VINUNIVERSITY
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AI-Driven Sustainability: Optimizing Tomato Production in Greenhouses

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EXECUTIVE SUMMARY

Overview

- Agricultural sector in Vietnam predominantly consists of subsistence farming managed on a small scale, resulting in high risks, low efficiency, and minimal value addition.
- Smallholder farming, representing 90% of agricultural production, remains the predominant form of agricultural organization, reflecting historical practices, though recent years have seen effective household economies reaching their developmental limits.

Solution

- We need to apply AI technology.(TomAIto)

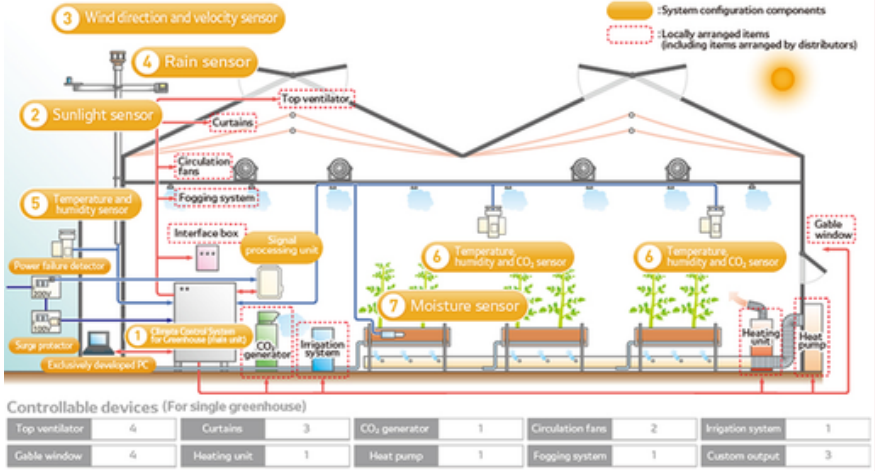
Impact

- To increase Viet Nam's agricultural productivity.

PROBLEM STATEMENT

- Up to 95% of agricultural enterprises in Vietnam are small and medium-sized. This sector in Vietnam also attracts less than 1% of foreign direct investment (FDI), while the global average is around 3%. By the end of 2019, FDI in agriculture only reached 3.5 billion USD, accounting for a deficient proportion of total FDI in Vietnam.
- Agriculture is the backbone of the economy in Vietnam, so we need to ensure sustainability. (1)

(2)



PROPOSED APPROACH

Brief des

- Type of data: *Quantitative data, publicly available.*
- To help Vietnam become one of the top economies, we should focus on improving and developing its strongest sector, which is agriculture. To achieve this, a shift from traditional outdoor farming to *greenhouse farming is necessary*. For instance, cultivating tomatoes in greenhouses can be a significant step forward. To foster its development, ensuring the optimal conditions within the greenhouse is crucial.

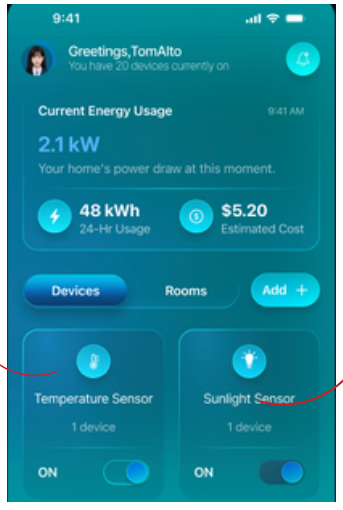
Detail

We offer 7 main features integrated in AI-application: ***Temperature sensor, Sunlight sensor, Control CO2, Irrigation system, Fogging system, Rain sensor, Climate Control system.***

Connects to the thermometer and heating system in the greenhouse. Summer: 24-29C (day), 16-24C (night). Winter: ~ 18-21C (day); ~ 7 C (night).

Optimizing Crop Growth: Adjust heating, cooling, or ventilation systems accordingly to maintain ideal temperature ranges for specific crops.

Detecting Pest and Disease Risks: By tracking temperature trends, farmers can implement timely pest management strategies. (3)



To track the sun's position and optimize the orientation of solar panels for maximum energy capture.

- Night: 18-24C, Day: 26-29C (4)
- Average lighting time: 12-16h/ day
- Set light intensity:
  - The plant prefers bright light: about 2,000 lux to 5,000 lux
  - The plant prefers low light: from 500 lux to 2,000 lux. (5)

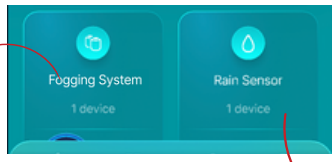
Automate Lighting Control

Adjusting artificial lighting according to natural light levels. In automotive use, they regulate automatic headlights, wipers, and climate control, improving safety and convenience for drivers. (6)

+ The Monnit Wireless CO2 Sensor.
+ 1200-1500 ppm.
+ Increase crop yield by up to 30%
CO2 development optimizes at 700 ppm. (7)

Subsurface Irrigation
+ Minimizes water evaporation and weeds by targeting irrigation directly to the root zone.
+ Schedules were set by using LOCOMOS. (8)

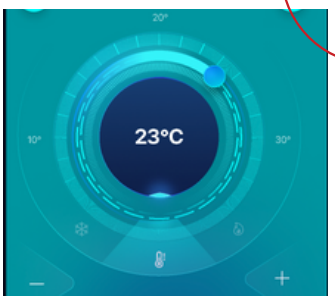
+ Mode: mist/pesticides.
+ Set the time.
+Moisture control.



+ Connects to the irrigation system, automatically turns off when it rains, and turns back on when the rain stops.
+ CPRSDBEX - Wired Rain Sensor
+ Set up the rainwater level height from ⅛ into ¾ in.

Climate Control Disease
Reduce climate differences and maintain a consistent temperature and humidity throughout a greenhouse.

Water Spray: cooling and humidity control -> plants grow optimally & small water prevent dust from flying in the air.
Spraying : Avoid the risk of pest infection
Save costs & effort. (9)



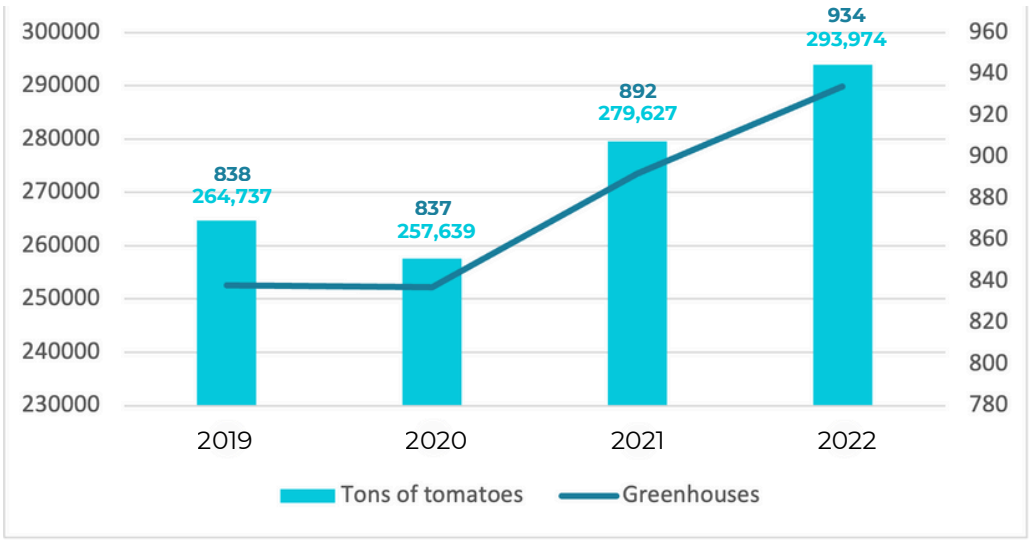
Optimizing Irrigation:
Utilizes real-time rainfall data to adjust irrigation, pausing or reducing watering when rain is detected, thereby conserving water and preventing overwatering.

The goal: is to control and sustain ideal environmental conditions. These systems regulate temperature, humidity, airflow, and air quality to suit various purposes such as comfort, preservation, or plant growth. (2)

Reducing Runoff and Erosion:
Help farmers anticipate heavy rainfall events and implement erosion control measures. (10)

EXPECTED OUTCOMES

The production of tomatoes in greenhouses in Canada in the last 4 years (11)



In Canada, it could rise from ***273,994 tons/year*** to approximately ***300,000 tons/year*** in ***the following years*** with the application and control of tomato production data.
So, by applying this technology model in Vietnam, the yield is expected to increase significantly when fully implementing technology in agricultural production.

POTENTIAL IMPACT

Economic: Harnessing AI and Machinery in Greenhouse Operations for *Enhanced Crop Growth and Quality*: A Path to Elevating Vietnam's Agricultural Productivity and Economic Prosperity.

Health: Technology helps to keep vegetables and fruit in good condition throughout its development stage. Making it safe for consumers to consume and *retain as much nutrition as possible* in fruit and vegetable.

Environment: Planting in greenhouses reduces water usage, pesticide dependency, and carbon emissions while extending the growing season and enhancing soil health, promoting environmental sustainability and resilience in agriculture.

References

1.Tap Chi Cong San
Development of agriculture in Vietnam: Issues and some solutions

2. Denso
Climate Control System for Greenhouse

3.Ontario
The effect of extreme temperatures on the tomato

4. Plantsomethingli.com:
How Much Sun Do Tomatoes Need? The Age Old Question

5. Laidback Gardener Website: How to Use a Grow Light for Tomatoes.

6. National Libary of Medicine
Effects of different light intensity on the growth of tomato seedlings in a plant factory

7.National Library of Medicine
Assessing the Impact of Higher Levels of CO2 and Temperature and Their Interactions on Tomato

8. Oregon State Univeristy
Irrigation System

9. Fogsis
What is fogging system?

10. Smart Water
Rain Sensor

11. Statistical Overview of the Canadian Greenhouse Vegetable and Mushroom Industry 2022