THE DIFFERENT COST AND RETURN OF CRICKET FARMING TYPES: THE CENTRAL REGION OF THAILAND EVIDENCE

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Abstract

This independent study aims to conduct comparative study between individual cricket farm and cricket network farm members in terms of initiation cost of cricket farming, including production cost, operating costs and total cost per unit. Additionally, the return of cricket farms are compared in term of return on investment (ROI), net present value (NPV) and internal rate of return (IRR). For this independent study, data were collected thorough in depth-interviews and observation of two cricket farmers in the central region of Thailand, including a small individual cricket farm and a cricket network farm member. The contents from interviews consisted of cricket farming process, production costs, operating costs, and selling methods. The major findings were that the cricket farm member had lower both initial investment and production cost due to gaining support from its parent farm; in addition, the commitment of the cricket farm member to sell raw crickets to parent farm 80% of production at $90 baht per kilogram, resulting to lower incomes than the individual farm. The breakeven points per a production cycle (2 months) were 78.46 kilograms for individual farm and 119.62 kilograms for network farm. Thus, the return as ROI, NPV and IRR of individual farm were higher than cricket network farm member. Research results pointed out that a key factor effects on cricket farms' return was the selling price.

Keywords: Crickets, Cost, Return, Cricket Farming, Net Present Value, Internal Rate of Return

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Introduction

Presently, it is clear that world population increase significantly to approximately 7,000 million; concurrently, the global warming makes the iceberg melts. This phenomenon affects the land shortage and the global warming itself make crop disaster and finally the shortage of foods for world population in the near future. This situation might lead to poverty in many countries, especially developing countries, such as Cameroon, Zimbabwe and Ethiopia. To solve the problem of the future world food shortage, the Food and Agriculture Organization of the United Nations (FAO), a special unit of the United Nation, announces that edible insect species is an environmentally sustainable solution to current and future food crises.

The FAO report indicated that people consume more than 1,900 insect species. The most popular edible insects has been beetles at approximately 31 percent of world edible insects species. The next is caterpillars at 18 percent. Furthermore, some research stated that insects are protein-rich food, which are readily available source of nutritious. Additionally, the FAO recommended alternative solutions to conventional livestock to feed and pointed out that the consumption of insects contributes positively to the environment, health and livelihood of populations. However, the biggest obstacle to promote insects as a viable source of protein is the consumer acceptance.

In Thailand, edible insects have been popular among people in the north-east region for a long period because this area has been rainless and low quality of lands for agriculture, leading to quite low agricultural products. Thus, people in this area encounter more poverty than other regions. To solve the famine of people in this area, they consume edible insects, such as silkworms, honeypot-ants, grasshopper and agave worms similar to many low and middle income regions of the world. At present, these popular dishes have been move to other regions of Thailand, especially Bangkok metropolitan and its vicinity.

Cricket farming in Thailand was initially started in 1998 with 22,340 cricket farmers (Hanboonsong et al., 2013). Since then, the number of farmers was approximately 20,000 in 2011. Cricket production in Thailand was approximately 6,523 tons in 2006, and increased to 7,500 tons in the last five years despite the slight reduction in farmers (Na Ayudtaya, 2011). Additionally, the cricket farming has developed into cricket farming network, meaning that a parent farm is a center to support farm members in term of cricket eggs, cricket food supplies with low price; in addition to give advice about cricket production process and etc. Therefore, researchers have a research question in mind that “Do the cost and return of the individual cricket farms differ from the network farm member?”. Thus, researchers conducted the study to respond the research question, which aim to conduct a comparative study of the individual cricket farm and the cricket network farm members in the central region of Thailand:

i) to investigate the initial cost of cricket farming, ii) to examine production cost, operating cost and cost per unit, iii) to conduct breakeven point and iv) to examine return on investment (ROI), net present value (NPV) and internal rate of return (IRR).

Literature Review

This section is divided into four major sections: 1) Cricket and Thai cricket farming 2) Types of costs 3) Cash flow estimation and 4) Financial tools analysis. Each subsection is discussed below.

2.1 Cricket and Thai cricket farming

Crickets are medium to large insects, which vary in length from 3 to 50 mm (0.12 to 2 inches). They have long shoulders, thin antennae, three-jointed tarsal (foot) segments, and two slender abdominal sensory appendages (called cerci). Their strong hind legs are for jumping and the two long membranous hind wings are used in flying. Males can sound from the friction of the front wing. Wives has spawning organs like needles (Kelly, 2016). They usually live naturally throughout the tropics, such as forests, grasslands and in the desert.

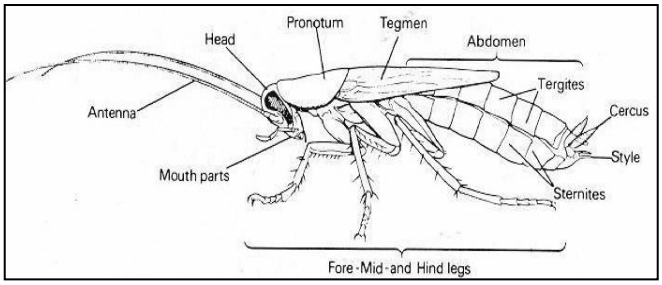

Figure 1 Characteris tics of cricket

Source: http://www.nawandihalabja.com

Life cycle of cricket normally takes two months long, from cricket egg, then grow up to nymph and finally fully grow to be adult cricket as shown in Figure 2 below.

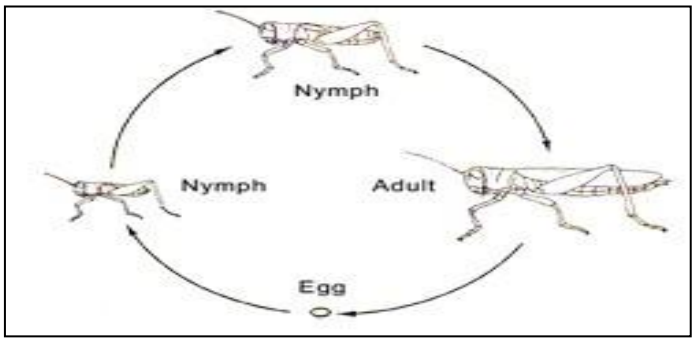

Figure 2 Characteris tics of cricket

Source: https://www.google.com/search

In Thailand, cricket farmers prefer rearing two species of crickets: house crickets (Acheta domesticus) and two-spotted crickets (Gryllus bimaculatus) (Hanboonsong et al., 2013). Normally, production systems are small scale in nature with limited inputs; which are likely to be household cricket farming (Durst and Hanboonsong, 2015) and are easy to implement and maintain (Halloran et al., 2017). Thereafter, cricket farming has developed from household farming into cricket farming network. This reflects the high demand of crickets. The cricket farming network performs in terms of one parent farm connecting with their member farms by selling low price of cricket eggs and foods, consulting cricket production process and finally buying back adult crickets. The system of cricket farming network is shown in Figure 3 below.

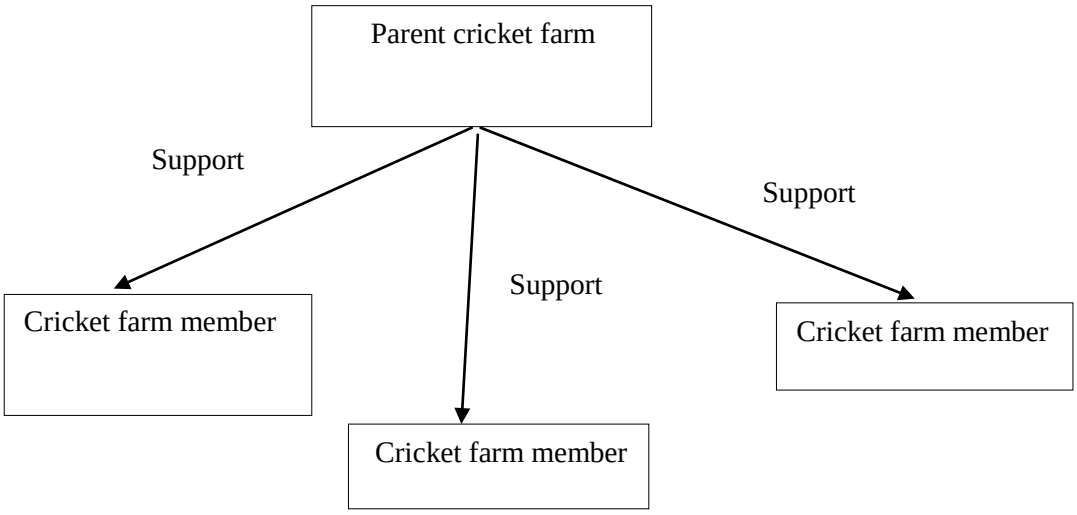

Figure 3 Cricket farming network

Cricket farming is intended to be a source of protein for consumption because of its high nutritional value and also used as raw materials for animal feeds because of its low cost and high protein content. For the last four years, Thailand transformed crickets into many types of food products. For example, snacks are produced in a variety taste, such as tum yum for Thai Style and wasabi for Japanese style. Furthermore, Cricket protein flour for making cakes or cookies is developed and export to China and European region, which gain a high positive respond from consumers. As a result, entrepreneurs of cricket farming collaborates to request the regulation of the good cricket farming practice from National Bureau of Agricultural Commodity and Food Standards in order to upgrade to high quality standard of cricket farming, because European customers need the certificate of high quality standard of cricket farming from international organization for standardization to ensure in the quality of cricket products (National Bureau of Agricultural Commodity and Food Standards, 2006).

2.2 Types of costs

Normally, cost or expense means the amount of cash that a company must pay to get goods or services. Cost can be classified to 3 major types of costs: 1) the product component of finished goods, 2) cost for related department and 3) cost behavior. The details of each criterion are explained below.

2.2.1) the product component of finished goods: Normally, the finished goods usually contain 4 types of cost as following:

1) Direct material: Cost of direct material is the core cost or principal cost of materials for producing finished goods. For example, clothes are direct material for human beings' dresses. The other example is that the cost of gold bar is a core cost of golden ring.

2) Direct labor: Direct labor means the core labor cost for producing finished goods in each stage of production. For examples, for dressmaking, the direct labor costs include the salary of designers and the wages of tailors.

3) Overhead cost: Overhead cost means all production costs, but exclude direct materials and direct labor, such as utility, electricity, rent, depreciation, insurance and tax.

2.2.2) Cost for related department: This criterion focuses on the cost occurrence depending on department activities. For example, sale commission belongs to marketing department because the major duty of marketing department is to stimulate customers to buy the firm's finished goods. However, some costs can exist in each department, such as salary and wage.

2.2.3) Cost behavior: This criterion focuses on the behavior of cost, which is divided into 3 types: fixed cost, variable cost (Nilapornkul, 2016) and mixed cost. The details of each type of cost are explained as follows.

1) Fixed cost or periodic cost: Fixed cost means the expense that quite remains the same amount or unchanged irrespective of the output level or sales revenue, such as salaries, office rent, depreciation and insurance. In reality, no cost is a purely fixed cost; therefore, time bound must takes account for fixed cost, such as one month, one quarter and one year.

2) Variable cost: Variable cost means the expenses that fluctuate proportionally with the quantity of products. Variable costs usually directly depend on the production volume, such as materials, labor and sales commissions.

3) Mixed cost: Mixed cost means the expense that has attributes of both fixed and variable costs. This means that it will vary on the amount of outputs; concurrently, it contains a specific amount of expenses in spite of no output. Thus, mixed cost changes with the volume of production like variable cost and included specific amount of cost without product volume like fixed cost. The examples of mixed costs are utility cost and home phone cost.

2.3 Cash flow estimation

Normally, there are two types of cash flow estimations for every business: a cash outflow and cash inflows. It is necessary to estimate both cash flows because of being major factors directly impacting on firms' returns. Estimation of the net cash flow of an investment project should cover the following procedures:

Step 1: Determination an Initial investment

Initial investment or start-up cost is the net cash outflows at the point of starting the business. It refers to the sum of all cash outflows and cash inflows occurring at that period. Net investment refers to the amount cash spending for the acquisition of fixed asset, which includes all expenses related to that fixed asset, such as freight, installation charges, custom duty etc. Generally, there are 4 components of initial investment: 1) all costs of new fixed asset, 2) sale of the old fixed assets, 3 the effect of tax depending on profit or loss of the old fixed assets and 4) the increase of networking capital. However, it is not fully necessary combination, depending on circumstance.

Step 2: Determination of annual net cash inflow after tax

It is the second step to estimate net cash inflow during the life of the project. This stage employs the basis of accounting concept, however, at last the earnings after tax have to transform to cash earnings after by plus the non-cash operating cost, such as depreciation.

Step 3: Determination of terminal value

Finally, the terminal value includes the salvage value of the new assets and the refunding of working capital. Normally, terminal value occurs at the last year of project. However, it is probably no internal value depending on circumstance.

2.4 Financial analysis tools

There are many financial tools for analyses firms' returns, both in accounting concept, such as gross profit margin, net profit margin, breakeven point analysis and return on investment; and in financial concepts, such as, net present value, payback period and internal rate of return. The details of each analysis tools are described below.

2.4.1. Accounting concept

Return analysis based on accounting concept focuses on accounting data; as a result, the analysis tools employs firms' financial reports to analyses firm's profitability, including gross profit margin, net profit margin, return on investment and breakeven point analysis (Besley and Brigham, 2008). The details of each tool are presented in Table 1 below.

Table 1 The formulas of gross profit margin, net profit margin, return on investment

Ratio	Formula
1.1 Gross profit margin	Gross profit / Sales
1.2. Net profit margin	Net profit / Sales
1.3. Return on investment	Net profit / Investment

Breakeven point analysis is a useful tool to study the relation among fixed costs, variable costs and revenue. The result of sale quality is the sale volumes that make total revenue equals to total cost or it can be called breakeven point (Q_{BE} as a symbol) (Eujirapongpan, 2009)

Q_{BE} = Fixed cost / (Selling price per unit – Variable cost per unit)……(1)

As a result, when a firm has a sale quantity higher than Q_{BE}, it means the firm gains profits; on the contrary, when a firm has a sale quantity lower than Q_{BE}, it means the firm gets loss. The point at Q_{BE} reflects that firm's revenue equals to total costs or zero profit.

2.4.2. Financial concept

Return analysis based on financial concept focuses on cash flows from firm activities. Thus, a firm has to estimate cash flows or employs accounting data and transforms them to cash basis. The four financial tools are payback period, net present value, profitability index and internal rate of return (Nilapornkul, 2016). The details of each tool are explained as follows.

1) Payback period (PB)

This method evaluates time period of generating net operating cash flows to cover initial investment. The criterion for decision is that PB should be less than expectation or the project's life.

2) Net present value (NPV)

This method is very popular among scholars. The concept of NPV is the different of the present value of cash inflows and the present value of net initial investment. Thus, formula can be formulated as below.

NPV = Present value of net cash inflows - Present value of net initial investment…..(2)

From the equation, when the result shows the positive sign, meaning that the firm gains profits. On the contrary, if the result shows the negative sign, meaning that the firm gets loss. Thus the criterion for selection is that NPV should be positive.

3) Profitability index (PI)

A profitability index attempts to identify the relationship between the costs and benefits of a proposed project. The profitability index is calculated by dividing the present value of the project's future cash flows by the present value of initial investment.

$$PI = \frac{\text{The present value of net cash inflows}}{\text{The present value of initial investment}}$$

If PI is greater than 1.0, it means the firm's profit; on the other hand, when PI is lower than 1.0, it means the firm's loss.

4) Internal rate of return (IRR)

The IRR is the method which is used to evaluate how much a business is attractive and worthy of investment. It is the interest rate which is considered when the NPV of the cash flows of the investment becomes equal to zero. This techniques are used for capital budgeting and are very successful in short term planning of investment. Thus, we can formulate the formulae below.

$$\text{The present value of net cash inflows} = \text{The present value of initial investment}$$

$$\sum \text{net cash inflows}(PVIF_{i,n}) = \text{initial investment}$$

Then, the equation is resolved to find out i, reflecting the IRR or the rate of return of the project. The summary of the decision criteria of each financial tools are presented in Table 2 as follows.

Table 2 The summary of the decision criteria of each financial tool

Financial tools	Decision criteria
1) Payback Period: PB	Less than project's life or expectation
2) Net Present Value: NPV	Positive sign
3) Profitability Index: PI	More than 1
4) Internal Rate of Return: IRR	Exceed cost of capital or at least equal to the required return

Data and Methodology

The study "The Different Cost and Return of Cricket Farming Types: The Central Region of Thailand Evidence" was conducted in qualitative research. This section aims to present research methodology by performing in four subsections: population and sample; research tools, data collection and analysis tools. Each subsection is described as below.

3.1 Population and sample

Population was the cricket farmers in the central region of Thailand. The two samples were selected based on voluntary basis to disclosure their business information, including cricket farming

process, sales methods, initial investment, production cost, operating cost, etc.

3.2 Research tools

The study is qualitative research to compare cost and return of two types of cricket farming: individual cricket farm and cricket network farm member. Thus, researchers used two major tools for data collection: in-depth interview and observations. The details of each tool are presented below.

1) In-depth interview

In-depth interview means one-on-one interviews, which are the most commonly used as qualitative research method (Isurus Market Research and Consulting, 2016). Researchers employed semi-structured interview, meaning that the addressed questions hidden in general questions to bring about friendly atmosphere during the interview. The major data obtained from the interview were classified into 3 main parts: general information of cricket famers and cricket farms, initial investments and all costs and 3) sale type including sales price.

2) Observations

Observation is a qualitative research method where researchers gather data by observing people's behavior or events in their natural setting (Isurus Market Research and Consulting, 2016). Thus, researchers made appointments to the two samples to interview at their cricket farms to collect data by both interview and observations. Additionally, researchers used the overt observation, which everyone knows they were being observed and requested permission to record the interviews.

3.3 Data collection

Researchers employed two sources of data: Primary data and Secondary Data. The details of each data are presented below.

1) Primary Data: The researchers collected data from in-depth interviews and observations of both farmers.
2) Secondary data: The researchers study from academic text, published journals and website related with cricket farming.

3.4 Data analysis

The tool for data analysis is Microsoft Excel for evaluating production cost, operating cost, cost per units, breakeven point, return on investment, net present value and internal rate of return.

Research Results

This section presents the results of two cricket farms. Researchers started with the cost analysis including the farm structure (building and equipment usage), production cost and operating cost. Then income analysis is presented and followed by financial tools analysis.

4.1 Cost analysis

The individual cricket farm owner started with studying the cricket production process from the internet, books and other cricket farms. He uses the old building with 49 square meter (width 7 x length 7 meters) in size for cricket production. The old building has steel structures with insulation and water system for cleaning. He uses four square concrete ponds with 2.592 cubic meters (width 2.4 x length 1.2 x height 0.9 meters) each and eight round concrete ponds with 0.314 cubic meters (¶ x radius 0.5^2 x height 0.4 meters) each. Each pond covers with a net to protect crickets from various natural enemies. He uses paper panel egg for cricket hiding at the time of molting, including food tray and water tray in

each pond. Normally, common weeds can be used to make crickets feel no stress. The individual farm produced adult cricket around 156 kilograms per 1 production cycle (2-month length).

While the network farm members have to sell the 80% of the products to the parent farm, parent farm fully support and give advice to farming network members. The farm member owner constructed a small building with size 28 square meter (width 4 x length 7 meters) and installed 2 eco-lights. He uses eight square concrete ponds with 2.592 cubic meters (width 2.4 x length 1.2 x height 0.9 meters) each. Normally, his farm produces products approximately 168 kilograms per 1 production cycle (production process takes 2 months). The initial costs of two cricket farms and the cost per 1 production cycle are presented as shown in Table 3.

Table 3 The initial costs of two cricket farms and the cost per 1 production cycle

Items	Amount	Baht/ unit	Total (Baht)	Lifetime (year)	Fixed production Cost/1 production cycle (Baht)
Individual farm					
Building	1 unit	50,000	50,000	20	416.67
Square concrete pound	4 units	2,000	8,000	5	266.67
Round concrete pound	8 units	3	2,400	10	40.00
	Initial investment		60,400		723.34
Network farm member					
Building	1 unit	20,000	20,000	20	166.67
Square concrete pound	8 units	8	6,400	5	213.33
Light bulb	2 bulbs	2	500	5	16.67
Total	Initial investment		26,900		396.67

Source: compiled by author

Then, variable production costs and operating costs of both farms are presented in Table 4 and the results of cost analysis are shown in Table 5 as follows.

Table 4 The variable production costs and operating cost of both farms

	Individual farm			**Network farm member**		
	Amount	Baht/unit	Cost / 1 production cycle (baht)	Amount	Baht/unit	Cost / 1 production cycle (baht)
Variable production cost						
Cricket eggs	56 units	50	2,800.00	32 units	50	1,600.00
Concentrated food	10 sacks	450	4,500.00	12 sacks	380	4,560.00
Paper panel egg	160 panel	1.5	240.00	370 panel	1.5	555.00
Fibrous husk	1 sacks	70	70.00	1 sacks	70	70.00
Food tray				80 tray	10	80.00
Total			7,610.00			6,865.00
Fixed operating cost						
Utility	2 months	200	400.00	2 months	200	400.00
Cooking oil	2 bottles	100	200.00			
Labor cost	60 days	100*	6,000.00	60 days	100*	6,000.00
Total			6,600.00			6,400.00
* Assumption working only 3 hours a day						

Source: compiled by author

Table 5 the result of cost analysis

	Individual	**Network farm member**
1.Fixed production cost (Baht)	723.34	396.67
2.Variable production cost (Baht)	7,610.00	6,865.00
3.Total production cost (Baht)	8,333.34	7,261.67
4.Fixed Operating cost (Baht)	6,600.00	6,400.00
5.Total cost (Baht)	14,933.34	13,661.67
6.A number of products (Kilogram)	156	168
7.Total cost per unit (Baht / kilogram)	95.73	81.32

4.2 Income analysis

As mentioned above, the production quantity was of 156 kilograms per 1 production cycle for individual farm. In regard to adult cricket selling, the farm owner normally sells both raw crickets and fried

crickets at 120 baht per kilogram and 350 baht for kilogram respectively. His marketing is viral marketing on his private Facebook account and He plans to move to online marketing in the

future. He said that the major problem of cricket production is the unknown cause of cricket death. This can be prevented only by dropping the drugs in water. The cricket farm owner pointed out that cricket farming in Thailand will gradually grow because of high demand of cricket products from overseas.

For cricket network members, the marketing strategy relies on farming network; therefore, they have to sell goods to parent farm at 80% of production, for 90 baht per 1 kilogram and the remaining goods can be sold at retail price of 120 baht per 1 kilogram. The total incomes of both cricket farms are presented in Table 6 as follows.

Table 6 Total income of both cricket farms

	Individual farm			**Network farm member**		
Type of sale	Amount (Kilogram)	Sale price/unit	Total revenue	Amount (Kilogram)	Sale price/ unit	Total revenue
Raw cricket	141	120	16,920.00	4	120	5,160
Fried cricket	15	350	5,250.00			
Sell to parent				1	90	11,250
Total incomes	156		22,170.00	1		16,410

4.3 Financial tools analysis

To respond to the objectives of the study, the accounting concept is used to calculate the return on investment (ROI) and breakeven point as shown in Table 7 below.

Table 7 Return on investment and breakeven point of both farms

	Individual	**Network farm member**
1. Total income (Baht)	22,170.00	16,140.00
2. Total cost (Baht)	14,933.34	13,661.67
3. Initial investment (Baht)	60,400	26,900
4. ROI (percentage per 2 months)	11.98%	10.22%
5. Total fixed cost (Baht)	7,323.34	6,796.67
6. Average selling price per kilogram	142.12	97.68
7. Variable cost per kilogram (2/6)	48.78	40.86
8. Breakeven point (kilogram)	78.46	119.62

Then financial concept is employed to calculate net present value (NPV) and internal rate of return (IRR). Thus, researchers have to forecast cash flows for the whole project within 2 assumptions: the project life equals to the lifetime of the building, and the minimum required return equals to interest rate of fixed deposit, approximately 2% per year, representing opportunity cost.

The initial investments, operating cash flow and terminal value of both farms are presented in Table 8, and the calculation of NPV and IRR are presented in Table 9 as follows.

Table 8 The initial investments, operating cash flow and terminal value of both farms

Items	Individual farm	Network farm member
Initial investment (plus net working capital = variable cost + operating cost) (baht)	= 60,400+7,610.00+6,600 = 74,610	= 26,900+6,865+6,400 = 40,165
Operating cash flows (baht)	= (22,170.00-14,933.34)+723.34 = 7,960 baht / 1 production cycle or 47,760 baht per year	= (16,140.00-13,661.67)+396.67 = 2,875 baht / 1 production or 17,250 baht per year.
Terminal value = working capital (baht)	= 7,610.00+6,600 = 14,210	= 6,865+6,400 =13,265

Table 9 The calculation of NPV and IRR

Year	Net cash inflows	Net cash outflows	Net cash flows	Net cash inflows	Net cash outflows	Net cash flows
0		-74,610	-74,610		-40,165	-40,165
1	47,760		47,760	17,250		17,250
2	47,760		47,760	17,250		17,250
3	47,760		47,760	17,250		17,250
4	47,760		47,760	17,250		17,250
5	47,760	-8,000	39,760	17,250	-6,900	10,350
6	47,760		47,760	17,250		17,250
7	47,760		47,760	17,250		17,250
8	47,760		47,760	17,250		17,250
9	47,760		47,760	17,250		17,250
10	47,760	-10,400	37,360	17,250	-6,900	10,350
11	47,760		47,760	17,250		17,250
12	47,760		47,760	17,250		17,250
13	47,760		47,760	17,250		17,250
14	47,760		47,760	17,250		17,250
15	47,760	-8,000	39,760	17,250	-6,900	10,350
16	47,760	47,760	17,250	17,250	16	47,760
17	47,760	47,760	17,250	17,250	17	47,760
18	47,760	47,760	17,250	17,250	18	47,760
19	47,760	47,760	17,250	17,250	19	47,760
20	61,970	61,970	30,515	30,515	20	61,970
IRR		63.36%		41.40%	IRR	
NPV		694,175.79		233,787.44	NPV	

Discussion and Conclusions

The study focuses on the different cost and return of individual cricket farm and cricket farm network members in the region of Thailand. Researchers employed qualitative research by in-depth interview and observations for 2 cricket sample farms. The two cricket farms are quite different in sales distribution. The individual farm did the business in small size and run his business without assistance from anyone; whereas, the network farm ran his business with full support from parent company. The similar and the different from the both cricket farms are presented in Table 10 as follows.

Table 10 Total financial analysis of both farms

	The first	**The second farm**
1. A number of products (Kilogram)	156	168
2. Total cost per unit (Baht / kilogram)	95.73	81.32
3. Initial investment (Baht)	60,400	26,900
4. Return on investment: ROI (% per 2 months)	11.98%	10.22%
5. Average selling price per kilogram	142.12	97.68
6. Breakeven point (kilogram)	78.46	119.62
7. Internal rate of return: IRR	63.36%	41.40%
8. Net present value: NPV (baht)	694,175.79	233,787.44

Table 10 shows that the individual farm produced lower quantity of crickets and total cost per unit was higher than the network farm member. However, its ROI, NPV and IRR were higher than the network farm member. This is because the network farm member had to sell 80% of production to parent cricket farming network with a low price as a commitment. This is a key factor to reduce the farm's return. The cricket parent farm supports variable cost, such as cricket eggs and foods at a lower price to network members, but it buys the products back at a high proportion of production with a low price, resulting network members gains lower return than individual cricket farms. In regard to breakeven point, the network farm member had higher breakeven point because of lower average selling price of cricket due to the price commitment. To gain more profit, the cricket network member should expand its production to gain more production volume which will increase initial investment.

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