Report on inventions and innovations

of Trapping and fermenting

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Varee Chiangmai School

Primary 5-6

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Topic Innovation : Trapping and fermenting

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View Research Report

"Every plate of rice, every piece of food, don’t waste it, for it is valuable. Many people are tired, struggling a lot and endure hardships. Have compassion for the children with innocent eyes." This childhood rhyme, may have slight variations depending on the region, but its core message remains the same that teach us the value of food, consideration for others, and the importance of finishing our meals. Today, food and water consumption have become a national priority. It’s not just out of sympathy for hungry children but our planet is facing a critical crisis!

Food waste Crisis is a major challenge for humanity, especially due to the greenhouse gases produced by discarded food. If we continue to generate food waste, how can we manage and resolve this issue to prevent further climate impacts? The consequences of excessive waste contribute to global boiling, leading to extreme weather patterns such as El Niño, which has caused the Northern Hemisphere to experience its hottest temperatures in 170 years and accelerated ice melting by 6-7 times. Additionally, La Niña has triggered flash floods and unusual cold spells in many countries, including Thailand. This is just one part of a growing crisis that affects the environment, economy, and all life on Earth. To address this, we must act urgently to create a low-carbon society and reduce greenhouse gas emissions. Building a low-carbon society is crucial in combating climate change, which is primarily driven by the release of carbon dioxide and other pollutants that contribute to global warming. Reducing greenhouse gas emissions not only helps lower global temperatures but also minimizes the risks of natural disasters such as severe storms and flooding.

As part of this effort, our team is committed to contributing to a low-carbon society. One of our initiatives is to repurpose leftover food waste from students at Varee Chiang Mai School into compost. This has led us to develop an innovative solution called "Trapping and Fermenting." This innovation combines technological and scientific knowledge to create a sustainable solution.

Trapping and Fermenting is an innovative process that filters food waste, captures fats, and ferments organic matter into compost. The fats collected through the filtration system are mixed with food waste for fermentation, while the filtered water is directed to a wastewater treatment facility before being safely released into the environment.

Preface

Introduction

Food waste Crisis is a major challenge for humanity, especially due to the greenhouse gases produced by discarded food. If we continue to generate food waste, how can we manage and resolve this issue to prevent further climate impacts? The consequences of excessive waste contribute to global boiling, leading to extreme weather patterns such as El Niño, which has caused the Northern Hemisphere to experience its hottest temperatures in 170 years and accelerated ice melting by 6-7 times. Additionally, La Niña has triggered flash floods and unusual cold spells in many countries, including Thailand. This is just one part of a growing crisis that affects the environment, economy, and all life on Earth. To address this, we must act urgently to create a low-carbon society and reduce greenhouse gas emissions. Building a low-carbon society is crucial in combating climate change, which is primarily driven by the release of carbon dioxide and other pollutants that contribute to global warming. Reducing greenhouse gas emissions not only helps lower global temperatures but also minimizes the risks of natural disasters such as severe storms and flooding.

Food waste management is one of the major challenges the world faces today. Discarded food often has a significant impact on the environment and natural resources. While various techniques are being researched and developed to address this issue, innovative solutions are needed to create sustainable change.

Our team is committed to contributing to a low-carbon society by repurposing leftover food waste from students at Varee Chiang Mai School into compost. The Trapping (filtration) and Fermenting (composting) process is a promising method for minimizing the impact of food waste, particularly in adding value to discarded food and reducing waste that contributes to greenhouse gas emissions. Thus, Trapping and Fermenting is an efficient process that filters, captures, and ferments organic waste, helping to reduce environmental harm while promoting sustainability.

Objectives of the Innovation

1. To help reduce carbon dioxide emissions from food waste by converting it into compost, promoting reuse and sustainability. This aligns with the Sustainable Development Goals (SDGs), specifically Goal 13, which calls for urgent action to combat climate change and its impacts.
2. To extract fats from food waste and repurpose them as fertilizer for soil and plant enrichment.

Expected Benefits

1. Utilizing food waste for environmental benefits by filtering fats from waste and converting them into compost.
2. Improving the quality of wastewater before releasing it into public water sources, ensuring better purification and reducing pollution.
3. Adding value to food waste, as the compost produced can be used for personal purposes or sold for additional income.

Scope of the Innovation

1. Knowledge & Research Areas

1. Study the process of food waste separation.

2. Research and apply technology to enhance the efficiency of food waste management.

3. Explore various composting methods, including burial, turning piles, and fermentation in containers.

4. Investigate the separation of fats and water and study methods for designing an oil-trapping system.

2. Location

Varee Chiang Mai School, Mueang District, Chiang Mai Province.

3. Timeline

January – February 2025

Chapter 2

Documents and Research

The project on Trapping and Fermenting Innovation was conducted by the research team through a thorough study and review of relevant theories and research papers, which include:

1. Composting from food waste
2. The working process of grease traps
3. The functionality of LEGO Mindstorms EV3
4. Coffee grounds
5. Manure fertilizer
6. Grease from grease traps

1. Compost

Food Waste Compost is a process of transforming food scraps from consumption or meal preparation such as leftover vegetables, fruit peels, coffee grounds, and other organic waste into valuable organic fertilizer. This compost can be used in agriculture to improve soil quality and support plant growth.

1.1 Food Waste Composting Process

1.1.1 Food Waste Collection: The process begins with collecting food scraps from various sources such as households, restaurants, and markets. Waste should be separated from general trash for proper management.

1.1.2 Composting: The collected food waste is mixed with other materials that add decomposition, such as dried leaves, straw, and coffee grounds, ensuring an appropriate carbon to nitrogen ratio.

1.1.3 Environmental Control: Factors like temperature, moisture, and aeration are monitored to optimize the composting process.

1.1.4 Decomposition: The composting process can take several weeks to months, depending on environmental conditions and materials used.

1.2 Benefits of Food Waste Composting

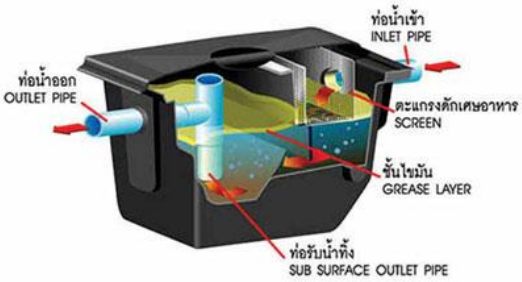
1.2.1 Waste Reduction: Composting food waste decreases the amount of organic waste sent to landfills, helping to mitigate environmental problems.

1.2.2 Soil Enrichment: Compost provides essential nutrients that enhance soil structure and fertility, promoting healthy plant growth.

1.2.3 Reduced Chemical Fertilizer Use: Using compost minimizes reliance on chemical fertilizers, which may have negative environmental and health impacts.

1.2.4 Lower Greenhouse Gas Emissions: Reducing food waste in landfills decreases methane emissions, a greenhouse gas contributing to climate change.

2. Grease traps



A Grease Trap is a device designed to manage and separate fats, oils, and grease (FOG) from wastewater before it enters the main drainage or sewage system. These traps are commonly used in kitchens of households, restaurants, hotels, and food processing plants. They prevent grease and oil from clogging pipes and disrupting wastewater treatment systems.

2.1 Working Mechanism of a Grease Trap

2.1.1 Wastewater Entry: Wastewater from kitchens enters the grease trap.

2.1.2 Grease Separation: The flow rate slows down inside the trap, allowing heavier water to sink while grease and oil float to the top.

2.1.3 Oil and Fat Collection: Fats and oils accumulate at the top, forming a distinct layer, while the remaining wastewater settles at the bottom.

2.1.4 Filtered Water Discharge: The treated water exits the trap into the main drainage system, while grease can be manually removed when solidified.

3. Lego Mindstorm NXT

LEGO Mindstorms NXT is a robotics kit developed by LEGO, designed for education and innovation in robotics and automation. It allows users to build robots capable of movement, sensing, and interaction with their environment.

3.1 Key Components of LEGO Mindstorms NXT

3.1.1 NXT Block: The main control unit, acting as the robot's "brain," featuring an LCD screen and buttons for basic controls.

3.1.2 NXT Motors: These motors drive robot movement and can adjust speed and torque based on programming needs.

3.1.3 Touch Sensors: Detect physical contact or pressure, allowing the robot to respond to external stimuli.

3.2 Applications

Education: Used in teaching STEM subjects (Science, Technology, Engineering, and Mathematics) through hands-on robotics and programming projects.

4. Coffee Grounds

Coffee Grounds are the residual materials left after brewing coffee. These remains are in a coarse or fine granular form, depending on the brewing method.

4.1 Benefits of Coffee Grounds

4.1.1 Composting: Coffee grounds are rich in nitrogen and serve as an excellent additive to compost, enriching the soil and supporting plant growth.

4.1.2 Soil Improvement: Mixing coffee grounds with soil enhances aeration, moisture retention, and overall soil quality.

5. Manure Fertilizer

Manure Fertilizer is organic fertilizer derived from animal waste, such as cattle, horses, and poultry manure.

5.1 Types of Manure Fertilizer

Cattle Manure: Popular due to its balanced nutrient composition and low acidity. Horse Manure: Generates more heat during decomposition and contains a diverse range of nutrients. Poultry Manure: Highly concentrated in nitrogen and requires proper treatment before use.

5.2 Benefits of Manure Fertilizer

5.2.1 Soil Structure Improvement: Enhances soil aeration and prevents compaction.

5.2.2 Nutrient Enrichment: Supplies essential nutrients like nitrogen, phosphorus, and potassium.

5.2.3 Water Retention: Helps soil retain moisture and reduces water wastage.

5.2.4 Slow Nutrient Release: Gradually decomposes, providing plants with a steady nutrient supply.

5.2.5 Reduced Chemical Fertilizer Dependency: Encourages sustainable farming practices with minimal chemical inputs.

6. Grease from Grease Traps

Grease from Grease Traps refers to the fats and oils separated from wastewater in grease traps. These substances are collected and stored in the trap to prevent clogging in sewage systems and reduce the burden on wastewater treatment facilities.

Chapter 3

Implementation Process

Equipment

1. Two plastic containers
2. Food waste filter basket
3. Motor
4. Control unit
5. Water faucet
6. Plastic pipes and recycled water pipes
7. Touch sensor
8. Acrylic sheet
9. Old LEGO parts

Materials for Composting with Food Waste

1. Coffee grounds
2. Manure

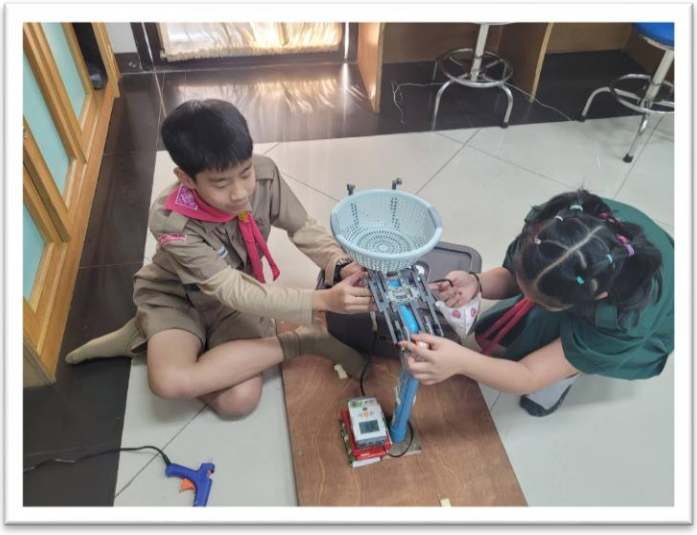
Implementation Steps (Design Thinking Process)

1. **Problem Identification and Understanding** : The team analyzes environmental issues starting from local concerns.
2. **Defining the Problem**: } Creating an innovation
3. **Exploring Various Solutions:**
4. **Prototype Development** : Make an innovation to solve the identified issue.

4.1 Designing a lifting mechanism for food waste transportation.

4.2 Constructing a custom-made grease trap.

4.3 Installing the food waste lifter onto the base and composting container.



5. Prototype Testing: Evaluating the invention's effectiveness and making improvements.

5.1 Users dispose of leftover food into the filter basket.

5.2 Testing the operation of the food waste lifting mechanism.

5.3 Ensuring waste falls into the compost bin without spillage.

Working of the Trapping and Fermenting Invention

Trapping and fermenting is a collaborative process involving a food waste filter, a grease trap, and food waste composting. The working procedure are as follows:

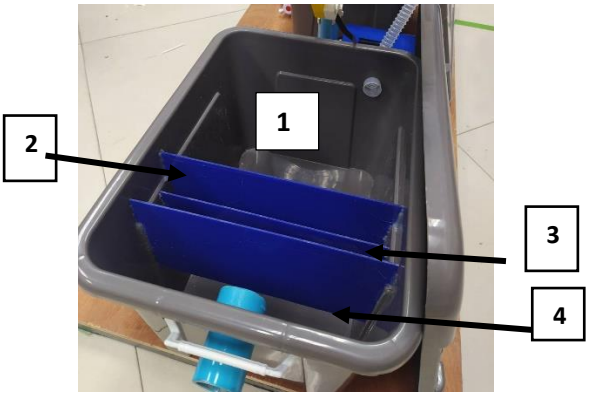
1. Technological Mechanism

1.1 Users dispose of leftover food into the filter basket, which separates solid waste from liquid.

1.2 When the food waste in the basket reaches the designated weight, it waits for 2 seconds. Then, the lever lifts the basket, tipping the food waste into the composting bin on the other side. After 5 seconds, the lever and basket return to their original position, ready to receive more food waste.

2. Grease Trap Functionality

When the liquid from food waste enters the compartment of the grease trap, which already contains water, the water and grease gradually separate over time. Since grease and oil are lighter than water, they rise to the surface. These oils and grease are collected in compartment 1, while the relatively cleaner water flows through compartments 2, 3, and 4. Finally, the filtered water is discharged from the grease trap into the drainage system for further treatment before being released into public waterways.



3. Composting Bin Operation

3.1 Composting Materials

3.1.1 Once an appropriate amount of food waste has been collected, it is mixed with coffee grounds. Coffee grounds are used because they are high in nitrogen and can be incorporated into compost, enriching the soil and promoting plant growth. The team can obtain coffee grounds from V Café, which is located within the school premises.

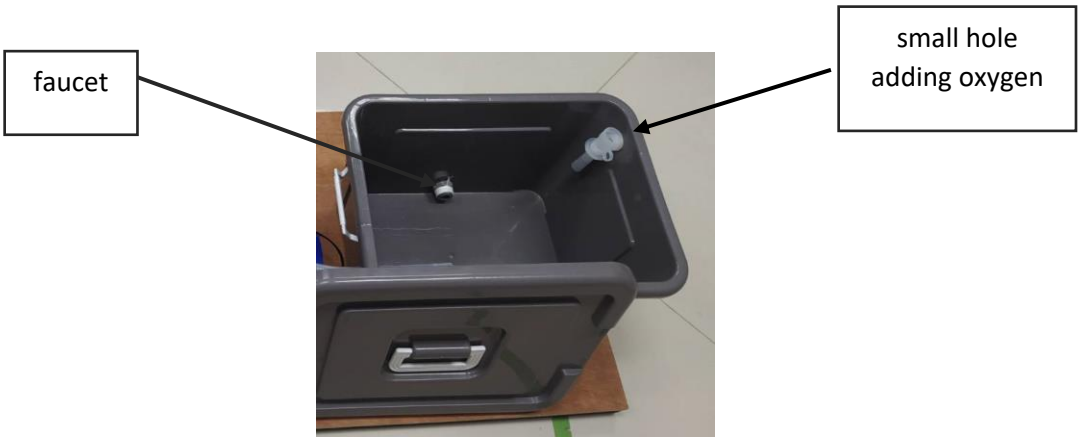
3.1.2 Cattle manure is added because it contains essential nutrients in appropriate amounts and has a low acidity level.

3.1.3 The team also incorporates grease collected from the grease trap into the composting process. According to environmental research journals, grease residues can be used in composting. A hose is connected between the composting bin and the grease trap to facilitate this process, making it more convenient for users who prefer not to handle the grease manually. However, the discharged grease may contain some water.

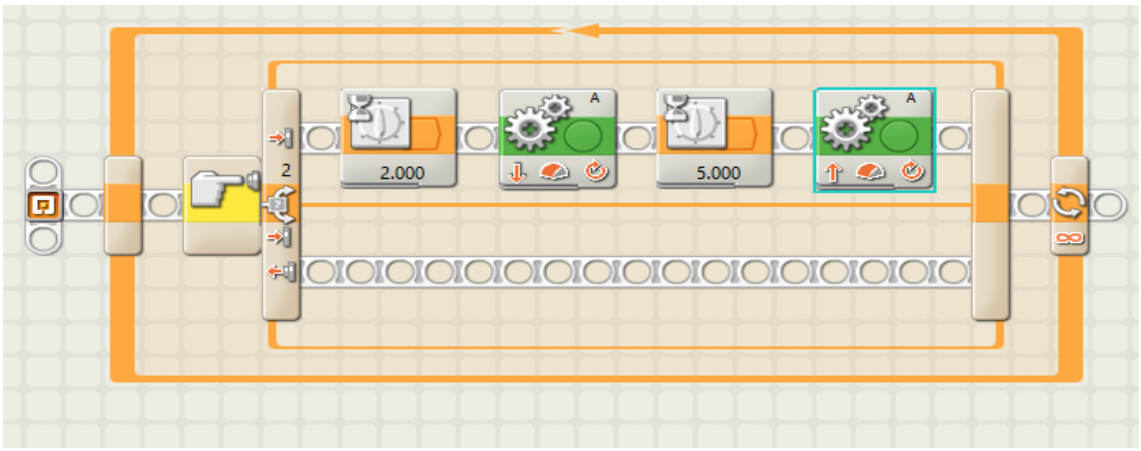
3.1.4 Dried leaves are added because they help absorb excess moisture in the compost.

3.2 Operation of the Composting Bin

Once all the necessary materials have been added, they are mixed thoroughly. The lid of the bin is then closed, but there are small holes on the sides to allow oxygen to enter the composting bin. The compost is turned every 2–3 days to enhance decomposition. Effective composting typically takes around 1–2 months or longer, depending on the breakdown rate of the materials used.



Program



Testing the Use of Food Waste Compost to Enrich Soil

1. Inspect the soil in the vegetable plot behind the school.

2. Image of the soil after mixing with food waste compost.

Steps for Testing Essential Nutrients for Plant Growth in Soil

1. Crushing the Soil

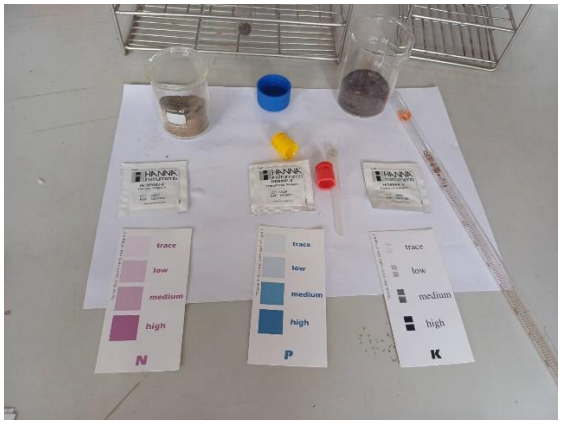
Soil that has not been mixed with food waste compost.

Soil that has been mixed with food waste compost for 10 days.

2. Testing for Nutrients

   Analyze the soil for nitrogen, phosphorus, and potassium.

   2.1 Soil Testing Equipment



2.2 Soil Testing Procedures

Chapter 4

Results

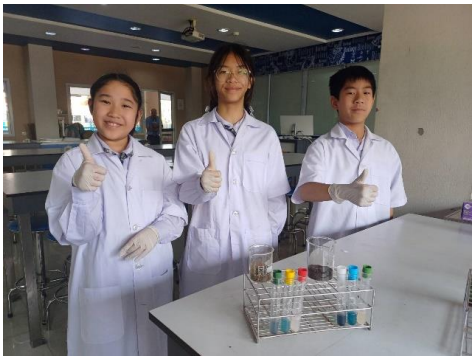
The Trapping and Fermenting system functions as intended according to the project plan. The testing process confirmed that:

1. Testing the Food Waste Lifting Lever

Test Attempt	Accuracy Result
1	100%
2	100%
3	100%
4	100%
5	100%
6	100%
7	100%
8	100%
9	100%
10	100%

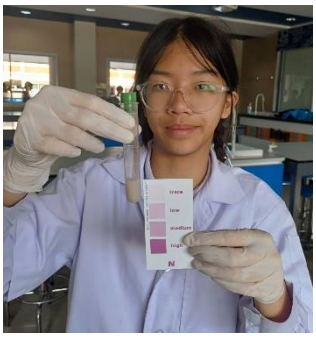
2. Testing the Compost Fermentation Bin: Oxygen was able to enter through the oxygen inlet of the bin.

3. The grease trap effectively captured fat from food waste and water was able to flow through the drainage outlet.



1. Soil that has not been mixed with food waste compost:

Results

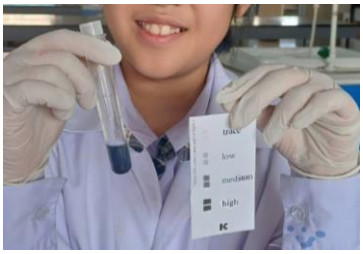


Nitrogen: Low level

Phosphorus: Moderate level

Potassium: Low level

2. Soil that has been mixed with food waste compost:



Results

Nitrogen: Low level Phosphorus: Fairly high level Potassium: Fairly high level

Chapter 5

Conclusion and Discussion of Experimental Results

The Trapping and Fermenting system functions as intended according to the project plan. The testing process confirmed that:

1. The lifting mechanism effectively transfers food waste from the filtering basket to the composting bin.
2. The composting bin successfully accommodates and processes up to 5 kilograms of food waste.
3. The grease trap efficiently separates grease from food waste, allowing water to flow through the drainage system properly.

Summary of Soil Nutrient Test

The test results for nitrogen, phosphorus, and potassium in the soil indicate that the vegetable plot behind the school initially had low levels of essential nutrients for plant growth. However, after adding food waste compost and allowing it to decompose for 10 days, the soil's fertility improved. The levels of nitrogen, phosphorus, and potassium increased to a more suitable range for plant cultivation.

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