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# Agroforestry Application on Forest Land Under Stands System to Increase Reserved Food and Forest Sustainability at Pujon, Malang District

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## 2 Agroforestry Application on Forest Land Under Stands System to Increase Reserved Food and Forest Sustainability at Pujon, Malang District

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**Abstract.** This research will produce a forest management model that can increase food reserves and the competitiveness of agricultural products from the use of forest land under stands, as an effort to increase food security. The research will be conducted in the production forest area of The State Forestry Public Company (*Perhutani*) BKPH Pujon KPH Malang Unit II, East Java from September 2020 to February 2021. The method of developing a management model is based on the level of land development. The analysis uses the Structural Equation Model (SEM) model with the help of the WarpPLS program (Partial Least Square development) which is able to accommodate reflective and formative indicators to test the effect between variables. Land use under stands carried out in the agroforestry model provides economic and environmental benefits, therefore, it was to be able to maintain forest sustainability. Profits from agroforestry on land under stands with intercropping of seasonal crops of vegetables and pulses B/C ratio = 1.77.

**Keywords.** Management, forest land, stands, products

### 1. Introduction

Agroforestry is a land management system based on sustainability that increases the overall yield of the land, combines the production of agricultural crops (including tree crops) and forest plants and/or animals simultaneously or sequentially on the same land unit and applies appropriate management methods, with the local culture. Agroforestry systems are forms of sustainable land use that combine trees and shrubs with crops and livestock in ways that enhance and diversify agricultural and production forests (Araujo, Ademir, Leite, Luiz, Iwata, Bruna, Andrade, Mario, Gustavo, Vale, Figueiredo, 2012)

Strengthening food security based on the development and strengthening of the agribusiness sector is aimed at improving the economy of communities around forest areas. As is known, the Wonosadi community has applied the concept of awareness of reality with the idiom diligently (sincerely). sign (hint). pressure (to the thing aspired to) and the concept of mythological awareness of *sangkan paraning dumadi* of the forest (Nurhadi, Bakti & Baiquni, 2012). Cassano, Camila., Barlow., Jos and Renata (2012) explained that the characteristics of the agroforestry model, humans can modify and create job opportunities by combining

agricultural, forestry, livestock and fishery production with biodiversity conservation in tropical forest areas. Anderson, Emily, Zerriffi, and Hisham (2012) explained that agroforestry is an Eco farming activity that is getting attention because of the potential to take advantage of the climate that can provide benefits in rural development, especially for small farmers. Further explained by Button., Place. and Gauthier (2013) that agroforestry aims to help increase farmers' income and welfare. Triwanto (2013) explained that Pujon Kidul Village, Pujon District, Malang Regency is one of several villages in the Malang Regency area, the community's economic activities are still based on the agricultural sector. research, so it is necessary to apply agroforestry under stands as an effort to increase food security to improve the economy and the environment of the community around the forest. The research aims to produce a study of land management models under production forest stands that are integrated, balanced and sustainable: Assessing various conditions of land under production forest stands at various stages of development that will be applied to agroforestry models, assessing optimal and sustainable land use models by combining between forestry activities and agricultural activities.

Complex agroforestry systems have not only proven to be economically beneficial as population density increases, but are also beneficial for environmental conservation in the long term.

The application of the agroforestry model is also "flexible" meaning that it can be developed in various types of areas, so that this agroforestry model is later expected to be one of the reference models for land management of production forest plantations that favors improving community welfare, food security and environmental sustainability of forest areas and strengthening food security. national (Simon, 2001 and Awang, 2005)

## **2. Research Method**

This research was conducted from September 2020 to February 2021 at RPH Pujon Kidul, BKPH Pujon, KPH Malang". Regional Division II The State Forestry Public Company (*Perum Perhutani*) II East Java in the Pujon District, Malang Regency. The research was conducted using the Structural Equation Model (SEM) model with the help of the WarpPLS (Partial Least Square development) program which is able to accommodate reflective and formative indicators to examine the influence between complex variables, namely between policy, economy, socio-culture, empowerment, management, ecology and performance.

## **3. A subsection**

### **3.1. Crop yield**

The types of agricultural crops planted by farmers are influenced by the level of agroforestry development and seasons. Based on the results of measurements on plots in the field, the average percentage of agricultural crops reached 85%. The types of vegetable crops grown are generally divided into 4 growing seasons, namely the first planting season (MT1) starting from October to December, the second planting season (MT2), from January to March, and the third planting season (MT3) starting from April to June. and the fourth planting season (MT4) from July to September of the current year, taking into account the availability of water, adaptation of plants to weather or climate, intensity of pest and disease attacks and the selling price of plants. Most of the farmers grow broccoli, cabbage and carrots with a percentage of more than 30%. In the second and third planting seasons, the types of vegetables grown were relatively varied, while in the fourth planting season, maize, potato and cabbage were dominated by percentages. The distribution of plant types is presented and the productivity of several

vegetable crops is presented in Table 1 and Table 2.

Table 1. Types of agricultural crops per growing season

Types of food crops	Growing season								Average	
	MT1		MT2		MT		MT4		Num	%
	Num	%	Num	%	Num	%	Nu	%		
Broccoli	128	16	77	10	79	10	96	12	399	12
Bean	24	3	16	2	21	3	16	2	81	2
Chili	26	3	40	5	66	8	40	5	182	5
Curly Chili	40	5	48	6	55	7	56	7	211	6
Corn	64	8	88	11	95	12	104	13	373	11
Potato	120	15	96	12	87	11	120	15	447	13
Cabbage	105	13	120	15	102	13	104	13	461	14
Chinese cabbage	80	10	80	10	79	10	88	11	347	10
Eggplant	24	3	56	7	55	7	32	4	181	5
Tomatoes	40	5	48	6	55	7	24	3	179	5
Carrot	146	18	128	16	103	13	120	15	529	16
Amount	797	100	797	100	797	100	797	100	3388	100

Grass harvest rotation at both levels of agroforestry is highly dependent on weather or climate. For the rainy season, harvesting rotation can be achieved for 3 months, while in the dry season it takes a longer time, reaching 4-6 months. Presented in table 2

Table 2. Productivity of vegetable crops

No	Types of Food Crops	Productivity (ton/Ha)
1	Broccoli	10Ton/Ha
2	Bean	10Ton/Ha
3	Chili	10Ton/Ha
4	Curly Chili	7 Ton/Ha
5	Corn	5Ton/Ha
6	Potato	16Ton/Ha
7	Cabbage	15Ton/Ha
8	Chinese cabbage	13Ton/Ha
9	Eggplant	5 Ton/Ha
10	Tomatoes	15Ton/Ha
11	Carrot	10Ton/Ha
12	Broccoli	10Ton/Ha

The forest land used by the residents for agroforestry based on vegetable crops under forest stands shows a B/C ratio of 1.77, which means that the model is profitable for farmers and this is feasible, provided that the environment is considered. Environmental conservation has become a shared responsibility that always maintains a very strong relationship with the forest environment and lives from the use of forest resources. The activities of vegetable-based agroforestry farmers have become a source of community income, which are presented in Table 3

Table 3. Income of vegetable-based agroforestry farmers

No	Income Description	Amount
1	Average land area share (Ha)	0,125
2	Average revenue (IDR/year)	55 million
3	Average cost of production facilities (IDR/year)	15 million
4	Average labor cost (IDR/year)	3 million
5	Average total cost (IDR/year)	18 million
6	Average profit (IDR/year)	37 million
7	BC Ratio	1,77

The issue of forest destruction is often associated with the number of people living around the forest who are experiencing economic difficulties, so they do illegal logging. Related to this issue, it is necessary to use land under stands without causing disturbance to forest damage (Mustofa, 2011).

Public policy is the main capital owned by the government to organize people's lives in various aspects of life (Nurgroho, 2017; Rusli, 2013 Widiyanto, 2016;). The economic environment is measured by six reflective indicators. The results of the outer loading of indicators from the economic environment can be seen in Table 4.

Table 4. Testing Results of the Indicators of the Economic Environment

No	Indicator	Outer Loading	p-value
1	Availability of places to sell factors of production	0,514	< 0,001
2	Availability of product marketing places	0	0
3	Freedom to sell produce	-0,596	< 0,001
4	Ease of accessibility	0,167	< 0,001
5	Dairy production per day	0,684	< 0,001
6	Animal feed price	0	0

In Table 4, all indicators of the economic environment have an outer loading value of 0.514; 0; -0.596; 0.167; 0.684 and 0 with four indicators showing p-value below 0.05. It can be concluded that the four indicators have a positive effect on measuring the economic environment and indicate the higher the indicator value, the higher the position of the economic environment.

In the production process of agroforestry farmers, there is a functional relationship between output (products of production) and production inputs (cost of production) (Effendy et al., 2010; Anindita, 2004; Kartadiharjo, 2008). The operational activities of agroforestry

farmers (production process) require various needs (capital) and affect the success of their performance. agriculture (Soemarno & Hidayat. 2010; Hairiah & Ashari 2013; Febriani, 2014).

Business sustainability from the aspect of ecological management is measured by five formative indicators. The results of the outer weight indicators of business sustainability from the aspect of ecological management can be seen in Table 5 as follows:

Table 5. Testing Results of Business Sustainability Indicators from the Aspect of Ecological Management

No	Indicator	Outer Weight	p-value
1	Knowledge of the importance of the existence of forests	0,546	< 0,001
2	Increased tree planting	0,402	< 0,001
3	Participation in forest maintenance and monitoring	0,307	< 0,001
4	Limiting the area of land use	-0,473	< 0,001
5	Operating revenues	0,128	< 0,001
6	Adding business assets	0,413	< 0,001
7	Addition of area	-0,436	< 0,001
8	Message obedience	-0,25	< 0,001

Based on Table 5, all indicators of business sustainability from the aspect of ecological management have an outer weight value of 0.546; 0.402; 0.307; -0.473; 0.128; 0.413; -0.436 and -0.25 with p-values all below 0.05. It can be concluded that all indicators have a positive effect on measuring business sustainability from the aspect of ecological sustainability. Of the eight indicators of business sustainability from the aspect of ecological management, the indicator of Increasing knowledge of the importance of the role of forests for agroforestry farmers dominates and the lowest indicator limits land conversion.

### 3.2 Discussion

The important value of agroforestry in providing forage to meet the needs of animal feed, the focus of providing forage in this income analysis is grouped as a component of calculated costs, namely costs that should be incurred by farmers but in reality farmers incur costs for purchasing grass, because they have fulfilled it from the land. Agroforestry as a form of forestry development has the same emphasis on all aspects of the forest resource system, both in the form of wood, non-timber and environmental services it has (Triwanto and Sidik, 2005). Agroforestry techniques to be applied must meet three principles, including; productivity, sustainability and adoptability. Furthermore, Triwanto (2006 a,b 2013 and 2015) explained that various studies on agroforestry showed many advantages over other land use systems, especially monoculture systems, in terms of ecology, economy, socio-culture and politics. Some of these advantages are; Ecological or environmental advantages, because agroforestry has relatively high ecological stability, Economic advantages; providing relatively high and sustainable welfare to farmers, Socio-cultural advantages, which have high compatibility with the conditions of knowledge, skills and cultural attitudes of farming communities, Political advantages, because agroforestry can fulfill the political desires of the wider community. Agroforestry is able to sustain production to increase social, economic and environmental benefits for land users at all levels (Buttoud, Place, and Gauthier, 2013). Understand agroforestry is useful in preventing the expansion of degraded soils, conserving forest

resources, improving agricultural quality, and enhancing silviculture intensification and diversification. Table 2 shows that this system has been practiced by farmers cultivating vegetable crops under forest stands showing a B/C ratio of 1.77 which means that the model is profitable for farmers and this is feasible with a note that it takes into account the environment. Prasad et al (2012) said that there are several advantages of agroforestry compared to other land use systems such as: Productivity, Diversity, Self-regulation; and Stability; Able to provide balanced results throughout land tenure, so as to ensure environmental stability. In table 4, the indicators of the economic environment, the indicator of cow's milk production per day are the most dominant and main indicators measuring the economic environment, while the lowest is the indicator of freedom to sell agricultural products (vegetables) prices still depend on middlemen. Agroforestry provides potential to farmers, reduces poverty through the production and sale of agroforestry to meet household consumption and well-being and contributes to food security by restoring agricultural soil fertility for food crops and production of fruits, nuts and vegetable oils, to reduce deforestation and pressure on forests by providing firewood, and increasing diversity in agriculture. Agroforestry, as part of a multifunctional working landscape, can play a major role in conserving and even enhancing biodiversity from agriculture, animal husbandry, forestry and plantations as an effort to demonstrate the biodiversity benefits of agroforestry. A form of land management that combines the principles of agriculture and forestry in the sense of using land to obtain food, fiber and animal protein. Forestry to obtain carpentry and or firewood production as well as aesthetic, hydrological and flora and fauna conservation functions.

Table 5 shows that knowledge of managing the ecology and forest environment is very important, in addition, in agroforestry to be feasible to be applied in a place, it must meet the requirements, such as technically applicable, economically feasible, socially acceptable to the local community (socially acceptable) and friendly to the environment (environmentally sound). According to Simon (2001); Sendzimir and Magnuszewski (2011) that in order to harmonize the forest management system with environmental conditions, on the one hand the interests of the community must be accommodated in forestry activities, while on the other hand the community is used to shape productive forest management performance for the common good. Agroforestry model as an alternative that can help prevent land degradation while allowing land use to continue to produce crops and livestock sustainably (Sardjono, 1990; Aujo, et al 2012; Suharjito, 2014) Further (Dhokal, Cockfield, and Maraseni, 2012) consider five key components of agroforestry: agricultural crops, livestock, forest tree crops, fruit tree crops and vegetable crops. As a tangible manifestation that will always be felt by forest village communities is through the development of productive businesses and agricultural crops or plantations without leaving elements of regional potential, population composition and life order (Suhendra, 2006, Triwanto, 2007 and Fauzi, 2017). Several factors that affect the level of farmers' income, among others, the factor of land area, the number of livestock and the level of development of agroforestry. These factors greatly affect the increase in farm productivity at various levels of agroforestry, while the factors of age, number of families, land area owned and level of education of farmers have no significant effect on farmers' profits. Therefore, through a scientific and technological approach, farmers should be able to obtain optimum benefits from the use of farming land at various levels of agroforestry development without having to damage forest crops.

#### 4. Conclusion and Suggestion

##### 4.1. Conclusion

The pattern of agriculture under the stand applied in the form of agroforestry provides economic and environmental benefits. The profit of agroforestry as a food reserve with a silvopasture model based on dairy farming on land under stands is greater than that of intercropping seasonal crops using vegetables and secondary crops, B/C ratio = 1.77.

##### 4.2. Suggestion

It is hoped that through this research, farmers can increase land intensification by paying attention to the positive ecological impact in the form of a more balanced environmental sustainability by minimizing the level of forest damage and improving the community's economy, so that agroforestry development patterns can be carried out optimally.

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