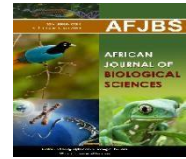


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Managing costs and returns of safe shrimp farming in Nakhon Pathom, Thailand

^[1] Kanokpatch Kopraserit, ^[2] Umawadee Detthamrong, ^[3] Jeeranun Khernkhan

^[1] Nakhon Pathom Rajabhat University, ^[2] College of Local Administration, Khon Kaen University,

^[3] King Mongkut's Institute of Technology Ladkrabang

^[1]kanokpatch@gmail.com, ^[2]umadet@kku.ac.th, ^[3]jeeranun33@gmail.com

Abstract— The objective of this research is to study the cost and return management of safe shrimp farming in Nakhon Pathom Province, Thailand. This research is used as a guideline for reducing the cost of raising giant freshwater prawns in clay ponds for shrimp farmers in Huai Muang Subdistrict, Kamphaeng Saen District, Nakhon Pathom Province, Thailand. Kamphaeng Saen District is the area with the most shrimp production for the market and shrimp farming is still the main occupation of farmers. The study revealed that 1. The payback period of the project is the period of time that makes shrimp farming safe and gives a return worth the investment, which is 2.02 years. 2. The payback period of the project that takes into account the present value when cash flows are calculated into the present value at the discount rate. A value of 7% is 2.48 years. 3. Net Present Value is 1,217,815 baht. 4. Benefit Cost Ratio is 1.82, which is greater than 1. Moreover, 5. the internal rate of return is 44.17%, indicating the ability of the funds to generate income from safe shrimp farming that is worth the investment.

Index Terms— costs and returns, safe shrimp farming, Nakhon Pathom

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I. INTRODUCTION

The world's food shortage crisis has been occurring for a long time, particularly in the globalization ages; the problems have caused changes in plantations way, from domestic plantations/crops to energy plantations in some areas, including natural disasters from the global climate changes. These phenomena significantly change the efficacies of food production and harvested outcomes, which directly affect the food insecurity caused by the world's population [1]. Thailand is one of the world's largest food hubs and an agricultural hub on the world scale because the geographical site is located in a tropical zone and compounded by ore deposit resources, air and water suitable for growth, whether plants or animals. These results in the fishery are widely popular for consumption and trade. Nonetheless, at present, fishery from natural sources is experiencing resource deterioration due to the natural sources have a significant decrease from the vast fishery farming. Additionally, the increasing world population also caused the high demand for food consumption. Therefore, aquaculture seems to be a

practical solution for increasing production to serve the high-demand food consumption and preserve natural resources. In this study, shrimp farming has been introduced to serve the demand, which is considered an important source of domestic consumption and generating income as an exported product from Thailand [2].

Thailand has been exporting agricultural products for ages, and it's generating huge trillions of income from global trade [3], especially the income from food products such as processed meat, seafood, processed aquatic animals, etc. Based on the export lists, shrimp products (except Lobster) are the first-ranked exported products from 2018 to 2022, which is approximately 169,584 tons (cost: 54,128 million baht). The five main targeted countries for shrimp products consisted of the United States (32.60%), Japan (24.44%), China (13.62%), South Korea (4.76%), Australia (3.82%) and other countries (20.76%) [4]. Table 1 presents Thai shrimp and products export volume in 2018-2022.

Table 1 Thai shrimp and products export volume in 2018-2022

Year	Volume (tons)	Value (Million Baht)	% Change of volume	% Change of value
2017	209,488	69,030		
2018	185,351	58,302	-11.52	-15.54
2019	176,481	51,722	-4.79	-11.29
2020	149,482	44,467	-15.30	-14.03
2021	153,275	48,286	+2.54	+10.84
2022	143,426	51,962	-6.43	+5.43
Average	169,584	54,128	-7.10	-4.92

Table 2 Quantity (tons) of marine shrimp production from MD and APD systems separated by shrimp type in 2017-2022

Year	White-vannamei	Black-tiger shrimp	Total	% Change		
				White-vannamei	Black-tiger shrimp	Total
2017	245,784.20	9,345.02	255,129.22			
2018	259,972.06	12,837.21	272,809.27	+5.77	+37.37	+6.93
2019	260,610.06	13,086.42	274,416.48	+0.25	+7.55	+0.59
2020	245,644.08	11,618.49	257,262.57	-5.74	-15.85	-6.25
2021	241,695.33	13,128.88	254,824.21	-1.61	+13.00	-0.95
2022	241,516.07	15,306.34	256,822.41	-0.07	+16.59	+0.78
Average	246,203.63	12,673.73	261,877.36	-0.28	+11.73	+0.22

Table 2 shows quantity of marine shrimp production from MD and APD systems separated by shrimp type in 2017-2022. The shrimp production situation from 2018 to 2022 indicated that the marine shrimp production (White-vannamei shrimp and Black-tiger shrimp) had an average production of approximately 261,877.36 tons, which consisting of an average White-vannamei shrimp production of 249,203.63 tons and an average Black-tiger shrimp production approximately 12,673.73 tons. Based on the production, the total shrimp production has increased by 0.22% compared with the past five years due to shrimp species, shrimp diseases, and climate change conditions causings declining in White-vannamei shrimp production. Nevertheless, with the high demand for shrimp consumption, the farmers tried to increase the production of Black-tiger shrimp in 2020. Unfortunately, the Covid-19 pandemic outbreak has affected shrimp farming with a number of

problems with product distribution channels, such as the Thai Market closing or flights to China having decreased, the high-cost transporting, container shortages, including labour shortages causing overall shrimp production in that period.

In general view, the production situation of shrimp production increased slightly, but White-vannamei shrimp production has decreased because shrimp farmers faced problems with shrimp diseases such as White Spot Disease (WSD), Early Mortality Syndrome (EMS), and White Feces Syndrome, which resulted in the shrimp grow slowly and eat a few foods. Other problems caused by climate changes and floods, which make shrimp farming difficult, and farmers face problems with the Yellow Head virus disease (YHD) in low salinity areas as well as unstable brood quality for fast-growing shrimp species. This causes the low-rate shrimp to survive and takes more time to farm. Based on the conditions, the farmer may face high production costs. However, the farmers who have good farm management can control production costs, although the costs of animal feed, electricity, fuel, and oil have increased. Figure 1 presents marine shrimp production in 2018-2022 (White-vannamei shrimp and Black-tiger shrimp)

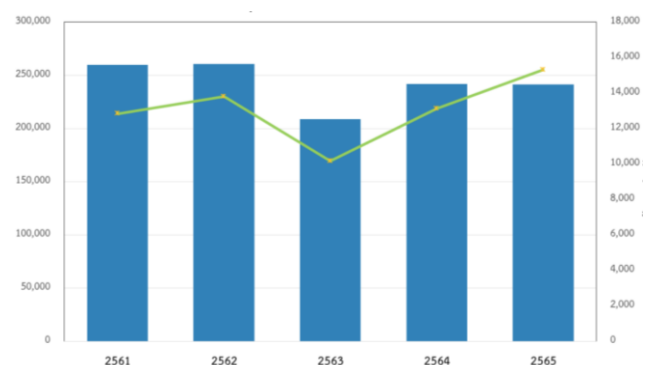


Figure 1 Marine shrimp production in 2018-2022 (White-vannamei shrimp (left) and Black-tiger shrimp (right))

From 2018-2022, the shrimp products price indicated that the White-vannamei shrimp from the farm has generally increased for all sizes. Due to the increase of Variable Electricity costs (FT) and shrimp feed, which has increased in line with the price of fish. However, due to economic factors and inflation, farmers still have to bear the cost of production factors such as energy, shrimp feed, and living

costs. These cause the farmers to have to adjust their farming management practices to reduce production costs more appropriately.

In Nakhon Pathom province, the various aspects of agriculture, including farming, livestock, and fishing, were primitively conducted. The people mostly engaged in the fishery area, totalling 90,153.14 Rais, including freshwater fish, giant shrimp, white shrimp, ornamental fish, crocodiles, and other aquatic animals. The 198 entrepreneurs consisted of traders, collectors or fish rafts, fishing ports or firms, importers, exporters, and products [5]. Traditional shrimp farming procedures in Asia were sustainable and had minimal environmental impact. Shrimp culture has become a capital-intensive industry with significant corporate investment, resulting in increased production and profitability [6].

Thus, Nakhon Pathom Province is an important source for safe shrimp farming in Thailand. Safe shrimp farming refers to shrimp farming with natural methods and raised in earthen ponds to reduce the use of chemicals in the farming process. In 2020, the safe shrimp sales value amounted to 82,352,180 million baht. Once the COVID-19 epidemic crisis occurred, the sales decreased due to the outbreak restriction and the closure of the market in the province [7]. In 2019, there were 603 shrimp farms, which have been certified with Good Aquaculture Practices (GAP) standards to certify the confidence of the consumer [8].

In 2021, due to the pandemic, shrimp farmers stopped farming and extended the time for catching shrimp, which affected the costs. The sales price decreased by 50 per cent from the original, including the people's lifestyles also changed from the pandemic. It can be seen that many related to the fishery resulted in a large amount of production, affecting the price and income of shrimp farming in Nakhon Pathom province, which is the highest amount of shrimp production, particularly in Kamphaeng Saen District, which people mainly conduct the shrimp farming for their income.

Additionally, it has also been found that there is an increase in shrimp farming, causing the price of shrimp to decrease in the future and may ignite the price risk as each type of shrimp is at different times. With these concerns, the researchers realized the importance of various problems, such as the relatively high cost per unit of shrimp varieties and the risk of loss of profit due to the constantly increasing price of shrimp

feed, which contrasts with the returns income. Therefore, the importance of cost reduction management to increase returns and result in shrimp farmers using would be a guideline for reducing the cost of shrimp farmers in Huai Muang Subdistrict, Kamphaeng Saen District, Nakhon Pathom Province since Kamphaeng Saen District is the most crowded the shrimp farming area.

II. RESEARCH OBJECTIVE

The study aimed to analyze the costs and returns of shrimp farming for shrimp farmers in Kamphaeng Saen District, Nakhon Pathom Province.

III. COST THEORITICAL FREMEWORK

Cost refers to the value of resources that can benefit the organization and is measured in monetary terms. Such costs can be separated according to behaviour into two types: 1) Variable Cost is a cost that changes in total amount directly proportional to the activity level or quantity of the cost driver, and 2) Fixed Cost is a cost that do not change in total costs and are based on changes in the activity over a period of time [9]. For some fixed costs from an allocation from the value of tangible assets, such as equipment depreciation, machine depreciation, vehicle depreciation, etc. As such, the depreciation occurs from systematically allocating the depreciable value of assets throughout their useful lives in accounting. The depreciation of tangible assets is the distribution of the cost of the asset as expenses in the various accounting periods that benefit from the asset in a correct and fair manner, which is calculated using the straight-line method from cost price less residual value divided by useful duration [10].

Return Theoretical Framework

Return refers to what the investor receives or what he receives from the investment, which may be property or various activities under conditions of uncertainty in the future, including accounting profits arising from total revenue minus all costs. The costs consist of costs used in production, including raw materials, labour, production expenses, and other operating expenses [11].

Investment Decision Theoretical Framework

The investment decisions may involve many investment options, and the investors must select investment projects that have the highest returns. In the selection of investment projects, the Investors consider the benefits or income

expected from the project to be greater than the costs or expenses expected to occur from the project, and the difference that occurs must be a high number to be considered [12]. The investment requires financial instruments as follows.

Payback Period (PB) is defined as the period of time in which the cash inflow from the project would be worth or exactly equal to the cash outflow for investment, which is calculated from the initial negative cash flow plus the cash inflows each year until the cumulative current returns to positive [13].

Internal Rate of Return (IRR) is defined from the discount rate in the cash inflows equal to the present value of the cash outflows to consider information regarding the required rate of return or capital cost rate compared to the rate of return received from the project. The Investors may select a project in which the return received from the project is greater than or equal to the desired return or cost of capital from financing [14].

Net Present Value (NPV) is defined as a technique used to evaluate investment projects using the concept of Discounted Cash Flows, where the net present value is equal to the difference of the total present value of the cash flows received from the investment [14].

Research Theoretical Framework

The study aimed to investigate the conditions, obstacles, and problems in shrimp farming as well as applying concepts, theories, and literature reviews related to costs and returns. The study employed cost analysis and returns analysis, including payback period, net present value and discounted rates of return for shrimp farming in Kamphaeng Saen District, Nakhon Pathom Province. After that, the data analysis was conducted to explore the ways to manage and reduce costs, as shown in the Figure 2.

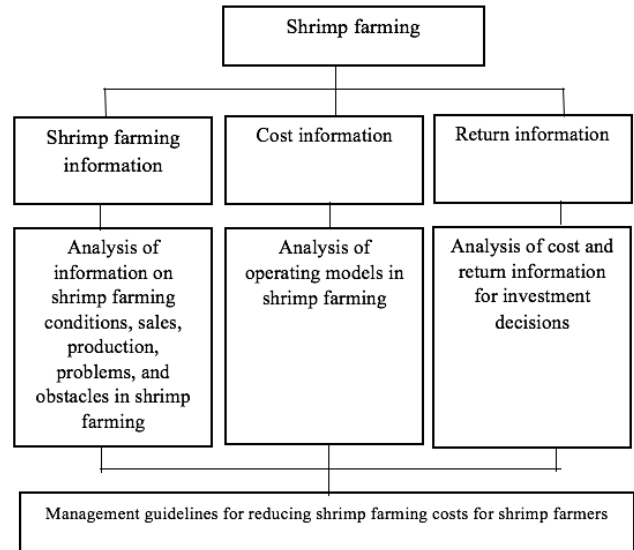


Figure 2 Research Theoretical Framework

Source: [15]

IV. RESEARCH METHODOLOGY

Population and Sampling

The population in the study is a group of safe shrimp farmers at Huai Muang Subdistrict, Kamphaeng Saen District, Nakhon Pathom Province, totalling 441 people. The samplings in this study were the key informants at Huai Muang Subdistrict, Kamphaeng Saen District, Nakhon Pathom Province, from the purposive sampling method for probability sampling. The selection criteria required the key informants to be farmers who mainly raise safe shrimp and have their own ponds. Once the sample group that met the key informant criteria was 15 people, the research collected data from the sampling until the theoretical saturation point was reached or referred to the inability to add any more critical content [16].

Research instrument

The research instrument employed open-ended interview questions regarding expenses related to the cost of and return for safe shrimp farming, and during the interviews, the audio was recorded for transcribing. Apart from the interviews, the secondary data was collected from various documents, textbooks, journals, and various related research for in-depth detail and categorized for an in-depth interview as a structured interview. After that, the trial interview was conducted to test data collection (Pre-test) to validate the common understanding of the questions used in communication with the sample group [16].

Data Collection

The data collection was carried out with observation and in-depth interviews with farmers who raised safe shrimp according to the specified criteria from June to November 2022.

Data Analysis

1. Data was taken from observation and interviews in the field study, which were recorded in notebooks, and transcribed data from audio recordings to be sorted, categorized, and summarized into the issues studied.

2. Examined data collected for accuracy and reliability by taking the summarized data back to the co-researcher or the informant to read or go back and ask the key informants again to reaffirm and provide the most accurate statement with the triangulation method [17]. For open-ended questions, the researcher employed group classification by coding the interview forms and organizing them into an analysis data file in the Excel program to get data into the number format on the types of costs, expense allocation, depreciation, income, and returns.

V. RESULTS

The analysis of costs and returns of investing in safe shrimp farming by interviewing farmers from 15 safe shrimp farmers in Nakhon Pathom Province. The details of average production costs can be classified as shown in the Table 3.

Investment expenses, an expense for purchasing non-current assets was included;

1. Water pumps and pumping pipes, the farmers use water pumps and pipes for pumping water from canals into shrimp ponds and pumping water out of ponds. When catching shrimp, the total of 3 machines and costed 40,000 baht, and lifespan 5 years.

2. Water beater to increase the amount of oxygen in the water. The farmer has 3 water beaters, costed 20,000 baht per each, and lifespan 5 years.

3. Lighting equipment (Light bulbs with equipment) for farmers to use for lighting up shrimp ponds, 4 sets, price 500 baht per set, lifespan 2 years.

4. Salinity meter, 1 unit, to control the salinity in the pond to be suitable for shrimp farming, costed 400 baht, lifespan 2 years.

5. A pH meter to control the pH in the pond to be suitable for shrimp farming, costed 400 baht, lifespan 2 years.

6. Feeding equipment, the farmers use 2 shoulder buckets for feeding, made from plastic, costed 200 baht per each, with a lifespan of 2 years.

7. Food mixing equipment, 1 set, price 500 baht, lifespan 2 years.

8. Fishing Net for checking, 2 sets, price 500 baht, lifespan 2 years.

9. Cars for carrying items and equipment used in shrimp farming, such as shrimp feed, carts, equipment, etc. The farmer has 2 vehicles for shrimp farming, priced at 300,000 baht each, lifespan 5 years.

10. Motorcycle For farmers to use throughout the area, 2 cars, price 40,000 baht each, lifespan 5 years.

11. Fishing Net for checking shrimp food made of stainless steel, 2 pieces, price 400 baht, lifespan 2 years.

12. Nets for sampling shrimp to see size and check general condition, 1 item, costed 900 baht, lifespan 4 years.

13. Digital scale for weighing shrimp to weigh accurately, 1 item, costed 1,000 baht per item, lifespan 5 years

14. Farmers' carts for pushing things such as feeding equipment, food, and small equipment, 1 item, costed 2,000 baht per vehicle, lifespan 5 years.

15. Storage equipment, costed 500 baht, lifespan 4 years.

16. Spoon net to scoop waste out of the pond, 1 piece, costed 200 baht, lifespan 2 years.

Table 3 Tools and Equipment for safe shrimp farming

Items	Quantity (unit)	Value per unit (Baht)	Total value (Baht)
Water pumps and pumping pipes	3	40,000	120,000
Water beater	3	20,000	60,000
Lighting equipment	4	500	2,000
Salinity meter	1	400	400
A pH meter	1	400	400
Feeding equipment	2	200	400
Food mixing equipment	1	500	500

Fishing Net for checking	2	500	1,000
Car	2	300,000	600,000
Motorcycle	2	40,000	80,000
Fishing Net	2	400	800
Nets	1	900	900
Digital scale	1	1,000	1,000
Farmers' carts	1	2,000	2,000
Storage equipment	1	500	500
Spoon net to scoop waste	1	200	200
Total			870,100

Table 4 The Assets Depreciation from Safe Shrimp Farming

Items	Total value (Baht)	lifespan (Year)	Depreciation per year (Baht)
Shrimp ponds	200,000	5	40,000
Water pumps and pumping pipes	120,000	5	24,000
Water beater	60,000	5	12,000
Lighting equipment	2,000	2	1,000
Salinity meter	400	2	200
A pH meter	400	2	200
Feeding equipment	400	2	200
Food mixing equipment	500	2	250
Fishing Net for checking	1,000	2	500
Car	600,000	5	120,000
Motorcycle	80,000	5	16,000
Fishing Net	800	2	400
Nets	900	4	225
Digital scale	1,000	5	200
Farmers' carts	2,000	5	400

Items	Total value (Baht)	lifespan (Year)	Depreciation per year (Baht)
Storage equipment	500	4	125
Spoon net to scoop waste	200	2	100
Total			215,800

Table 4 shows the depreciation of the assets at the end of 2022, which consists of depreciation of shrimp ponds 40,000 baht, water pumps and pipes 24,000 baht, water beaters 12,000 baht, lighting equipment 1,000 baht, meters, salinity 200 baht, A pH meter 200 baht, Feeding equipment 200 baht, Food mixing equipment 250 baht, Fishing Net 500 baht, Car 120,000 baht, Motorcycle 16,000 baht, Fishing Net check shrimp feed 400 baht, Net 255 baht, Digital scale 200 baht, Cart 400 baht, Store equipment 125 baht, and Spoon net to scoop the waste out of the pond 100 baht, the total annual depreciation 215,800 baht.

Table 5 Cost of digging a Shrimp Pond

Items	Area size per pond (Rais)	Number of ponds	Cost of improving the pond (Baht)
Shrimp Pond	3	4	200,000

Table 5 shows the cost of digging a shrimp pond. The average area size is 12 rais, with 4 ponds. The farmer has paid these expenses for improving and digging the ponds in the initial investment for about 5 years. After that it will be dug again to maintain the condition and size of the pond. The average cost of digging a well in the first year is 200,000 baht, with a lifespan of 5 years.

Cost of raising is an expense that must be paid for safe shrimp farming ready for sale, which consists of direct raw material costs, direct labour cost, and production costs.

Direct raw material costs consist of expenses related to shrimp breeding and shrimp feed costs. The source of the shrimp is varieties from private hatcheries and the Government Fisheries Department Hatchery.

Table 6 Direct raw material costs

Items	Cost for generation (Baht)	Cost for 4 generations (Baht)
Cost of shrimp	100,000	400,000
Cost of shrimp feed	40,000	160,000
Total	140,000	560,000

Table 6 shows a list of direct raw material costs for raising safe shrimp, which is approximately 140,000 baht over 1 year. Thus, for raising 4 generations of safe shrimp, a total of direct raw material would cost about 560,000 baht per year.

Direct labor cost is the cost of labour used in raising safe shrimp, and consists of

1. Domestic workers' wage is 10,000 baht per month (120,000 baht per year).

2. Temporary employees who are hired only while catching shrimp for sale. The wage for catching 16 people at a time is 200 baht per person, totalling 3,200 baht. The cost of cleaning shrimp is 2,400 baht. Total wages are 5,600 baht per production batch. If the farmers produce 3 batches per year, the total wages are 16,800 baht. As shown in Table 7.

Table 7 Direct labor costs

Items	In house labor (Baht)	Casual worker (Baht)	Total labor costs (Baht)
Direct labor costs	120,000	16,800	136,800
Total			136,800

Production costs

Production costs are indirect costs, which consist of lane removal costs, electricity costs, and fuel costs, as shown in the Table 8.

Table 8 Production Expenses List

Items	Costs per month (Baht)	Costs per year (Baht)
Lane removal costs	12,000	144,000
Electricity costs	3,000	36,000
Fuel costs	3,000	36,000
Total	18,000	216,000

The total monthly costs are 18,000 baht, which totals production expenses of 216,000 baht per year.

Table 9 Total production costs

Items	Costs per year (Baht)
Asset costs, Tools, and equipment	215,800
Direct raw material costs	560,000
Direct labour costs	136,800
Manufacturing overhead costs	216,000
Total	1,128,600

Table 9 shows the total cost of producing safe shrimp per year, including Asset costs, Tools, and equipment of 215,800 baht, direct raw material costs of 560,000 baht, direct labour costs of 136,800 baht, and manufacturing overhead costs of 216,000 baht, total production costs of 1,128,600 baht.

Table 10 Details of total production costs (Baht)

Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Shrimp ponds	200,000					
Tools, and equipment	870,100					
Total investment for the first year	1,070,100					
Direct raw material costs		560,000	588,000	617,400	648,270	680,683
Direct labour costs		136,800	143,640	150,822	153,363	166,281
Manufacturing overhead costs		216,000	226,800	238,140	250,047	262,549
Total production costs		912,800	958,440	1,006,362	1,056,680	1,109,514
Total project costs	1,070,100	912,800	958,440	1,006,362	1,056,680	1,109,514

Table 10 shows detailed estimates of total production costs from 1-5 years by operating expenses, which increase by 5% per year.

The return on investment in shrimp farming is safe.

Farmers who raise safe shrimp would earn income from selling safe shrimp with a middleman. The average price is 150 baht per kilogram; the average production is 800 kilograms per pond, totalling 4 ponds, representing a total production of 3,200 kilograms per lot. When calculated as an income of 480,000 baht per generation, the annual income would be 1,440,000 baht. Once deducted from the annual production cost of 1,128,600 baht, safe shrimp farmers will have a net profit of 311,400 baht annually.

Table 11 The total income from safe shrimp farming from 1-5 years

Year	Total income from safe shrimp farming (Baht)
1	1,440,000
2	1,512,000
3	1,587,600
4	1,666,980
5	1,750,329

Table 11 shows the estimated total income from safe shrimp farming from 1-5 years from selling safe shrimp, which increases by 5% per year

Table 12 Cash Flow Projection

Items	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cash inflow	0	1,440,000	1,512,000	1,587,600	1,666,980	1,750,329
Less expenses	870,100	912,800	958,440	1,006,362	1,056,680	1,109,514
Less depreciation	0	215,800	215,800	215,800	215,800	215,800
Operating Profit	-870,100	311,400	337,760	365,438	394,500	425,015
Plus depreciation	0	215,800	215,800	215,800	215,800	215,800
Less cash paid from investments	200,000	0	0	0	0	0
Total cash inflow	-1,070,100	527,200	553,560	581,238	610,300	640,815
Present value of total income	0	1,345,794	1,320,639	1,295,955	1,271,731	1,247,960
Present value of total costs	1,070,100	853,084	837,139	821,491	806,136	791,068
Present value of cash flows	-1,070,100	492,710	483,501	474,463	465,595	456,892

Table 12 shows the estimated cash flow of safe shrimp farming at a discount rate of 7%

Table 13 Analysis of net present value at a discount rate of 7%

Year	Present value of total income	Present value of total costs	Net Present value
0	0	1,070,100	-1,070,100
1	1,345,794	853,084	492,710
2	1,320,639	837,139	483,501
3	1,295,955	821,491	474,463
4	1,271,731	806,136	465,595
5	1,247,960	791,068	456,892
	6,482,079	4,308,918	1,303,061

Table 13 shows the results of the present value analysis at a discount rate of 7% (based on the average commercial bank loan interest rate). The table indicated that the present value of total revenue is 6,482,079 baht, the present value of total costs is 4,308,918 baht, and the net present value is 1,303,061 baht.

Table 14 Analysis of costs and returns from investment

Analysis of costs and returns from investment	Results
The Payback Period (PB)	2.02 years
The Discounted Payback Period (DPB)	2.48 years
Net Present Value (NPV)	1,217,815 Baht
Benefit Cost Ratio (B/C Ratio)	1.82
The Internal Rate of Return (IRR)	44.17%

From Table 14 indicates that safe shrimp farming in Nakhon Pathom Province has economically feasible and appropriate for investment as follows:

1. The Payback Period (PB) is the period of time that makes shrimp farming safe and gives a return worth the investment, which is 2.02 years.

2. The Discounted Payback Period (DPB) is the period of time that makes shrimp farming safe and gives a return worth the investment when cash flows are calculated into the present value at the discount rate, which value 7% or 2.48 years.

3. Net Present Value is equal to 1,217,815 baht, which is greater than zero. This means that the sum of the present value of the project's net returns is positive. It shows that this safe shrimp farming project will provide a return that is worth the investment and is an interesting project.

4. Benefit Cost Ratio: /C Ratio is equal to 1.82, which is greater than 1, meaning that this safe shrimp farming project provides a return of 1.82 times when compared to the money invested.

5. The Internal Rate of Return (IRR) is equal to 44.17%, indicating the ability of the funds to generate income from safe shrimp farming that is worth the investment. The calculated IRR is higher than the average commercial bank loan interest rate of 7.00 percent, meaning that this safe shrimp farming project is an interesting project and is worth for investment.

VI. CONCLUSION AND DISCUSSION

In the analysis of the costs and returns of safe shrimp farming in Nakhon Pathom Province study. The criteria for the entrepreneur who owns the shrimp farm must have a soil pond and reduces the use of chemicals in the farming process, as well as the discount rate, was set at 7.00 percent per year. The study indicated that safe shrimp farming had a payback period of the project (PB) of 2.02 years and took a discounted payback period (DPB) of 2.48 years. The net present value (NPV) is equal to 1,217,815 baht, the cost-benefit ratio (B/C Ratio) is equal to 1.82, and the project internal rate of return (IRR) is equal to 44.17%. This can be seen that the NPV is positive, which means when farmers invest, they have the capacity to return to investors. When calculated at present value, it's higher than the present value of expenses incurred over the life of the project. Therefore, for farmers who invest in shrimp farming, the cost-benefit ratio is greater than one and the rate of return within the project is higher than the discount rate, which reflects the worthiness of the investment.

Suggestions

The farmers who raise safe shrimp should maintain equipment that can be used for many farming cycles. This would reduce fixed costs, and the highest variable costs in raising safe shrimp are shrimp breeding and shrimp feed costs. When there is an error in checking the amount of food, the shrimp fed in each meal should be controlled appropriately. This would help to ensure that there is no shrimp food left or left in the pond at the bottom of the pond, which causes the water in the pond to be polluted faster. In addition, dying shrimp during farming would cause higher costs than normal and result in the risk of loss. Therefore, the farmer should pay attention to reducing production costs in shrimp farming in both direct raw materials, direct labour costs and production costs to increase profits for farmers and be able to continue their safe shrimp farming business in a stable manner.

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