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RESEARCH ARTICLE

FINANCING MODEL OF SHARIA ECONOMY-BASED COFFEE AGROINDUSTRY USING DYNAMIC SYSTEM SIMULATION IN BANDUNG DISTRICT

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Abstract

West Java Province is one of the producers of export quality Arabica coffee, namely Java Preanger Coffee. The problem that often arises in the agricultural sector is that most farmers do not have the funds to make capital. Another problem in agriculture is capital. This can cause crop failure due to a lack of capital so the process of agriculture is delayed and hampered. The aim of the Islamic financing modelling research is to determine the relationship between variables in the Islamic economic-based financing system as well as a comparison between the application of the concept of profit-sharing margins for mudharabah and musyarakah between farmers and Muhammadiyah Branch Managers (PCM) using the system dynamics method using the Powersim Software. System dynamics are defined to address large-scale and complex systems and understand the relationships among behavior in a given system over time and the underlying structures and decision rules. The sharia economy-based coffee agroforestry financing model results in the application of profit sharing that reflects more justice. The principle of profit sharing carried out by PCM is beneficial for both parties who have achieved the principle of justice, by avoiding things that are unlawful. This can be seen from the results of the profits and losses are not on one side. The simulation results can be used as a consideration for decision making for financing coffee agroforestry in Bandung Regency.

Introduction:-

In general, the problem that often arises in the agricultural sector is that most farmers do not have funds to use as capital for financing (Heri Susanto et al. 2022). This can cause crop failure due to a lack of capital so the process in agriculture is delayed and hampered. Financing capital built in the form of partnerships is certainly a solution in supporting the sustainability of Arabica Java Preanger coffee agroforestry in terms of venture capital (Startup Capital) (Baluku et al. 2016).

Capital loans can be made to conventional banks and Islamic banks. Conventional banks carry out profit transactions using the interest system, which earns profits with the interest system, customers have considered that interest in conventional banks is unlawful which is prohibited by Islam because it is included as usury property. Islamic banks

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have approached Islamic law and are more profitable with a profit-sharing system. This profit-sharing system is beneficial for both customers and Islamic banks as financial managers (Ustman 2016). Islamic banking can be ascertained free from usury/interest. Financing according to Law No. 21 of 2008 concerning Islamic banks, namely the provision of funds or equivalent claims in the form of profit-sharing transactions in the form of mudharabah and musyarakah. Mudharabah is a cooperation between two or more parties, where the first party is the provider of all capital, while the other party is the manager. Business profits are shared according to a mutual agreement and losses are borne by the owner of the capital as long as the loss is not the result of the manager's negligence. If the loss is caused by the manager, then the loss is borne by the manager. Musyarakah is a cooperation contract between two or more parties for a particular business in which each party contributes funds with an agreement that the profits and risks will be shared according to the agreement (Susana dan Prasetyanti 2011).

The research aims to make Islamic financing modelling to determine the relationship between variables in an Islamic economic-based financing system using the system dynamics method using the Powersim Software. Dynamic systems are defined to address large-scale and complex systems and understand the relationships between behaviour in a given system over time and the underlying structures and decision rules (Machado dan Morioka 2021). The system dynamic model has been used to estimate and plan sharia financing in profit sharing with mudharabah and musyarakah. Through this system-dynamic approach, a decision-maker can use his experience in making decisions and making policies based on model simulations and the behaviour of the system at hand (Wolstenholme 1990). This research will have a positive impact on coffee farmers in the Bandung Regency area related to issues of capital and profit sharing

Material and Method:-

Determination of the research area.

This study was conducted to formulate a partnership model based on the sharia economy to build and develop coffee agroforestry in the study area (Bandung Regency). Therefore, the research area was determined using the purposive method, namely the Margamulya farmer group in Margamulya Village, Pangalengan District, Bandung Regency.

Sampling method.

In this study, the simple random sampling method was used with direct interviews with the leaders of the farmer groups and several coffee farmers in the study area as respondents with the consideration that the respondents were competent to provide accurate farming information according to what they had been doing so far. Interviews were conducted directly with the respondents with questions aimed at obtaining information regarding the area of coffee plantations, coffee production per hectare per year (productivity), selling price of cherry coffee, and other information.

Data analysis method.

Data analysis used in this research is the qualitative analysis and quantitative analysis. Qualitative analysis is used to find out the general description and explain the cost of farming revenue at the research location which is broken down descriptively. The quantitative analysis used is a simulation of the financing system and profit sharing of the mudharabah and musyarakah partnership model in Arabica coffee agroforestry, Java Preanger, Bandung Regency.

Qualitative analysis is used in preparing each stakeholder's needs and the profit-sharing strategy using the principles of mudharabh and musyarakah. Meanwhile, quantitative analysis is used to explain causal relationships between variables in the model and the process of transforming causal loop diagrams into stock-flow diagrams.

This study uses primary data obtained by conducting opinion surveys through questionnaires given to experts and obtaining alternative strategies for these problems and secondary data obtained from farmer archive data for planting area data and production yield data. Next, calculate how much capital is needed by farmers. Then conceptualize the model by making a rich picture diagram. Next, transform the causal loop diagram into a stock-flow diagram. Stock-flow diagram which is a simulation model that will be verified and validated. model verification and validation to ensure that the model that has been created reflects precisely and accurately according to the real system and also ensures that no errors occur when running the model. The simulation results in the form of tables and graphs can be used as a consideration for decision-making for coffee agroforestry financing in Bandung Regency.

Results and Discussion:-

System identification.

Without understanding the system properly, the formulation and definition of the problem become unrepresentative, biased, and deviates from the purpose of the analysis. Identification of the system consists of actors or elements involved in the system and the relationships that occur between elements/actors described in the Causal Loop Diagram (CLD) (Daellenbach dan McNickle 2005). The identification of the system includes elements of the problem, system stakeholders, system hierarchy, and system behaviour.

Element Of Problem.

The elements of the problem in financing sharia-based coffee agroforestry are as follows.

1. Decision maker: coffee farmers.
2. Decision maker object: optimizing financing funds
3. Performance measure: the number of financing funds.
4. Control input/alternative solution: increased productivity and land extensification.

Stakeholder System.

The stakeholder system for sharia-based coffee agroforestry financing is as follows.

1. Problem solver: coffee farmers.
2. Problem user: PCM.
3. Customer problem: coffee bean buyers.
4. Problem analyst: Students and Lecturers.

System Hierarchy.

Hierarchy of the system in sharia-based coffee agroforestry financing is coffee farmers and PCM as the main system, coffee yields as the main sub-system, and capital sharing or profit sharing as the main sub-system.

Behavior System.

The Behavior System for sharia-based coffee agroforestry financing is as follows:

1. System variable: sharia financing.
2. System stat: musyarakah and mudharabah.
3. Emergency properties: smooth financing for coffee production.

Model Conceptualization.

The conceptualization of musyarakah and mudharabah financing models from the problem is mapped based on the Causal Loop diagram (Figure 1).

Each interacting variable component is connected by using an arrow symbol. The causal loop relationship between one element and another is positive if these changes are mutually reinforcing, meaning that if A increases it causes an increase in B or vice versa, if there is a decrease in A it will also cause a decrease in B as well. This relationship is indicated by a positive (+) loop or also called the Reinforcing Loop. The causal loop relationship between one element and another is negative if these changes are opposite to each other, meaning that if A increases then it causes B to decrease or vice versa, if there is a decrease in A it will cause an increase in B. This relationship is indicated by a negative (-) loop or is called also a Balancing Loops.

Model Formulation.

SeAfter conceptualizing the model, the system model is formulated into a stock-flow diagram, which is the creation of an Islamic economic-based financing system model for coffee agroforestry. Figures 2, 3, and 4 show stock-flow diagrams.

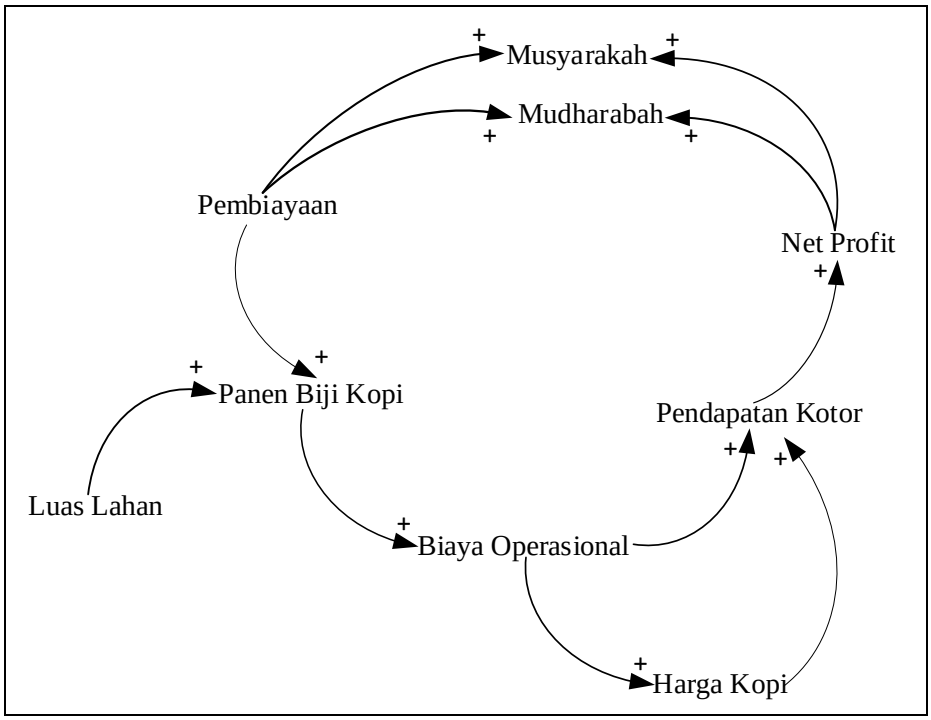

Figure1:- Causal Loop Diagram.

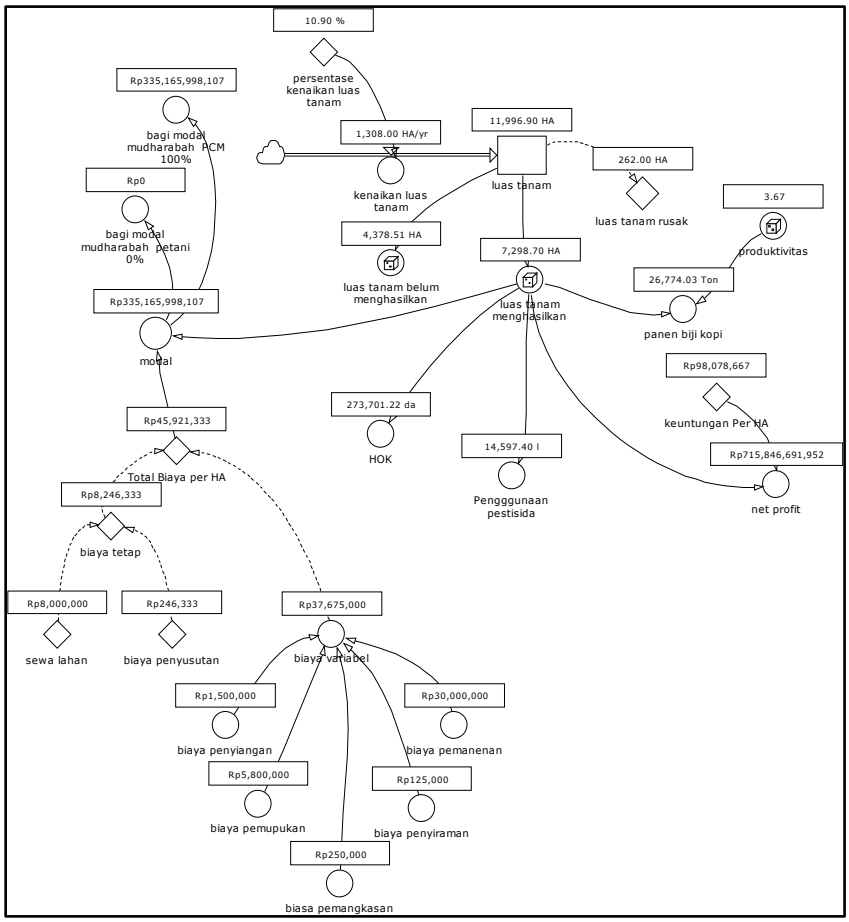

Figure2Stock-Flow Diagram in Existing Conditions

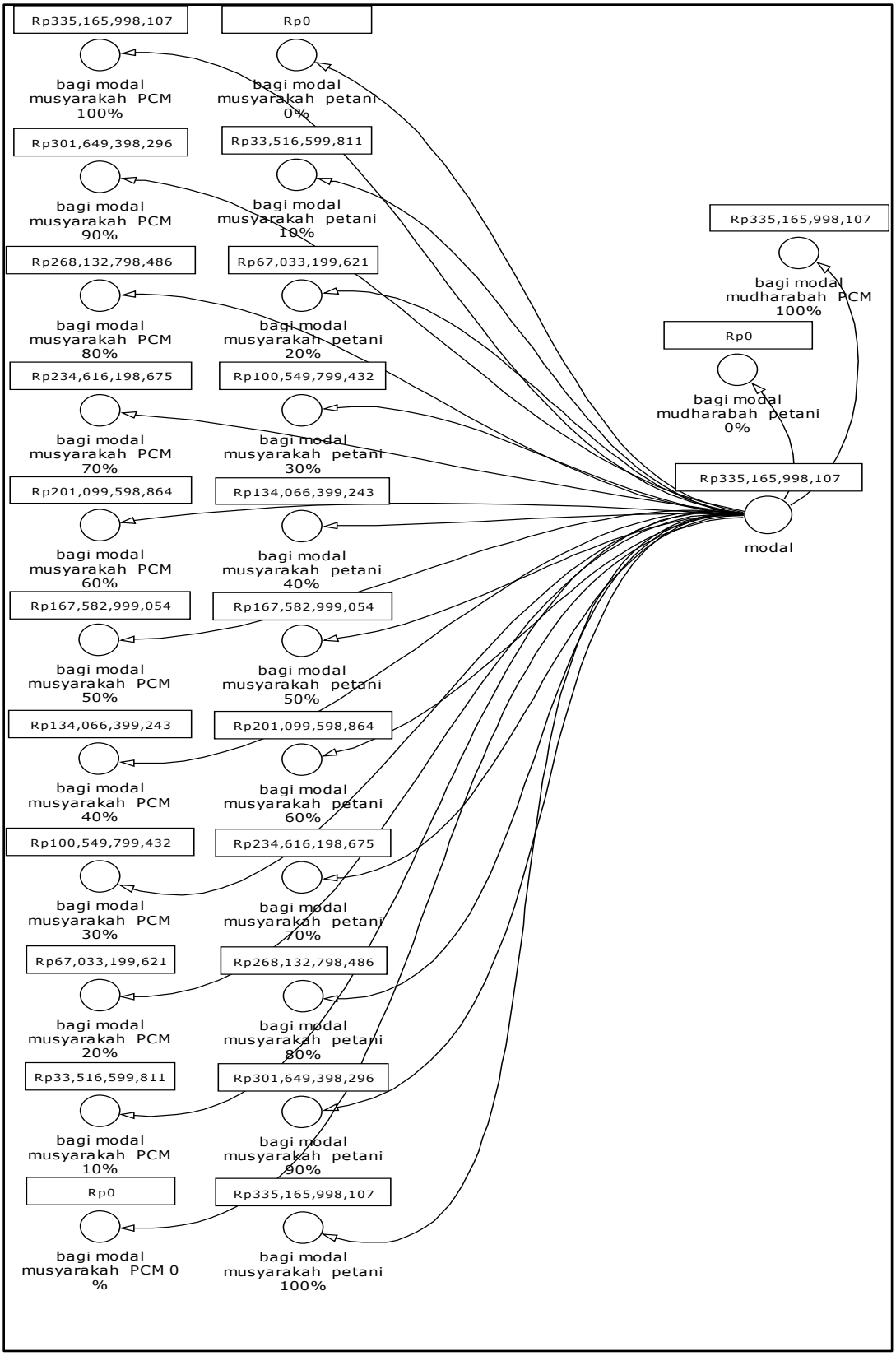

Figure3:- Musyarakah Partnership Stock-Flow Diagram.

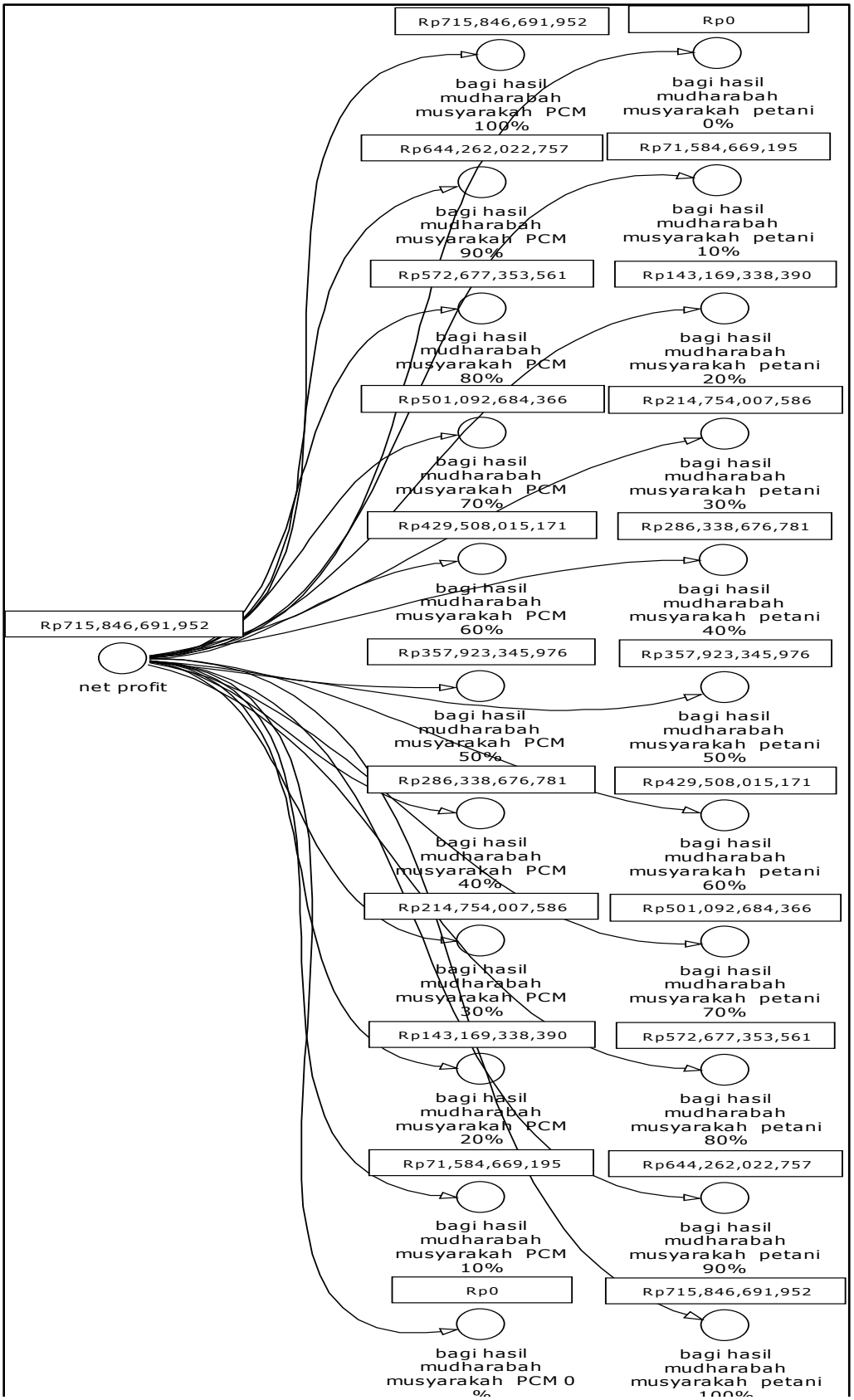

Figure4:-MudharabahPartnership Stock-Flow Diagram.

Model Verification and Validation.

Model verification aims to check for errors and ensure that the model behaves according to the research logic (Barlas 1989). Verification is used to prove that the results of the model made are by the design of the conceptual model of the system. While validation is used to see whether the model created is by reality or not. Validation is a process carried out to determine whether the simulation model can represent the real system accurately. Validation is the process of testing a simulated conceptual model that can represent accurately the real system being simulated (Kelton 2000).

The verification process is carried out by running the model in Powersim Studio 10 software. The results show that the model can be run properly and that the existing calculations and formulas are dimensionally consistent. Based on this it can be concluded that the model has been verified. The model verification process is carried out by reviewing the calculations in the variables and examining the model output fairly.

Validation was tested with a real system, namely with the MAPE test (Equation 1) or the mean absolute percentage error. This test can be used to determine the suitability of the simulated data with actual data. Table 1 shows the results of model validation using MAPE.

$$\text{MAPE} = 1/n \sum_{n=1}^{n} \left(\frac{St - At}{At}\right) 100\% \quad (1)$$

Under the condition

1. MAPE < 5%: very accurately describes the actual conditions.
2. 5% < MAPE < 10%: sufficiently accurate to describe the actual condition.
3. MAPE > 10%: does not accurately describe the actual condition.

Table1:-Model Validation Using MAPE.

Years	Producing planting area		Harvest coffee beans		Capital (Rp in million)		Net profit (Rp in million)	
	Actual	Simulation	Actual	Simulation	Actual	Simulation	Actual	Simulation
2019	7.463.11	7.285.45	26.688.8	26.778.2	342.715,96	334.557,47	731.971,88	714.547,00
2020	8.048.11	8.274.95	30.106.4	30.438.1	369.579,94	379.996,94	789.347,90	811.596,51
MAPE	0.2190%		0.7183%		0.2190%		0.2190%	

Source: Processed Data, 2022

A MAPE value of less than 5% means that the system model that has been made is very precise and fairly accurately describes the actual system conditions. After being declared valid, the model is used to predict coffee bean harvests and Islamic financing from 2021 – 2030.

Existing Condition Simulation Results

Simulation results of current conditions (existing) based on economic, social and environmental aspects (Table 2). The economic aspect can be seen in Figure 5 where farmers' income continues to increase every year, although it is not significant. With increasing farmer income, the economic conditions of farmers will improve. The social aspect can be seen in Figure 6 where the daily working person increases every year. The coffee planting area has increased, meaning that more daily workers are needed. Environmental aspects can be seen in Figure 7 where the use of chemicals, namely pesticides, in coffee farming increases every year. The coffee planting area has increased, meaning that more pesticides are needed.

Table2:-Existing Condition Simulation Results.

Time	luas tanam menghasilkan (HA)	panen biji kopi (Ton)	modal (RP)	net profit (RP)	HOK (da)	Pengggunaan pestisida (l)
Jan 1, 2019	7,285.45	26,778.20	334,557,470,654	714,547,000,556	273,204.29	14,570.90
Jan 1, 2020	8,274.95	30,438.09	379,996,942,687	811,596,510,118	310,310.80	16,549.91
Jan 1, 2021	8,930.65	32,766.31	410,107,530,866	875,906,628,277	334,899.52	17,861.31
Jan 1, 2022	9,759.73	36,075.83	448,179,680,934	957,221,030,201	365,989.77	19,519.45
Jan 1, 2023	10,452.76	38,524.40	480,004,528,736	1,025,192,459,730	391,978.38	20,905.51
Jan 1, 2024	11,496.24	42,312.55	527,922,659,098	1,127,535,881,491	431,108.99	22,992.48
Jan 1, 2025	12,041.25	44,073.63	552,950,369,070	1,180,990,001,217	451,546.97	24,082.51
Jan 1, 2026	12,919.56	47,283.22	593,283,200,850	1,267,132,761,431	484,483.32	25,839.11
Jan 1, 2027	13,840.02	51,001.40	635,552,139,773	1,357,410,654,389	519,000.73	27,680.04
Jan 1, 2028	14,716.20	54,168.74	675,787,307,001	1,443,344,822,899	551,857.33	29,432.39
Jan 1, 2029	15,552.01	57,453.65	714,168,827,924	1,525,319,978,315	583,200.21	31,104.01
Jan 1, 2030	16,046.88	58,971.93	736,894,080,708	1,573,856,515,795	601,757.97	32,093.76

Source: Processed Data, 2022

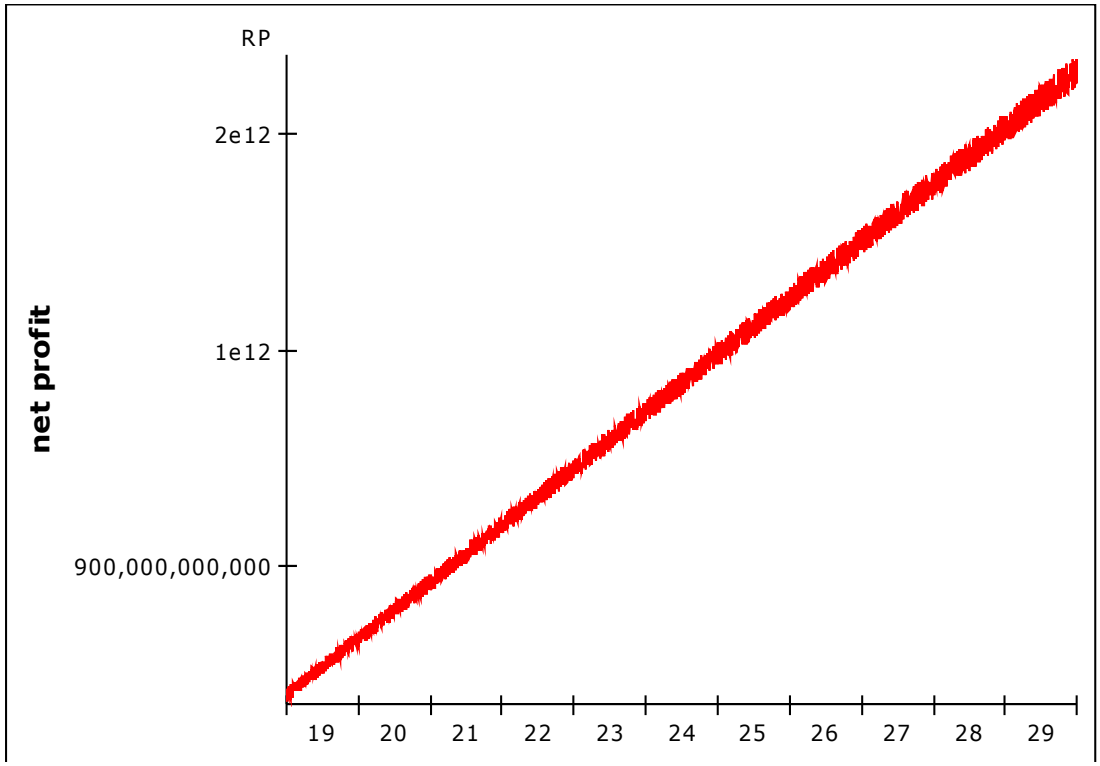

Figure5:-Farmer Income Simulation Results.

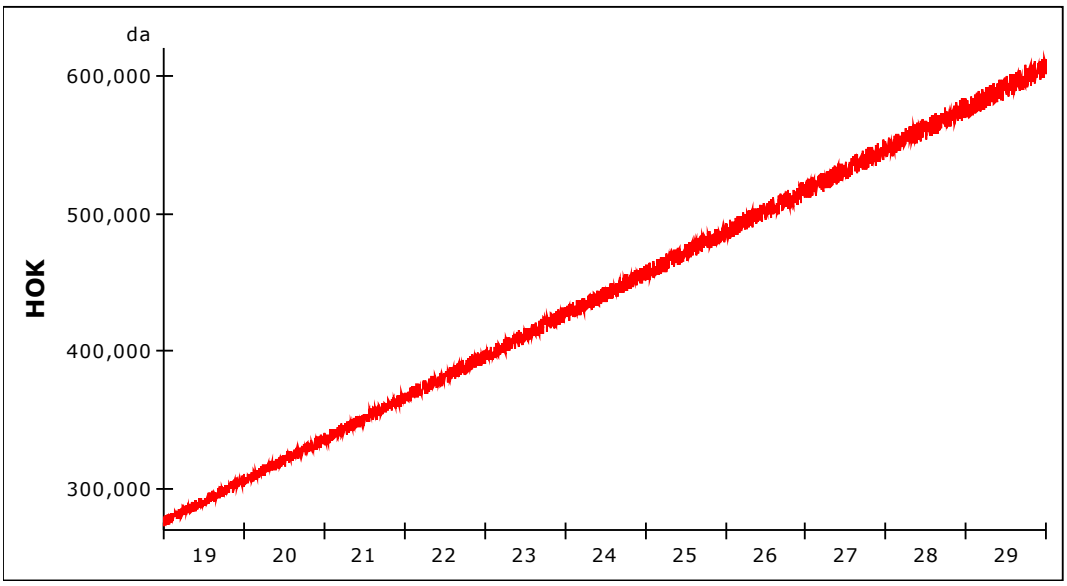

Figure6:- DailyWorkingPersonSimulation Results.

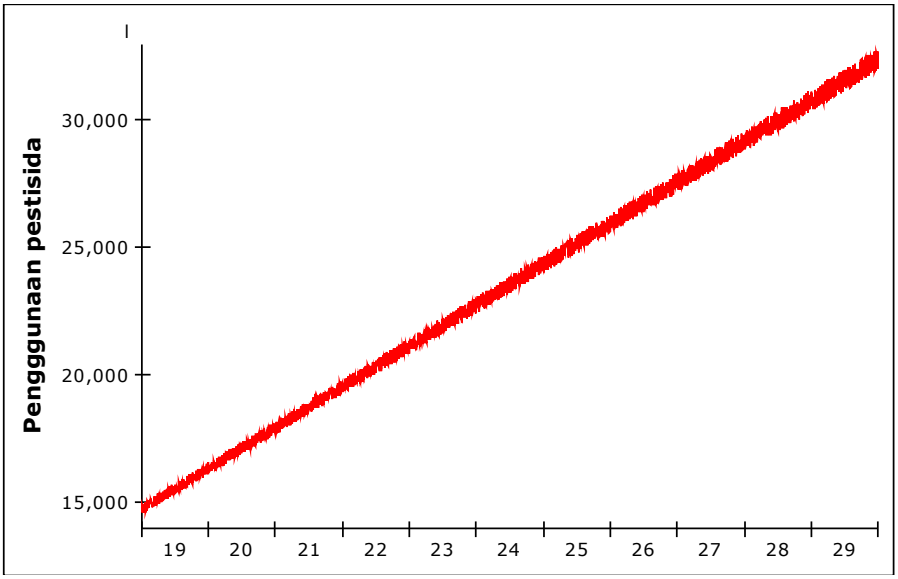

Figure7:- Pesticide Use Simulation Results.

Mudharabah Principle Financing.

Financing uses the Mudharabah principle, the farmer must notify and explain the business/business to the PCM to find out if the business/halal business is halal. Mudharabah is a collaboration between PCM and farmers where PCM is the provider of all the capital, while the farmers are the coffee managers.

Musyarakah Principle Financing.

Financing uses the Musyarakah principle, the farmer must inform and explain the business/business to the PCM to find out if the business/halal business is halal. Musyarakah is a cooperation contract between PCM and farmers for coffee businesses where each party contributes funds by mutual agreement. In the financing model using the musyarakah principle, every 10% increase is simulated to see the distribution of capital between PCM and farmers and to be taken into consideration for making decisions in dividing financing.

Profit Sharing Principles of Mudharabah and Musyarakah.

Profit sharing uses the mudharabah principle where business profits are shared according to a mutual agreement and

losses are borne by the PCM as long as the loss is not the result of the farmer's negligence. If the loss is caused by the farmer, then the loss is borne by the farmer. Whereas profit sharing uses the musyarakah principle where profits and risks will be shared according to the agreement.

Land Utilization Policy Scenario.

In the existing conditions, the land area consists of immature land, productive land and damaged land. Immature land and damaged land can be repaired by looking for what causes them. If the land is repaired and fertile again, the planting area will increase, which will increase coffee yields and income. In this scenario, the system will be created by minimizing immature land and damaged land. Utilization of land use by increasing 7.5% of productive planting land. Table 3 shows the results of the simulation of capital and income in Scenario 1.

Table3:- Capital and Income Simulation Results Scenario 1.

Time	luas tanam menghasilkan (HA)	panen biji kopi (Ton)	modal (RP)	net profit (RP)	HOK (da)	Pengggunaan pestisida (l)
Jan 1, 2019	9,672.45	35,384.10	444,171,728,250	948,660,854,985	362,716.82	19,344.90
Jan 1, 2020	10,714.17	39,112.01	492,009,073,724	1,050,831,736,587	401,781.46	21,428.34
Jan 1, 2021	11,961.71	44,202.84	549,297,574,729	1,173,188,372,292	448,564.05	23,923.42
Jan 1, 2022	13,057.09	47,665.35	599,599,178,094	1,280,622,409,671	489,641.04	26,114.19
Jan 1, 2023	14,103.96	51,870.92	647,672,709,445	1,383,297,736,472	528,898.55	28,207.92
Jan 1, 2024	15,085.24	55,384.20	692,734,403,621	1,479,540,389,043	565,696.56	30,170.48
Jan 1, 2025	16,258.05	59,967.04	746,591,317,225	1,594,567,849,048	609,676.87	32,516.10
Jan 1, 2026	17,152.95	63,068.33	787,686,341,624	1,682,338,498,331	643,235.64	34,305.90
Jan 1, 2027	18,404.45	67,581.55	845,156,683,476	1,805,083,509,258	690,166.72	36,808.89
Jan 1, 2028	19,488.09	71,684.98	894,918,857,638	1,911,365,435,108	730,803.20	38,976.17
Jan 1, 2029	20,591.20	75,366.82	945,575,427,000	2,019,557,607,967	772,170.06	41,182.40
Jan 1, 2030	21,345.33	78,538.39	980,206,160,477	2,093,521,841,032	800,450.00	42,690.67

Source: Processed Data, 2022

EconomicAspect.

The economic aspect can be seen in Figure 8 where farmers' income continues to increase every year. With increasing farmer income, the economic conditions of farmers will improve. In the existing conditions, income increases. In scenario 1, revenue increases dynamically every year with a profit increase of 32.76%. Based on the economic aspect, it can be concluded that the Land Use Policy has a positive impact on agroforestry activities for Arabica Java Preanger coffee.

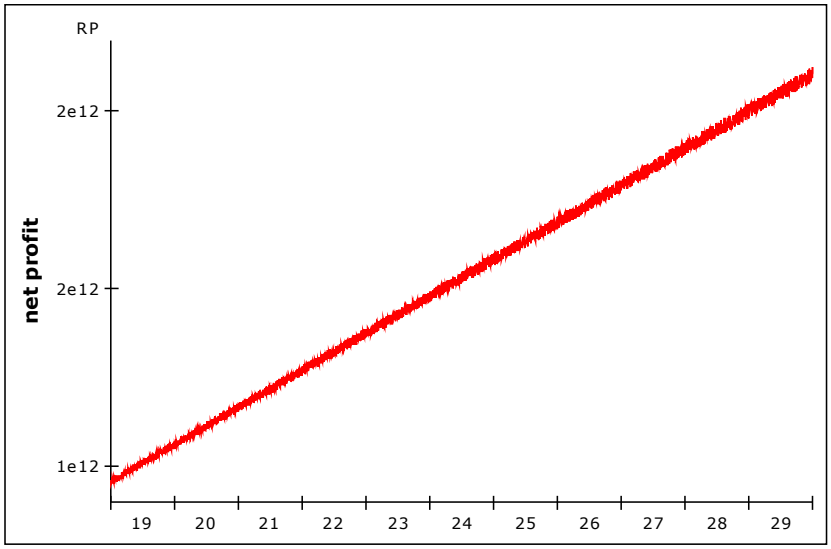

Figure8:-Income Simulation Results Scenario 1.

EnvironmentalAspect.

Environmental aspects can be seen in Figure 9 where pesticides are increasing. The coffee planting area increased, meaning that more pesticides were needed with an increase in pesticide use of 32.7%. Based on the environmental aspect, it can be concluded that the Land Use Policy hurts agroforestry activities for Arabica Java Preanger coffee. Minimization of the use of pesticides must be done. There needs to be a substitution of the use of pesticide fertilizers for organic fertilizers (biopesticides). The Zero Emission target also needs to be applied to the agroforestry activities for Arabica Java Preanger coffee.

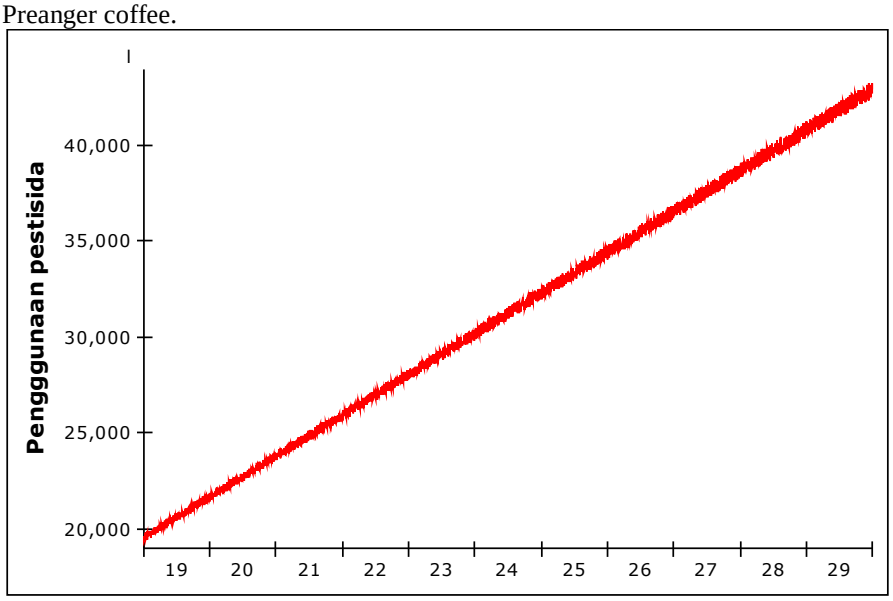

Figure9:-Pesticide Use Simulation Results of Scenario 1.

SocialAspect.

The social aspect can be seen in Figure 10 where the daily working person is increasing every year. The planting area has increased, meaning that it requires additional workers, especially during harvest. If workers increase, daily working person will also increase with an increase in daily working person of 32.7%. Based on the social aspect, it can be concluded that the Land Use Policy has a positive impact on the agroforestry activities for Arabica Java Preanger coffee. Increasing the welfare of the community can increase with the availability of employment opportunities.

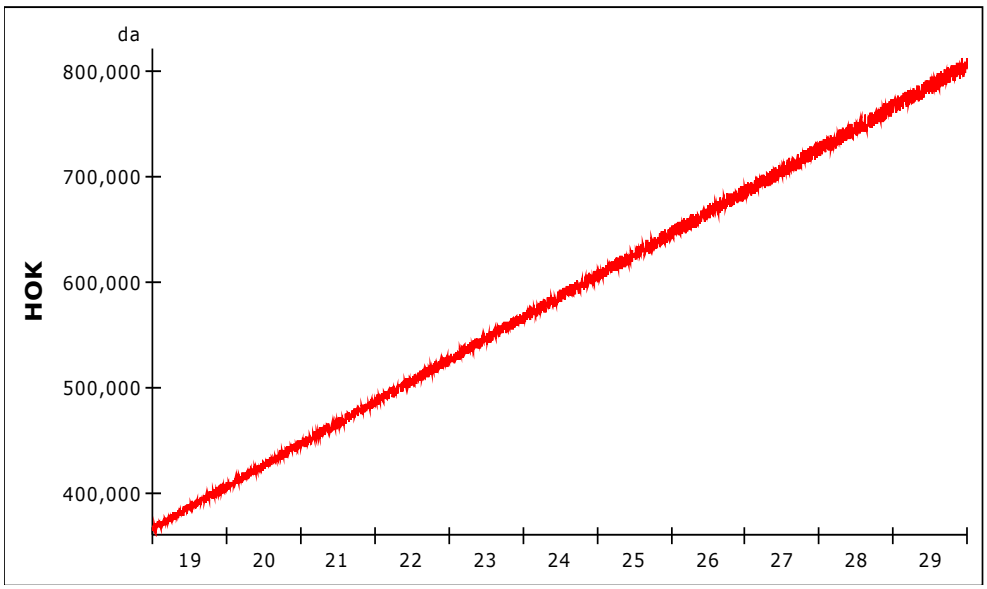

Figure10:- Simulation of daily working personof Scenario1.

Policy Scenario for Increasing Harvest Productivity and Land Utilization.
In this scenario, the productivity of the crop increases over 2 times. Productivity in the existing conditions is 3.66 tons/ha, in scenario 2 productivity is 7.32 tons/ha.

Table 4:-Capital and Income Simulation Results Scenario 2.

Time	luas tanam menghasilkan (HA)	panen biji kopi (Ton)	modal (RP)	net profit (RP)	HOK (da)	Pengggunaan pestisida (l)
Jan 1, 2019	8,480.78	61,860.56	389,448,566,115	831,783,263,558	318,029.12	16,961.55
Jan 1, 2020	9,461.18	69,211.27	434,469,977,893	927,939,881,085	354,794.23	18,922.36
Jan 1, 2021	10,483.71	76,075.73	481,426,079,622	1,028,228,604,522	393,139.24	20,967.43
Jan 1, 2022	11,229.66	81,501.39	515,680,996,481	1,101,390,169,404	421,112.28	22,459.32
Jan 1, 2023	12,203.15	88,932.42	560,384,692,680	1,196,868,210,800	457,617.94	24,406.29
Jan 1, 2024	13,244.40	96,916.02	608,200,567,173	1,298,993,234,734	496,665.05	26,488.80
Jan 1, 2025	14,122.01	102,808.41	648,501,356,629	1,385,067,559,034	529,575.24	28,244.01
Jan 1, 2026	15,157.52	110,671.98	696,053,390,706	1,486,629,073,274	568,406.89	30,315.03
Jan 1, 2027	16,019.75	116,625.51	735,648,074,439	1,571,195,298,753	600,740.46	32,039.49
Jan 1, 2028	17,019.96	123,461.57	781,579,136,834	1,669,294,745,770	638,248.41	34,039.92
Jan 1, 2029	18,029.14	131,133.20	827,922,140,737	1,768,274,016,421	676,092.75	36,058.28
Jan 1, 2030	18,994.33	138,190.78	872,245,003,554	1,862,938,674,842	712,287.42	37,988.66

Source: Processed Data, 2022

EconomicAspect.
The economic aspect can be seen in Figure 11 where farmers' income continues to increase every year. By increasing the income of farmers, the economic conditions of farmers will improve with an increase in income in scenario 2 of 16.4%. Based on the economic aspect, it can be concluded that the Policy to Increase Harvest Productivity and Land Utilization has a positive impact on agroforestry activities for Arabica Java Preanger coffee.

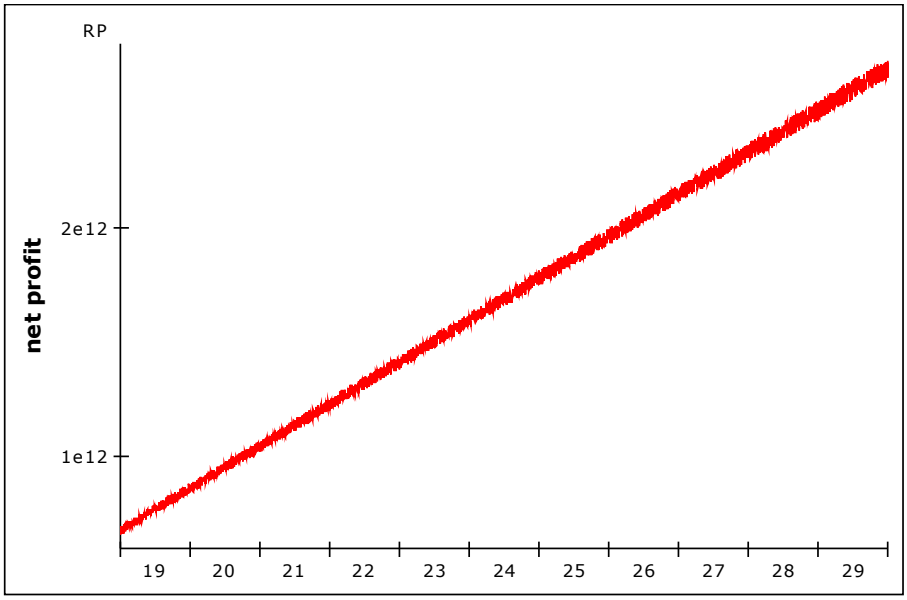

Figure11:- Income Simulation Results Scenario 2.

Environmental Aspects.
Environmental aspects can be seen in Figure 12 where pesticides are increasing. The coffee planting area increased, meaning that more pesticides were needed with an increase in pesticide use of 16.4%. Based on environmental

aspects, it can be concluded that the Policy to Increase Harvest Productivity and Land Utilization hurts agroforestry activities for Arabica Java Preanger coffee. The same thing needs to be done as in the Land Utilization Policy. Minimization of the use of pesticides must be done. There needs to be a substitution of the use of pesticide fertilizers for organic fertilizers (biopesticides). The Zero Emission target also needs to be applied to the agroforestry activities of Java Preanger Arabica coffee.

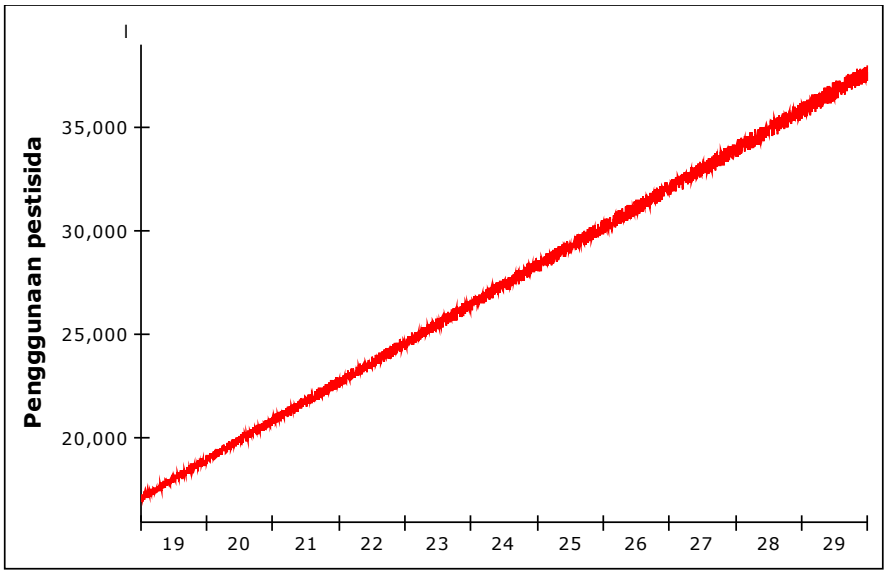

Figure12:-Pesticide Use Simulation Results of Scenario 2.

SocialAspect.

The social aspect can be seen in Figure 13 where the daily working person are increasing every year. The planting area has increased, meaning that it requires additional workers, especially during harvest. If workers increase, daily working person will also increase with an increase in daily working person of 16.4%. Based on the social aspect, it can be concluded that the Policy for Increasing Harvest Productivity and Land Utilization has a positive impact on agroforestry activities for Java PreangerArabica coffee. Increasing the welfare of the community can increase with the availability of employment opportunities.

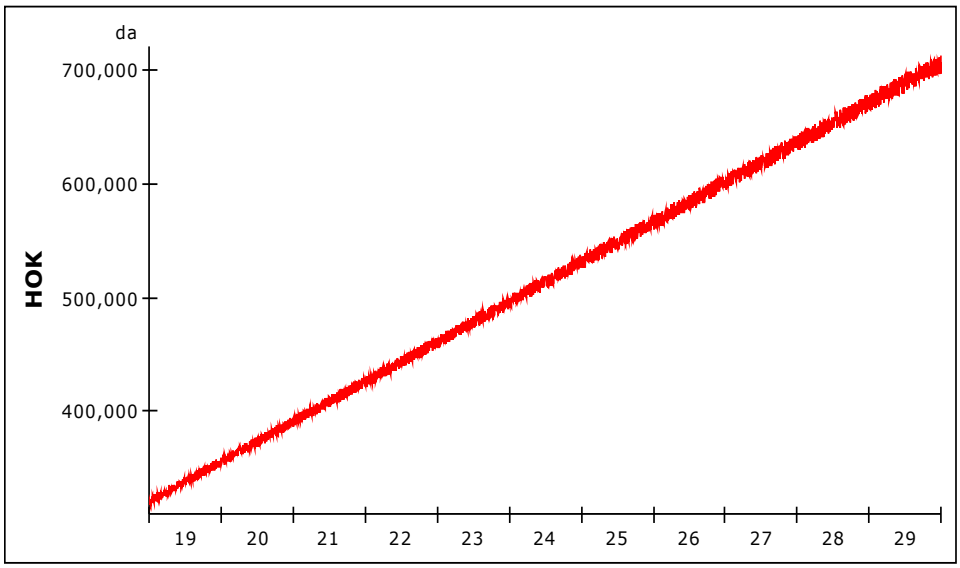

Figure13:- Simulation of daily working personof Scenario 2.

Conclusion:-

The results of the current condition simulation based on economic, social and environmental aspects show that farmers' income increases, from the social aspect the increased crop area, will affect the increase in daily working person, and the environmental aspect increases where the use of lots of fertilizers and pesticides. In the land use policy scenario (Scenario 1), from an economic perspective, farmers' income continues to increase every year, although it is not significant. With increasing farmer income, the economic conditions of farmers will improve. In the existing condition, income tends to increase and some decrease over several years. In Scenario 1, from an economic point of view, farmers' income increases, from an environmental aspect, the planted area increases which will affect the use of chemicals in coffee farming. On the social aspect, the increased planting area will also affect the daily working person. In the policy scenario for increasing crop productivity and land use (Scenario 2), from an economic perspective, farmers' income continues to increase every year, although not significantly. On the environmental aspect, the planting area will increase which will affect the use of chemicals in coffee farming. On the social aspect, the increased planting area will also affect the daily working person. The planting area has increased, meaning that it requires additional workers, especially during harvest. If workers increase, daily working person also increases.

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