



Financial Feasibility of Nutmeg Cultivation with the Application of Integrated Pest Management Technology

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<http://dx.doi.org/10.18415/ijmmu.v6i5.1119>

Abstract

The purpose of this study was to analyze and to find out the financial feasibility of nutmeg cultivation by applying Integrated Pest Management (IPM) technology patterns. The data for 2007-2017 shows that the productivity of dried nutmeg crop seeds was 0.86 tons per hectare in 2007 and decreased 0.83 tons per hectare in 2017. The decline in production and mortality rate of nutmeg plants was increasing due to several factors, one of which was pest and disease attacks. The results of this study showed that the nutmeg cultivation system with IPM technology pattern for an average of 1 hectare land obtained NPV of Rp 144.185.587, Net B/C Ratio of 4.43, IRR of 17.97%, and Payback Period (PP) 12.19. Therefore, financially, the cultivation of nutmeg plants with IPM technology is feasible and profitable to be cultivated. The sensitivity analysis of nutmeg cultivation with IPM technology with the assumption that the possibility of costs increased by 10%, due to a decrease in production by 20% and a combination of costs up 10% and production decreased by 20% shows the results that the cultivation of nutmeg plants with IPM technology are still feasible to be cultivated.

Keywords: Nutmeg Plant; Integrated Pest Management; Financial; South Aceh Regency

Introduction

South Aceh Regency known as the nutmeg region, is the second largest nutmeg producing region in Indonesia after Maluku Province, and is the main center of nutmeg production in Aceh Province. The plants that have the largest average planting area in South Aceh are nutmeg plants with an average planting area of 12,265.38 ha, which is 65.30 percent of the average planted area of nutmeg in Aceh, more than 50 percent the average planting area of nutmeg plants in Aceh originates from South Aceh, this is not surprising considering that South Aceh is an area of nutmeg plant development (Zakiah, et al. 2015).

Perkembangan kebun tanaman pala Kabupaten Aceh Selatan terus meningkat dari waktu ke waktu. Pengamatan selama 10 tahun terakhir menunjukkan perkembangan yang sangat signifikan. Total lahan terus meningkat dari pertumbuhan tanaman belum menghasilkan (TBM), tanaman menghasilkan (TM)

sehingga total perkembangan total dan luas lahan pada tahun 2007 dari 11.887 ha menjadi 16.289 ha pada tahun 2017. Perkembangan tanaman rusak (TR) terus juga meningkat semenjak tahun 2007 sampai tahun 2017 dari 1.231 ha menjadi 5.733 ha. Data perkembangan Tanaman Pala disajikan pada tabel dibawah ini.

The development of nutmeg plantations in South Aceh continues to increase from time to time. Observations over the past 10 years show very significant developments. Total land continues to increase from the growth of immature plants (*tanaman belum menghasilkan; TBM*), mature plants (*tanaman menghasilkan; TM*) making the total development and land area in 2007 from 11,877 ha to 16,289 ha in 2017. The development of damaged plants (*tanaman rusak; TR*) continues to increase from 1,231 ha in 2007 to 5,733 ha in 2017. The development of nutmeg data is served in this Table 1 below.

Table 1. Development of Nutmeg Plants in South Aceh Regency

Tahun	Nutmeg Planting Area				Production (ton)	Produktivity Rate (Ton/Ha)
	TBM	TM	TR	Total		
2017	4.226	6.330	5.733	16.289	5.238	0,83
2016	4.813	6.947	4.061	15.821	5.748	0,83
2015	6.910	7.851	1.060	15.821	6.614	0,84
2014	6.633	7.733	1.024	15.430	6.510	0,84
2013	6.671	7.356	864	14.886	5.906	0,80
2012	6.459	6.518	1.114	14.091	5.192	0,80
2011	7.044	5.597	1.182	13.823	4.650	0,83
2010	7.310	4.997	1.209	13.516	4.168	0,83
2009	6.351	4.651	1.159	12.161	3.909	0,84
2008	6.357	4.759	1.284	12.400	3.909	0,82
2007	5.909	4.747	1.231	11.887	4.096	0,86

Source: *Kabupaten Aceh Selatan Dalam Angka, 2018*

Nutmeg production in South Aceh continues to experience a decrease in productivity. Data for 2007-2017 shows that the productivity of dried nutmeg crop seeds was 0.86 tons per hectare in 2007 and decreased by 0.83 tons per hectare in 2017. The decline in production and mortality of the nutmeg plant is increasing due to several factors, one of which is pest attack. According to the survey results, the symptoms of a root fungus attack in South Aceh are widespread. The symptoms of the attack are seen with many dead nutmeg plants. (Harni, et al. 2011).

According to (Susanna, 2018) epidemic molting disease on nutmeg plants that have been experienced since 2003 in South Aceh is more dominant due to the fungus *Lasioidiplodia theobromae* (Patouillard) Griffon & Maublanc (Syn. *Botryodiplodia theobromae* Pat.). The main predisposing factor to molting disease is drought. Meanwhile, factors related to epiphytotic are: age of plants, monoculture cropping patterns, lack of weed control, soil that has a low *Cation Exchange Capacity* (CEC) and phosphor (P) deficiency, and low abundance of antagonistic and beneficial soil microorganisms. The recommended control strategies are: plant rejuvenation, P fertilization, weed control, provision of soil organic matter, and utilization of soil antagonistic agents from nutmeg plantations. The control using antagonistic agents is one way in integrated pest management which is an effort to control by suppressing population or disease attack rates. According to (Untung, 1984), Integrated Pest Management (Integrated Control) is a multi-disciplinary ecological approach to population management that utilizes a diversity of compatible control techniques in a unified combination of Smith's management system (1979) in Untung (1984), that IPM is an attempt to optimize the results of pest control economically and ecologically. This can be achieved by using various tactics in a comprehensive manner by maintaining pest damage under

the level of economic damage, and protecting against threats or harm to humans, animals, plants, and the environment.

To cultivate nutmeg plants with integrated pest control technology is not only required a large investment, it is also expected to be able to adopt new technologies such as integrated pest control and nutmeg is one of the plantation crops that have a waiting period for plants to produce relatively long. Therefore it is necessary to calculate the level of feasibility of nutmeg farming by applying IPM technology whether in the long run it is still profitable or not, especially in South Aceh.

From the background that has been explained above, it is necessary to study to see the level of investment feasibility of the nutmeg cultivation with the application of IPM technology in financial terms.

Research Purposes

This study aims to analyze the financial feasibility of nutmeg cultivation by applying integrated pest management technology patterns in order to be used as recommendations for policy makers in developing nutmeg commodity in South Aceh.

Research Methods

This research was conducted in South Aceh, which was determined deliberately in selecting secondary data to determine the initial conditions of the nutmeg and primary plants used to determine the real condition in the field. Therefore, the combination of secondary and primary data is supporting each other in this study.

Population and Research Samples

The population and sample of this study are all regions that adopt IPM technology patterns in South Aceh.

Data Sources and Data Collection

The data used in this study are secondary data obtained from BPS (*Badan Pusat Statistik*) publication data and primary data obtained from in-depth observations and interviews among nutmeg farmers applying IPM technology patterns in South Aceh.

Data Analysis Method

This research used qualitative and descriptive method which carried out by secondary data exploration methods starting from the general condition of nutmeg commodity and primary data starting from the application method, production costs and production results received by nutmeg farmers who

apply IPM technology patterns. This data was analyzed using the *Net Present Value (NPV)* and *Internal Rate of Return (IRR)* methods.

Net Present Value (NPV)

$$NPV = \sum_{t=0}^n \frac{Bt - Ct}{(1+i)^t}$$

Annotations:
 Bt = Benefits from projects from year 1 to 25
 Ct = Costs from year 1 to 25
 n = Project age (25 years)
 i = KUR 9% interest rate
 t = starting in year 0

$$Net\ B/C = \frac{\sum_{t=0}^n \frac{Bt - Ct}{(1+i)^t}}{\sum_{t=0}^n \frac{Bt - Ct}{(1+i)^t}}$$

Annotations:
 Bt = Benefit in year t
 Ct = Cost in year t
 i = Interest Rate (9%)
 n = Number of years t = Year 1, 2, 3, etc.
 Criteria:

If the B/C ratio > 1, the nutmeg plantation business is considered as feasible and efficient, otherwise, if the B/C ratio < 1, the nutmeg plantation business is considered as not feasible and inefficient.

Results And Discussion

South Aceh is one of the areas of production centers of nutmeg in Indonesia, including one of the areas that contribute to meet the domestic and international nutmeg needs. The income of the people of South Aceh is generally obtained from farming nutmeg to meet their daily needs. But they still cultivate nutmeg in a conventional way; from cropping patterns to post-harvest. Due to monocultures cropping patterns with irregular spacing, lack of fertilization and environmental sanitation efforts, the problem of reduced nutmeg productivity also occurs in the Regency.

Cash in Flow

Nutmeg plants start producing in the 6th year after planting and will continue to increase every year, the higher the age of the nutmeg plants, the higher the level of production. Generally, nutmeg starts to bear its fruit in the 7 and at the age of 10 have produced profitably. Nutmeg production will continue to increase and at the age of 25 reach the highest production. Nutmeg trees continue to produce until the age of 60-70 years. The nutmeg total production until the age of 25 years was 56.465 kg per hectare with a

total revenue of Rp. 1.298.695.000. The average production and sale of wet nutmeg seeds per hectare can be seen in the Table 2 below.

Table 2. The Average Production and Sales of Nutmeg in One Hectare

Year	Wet Nutmeg Seed Production Results (Kg)	Wet Nutmeg Seed Selling Price (Rp)	Revenue (Rp)
0	-	23.000	-
1	-	23.000	-
2	-	23.000	-
3	-	23.000	-
4	-	23.000	-
5	-	23.000	-
6	57,50	23.000	1.322.500
7	172,50	23.000	3.967.500
8	345,00	23.000	7.935.000
9	690,00	23.000	15.870.000
10	1.035,00	23.000	23.805.000
11	1.265,00	23.000	29.095.000
12	1.610,00	23.000	37.030.000
13	1.955,00	23.000	44.965.000
14	2.300,00	23.000	52.900.000
15	2.645,00	23.000	60.835.000
16	2.990,00	23.000	68.770.000
17	3.335,00	23.000	76.705.000
18	3.565,00	23.000	81.995.000
19	3.910,00	23.000	89.930.000
20	4.255,00	23.000	97.865.000
21	4.600,00	23.000	105.800.000
22	4.945,00	23.000	113.735.000
23	5.290,00	23.000	121.670.000
24	5.635,00	23.000	129.605.000
25	5.865,00	23.000	134.895.000
Total Revenue	56.465,00		1.298.695.000

Cash out Flow

This cash flow comes from business investment activities either income or expenditure. Activities that included into this investment are sales and purchase activities of company assets and activities related to trade receivables. Cash out flows are classified into two parts: investment costs and operational costs. Investment costs are costs that must be incurred at the beginning of a business year or when a business is in progress which are used in the production process to provide information about the ability of an entity's business to generate cash flow in the future. Meanwhile, operational costs or variable costs are costs incurred by farmers to keep the production process going.

To start the nutmeg farming, farmers shall spend a number of costs in the first year to obtain several economic benefits incurred at the beginning of the activity with a large enough amount and calculated as an investment cost.

Table 3. Investment Cost

Description	Unit	Total	Unit price (Rp)	Total cost (Rp)
Area	Ha	1	25.000.000	25.000.000
Land clearing	Package	1	1.500.000	1.500.000
Seeds	Seedlings	115	8.000	920.000
Hoe	Unit	1	50.000	50.000
Machete	Unit	2	45.000	90.000
Knife	Unit	2	28.000	56.000
Sickle	Unit	2	30.000	60.000
Bucket	Unit	2	15.000	30.000
Hand Sprayer	Unit	1	280.000	280.000
Rattan Baskets	Unit	1	180.000	180.000
Total Investment Cost				28.166.000

In the following year there are reinvestment costs in accordance with the economic life of the inventory used by farmers at the beginning of production. However, not all investment costs are reinvested, such as land costs, land clearing and seedling costs, which are only done once at the beginning of the year at the start of the nutmeg farming. Investment costs incurred by farmers will always be in accordance with the economic age of the equipment used. The average reinvestment cost incurred by farmers can be seen in the Table 4 below.

Table 4. Reinvestment Cost

Description	Unit	Total	Unit Price (Rp)	Total Cost (Rp)	Economic Age (years)
Hoe	Unit	1	50.000	50.000	5
Machete	Unit	2	45.000	90.000	5
Knife	Unit	2	28.000	56.000	5
Sickle	Unit	2	30.000	60.000	5
Bucket	Unit	2	15.000	30.000	5
Hand Sprayer	Unit	1	280.000	280.000	5
Rattan Baskets	Unit	1	180.000	180.000	5
Total Reinvestment Cost				746.000	

Variable costs of nutmeg farming include organic fertilizer, inorganic fertilizer and biological control agent (*agen pengendali hayati*; APH). The organic and biological control agent is used annually, while the inorganic fertilizer is used when the plant is four years old after planting. The nutmeg fertilization uses assumptions which refer to the existing recommendations in nutmeg cultivation, because what occurs in the field is that the nutmeg rarely fertilized. The following table is a breakdown of the operational costs of the nutmeg farm business.

Fixed costs are costs that are not affected by the amount of production in a business in a certain time period. Fixed costs incurred in the nutmeg cultivation business include labor costs which are calculated based on the assumption of labor needs during the business period with the applied standard daily wage in South Aceh currently.

Table 5. Operational Costs of Nutmeg Farming with 1 hectare area until 25 years

No	Cost Component	Volume	Unit	Unit Price (Rp)	Cost (Rp)	
1.	Urea fertilizer	2.300,00	Kg	2.000	4.600.000	
Variable Cost	TSP fertilizer	2.599,00	Kg	5.450	14.164.550	
	KCL fertilizer	2.944,00	Kg	5.800	17.075.200	
	Organic Fertilizer + Tricoderma	13.000,00	Kg	1.000	13.000.000	
	Pseudomonas Biological Agents	52,00	Litre	40.000	2.080.000	
	Trichoderma Biological Agents	52,00	Litre	40.000	2.080.000	
	Plastic Ice Bag	12,00	unit	15.000	180.000	
	Raffia Plastic Rope	12,00	unit	6.000	72.000	
	Total Variable Cost				53.251.750	
	2. Fixed Cost	Seedling Distribution to Plantation Area	4,00	HOK	100.000	400.000
		Planting and Replanting	9,00	HOK	80.000	720.000
Weeding		312,00	HOK	80.000	24.960.000	
Fertilizing		236,00	HOK	60.000	14.160.000	
Harvesting		2.823,25	HOK	100.000	282.325.000	
Total Fixed Cost				322.565.000		
Total Operational Cost				375.816.750		

Investment Criteria

The feasibility of a business can be assessed by investment criteria. The investment criteria consist of *net present value* (NPV), *B/C ratio*, *internal rate of return* (IRR) and *payback period* (PP). The results of the analysis of investment criteria for the nutmeg cultivation with integrated pest management (IPM) technology can be seen in the Table 6 below.

Table 6. The Results of Analysis of Investment Criteria for Nutmeg Cultivation with IPM Technology in 1 Ha Scale

Criteria	Value	Result
<i>Net Present Value</i> (NPV)		Feasible
<i>Net Benefit and Cost Ratio</i> (Net B/C Ratio)	4,43	Feasible
<i>Internal Rate of Return</i> (IRR)	17,97 %	Feasible
<i>Payback Period</i> (PP)	12,19	Feasible

Based on the financial analysis listed above, it can be seen that the nutmeg cultivation with IPM technology in South Aceh obtained an NPV > 0 as much as Rp 144.185.587; which means that nutmeg cultivation with IPM technology in the study area is still feasible to be cultivated. *Net Present Value* which is equal to Rp. 144.185.587 shows the net benefits received by farmers while cultivating the nutmeg with IPM technology in accordance with the age of the plant to the applied discount rate. In addition to NPV, other criteria analyzed was the Net B/C value > 0, which is 4.43; which means that every 1 rupiah spent during the business period generates Rp. 4.43 units of net benefits. IRR value obtained from nutmeg cultivation with IPM technology is 17.97% where IRR value is greater than the applicable discount rate of 9%. IRR value which shows 17.97 percent and IRR > 9 percent, the internal rate of return for business is 17.97 percent; and for the period of return on investment costs can be obtained when the age of the plant reaches 12 years 2 months. From the results of these four criteria, the nutmeg cultivation with IPM technology in Aceh Regency is still feasible.

Sensitivity Analysis

Analisis sensitivitas digunakan untuk melihat kondisi bila terjadi perubahan-perubahan yang ada pada berbagai komponen biaya dan manfaat, seperti naik turunnya harga output atau input, dan volume produksi. Analisis sensitivitas yang dilakukan dalam penelitian ini yaitu terhadap kenaikan biaya produksi 10 persen, dan penurunan produksi Tanaman Pala sebesar 20 persen akibat serangan organisme pengganggu tanaman, maupun kombinasi keduanya. Penentuan variabel tersebut adalah berdasarkan fakta dilapangan bahwa biaya bisa naik akibat terjadinya inflasi, demikian halnya dengan produksi bisa menurun serangan organisme pengganggu tanaman. selain itu tingkat discount yang digunakan masih tetap 9% sesuai dengan tingkat suku bunga kredit usaha rakyat (KUR). Pada tabel di bawah disajikan hasil analisis sensitivitas budidaya Tanaman Pala dengan teknologi PHT.

Sensitivity analysis is used to examine the condition if changes occur in various components of costs and benefits, such as the fluctuation of output or input prices, and production volumes. The sensitivity analysis carried out in this research is intended to increase production costs by 10 percent, and decrease nutmeg production by 20 percent due to the attack of plant pests, as well as a combination of both. Determination of these variables is based on the facts in the field that costs can rise due to inflation, as well as production can decrease the attack of plant pests. Other than that the discount rate used is still 9% according to the *Kredit Usaha Rakyat's* interest rates. Table 7 below presents the results of the sensitivity analysis of nutmeg cultivation with IPM technology.

Table 7. Results of Sensitivity Analysis of nutmeg cultivation with IPM technology with 1 ha land area

Condition	Investment Criteria			
	NPV	Net B/C	IRR	PP
Normal	144.185.587	4,43	17,97%	12,19
Cost Increase 10%	130.073.726	3,98	17,79%	12,45
Decreased Production 20%	107.023.912	3,51	17,56%	13,04
Combination of 10% Cost Increase and 20% Decreased Production	92.259.489	2,98	17,24%	13,91

The results above show that nutmeg cultivation of with IPM technology is financially feasible. This can be seen from the value of NPV > 0, IRR > discount rate, and Net B/C > 1. In the results of sensitivity analysis, a 10% increase in costs, a decrease in production of nutmeg Plants by 20%, and likewise the

combination of the two; shows that the nutmeg cultivation with technology IPM is still feasible to be cultivated in South Aceh.

Conclusion and Recommendationn

Conclusion

For an average of 1 hectare land, nutmeg cultivation with IPM technology obtained NPV of Rp 144.185.587, Net B/C Ratio 4.43, IRR of 17.97%, and Payback Period (PP) 12.19. Therefore, financially, nutmeg cultivation with IPM technology is feasible and profitable to be cultivated. The sensitivity analysis of nutmeg cultivation with IPM technology with the assumption that the possibility of costs increased by 10%, due to a decrease in production by 20% and a combination of cost increase by 10% and production decreased by 20% shows the results that nutmeg still feasible to be cultivated with IPM technology.

Recommendation

Farmers must determine the attitude, by knowing the feasibility of nutmeg cultivation with IPM technology is expected to provide business motivation, then farmers be able determine actions and directives to be independent, thereby increasing efforts in developing nutmeg cultivation with IPM technology that is sought on a large scale for the long term.

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