

Feasibility study of investment in layer feces management technology: Case study of a farm in the south of Thailand

การศึกษาความเป็นไปได้ของการลงทุนในเทคโนโลยีจัดการมูลไก่ไข่: กรณีศึกษาฟาร์มไก่ไข่ แห่งหนึ่งในภาคใต้

Jittima Khongkhlik

Graduate Student, Master of Business Administration Program ,
School of Accountancy and Finance, Walailak University

จิตติมา คงขลิค

นักศึกษาหลักสูตรบริหารธุรกิจมหาบัณฑิต

สำนักวิชาการบัญชีและการเงิน มหาวิทยาลัยวลัยลักษณ์

E-mail: Jittima.khongkhlik@gmail.com; Ph: 062-656-9624

วันที่ได้รับต้นฉบับบทความ : 9 สิงหาคม 2565

วันที่แก้ไขปรับปรุงบทความ : 12 กันยายน 2565

วันที่ตอบรับตีพิมพ์บทความ : 15 กันยายน 2565

Dr. Kanokwan Meesook*

Full time Lecturer, Accounting Department,

School of Accountancy and Finance, Walailak University *Corresponding author

ดร. กนกวรรณ มีสุข

อาจารย์ประจำสาขาวิชาการบัญชี

สำนักวิชาการบัญชีและการเงิน มหาวิทยาลัยวลัยลักษณ์

E-mail: mkanokwa@wu.ac.th; Ph: 095-647-4519

Dr. Somnuk Aujiropongpan

Associate Professor of Accounting Department,

School of Accountancy and Finance, Walailak University

ดร.สมนึก เอื้อจิระพงษ์พันธ์

รองศาสตราจารย์ประจำสาขาวิชาการบัญชี

สำนักวิชาการบัญชีและการเงิน มหาวิทยาลัยวลัยลักษณ์

E-mail: Somnuk.aujiropongpan@gmail.com; Ph: 081-803-9507

บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาเทคโนโลยีที่นำมาใช้ในระบบการจัดการมูลไก่ไข่ ศึกษาความต้องการทางการตลาดของมูลไก่ไข่ ศึกษาความคุ้มค่าทางการเงินในการลงทุนพัฒนามูลไก่ไข่ และศึกษาผลกระทบของระบบเทคโนโลยีในการพัฒนามูลไก่ไข่ โดยเก็บรวบรวมข้อมูลจาก 3 กลุ่มตัวอย่าง ได้แก่ ผู้ประกอบการฟาร์มไก่ไข่ ผู้ใช้มูลไก่ไข่ และ กลุ่มชุมชนที่อาศัยอยู่บริเวณรอบๆ ฟาร์มไก่ไข่ที่เป็นกรณีศึกษา ข้อมูลที่ได้จากการศึกษา พบว่า เทคโนโลยีที่สามารถช่วยในการจัดการมูลไก่ไข่และสามารถพัฒนามูลไก่ไข่ให้ดีขึ้นในฟาร์มไก่ไข่ที่เป็นกรณีศึกษา คือ เทคโนโลยีถังหมัก Compo ซึ่งลักษณะโครงสร้างมีความแข็งแรงและทนทาน มีฉนวนกันความร้อนสามชั้นเพื่อช่วยในการรักษาธาตุอาหารที่เป็นประโยชน์และพลังงานต่อพืช สามารถติดตั้งในพื้นที่น้อยหรือพื้นที่จำกัดได้ อีกทั้งยังเป็นมิตรต่อสิ่งแวดล้อมช่วยลดมลพิษขณะหมักและย่อยมูลสัตว์ ซึ่งผลิตภัณฑ์ที่ได้จัดเป็นปุ๋ยอินทรีย์ระดับพรีเมียมแท้ 100 เปอร์เซ็นต์ มีลักษณะแห้งเป็นผงแบ่งหรือเป็นชิ้นส่วนเล็กๆ และ พบว่ามีค่าธาตุอาหารหลักสำหรับพืช ได้แก่ ไนโตรเจน ฟอสฟอรัส และ โพแทสเซียม ที่เพิ่มสูงขึ้น ซึ่งมีคุณสมบัติของปุ๋ยอินทรีย์ที่ตรงต่อความต้องการของผู้ใช้มูลไก่ไข่ จากผลการศึกษาความคุ้มค่าทางการเงินของการลงทุนพัฒนามูลไก่ไข่ด้วยเทคโนโลยีถังหมัก Compo ของฟาร์มที่เป็นกรณีศึกษา พบว่าการลงทุนเทคโนโลยี. ในระยะเวลา 10 ปี ที่อัตราคิดลดเท่ากับ ร้อยละ 8.4 มีมูลค่าปัจจุบันสุทธิ เท่ากับ 15,164,980 บาท และ อัตราผลตอบแทนภายใน เท่ากับ ร้อยละ 15 รวมถึงมีระยะเวลาคืนทุน เท่ากับ 5 ปี 5 เดือน นอกจากนั้นแล้วการใช้เทคโนโลยีเพื่อสร้างมูลค่าเพิ่มให้กับมูลไก่ไข่ ยังก่อให้เกิดผลกระทบทางเศรษฐกิจในแง่บวกกับผู้ประกอบการฟาร์มไก่ไข่อีกด้วย ผลการศึกษาเป็นประโยชน์ต่อการศึกษาความเป็นไปได้ของการลงทุนในเทคโนโลยีจัดการมูลไก่ไข่

คำสำคัญ: มูลไก่ไข่ ปุ๋ยอินทรีย์ เทคโนโลยีถังหมัก Compo

Abstract

The objectives of this study were to study the technology to be implemented as the management system of layer feces, the market demand of layer feces, the financial worthiness of investment, and the impact of the technology for the layer feces development. Data were collected from 3 groups of samples, namely, layer farm operator, user of layer feces, and communities surrounding, a case study of a farm in the south. Based on the data obtained from this study, the Compo fermentation container technology was found to be able to manage the layer feces, and can improve the layer feces of the farm. Its structure is strong and durable with three layers of insulation to help keep beneficial nutrients and energy for plants. It can be installed in a small or limited area, as well as be environmentally friendly, reducing pollution while fermenting and digesting animal feces. The products that are classified as 100% premium organic fertilizers are in the form of dry powder or small particles. It was also found to be nourished with higher macronutrients for plants, which are organic fertilizers with features that meet the needs of the users of layer feces. Based on the financial worthiness of investment at a discount rate of 8.4%. It was found that Net Present Value is equal to 15,164,980 baht and the Internal Rate of Return is equal to 15%. In addition, the payback period is 5 years and 5 months. Moreover, applying the technologies is creating the layer feces value on the economic aspect gave a positive result for the egg hens entrepreneurs, the products reached the quality that increased the value of agricultural products, got more quantity and higher incomes. The result of study is useful for feasibility study of investment in layer feces management technology.

Keywords: Layer Feces, Organic Fertilizer, Compo Fermentation Container Technology

Introduction

Chickens farm which is a case study, has been established approximately 28 years. The core purpose is to do the farm for hens raising and eggs production. The farm is in family business type, with the farm owners, skillful entrepreneur in raising chickens and has a lot of experience on chickens. Such farm locates in Takua Pa District, Phang Nga Province. About 500 battery cage chickens raised for the first time in 1994 in an open chicken coop, with a free farm not dependent on private corporations. Later, in 2004, technologies brought to the farm enhanced the operation and increased the production capacity. Also, the improvement of this henhouse to be a closed-system using more modern machines to control with computer system covering all of the henhouse parts, it helps be easier to monitor the quality and operation. Today, the farm has 160,000 battery cage chickens raised freely and 260,000 young hens, 420,000 chickens' total. The farm is encountering a crucial problem in waste management. For instance, too many layer feces on the farm are increasing depending on the increasing number of hens, bad smell from the layer feces, environmental pollution, and poisonous gas from layer feces affecting the poultrymen and the hens, including the people living surrounded. Hence, it is necessary to improve the hens to reach higher quality by reducing the pollution to be friendly to the environment and increase profits. Therefore, one of the researchers, who are a descendant directly, would like to study the feasibility of bringing technologies to help manage the layer feces problem. The technologies used in the management and development of layer feces emphasize high products and marketing needs, including the technological impacts, to support the decision for chicken farm entrepreneurs whether it is worthy of investment and advantage or disadvantage.

Purposes of the Study

For the feasibility study of investment in layer feces management technology: A case study of a farm in the south, the research determines the research purposes as follows:

1. To study the suitable technologies and can apply them in creating values to the layer feces;
2. To study the marketing needs of the layer feces;
3. To study the financial worthiness of the technology investment to create the values of the layer feces; and
4. To study the effects of applying the technologies in creating the values of the layer feces.

Literature Review

Technology Acceptance

The Technology Acceptance Model (TAM) is a theory discovered by Davis et al., (1989). It is developed from the Theory of Reasoned Action. TAM emphasizes the study regarding various factors affecting the acceptance or decision to use technology. The crucial factors directly impacting technology acceptance are Perceived Ease of Use and Perceived Usefulness. Both components are essential generated from the attitudes toward using to the behavioral intention of use and finally is an actual system use. The relationship among such factors can express as shown in Figure 1. It is a model famous in use for technological assessment of whether such technology can be accepted and used widely.

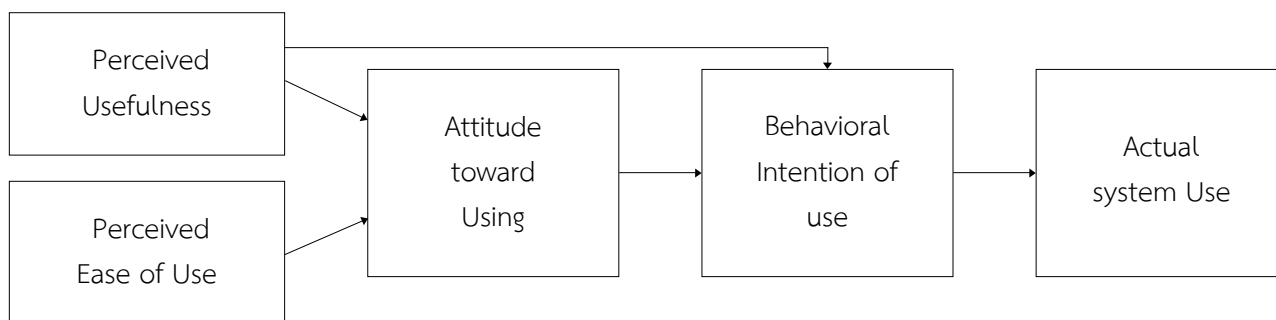


Figure 1 The Technology Acceptance Model (TAM)

Consumer Behavior

6W1H is the study and analysis of consumer behavior theory in order to formulate a marketing strategy, finding the target group of the business to grow sales effectively. The principle of analysis of this theory consists of 6W is Who What Where Why When Whom and 1H is How' (Kinoshita & Kinoshita, 2016)

Analysis of investment worthiness

When executives or entrepreneurs decide to do any project, financial instruments used to evaluate the risks and compensates are necessary for the project. Aujirapongpan (2004) concluded that financial instruments able to use for risks and compensation assessment that reflect the investment worthiness are as follows:

1. The payback period is a period that the entrepreneurs will get compensation.

The performance in the project invested is equal to the money used in the investment. Analyzing the payback period reflects the investment risk. If the payback period consumes a long time until it almost expires of the investment project, it means that the project has a high risk. For example, if the entrepreneurs invest in a machine for a value of 1,000,000 baht, its life equals ten years. And when having used the instrument, the entrepreneur will get net cash each year of 125,000 baht. The payback period is equal to eight years (1,000,000/125,000), using Formula (1), which is 80% of all periods. It considers the investment tends to have a high risk. (Cooper et al., 2002).

$$\text{Formula 1) Payback Period} = \frac{\text{Initial Investment}}{\text{Annual operating cash inflow}}$$

2. Net Present Value (NPV) is a net compensation with the present value of the invested money and all net cash with all net cash which will receive all the time of that invested project, calculated as the Formula (2). If the NPV of all time invested project is more than all of the money used in the investment, it will make that investment project have the NPV a positive value. It reflects the entrepreneurs or investors to realize that such a project gives the compensation worthily toward the investment.

Formula (2) (Khan,1999)

$$NPV = \sum_{t=0}^n \frac{NCF_t}{(1+r)^t}$$

By determining NPV = Net Present Value (NPV)
CFT= Net cash each time
r = Discount rate

3. Internal Rate of Return (IRR) is the compensation rate of each investment project. IRR calculation is the bringing of the cast received from the investment over the invested project life to compare with the money which has to be used in that project investment, as shown in Formula (3). If IRR had higher values than the cost of capital rate or the compensation rate needed by the entrepreneurs, it considers that project gives the compensation worthy toward the investment.

Formula (3) $I=0$

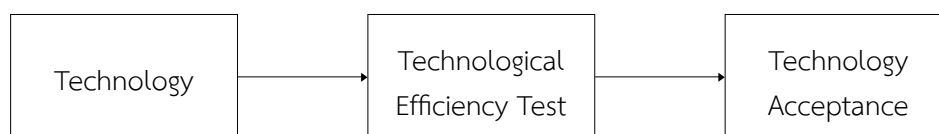
Be determining I = the money paid at the down payment
 C_t = net cash each time
 r = the compensation rate from investment

Research Methodology

For the research entitled the feasibility study of investment in layer feces management technology: A case study of a farm in the south, the researcher determines the guidelines of the research methodology under the purposes as follows:

1. To study the suitable technology and apply it to create value for the layer feces.

The description of this purpose is categorized into three stages as follows:



Technology

The population used in the study per this objective is the egg hens farm business entrepreneurs in the south, using the Compo fermentation container technology. It is determined to be the core technology that manages the layer of feces. The sample selection was Purposive Sampling, which is the farm entrepreneurs who are a case study. The data collection was from the in-depth interview with general observation within the farm and operation, research studies, and textbooks related to the technologies used for layer feces management, including the information from websites as the reference and qualitative data analysis. The presentation is in the form of a lecture and description with conceptual images.

Technological Efficiency Test

The researcher tested the efficiency of the Compo fermentation container technology by observing the number of layers feces and moisture, then analyzed the quality and physical characteristics of the layer feces which have passed through the fermentation process by comparing it with the layer feces before improvement.

Technology Acceptance

It is a study on the benefits of technology use, convenience, and easiness of technology use, including the suitability of the technology use, which leads to the acceptance in the investment of technology selection.

2. To study the marketing needs of the layer feces.

The population used in the research is the layer feces users selected by the Purposive Sampling method, a total of 50 users. The data collection was done by operating the fieldwork and giving out the questionnaires in the south toward the Andaman coasts. The data analysis was from the general information and the needs of layer feces use, by the Descriptive Statistics to describe general characteristics, Frequency, and Percentage.

3. To study the financial worthiness of the technology investment to create layer feces values.

The population used in the study for this purpose is the egg hens farm business' entrepreneurs in the south using the Compo fermentation container technology. The sample was from the Purposive Sampling method, which includes the egg hens farm entrepreneurs, a case study, by interviewing the financial information; capital resources, down payment, labor cost, expenses of performance, and income. The data analysis was through the Quantitative Method of financial information analysis, which includes Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period.

4. To study the effects of applying the technology for creating the layer feces values.

The population used in the study under this objective is a sample group selected using the Purposive Sampling method. Three groups of the samples consist of 1) egg chickens farm entrepreneurs (a case study), 2) ten layer feces users, and 3) thirty people living in the community around the farm. The instruments used are the interview form and a questionnaire for collecting data regarding the technological impacts, consisting of three aspects: economy, environment, and human and society. Then, the researcher analyzed and concluded the overall images from the data of all three sample groups in a Table form. The Table divides into positive and negative impacts of each aspect.

Result

For the feasibility study of investment in layer feces management technology: A case study of a farm in the south, the research proposes the result according to the research objective as follows:

1. To study the suitable technology and apply it to create the values of layer feces.

Technology

The technology which helps manage the layer feces and can develop the layer feces is the Compo fermentation container technology. The result revealed that its structure is strong and durable with three layers of insulation. The installation is in a small or limited area. Its technological working principle is the process of fermentation using oxygen by an automatic closing system.

Technological efficiency test

Regarding the study result to compare the number of layer feces and layer feces moisture, before and after entering into the Compo fermentation container technology, 22 tons of layer feces before improvement (100%) with 80% moisture could reduce the quantity and humidity. The layer feces after being improved was at 4.5 tons (20%), with 20% moisture, as shown in Figures 1 and 2.



Figure 1 Layer feces Quantity before and after the Compo fermentation container technology

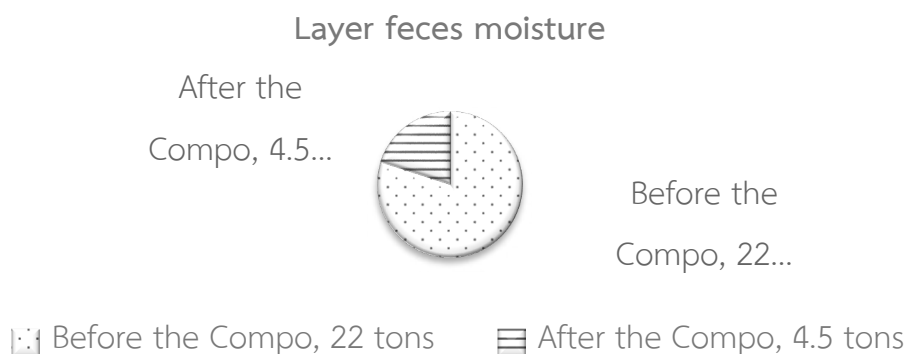
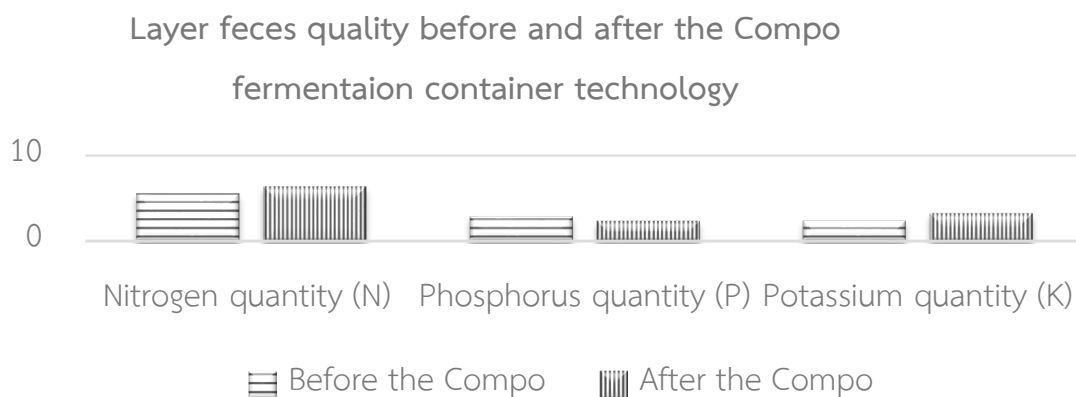


Figure 2 The layer feces moisture before and after entering into Compo fermentation container technology

The study result of comparing the quality of layer feces before and after entering into the Compo fermentation container technology indicated that Nitrogen (N) of 5.5% increased to 6.33%, Phosphorus (P) of 2.9% became 2.38%, and Potassium (K) of 2.4% up to 3.25%, as shown in Figure 3.



**Figure 3 Layer feces quality before and after
entering into the Compo fermentation container technology**

Physical characteristics of the layer feces before the adjustment revealed that they possess light brown mixed with white color, bad smell, pungent smell, stinking smell, with big size and wet lumps. The physical characteristics of the layer feces after the improvement indicated that they had a light brown color. They smell like burned fish meal, with tiny size as a fine and dry powder.

Technology Acceptance

According to the interview of egg hens farm entrepreneurs, a case study on the technology acceptance of the Compo fermentation container technology revealed as follows: The perceived usefulness and the efficiency of layer feces management were high. It could reduce the layer feces. Furthermore, the layer feces had better quality and were reusable. Besides, the technology had a small and compact size that helped save the installation space in a limited area. The materials were strong and durable, and the price was worth comparing to its systematic effectiveness. For perceived ease of use, this Compo was easy and convenient. The maintenance or treatment was quite easy and safe. Concerning the use requirements, this technology can apply to problem-solving and layer feces development really.

2. To study the marketing needs of the layer feces

Regarding the study result on the marketing needs of the layer feces, the information of the people who needed layer feces found that they upheld the agriculturalists the most (68%) and had an income of more than 50,000 baht (58%). The result about the purchase and use needs of layer feces among the egg hens users revealed that they wanted to reduce the expenses of planting or the cost at best (72%). It indicated that the users had used the layer feces for more than six years (40%), they purchased the layer feces during the early years (50%), and secondly was at the end of the year (40%). Furthermore, they used the layer feces about 3-4 times per year (62%). They needed to purchase and use the layer feces more than 10 tons per year (70%). The purchasing price was 180 baht per sack the most (100%), the most frequent buying place was egg hens farm near home (98%),

and most of them purchased for use with the gardening plants (66%), which was dry and granular powder (52%), the secondly was in a pellet form (48%). Besides, the sack packaging most needed was 25 kilograms (54%), and the samples decided to buy layer feces (52%).

3. To study the financial worthiness of the technology investment for creating the values to the layer feces

According to the analysis result of the financial investment to develop the layer feces by the Compo fermentation container technology, a case study in Takua Pa District, Phang Nga province, the technology investment with functional life of around ten years at a discount rate of 8.4% revealed that the Net Present Value (NPV) was equal to 15,164,980 baht. The Internal Rate of Return (IRR) at 15% found that the Payback Period (PB) was five years and five months.

4. To study the effects of technology use in creating the values to layer feces

Economic aspect

It indicated the positive effects for the egg hens entrepreneurs, the products reached quality and enhanced to increase the values of agricultural products, the products got more quantity, increased incomes, saved expenses of employment, the trading market was broader causing the products selling more. Furthermore, production, management, and development procedures became shorter. The transporting and moving layer feces were easy and convenient. For agriculturalists, the productivity of plantings reached quantity and gave fruits consistently with higher quantity, helping reduce the costs to the farmers that enhance incomes. For negative impact, it identified high technology investment costs of management and development on layer feces might generate debts. Besides, it did not promote employment and new occupation.

Environment Aspect

The positive impact; it did not cause the problem of noise, wastewater, dust, worms, and flies. Moreover, the bad smell from layer feces decreased, the soil was suitable for planting, and increased the organic matter, including without chemical residues;

Human and Society Aspect: the positive impacts; the labor force decreased, enhancing the performance efficiency that facilitated working without settlement, increased alternatives to the farmers on fertilizers selection and felt safe when using the layer feces without chemicals. For negative impacts; it affected health in parts of various symptoms such as nose burning and sore throat, including a little itchy skin and eyes in the stage of layer feces packaging dehydrated and during the time of using layer feces with the agricultural fruit.

Discussion

From the feasibility study of investment in layer feces management technology: A case study of a farm in the south; the researcher could discuss the study result under the research purposes as follows:

1. To study the technology used in layer feces management

The technology which can apply to the layer feces management and develop the layer feces better are the Compo fermentation container technology and dung dehydrated CRI-MAN machine technology, HBC Generation. When comparing, the Compo fermentation container technology had a structure of vertical and circle cylindrical shapes installed in a small space. It had a short production stage by entering the fresh layer feces into the Compo fermentation container technology straightly (Chubu Ecotec, 2022). The dung dehydrated CRI-MAN machine HBC Generation had vertical and square cylindrical shapes installed in a small space. However, it had more production processes and needed more space for layer feces management by having the bucket to mix the layer feces that had to use more area. Then, it had to pump the layer feces mixed with water into the pressing machine for water evacuation before putting it in the dehydrated CRI-MAN machine (CRI-MAN, 2022). The technology which is suitable for the limited space of the case study farm and helps save the time of production is the Compo fermentation container technology.

According to the comparison of layer feces before and after entering into the Compo fermentation container technology, the layer feces before adjustment with 22 tons had less quantity. It became the layer feces after improvement to 4.5 tons. The number of layer feces decreased much to 80%. Moreover, when comparing the moisture, the layer feces before improvement with 80% decreased after the adjustment to 20%. Hence, the moisture quantity decreased to 75%.

Furthermore, the study result of comparing the quality of layer feces before and after entering into the Compo fermentation container technology indicated that Nitrogen (N) 5.5% increased to 6.33%, Phosphorus (P) 2.9% reduced 2.38%, and Potassium (K) 2.4% increased to 3.25%. It can see that the value of Nitrogen (N), and Potassium (K) all increased but the value of Phosphorus (P) slightly reduced, after passing the fermentation process with the Compo fermentation container technology when comparing the research contribution regarding the core nutrients of plants in other organic fertilizers, as shown in Table 1.

Table 1 Comparison of nutrients on each plant by literature review and experiment with Compo fermentation container technology

Nutrients	From Literature Review							
	Aran Ngampongsai (2010)			Usa Srisai (2008)	Napaporn Jampee (2014)			From the experiment with the Compo fermentation container technology
	Goat feces	Cattle manure	Dried goat feces	Bagasse mixed with layer feces	Cattle manure	Fertilizer	Azolla	Dehydrated layer feces
Nitrogen (N)	1.17	1.24	2.34	2.2	1.64	1.95	3.08	6.33
Phosphorus (P)	0.27	0.53	0.51	0.44	0.63	0.84	0.41	3.28
Potassium (K)	0.32	1.84	4.38	1.22	1.8	0.41	4.36	3.25

Source: Experiment and literature review

The dehydrated layer feces improved by the Compo fermentation container technology had much higher Nitrogen (N), Phosphorus (P), and Potassium (K) than other organic fertilizers, which included goat feces, cattle manure, bagasse mixed with layer feces, and fertilizer. And when compared to the Azolla, the fresh plant giving high nutrients and dried goat feces, Phosphorus (P), and Potassium (K) had the value of nearly the layer feces when testing with the Compo fermentation container technology. While observing the Nitrogen (N) of the layer feces from the Compo fermentation container technology, the value of Nitrogen (N) was much higher when compared to every kind of organic fertilizer mentioned above.

The technology acceptance on perceived usefulness: the high efficiency of layer feces management helped the number of layer feces be less. The quality of fermented layer feces was better and could reuse. Its size was small and compact until it could save the installation space in a limited area, its materials were strong and durable, and the price was worthy compared to the system's effectiveness. For perceived ease of use: it was easy and convenient for use, easy maintenance and treatment, and safe operation. For the behavioral intention of use: it could deal with the problems and develop the layer feces really. The research result was concordant with Taesopapong (2019) study about the innovation model of wastewater management system by the distribution center that brought the wastewater to reuse in the community. It can conclude that a part of technology acceptance on perceived usefulness focuses on the effectiveness of wastewater treatment. The quality after the treatment could reuse, the material use was environmentally friendly, using a few spaces for installation, strong and durable, and the price was worthy compared to the system's effectiveness. Secondly, it helped save energy, and expenses

from maintenance and system running, including the beauty. For the perceived ease of use, there was the need for easy use, easy treatment, and safe operation, and for the operation requirement, the system operation was really satisfactory.

2. To study the marketing need of the layer feces

From the research of purchase and use needs of the layer feces users, to realize the requirements and behaviors of the purchase and use by using the 6W1H instrument to analyze and find the characteristics of the consumers' purchase and use needs: the most of the targets were male, age between 50-57 years old, the marital status was married, the educational level was lower than Bachelor's Degree level, upholding the gardeners and agriculturalists, had incomes more than 50,000 baht, and used the layer feces for more than six years. The result indicated that the consumers mostly wanted to buy genuine layer feces fine and dried powder form. Secondly, it was in pellet form with 25 kilograms and wanted to use for 180 baht per sack. The purpose of buying was to reduce the expenses on planting (cost reduction) the most. Most of them used the fertilizers with the gardening plants the most. The consumers mostly bought for themselves, secondly was the family members who helped make a decision. The consumers needed the product in the early years the most. Secondly was during the end of the year. The place for buying was from the egg hen farm the most. And the purchase characteristic was buying the layer feces the most at the average of 3-4 times per year and more than 10 tons per year.

3. To study the financial worthiness of investment in layer feces development

Net Present Value (NPV) is equal to 15,164,980 baht. Its value is positive and more than zero. It means that when investing in this project, it can give compensation. When calculating the present compensation value, the value is higher than the present one of the expenses that occurred all the time during the project. It generates profits. Therefore, the investment project is possible to invest in and is worth such investment. The Internal Rate of Return (IRR) equals 15%, which is higher than the discount rate of 8.4%. Hence, it should accept the project. The payback period is five years and five months within ten years of the determined project. It indicates that the project is worth investment. The study was concordant with the research result of Saranrom (2014) about the feasibility of the establishment of waste processing plant fuel: a case study in Nonthaburi Municipality, Nonthaburi Province. The project life is 15 years at a discount rate of 10%. The NPV equals 396.79 million baht, and the IRR is equal to 55.47%, with a payback period of 2.11k years. Besides, when the factors of waste quantity, price of waste fuel, and waste heating value change and reduce by 10%, it has a payback period of 2.63 years, and when the change increases 10%, the payback period equals 1.60 years.

4. To study the effect of technology in creating the values of layer feces

The study result of the technological impact in creating the layer feces value on the economic aspect gave a positive result for the egg hens entrepreneurs, the products reached the quality that increased the value of agricultural products, got more quantity and higher incomes. Besides, it helped save the expenses of employment. The trading market was broader, which helped increase the product selling. Furthermore, the production process at the stage of management and layer feces development was shorter, and the transportation and movement of the layer feces were easy and comfortable. For agriculturalists, the products reached quality and gave fruits consistently with higher quantity, reducing the cost to the farmers that helped them have increasing incomes. For negative impact; it had high capital in management technology and layer feces development that might cause debts. In addition, it did not generate employment and new jobs.

The result is concordant with The Institute for the Promotion of Teaching Science and Technology (IPST, 2019.). applying technology for performance helps the business be convenient, quick, and get profit more. Moreover, it reduced the human labor forces. The products had good quality directly, more relying on the consumers' needs. Good products can enhance productivity and reduce costs to the consumers.

For the environmental aspect: it revealed that there was no problem with the noise because the Compo fermentation container technology uses the automatic fermenting process in the closed system. The machine had the wind blowing within and had the fan stir slowly that not to make a loud noise. Furthermore, it did not cause wastewater because the Compo fermentation container technology did not have the waste management by water evacuation or grounds squeezing helps not to generate wastewater (Chubu Ecotec, 2022). For smell problems, the farm had much smell reduction. According to the interview of the egg hens users and people living around, it indicated in the same way that the odor decreased or still had but a little. When comparing the level of smell under the determination of the Pollution Control Department, it was at a level that could investigate the odor, or the concentration was at 11-20 OU, which did not cause annoying to human beings (Pollution Control Department, 2015). For worms and flies issues, since there was the management of fresh layer feces quantity in the coops reduced quickly day by day, there were no residues anymore. Hence, it helped eliminate worms and flies. When without flies, the dust problem was also less because the fly wing is one of the factors causing the dust. Without fresh feces in the coop, it enhances good results not to cause pollution, which includes carbon dioxide, carbon monoxide, ammonia, and dust, will be less (Pollution Control Department, 2011). Besides, it revealed that the dehydrated layer feces from the Compo fermentation container technology helped reduce the acid state of the soil. The soil was suitable for planting and had organic matter. It can observe from the earthworms around the soil surface. The silty soil could hold water appropriately. Also, it can see from the growth of plants that the soil has more nutrients (Land Development Department, 2010) and does not cause the chemical residues problems

Human and society aspect: for positive effect; the labor force was less, helped increase the operation effectiveness, work with more convenience, without new settlement, increased alternatives to the farmers from utilizer's use, felt safe when using the layer forces without chemicals. The result complies with (IPST, 2019.) which concludes that technology helps reduce the labor force and makes the operator work easily and conveniently. Besides, it helps manage and treat the wastes from the production process in the industrial sector. It enhances the products to reach qualitative and varied for the consumers to select more. While the negative effect, it affects the health by the symptom of nose burning and sore throat, including itchy skin and eyes a little from the process of dehydrated layer feces packaging and using them with the agricultural plants. It is because the products with layer feces are the essential materials from the Compo fermentation container technology, which was fine and dried powder, it can scatter easily that causes directly to the person who touches the layer feces (Chubu Ecotec, 2022).

Recommendations from the research result

1) The Compo fermentation container technology helps manage the problem of high quantity layer feces to decrease. Furthermore, it develops the layer feces to become a high-quality organic fertilizer. It is recommended to the egg hens entrepreneurs to turn to focus on and improve the fertilizer products to enhance the business to get more income;

2) From the study result of the layer feces need, the egg hens entrepreneurs should improve and develop the products to be varied, meeting the consumer's needs more. It includes improving the formula to be concordant with the plants' requirements, such as flowers or fruits acceleration formula, making fine and pellet forms for layer feces in various packaging. Moreover, it should promote during the time of product purchase and should have more channels of distribution, which include cooperatives group and distribution representatives;

3) The study result of investment worthiness on the Compo fermentation container technology indicates that there was a possibility to be worthy of investment. The egg hens entrepreneurs who are interested in the investment can decide to invest in this technology; and

4) The study result of the technology found that it affects health a little. The egg hens farm should suggest the preventive ways to the person who touches the layer feces directly by putting on the preventive equipment before operating or improve and adjust by making the pellet machine to the layer feces in the further stage.

Recommendations for the further research

1) Since the research is the study from a single egg hens farm, therefore, it should have the additional study from other farms regarding the technological selection for layer feces management;

2) It should study the technology which helps manage and develop the hen eggs apart from the Compo fermentation container technology elaborately in a part of the technological efficiency test;

3) It should study the factors of marketing mix affecting the purchase decision of the consumers toward the layer feces;

4) It should study the financial worthiness of investment and development of layer feces additionally in a part of other technological investments to compare the worthiness of investment in each technology;

5) It should study the effects of technology on other sample groups more, such as stakeholders or shareholders of the farm.

Funding: This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: All authors contributed to the conception and design of the study

References

- Aujirapongpan, S. (2004). *Cost Accounting* (2th ed.). McGraw Hill Higher Education.
- Chubu Ecotec. (2022, January 20). *Product Compo*. <http://www.ecotec-compo.com/product/index.html>
- Cooper, W. D., Morgan, R.G., Redman, A., & Smith, M. (2002), *Business Forum*. <https://scholar.google.com/citations?user=DYXNNncAAAAJ&hl=en>
- CRI-MAN. (2022, January 20). *Hygienizing Biocell Product*. <https://www.cri-man.com/products/hygienizing-biocell>.
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35(8), 982–1003.
- Jampee, N. (2014). *Effect of Organic Fertilizers and Azolla on Growth and Yield of San-Pah-Tawng 1 Rice Variety* [Master's thesis]. Maejo University. [In Thai]
- Khan, M.Y. (1999). *Theory & Problems in Financial Management*. McGraw Hill Higher Education.
- Kinoshita, S., & Kinoshita, Y. (2016). *The 6W1H Model as a Basis for Systems Assurance Argument*. In A, Skavhaug., J, Guiochet., E, Schoitsch., F, Bitsch. (eds.) *Computer Safety, Reliability and Security. SAFECOMP 2016. Lecture Notes in Computer Science*, vol 9923. Springer, Cham. https://doi.org/10.1007/978-3-319-45480-1_6
- Land Development Department. (2010, March 2). *Problematic Soil*. http://osl101.ddd.go.th/easysoils/s_problem2.htm. [In Thai]
- Ngampongsai, A., Kuprasert, S., Ngampongsai, W., Lawpetchara, A., Sresai, A., & Khachathong, S. (2010). *Use of Goat Feces as Organic Fertilizer in Chili Production*. Research report, Prince of Songkla University. [In Thai]
- Pollution Control Department. (2015, August). *Handbook of A Measuring Odour Concentration by Sensory Test*. https://www.pcd.go.th/wp-content/uploads/2020/05/pcdnew-2020-05-20_07-55-07_501188.pdf. [In Thai].
- Pollution Control Department. (2011, January). *Handbook of Odour Management in Poultry Farm*. <https://www.pcd.go.th/publication/4259> . [In Thai].
- Saranrom, K. (2014). *A Research in Possibility of Refuse Derived Fuel : A Case Study in Nonthaburi Municipality Nonthaburi Province* [Master's thesis]. Chulalongkorn University. [In Thai]
- Srisai, U. (2008). *Effect of Organic and Chemical Fertilizers Utilization on Rubber Growth and Yield in Tha-sae Soil Series*. Research report, Prince of Songkla University. [In Thai]
- Taesopapong, S. (2019). *Innovative Prototype of Decentralized Wastewater Management System with Water Reclamation for Community* [Doctoral dissertation] Chulalongkorn University. [In Thai]
- The Institute for the Promotion of Teaching Science and Technology. (2019). *Technology : Design and Technology*. Chulalongkorn University. [In Thai].