



Sustainability and Agrosilvopastoral Development Model: Farmers Perceptions and Supporting Factors in West Sumatera, Indonesia

Fitrimawati*¹ and Indira Adnani²

Andalas University, Padang City, West Sumatera - 25175, Indonesia

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ABSTRACT

The Agrosilvopastoral model application can transform an agricultural development system efficiently and sustainably. This model can integrate a potential for some agricultural sub-sectors in a region. This study aims to analyze farmers' perceptions and supporting factors for a livestock development by using the Agrosilvopastoral model. The research was being conducted by smallholder farmers in Tanah Datar district of West Sumatera province. They were asked to fulfill out the relative questionnaires with that research. The obtained data was analyzed by using a Likert Scale and Structural Equation Modeling. Thus the research results are obtained from farmers' perceptions for applying the Agrosilvopastoral model, it is included a good category. Significantly, the factors only encourage the farmers to apply for it in West Sumatera. Those are as the aspects of economy and social. On the other hand there are also the insignificant and environmental technical aspects to encourage them as application in the Agrosilvopastoral model. Therefore, it's an obligation to increase knowledge and skills to raise and create the livestock population, the business scale, the income and farmers' welfare. The environmental awareness is a need increased to realize the sustainable livestock development.

Key words: Sustainably, Agrosilvopastoral, Perception, West Sumatera

The agricultural is a very important sector in Indonesia, but a socio-economic condition of the farming community in Indonesia still shows some wondering questions until now. One of them is shown from a level of the farming community which is still relatively low compared with residents struggling in other economic sectors. It is closely related to various factors, including to the agricultural land ownership and policies which are adopted by the related government regarding in the incentives provision for farmers (Sutrisno 1999). Therefore, the agricultural development is done continuously in Indonesia. The agricultural development is an attempt to change the agricultural conditions; they are from unfavorable to be more favorable conditions. A basic concept of the agricultural development is to be able to optimize the available resources to improve the welfare of farming communities and achieve the food secure protection. A perspective of sustainable agriculture needs to

be taken in remembering mind that Indonesia's population is very big while the natural resources are very limited. The sustainable development is in an effort to maximize a net to benefit of economic development on the conditions that it can maintain and improve some services, qualities and quantities of the natural resources over time (Turner *et al.* 1993).

The sustainable agriculture is a thinking concept in the future. It is still a continuously agriculture till now, also in the future and forever. It's meaning that the agriculture is still exist and benefit and does not cause a disaster for all. The agricultural development planning must fulfill the sustainability principle, which it includes the ecological, the social, and the economic aspects (Wibiwo 2004). The ecological aspects require the sustainable agriculture by emphasizing the environmental quality preservation, agroecosystem, biodiversity, preservation, and nature conservation balance. The economic aspects require the sustainable agriculture as an agricultural business that is able to supply for the high quality products, they are for consumption safe, stable, and continuous all the times. Meaning of the agricultural products are economically

¹Dr. Fitrimawati, Senior Scientist (fitrimawati@ansci.unand.ac.id), Andalas University, Padang City, West Sumatera - 25175, Indonesia

²Dr. Indira Adnani, Senior Scientist (indiraadnani@gmail.com), Andalas University, Padang City, West Sumatera - 25175, Indonesia

efficient, competitive, and having a plus value as profitable. The social sustainability means that the development can create an equitable distribution of the development outcomes, social mobility, social cohesion, community participation, community empowerment, social identity, and institutional development (Serageldin 1996).

The Sustainable agriculture system can be implemented by using a various model and including an organic farming system, integrated farming, integrated pest control, and LEISA (Low External Input Sustainable Agriculture) (Salikin 2003). The Agrosilvopastoral as a model of the sustainable agriculture also has long been applied in Indonesia. It is formed on three main components such as the forestry, the agriculture, and the animal husbandry (Budiasa 2011). It can also function to balance an environmental quality such as mitigating floods, controlling soil erosion, maintaining groundwater supplies, carbon sequestering, air conditioning and freshener, and preserving biodiversity, and creating panoramas (beauty) and rural attractions (Nair 1989c, Chundawat and Gautam 1993, Lal 1995).

In West Sumatra, the smallholder farm majorities are like the beef cattle, the buffaloes and the goat, they are maintained by using the Agrosilvopastoral model. This is very supported because West Sumatra has a natural resource potential where it has a bigger enough production forest is 587,903 Ha, a wide agricultural land where there are also 230,098.6 Ha paddy fields, 346 368.90 Ha plantations and 514,180.20 plantations Ha field 141 .668.00 Ha. rice production 2,810,477.69 tons as much as, corn 985 847 tons, peanuts 4 313 tons, green beans 286 tons, cassava 209 115 tons and sweet potatoes 112 919 tons. It has also quite some agricultural productions and increase productions continuously, namely the crops 7,676.96 tons and fruits 584 234.9 tons. The forest land and agricultural production waste support the farms community development in West Sumatra. This is evident the largest livestock population in it as the beef cattle, goats and buffalo population. In 2017, the population of the beef cattle was 393,481 tails, the goats 255,463 tails and the buffalo 110,236 tails (West Sumatra Central Statistics Agency 2018).

Besides the potential of agriculture, plantation, forestry and livestock are owned by West Sumatra province's communities that have also a human resource potential in the Agrosilvopastoral conducting based on the farming. The farmers have a local knowledge about the Agrosilvopastoral model. They have long adopted about it and even become a tradition. This is the evident from Minangkabau's proverbs (West Sumatra), *bumi sanang padi manjadi, padi masak, jaguang maupia taranak bakambangbiak*. This means that the farming community has implemented integrated the farming with agriculture over there. They work as farmers, planting trees on their lands and as farmers. They use the agricultural waste to feed their livestock and use manure to fertilize their farmlands. These farmlands are surrounded by shady forests.

This is an interesting phenomenon researched how about the farmers' perceptions in the livestock's raising and

keeping in West Sumatra while they use the Agrosilvopastoral model of sustainability approaches. And what factors influence the Agrosilvopastoral model adoption for the investigating terms of the sustainability approach in West Sumatra.

MATERIALS AND METHODS

This research is between a descriptive study mixture and causal research where farmers' perceptions are examined by a descriptive study method while the factors that influence the adoption of animal husbandry by using the model above is analyzed into the causal research usage. This research method is a case study. Determination of the research location based on a purposive sampling in Tanah Datar district. It was a reason chosen to represent the province of West Sumatra because the district has a rugged and hilly topography. The land is planted with the forests, gardens, fields and farm fields, vegetables and fruits. Many people raise the beef cattle, goats and buffaloes by using the Agrosilvopastoral model.

The data are used in this study as a main data which obtained from the farmers as respondents also. The main data was also gotten from interviews and filling out questionnaires by the respondents. The record data on the farmer and rancher numbers by using it is not available in West Sumatra. Therefore, the sample is determined to use the Simple Random Sampling method on the basis of non-statistical (Non-statistical Aspects). It is used if the sample is determined to test the hypothesis empirically and there is no information about the population (Al-Rasyid 1993). The sample numbers based on the calculation is 100 people. The farmer's perception data processed into this research is a scala likert's form. The form of the Likert scale answer is an agreement value strongly (5), agreed (4), doubt (3), disagreed (2), and strongly disagreed (1). Then It is determined trough the farmers or breeders' perceptions who will be grouped into seven categories in a next, namely Very Good, Good, Somewhat Good, Neutral, Somewhat Bad, Not Good and Not very Good. This category determination is being calculated by the total score from each individual's answers.

$$\text{Formula: } T \times P_n$$

T = Total chosen respondents

P_n = Likert score Choice.

All the results are totaled calculated. In order to obtain the results of interpretation, the highest score (X) and the lowest score (Y) must be known for the assessment items by using the following formula:

Y = the highest score Likert × number of respondents

X = the lowest score Likert × number of respondents

The Structural Equation Modeling by using the Partial Least Square (SEM-PLS) used in this study to analyze the factors that drive in the Agrosilvopastoral model application in West Sumatra. It is also used in this study to see the relationship of the social latent variables, environmental and economic aspects to the application latent variables of the

Agrosilvopastoral model by smallholder farmers. The latent variables are formed from indicators that are more reflexive. The path analysis model is built in (Fig 1).

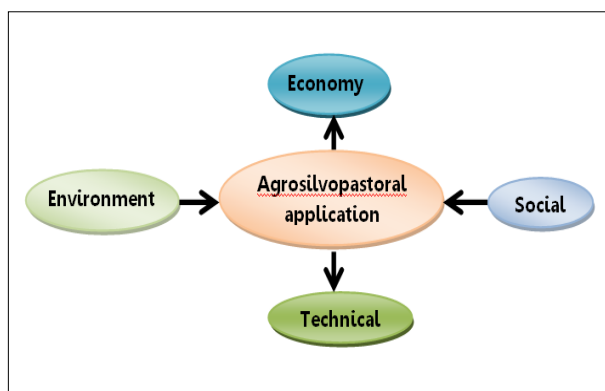


Fig 1 Diagram paths

It is estimated according to the relationship to be analyzed. There are two relationships analyzed in this SEM-PLS capital, which are the inner and outer models. The inner model describes the relationships between the latent variables based on the substantive theories. The outer model is also called the measurement model, which is the relationship of each indicator block with its latent variable. The outer model is evaluated by convergent and discriminant validity of the indicator and composite reliability for the indicator block. The convergent validity of the measurement model is assessed based on the

correlation between item scores with construct scores greater than 0.70. The discriminated validity of the measurement model is assessed based on cross loading measurements with constructs of more than 0.5. The square root of average variance extract (AVE) will also be used to determine discriminated validity. They are the composite reliability and cronbach alpha values above 0.7. The Inner Model is evaluated by looking at the estimated results of the path parameter coefficients and their significance levels.

RESULTS AND DISCUSSION

The development of the Agrosilvopastoral-based on the animal husbandry has long been applied and even become a tradition by the people of West Sumatra in their agricultural systems. Those are supported by the owned topography and agricultural resources. An interesting thing knows about the views and attitudes of the farming community in applying the livestock with the Agrosilvopastoral model in West Sumatra. This can be reflected from their perceptions about the adoption of the Agrosilvopastoral-based on the animal husbandry model and factor that they influence the development of them. The Perception is to selectively interpret what someone sees based on one's interests, background, experience, and attitude.

Basically the research results are obtained by farmers' perceptions in applying the Agrosilvopastoral model. The obtained scale range was 534.86 to 620.43. The average score of each perception variable is 543.73 for economic aspects, 539.44 for social aspects, ecological aspects 562.90 and technical aspects 540.73.

Table 1 Farmers' perceptions

Perception variable	Scale range	Rata-rata score of variables	Categories of perception
Economic Aspects	534,86 - 620,43	543,73	Good
Social Aspects	534,86 - 620,43	539,44	Good
Ecological Aspects	534,86 - 620,43	562,90	Good
Technical Aspects	534,86 - 620,43	540,73	Good

The average score of the obtained variables for each variable is adjusted to the scale range. For all the farmers' aspects perceptions of the Agrosilvopastoral adoption based on the animal husbandry business model is included to the good category. The Farmers' economic aspect perceptions of the Agrosilvopastoral model in the farm business sustainability approach are very well. This means that the Agrosilvopastoral-based on the animal husbandry business model can increase the farmers' income, provide the employment and meet the food and clothing needs for the farmers. The Capital for developing this business is quite affordable, the cost is quite low and having a great opportunity to develop an animal husbandry business based on the Agrosilvopastoral model.

The farmers' sustainability perceptions of the Agrosilvopastoral-based on the animal husbandry business and the technical aspects are also included the good categories in this research. The meaning is that the farmers have the knowledge and skills in the farming with the

Agrosilvopastoral model in West Sumatra. The land and topography are suitable for applying the Agrosilvopastoral model. The used technology is easy to obtain and apply for it. The water sources and facilities and infrastructures are available to implement the Agrosilvopastoral model.

The Farmers' perceptions about the Agrosilvopastoral sustainability based on the animal husbandry business model when are viewed from a social aspect as good categories. So that it can create the good relations and help each other among our fellow farmers, ranchers and extension workers. These animal husbandry businesses can also build a social capital bridging how they join the farmers as farmers' cooperatives. This Agrosilvopastoral activity can create the participation, mutual trust, solidarity and cooperation between the farmers and ranchers. It can also increase a prestige and hope. Even more it often gets awards and praise from the community and government.

The farmers' perceptions about the ecological aspects in applying the Agrosilvopastoral model are very good. The

farming community in West Sumatra realizes the environmental preservation importance. They realize that the Agrosilvopastoral can make the beautiful environment, can also add the plants, animals and microbes and can fertilize the soil. It is realized by the farming community that it can make the air healthy (increase oxygen) and reduce the global heat. Although the results of the study, that the farmers' perceptions are very good in applying the Agrosilvopastoral model, but it is necessary to know what factors influence and encourage the farming community to apply the Agrosilvopastoral model from the sustainable

development approach actually in West Sumatra. To find out them we use the statistical analysis by using the Structural Equation Modeling method with Partial Least Square (SEM_PLS). The outer model estimation results obtained are as well as. This is evidenced from the results of convergent validity testing. And the loading factor is obtained from the indicators for each construct has fulfilled the convergent validity test where all the loading factors of each indicator are over 0.70. This model is valid because the value of discriminated validity evaluated from the f Average Variance Extracted value (AVE) is greater than 0.50.

Table 2 Estimation from the outer model

Contract	Composite reliability	Average variance extracted	Cranach alpha
Economic Aspects	0.978	0.936	0.968
Social Aspects	0.833	0.691	0.765
Ecological Aspects	0.865	0.681	0.790
Technical Aspects	0.868	0.686	0.862
Agrosilvopastoral development	0.924	0.859	0.860

AVE value must be greater than 0.50 recommended by Fornell and Larcker (1981) in Ghazali (2014). The AVE value obtained in this study is higher than the correlation value among other constructs. This means that all constructs have the high discriminant validity. This model is also valid where the composite reliability values are 0.60 and Cronbach alpha is 0.80 (Table 2) above. Then we evaluate the inner value of the model to see the relationship between

the latent constructs. The estimation results of parameter coefficient paths and significance levels can be seen in (Table 3) below. The estimation results found that there are two constructs that significantly influence the application of the Agrosilvopastoral model in West Sumatra, such as the economic and social aspects. The ecological and technical aspects do not influence the application of the Agrosilvopastoral model significantly in West Sumatra.

Table 3 Estimation from the inner model

Contract	Coefficient	T Statistic	P Value
Economic -> Agrosilvopastoral Development	0.659	7.607	0.000
Social -> Agrosilvopastoral Development	0.197	2.288	0.023
Ecological -> Agrosilvopastoral Development	-0.052	0.758	0.449
Technical -> Agrosilvopastoral Development	0.152	1.613	0.107

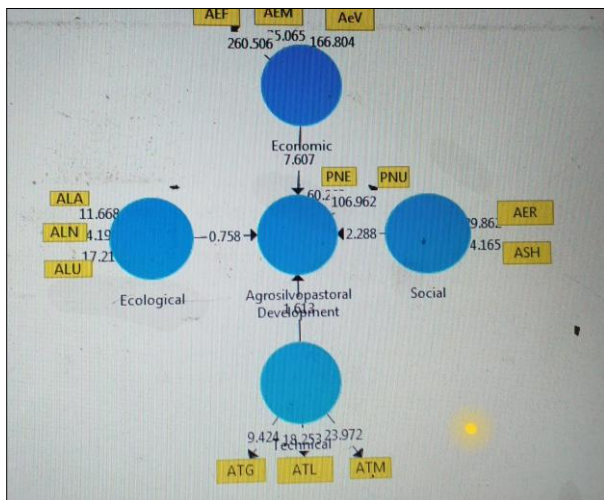


Fig 2 Result of diagram paths

The economic aspects are positively and significantly related (P value = 0.00 < α 0.01) to the Agrosilvopastoral

model application in West Sumatra. This means that what encourages the farming community to apply the Agrosilvopastoral model is the capital and costs used to raise the livestock with a lower and affordable Agrosilvopastoral model. The fixed costs incurred for making the pens and cultivating land for planting is quite low. And also that the variable costs such as the purchase of the livestock and plant seeds, feed, and medicines are quite low. Thus the agricultural soil can be fertilized with an organic fertilizer produced from the livestock manure. The feed for the livestock can be obtained from their agricultural waste. This factor drives them to apply the Agrosilvopastoral model.

Besides the economic aspects, social aspects are also positively and significantly related (P value = 0.00 < α 0.05) to the Agrosilvopastoral model application in West Sumatra. The social aspects encourage the farmers to apply it because with these farmer systems can build their social capital the social bonding capital, bridging and even more the social linking capital. The breeders can establish the good relations, mutual trust, mutual assistance and cooperation

with fellow the breeders and extension workers. They really participated in their cooperatives what they have founded. These systems can build and increase their knowledge, skills with a positive social attitude such as the praise and provide hope and constructive criticism among them.

The technical and ecological aspects did not influence the application of the Agrosilvopastoral model significantly in West Sumatra. Meaning of that their Agrosilvopastoral agricultural land and crops do not encourage them to implement this system significantly. They apply the Agrosilvopastoral model not driven by the ecological aspects yet. This means that they apply for it which has not been significantly driven by the desire to create a healthy environment such as fresh air, reduce global heat and fertilize plants.

The development of the sub-sector livestock are the inseparable part of agricultural development which aim to increase the income and standard of living of the community, expand employment and business opportunities and meet the needs of food and nutrition accordingly. The Agrosilvopastoral as a model of sustainable agricultural development has long been applied in West Sumatra and even has become a tradition in agricultural activities. Because of being interesting in knowing the perceptions and driving factors of the West Sumatra farming community to apply the Agrosilvopastoral model. It turns out that the results of research farmers' perceptions are categorized as good analyzed from four aspects namely economic, social,

engineering and environmental aspects. The factors that encourage farmers to apply this system are economic and social aspects while the technical and environmental aspects are not significant as a driving factor for the adoption of Agrosilvopastoral by farmers in West Sumatra. Sustainable livestock development has not been fully implemented by the people in West Sumatra. Technical and environmental aspects must be a serious day to day in the future.

Suggestion

The farm development by using the Agrosilvopastoral model needs to be developed through:

1. To improve the knowledge and skills of farmers in applying the Agrosilvopastoral model in order to increase the livestock population, the business scale, the income and the farmers' welfare.
2. To increase the breeders' awareness of environmental sustainability through the adoption of the Agrosilvopastoral model to create the sustainable livestock development

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