

Identification of Technical Practices for Climate-Smart Agriculture (CSA) in Indonesia: A Case Study in the Sukabumi Regency, West Java

Output 4 – Analyse Market Potential and Cost-Benefit of
the Fully Integrated System

Final Report on Cost Benefit and Financing Mechanisms for the
Deployment of the Fully Integrated System

D4.2.1

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1 Introduction

This section is a continuation of the previous section, namely the analysis of the financial feasibility of the technology used to overcome the problem of climate change through climate smart agriculture. The technology used is a fully integrated technology for soil monitoring systems and automatic irrigation with fertilization, with a focus on improving agriculture through intelligent systems. Key components include field sensors for soil and environmental monitoring, Field Controllers/Remote Terminal Units (RTUs) for data processing and command execution, and various actuators for irrigation and fertilizer distribution.

The technology used is equipped with user interface technology for real-time field monitoring and system control. This integrated approach aims to optimize water and nutrient provision based on real-time field conditions, thereby encouraging efficient and sustainable agricultural practices.

The integration of smart irrigation and fertilization systems has advanced agriculture significantly. Technologies such as precision farming, data analysis, automated actuators and remote monitoring have transformed crop management, increasing efficiency, productivity and sustainability. Precision farming uses advanced sensors for accurate application of water and fertilizer, while data analysis optimizes resource use. Automated actuators provide real-time, precise feedback, and remote monitoring enables field management from anywhere. The user-friendly interface makes this technology accessible to all farmers.

Economic benefits for farmers include reduced costs and increased profits, increasing the competitiveness of national agriculture. This technology also addresses water scarcity and land degradation, optimizing water use and improving soil health. Higher crop yields and resource conservation will increase incomes and also contribute to food security and development of rural communities as well as improved living standards.

This research was conducted to determine the benefits of this technology and funding through financial feasibility analysis, so that it can provide information to be able to apply this technology in other areas. The funding aspect includes investment costs and operational costs. This project requires investment costs in the form of land, buildings, purchasing technology with the company that produces the technology, and others.

In this feasibility analysis, the commodities taken into consideration are chilies, tomatoes and eggplant. The planting pattern is carried out twice a year, namely for Period I is large red chilies and Period II is intercropping for tomatoes and eggplant.

1.1 Intercropping

Intercropping is the activity of cultivating two types of crops on land at the same time with the main reason being to increase productivity per unit area of land. In general, the intercropping system is more profitable than the monoculture system because land productivity is high, the types of commodities produced are diverse, it is economical in the use of production facilities and the risk of failure can be minimized (Sasmita et al, 2014).

Intercropping has advantages and disadvantages. These advantages include:

- 1) Energy efficiency is easier to achieve because planting preparation, land work, maintenance, fertilization and collection are more easily mechanized,

- 2) The number of plants per hectare can be easily monitored by adjusting the planting distance between and behind the rows, resulting in more productivity,
- 3) More attention can be paid to each type of plant so that the plants planted can be adapted to the climate, fertility and texture of the soil,
- 4) The risk of crop failure is reduced,
- 5) Possibly the form that provides the highest production because it uses land and sunlight more efficiently (Maheda, 2015).

The intercropping system not only has advantages but also has disadvantages including:

- 1) Competition in nutrients in intercropping patterns, there will be competition in absorbing nutrients between the plants planted,
- 2) Commodity selection, market demand for intercropping patterns, not always crops that become intercropping crops have high demand, whereas selecting intercropping plants that are suitable for intercropping with the main crop is not an easy business because it requires broader insight.
- 3) Requires additional costs and treatment, to be able to implement intercropping patterns properly, several environmental factors that have an influence need to be taken into account, including water availability, soil fertility, sunlight and pests and diseases.

In this analysis, intercropping is exemplified by tomato and eggplant plants. This consideration was made, based on a study by Mansour et al 2012, intercropping of tomato plants with other plants can increase the number of mealybugs, Whitefly, *Bemisia tabaci* (Genn.). This pest is one of the pests on tomatoes which can cause diseases that affect plant vigor, transmit Gemini virus and reduces plant quality. The experiment of Mansour et al, 2012, stated that the population response of *Bemisia tabaci* when tomatoes (*Solanum lycopersicum* MT1) were planted alone (non-choice), tomatoes were planted with eggplant (*Solanum malagna* MTe1), tomatoes with chilies (*Capsicum annuum* MC11), tomatoes with okra (*Abelmoschus esculentus* MKBE1), and all (select experiments) under greenhouse conditions (30-36 °C, 80% RH). The results showed that the number of adults, eggs, and nymphs was significantly higher ($P < 0.05$) on tomato plants alone or those planted with chilies, whereas the number of adults, eggs, and nymphs was significantly lower on tomato plants planted with okra and eggplant.

1.2 Methodology for Business Feasibility Analysis

Calculating a business feasibility study helps farmers and business people to analyze whether or not a business is feasible to run. In a business feasibility study, various factors are taken into consideration that will support the successful running of a business. Feasibility analysis is something related to financial feasibility analysis which includes Net Present Value (NPV), Payback Period (PP), Internal Rate Return (IRR), and Net Benefit-Cost Ratio (Net B/C)

1.2.1 Net Present Value (NPV)

Calculation of the feasibility of a business is related to the total amount of benefits received and exceeding the costs incurred. The NPV method is the calculation of the difference between the cash flows issued by the company, the NPV value calculated using a certain interest rate, the NPV value produced by generating net income is greater than the current investment value, so the NPV value is positive, and it can be said that the investment project is worthy. The value of net cash receipts is smaller

than the investment value, so the NPV is said to be negative, so the investment project undertaken can be categorized as not feasible. The NPV calculation formula is:

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+i)^t}$$

Where:

B_t = profit for a year
 C_t = investment costs for a year
 i = discount rate used
 n = economic life of the investment
 t = Year

NPV > 0, investment in a business worth running

NPV < 0, investment in a business is not worth running

NPV = 0 requires consideration to continue investing or not

1.2.2 Internal Rate of Return (IRR)

The rate of return in the Internal Rate of Return determines whether an investment project is considered feasible or not, by comparing the IRR with the expected level of profit. The IRR calculation is carried out using the discount rate with present value. If the IRR value is > 1, then NPV > 0, it can be said that the business is worth continuing. If IRR < 1 then NPV < 0 then the business being run is not worth continuing. If IRR = 1, NPV = 0 then the business being run only bears the costs of the current interest rate. The formula used is:

$$IRR = i_1 + \frac{NPV}{NPV_1 - NPV_2} \times (i_2 - i_1)$$

Where:

i₁ = discount rate which produces a positive NPV
 i₂ = discount rate which produces a negative NPV
 NPV₁ = positive NPV
 NPV₂ = negative NPV

1.2.3 Net Benefit Cost Ratio (Net B/C ratio)

Measuring whether an investment project is feasible or not is by comparing the present value, if the Net B/C value is > 1 then it is said to be feasible and if the Net B/C < 1 then a business is not said to be feasible. The formula used is:

$$Net \frac{B}{C} = \frac{\sum_{t=0}^n \frac{B_t}{(1+i)^t}}{\sum_{t=0}^n \frac{C_t}{(1+i)^t}}$$

Information:

B_t = monthly profit
 C_t = costs incurred every month (Rp)
 i = interest rate
 N = number of years

1.2.4 Payback Period

In the feasibility study, the payback period calculation provides an explanation of the investment amount at present value. By knowing the payback period, farmers will know how long the investment they carry out can provide profits to farmers. If the

payback period is smaller than the economic life of the investment then the investment is said to be feasible and if the payback period is greater than the economic life then it can be said to be not feasible. The payback period calculation formula is:

$$PP = \frac{1}{Ab}$$

Information:

I = The amount of investment costs

Ab = Net benefits obtained each year

2 Business Feasibility Analysis

In this section, the first analysis is to carry out an analysis of the minimum number of agricultural models using the modern method used in this study, namely using drip irrigation, covering an area of 400 m². Next, an analysis of the business and its financial feasibility is carried out. The results of the analysis with an area of 400 m² were that it was not feasible for a business carried out for a period of 1 year, so the business was then expanded to 1 hectare. When compared with conventional methods, the results of conventional method analysis with an area of 400 m² are profitable in every season.

Therefore, a financial feasibility analysis was carried out on both, especially for modern agricultural models. Based on an analysis of 1 hectare of modern agricultural models, the results are feasible. The following is the analysis.

2.1 Financial Analysis

The financial aspect of cultivation is related to analyzing the feasibility of a business from a financial perspective, so that by carrying out the analysis the feasibility aspects of running a business can be considered. The financial aspects that are taken into consideration are related to cash flow (Cash Flow), Net Present Value (NPV), Net Benefit Cost Ratio (Net B/C), Internal Rate of Return (IRR) and Payback period.

The analysis was carried out over a period of 10 years, considering that in this drip irrigation technology there are tools whose technical lifespan can reach 10 years, namely water tanks. Meanwhile, other tools are adjusted to the technician's age of the equipment used.

2.1.1 Cash Flow

Inflows or benefits are anything that can increase revenue for the company or project implementer. The inflow received by this farm consists of sales of red chilies in the first 6 months and then tomatoes and eggplants for the next 6 months. In this activity, water conditions are very important in carrying out agricultural cultivation, but with drip irrigation, water utilization can be carried out as optimally as possible.

2.1.2 Inflow

Chili, tomato and eggplant plants are annual plants where these plants will complete their life cycle in one season. Therefore, the production of commodities in this study is assumed to be constant, while the output price is also fixed. The production results and prices of commodities in this research can be seen in Table 2.1.

Table 2.1 Revenue of Red Chilies, Tomatoes and Eggplants with a Land Area of 400 m² in a year.

Component	Commodity					
	Red Chili		Tomatoes		Eggplant	
	a	b	a	b	a	b
Productivity (Kg/Ha)	15,000	19,500	18,000	23,400	14,500	18,850
Production for 400 m ²	624	780	749	936	603	754
Price (IDR/kg)	15,000	15,000	5,000	5,000	2,500	2,500
Revenue IDR	9,360,000	11,700,000	3,745,000	4,680,000	1,507,500	1,885,000
USD	603.87	754.84	241.61	301.94	97.26	121.61
Total Revenue					Conventional IDR	14,612,500
					USD	947.74
					Modern IDR	18,265,000
					USD	1,178.39

*)Productivity of commodities used modern technology is 1.3 times than conventional

Notes:

a) Conventional

b) Modern

The amount of production of red chilies, tomatoes and eggplants for drip irrigation is assumed to be the same as conventional, although from some literature it is usually higher. For example, for paprika, the difference between precision and manual irrigation reaches 30% (Odelia and Sulistyowati 2020).

2.1.3 Outflow

Outflow is anything that becomes an expense or cost in running a business. Several components of Outflow include investment costs and variable costs. Investment costs are costs that must be incurred to obtain production factors used in the production process. Meanwhile, operational costs are costs incurred so that the production process can take place.

2.1.3.1 Investment Costs

Investment costs are all costs incurred before the farming business starts (Kusmayadi, Sujaya, & Noormasyah, 2017). The investment costs in this farming business include equipment units for drip irrigation technology packages including solar panels, land rental and other equipment. An outline of the investment needs can be seen in Table 2.2. According to Table 2.2, total fix cost for first year is Rp 35,900,816.

Table 2.2 Investment costs for 400 m2 for First Year.

No	Component	Technology				Lifespan (Year)
		Modern		Conventional		
		Cost (IDR)	Percentage	Cost (IDR)	Percentage	
1	Reservoir and accessories	3,704,500	10.32%			10
2	Pompa and accessories	2,345,000	6.53%			5
3	Mainline and Submain	1,465,000	4.08%			10
4	Lateral and accessories	3,236,066	9.01%			2
5	Dosing system	2,900,000	8.08%			5
6	Panel Control and server	11,300,000	31.48%			2
7	Microcontroller	10,000,000	27.85%			5
8	Land rent	600,000	1.67%	600,000	30.00%	1
9	Others	350,250	0.98%	1,400,000	60.00%	3
	Total					
	IDR	35,900,816	100.00%	2,000,000	100.00%	
	USD	2,316.18		129.03		

The largest investment costs (modern technology) are for control panels and servers, which reach 31.48% of total fixed costs, or around IDR 11,300,000. Next is microcontroller, IDR 10,000,000 or about 27.85%. Then, the reservoir and accessories amounting to 10.32% or around IDR 3,704,500. Meanwhile, land rental costs are around 1.67% or IDR 600,000 for an area of 400 m². Components that have a long service life are tanks or water tanks which are included in the reservoir and accessories cost component. Meanwhile, the laterals and accessories were replaced after 2 years, as were the sensors and batteries in the control panel and server components. Meanwhile for conventional technology, investments are for land rent and other input, the cost are IDR 2,000,000.

If we look at the lifespan of these components, the reservoir and mainline are the components that have the longest lifespan, namely 10 years. These two components are the basis for calculating financial feasibility, because they have the longest service life. Next are pumps, dosing systems and microcontrollers which have a lifespan of 5 years.

2.1.3.2 Operational Costs

Operational costs are routine costs used in carrying out farming. Operational costs are incurred in the first to tenth years. The description of operational costs is shown in Table 2.3. Based on Table 2.3, expenditure on red chili plants is higher than expenditure on intercropping of tomatoes and eggplant. What is interesting is that for medicines the value for intercropping farming is smaller than for red chilies, one of the

reasons is because by intercropping tomatoes and eggplants the number of pests is somewhat reduced, especially for whitefly pests. Meanwhile, for fertilizer, the amount of red chili fertilizer used is higher than intercropping, this is because the selling price of red chilies is usually higher than others, so farmers will focus more on red chili plants so that the amount of production is large so that revenue increases.

Table 2.3 Variable Costs for Red Chilies, and Intercropping of Tomatoes and Eggplants with an Area of 400 m².

No	Input	Cost (IDR)	
		Modern	Conventional
A. Red Chili			
1	Seed		
	Red Chili	144,000	144,000
2	Fertilizer	900,000	1,080,000
3	Pesticides	325,000	390,000
4	Labor	2,000,000	3,000,000
5	Mulch	240,000	240,000
6	Lime	234,000	234,000
7	Borates	10,680	10,680
8	Rope	12,800	12,800
9	Screen	15,000	15,000
10	Stake	324,000	324,000
11	Bamboo	30,000	24,000
	Total A		
	IDR	4,225,139	5,474,480
	USD	272.59	353.19
B. Tomato and Eggplant			
1	Seed		
	Tomato	92,500	92,500
	Eggplant	18,000	18,000
2	Fertilizer	650,000	780,000
3	Pesticides	100,000	120,000
4	Labor	2,000,000	2,500,000
5	Lime	175,500	175,500
6	Borates	6,000	6,000
7	Others	500,000	500,000
	Total B		
	IDR	3,542,000	4,192,000
	USD	228.52	270.45
Total Cost in a Year			
	IDR	7,767,139	9,666,480
	USD	501.11	623.64

Some inputs for intercropping commodities do not cost money because when planting red chilies they are already available, such as mulch and stakes. In this case, for intercropping the number of stakes will just be added, because the previous ones can be used like mulch.

The amount of labor used is almost the same for both because the harvest period is almost the same, the harvest can take up to 6 months. In the use of labor, the difference between cultivation using IoT technology and conventional cultivation is that cultivation using IoT technology requires operators to digitize. Apart from that, the use of labor for irrigation and fertilization can be reduced by using digital drip irrigation technology. Fertilizer use for conventional is assumed to be 1.2 times than drip irrigation. Likewise with the use of pesticides, conventional is 1.5 times higher than modern (drip irrigation), one of which is due to the use of fertilizer which can increase weed growth.

Modern agricultural expenditure as shown in Table 2.3 is lower than conventional agriculture, this is because expenditure on labor, fertilizer and pesticides in conventional agriculture is higher compared to the use of these inputs in modern agriculture.

2.2 Analysis of Financial Criteria

Investment criteria used for financial feasibility analysis include Net Present Value (NPV), Net Benefit Cost Ratio (Net BC), Internal Rate of Return (IRR) and Payback Period (PP). This analysis uses a discount rate of 15% and refers to BRI Bank's commercial interest rate in the MSME category and a business life of ten years.

Table 2.4 Results of Financial Feasibility Analysis with a Land Area of 400 m².

No	Criteria	Value	Result
1	NPV	(IDR 12,556,147)	Not feasible
2	IRR	-5.05%	Not feasible
3	NPV POSITIF	35,402,156	
4	NPV NEGATIF	41,789,049	
5	BCR	0.85	Not feasible
6	Payback Period		Not feasible

2.2.1 Net Present Value

NPV calculation is calculating the difference between benefits and revenues and the costs incurred during cultivation. A positive NPV value ($NPV > 0$), in a situation like this means that the income is greater than the amount invested and in a negative NPV situation ($NPV < 0$) the income is smaller than the amount invested. In this study, the discount factor level used is 15%, the results of this research show that the NPV obtained by using drip irrigation technology, the NPV value is IDR -12,556,147, has a negative value, where the amount produced is smaller than the amount invested. This means that with a discount factor level of 15%, this business is not feasible with an area of 400 m².

2.2.2 Net Benefit Cost Ratio (Net B/C)

The Net B/C value that is used as a comparison is the sum of positive NPV and negative NPV, where this situation can represent how many times the benefits

obtained are the amount of costs incurred. This is very important to review considering that in business or the business world, it will help the development and sustainability of the business. This business produces a Net B/C value of less than 1, namely 0.85. This shows that this business is not feasible with an area of 400 m².

2.2.3 Internal Rate of Return (IRR)

The calculation results show that the IRR is -5.05%, where the IRR is related to the interest rate on the net value (NPV) equal to the amount of investment in cultivation. The use of IRR also provides a measure of the return on investment used. This research produces an IRR value negative, so this business is not feasible to carry out with an area of 400 m².

Meanwhile, for the conventional model, with an area of 400 m², a detailed analysis of income in the first year can be seen in Table 2.5. The highest income was for the red chili commodity amounting to IDR 9,360,000. Total revenue are IDR 14,612,500 or USD 942.74. Overall income is IDR 4,946,020 or USD 319.10. The RCR value for a year for this conventional model is 1.51, which is feasible.

Table 2.5 Resume of Feasibility in Conventional Model in a Year.

No	Item	Red Chilli	Tomato	Eggplant	Total (in a Year)
1	Revenue				
	IDR	9,360,000	3,745,000	1,507,500	14,612,500
	USD	603.87	241.61	97.26	942.74
2	Cost				
	IDR	5,474,480		4,192,000	9,666,480
	USD	353.19		270.45	623.64
3	Income				
	IDR	3,885,520		1,060,500	4,946,020
	USD	250.68		68.42	319.10
4	RCR	1.71		1.25	1.51

2.2.4 Feasibility Analysis for 1 Hectare

Based on the results of previous analysis, the drip irrigation model using an area of 400 m² is not feasible in the first year. Therefore, in this analysis a land area of 1 hectare is used. The results of the analysis can be seen in Table 2.6. Some adjustments for increasing this area are for agricultural inputs, meanwhile for increased investment are for Lateral and accessories, other fixed costs and land area, where with an increase to 1 hectare, the Lateral costs and accessories and land area, increased by 25 times.

Table 2.6 Investment costs for 400 m² for First Year.

No	Component	Technology				Lifespan (Year)
		Modern		Conventional		
		Cost (IDR)	Percentage	Cost (IDR)	Percentage	
1	Reservoir and accessories	3,704,500	2.79%			10
2	Pompa and accessories	2,345,000	1.77%			5
3	Mainline and Submain	1,465,000	1.10%			10
4	Lateral and accessories	80,901,639	61.00%			2
5	Dosing system	2,900,000	2.19%			5
6	Panel Control and server	11,300,000	8.52%			2
7	Microcontroller	10,000,000	7.54%			5
8	Land rent	15,000,000	11.31%	15,000,000	60.00%	1
9	Others	5,000,000	3.77%	10,000,000	40.00%	3
	Total					
	IDR	132,616,139	100.00%	25,000,000	100.00%	
	USD	8,555.88		1,612.90		

In Table 2.6, it can be seen that the costs for laterals and accessories increased to IDR 80,901,639 or around 61.00% of the total fixed costs which reached IDR 132,616,139. Another high cost is land rental of IDR 15,000,000 or around 11.31%. Meanwhile other costs reach IDR 5,000,000 or around 3.77%. For conventional models, the increase in fixed costs can reach IDR 10,000,000 or around 40.00% of fixed costs.

Table 2.7 Operational Cost Red Chili, Tomato and Eggplant in 1 Hectare.

No	Input	Cost (IDR)	
		Modern	Conventional
A	Red Chili		
1	Seed		
	Red Chili	3,600,000	3,600,000
2	Fertilizer	22,500,000	27,000,000
3	Pesticides	8,125,000	9,750,000
4	Labor	50,000,000	75,000,000
5	Mulch	6,000,000	6,000,000
6	Lime	5,850,000	5,850,000
7	Borates	267,000	267,000
8	Rope	320,000	320,000
9	Screen	375,000	375,000
10	Stake	8,100,000	8,100,000

11	Bamboo	750,000	600,000
	Total A		
	IDR	105,887,000	136,862,000
	USD	6,831.42	8,829.81
B	Tomato and Eggplant		
1	Seed		
	Tomato	2,312,500	2,312,500
	Eggplant	450,000	450,000
2	Fertilizer	16,250,000	19,500,000
3	Pesticides	2,500,000	3,000,000
4	Labor	50,114,818	62,500,000
5	Lime	4,387,500	4,387,500
6	Borates	150,000	150,000
7	Others		
	Total B	88,550,000	104,800,000
	IDR	5,712.90	6,761.29
	USD		
C	Total Cost in a Year		
	IDR	194,437,000	241,662,000
	USD	12,544	15,591

Furthermore, in Table 2.7, it can be seen the difference in costs between modern (precision) and conventional. In general, the costs for conventional are higher than modern, because the use of fertilizers, pesticides and labor in modern models is lower than conventional, as stated in the previous section.

In first year, total cost for modern model is IDR 194,437,000 while a conventional model reaches IDR 241,662,000. This cost is for two seasons, for red chili and for tomato and eggplants. Based on Table 2.8, it can be seen that revenue for modern models is higher compared to conventional models with a comparison of IDR 456,625,000 for modern models while for conventional models it is IDR 351,250,000. Based on the results of this analysis, the income of the modern model is higher than the conventional model with an area of 1 hectare. RCR for precision model is 1.40, meanwhile for conventional model is 1.32.

When compared with an area of 400 m², the size of 1 hectare is more profitable. In 400 m², precision model is not feasible. This is because on an area of 1 hectare the only increases for fixed costs are Lateral and accessories, while the others are fixed. Meanwhile, operational costs, both conventional and modern, have increased.

Table 2.8 Income Analysis for 1st Year (1 Hectare).

No	Item	Modern	Conventional
1	Fix Cost		
	IDR	132,616,139	25,000,000
	USD	8,555.88	1,612.90
2	Operational Cost		
	IDR	194,437,000	241,662,000
	USD	12,544.32	15,591.10
3	Total Cost		
	IDR	327,053,139	266,662,000
	USD	21,100.20	17,204.00
4	Revenue		
	IDR	456,625,000	351,250,000
	USD	29,459.68	22,661.29
4	Income		
	IDR	129,571,861	84,588,000
	USD	8,359.47	5,457.29
5	RCR	1.40	1.32

Meanwhile, based on their financial feasibility analysis, over a ten year period, both have positive NPV values at an interest rate of 15% (Table 2.9). However, if we compare the NPV values, the NPV value of drip irrigation technology (precision) is higher than the conventional model. This means that drip irrigation technology (precision) has higher advantages compared to conventional models. Drip irrigation technology (precision) is more profitable compared to conventional models.

Table 2.9 Status of NPV for 10 Years.

Model	Interest Rate	NPV	Status
Modern	15%	IDR 1,020,671,888	Feasible
Conventional	15%	IDR 514,262,383	Feasible

CONCLUSION

Agriculture using modern (precision) technology, such as using IOT and drip irrigation, requires quite high investment costs, around IDR 135 million for each hectare. This cost is not small when compared to the fixed cost for conventional methods. Where the fixed cost for the conventional method is only around IDR 25 million.

In terms of operations, the costs for farming with modern technology are lower compared to conventional methods. This is because modern models are driven more by using more precise equipment and use, so that fertilization is given precisely to the plants, so they don't produce as many weeds. So, with precision technology, production is higher compared to conventional ones.

On the other hand, if the area used is limited, for example with an area of 400 m². This can be seen in the results of the feasibility analysis that with this area the

business is not feasible. Therefore, in its implementation, it is necessary to consider the land area so that technology can increase farmers' income.

2.2.5 Payback Period

According to Djumanto et al. (2016) the period of return on initial investment in the form of cash flow, based on total income minus costs, the results of the Payback Period calculation determine the return period for invested funds, so that a short payback period can indicate the risks faced by short-term farmers. The research results show the payback period is 3 years and 5 months. The results of the research show that the use of drip irrigation technology shows decent results, thus the use of this technology is feasible to apply.

According to Muchtar et al. (2021) the use of technology will increase productivity and increase competitiveness and support efficiency so as to produce sustainable cultivation production. This statement is in line with the results of the study conducted where the research results show that the adoption of technology produces financial feasibility and is feasible to develop because it produces profits in terms of cultivation and increases the quality of production due to the intensive and appropriate fertilization model for its use through drip irrigation.

3 Financing Mechanism

After analyzing the equipment, technology and financial feasibility, the next step in implementing this study is to understand the financing mechanism. In the previous analysis, related to financing, you can see the sub-chapter financing models to support technology adoption. In the section on financing models to support technology adoption, various models of funding sources have been presented, both from the government, international institutions and the private sector.

After this technology is implemented, what needs to be considered is how to manage this technology and how to finance it. This is because the cost of technology investment is not cheap. Apart from that, most of the poor people in Indonesia come from rural areas where rural areas are synonymous with agriculture. This is in accordance with the data from Biro Pusat Statistik (BPS), where the number of poor people in March 2023 is 25.90 million people, where 51.33 percent of poor households in Indonesia were from the agricultural sector.

Therefore, in introducing and implementing this technology, it would be suitable if it were managed by farmer groups, where the number of farmer groups is usually between 20 and 30 people, so it is necessary to consider the financing mechanism for the application of this technology by farmer groups. This activity requires quite intense coordination between farmer groups, especially because irrigation and fertilization are carried out simultaneously for farmers exposed to this technology/project. It also means that this mechanism is support for gender mainstreaming in agriculture through climate-smart technology. Women as a member of formal organizations recognized by the government can participate in the planning and implementation phase of the adoption of the technology.

In fact, with this activity, an agricultural activity called corporate farming can be introduced, where the management is carried out jointly by the farmers. The definition of corporate farming is the activity of combining agricultural land which is jointly organized by farmers and integrated into one single management. This system could be a solution to many of the problems faced by farmers today, where the average land ownership of farmers in Indonesia is less than 0.3 hectares. Even if the women had the land or as head of the family, the mechanism is needed to involve them without discrimination in treatment. The government has even issued regulations regarding corporate farming, namely in the Regulation of the Minister of Agriculture of the Republic of Indonesia Number 8/Permentan/Rc.040/4/2018 concerning Guidelines for the Development of Agricultural Areas Based on Farmer Corporations. Based on this regulation, a Farmer's Corporation is a Farmer's Economic Institution with a legal entity in the form of a cooperative or other legal entity with the majority of capital ownership owned by farmers.

According to this regulation, the objectives of developing Agricultural Areas based on Farmers' Corporations are:

- Increasing added value and competitiveness of regions and agricultural commodities for sustainable national food security;
- Strengthening the farming system as a whole in one area management; And
- Strengthening farmer institutions in accessing information, technology, public infrastructure and facilities, capital as well as processing and marketing

Meanwhile, the targets of corporate farming activities include:

- Increasing production, productivity, added value and competitiveness of national priority commodities;
- Availability of optimal support for agricultural infrastructure and facilities in Agricultural Areas;
- Application of location-specific innovative technology in agricultural areas;
- Increasing farmer knowledge, skills and entrepreneurship in managing farmer economic institutions; and
- Functioning of the Farming Business system as a whole, effectively and efficiently

Furthermore, the parameters of this corporate farming activity include:

- Real income of farmer households;
- Farming Business Scale;
- Farmer profit margin; and
- Product differentiation and down streaming

Based on these regulations, this activity is very suitable for increasing farmers' income through increasing the scale of farmers' businesses so that it can increase farmers' margins.

In its implementation, technically, after handover to farmer groups, a management mechanism needs to be created, such as who will calculate fertilizer needs, who will operate it, who can access existing data to adjust it to real conditions regarding water needs, fertilizer and soil conditions.

Meanwhile, for the financing mechanism, this can be done in mutual cooperation by farmers who are members of farmer groups whose areas receive the application of this technology. Financing, because investment already exists, farmers can collect funding based on the area of land irrigated by this irrigation technology. Financing is used to buy fertilizer, for those operating it if they need to hire additional workers or for savings if damage occurs.

This financing can even be used with a revolving fund model. The revolving fund model is the provision of revolving fund loans which are categorized by the characteristics of being distributed or lent to revolving fund recipients, collected back and rolled back to other revolving fund recipients.

According to Sidik in Utami (2009), revolving funds are a form of government intervention in the economic sector in order to increase equality.

One of the characteristics of revolving funds is that these funds are distributed to the community/community groups, collected back with or without added value, and rolled back to the community/community groups or known as revolving funds. With the mechanism for providing revolving funds, it is hoped that the community or community groups can utilize the revolving funds received to increase their business and economic levels.

In this case, prior investment capital is provided from government, private and international institutions to farmers who use this technology, where from this business the community benefits. It is assumed based on previous feasibility analysis that the production results obtained using this technology are 30% higher than conventional models. Therefore, efforts are made to ensure that while using this technology, farmers can give a small portion of their profits so that they can be turned back so that this technology can be applied to more farmers.

If the distribution of revolving funds to a community/community group has succeeded in increasing the level of business and the economy so that it can run independently,

then the funds can be rolled back to invest in new equipment to other communities/community groups with the same goal, namely improving business and the economy.

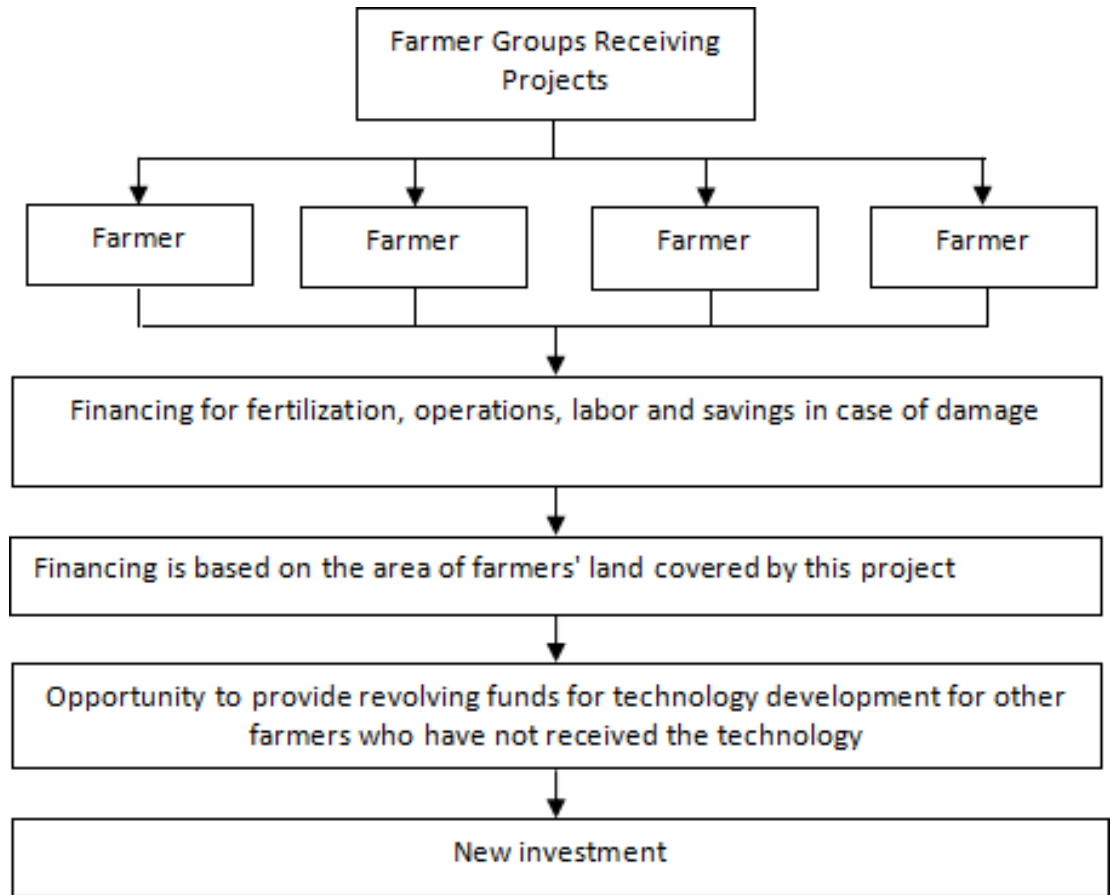


Figure 3.1 Proposed financing mechanism.

If it is needed, the women group farmers can be involved in financing mechanism that women represent each parcel land who united in the schema can provide the fee. They can collect it at monthly meetings, especially for the first period when plants need more fertilizer to support maximum growth. After this period, the collected fee is regarding the growing stage of the plant.

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