www.bircu-journal.com/index.php/birci
Budapest International Research and Critics Institute-Journal (BIRCI-Journal)
Humanities and Social Sciences
ISSN 2615-3076 Online)
ISSN 2615-1715 (Print)
Budapest Institute

A Feasibility Study of Silkworm (Tubifex Sp.) Cultivation Business Using Multilevel Containers with Semi Closed Recirculating System (SCRS) for Community Welfare

Erfan Effendi[1], Tengku Said Muhammad Farid[2]
[1,2]*Universitas Islam Riau, Indonesia*
effendierfan@eco.uir.ac.id, *saidfarid@student.uir.ac.id*

Abstract

Tubifex sp is a natural food for the cultivation of freshwater and ornamental fish in the hatchery phase. The availability of these worms in Pekanbaru City is fluctuating due to the condition of the river volume. Preliminary studies have been conducted to determine the needs of fish cultivators for Tubifex sp and its market value. These studies indicated that Tubifex sp's demand is approximately 2000 liters/month, with a limited supply of only 600 liters/month or 30% out of 100% of the total demand. Furthermore, a survey was also carried out to determine factors responsible for the inadequate supply of Tubifex sp. The results showed that the limited supply was due to (1) the availability of few farmer groups and (2) lack of cultivators. Based on these conditions, Tubifex sp was first cultivated by farmers in an unused sewer. The result showed, (1) sewer water easily permeates these worms, (2) Tubifex sp is attacked by pests, (3) it is difficult to maintain the Tubifex sp environment, (4) there is no production. Therefore, based on these conditions, this research was carried out to cultivate Tubifex sp using a multilevel container with a semi-closed recirculating modern system, as well as ph and water sensors connected to smartphones to maintain the cultivation environment. The results showed that (1) pest attack reduced by 95%, (2) there is an efficient use of water and raw materials, (3) easy environmental conditions to maintain Tubifex sp, (4) amount of production can be controlled, (5) efficient land use, and (6) the worms can be developed on a commercial scale.

Keywords
silkworm (tubifex sp.); multilevel containers; semi closed recirculating system

I. Introduction

Fishery is one of the main economic sectors in Indonesia. The Central Bureau of Statistics (2017) had stated that the Gross Domestic Product (GDP) growth in the fisheries sectors was always above the National GDP and Agricultural GDP. In 2017 the growth of GDP in the fisheries sectors was approaching 6.79% or equal to IDR 169,513.10. Moreover, the fishery production volume was relatively increasing each year. In the fourth quarter of 2017, the volume of wild fish catch and cultivated fish were 6.04 million tons and 17.22 tons, respectively. While, in 2016, the wild fish catch and cultivated fish volume were 6.52 tons and 16.68 tons, respectively.

Pekanbaru City with a width of 632.26 km2 has great potential as the center of the freshwater fish cultivation business. The level of fish consumption among the population also increased each year. According to Pekanbaru City Central of Bureau Statistic, fish consumption among the community was significantly increasing. The total of fish consumption in 2015, 2016, and 2017 were 30.31 kg/capita, 33.94 kg/capita, and 34.62 kg/capita, respectively. This situation might happen due to the rapidly growing population.

A rapid increase in the number of fish consumption should have followed by the increased number of fish production volumes. A successful production activity was essential to ensure that the production volume capable of meeting the product demand. In the aquaculture business, the prosperous production of cultivated fish determined by a good fish seeding process. The availability of natural fish meal contributes as a vital factor in the initial phase of aquaculture or the seeding process. Silkworm (Tubifex tubifex L.) considers as an adequate source of fish meal for cultivated freshwater fish, especially in their larvae form. It observes as a good source of nutrition for the fish. Its size also fits the larvae's mouth opening (Muria, 2012).

A field survey was conducted to know the demand and supply of silkworm in Pekanbaru City. It found that the total supply did not meet the demand of silkworm. This situation might occur due to the limited number of silkworm cultivation farmer groups. Moreover, the supply of silkworm was also highly associated with the season and river streams that led to uncertainty of its quantity and sustainability of supply.

Figure 1. *Silkworm Seeker in Pekanbaru City's River*

Based on those data, we were trying to cultivate silkworm through several trials. The first cultivation trial conducted in the abandoned drainages. These experiments did not meet our expectations since we found some hindrances: (1) pest attack, (2) water leaking, (3) no production, (4) difficulty in maintaining stable cultivation media, and (5) dryness during the dry season that lead to minimum volume of water, death of silkworm, and low production volume. Hence, a breakthrough of innovation required to improve silkworm volume production.

Figure 2. *Silkworm Cultivation that Located in the Drainages*

We then proposed a silkworm cultivation method with a modern system. A multilevel container with the semi-closed circulating system (SCRS) that would be equipped with pH and water censors applied to maintain the cultivation media. We will set adequate pH and water levels on the cultivation media, the censors equipped in each container would record and report the inadequate pH and the water level on the cultivation media to our

smartphones. We found that the implementation of this system provided some beneficial effects to the business: (1) decreasing the pest attack (up to 95%), (2) providing a more convenient way in managing the cultivation media, (3) saving more water and probiotic, (4) presenting more efficient land-use, (5) capable of producing one-liter silkworm per day, and (6) giving more control of the production volume, hence it easier to achieve certain level of supply sustainability. Silkworm cultivation with multilevel containers produced better silkworm commodities in comparison with silkworm cultivation in drainages. Based on this evidence, we are convinced to run the silkworm cultivation business with a multilevel containers system to meet 70% demand of silkworm commodities in the market.

Figure 3. *Experiment Shelf of the Modern Silkworm Cultivation*

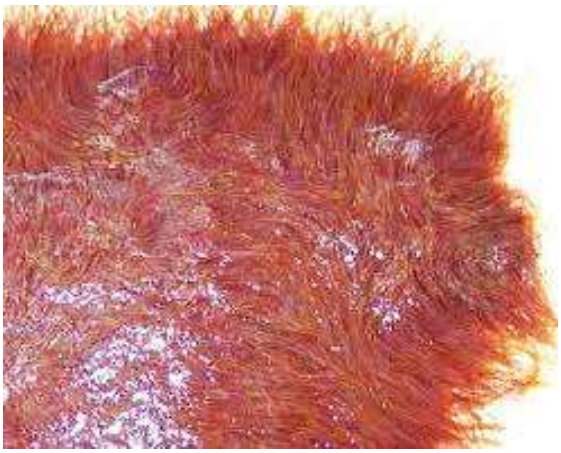

Figure 4. *Silkworm (Tubifex SP)*

II. Review of Literature

2.1 Product Feasibility

a. Taxonomy of Silkworm

Silkworm cultivation business concentrated on silkworm breeding activities for the natural farming fish meal, such as for the catfish or ornamental fish seed. ITIS (2015) stated that the taxonomy rank of Silkworm (*Tubifex sp*.) is as follow:

Kingdom : Animalia
Phylum : Annelida
Class : Oligochaeta

Order : Tubificidae
Family : Naididae
Genus : Tubifex
Species : Tubifex tubifex L.

b. Morphology of Silkwsorm

Tubifex worm is also known as silkworm or hairworm because it has a very soft and silky body. It is relatively easy to be recognized from its silky thread-like body shape and brownish-red color (Suharyadi, 2012).

Silkworm dominantly has rosy color due to high hemoglobin concentration in their body. Their body is composed of 57% protein and 13% fat. It is 1-2 cm long, slender, and soft. Silkworm usually lives in groups. Each worm would gather into colonies that are difficult to disintegrate. These worms live by forming colonies in clear water that is abundant of organic materials (Khaeruman et al, 2008)

Pennak (1978) also elaborated the morphology of silkworm (*Tubifex tubifex*). They explained that silkworm has no gill with a small and thin body. This structure makes the exchange of oxygen and carbon dioxide on their body surface possible to be occurred.

Silkworm's cultivation media is the food source for the silkworm. This media should compose of high organic materials that influence the growth of the silkworm. It is commonly difficult to find silkworm in media with low organic materials (Suharyadi, 2012).

c. Product's Price

Silkworm is sold in 300 gram-milk cans units, or locally known as the unit of *centang*. Silkworm is bargained with varied prices, usually between IDR 11,000-IDR 13,000 per *centang* or IDR 33,000 – IDR 39,000 per liter. The silkworm's price was relatively fluctuated due to their harvesting seasons. Silkworm was quite difficult to be harvested during the rainy season due to the high volume of water in the river. Hence, there were limited supply and a high price of the silkworm commodity in the market during the rainy season. Silkworms was traded for IDR 13,000 during the rainy season and IDR 11,000 during the dry season.

The price of silkworms was set based on the production cost and market price. According to the production cost, the price offered to the market was relatively cheaper than the market price. The calculation applied is as follow:

- Production cost per month/production volume = IDR 2,725,000/120 liters
  = IDR 22,700/liters

The production volume of the silkworm in a month with four units of cultivation containers was approximately 120 liters/month. Based on the production cost, the selling price for one liter of silkworm was IDR 22,700/liter, while the market price could reach IDR 33,000/liter. The SCRS system help to suppress the production cost up to IDR 30,000/liter.

d. Product Superiority

- **Assurance of Its Quality, Quantity, and Sustainability**
  The supply of silkworm in Pekanbaru City originally came from the river streams. This data indicated no assurance of silkworm quality, quantity, and sustainability in the study location. The water volume usually significantly increases during the rainy season. It challenged the process of reaching the silkworm on the bottom of the river.

This situation led to a low supply of silkworm and no assurance of the sustainability of supply.

Silkworm cultivation that employed multilevel containers with SCRS could guarantee a certain number of silkworm production volumes. Therefore, this cultivation method was more convenient to control the market demand and assure the sustainability of the silkworm supply.

- **Competitive Pricing**

  Silkworm cultivation business using the SCRS system had produced a cheaper market price. Nevertheless, it was still providing profits due to its efficient production process.

- **Healthier Meal for the Fish Seed**

  Effendi Mahmud (2017) explained that wild silkworm were quite hazardous to directly distributed as fish seed's meal. It needs to be isolated before being given to the fish seed. This wild silkworm tended to be contaminated by the chemical substance in the river and was not safe for the fish seed.

2.2 Market Target Feasibility

a. Analysis of Market Potential and Opportunities

A field survey in July 2019 among catfish farmers in Pekanbaru City through direct and indirect interviews conducted to explore the monthly demand of silkworms, their supply availability, and the selling price set. Results revealed that the silkworm demand for catfish cultivation was 2,000 liters/month. Unfortunately, the silkworm farmers only provided 20 liters to 600 liters of silkworm commodities per month. Further, this supply of silkworm was only could be provided if no increase of river streams occurred. These findings signified that the silkworm supplies only able to met 30% of fish cultivation business demand. In other words, there was a broad chance of silkworm cultivation business to be developed. Silkworm cultivation businesses that employed the SCRS system had perceived as a potential method to deal with the limited silkworm supply in Pekanbaru City.

b. Marketing Strategy

Based on several issues had elaborated, silkworm cultivation business with SCRS system considered to be a feasible solution for ensuring the quality, quantity, and sustainability of silkworm supply.

The result from a survey of silkworm demand in Pekanbaru City revealed that the silkworm demand was reaching 24,000 liters/year. A silkworm cultivation container was producing 360 liters of silkworm/year. In the early stage of business, a target set was 20 cultivation containers to meet 30% of the market demand. In the second year of business, it planned to add more cultivation containers, up to 46 units. This extension of containers number aimed to improve the production capacity up to 69%. It was able to cover the 70% shortage of needs per month.

This business did not only meet the silkworms demand in Pekanbaru City but also reach market demand in other cities in the following years. It was possible due to active community involvement as the business partner of silkworm cultivation. As the business partner, they have to provide cultivation land, cultivation containers, and workers. For the training purpose, qualified seed, and raw materials had been prepared to ensure the quality of silkworm cultivated, prevent self-selling, and improve market certainty.

The profit gained from this business did not only come from market transactions of silkworm, but also raw material transactions. A work contract suggests being provided

for fish farmers in Pekanbaru City to ensure the availability of silkworm commodities.

III. Results and Discussion

3.1 Operational Feasibility

a. Raw and Supplementary Materials

No	Raw Material	Function
1	Tofu Dreg	Media and fish feed/pellets for cultivated silkworm.
2	Chicken Manure	Media and fish feed/pellets for cultivated silkworm.
3.	EM4 Probiotic	Activator liquid for raw material fermentation
4.	Palm Sugar	Meal/feed for the activator bacteria
5	Freshwater	Added on EM 4 liquid to provide adequate media for bacteria reproduction process

b. Tools

The tools required were:

1.	Waterpump	9.	100 Liters Water Barell
2.	Paranet	10.	20 milimeters Board
3.	Washbowl	11.	Snail
4.	Scoop	12.	Pipe
5.	A ½ inch hose	13.	Elbow
6.	HDPE Plastic	14.	pH sensor/detector
7.	Mini Water Tub	15.	Water sensor/detect
8.	Iron Shefl		

c. Production Process

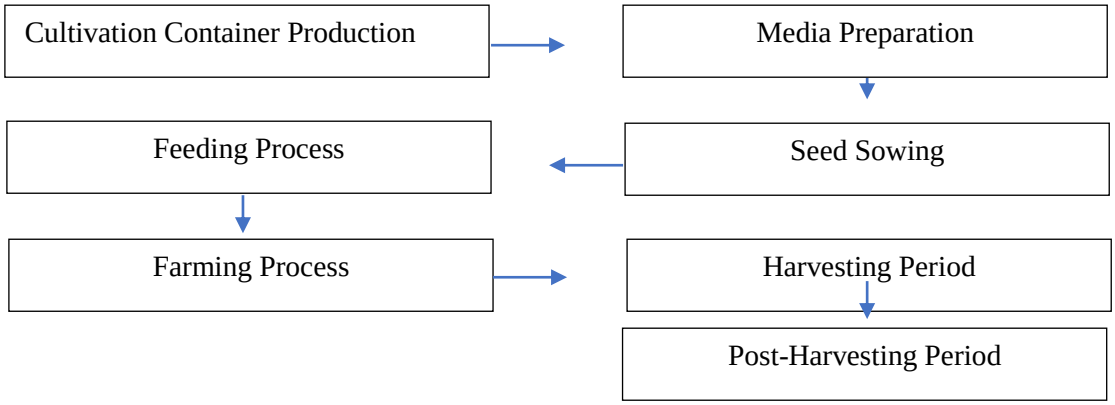

Figure 5. *Flow chart of Silkworm Production and Cultivation*

d. Cultivation Container Production

Silkworm cultivation containers production was essential to begin a silkworm cultivation business. Cultivation container are made of iron and wood. It was 3 meters long, 1 meter wide, and 1.5 meters tall. The iron unit is composed of 5 levels. Pipes were equipped on each level to irrigate the containers.

Figure 6. *Silkwork Cultivation's Shelf*

e. Media Preparation

One cultivation container required 20 kg of tofu dregs, 30 kg of dry chicken manures, 200 ml of probiotics, 200 gram of palm sugar, and 5 liters of water. These materials were mixed in a container. After that, an activator (probiotic and palm sugar) is added for the fermentation process.

The fermentation process was conducted in 4-5 days in a 100 ml water barrel. The barrel would be opened and the materials inside the barrel are mixed for 1-2 minutes on each day for five days. This process aimed to evaporate the gases produced by the chicken manures. After five days, the raw materials could be applied on the cultivation shelf as the media for silkworm cultivation.

f. Seed Sowing

Seed sowing is commonly conducted in the morning (7 to 9 a.m) or afternoon (4 to 5 p.m). Those courses were selected to prevent silkworm's stress due to high temperatures. Silkworm is vulnerable to stress, hence adequate timing of seed sowing was important. High temperatures posed lower seed quality and a lower ability to adjust in new media (Effendi, 2014).

A cropping system applied during the seed sowing process. A 3-5 cm hole was made in a medium with a 30 x 20 cm distance between the holes. Five milliliters of seed were sowed in each hole.

g. Feeding Process

The silkworm was fed once in 14 days. Fifty kilograms of silkworm meals are required for five levels-3 m x 1 m x 1.5 m-size-shelf. The meal are composed of 20 kg of tofu dregs and 30 kg of chicken manures. Spread techniques were applied to assure silkworm in all media had fed with an adequate amount of food.

h. Farming Process

The application of multilevel containers with the semi-closed recirculating system expected swift water machine performance. A regular evaluation was necessary to be conducted to assure no obstruction had occurred on the water machine. Once in seven days, the worker would check and clean the machine from sand or mud that possibly stuck in the machine.

i. Harvesting Period

Silkworm could be harvested every ten days. The harvesting period process is elaborated as follow:

1. The pump machine's water flow was being turned off prior to the harvesting process to make the harvesting process easier.
2. The upper part (approximately 2 cm) of the media was scooped. Adult silkworms usually live on the top layer of the media.
3. Then the scooped silkworm was put into a closed washbowl. A closed washbowl stimulated the silkworm to come to the surface of the media to get adequate oxygen, so it made the cultivation process easier. Usually, one unit of container could produce 10 liters of silkworms in 10 days.

j. Post-Harvesting Period

There were several methods required before distributing silkworm to the market:

1. Water Infusion

Silkworm was placed in a container after the harvesting period. A mini water pump was applied to fill the container with water. It aimed to maintain an adequate amount of oxygen concentration for the silkworm. This step also made the packaging process more convenient for the farmer.

2. Silkworm Packaging

The packaging process of silkworm depended on the shipping distance and the duration of delivery. If the shipping distance were approximately 15-20 km or could be traveled less than one hour, the silkworm would be packaged in 0.5 to 1 kg sized plastics. However, if the shipping distance were up to 100 km or more with 4-8 hours duration of delivery, then there are several steps of packaging:

- Oxygen administration. It was added to the silkworm container prior to the shipping procedures.
- Assured no sunlight exposure during the shipping procedures. It done to avoid high temperatures on the shipping containers.
- Secured the water pH on the range between 7 to 8.
- Maintained the water volume density. The proportion between the volume of water and the volume of silkworm should not exceed 3:1 to keep the silkworm fresh and alive when they reach their destination.

3. Pick-Up and Delivery Process

Pick-up or delivery activities are part of the marketing process on the silkworm cultivation business. In this study, consumers were free to pick it up at the cultivation sites or ask the cultivation owner to ship them to the certain place agreed.

3.2 Financial Feasibility

a. Investment Cost for 20 Cultivation Containers

No	Material/Tool	Volume	Unit	Price/Unit (IDR)	Total (IDR)	EL	Depreciation Cost (IDR)	Residual Value (IDR)
1	Production of cultivation container (4 workers, 20 unit) 30 days	30	HK	400,000	12,000,000	-	-	-
2	Metal iron for container's frame	120	Rod	45,000	5,400,000	5	1,080,000	1,080,000.0
4	Media filter	10	Unit	35,000	350,000			
6	Pipe glue	20	Pcs	12,000	240,000			
7	Pipe connection (L)	40	Pcs	15,000	600,000			
8	Pipe connection (T)	30	Pcs	15,000	450,000			
9	Pipe (1 inch)	10	M	15,000	150,000			

11	Plastic for media's container	16	M	35,000	560,000			
12	Plastic for UV cover	16	M	15,000	240,000			
13	Paranet (2x50 m) with compactness of 50%	16	M	18,000	288,000			
14	Nail	3	Kg	30,000	90,000			
15	Water sedimentation container	2	set	300,000	600,000			
16	Fermentation container	3	unit	140,000	420,000			
17	**Production Tool**							
	b. Scoop	10	unit	15,000	150,000	5	30,000	30,000
	c. Washbowl	10	unit	30,000	300,000	5	60,000	60,000
	d. Hose 0,5 inch	20	M	10,000	200,000	5		40,000
	e. HDPE Plastic (30 cm x 40 cm)	5	M	70,000	350,000	5	70,000	70,000
	f. Water machine	1	unit	600,000	600,000	5	120,000	120,000
	Investment Cost Total				**25,988,000**		**2,541,000**	**2,149,600**

Assumed Investment Cost

- In the first year of business, there were 20 cultivation containers. This container production had involved four workers that paid for IDR 100,000/day. It was completed after 30 days of production.
- The price for each material written based on the price on October 2019 in Pekanbaru City
- Several tools purchased are assumed as consumable costs or has no economic life (EL).

b.Working Capital Cost

First Year's Working Capital Cost of Silkworm Culvation Busines

No	Description	Unit	Volume	Price/Unit (IDR)	Total (IDR)
1	**Silkworm seed**	Liter	100	30,000	3,000,000
2	**Production cost**				
PRODUCTION OF CULTIVATION MEDIA, FEEDING, AND FERTILIZATION IN THE FIRST YEAR (20 UNITS)					
	- Tofu Dreg	sack	200	20,000	4,000,000
	- Chicken Manure	sack	180	40,000	7,200,000
	- Probiotic	bottle	100	23,000	2,300,000
	- Palm Sugar	kg	100	15,000	1,500,000
WORKER'S PAYMENT FOR 15 DAYS					
YEAR 0	**36**	HK	4	100,000	14,400,000
ELECTRICITY COST					
- Water machine (200 watt)		kwh	200	1,500	300,000
TOTAL OF OPERATIONAL COST					**32,700,000**

Second Year's Working Capital Cost of Silkworm Culvation Business

No	Description	Unit	Volume	Price/Unit (IDR)	Total (IDR)
1	**Silkworm Seed**	-	-	-	-
2	**Production Cost**				
PRODUCTION OF CULTIVATION MEDIA, FEEDING, AND FERTILIZATION IN THE SECOND YEAR (46 UNITS)					
	- Tofu Dreg	sack	420	20,000	8,400,000
	- Chicken Manure	sack	400	40,000	16,000,000
	- Probiotic	bottle	150	23,000	3,450,000
	- Palm Sugar	kg	150	15,000	2,250,000
WORKER'S PAYMENT FOR 15 DAYS					
YEAR 2	**36**	HK	6	100,000	21,600,000
ELECTRICITY COST					
	- Water Machine (600 watt)	kwh	600	1,500	900,000
TOTAL OF OPERATIONAL COST					**52,600,000**

Third Year's Working Capital of Silkworm Culvation Business

No	Description	Unit	Volume	Price/Unit (IDR)	Total (IDR)
1	**Silkworm Seed**	-	-	-	-
2	**Production Cost**				
PRODUCTION OF CULTIVATION MEDIA, FEEDING, AND FERTILIZATION IN THE THIRD YEAR (70 UNITS)					
	- Tofu Dreg	Sack	600	20,000	12,000,000
	- Chicken Manure	Sack	580	40,000	23,200,000
	- Probiotic	Bottle	250	23,000	5,750,000
	- Palm Sugar	Kg	250	15,000	3,750,000
WORKER'S PAYMENT FOR 15 DAYS					
YEAR 2	**36**	HK	8	100,000	28,800,000
ELECTRICITY COST					
- Water Machine (800 watt)		Kwh	800	1,500	1,200,000
TOTAL OF OPERATIONAL COST					**74,700,000**

c. Projected Cash Flow Statement of the Silkworm Cultivation Business

	2020	2021	2022
	(IDR)	(IDR)	(IDR)
Operating Cash Flow			
Net Income	51,244,400	289,367,120	540,280,400
Non-Cash Expense	-	-	-
Cash Flow from Operating Activity	51,244,400	289,367,120	540,280,400
Investment Cash Flow			
Tool and Property Investment	16,988,000	39,027,400	59,458,000
Cash Flow from Investing Activity	16,988,000	39,027,400	59,458,000
Cash Flow Financing			
Issuance (repayment) of debts	-	-	-
Issuance (repayment) of equity	-	-	-
Cash Flow from Financing Activity	-	-	-
Net increase (decrease) in cash	34,256,400	250,339,720	480,822,400
Add: Beginning cash balance	0	34,256,400	216,083,320
Ending cash balance	34,256,400	216,083,320	264,739,080

d. Investment Feasibility

Investment feasibility is essential to measure the level of feasibility of a business investment. Thus, a business feasibility study is closely associated with investment decisions. Fahmi (2014) had defined business feasibility study as scientific research that evaluated the feasibility of a business (feasible or infeasible). It performed by placing qualitative and quantitative measures that finally posed a recommendation.

In this study, net present value (NPV) employed to calculate the feasibility of the business. NPV also applied to predict the final result of an investment or project before the initiating stage of a project. NPV describes as the value of net profit or profit earned at the end of the project or investment work (Irham Fahmi, 258, 2016).

- An NPV of zero signified that the project's cash flow is sufficient to repay the capital invested in the business. It also provided a certain level of return that required in the capital (cost of venture capital). An NPV of zero also indicated no change of investment would be noted.
- A positive NPV value represented residual profits from the cash flow.

In addition to the NPV, the discount rate is also calculated. Discount rate will cause the NPV in an investment equal to zero. If IRR ≥ Cost of Capital, the investment is declared as a feasible work. The Profitability Index (PI) is used to compare the future net cash flow value with the initial investment value. PI > 1 showed that the investment can be executed (accepted), while PI < 1 indicated that the investment is not feasible (rejected).

NPV 12%

Year	Investment Cost	Operational Cost	Total Cost	Benefit	Net Benefit	DF (12%)	NPV
0	16,988,000	36,370,000	53,358,000	216,000,000	162,642,000	1.0000	162,642,000
1	39,027,400	52,600,000	91,627,400	496,800,000	405,172,600	0.8929	361,761,250
2	59,458,000	36,370,000	95,828,000	756,000,000	660,172,000	0.7972	526,285,077
Total	115,473,400	125,340,000	240,813,400	1,468,800,000	1,227,986,600		1,050,688,327

NPV 15%

Year	Investment Cost	Operational Cost	Total Cost	Benefit	Net Benefit	DF (15%)	NPV
0	16,988,000	36,370,000	53,358,000	216,000,000	162,642,000	1.0000	162,642,000
1	39,027,400	52,600,000	91,627,400	496,800,000	405,172,600	0.8696	352,324,000
2	59,458,000	36,370,000	95,828,000	756,000,000	660,172,000	0.7561	499,184,877
Total	115,473,400	125,340,000	240,813,400	1,468,800,000	1,227,986,600		1,014,150,877

NPV	**12%**	**1,050,688,327**
	15%	**1,014,150,877**
IRR		**98%**
Payback		**1 Year**
Profitability Index		**4.46**

e. Profit and Loss Agreement of Silkworm Cultivation Business

No	Description	1st Year	2nd Year	3rd Year
A.	Production	7,200	16,560	25,200
B	Selling Price	30,000	30,000	30,000
C	Revenue Total	216,000,000	496,800,000	756,000,000
D.	Unit Total	20 UNITS	46 UNITS	70 UNITS
E.	Cost			
	- Investment Cost	16,988,000	39,027,400	59,458,000
	- Operational Cost	36,370,000	52,600,000	36,370,000
	- Worker's Salaries (Owner)	108,000,000	108,000,000	108,000,000
	- Accumulated Depreciation of Equipment	3,397,600	7,805,480	11,891,600
	- Total	**164,755,600**	**207,432,880**	**215,719,600**
F	0.5% Tax	10,800,000.	24,840,000	37,800,000
G.	Net Profit/Net Loss	51,244,400	289,367,120	540,280,400
H.	BCR	1.31	2.39	3.50
	BCR Mean	2.40		

f. Profit and Loss Assumption Agreement

- The number of production had assumed to be increased on each year because of the increasing number of the units.
- There was an additional investment cost on each year due to the increasing number of the units.
- Operational costs consisted of the raw materials' purchasing cost and worker's salaries.
- Worker's salaries calculated as the accumulated expenses.
- Tax was assumed to be 0.5%, following the government regulation number 23 of 2018.

3.3 Human Resources Feasibility

a. Human Resources Requirement Analysis

Year	Unit Total	Human Resources Required (Person)	Human Resources Allocation
1	20	5	Production Staff and Expert
2	46	9	Production Staff and Expert
3	70	12	Production Staff and Expert

b. Human Resource Qualification

1. Production Staff

There were no specific qualifications of the production staff in this business. Detail production process training would be given to the production staff prior to the production process.

2. Expert Staff

Specific qualifications in finance, engineering, and fishery fields are required for the expert staff position.

c. Job Descriptions

1. Production Staff
   - Preparing the silkworm cultivation media
   - Sowing the silkworm seeds
   - Feeding the silkworm once in two weeks
   - Performing equipment maintenance works
   - Managing the harvesting and post-harvesting period
   - Preparing production for the harvesting period
2. Finance and Marketing Staff
   - Predicting the need for investment costs, working capital, cash flow, and profit and loss agreements for the silkworm farming cultivation business
   - Listing the total of business's incomes and expenses
   - Managing partnership contracts with the fish seed cultivators
   - Promoting the cultivation products to several market segments
3. Informatics Engineering Staff
   - Monitoring the cultivation container's pH and water censors. The cencors played an essential role to record and report the pH and water level to the smartphones
   - Performing maintenance works on the censor equipment
4. Fisheries Staff
   - Ensuring the safety of raw materials for the silkworm cultivation
   - Preparing production plan for the production staff
   - Monitoring worker's work performance and the maintenance of production equipment

- Managing sustainable research projects to improve the silkworm production volume

d. Payroll/Wage System

The wage system applied for production staff was the time wage system, assuming that production staff only worked in certain production periods. The wage system used for the expert staff (marketing and finance, informatics engineering, fisheries) was a monthly salary, assuming that they had been involved in the production and outside the production process.

IV. Conclusion

The Central Bureau of Statistics (2017) had stated that the Gross Domestic Product (GDP) growth in the fisheries sectors was always above the National GDP and Agricultural GDP. In 2017 the growth of GDP in the fisheries sectors was approaching 6.79% or equal to IDR 169,513.10. Furthermore, the fishery production volume was relatively increasing each year. In the fourth quarter of 2017, the volume of wild fish catch and cultivated fish were 6.04 million tons and 17.22 tons, respectively. While, in 2016, the wild fish catch and cultivated fish volume were 6.52 tons and 16.68 tons, respectively.

The number of community interest in consuming cultivation fish significantly increased due to the rapidly growing population. In accordance with the data from Pekanbaru City Local Central Bureau of Statistics, the number of fish consumption/capita in Pekanbaru City was significantly increasing each year. The total of fish consumption in 2015, 2016, and 2017 were 30.31 kg/capita, 33.94 kg/capita, and 34.62 kg/capita, respectively.

A survey in Pekanbaru City revealed that the silkworm cultivation businesses were only able to meet 30% from the 100% total demand of silkworm commodities. This situation occurred because of the limited number of silkworm cultivation businesses in the city. Further, the supply of silkworm was also highly affected by the seasons and river streams. The absence of intensive and well-directed cultivation business also contributed to this low supply of silkworm.

We had investigated the silkworm cultivation business and its marketing strategy. We suggest (1) conducting studies that examine strategy or method to improve the silkworm's biomass and their population and (2) encouraging more investment in silkworm cultivation business due to the high and sustainable demand of silkworm (2000 liters/month).

References

Badan Pusat Statistik 2017. Total Produksi Perikanan https://www.bps.go.id/pencarian.html?searching=total+produksi+perikanan&yt1=Cari

Dinas Pertanian Kota Pekanbaru, 2013, Laporan Tahunan Seksi Produksi Tahun 2013, Pemerintah Kota Pekanbaru, Riau

Dinas Pertanian Kota Pekanbaru, 2014, Laporan Tahunan Seksi Produksi Tahun 2013, Pemerintah Kota Pekanbaru, Riau

Dinas Pertanian Kota Pekanbaru, 2015, Laporan Tahunan Seksi Produksi Tahun 2013, Pemerintah Kota Pekanbaru, Riau

Dinas Pertanian Kota Pekanbaru, 2016, Laporan Tahunan Seksi Produksi Tahun 2013, Pemerintah Kota Pekanbaru, Riau

Dinas Pertanian Kota Pekanbaru, 2017, Laporan Tahunan Seksi Produksi Tahun 2013, Pemerintah Kota Pekanbaru, Riau

Efendi Mahmud, 2014, Beternak cacing sutera cara modern, Jakarta Timur : Penebar Swadaya

Fahmi, Irham, 2016, Pengantar Manajemen Keuangan, Bandung: Alfabeta

https://riau.bps.go.id/statictable/2017/01/25/323/produksi-perikanan-menurut-jenis-dan-kabupaten-kota-2015-ton-.html (Diakses tanggal 24 september 2019)

ITIS. 2015. Classification of Tubifex tubifex L.. http:// www.itis.gov /Static/include/foo ter.html. (Diakses tanggal 24 Desember 2020).

Khairuman dan Sihombing. 2008. Peluang Usaha Budidaya Cacing Sutra Pakan Alami Bergizi Untuk Ikan Hias. Jakarta: Agromedia Pustaka.

Muria, E S, E. D. Masithah dan S Mubarak. 2012. Pengaruh Penggunaan Media dengan Rasio C:N yang Berbeda terhadap Pertumbuhan Tubifex. Fakultas Perikanan dan Ilmu Kelautan. Universitas Airlangga, 2 hlm (Abstrak).

Pennak, R. W. 1978. Freshwater Invertebrates of the United States. A Wiley- Interscience Publication. John Willey and Sons, New York.

Suharyadi. 2012. Studi Pertumbuhan dan Produksi Cacing Sutra (Tubifex sp.) dengan Pupuk yang Berbeda dalam Sistem Resirkulasi. Tugas Akhir Program Magister Universitas Terbuka. Jakarta.