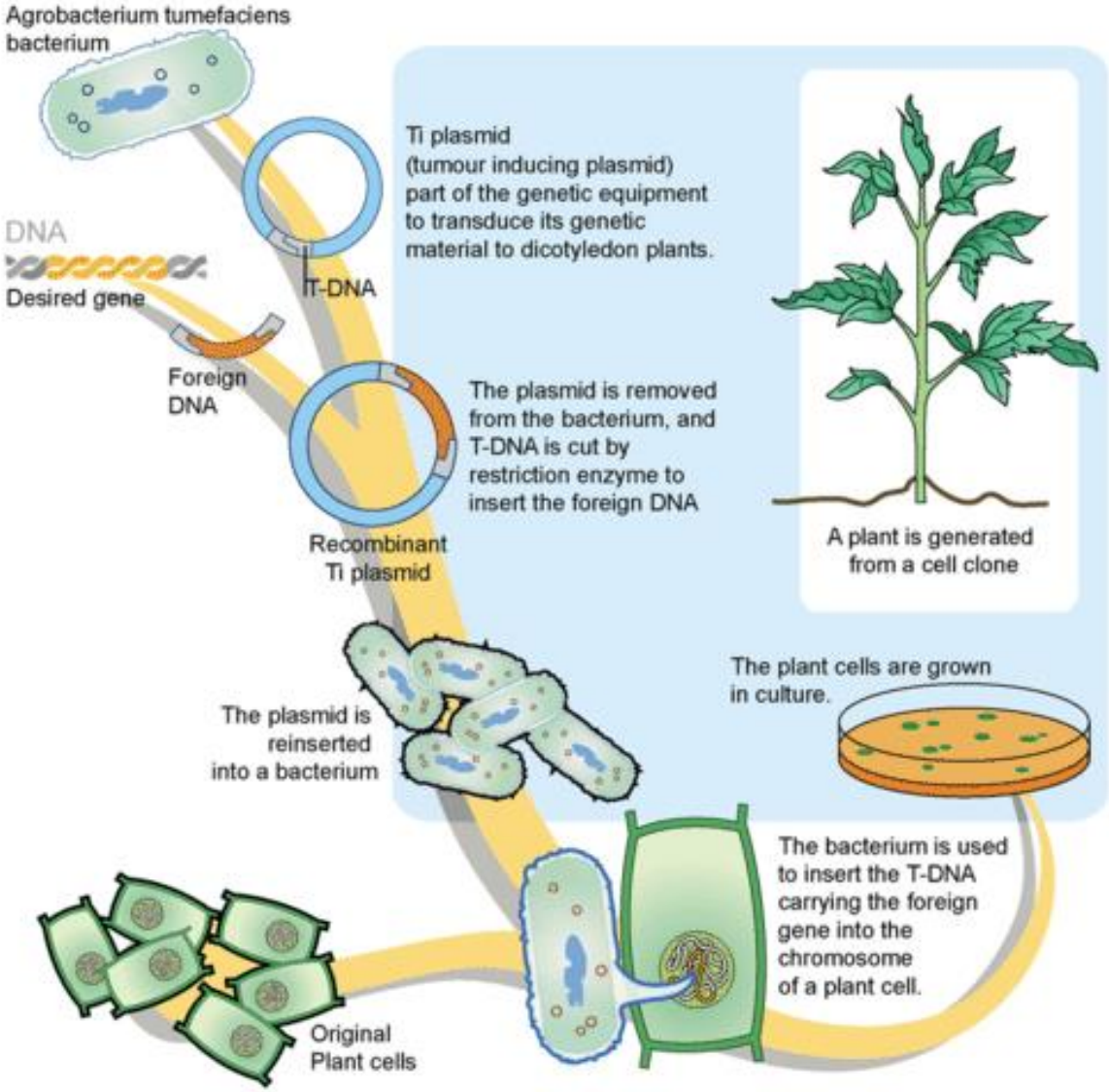
- Understanding plant growth, development, and stress responses
- Optimizing photosynthesis, nutrient uptake, and yield
- Managing flowering, fruiting, and crop quality

📌 Example: Improving drought and salinity tolerance in rice or fruit crops.



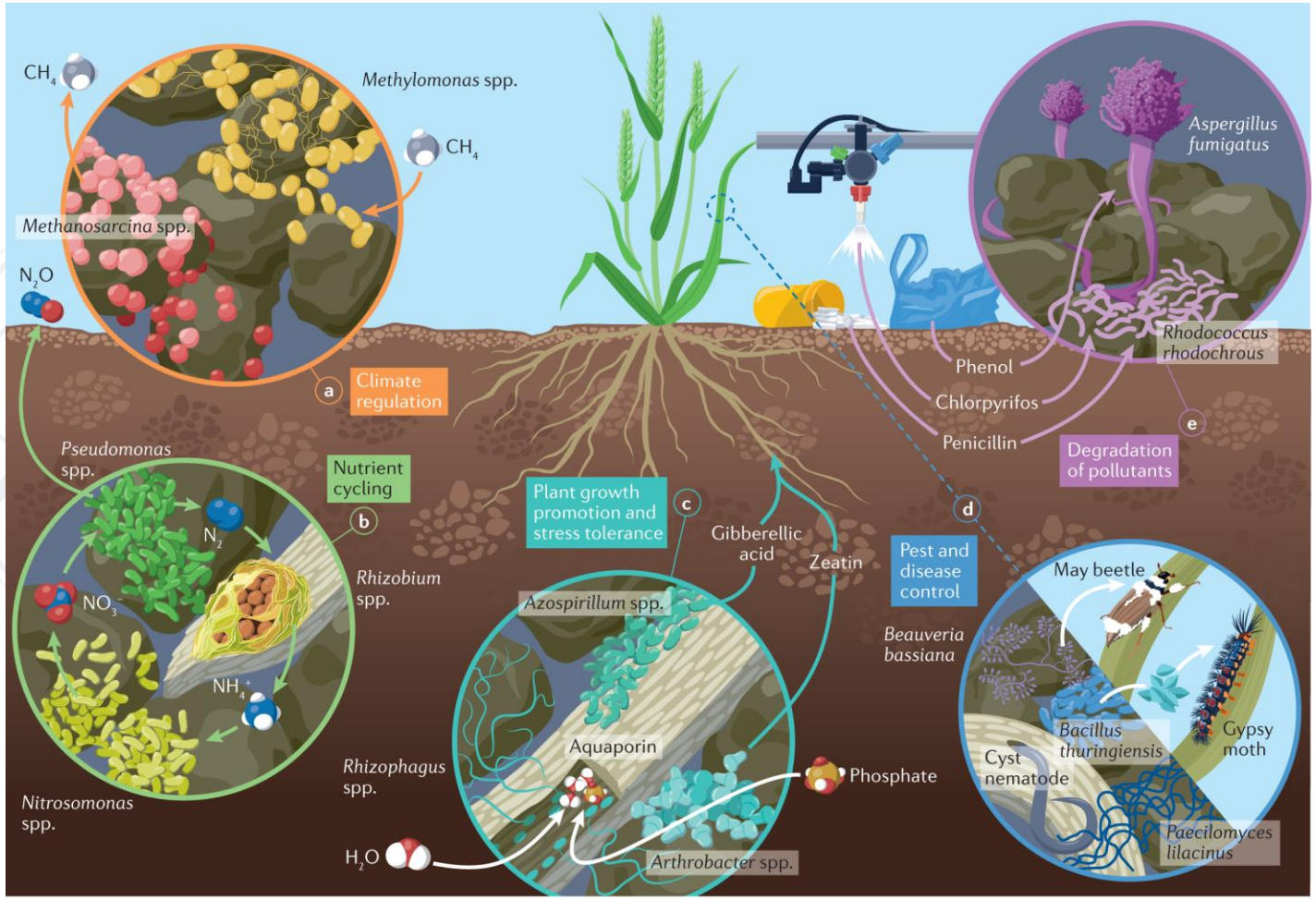
APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

- **2 Soil Biology & Microbiology**
- Role of beneficial microorganisms (PGPR, Rhizobium, Trichoderma, Bacillus)
- Enhancing soil fertility and structure biologically
- Reducing dependence on chemical fertilizers
- *Example:* Biofertilizers to improve nitrogen and phosphorus availability.



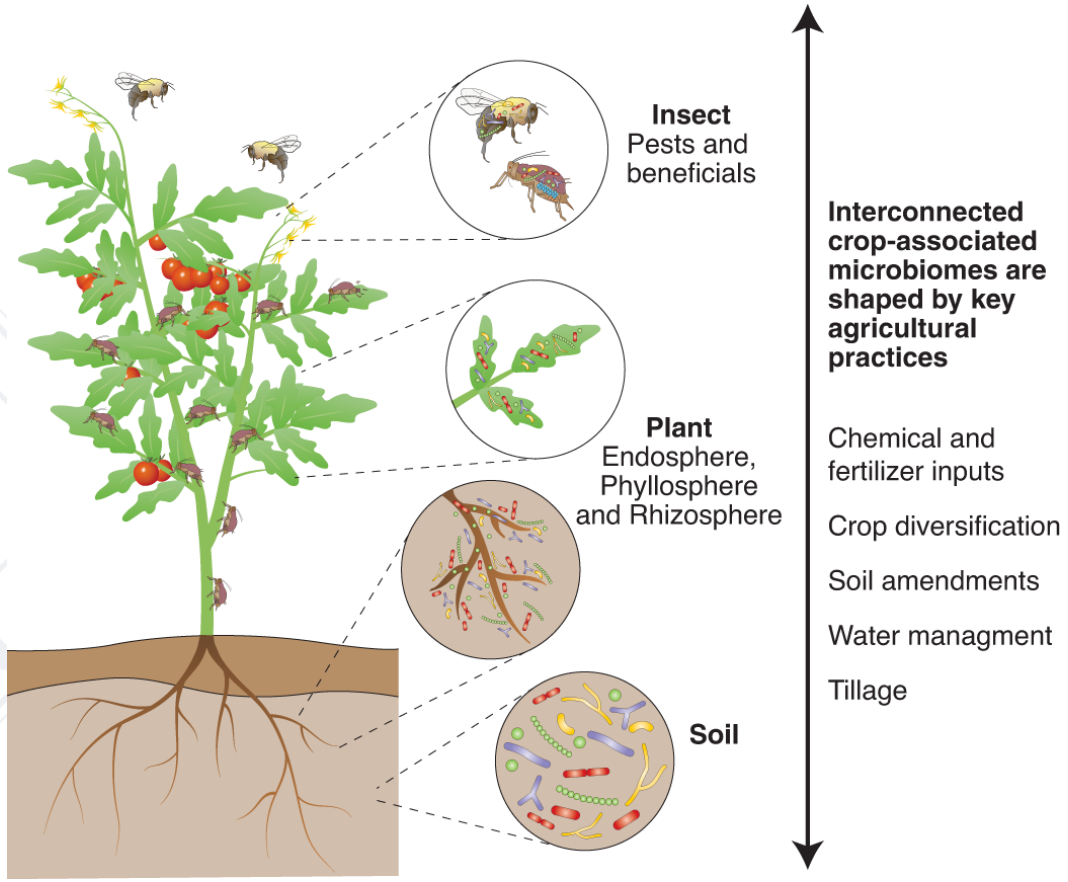
APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

- **3 Biological Pest and Disease Management**
- Using natural enemies, microbial biopesticides, and plant resistance
- Integrated Pest Management (IPM)
- Reducing chemical pesticide residues
- 📌 *Example:* Biological control of fungal diseases instead of fungicides.



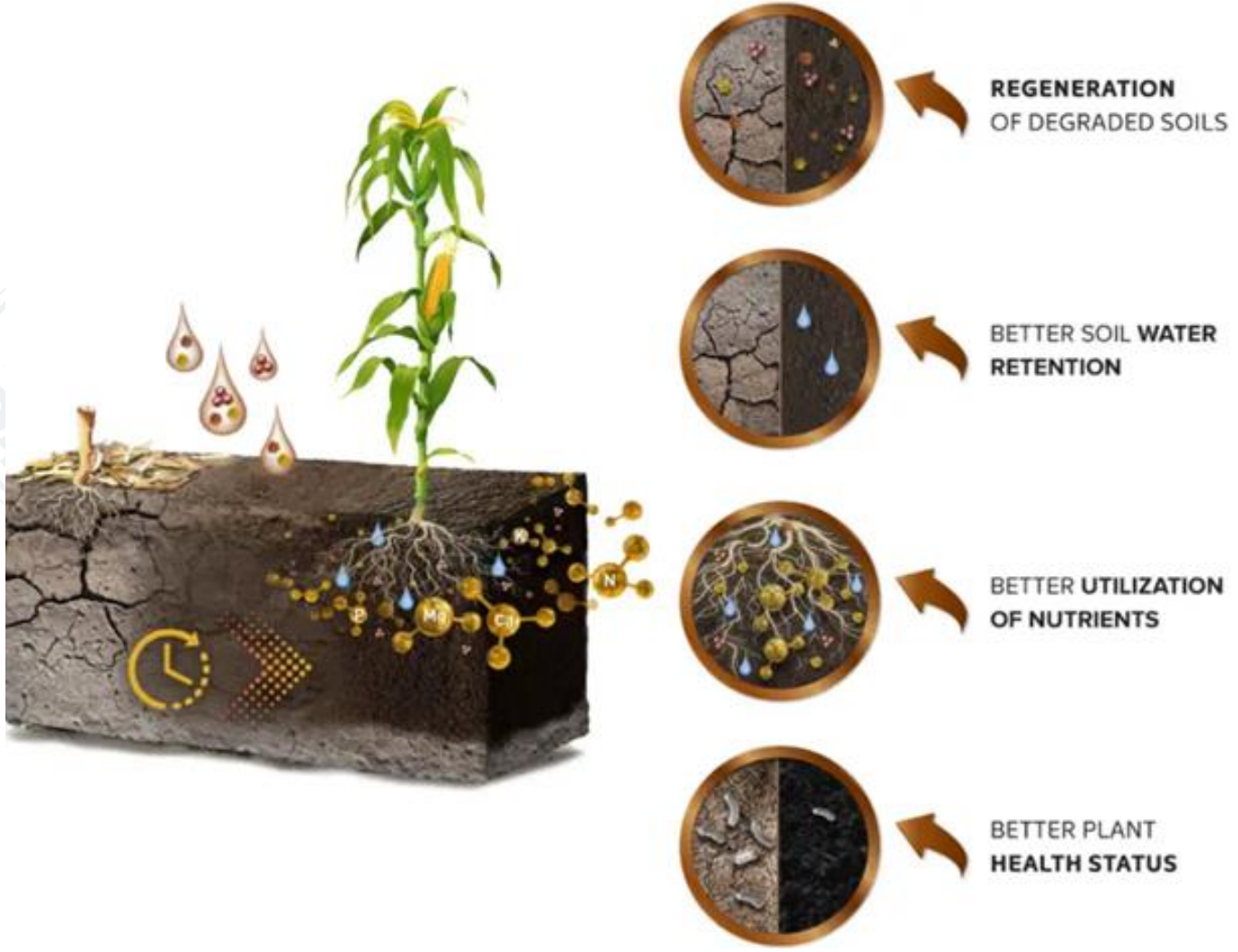
APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

- **4 Biotechnology & Molecular Biology**
- Tissue culture, clonal propagation
- Molecular markers and genetic improvement
- Safe and targeted breeding approaches
- *Example:* Producing disease-free planting materials through tissue culture.



APPLIED BIOLOGICAL SCIENCE FOR SUSTAINABLE AGRICULTURE

- **5 Environmental & Ecological Sustainability**
- Conserving biodiversity
- Reducing soil degradation, water pollution, and greenhouse gas emissions
- Recycling agricultural waste through biological processes
- *Example:* Composting and bio-conversion of crop residues.



Why Is It Important for Sustainable Agriculture?

- **Applied biological science helps agriculture to:**
- ✔ Increase productivity without exhausting natural resources
- ✔ Reduce chemical inputs and environmental pollution
- ✔ Improve resilience to climate change (heat, drought, salinity)
- ✔ Ensure food safety and quality
- ✔ Support smallholder farmers and rural livelihoods
- This is **especially critical in regions like the Mekong Delta**, where agriculture faces **climate change, salinity intrusion, and soil degradation**.

Applied Biological Science & Artificial Intelligence for Sustainable Agriculture in the Mekong Delta, Vietnam

- Sustainable agriculture under climate change
- Integration of biology and digital intelligence
- Climate-smart, resilient food systems

Applied Biological Science & Artificial Intelligence for Sustainable Agriculture in Mekong Delta, Vietnam

***Why the Mekong Delta Needs Innovation:**

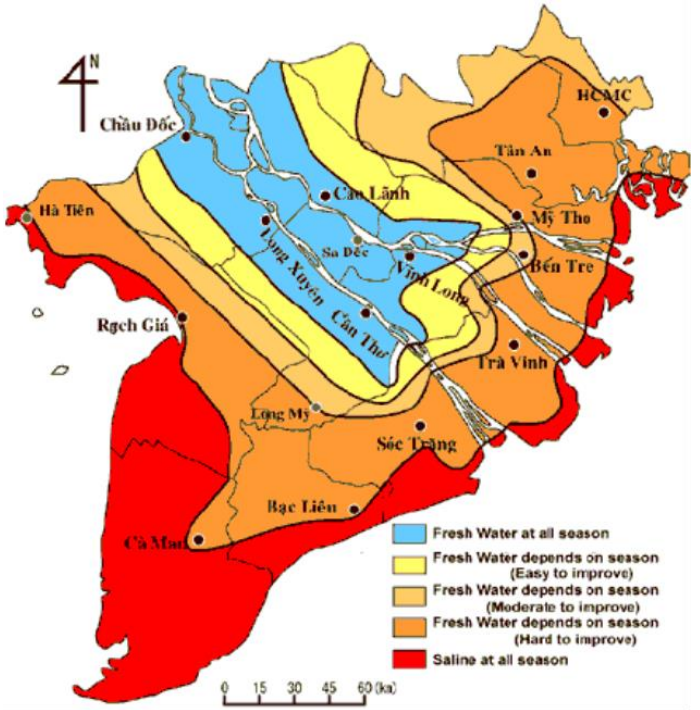
Vietnam's main food basket

- Increasing threats:

+ Climate change + Salinity intrusion

+ Drought and flooding + Overuse of chemical

** Urgent need for sustainable, adaptive solutions*

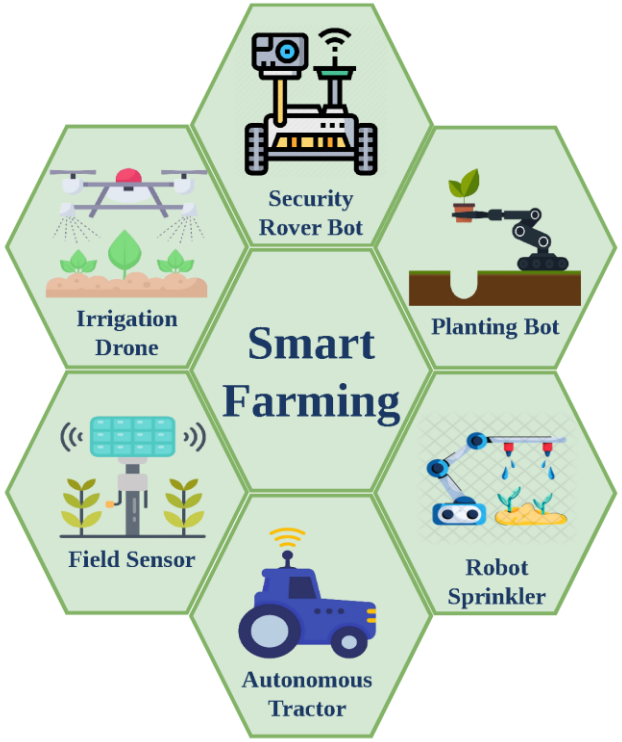


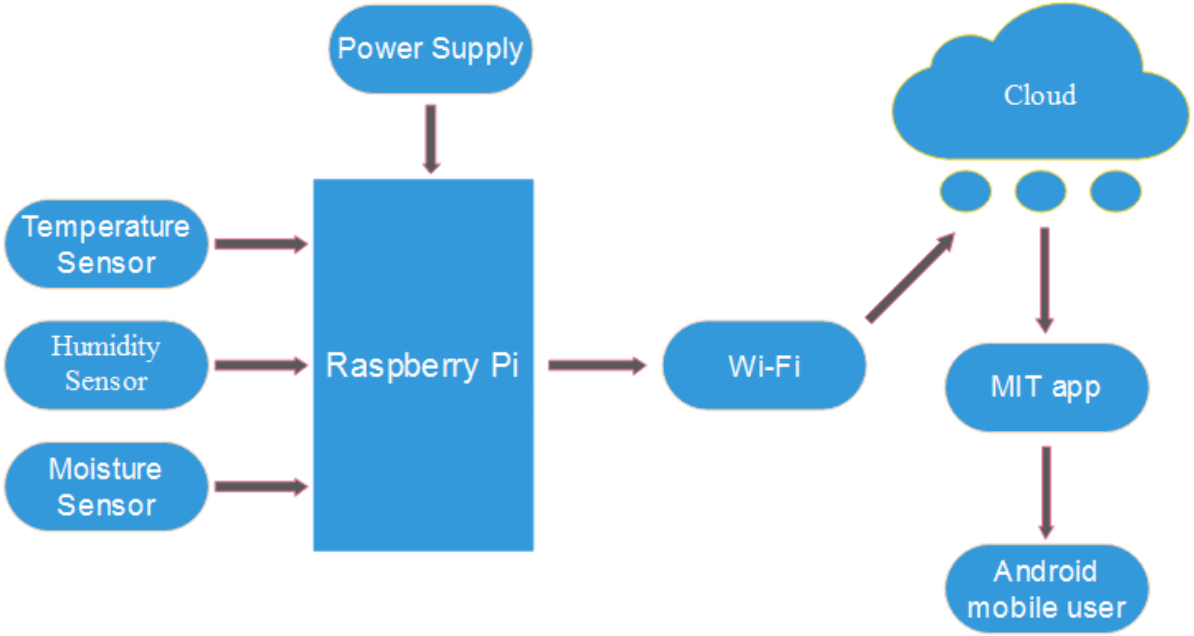
Applied Biological Science & Artificial Intelligence for Sustainable Agriculture in Mekong Delta, Vietnam

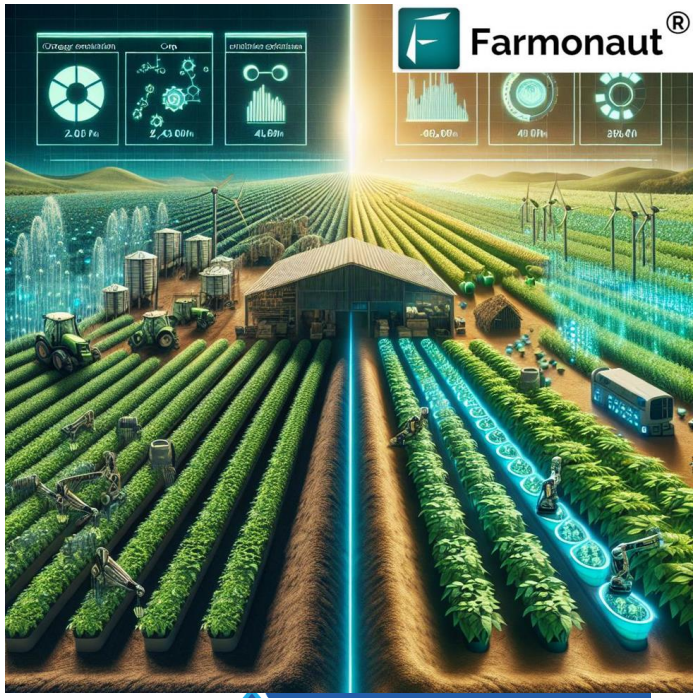
Conceptual Framework

Biology + AI = Sustainable Agriculture

- Applied biological science → ecological foundation
- Artificial intelligence → optimization & decision-making
- Integrated system → productivity + environmental protection







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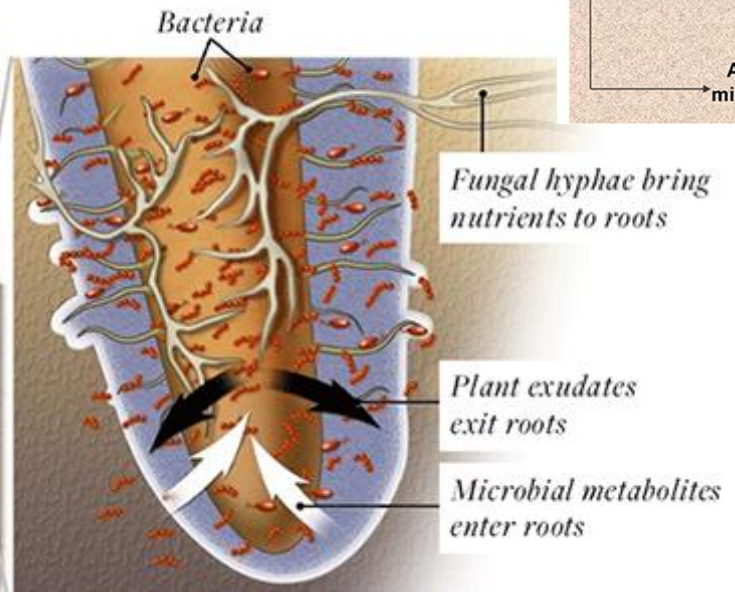
*** Biological Solutions for Sustainability**

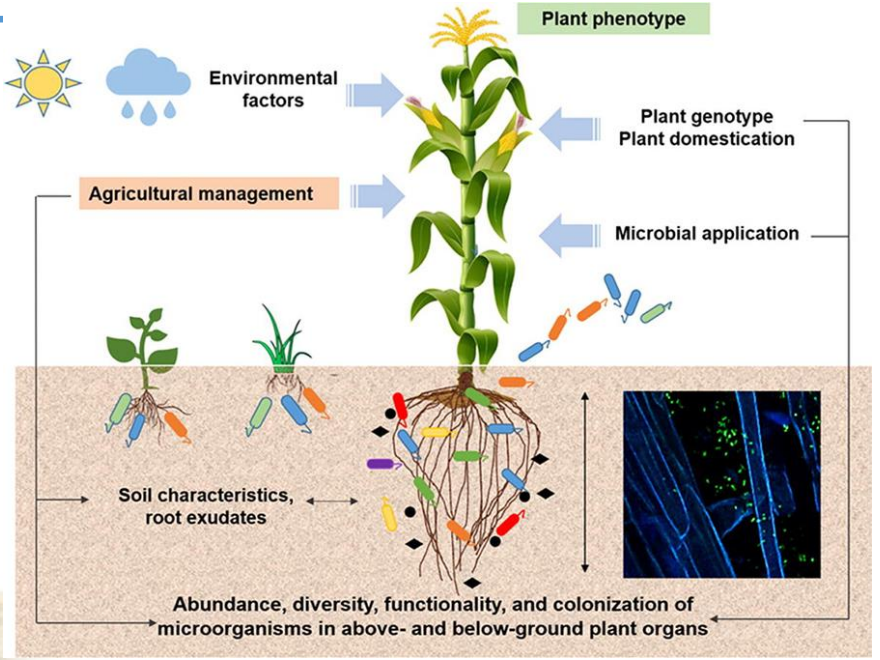
- Biofertilizers → improve nutrient use efficiency
- Biopesticides → reduce chemical residues
- Microbial inoculants → enhance soil health
- Restore agro-ecosystem balance

Unfertile Agricultural Land

Biofertilizer Application

Sustainable Agricultural Farm





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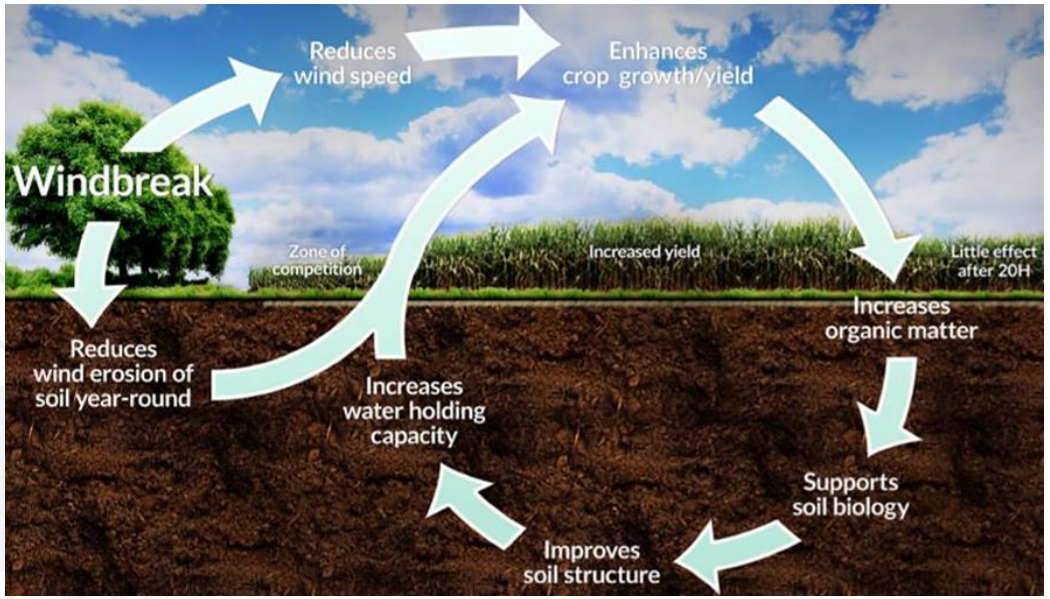
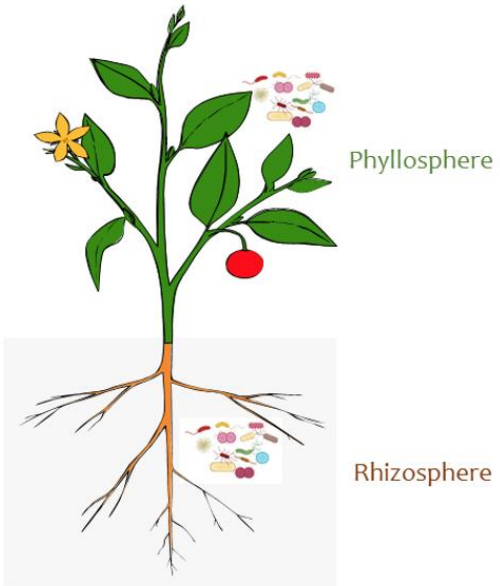
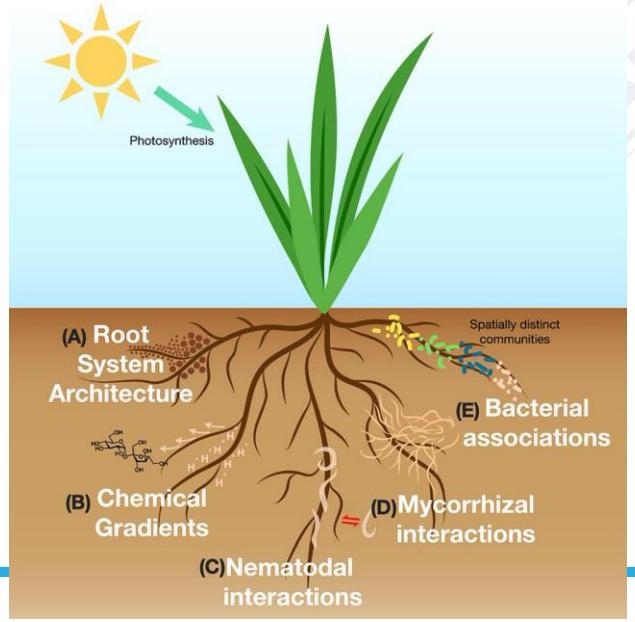
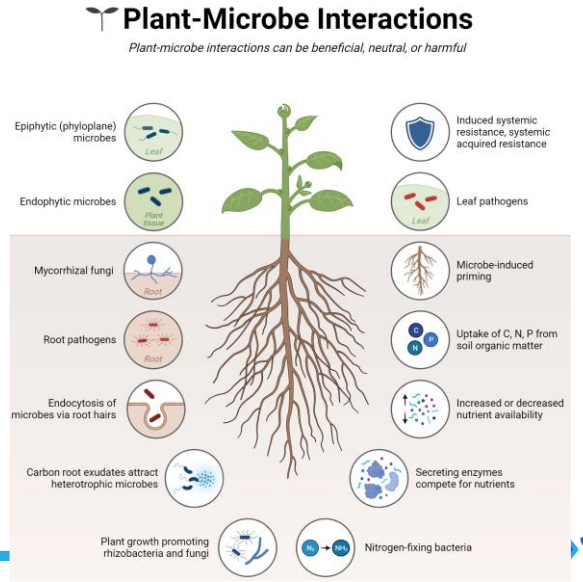
Soil Health & Plant–Microbe Interactions

* Foundation of Sustainable Production
  - Beneficial microbes improve:
    + Nutrient cycling
    + Stress tolerance (salinity, drought)
    + Disease suppression
  - Healthy soil = resilient crops









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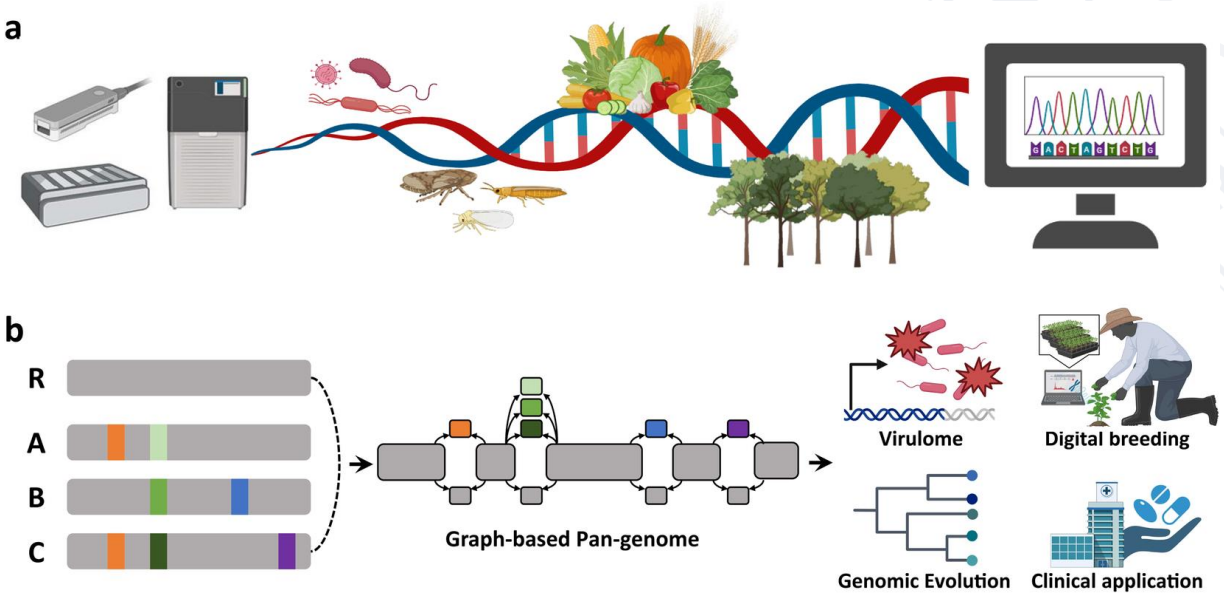
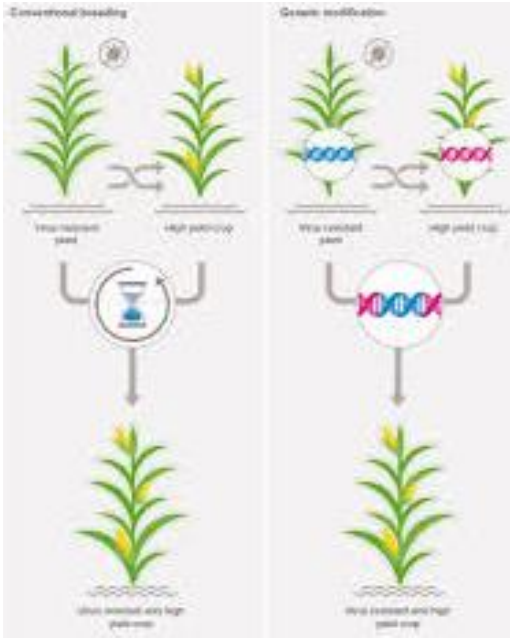
* Genetic Improvement & Molecular Breeding Crops Adapted to Local Conditions

- Stress-tolerant varieties (salinity, drought)
- Molecular breeding accelerates selection
- Locally adapted crops for Mekong Delta ecosystems





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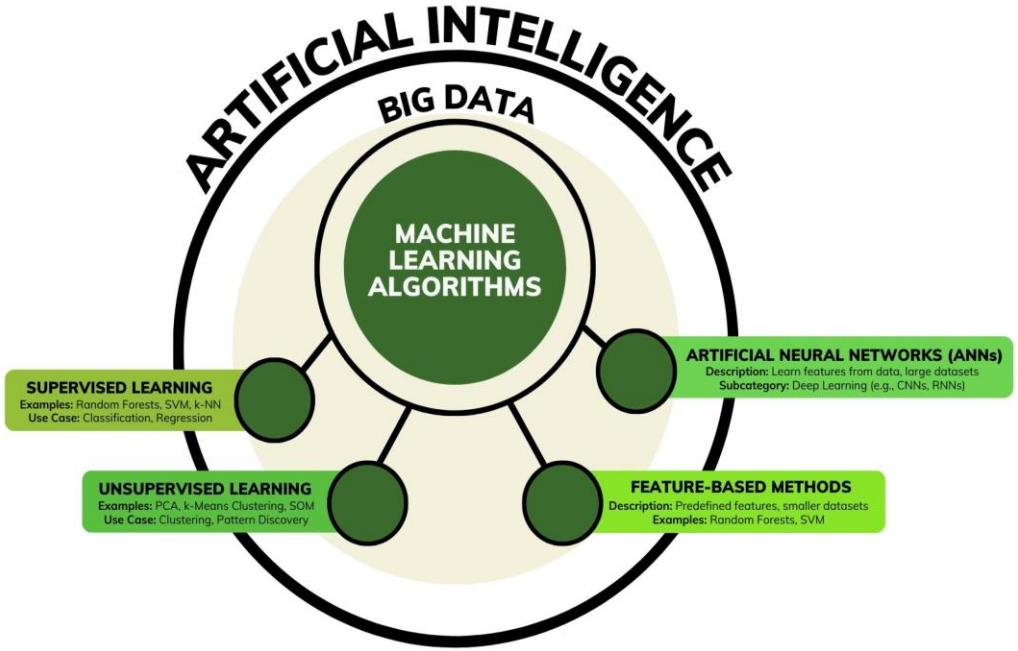
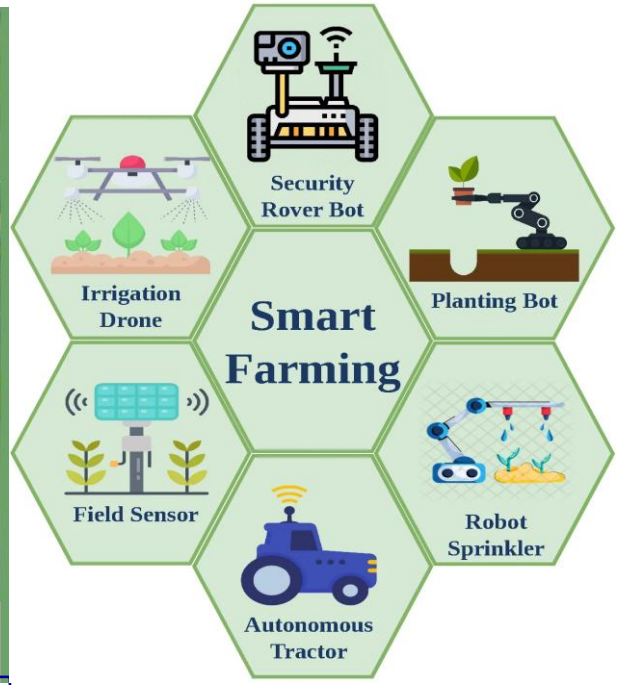
*** Role of Artificial Intelligence (AI)**

AI as an Accelerator of Biological Innovation

- High-throughput genomic data analysis
- Predictive modeling of plant–microbe interactions
- Optimization of input use (water, nutrients, bio-products)





Applications of machine learning for precission agriculture

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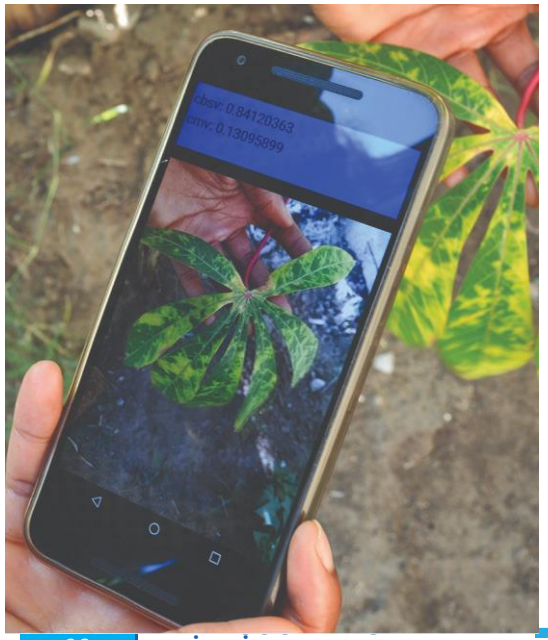
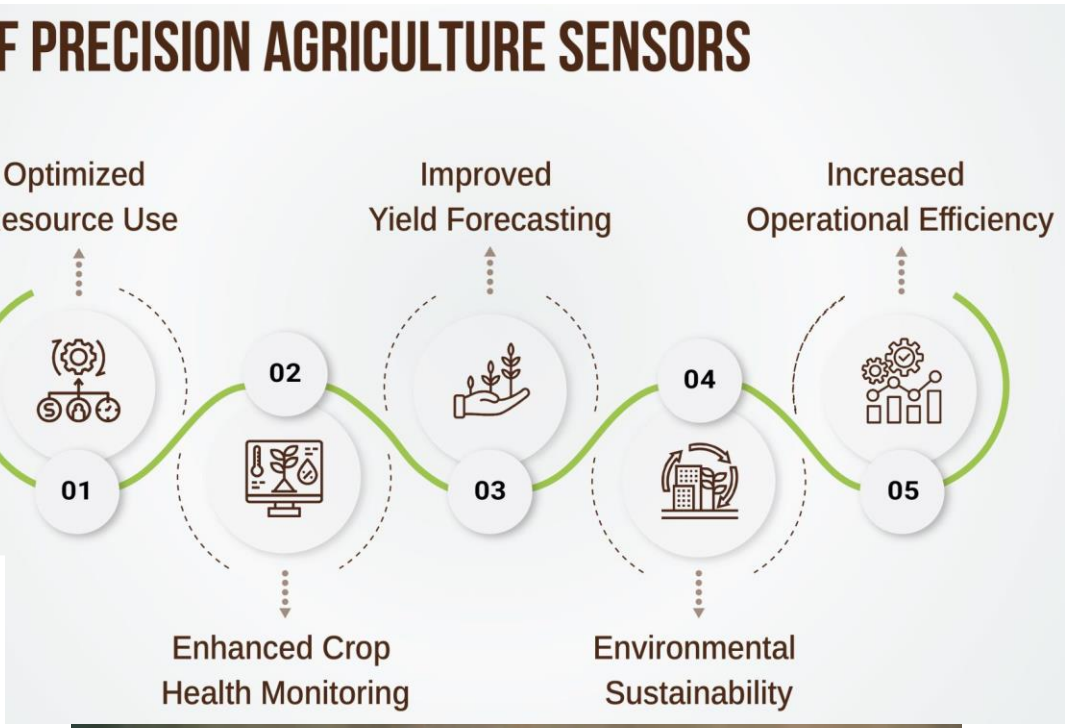
*** AI in Precision Agriculture**

Smart Farming Applications

- Image recognition:
  + Early pest and disease detection
- Sensors:
  + Soil and water quality monitoring
- Real-time decision support for farmers



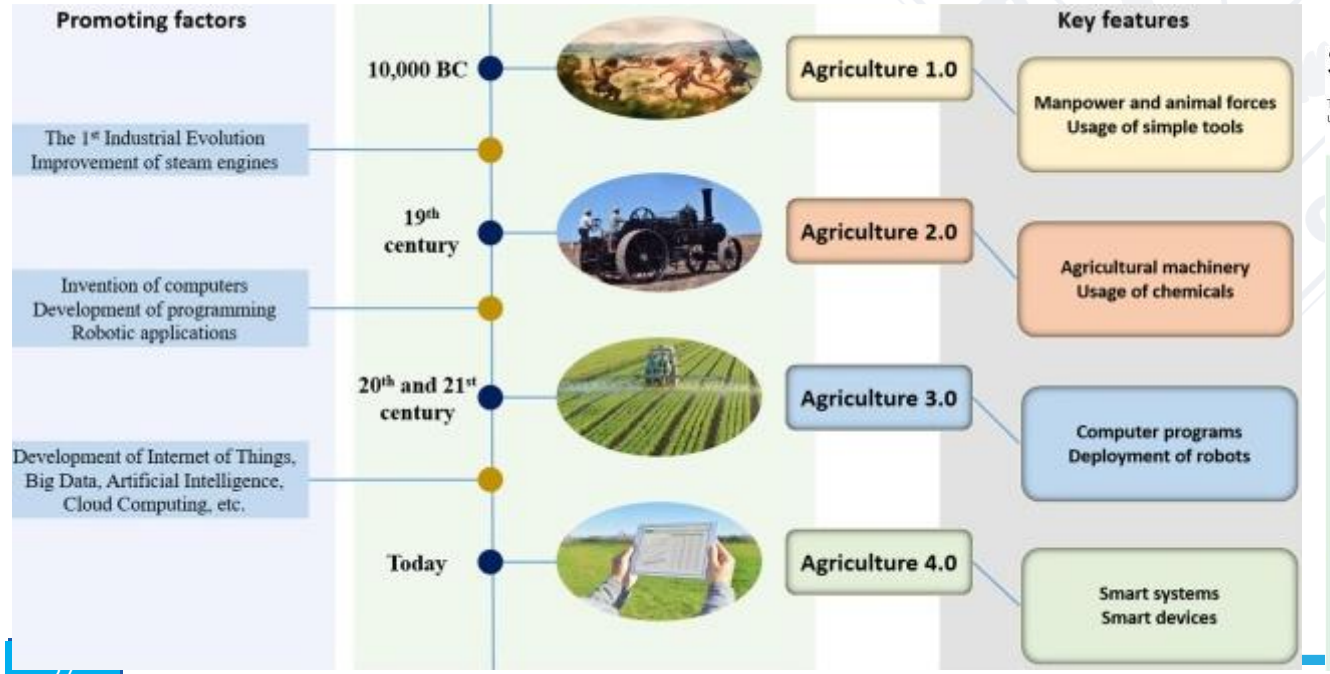


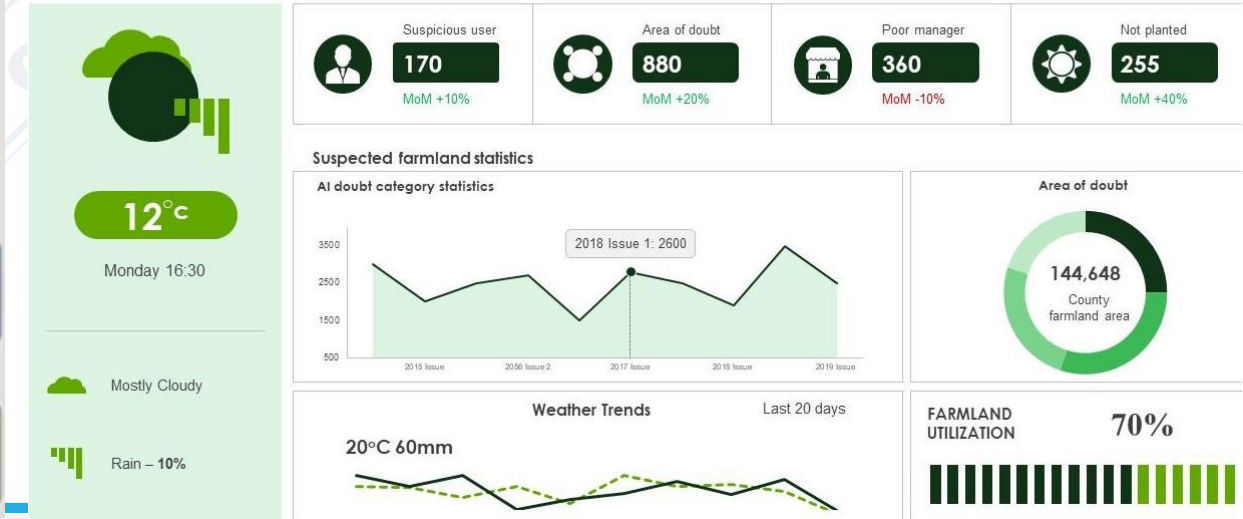
Applied Biological Science & Artificial Intelligence for Sustainable Agriculture in Mekong Delta, Vietnam

* AI-Supported Decision Systems

From Data to Action

- AI-powered platforms:
  + Recommend biofertilizers & biopesticides
  + Optimize timing and dosage
- Reduce costs and environmental impacts
- Increase farmer confidence in sustainable inputs





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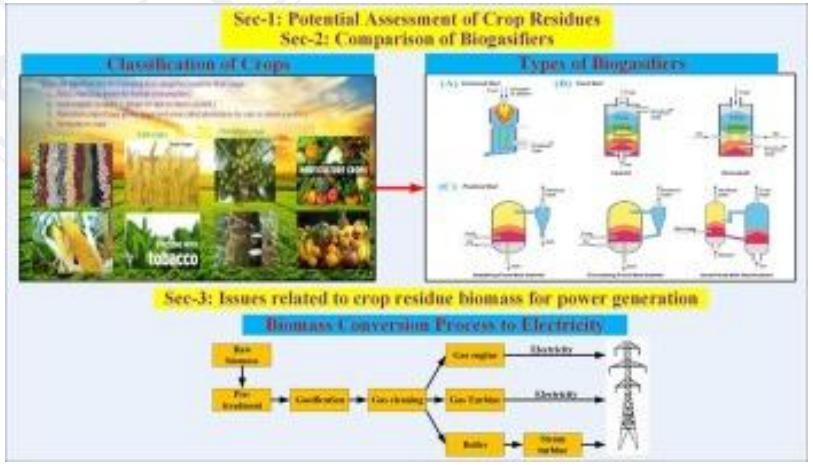
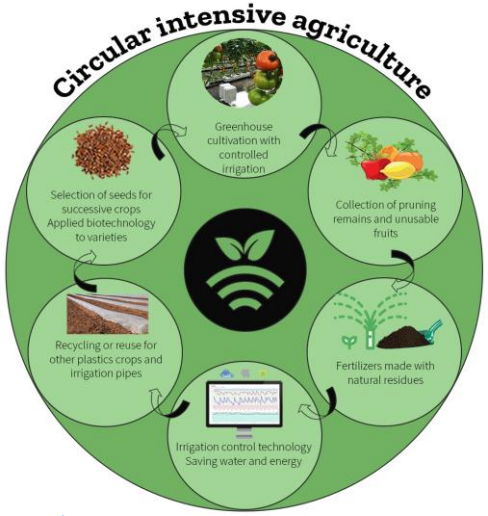
* Circular & Climate-Smart Agriculture

Closing the Resource Loop

- Smart residue management
- Composting and bioenergy production
- Reduced waste and greenhouse gas emissions
- Sustainable nutrient recycling





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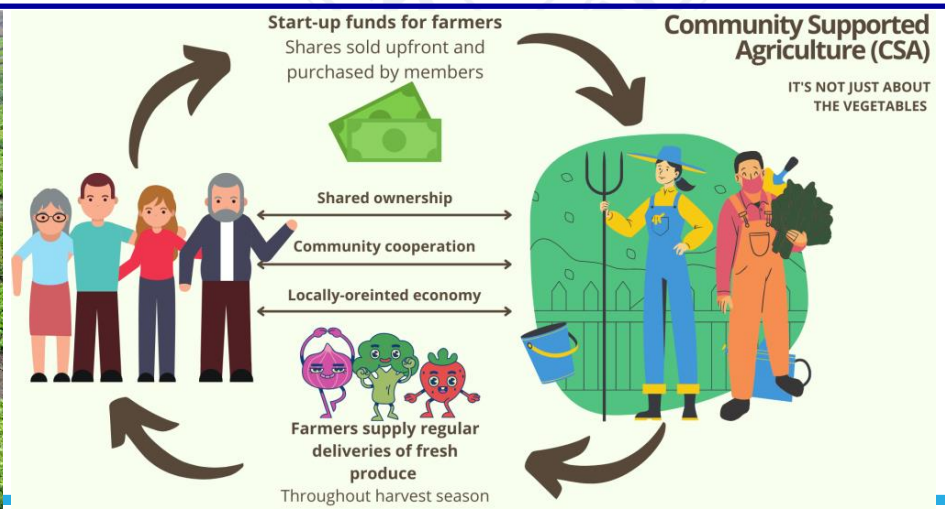
*** Participatory & Digital Extension Models**

People-Centered Innovation

- Collaboration among:
  - + Scientists
  - + Policymakers
  - + Farmers
- Digital extension services
- Knowledge-sharing networks

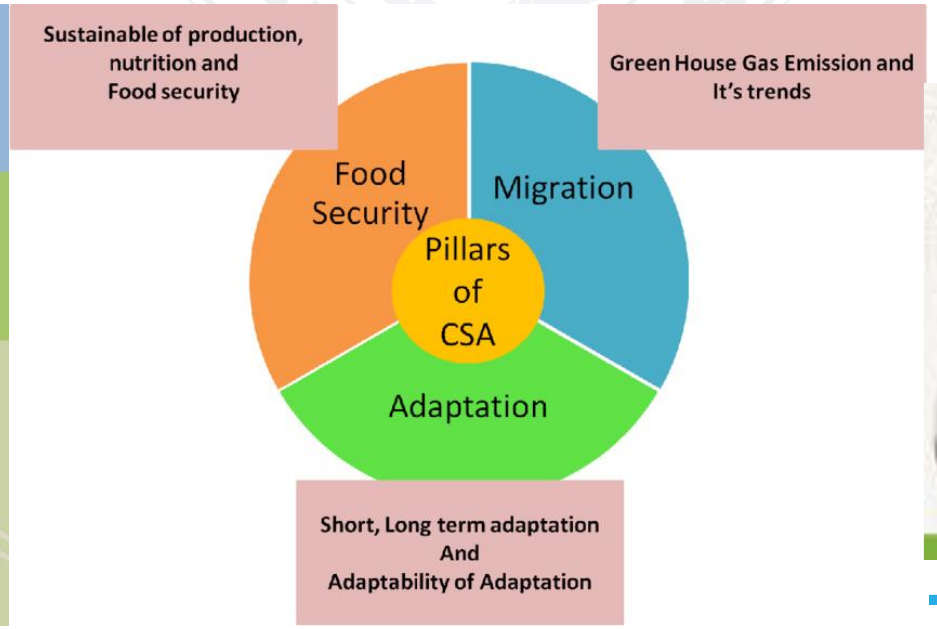


Applied Biological Science & Artificial Intelligence for Sustainable Agriculture in Mekong Delta, Vietnam

Expected Impacts

Benefits of Biology–AI Integration

- Increased productivity and resilience
- Reduced chemical dependency
- Improved soil and water quality
- Enhanced rural livelihoods
- Climate-smart agriculture systems



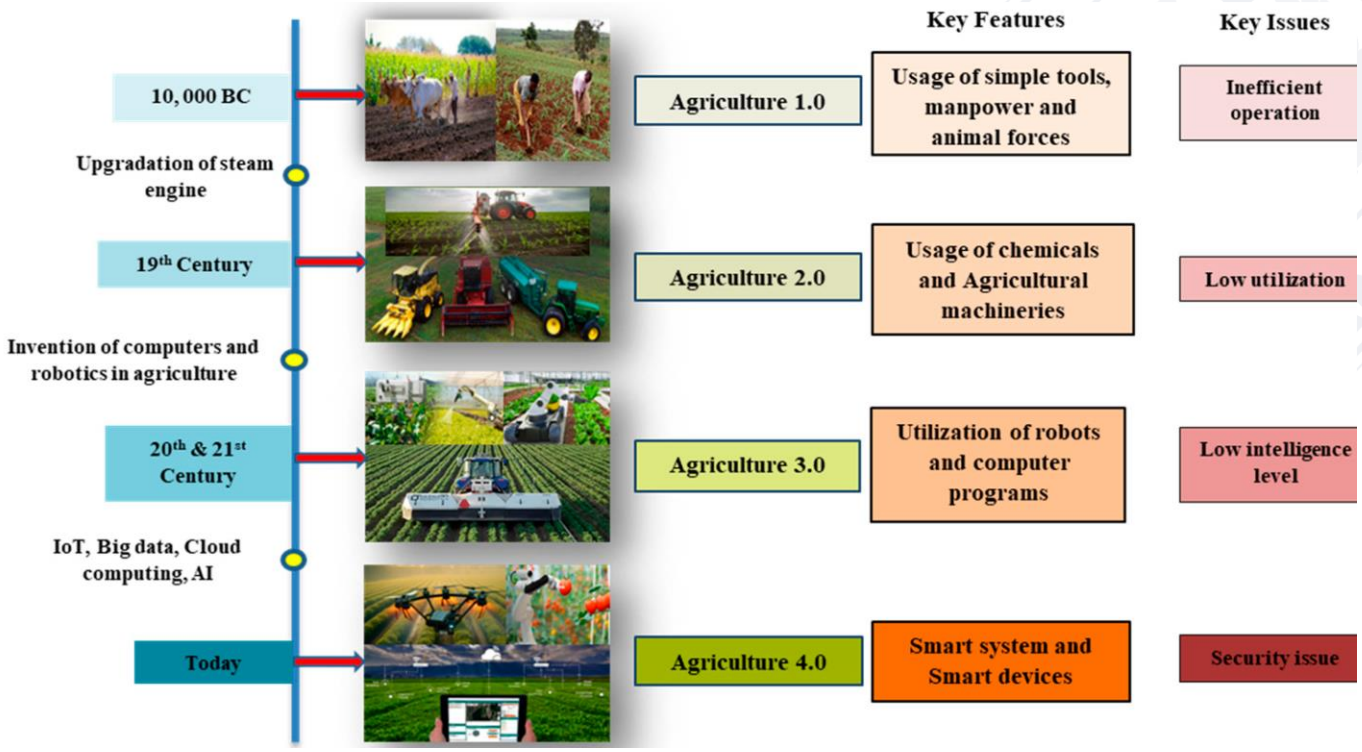
Applied Biological Science & Artificial Intelligence for Sustainable Agriculture in Mekong Delta, Vietnam

*** Strategic Vision for Vietnam**
Towards Sustainable Development Goals

- Food security under climate change
- Environmental protection
- Digital transformation of agriculture
- Long-term resilience of the Mekong Delta

CONCLUSION

- Integrating applied biological science with AI-enabled technologies, Vietnam can transform its agriculture in the Mekong Delta into a resilient, climate-smart, and environmentally sound system that secures food production, improves rural livelihoods, and advances the nation's sustainable development goals.




Thank you very much!
For a Modern, Efficient and Friendly Education System
Many Thanks to Tay Do University
and Cantho University

NEW TECHNOLOGIES IN AGRICULTURE

1. Advanced Biotechnology & Microbiology

a. Gene Editing (CRISPR/Cas9, Prime Editing)

- Creating salt-tolerant, drought-tolerant, and acid-tolerant rice varieties.
- Creating disease-resistant fruit tree varieties (bananas, mangoes, durians).
- Reducing fertilizer requirements → reducing N_2O emissions.

b. "Next-Generation" Microbial Fertilizers

- PGPB strains that increase nitrogen absorption (Azotobacter, Bacillus, Paenibacillus).
- Strains that dissolve insoluble phosphorus (PSB).
- Carbon-fixing microorganisms in the soil: Actinobacteria, Streptomyces.

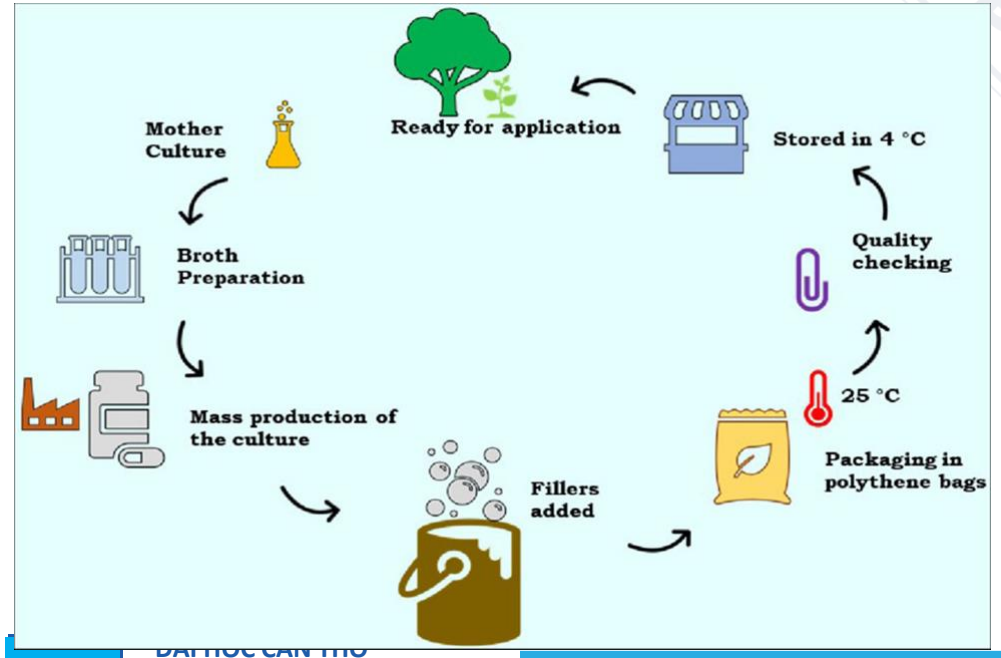
NEW TECHNOLOGIES IN AGRICULTURE

c. Biological plant growth regulators

- Biological hormones obtained from microorganisms: IAA, GA3, cytokinins.
- Applications in rice, vegetables, durian, and fruit trees.

d. Enzyme and fermentation technology

- Production of humic/fulvic acid from agricultural by-products.
- Fermentation of amino acids, lactic acid, and bio-chitosan.
- Technology for fermenting rice straw to create high-quality organic fertilizer.



NEW TECHNOLOGIES IN AGRICULTURE

2. Digital Technology – AI in Agriculture

a. AI for Yield and Disease Prediction

- AI models for predicting rice blast, brown spot, and nematodes.
- Application of cameras + AI for detecting leaf diseases.

b. IoT & Smart Sensors

- NPK nutrient sensors in soil.
- Salinity, pH, and ORP sensors for rice in coastal areas.
- Automatic irrigation monitoring.

c. Drones & Robotics

- Drones for spraying bio-fertilizers.
- Robots for harvesting vegetables and sowing seedlings.

NEW TECHNOLOGIES IN AGRICULTURE

3. Green Materials & Biotechnology Applications

a. Biochar

- A carbon-rich material produced from the pyrolysis of organic biomass (rice husks, straw, wood) in an anaerobic environment.
- Fixes carbon, improves soil, and increases water retention.
- Reduces greenhouse gas emissions by 30–40%.

b. Biodegradable Packaging

- PLA (Polylactic Acid) and PHA (Polyhydroxyalkanoates) are two types of biodegradable plastics used in agricultural packaging.
- PLA: polyester made from renewable raw materials such as corn starch, sugarcane, cassava, potatoes, or other fermented sugars.
- PHA: biopolymer created from bacteria through the fermentation of sugars.

NEW TECHNOLOGIES IN AGRICULTURE

***Possible applications for Vietnam:**

- Producing biofertilizer from rice straw and cellulose-degrading bacteria.
- Using AI to detect plant diseases (fruit trees: durian, jackfruit, mango, etc.).
- Building a "rice-shrimp-AI-biology" model.
- Developing a microbial complex to control banana yellow leaf disease and durian disease.

NEW TECHNOLOGY IN AQUACULTURE

1. Biotechnology for Aquaculture

a. Next-Generation Probiotics

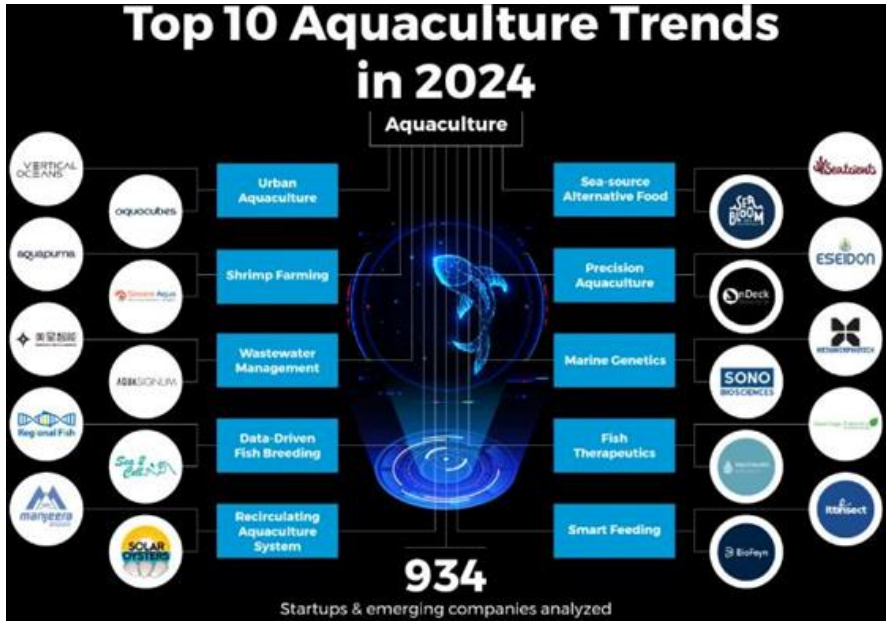
- Bacillus, Lactobacillus, and Shea butter strains improve digestion and immunity.- Reduce antibiotic use.

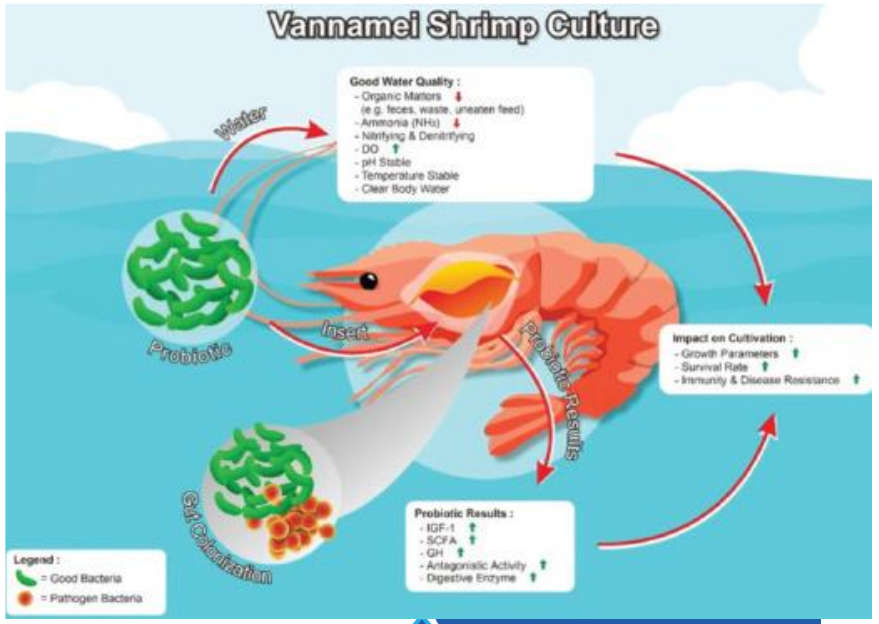
b. Third-Generation Vaccines

- DNA/RNA vaccines for catfish, tilapia, and shrimp.
- Reduce the risk of disease outbreaks (EMS, EHP, Vibrio).

c. Feed Biotechnology

- Digestive enzymes (protease, phytase) → reduce FCR.
- Precision Feeding based on AI.





NEW TECHNOLOGY IN AQUACULTURE

2. Digital Technology & Automation

a. IoT in aquaculture ponds (Internet of Things).

- Sensors for DO, NH_4^+, nitrite, pH, ORP (Oxidation-Reduction Potential).
- Early warning system via phone.- AI-powered automatic feeding → reduces feed consumption by 15–20%.

b. Image analysis – Computer Vision

- Fish counting, swimming speed measurement, stress detection.- Identification of diseased shrimp based on color and behavior.

c. Recirculating Aquaculture Systems (RAS)

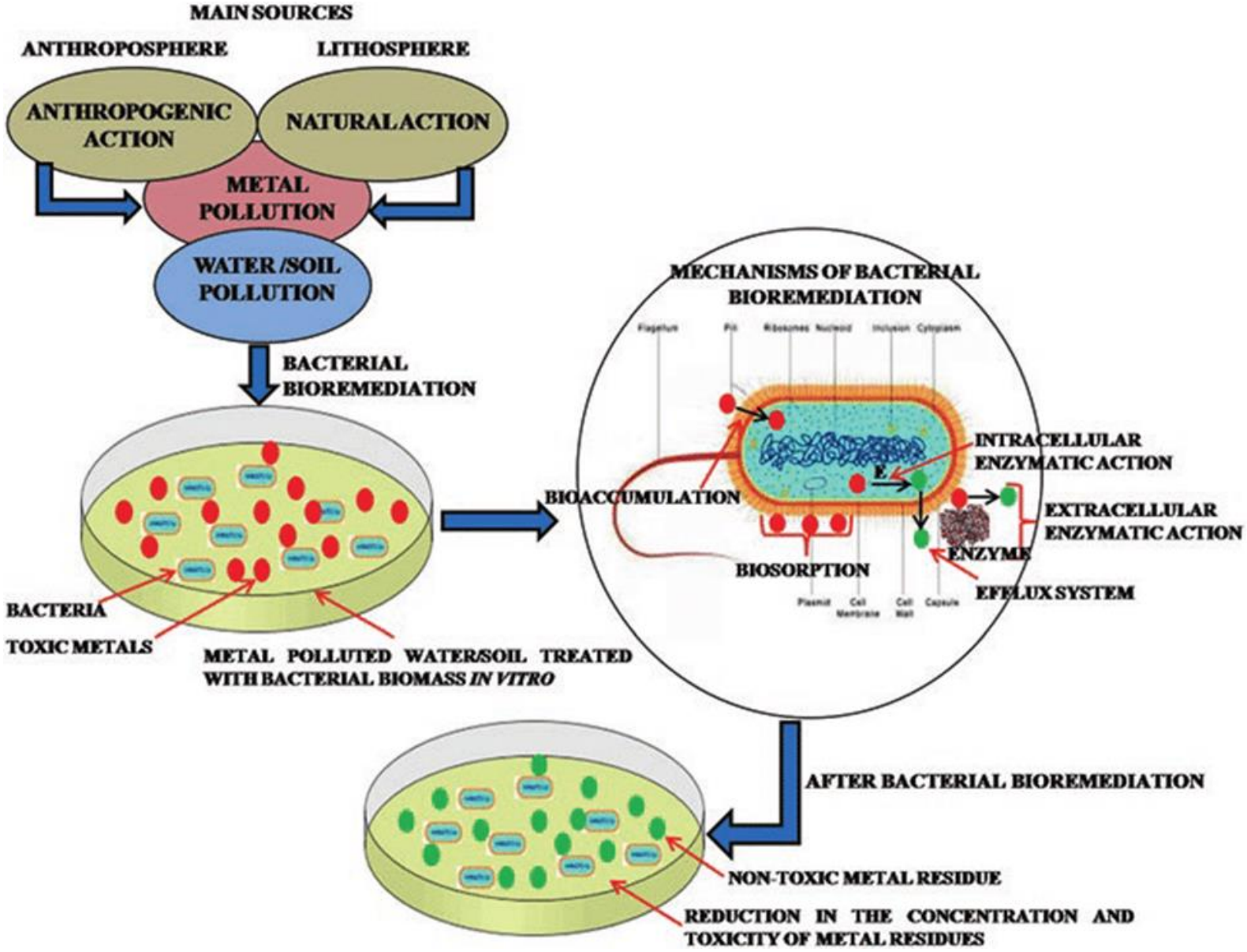
- Biological filtration + nitrifying microorganisms.
- Reduces wastewater by 90%.

NEW TECHNOLOGY IN AQUACULTURE

Possible applications in Vietnam

- IoT (Internet of Things) model + probiotics in 2-3 stage shrimp farming.
- Application of RAS for snakehead fish, eels, and catfish.
- Biological vaccines for catfish disease prevention in Dong Thap and Can Tho.
- AI-powered water quality monitoring for high-tech shrimp ponds in Bac Lieu and Ca Mau.

NEW TECHNOLOGIES IN THE ENVIRONMENT



NEW TECHNOLOGIES IN THE ENVIRONMENT

*** 1. Environmental Biotechnology**

a. Bioremediation (Biological Treatment)

- Bacteria decompose pesticides and heavy metals (Pseudomonas, Rhodococcus).
- Treatment of oil and hydrocarbon pollution.
- Pleurotus and Trichoderma fungi decompose xenobiotics.

b. Biofiltration & Microbial Treatment of Exhaust Gases

- Removal of H_2S, NH_3, and odors from pigs, chickens, and seafood.

c. Wastewater Treatment Technology using MBBR/MBR + Microorganisms

- Highly effective, suitable for agricultural processing industrial zones.

* Công nghệ MBBR/MBR + vi sinh là phương pháp sinh học sử dụng vi sinh vật để phân hủy chất ô nhiễm, với MBBR (Moving Bed Biofilm Reactor) sử dụng giá thể di động để vi sinh bám dính. MBR (Membrane Bioreactor) kết hợp vi sinh với màng lọc để phân tách bùn và nước thải.

BIO-ENERGY TECHNOLOGY

a.Next-Generation Biogas Technology

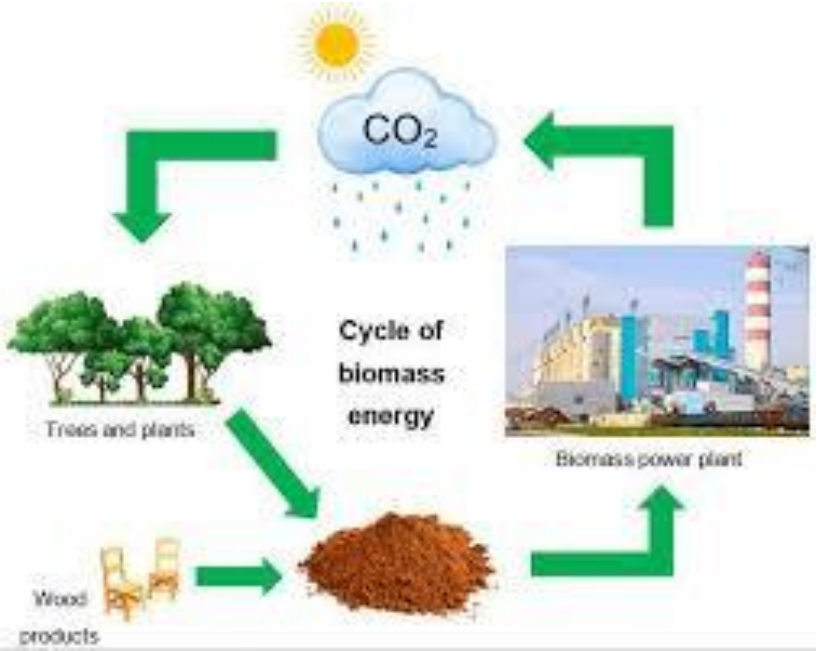
- HDPE membrane biogas digesters, gas recovery efficiency of 70–85%.
- Combined with electricity generation → power-generating farm model.

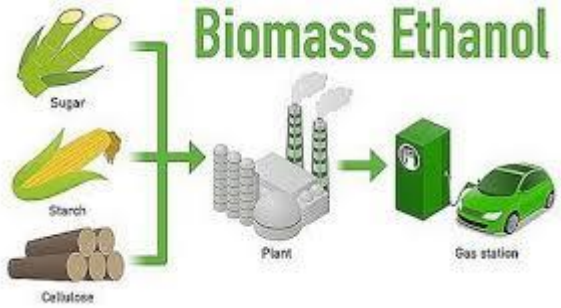
b. Biofuels (Bioethanol, Biodiesel)

- Utilizing sugarcane bagasse, straw, palm oil, and algae.
- Cellulose enzyme technology for producing second-generation ethanol.

c. Biocarbon Recovery

- Biochar for carbon fixation from by-products.
- Bio-CCS (Carbon Capture and Storage) technology.





NEW TECHNOLOGIES IN THE ENVIRONMENT

Possible applications for Vietnam:

- Treating odors and emissions from livestock farms using biofilters.
- Converting rice straw into ethanol or organic fertilizer – biochar.
- Treating aquaculture wastewater using MBBR
+ indigenous microorganisms.
- Recovering biocarbon credits for rice and livestock farms.