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# THE MODEL OF SUSTAINABLE AGRICULTURE DEVELOPMENT TOWARDS THE STRATEGY FOR INCREASING POTATO FARMER (*SOLANUM TUBEROSUM L*) INCOME IN THE AGROPOLITAN REGION IN SIMALUNGUN REGENCY, INDONESIA

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**Abstract:**
Problems in the agricultural sector always take place, especially the problem of increasing income, which focuses on the issue of the production of agricultural products, especially potatoes (*Solanum tuberosum L*). Simalungun Regency is an region that has superior commodity of potato plants. There are still problems encountered, especially the availability of superior seeds that have not met standardization, fertilizer that has not been met, and limited labor. The objectives of this study are: 1) To find out the social aspects, economic aspects, and environmental aspects influence the income of highland potato farmers in the agropolitan area in Simalungun Regency. 2) To find out the sustainable agricultural development model affect the income of highland potato farmers in the agropolitan area in Simalungun Regency. Sustainable agricultural development is a relationship of several aspects that are integrated with one another. With the ongoing process of sustainable agricultural development the target achievement is a strategy to increase the income of potato farmers. The population in this study was the potato farmer community from four Districts of 800 consisting of Purba District, Pematang Silimahuta District, Dolok Silo District, Silimakuta District and 200 people were taken using the Cochran formula. Data collection techniques used a questionnaire given to each respondent whose results can be tabulated. The method used is Structural Equational Modeling (SEM) analysis using the AMOS program. Based on the results of testing with structural equation modeling, with the AMOS 21 program at the final stage, namely the stage after the modification of the model gives a better model of goodness of fit. The path coefficient of sustainability effect on potato farmers is 0.860, where the structural equation form can be written as follows: $\hat{Y} = 0.860 X$, R-square = 0.739. The direct effect of sustainable agriculture (X) on the income of farmers (Y) of potato crops was 0.860.

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**Keywords:** social aspects, economic aspects, environmental aspects, sustainable agricultural development, farmer's income

## 1. Introduction

### 1.1 Background

The development of the agropolitan area as a spatial implementation and agribusiness system is based on economic theory, namely the theory of economic location and economic scale theory. Local economic theory guides where the up-stream and down-stream agribusiness industries must be developed so that the movement of goods and services in space is efficient. Whereas economics of scale theory will guide on how large the scale of down-stream and up-stream businesses should be developed. Support service subsystems will follow where on-farm, up-stream, and down-stream locations are developed.

Based on these economic principles, agribusiness activities will be developed in an area ranging from up-stream agribusiness, on-farm agribusiness, down-stream agribusiness and service for agribusiness. This is what is called an "agricultural city" (agropolitan). There are three main things that are targeted for agropolitan development. First, produce agribusiness products that have competitiveness (world quality and competitive prices). Second, increase the regional economic capacity in providing employment opportunities and people's income for an ongoing basis. Third, prevent and slow down the flow of urbanization.

During this time, the result of development that is more urbanized (urban bias) has driven the urbanization of resources from rural to urban areas. Urbanization that is most detrimental to rural areas is capital-drain and brain-drain quality by the urban from rural areas. As a result, villages suffer from a lack of quality capital and human resources, while cities experience over investment and overpopulation.

By developing the agropolitan area, it is hoped that it will slow or prevent urbanization. It is even expected to reverse urbanization (ruralization), which is to withdraw quality capital and human resources from cities to the agropolitan area in the countryside. This reversal process in the long term is expected to lead to a balance of regional development.

Simalungun Regency has a superior vegetable commodity with a very large crop productivity based on production and land area. But in the field implementation of the concept of agropolitan development there are still many weaknesses that are found both in terms of social, economic, environmental, institutional and technological aspects and information. Thus, there is a need for increased productivity of human resources, especially farmers who manage vegetables in the highlands.

For this reason, it is necessary to support the related sub-sectors in an integrated and sustainable manner. Given the importance of the highland vegetable area in supporting agricultural development, especially for stakeholders, therefore, it is necessary to develop a model of sustainable agricultural development to increase the income strategy of highland potato farmers (*Solanum tuberosum L*) in the agropolitan area in Simalungun Regency.

**1.2 Research Purposes**

The purpose of this study is as follows:

1) To know the social aspects, economic aspects, and environmental aspects influence the income of highland potato farmers in the agropolitan area in Simalungun Regency.
2) To find out the model of sustainable agricultural development influencing the income of highland potato farmers in the agropolitan area in Simalungun Regency.

**2. Theoretical Foundation**

**2.1 Sustainable Development**

According to Barber (1998), sustainable development is a development process that harmonizes the relationship between environmental and ecological aspects, economic aspects and community aspects. This relationship is described as follows:

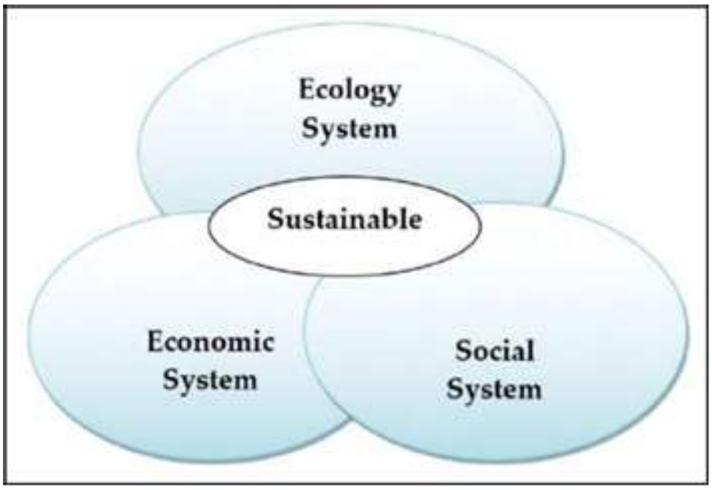



**Figure 1:** Sustainable Development System (Barber, 1998)

Furthermore, the agropolitan area development program deals with social, economic and environmental aspects; the following is accompanied by study opportunities for its development:

**2.2 Social Aspects**

Institutional is the basis for various service functions, access and flow of benefits to support agropolitan development. Important elements within the institution (Wiliamson, 1995) are modes of organization and uncertainty. Mode of organization, relates to alternatives in production systems including making or buying (intermediate products), using own capital or debt and (de) regulatory support (in privatization).

Uncertainty relates to risks (investment hazard), which also accompany contracts including administration costs (compensation in transaction costs), demoralization costs (corruption and rent seekers), and various short-term and long-term policies (such as taxes, pricing policy, quotas or other restrictions) that cause distortions and depreciation of assets. The issue or opportunity of study to support institutional development is very broad following the existing production system in the agropolitan area, which is focused on policy analysis, organization and partnership. Rusastra et al (2004) stated that the success of agropolitan development requires institutional strengthening support, especially aspects of land (land reform), capital for farmers, diversification of agricultural commodities, and environmental conservation.

### 2.3 Economic Aspects

Agropolitan economic aspects include infrastructure, the production sector and demand. Supporting infrastructure includes transportation, ports, telecommunications, energy and clean water. Infrastructure can streamline flow and reduce investment risk. Meanwhile, the production sector covers the entire agribusiness system, namely on-fram, upstream and downstream fram and its supporting sectors. Demand consists of the flow of goods, services and capital out of the region or exports and into or imports. Interaction of all production and demand sectors results in regional economic growth. Study opportunities include increasing productivity, developing appropriate technology, sectoral feasibility studies, improving business management, analyzing supply and demand, analyzing infrastructure needs and infrastructure, policy analysis, general balance analysis, or developing small industries.

### 2.4 Environmental Aspects

Environmental aspects are characterized by the presence of protected, cultivated and special areas. These three types of land use function as a place, providing input to production systems and assimilation of adverse environmental impacts. The scope of the study includes spatial planning based on community demand, commodity zoning, studies of environmental carrying capacity, environmental quality standards, wilingness to pay for environmental commodities, greening programs, and rewards and punishment in implementing the rule of law.

### 2.5 Potato Plants

Potatoes (*Solanum tuberosum L.*) originating from cold climates (Netherlands, Germany). Potato plants have been known in Indonesia since before World War II called Eugenheimer. This potato is the result of selection in the Netherlands in 1890, tuber skin, yellowish fleshy, and tastes good. The disadvantages of these potatoes are that they are sensitive to leaf rot, Y and A viruses, and sensitive to wilting. Although potatoes are not a staple food for the people of Indonesia, but consumers tend to increase from year to year because the number of products is increasing and the number of foreign tourists living in Indonesia.

Systematic (taxonomic) potato plants are generally classified as follows:
Kingdom: Plantae (Plants)
Subkingdom: Tracheobionta (vascular plants)
Super Division: Spermatophyta (producing seeds)
Division: Magnoliophyta (flowering plants)
Class: Magnoliopsida (two pieces / dicot)
Subclass: Asteridae
Order: Solanales
Family: Solanaceae (eggplant tribe)
Genus: Solanum
Species: *Solanum tuberosum L.*

**2.6 Types of Potatoes**

Potatoes have a considerable diversity of species, consisting of local species and some superior varieties. The types of potatoes have differences, namely in the shape, size, color of tuber flesh, skin color, storability, chemical composition, processing properties and harvest age. Potatoes produce tubers as a vegetable commodity that is prioritized for development and has the potential to be marketed domestically and exported. Based on the color of the skin and tuber flesh, there are three classes of potatoes, namely yellow potatoes, white potatoes, and red potatoes. Yellow potatoes have yellow skin and tuber flesh. Which includes the yellow potato group is a variety of Pattrones, Katella, Cosima, Cipanas, Granola and others. White potatoes have white skin and tubers. Varieties that are included in the group of white potatoes are Donata, Radosa, and Sebago. Red-skinned red potatoes with yellow tuber flesh. The varieties are Red Pontiac, Arka, and Desiree. The most preferred type of potato is yellow potato because it has a good taste, is flavorsome, tender, and slightly runny. Sometimes there is a green color on the skin of a potato. The green color of the potato tuber is not preferred because it tastes bitter. Apart from that, this green part.

**2.7 Potato Morphology**

Potatoes are a sweet potato plant and classified as a year plant. The shape of potatoes is actually bushy and pervasive. The stem is rectangular in shape, reaching 50-120 cm in length and has no leaves and the leaves are reddish green or purple in color. In addition, potatoes also have tuber organs. The tubers come from the side branches that enter the ground. This branch is a place to store carbohydrates so that they swell and can be eaten. Bulbs can remove the buds and later will form new branches.

**2.8 Farming Science**

According to Soekartawi, (2011) Farming is the study of how a person cultivates and coordinates the factors of production in the form of land and natural surroundings as capital, so as to provide the best benefits.

### 2.9 Farmer Exchange Rates

Government policy in increasing farmers' income has a very strategic meaning. One measure of farmers' purchasing power that reflects the level of income of farmers, has been published by the Central Statistics Agency (BPS) and formulated in the form of Farmer Exchange Rates (NTP) (Parawaty, 2011). Farmer Exchange Rate is an indicator to see the level of welfare of farmers (Badan Pusat Statistik, 2012).

### 2.10 Framework

Regional Development Planning is a whole and integrated concept with regional development. Regional development planning is broadly interpreted as an effort to formulate and apply a theoretical framework to a sustainable agropolitan development program which considers taking into account integrating the empowerment of farming communities, developing farmers' partnerships.

The concept of agropolitan has a goal in the construction of facilities and infrastructure to support agricultural activities, both facilities providing production facilities and infrastructure for roads, irrigation, and markets and the provision of agricultural support services such as KUD and financial institutions in rural areas. The concept of agropolitan is also an area as a center of production of superior crop commodities whose results can be consumed by the local community itself and are also able to go to the international market which is better known as exports.

The social aspect in sustainable agropolitan development is necessary, because it can increase human resources through the level of farmer education. The level of education of farmers is expected so that farmers are able to absorb knowledge with broader insights, especially obtaining education about farming management, production management and marketing management. After being able to reach the level of education. The experience of farmers can help farming businesses in increasing the production of agricultural products because they have gained knowledge in the field directly through routine activities carried out every day apart from the level of education. Farmer participation will be even better and can work en masse or together in realizing the success of sustainable agropolitan development.

Sustainable agropolitan development to achieve goals on developing partnerships, increasing farmer incomes, developing superior commodities, increasing farmer capital and increasing agricultural production. If the achievement of the agropolitan concept goes well and smoothly then sustainable agropolitan development in Simalungun Regency can be continued and enhanced.

Sustainable agropolitan development for achieving goals on developing farmer incomes, farmer exchange rates, farmer incomes, and agricultural production. If the achievement of the agropolitan concept goes well and smoothly then sustainable agropolitan development in Simalungun Regency can be continued and enhanced. The framework for thinking of sustainable agricultural development towards increasing income of highland potato farmers in the agropolitan area can be seen as follows:

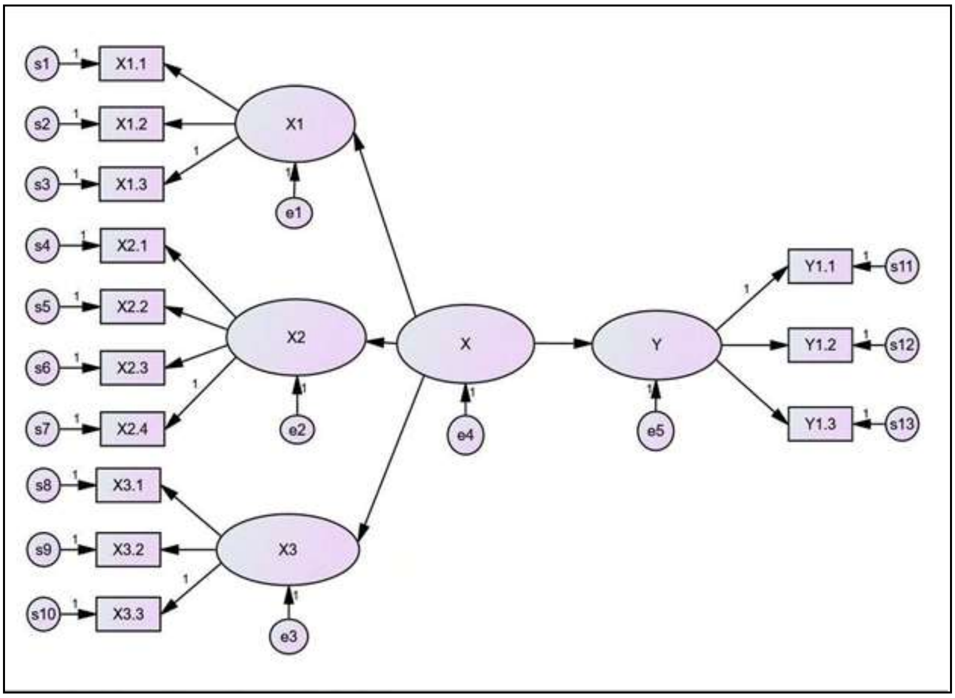



**Figure 2:** Structural Equation Modelling Model

Based on the picture above the structural equation model (Structural Equation Modelling): X1 = Social Aspect, X1.1 = Education Level, X1.2 = Farmer Experience, X1.3 = Farmer Participation, X2 = Economic Aspect, X2.1 = Productivity Level, X2.2 = Agricultural Land Lease, X2.3 = Labour, X2.4 = Acceptance of Agricultural Products, X3 = Environmental Aspects, X3.1 = Intensification, X3.2 = Extensification, X3.3 = Diversification, X = Sustainable Agriculture , Y = Farmer's income, Y1.1 = Farmer Exchange Rate, Y1.2 = Agricultural Production, Y1.3 = Leading Commodity Development.

## 3. Research Methods

### 3.1 Research Location and Time

The place of this research was conducted in Pematang Silimahuta District, Dolok Silon District, Silimakuta District and Purba District in Simalungun Regency and the time of research activities starting from May 2017 - December 2018.

### 3.2 Population and Sample

The population for this research is the people in the highland vegetable farming area of Simalungun Regency which are spread in 4 sub districts: Silimakuta District, Purba District, Pematang Silimahuta District, and Dolok Silou District. Can be seen in Table 1 below:

**Table 1:** Potato Farmer's Population in Each District

| No | Districts | Population (people) |
|---|---|---|
| 1 | Silimakuta | 164 |
| 2 | Pematang Silimahuta | 250 |
| 3 | Purba | 238 |
| 4 | Dolok Silou | 148 |
| | Total | 800 |

**Source:** Data processed, 2017.

The Cochran standard sample size is known, and then further determines the sample value.

**Table 2:** Samples of Potato Farmers from Each District

| No | Districts | Proportional Sample Allocation | $n_{ps}$ |
|---|---|---|---|
| 1 | Silimakuta | (164/800) x 200 | 41 |
| 2 | Pematang Silihmahuta | (250/800) x 200 | 62 |
| 3 | Purba | (238/800) x 200 | 60 |
| 4 | Dolok Silou | (148/800) x 200 | 37 |
| | Total | | 200 |

**Source:** Data processed, 2017.

### 3.3 Research Methods

The results of tests are with structural equation modeling (structural equation modeling) with the AMOS program. The model is said to be good when it fulfills the good requirements of a model that is measured with some theoretical statistics. The results of SEM analysis in the form of an Early Stage path diagram can be seen in figure 3:

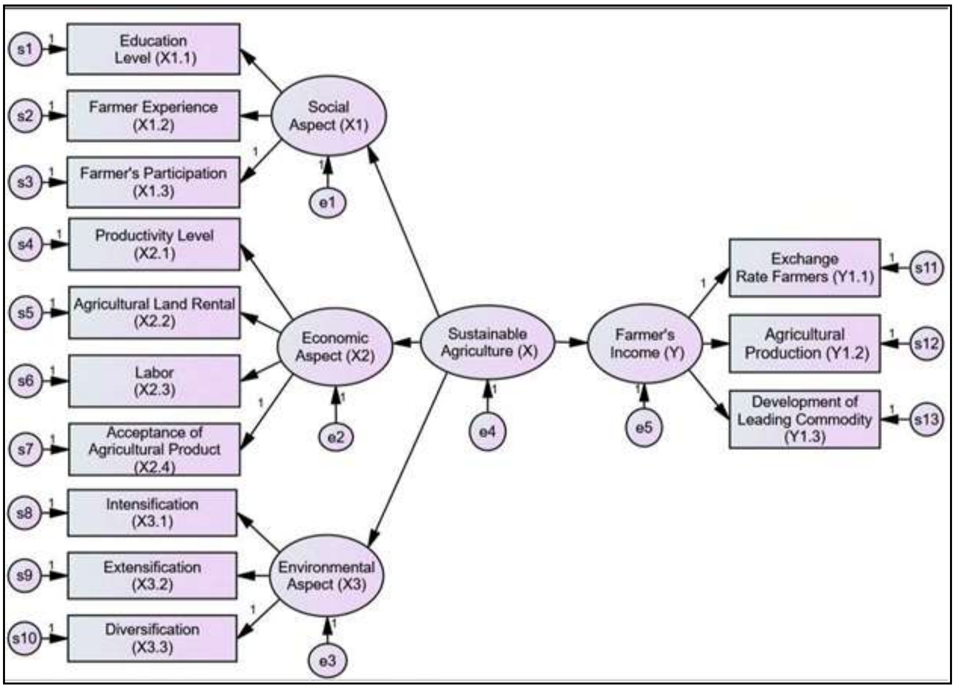



**Figure 3:** Structural Equation Modelling

Based on the picture above structural equation model (Structural Equation Modelling) X1 = Social Aspect, X1.1 = Education Level, X1.2 = Farmer Experience, X1.3 = Farmer Participation, X2 = Economic Aspect, X2.1 = Productivity Level, X2.2 = Agricultural Land Lease, X2.3 = Labour, X2.4 = Acceptance of Agricultural Products, X3 = Environmental Aspects, X3.1 = Intensification, X3.2 = Extensification, X3.3 = Diversification, X = Sustainable Agriculture , Y = Farmer's income, Y1.1 = Farmer Exchange Rate, Y1.2 = Agricultural Production, Y1.3 = Leading Commodity Development.

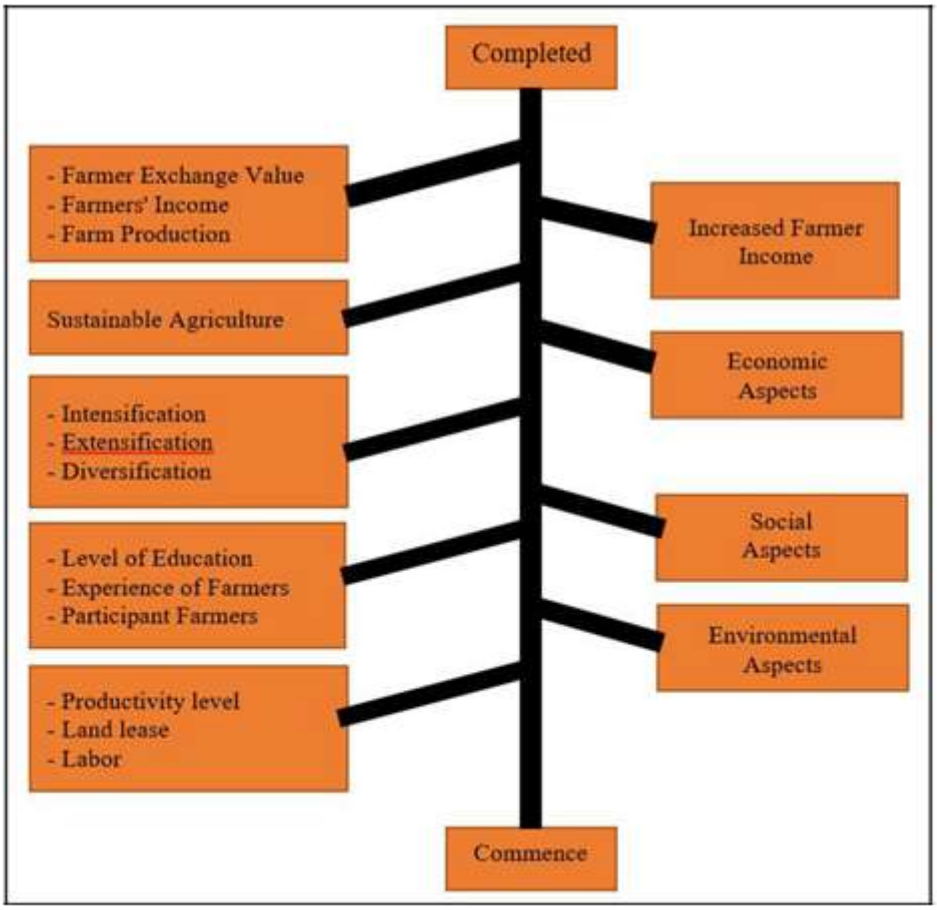



**Figure 4:** Fishbone Concept Framework (Ishikawa, 2008)

### 3.4 Data collection technique

The data collection techniques used include:

- Interview, which is in the form of unstructured interviews by asking questions to students who have been selected, so that initial information about various issues or problems that exist on the object (Sugiyono, 2014: 228)
- Questionnaires, which are data collection techniques carried out by giving a set of questions or written statements in the form of questionnaires to respondents to be answered using a Likert scale with a checklist form. Before the questionnaire is distributed to respondents, the questionnaire will first be validated.

**Table 2a:** Likert Scale

| Scale | Value Weights |
|---|---|
| Strongly Agree (SS) | 5 |
| Agree (S) | 4 |
| Neutral (N) | 3 |
| Disagree (TS) | 2 |
| Strongly Disagree (STS) | 1 |

## 4. Research Result

### 4.1 Analysis of a Complete Procedural Model

Analysis of factors of farmer exchange rates, farmer income, agricultural production and development of potato commodities to farmers' income in the agropolitan area in Simalungun Regency.

### 4.2 Measurement of Variable Y (Potato Farmer)

**Table 3:** Potato Farmers

| No | Variable | Potato Farmers | | |
|---|---|---|---|---|
| | | Load. | Load. 2 | Error |
| 1 | Y1. 1 | 0,72 | 0,52 | 0,52 |
| 2 | Y1.2 | 0,64 | 0,41 | 0,41 |
| 3 | Y1.3 | 0,79 | 0,62 | 0,63 |
| 4 | Y1.4 | 0,81 | 0,65 | 0,65 |
| | Total | 2,96 | 2,2 | 2,21 |

The results of testing the factor loading value for each indicator of the variable Y (Potato farmers) has indicated that the magnitude of the loading value on the four indicators above 0.5.

In this study, in calculating reliability using composite (construct) reliability with a cut of value is a minimum of 0.7 (Malholta in Solimun, 2002). The construct reliability calculation is as follows:

$$Construct\,Reliability = \frac{(\sum Std.Loading)^2}{(\sum Std.Loading)^2 + \sum \varepsilon j}$$

$$Construct\,Reliability = \frac{(2{,}96)^2}{(2{,}96)^2 + 2{,}21} = 0{,}7985$$

Based on the calculation results, the value of construct reliability is around 0.7985.

Indicators that contributed to the variable (Y) farmer income are (Y1.1) the farmer exchange rate contributed 0.72, (Y1.2) farmer income contributed 0.64, (Y1.3) agricultural production contributed amounted to 0.7985, and (Y1.4) the development of superior commodities contributed 0.81. The biggest contribution to the variable (Y) of farmer income is the development of superior commodities and agricultural production.

### 4.3 Measurement of Variable X1 (Social Aspects of Potato Crops)

**Table 4:** Social Aspects of Potato Plant Commodities

| No | Variable | Social Aspects of Potato Plant Commodities | | |
|---|---|---|---|---|
| | | Load. | Load. 2 | Error |
| 1 | X 1.1 | 0,44 | 0,19 | 0,20 |
| 2 | X 1.2 | 0,80 | 0,64 | 0,63 |
| 3 | X 1.3 | 0,46 | 0,21 | 0,21 |
| | Total | 1,7 | 1,04 | 1,04 |

The results of testing the factor loading value for each indicator of the variable X1 (social aspects of the commodity of potato plants) showed that the magnitude of the loading value on the indicator above 0.5, on the X1.2 variable of 0.80.

In this study, in calculating reliability using composite (construct) reliability with a cut of value is a minimum of 0.7 (Malholta in Solimun, 2002). The construct reliability calculation is as follows:

$$Construct\,Reliability = \frac{(\sum Std.Loading)^2}{(\sum Std.Loading)^2 + \sum \varepsilon j}$$

$$Construct\,Reliability = \frac{(1{,}7)^2}{(1{,}7)^2 + 1{,}04} = 0{,}7353$$

Based on the calculation results, it has obtained construct reliability values range from 0.7353. Indicators that contributed to the variable (X1) social aspects were (X1.1) the level of education and training contributed 0.44, (X1.2) the experience of farmers contributed 0.80, and (X1.3) farmer participation contributed 0.46. The biggest contribution to the social variable (X1) is the experience of farmers and farmer participation.

### 4.4 Measurement of Variable X2 (Economic Aspects of Potato Crops)

**Table 5:** Economic Aspects of Potato Plant Commodities

| No | Variable | Economic Aspects of Potato Plant Commodities | | |
|---|---|---|---|---|
| | | Load. | Load. 2 | Error |
| 1 | X 2.1 | 0,28 | 0,08 | 0,08 |
| 2 | X 2.2 | 0,56 | 0,31 | 0,31 |
| 3 | X 2.3 | 0,84 | 0,70 | 0,71 |
| 4 | X 2.4 | 0,80 | 0,64 | 0,63 |
| | Total | 2,48 | 1,73 | 1,73 |

The results of testing the factor loading value for each indicator of the variable X2 (economic aspects of potato commodity commodities) show that the loading value of the indicator is above 0.5, the variable X2.2 is 0.56, the variable X2.3 is 0.84, and variable X2.4 of 0.80.

In this study, in calculating reliability using composite (construct) reliability with a cut of value is a minimum of 0.7 (Malholta in Solimun, 2002). The construct reliability calculation is as follows:

$$Construct\,Reliability = \frac{(\sum Std.Loading)^2}{(\sum Std.Loading)^2 + \sum \varepsilon j}$$

$$Construct\,Reliability = \frac{(2{,}48)^2}{(2{,}48)^2 + 1{,}73} = 0{,}7804$$

Based on the calculation results, it has obtained construct reliability values range from 0.7804.

Indicators that contribute to the variable (X2) economic aspects are (X2.1) the level of productivity contributes 0.28, (X2.2) agricultural leasehold contributes 0.56, (X2.3) labor contributes amounted to 0.84, and (X2.4) receipt of agricultural products contributed 0.80. The biggest contribution to the variable (X2) of economic aspects is labor and agricultural income.

### 4.5 Measurement of Variable X3 (Aspects of the Potato Crop Commodity)

**Table 6:** Environmental Aspects of Potato Plant Commodities

| No | Variable | Environmental Aspects of Potato Plant Commodities | | |
|---|---|---|---|---|
| | | Load. | Load. 2 | Error |
| 1 | X 3.1 | 0,67 | 0,45 | 0,45 |
| 2 | X 3.2 | 0,67 | 0,45 | 0,44 |
| 3 | X 3.3 | 0,51 | 0,26 | 0,51 |
| | Total | 1,85 | 1,16 | 1,4 |

The results of testing the factor loading value for each indicator of the X3 variable (Environmental aspects of the commodity of potato plants) show that the loading value of the three indicators is above 0.5,

In this study, in calculating reliability using composite (construct) reliability with a cut of value is a minimum of 0.7 (Malholta in Solimun, 2002). The construct reliability calculation is as follows:

$$Construct\,Reliability = \frac{(\sum Std.Loading)^2}{(\sum Std.Loading)^2 + \sum \varepsilon j}$$

$$Construct\,Reliability = \frac{(1{,}85)^2}{(1{,}85)^2 + 1{,}4} = 0{,}7096$$

Based on the calculation result, it has obtained construct value around 0.7096.

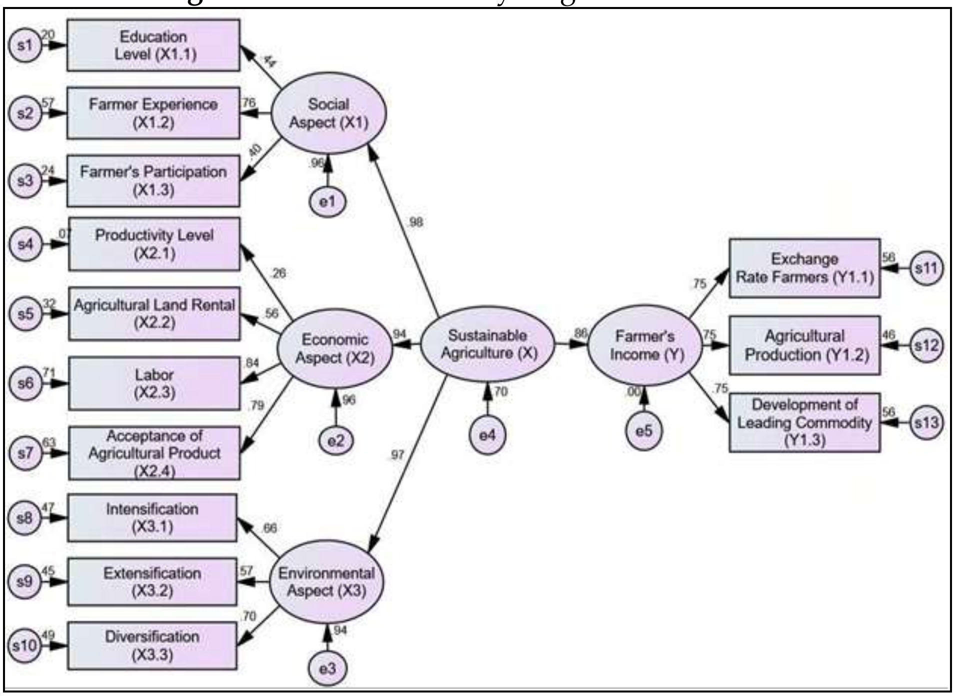
Indicators that contribute to the variable (X3) environmental aspects are (X3.1) intensification contributes 0.67, (X3.2) extensification contributes 0.67, and (X3.3) diversification contributes 0, 51. The biggest contribution to the variable (X3) aspects of the environment is intensification and extensification.

### 4.6 Complete Structural Model Analysis

Measurement of farmer income variables (Y), Sustainable Agriculture (X), Social Aspect variables (X1), Economic Aspects (X2), Environmental Aspects (X3), was using structural equation modeling.

### 4.7 Early Stage SEM Analysis

**Figure 5:** SEM Model Early Stage Potato Farmers




**Description**: X1 = Social Aspect, X1.1 = Education Level, X1.2 = Farmer Experience, X1.3 = Farmer Participation, X2 = Economic Aspect, X2.1 = Productivity Level, X2.2 = Agricultural Land Lease, X2.3 = Labor, X2.4 = Acceptance of Agricultural Products, X3 = Environmental Aspects, X3.1 = Intensification, X3.2 = Extensification, X3.3 = Diversification, X = Sustainable Agriculture, Y = Farmer's Income, Y1.1 = Exchange Rate Farmers, Y1.2 = Agricultural Production, Y1.3 = Development of Commodity.

The results of testing with structural equation modeling (structural equation modeling) with the complete AMOS 21 program can be seen in Appendix 1. The model is said to be good when it meets the requirements of the goodness of a model that is measured by several statistics theoretically. The results of SEM analysis in the form of an Early Stage path diagram can be seen in Figure 5.

Furthermore, some goodness of fit test results from the default model can be seen in Table 7 where the results of the analysis show that the model is not yet feasible to be used to prove the hypothesis. Thus, it is necessary to modify the model.

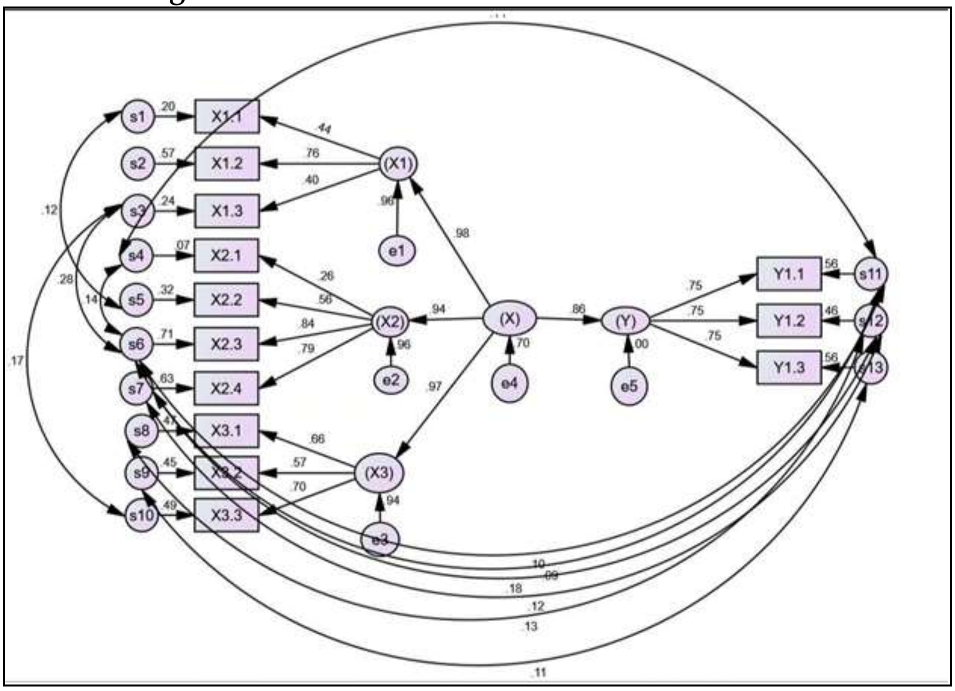
**Table 7:** SEM Suitability Index of Early Potato Farmers

| **Criteria** | **Cut-off value on n = 200; df = 73; alpha = 0.05** | **Result of AMOS** | **Description** |
|---|---|---|---|
| Free degree (db) | >0 | 73 | Qualify |
| Chi – Square | < 93.945 | 169,889 | Not Qualify |
| P-value | P value ≥ 0.05 | 0,000 | Not Qualify |
| CMIN/DF | ≤ 2,00 | 2,327 | Not Qualify |
| Root Mean Square Error of Approximation (RMSEA) | < 0.08 | 0,057 | Qualify |
| Goodness of Fit Index (GFI) | ≥ 0.90 | 0,944 | Qualify |
| Adjusted Goodness of Fit Index (AGFI) | ≥ 0.90 | 0,918 | Qualify |
| Tucker Lewis Index (TLI) | ≥ 0.95 | 0,947 | Not Qualify |
| Comparative Fit Index (CFI) | ≥ 0.95 | 0,958 | Qualify |

n = number of samples; df = free degrees

## 4.8 Final Phase SEM Analysis Results

**Figure 6:** SEM Model Final Phase of Potato Farmers




**Description**: X1 = Social Aspect, X1.1 = Education Level, X1.2 = Farmer Experience, X1.3 = Farmer Participation, X2 = Economic Aspect, X2.1 = Productivity Level, X2.2 = Agricultural Land Lease, X2.3 = Labor, X2.4 = Acceptance of Agricultural Products, X3 = Environmental Aspects, X3.1 = Intensification, X3.2 = Extensification, X3.3 = Diversification, X = Sustainable Agriculture, Y = Farmer's Income, Y1.1 = Exchange Rate Farmers, Y1.2 = Agricultural Production, Y1.3 = Development of Commodity.

Analysis of farmers' income towards sustainable agriculture in Simalungun Regency. The test results with structural equation modeling with the AMOS 21 program in the final stage, namely the stage after the model modification gives a better model of goodness of fit, as shown in Figure 6.

In Table 7 it is shown that for the 9 (nine) criteria used to assess the goodness of a model, all criteria have been met.

**Table 8:** SEM Suitability Index After Modification of Potato Farmer Models

| **Criteria** | **Cut-off value on n = 200; df = 61; alpha = 0.05** | **Result of AMOS** | **Descriptions** |
|---|---|---|---|
| Free Degree (db) | >0 | 61 | Qualify |
| Chi – Square | <72.153 | 57,922 | Qualify |
| P-value | P value ≥ 0.05 | 0,1039 | Qualify |
| CMIN/DF | ≤ 2,00 | 1,233 | Qualify |
| Root Mean Square Error of Approximation (RMSEA) | < 0.08 | 0,024 | Qualify |
| Goodness of Fit Index (GFI) | ≥ 0.90 | 0,975 | Qualify |
| Adjusted Goodness of Fit Index (AGFI) | ≥ 0.90 | 0,957 | Qualify |
| Tucker Lewis Index (TLI) | ≥ 0.95 | 0,991 | Qualify |
| Comparative Fit Index (CFI) | ≥ 0.95 | 0,994 | Qualify |

n = number of samples; df = free degrees

Table 8 shows that all the criteria used to assess a model have values that meet the requirements. Compared to the initial stage model, more criteria can be met by the modified model than the initial model. Because the modified model is better, this model will be interpreted in this study. Furthermore, it can be seen the path coefficient of the relationship between exogenous and endogenous variables used in the study to test 10. The value of the path coefficient can be seen in table 8.

Based on the results of SEM analysis, the causality relationship between variables, the hypothesis testing can be explained in table 8 as follows:

**Table 8:** Test Results of the Effects of Sustainable Agriculture on Potato Farmers

| **Variable** | **Model** | **Estimate** | **CR** | **Rob (p)** | **Description** |
|---|---|---|---|---|---|
| Sustainable Agriculture (X)→Farmer's Income (Y) | Regression | 0.606 | 6,979 | < 0.001 | Significant |
| | Standardized Regression | 0,860 | | | |

**Source:** Primary Data, 2017.

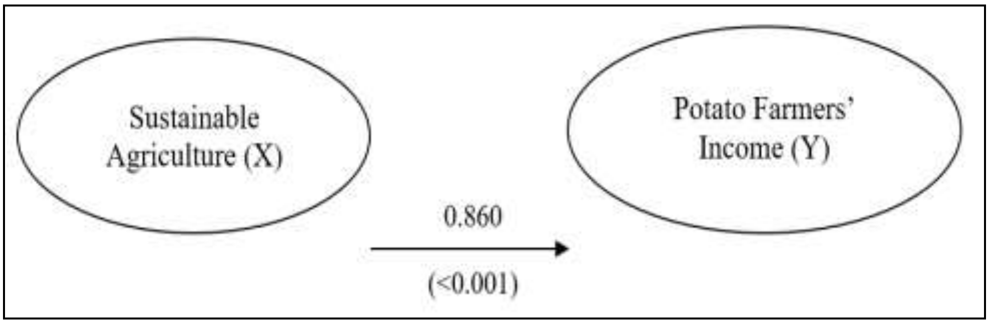



**Figure 7:** SEM Analysis Results: Effect of Sustainable Agriculture on Potato Farmers

The path coefficient of sustainability effect on potato farmers is 0.860, where the structural equation form can be written as follows: $\hat{Y} = 0.860$ X, R-square = 0.739. From the previous description has been explained about the indicators that can determine whether or not a hypothesis is accepted. Based on table 8 the path coefficient interpretation is as follows. The AMOS calculation results presented in show that agricultural sustainability (X) influences significantly and positively by farmers' income (Y). This can be seen from the path coefficient that is positive with a critical ratio (CR) value of 6.797 (greater than 1.96) and a significance probability (p) of <0.001 is obtained. This value is smaller than the significance level (◎) which is determined at 0.05. Thus, the research hypothesis has been answered, where Sustainable Agriculture (X) has a significant effect on farmer income (Y) proven to be true. In other words, it can be said that the direct effect of Sustainable Agriculture (X) on farmers' income (Y) is 0.860.

### 4.9 Factors that Contribute to Sustainable Agriculture in Potato Farmers in Simalungun Regency

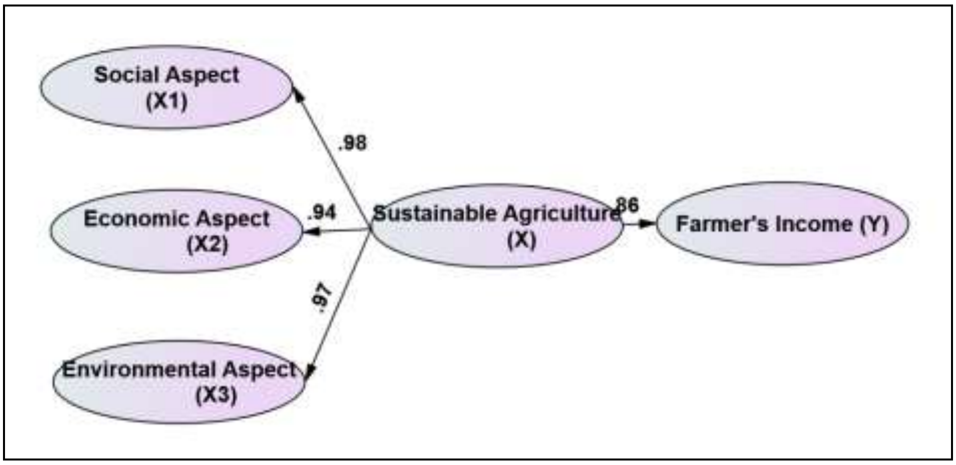
In structural equations involving many variables and the path between variables there are influences between variables which include direct influence, indirect effect and total effect. For this reason, each influence will be discussed in detail. The direct relationship occurs between the exogenous latent variable Sustainable Agriculture (X) with the endogenous latent variable Farmer income (Y) presents the results of testing the direct effect that occurs between exogenous and endogenous latent variables.

**Table 9:** Direct Effects between Potato Farmer Research Variables

| **Influence between Variables Unobserved Variable** | **Direct Influence** |
|---|---|
| → X Y | 0,86 |
| → X $X_1$ | 0,98 |
| → X $X_2$ | 0,94 |
| → X $X_3$ | 0,97 |

**Source:** Primary Data, 2017.

**Figure 8:** Structural Model with Endogenous
Variable Substructure in Potato Farmers




**Description**: X = Sustainable Agriculture; X1 = Economic Aspects; X2 = Social aspects of dban X3 = Environmental aspects and Y = Farmer's Income

From Table 9 we can explain the direct effect of exogenous latent variables on endogenous latent variables. The direct effect of Sustainable Agriculture (X) on the income of potato farmers (Y) was 0.86. Whereas the Sustainable Agriculture (X) was formed by three aspects, where the Social Aspect variable (X1) contributed 0.98 to Sustainable Agriculture (X), the Economic aspects variable (X2) contributed 0.94 to Sustainable Agriculture (X) and Environmental aspects variable (X3) contributed 0.97 to Sustainable Agriculture (X). Thus, the direct effect gives a significant result with a positive standardized estimate.

## 5. Conclusions and Recommendations

### 5.1 Conclusion

This study concludes, among others:

1) Based on the analysis of social aspects factors, the value of construct reliability ranges from 0.7985 and income of potato farmers, the value of construct reliability ranges from 0.7991
2) Based on the results of testing with structural equation modeling with the AMOS 21 program at the final stage, namely the stage after the model modification gives a better model of goodness of fit. The path coefficient of sustainability effect on potato farmers is 0.860, where the structural equation form can be written as follows: $\hat{Y} = 0.860$ X, R-square = 0.739.
3) The direct effect of sustainable agriculture (X) on the income of farmers (Y) of potato crops is 0.860.

### 5.2 Suggestion

Sustainable agricultural development towards increasing the upland potato farming income in the agropolitan area in Simalungun Regency will be possible to be realized in the following ways:

1) Improving the quality of human resources (community), and empowering the community through various programs of counseling, training and coaching activities carried out in an integrated manner, in order to improve the quality and skills of the farming community
2) Establish a cooperative relationship and develop business partnership patterns to distribute agricultural products, in order to achieve maximum productivity and income.
3) Providing capital credit assistance to farmers, for this reason it is necessary to develop financial institutions such as cooperatives that can help provide additional capital to farmers in Simalungun Regency.
4) To achieve the development of highland potato farming it is necessary to develop a development strategy that is fully supported by the government and the community in Simalungun Regency.
5) Empowering farmers to be more active and able to provide participation in various program activities that can provide knowledge about the development of the highland potato agropolitan area in Simalungun Regency.

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