



Structural modelling of rice fields-buffalo livestock based integrated agricultural systems in the context of regional development in Humbang Hasundutan, Indonesia

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Data of the article

First received :10 July 2018 | Last revision received : 26 August 2019

Accepted : 26 August 2019 | Published online : 30 November 2019

doi:10.17170/kobra-20190709595

Keywords

external conditions, integrated agriculture, rice fields, income, regional development, Indonesia

Abstract

This study analyses the influence of external and internal agriculture conditions on rice fields-buffalo livestock-based integrated agricultural systems in the context of regional development in the Humbang Hasundutan District. The method of analyzing data in research is structural equation modeling (SEM) with IBM SPSS® Amos 22 device. The results indicate that both external and internal agricultural conditions have a significant, positive influence on both rice field-buffalo livestock integrated agricultural systems and regional development. Furthermore, rice fields-buffalo livestock integrated agricultural systems have a significant positive influence on regional development. The direct influence of external agriculture conditions on regional development is 0,26. The indirect influence of external agriculture conditions on regional development by the intermediate of integrated agriculture systems is 0,32 and total influence is 0,58. Furthermore, the indirect influence of internal agriculture conditions on regional development is 0,24. The indirect influence of internal agriculture conditions on regional development by the intermediate of integrated agriculture systems is 0,28, with a total influence is 0,52. Based on the conclusion it is suggested that the government; a) provide guidance to improve farmers' knowledge of integrated agricultural systems; b) improve farmers' ability to develop their farms so as to have an impact on increasing incomes; c) establish agricultural development programmes for the longer-term increase of production, which will have an impact on regional economic growth; d) assist farmers by providing access to capital for agricultural development ensure the stability of output prices of agricultural products.

Introduction

Regional development is the cumulative effect of a complex system of interacting development process influenced or controlled by governmental and non-governmental interventions and by collective and individual decisions made at the local, the central, and the intermediate level (Ahmad, & Bajwa, 2005). Regional devel-

opment is achieved through gradual specialisation of selected products, competitive on the foreign markets (Szajnowska, & Wysocka, 2009).

Wantu, Moonti, and Wantu (2018) said one of the triggers of stagnant regional development that can reduce

Citation (APA):

Nainggolan, H.L., Aritonang, J., Sihombing, M., Supriana, T., Tafsin, M (2019). Structural modelling of rice fields-buffalo livestock based integrated agricultural systems in the context of regional development in Humbang Hasundutan, Indonesia , *Future of Food: Future of Food: Journal on Food, Agriculture and Society* (106)



the poverty line and can create people welfare and prosperity. Conceptually, regional development is a series of efforts to realize integration in the use of various resources, increasing harmony between regions, integrating between sectors through a spatial planning process to achieve sustainable development goals. In pursuing these economic development projections, the challenge facing local governments is to increase employment opportunities, especially those that are labour-intensive (Wantu, Moonti, & Wantu, 2018).

Regional development is an effort in spurring socio-economic development, reducing disparity between regions, maintaining environmental preservation of a region. In addition, development of rural areas may contribute to the preservation of the rural landscape, the protection of indigenous cultures and traditions while rural societies could serve as a social buffer for the poor (Anríquez, & Stamoulis, 2007). Regional development can be started from rural development. Withanachchi, Kopke, and Frettsome (2013) said rural development is tied to programmes which connect rural society. An alternative political culture for rural development will consider rural people as the centre of development according to development goals. Thus rural development is considered an integral part of state development.

Regional development strategies should be based on the sound assessment of regional business potentials and on opportunities to develop the defined potentials in order to form competitive advantage (Harmaakorpi, & Pekkarinen, 2003, August, 27-31). Agriculture sector as competitive advantage in a region, can be developed to spur of regional development as said Rich, Rich, and Dizyee (2018) public policies were also promulgated to accelerate the development of agriculture. Regional development strongly bound to the institutional set-up of a region and can, therefore, be a useful tool in exploring existing potentials in manifold regional resource configurations (Harmaakorpi, 2006), because regional development, it is still only pursuing more dominant economic growth level (Wantu, Moonti, & Wantu, 2018).

Regional development is a process intended to make changes toward better development of society, by employing various resources such as agricultural sector (Borisov, 2015; Nainggolan et al., 2017, October 25). Regional government policy should re-activate agricultural development sector, that not only refers to the regional economic activity, but also create workplace, particularly in the rural area (Wantu, Moonti, & Wantu, 2018). Therefore, development of the agricultural sector is a priority in Indonesia. Agriculture as one of the important sectors in development, because this sector is a food producer,

raw material for production which is very important in encouraging development (Perdinan, Dewi, & Dharma, 2018). Future agricultural development must be well planned to improve the welfare of farmers and must encourage the realization of regional economic development through high competitive productive activities.

Mohammed (2016); Wahyudi, Priyarsono, and Rifin (2014) also said that the agricultural sector has an important and strategic role in regional and national development. The agricultural sector not only plays a role in regional food security, but also affects gross regional domestic income (GRDP) of the region and has the role of providing employment for the community. In line with that, the agricultural sector has an important role for Humbang Hasundutan District, even this sector is able to contribute 52.79% in 2012, and 53.6% in 2014 to the gross regional domestic product (GRDP) of this region, with an average growth rate of 3.83% in 2009–2014 (The Central Bureau of Statistic, Humbang Hasundutan in Figures, 2016). However, the productivity of farming in Humbang Hasundutan Regency is not optimal.

The Central Bureau of Statistics Humbang Hasundutan District (2016) pointed out that the growth rate of rice productivity in Humbang Hasundutan District fluctuated in 2009-2012. In 2009 with 1.0% productivity growth rate, it increased to 1.48% in 2010 and decreased to 0.10% in 2011 and then increased by 0.60% in 2012, with an average growth rate of 0.80% and smaller compared to the average growth rate of North Sumatra's rice productivity of 2.14% (The Central Bureau of Statistics North Sumatra, 2016). Thus efforts are needed to improve agricultural development in this region. Agricultural development can be done through intensification, extensification, diversification and integrated farming systems to increase farmer income and regional income.

The development of the agricultural sector must be in accordance with physical conditions that are external and internal, namely; land use, land management, fertilization, seeds, plant cultivation, plant protection. Then socio-economic conditions that are external and internal, such as; labour, farmer education level, institutional, capital, farmer family income, inflation, and external development variables such as; road and irrigation or irrigation facilities (Nainggolan et al., 2019). Utilization of agricultural land as an external physical variable, if not in accordance with its potential will result in a decrease in productivity, and cause degradation of agricultural land, so that sustainable planning is needed, including by analysing economic, social and environmental aspects (Niemmanee, Kaveeta, & Potchanasin, 2015, February 05-07).



Pedrosa, and López (2012) state that the physical external conditions of agriculture consist of; types of agriculture, land suitability, soil fertility, land topography, land use, landscape quality, climate and agricultural structure. Social variables in the form of; management and forms of activities that can affect farm productivity are also external conditions that affect farming production.

Agricultural business is managed in accordance with the concept of agricultural integration between rice fields (are also called paddy fields or rice paddies) farming as core business and buffalo livestock. This system is a farming managed by hereditary as local wisdom. The Central Bureau of Statistic, Humbang Hasundutan in Figures, (2016) indicated that farmers who work on rice fields integrated with buffalo livestock amount to 8,937 families or 21.91% of 40,783 families spread over 10 sub-districts. Ugwumba et al., (2010) said that one of the efforts to increase agricultural production is through an integrated farming systems which is a system for managing plants, livestock and fish with their environment to produce an optimal product. This systems has a significant positive impact and meets the requirements and criteria for sustainable agricultural development because it is developed based on organic and local resources so that external inputs are low (Tullo, Finzi, & Guarino, 2019).

Soni, Katoch, and Ladohia (2014) also said that integrated farming systems are management systems that integrate agricultural components, such as; plants, animals and fish in a unified whole. The farming system must be fully integrated in order to optimize the use of locally available alternative resources. The system of integrating livestock plants is an agricultural systems characterized by a close link between the components of plants and livestock in a farm in an area. This linkage is a trigger factor in driving farmers' income growth, regional economic growth in a sustainable manner (Tullo, Finzi, & Guarino, 2019). Based on this background, this study aims to analyse the influence of external and internal agricultural conditions towards a rice field-buffalo livestock integrated agricultural systems in the context of regional development in Humbang Hasundutan District.

Literature Review

Regional Development

The concept of sustainable development is based on three dimensions mentioned above. Regions 'development is usually defined as the integral community development (social, economic, environmental and healthcare, technological, cultural and recreational) on

a particular territory (Jovovic et al., 2017). Region's development must be based on their optimal expansion constituents (social, natural and economic development aspects) aimed at certain life's level maintenance and quality improvement through the mentioned constituents.

Regional development encompasses not only traditional policy on a concrete territory, but also socioeconomic process organized in the specific political and cultural context (Spangenberg, 2002). Besides the cultural context, Reinbott (2013) said that the concept of empowerment is part of regional development by strengthening the capacity of groups or individuals to increase their political, economic and social participation in development.

Regional development in today's context is at a critical juncture, with multiple crises (financial, food and energy) forcing us to re-assess the economic paradigm of our time and to evaluate how to better address the unfulfilled promises that we are currently leaving to future generations in the areas of employment, social progress, quality of life and respect for nature (Jovovic et al., 2017).

Regional development related to administrative areas, integrated economic functions and socio-cultural identity, which form a competitive advantage of a region. In social theory related to regional development, there is a concept of territorial competitiveness that is used for regional development and is closely related to environmental, social and cultural sustainability in a region (Janković, 2012).

According to Susilo (2006) the concept of regional development in Indonesia, in terms of its application is based on several theories, including; First is Walter Isard as a pioneer of regional science that examines the causal relationship of the main factors forming regional space in the form of external conditions, namely physical, socio-economic and cultural factors. The second is Myrdal in the 1950s era with his theory which explained the relationship between developed regions and their back regions by using the term backwash spread effect. The third is Friedman in the era of 1960s which emphasized the formation of a hierarchy, in order to facilitate the development of a development system which became known as the theory of the centre of growth. And the fourth is Douglass in the 1970s who introduced rural-urban linkages in regional development.

Regional development policies are needed because of differences in the geographical (Eberhardt, & Vollrath, 2016), social, economic and cultural conditions of the



community between regions, so that the establishment of regional development policies must be adjusted to the conditions, potentials and problems in the region concerned. Thus regional development can be said as a process intended to make changes towards a better development of society, by utilizing various resources such as the agricultural sector (Resosudarmo et al., 2012; Sertoglu, Ugural, & Bekun, 2017).

Integrated Agricultural Systems

Sertoglu, Ugural, and Bekun (2017) said the agricultural sector is a potential resource and has a strategic role in regional development because this sector acts as an absorber of labour, a producer of basic foodstuffs, a driver of exports, a source of raw materials for the manufacturing industry and a source of livelihoods (Simamora, Sirojuzilam, & Supriadi, 2013). This is in line with Budiman et al., (2016) who stated that in accordance with climatic conditions in Indonesia, the government's priority development sector, is the development of energy, food and maritime. Agricultural development can be done through intensification, extensification, diversification and integrated farming systems to be able to increase farmer income and regional income.

Ugwumba et al., (2010), said that an integrated farming system is a system for managing plants, livestock and fish with their environment to produce an optimal product and its nature is closed to external inputs. This system has a significant positive impact that meets the requirements and criteria for sustainable agricultural development because it is developed based on organic and local potential (local resources). So the purpose of implementing an integrated farming system is to suppress minimum input from the outside (low input) and be sustainable (Bijttebier et al., 2017).

The development of the agricultural sector carried out with various approaches certainly has links with various things, such as physical variables, namely; land use, land management, fertilization, seeds, plant cultivation, plant protection. Then the social variables are; farmer education level and culture and institutions, economic variables in the form of; capital, farm input and output prices, farmer family income, inflation and development variables in the form of; road and irrigation or irrigation facilities. Utilization of land resources must be adapted to the agroecological conditions, so that agricultural businesses can be sustainable (Niemmanee, Kaveeta, & Potchanasin, 2015, February 05-07). Furthermore Pedrosa, and Lopez (2012) stated that the physical environment is in the form of; land suitability class, soil fertility, land topography, land use, landscape quality, climate and even

social variables in the form of; management and forms of farming activities also influence farm productivity.

Nuraeni et al., (2013) said that external agricultural conditions are external factors that influence farming activities which are difficult to intervene including, culture, social capital, market access, access to capital, input prices and output prices. Furthermore, Nuraeni et al., (2013) stated that external factors that influence the activities of the community that manage forest resources are social, economic, cultural and market conditions, such as; input prices and production output, that internal conditions are factors that influence farming activities internally, including the knowledge, attitudes and skills of farmers to apply environmental conservation techniques.

Future agricultural development must be well planned to improve the welfare of farmers and must encourage the realization of regional economic development through high competitive productive activities. The agricultural sector is a potential resource and has a strategic role in the process of economic development because the agricultural sector acts as an absorber of labour, a staple food producer, agricultural development as a driver of exports and agricultural commodities as a manufacturing industry, a source of livelihood and a driver of regional development (Simamora, Sirojuzilam, & Supriadi, 2013). Even the development of the agricultural sector is a strategy to spur economic growth, thus providing a multiplier effect on other sectors. Besides that, the agricultural sector also has an important role for the regional economy because it contributes to the GRDP of a region (Sertoglu, Ugural, & Bekun, 2017).

Methodology

Research Location

The research was conducted in the Humbang Hasundutan District as purposively determined, in which area is potential for agricultural sector development with an integrated systems. The research population was 8,937 families, consisted of rice farmer-buffalo breeder in household-scale spread over 10 sub-districts, i.e. Sub-district of Pakkat (1,663 families), Onan Ganjang (708 families), Sijamapolang (233 families), Doloksanggul (1,456 families), Lintong Nihuta (1,150 families), Paranginan (560 families), Baktiraja (152 families), Pollung (1,242 families), Parlilitan (1,342 families) and Tarabintang (428 families) (The Central Bureau of Statistics Humbang Hasundutan District, 2016). The sample was determined by the following Slovin formula;



$$n_c = \frac{N}{1 + Ne^2}, (1)$$

which; n_c = sample size, e = error interval (0,1), N = total population.

The number of obtained samples of 99.98 was rounded into 100 samples. The samples interviewed by each sub-district were determined proportionally, i.e. Sub-district of Pakkat (19 respondents), Onan Ganjang (8 respondents), Sijamapolang (3 respondents), Doloksanggul (16 respondents), Lintong Nihuta (13 respondents), Paranginan (6 respondents), Baktiraja (2 respondents), Pollung (14 respondents), Parlilitan (15 respondents) and Tarabintang (5 respondents).

Type and Data Sources

The applied data in this study was primary data obtained from the field through interviews with respondents by using questionnaires. Secondary data were obtained from publications; Central Bureau of Statistics-North Sumatra Province, Central Bureau of Statistics Humbang Hasundutan District, research, journals and other official publications.

Variables and Data analysis method

In order to analyse the influence of external and internal agricultural conditions on an integrated agricultural systems of rice field-buffalo livestock and regional development in Humbang Hasundutan District, we used Structural Equation Modelling (SEM) using IBM® SPSS® Amos 22 software, with the following formula. The latent variable model for the hypothetical model by using the equation:

$$Y1 = \gamma1 \cdot X1 + \gamma2 \cdot X2 + f1, (2)$$

$$Y2 = \gamma3 \cdot X1 + \gamma4 \cdot X2 + \beta \cdot Y1 + f2, (3)$$

In this study, $\gamma1$ represents the direct influence of $X1$ on $\gamma1$, $\gamma2$ represents the direct influence of $X2$ on $\gamma1$, $\gamma3$ represents the direct influence of $X1$ on $\gamma2$, and $\gamma4$ represents the direct influence of $X2$ on $\gamma2$. The structural parameter β represents the direct influence of $\gamma1$ on $\gamma2$. In the hypothesized model $X1$ and $X2$ does not only have a direct influence on $\gamma2$ but also have an indirect influence mediated by $\gamma1$. The indirect influence of $X1$ to $\gamma2$ is equal to $\gamma3 + \gamma1 \cdot \beta$ and the indirect influence of $X2$ to $\gamma2$ equals to $\gamma4 + \gamma2 \cdot \beta$. Random errors of $f1$ and $f2$ are assumed to have zero-expected values and independent homoscedastic variance (both are non-autocorrelated) and are not correlated with $X1$ and $X2$.

An exogenous latent variable of external agricultural condition ($X1$) has 7 indicators or measurable variables according to research Pedroza and Lopez (2012); Nuraeni et al., (2013) i.e. guidance ($X11$); culture ($X12$); social capital ($X13$); market access ($X14$); capital access ($X15$); input price ($X16$); and output price ($X17$). Exogenous latent variables internal agricultural condition ($X2$) has 5 indicators or measurable variables according to research Pedroza and Lopez (2012); Nuraeni et al., (2013) i.e. land area ($X21$); topography ($X22$); land use ($X23$); road facilities ($X24$); and farming experience ($X25$). An endogenous latent variable of the integrated agricultural systems ($\gamma1$) has 3 indicators or measurable variables i.e. raised income ($\gamma11$); increased food security ($\gamma12$); and cultural preservation ($\gamma13$).

An endogenous latent variable of regional development ($\gamma2$) has 4 indicators or measurable variables-according to research Pedroza and Lopez (2012); Nuraeni et al., (2013) i.e. the provision of the conducive environment ($\gamma21$); environmental impact reduction ($\gamma22$); poverty reduction ($\gamma23$); and increased market access ($\gamma24$). The measurement model for the exogenous variable of $X1$ (external agricultural condition) with the following equation:

$$X11 = \lambda1 \cdot X1 + e1, (4)$$

$$X12 = \lambda2 \cdot X1 + e2, (5)$$

$$X13 = \lambda3 \cdot X1 + e3, (6)$$

$$X14 = \lambda4 \cdot X1 + e4, (7)$$

$$X15 = \lambda5 \cdot X1 + e5, (8)$$

$$X16 = \lambda6 \cdot X1 + e6, (9)$$

$$X17 = \lambda7 \cdot X1 + e7, (10)$$

The measurement model for the exogenous variable of $X2$ (internal agricultural condition) with the following equation:

$$X21 = \lambda8 \cdot X2 + e8, (11)$$

$$X22 = \lambda9 \cdot X2 + e9, (12)$$

$$X23 = \lambda10 \cdot X2 + e10, (13)$$

$$X24 = \lambda11 \cdot X2 + e11, (14)$$

$$X25 = \lambda12 \cdot X2 + e12, (15)$$

The measurement model for intervening endogenous variable of $\gamma1$ (integrated agricultural systems) of rice field-buffalo livestock with the following equation:

$$Y11 = \lambda13 \cdot Y1 + e13, (16)$$

$$Y12 = \lambda14 \cdot Y1 + e14, (17)$$

$$Y13 = \lambda15 \cdot Y1 + e15, (18)$$

The measurement model for the dependent endogenous variable of $\gamma2$ (regional development) with the fol-



Table 1: Compatibility criteria of measurement model and structural model

Indicator	Definition	Acceptable compatibility level	Remark
Chi-Square		Smaller (p-value $\geq 0,05$)	Better
RMR	Root mean square residual	$RMR \leq 0.05$	Good
GFI	Goodness of fit index	$GFI \geq 0.90$ $0.80 \leq GFI < 0.90$	Good Quite good
NFI	Normed fit index	$NFI \geq 0.90$ $0.80 \leq NFI < 0.90$	Good Quite good
CFI	Comparative fit index	$NFI \geq 0.90$	Good
NCP	Non-centrality parameter (fixed parameter associated with DF)	Smaller	Better
RMSEA	Root mean square error of approximation	$RMSEA \leq 0.01$ $0.01 < RMSEA \leq 0.05$ $0.05 < RMSEA \leq 0.08$	Very good Good Quite good

Source: Processing, 2018

lowing equation:

$$Y_{21} = \lambda_{16} \cdot Y_2 + e_{16}, (19)$$

$$Y_{22} = \lambda_{17} \cdot Y_2 + e_{17}, (20)$$

$$Y_{23} = \lambda_{18} \cdot Y_2 + e_{18}, (21)$$

$$Y_{24} = \lambda_{19} \cdot Y_2 + e_{19}, (22)$$

The equations (4) to (22) are linear in their variables and parameters. The structural parameter of λ_i , ($i = 1, 2, \dots, 17$) represents the expected change in the i th measured variable referring to a single unit of increase in the corresponding latent variable. The error rates e_j , ($j = 1, 2, \dots, 12$) are measurement errors for X_j and e_k , ($k = 13, 14, \dots, 19$) are measurement errors for Y_k . It is assumed that these measurement errors have zero-expected values and also independent homoscedastic variance (non-autocorrelated), non-correlated with latent variables of X_1, X_2, γ_1 , and γ_2 , and non-correlated with a latent error of f_1 and f_2 .

Structural modelling process was conducted through several steps (Shek, & Yu, 2014) i.e. 1) Model specifications by establishing models based on empirical evidence; 2) Model identification, for endogenous variables, error rates were made by regression weights; 3) Model estimation (part 1). Analyse each measurement mod-

el. Modification of the initial model takes into account model compatibility and modification index. 4) Model estimation (part 2). An overall analysis of the structural model; 5) Model evaluation. Goodness-of-fit evaluation of the whole model. 6) The model modification is based on model compatibility and hypothetical model is based on model compatibility index. In this study used an assessment of the compatibility of the whole model i.e. compatibility criteria of measurement model and structural model in Table 1.

If the model has not met the compatibility criteria with the data, the model goes through respecification in post-rock. The path in the model is insignificant ($p > 0.05$) indicating the incorrect factor load. The next stage examines the correlation between the external agricultural conditions, the integrated agricultural systems of rice field-buffalo livestock and regional development in Humbang Hasundutan District.

Direct influence will be seen based on the standard regression weight (path coefficient) between the latent variables. Direct influence is significant if the probability value of the standard regression weight ($p < 0.05$) with 95% confidence interval. Indirect influence is expressed by summing independent variable --> intermediate vari-



Table 2: Full Model Regression Weight SEM

			Estimation	S.E.	C.R.	P
Integrated_agricultural_systems		External_agricultural_condition	0.333	0.076	4.389	***
Integrated_agricultural_systems		Internal_agricultural_condition	0.130	0.059	2.203	0.028
Regional_development		Integrat_agricultural_systems	0.423	0.059	7.221	***
Regional_development		External_agricultural_condition	0.217	0.058	3.74	***
Regional_development		Internal_agricultural_condition	0.133	0.059	2.204	0.029

able --> dependent variable. Standard regression weight values for both paths are multiplied (value of the independent variable and intermediate variable x value of the intermediate variable and the dependent variable). The probability value review is done after calculating the multiplication of standard regression weight of independent variable and intermediate variable along with the standard regression weight of intermediate variable and independent variable. The influence of mediation is significant if the probability value of each standard regression weight is significant ($p < 0.05$) with 95% confidence interval.

Results and discussion

The Influence of External and Internal Agricultural Condition on Integrated Agricultural Systems of Rice Field-Buffalo Livestock

TBased on the result of data analysis through structural equation modelling (SEM), in order to observe the influence of external and internal agricultural condition to the integrated agricultural systems of rice field-buffalo livestock and regional development in Humbang Hasundutan District, we obtained full model regression weight SEM in Table 2.

Table 2 shows the probability of obtaining critical ratio value of the integrated agricultural systems of rice field – buffalo livestock and regional development in absolute value is less than 0.01, which means regression weight for external and internal agricultural conditions in predicting integrated agricultural systems in the context of regional development at the 0.01 level (two-tailed). If ex-

ternal and internal agricultural conditions increase by 1 standard deviation, the integrated agricultural systems and regional development will increase by the estimated standard deviation value in Table 3.

Based on the result of data analysis with structural equation model (SEM) represents of path coefficient of external agricultural condition to integrated agricultural systems of rice field – buffalo livestock by 0,61 with CR value of 4,389 > 1,96 and $p (** *) < 0.01$ (Table 2). This indicates that external agricultural conditions significantly have positive influence on the integrated agricultural systems of rice field-buffalo livestock in Humbang Hasundutan. Based on the data analysis results it can be seen that path coefficient values are visually shown through the structural model in Figure 1.

Figure 1 shows that indicator variables of external agricultural conditions i.e. guidance, culture, social capital, market access, capital access, input price and output price are statistically significant with standard regression weight (p) of each indicator, $p < 0.01$. Indicator variable of the integrated agricultural systems of rice field – buffalo livestock i.e. raised income, increased food security and cultural preservation are also statistically significant with standard regression weight (p) of each indicator, $p < 0.01$.

The results of the research defined that guidance factor is one predictor of external agricultural condition that significantly contributes to the perception of farmers to the integrated agricultural systems of rice field – buffalo livestock. This is in accordance with research by Indraningsih (2011) that one of the factors affecting farmers



Table 3: Standard Deviation Value

Variable		Variable	Estimation
Integrated_agricultural_systems	←	External_agricultural condition	0.612
Integrated_agricultural_systems	←	Internal_agricultural condition	0.524
Regional_development	←	Integrated_agricultural_systems	0.533
Regional_development	←	External_agricultural condition	0.265
Regional_development	←	Internal_agricultural condition	0.244

in Garut District to adopt agricultural technology is the perception of farmers towards the guidance.

Cultural factors of hereditary farming on Humbang Hasundutan community influence perceptions of farmers in the integrated agricultural systems. This is in accordance with research by Ejembi and Obekpa (2017); Diwyanto, Priyanti, and Saptati (2007) that community culture becomes an important consideration in the integrated agricultural systems. In addition, social capital significantly contributes to the perception of farmers on integrated agricultural systems. This finding was supported by research by Wibisono and Darwanto (2016) and than Dewi et al., (2017) that social capital has a positive and significant influence on agricultural productivity and determinant of the success of the integrated agricultural systems in Klungkung District. The results of data analysis indicate that some factors such as market access, capital access, input price, and output price contribute to perceptions of farmers to the integrated farming systems in Humbang Hasundutan District. This is in line with the research of Giroh, Umar, & Yakub (2010) and Kizito (2011) that lack of facilities and infrastructure, access to capital and access to market information will cause farmers unable to control price increase, that the price changes at consumer level are not transmitted to farmers level (Waroko et al., 2008).

The result of data analysis by using structural equation modelling (SEM) shows path coefficient of internal agricultural condition to the integrated agricultural systems of rice field – buffalo livestock at 0,52 with CR value of $2.203 > 1.96$ and $p (0.028) < 0.05$ (Table 2). This represents that internal agricultural conditions significantly ($\alpha = 5\%$) have a positive influence on the integrated agricultural systems. Based on the result of data analysis, it is known that path coefficient values are visually shown through the structure model in Figure 1.

The result of data analysis is shown in Figure 1 in which variable of internal agricultural condition i.e farming experience, road facilities, land use, topography and land area are statistically significant with standard regression weight (p) of each indicator, $p < 0.01$. Indicator variable of the integrated agricultural systems i.e. raised income, increased food security and cultural preservation are also statistically significant with standard regression weight (p) of each indicator, $p < 0.01$. The farming experience is one of the predictors of the internal agricultural condition, contributing significantly to the perception of farmers to integrated agricultural systems of rice field – buffalo livestock.

The results of this study are in line with the findings of Aryana, Budhi, and Yuliarmi (2016) stated that the higher the farmer's experience, the easier it is to increase production in order to achieve maximum profit. Ainembabazi and Mugisha (2014) conveyed one of the main indicators of the reflector of farmer-breeder quality variables is the farming experience that affects the application of cattle and food crops business.

The results also represent that road facilities and land area significantly contribute to perceptions of farmers to integrated agricultural systems in Humbang Hasundutan District. This is in line with Suroyo and Handayani (2014) study indicating the welfare level of Kulonprogo farmers is below average due to unavailability of upstream-downstream agribusiness facilities and infrastructure and Mahananto, Sutrisno, & Ananda (2009) defined factor of cultivated land area, experience of farmers in agricultural business has a significant influence on increasing rice production.

The Influence of External and Internal Agricultural Condition on Development

The result of data analysis by using structural equation

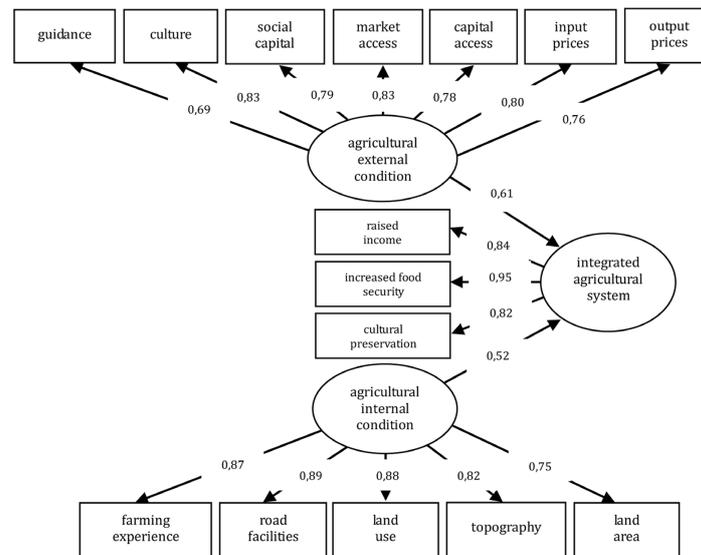


Figure 1: Structural model of direct influence of external and internal agricultural condition on integrated agricultural systems of rice field – buffalo livestock

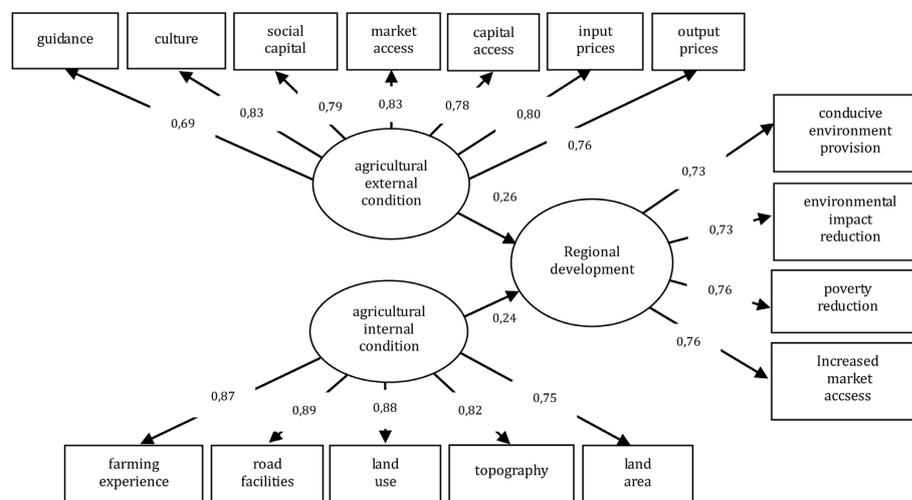


Figure 2: Structural model of the influence of external and internal agricultural condition on regional development

modelling (SEM) exhibits path coefficient of external agricultural condition to the regional development equal to 0,26 with a value of CR 3,740 > 1,96 and $p^{***} < 0.01$ (Table 2). It indicates that agricultural external conditions significantly ($\alpha = 5\%$) have a positive influence on the regional development and is visually shown through the structural model in Figure 2.

The result of data analysis as shown in Figure 2 exhibits that indicator variables of the external agricultural condition i.e. guidance, culture, social capital, market access,

capital access, input price and output price are statistically significant with the standard regression weight (p) of each indicator, $p < 0.01$. Indicator variable of regional development is the provision of a conducive environment, environmental impact reduction, poverty reduction and increased market access that is also statistically significant with the standard regression weight (p) of each indicator, $p < 0.01$.

The results of the study point out guidance as a predictor of the external agricultural conditions have con-



tributed to the regional development in the Humbang Hasundutan District. This is in line with the research of Mangkuprawira (2010) that agricultural guidance is required in regional development. In the long term, the guidance aims to improve the community lives. Indraningsih (2011) defined the purpose of agricultural guidance to increase food production, stimulate economic growth, and improve the welfare of farmers.

The regional development contains socio-cultural aspects that must be maintained and preserved, as Sultani (2016) defined that the regional development should be raised internally by involving local wisdom. The results represent that there is a close relationship between culture and environment that is greatly obvious to the community in Humbang Hasundutan District. They have spiritual, cultural, social and economic relation with their traditional territories in the form of customary laws, including the responsibility for preserving their territory for the needs of future generations. An important element of successful rural development is social capital. Sultani (2016) stated that regional development by involving social capital will foster a sense of responsibility towards implementation of the development. Sunarsih et al., (2014) also suggested that social capital rooted in tradition, which includes socialization in agriculture plays a role in maintaining the relation between human, human and nature, and human and the community.

The result of data analysis using structural equation modelling (SEM) exhibits direct influence of internal agricultural condition to the regional development with path coefficient of 0,24 and CR value of 2,204 > 1,96 and $p(0,025) < 0.05$ (Table 2). It shows that internal agricultural conditions have significant influence ($\alpha = 5\%$) to the regional development as visually represented by the structural model in Figure 2.

Figure 2 represents indicator variable of the internal agricultural condition i.e. farming experience, road facilities, land use, topography and land area that are statistically significant with standard regression weight (p) of each indicator, $p < 0.01$. Indicator variable of the regional development i.e. provision of a conducive environment, environmental impact reduction, poverty reduction and increased market access are also statistically significant with the standard regression weight (p) of each indicator, $p < 0.01$. The results of the research indicate that infrastructure facility is a locomotive to drive economic development and is a determinant of the smooth flow of goods, services, people, and information in Humbang Hasundutan District. This is in line with the research of Srinivasu and Rao (2013); stating that the quality of road infrastructure positively affects the marketing system

of agricultural products. The better the quality of infrastructure, more smoothly the farmers market their agricultural products to the market or consumers.

In relation to regional development, the results exhibit that agricultural land has economic value as a food support and ecological function. Snieska and Simkunaite (2009); Rudiarto and Doppler (2013) stated if the benefits of agricultural land are not maintained, it will disrupt the ecosystem that leads to socio-economic changes and tend to harm and reduce farmers' income.

The pace of development as triggered by the increase in population leads to a change in land use. Agricultural land becomes a residential and industrial area (Prabowo, Bachri, & Wiwoho, 2017). The interaction between space and time dimension with biophysical and human dimensions is also the cause of change in land use, including economic activity and transportation can change land use (Koomen et al., 2007; Wu et al., 2006).

The development of a region can change land use patterns in rural characteristic areas (Kim, Hong, & Ha, 2003) such as Humbang Hasundutan District. Changes in land use in this area indicate the negative impact on the environment, i.e. the emergence of degraded land due to deforestation and environmental vulnerability issues such as; the occurrence of erosion and landslides. In line with that, Sinurat, Munibah, and Baskoro (2015) with the CLUE-S Model (the Conversion of Land Use and its Effects at Small region extents) exhibits that there has been a change in land use in Humbang Hasundutan District covering 5,362 ha in the period (2003-2013). This study even shows that a change in land use based on the rate of natural change indicates the area of forest land use in 2033 was only left by 27.5% of the total area of Humbang Hasundutan District, this shows that land use for the development process due to population growth can cause a decline in farming production which in turn also affects economic growth, in line with the findings of Wang, Chai, and Li (2016); Tali, Divya, & Murthy (2013) which states that population growth will affect the decline in agricultural land area, which can cause a decrease in farm production.

The Influence of Integrated Farming Systems of Paddy Rice-Paddy Rice to Regional Development

Based on the result of structural equation modelling (SEM) analysis, it is known that the direct influence of the integrated agricultural systems of rice field – buffalo livestock to the regional development in Humbang Hasundutan District with a path coefficient of 0,53 and CR value of 7,221 > 1,96 and $p(***) < 0.01$. This suggests

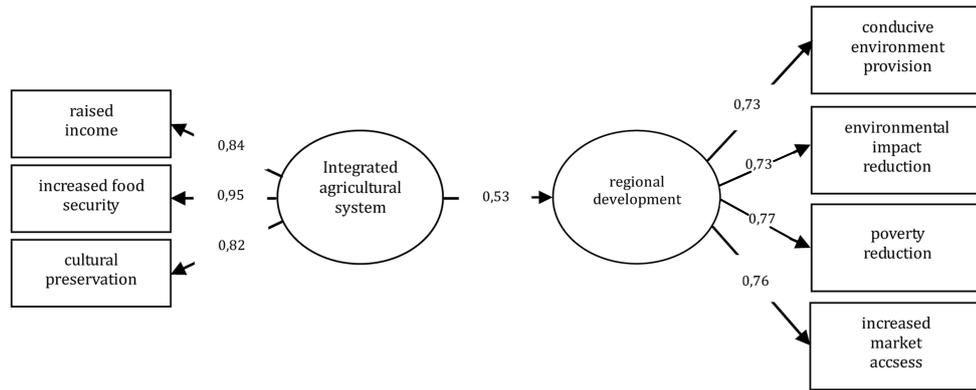


Figure 3: Structural model of the influence of integrated agricultural systems of rice field–buffalo live-stock to regional development

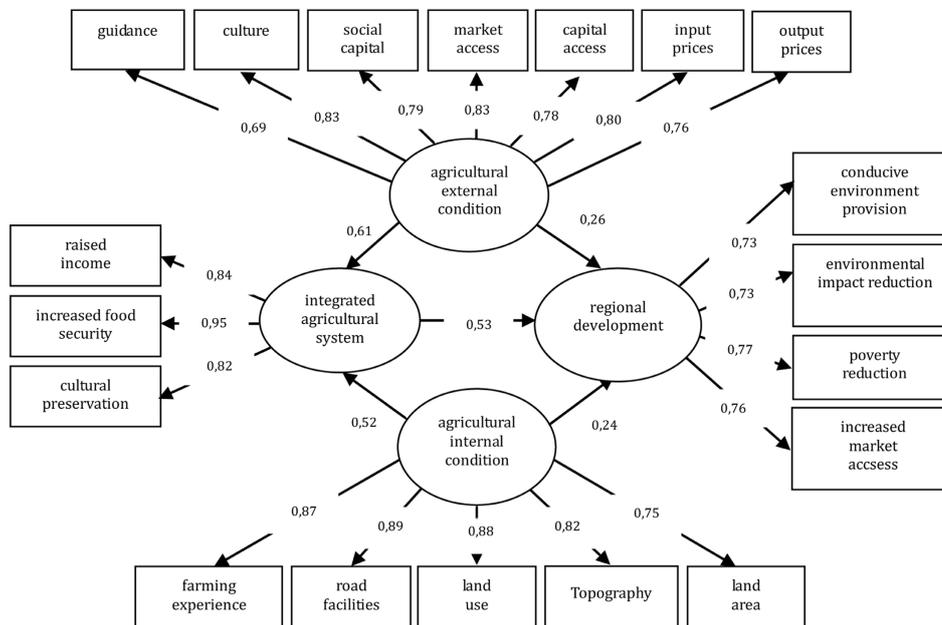


Figure 4: Structural model of the influence of external and internal agricultural condition to the regional development through integrated agricultural systems of rice field–buffalo livestock

that integrated agricultural systems have a positive and significant impact on the regional development as visually shown by the structural model in Figure 3.

Figure 3 represents indicator variables of the integrated agricultural systems i.e. raised income, increased food security and cultural preservation was statistically significant with standard regression weight (p) of each indicator, $p < 0.01$. Indicator variable of regional development i.e. the provision of conducive environment, environmental impact reduction, poverty reduction and increased market access that are also statistically significant with the standard regression weight (p) of each indicator, $p < 0.01$, thus integrated agricultural systems significantly have a positive effect on the regional devel-

opment in Humbang Hasundutan District.

The result of data analysis as shown in Figure 3 exhibits the cultural preservation as a predictor of an integrated farming systems that gives a real contribution to regional development. Indigenous peoples in Humbang Hasundutan District have been familiar with farming and livestock customs, utilizing rice crops as a source of food, buffalo as farming aids, and horses as a means of transportation. Crops cultivation and livestock development of the integrated systems in the eco-friendly agricultural system is a strategy in reducing environmental impacts as well as actualizing the welfare of farmers and rural communities. This is in line with research by Diwyanto, Priyanti, and Saptati (2007) that the pattern



of crop-livestock integration systems makes serious efforts to improve soil structure and microbiology and improve farm productivity, income, and farmers' welfare. In line with the notion of James C. Scott in Willmore (2017) the integrated agricultural system is a good agricultural model to apply in the rural areas of Humbang Hasundutan District.

Soni, Katoch, & Ladohia, (2014) defined an integrated agricultural system that is a business management to integrate agricultural components, such as plants, animals, and fishes in a unified whole. Integrated farming systems, involving crops (rice fields, wheat) and livestock (dairy animals, poultry, fish, rabbits and honey bees), proved more profitable than crops alone in terms of net returns. Further, integrated systems resulted in better utilization of land, water input and human resources. The crop-livestock integration system is characterized by a close association between crop and livestock components in agricultural business in the region. This linkage is a factor to encourage the growth of farmers' incomes and regional economic development in a sustainable way.

The Influence of External and Internal Agricultural Conditions on Regional Development through Integrated Agricultural Systems of Rice Field–Buffalo Livestock

From the result of data analysis with structural equation modelling (SEM) is known as indirect influence of external agricultural condition to regional development through an integrated agricultural systems of rice field – buffalo livestock showed by the structural model in Figure 4.

Figure 4 exhibits the direct influence of external agricultural conditions on the regional development of 0.26. The indirect influence of external agricultural conditions on the regional development through integrated agricultural systems of rice field-buffalo livestock is $0.61 \times 0.53 = 0.32$. Total influence of external agricultural conditions on regional development is $(0.32) + (0.26) = 0.58$. Thus the external agricultural conditions have a positive and significant influence on the regional development through an integrated agricultural systems of rice field – buffalo livestock.

The results of data analysis represented an increase in the predictors of external agricultural conditions that determine the success of integrated agricultural systems will be able to increase regional development. Agricultural guidance as a predictor of external agricultural conditions plays a role in alleviating poverty, in which the success of guidance is related to increasing productivity

and income in the agricultural sector.

Social capital contributes to regional development in Humbang Hasundutan District. The farmers have a low quality of social capital that it will result in lack of access to information, as they have not done maximally in accessing information due to the domination of market opportunities by the middlemen.

Thus the adoption of knowledge and technology in agriculture is influenced by socio-cultural problems, thus it takes time and energy to convince and change the habits of farmers. Therefore, it requires good guidance program that farmers have no obstacles in Humbang Hasundutan District in developing their business due to limited capital and lack of accessibility to the source of capital.

The result of data analysis with structural equation model (SEM) is known as indirect influence from the internal agricultural condition to regional development through an integrated agricultural systems of rice field – buffalo livestock, as visually shown by the structural model in Figure 4.

Figure 4 represents the direct influence of internal agricultural conditions on the regional development in Humbang Hasundutan District of 0.264. The indirect influence of the internal agricultural conditions on the regional development through integrated agricultural systems of rice field – buffalo livestock is $0.52 \times 0.53 = 0.28$. Total influence of internal agricultural conditions on regional development is $(0.28) + (0.24) = 0.52$. It can be said that the internal agricultural conditions have a positive but insignificant influence on the development of Humbang Hasundutan District by an integrated agricultural systems of rice field – buffalo livestock.

The results of the data analysis indicate that although the improvements were made to the predictors of internal agricultural conditions which are the determinants of integrated agricultural systems, it insignificantly improve regional development. The diverse topography of Humbang Hasundutan District from flat land to hilly and mountainous terrain does not contribute significantly to perceptions of farmers to regional development by integrated agricultural systems. This is because the farmers consider that diverse land topography cannot be employed as agricultural land. They assume that the hillside is a factor required to consider, from land preparation, planting and process of collecting products.

The results of data analysis also indicate that road facilities significantly contribute to perceptions of farmers to



integrated agricultural systems, as it turned out that it did not significantly contribute indirectly to regional development. Prowse and Chimhowu (2007) argued that infrastructure is a key factor in supporting rural poverty reduction programs. Having observed in other countries such as in Vietnam, the rapid decline in poverty is inseparable from high investment for the irrigation and roads construction in the agriculture area. Similarly, in India and Ethiopia, which suffered from food and hunger crises in the mid-1980s, the infrastructure improvements of rural roads are a means of increasing market access for farmers in order to increase the farmers' welfare.

Therefore, in order to attract investors into the agricultural sector, it is required to facilitate the accessibility and distribution of agricultural production and output facilities, as it requires adequate infrastructure. Due to the low level of government investment in infrastructure, there are a lot of damaged farm roads, production roads, and irrigation networks. It is necessary for the development and rehabilitation of farm roads, production roads, irrigation networks, shallow ground irrigation, absorption wells, ponds, reservoirs, in order to support the development of integrated agriculture in Humbang Hasundutan District.

Conclusion and Suggestions

Based on the result of the research, it can be concluded that: a) External and internal agricultural conditions have a significant positive influence on integrated agricultural systems of rice field-buffalo livestock, b) External and internal Agricultural conditions have a significant positive influence on the regional development, c) Integrated agriculture systems of rice field-buffalo livestock has a positive and significant influence directly on the regional development, d) Direct influence of external agriculture conditions to regional development is 0,26. Indirect influence of external agriculture conditions on regional development by intermediate of integrated agriculture systems is 0,32 and total influence is 0,58, e) Direct influence of internal agriculture conditions to regional development is 0,24. Indirect influence of internal agriculture conditions on regional development by intermediate of integrated agriculture systems is 0,28, with a total influence is 0,52.

In accordance with the conclusions, it is suggested that; a) the government must be educate farmers to improve their knowledge of integrated agricultural systems, in addition, the role of government is necessary to ensure capital access and market access to facilitate marketing process of farmers' agricultural production, b) the government conducts education and training to improve

the ability of farmers to manage and develop their farms so as to have an impact on the increase of farmers' income, c) the government must be creates agricultural development programs for longer-term purposes to obtain higher quality agriculture in order to increase agricultural production that impact on regional economic growth, d) the government will help farmers to obtain agricultural business capital or access to more flexible capital access and can ensure the agricultural output price stability, e) the government builds road facilities to agricultural centres, irrigation canals, reservoirs and absorption wells in order to support agricultural development.

Acknowledgement

The authors would like to acknowledge Department of Agribusiness, Faculty of Agriculture, University of HKBP Nommensen Medan Indonesia for supporting the writing process of this paper. We extend our greatest gratitude to The Indonesia Endowment Fund for Education (Lembaga Pengelola Dana Pendidikan/LPDP) of the Ministry of Finance of the Republic of Indonesia, which has helped to finance the implementation of this research, in 2016-2017. We are especially grateful to the interviewees for their time and to the reviewers for their careful reading of the papers and constructive comments.

Conflict of Interests

The authors hereby declare that there are no conflicts of interest.

References

- Ahmad, I, & Bajwa, I. U. (2005). Regional development planning-issues and realities. 41st ISoCaRP Congress. Retrieved from http://www.isocarp.net/data/case_studies/649.pdf.
- Ainembabazi, J. H., & Mugisha, J. (2014). The role of farming experience on the adoption of agricultural technologies: evidence from smallholder farmers in Uganda. *Journal of Development Studies*, 50 (5), 666-679. doi: 10.1080/00220388.2013.874556.
- Anríquez, G, & Stamoulis, K. (2007). Rural development and poverty reduction: is agriculture still the key? *Electronic Journal of Agricultural and Development Economics*, 4 (1), 5-46.
- Aryana, A. A. N. B., Budhi, M. K. S., & Yuliarmi, N. N. (2016). Pengaruh karakteristik petani dan peran pen-



- damping terhadap keberhasilan simantri di Kabupaten Badung (Effect of farmer characteristics and companion role on the success of simantri in Badung District). *E-Jurnal Ekonomi dan Bisnis Universitas Udayana*, 5(4), 689-720.
- Bijttebier, J., Hamerlinck J., Moakes. S., Scollan, N., Van. Meensel, J., & Lauwers, L. (2017) Low-input dairy farming in Europe: exploring a context-specific notion. *Agricultural Systems Journal*, 156, 43-51. doi:10.1016/j.agsy.2017.05.016.
- Borisov, B. (2015). Spatial planning in regional planning of agricultural lands and rural areas. *Bulgarian Journal of Agricultural Science*, 21(4), 751-756.
- Budiman, I., Takama, T., Pratiwi, L., & Soeprastowo, E. (2016). Role of micro-finance to support agricultural climate change adaptations in Indonesia: encouraging private sector participation in climate finance. *Future of Food: Journal on Food, Agriculture and Society*, 4 (3), 55-68.
- Dewi, N. L. P. R., Utama, M. S., & Yuliarmi, N. N. (2017). Faktor-faktor yang mempengaruhi produktivitas usaha tani dan keberhasilan program SIMANTRI di Kabupaten Klungkung (Factors that influence farm productivity and the success of SIMANTRI programs in Klungkung Regency). *E-Jurnal Ekonomi dan Bisnis Universitas Udayana*, 6 (2), 701-728.
- Diwyanto K., Priyanti, A., & Saptati, R.A. (2007). Prospek pengembangan usaha peternakan pola integrasi (The prospect of developing an integrated breeding business. *Jurnal Sains Peternakan*, 5(2),26-33.
- Eberhardt, M., & Vollrath, D. (2016). The Effect of agricultural technology on the speed of development. *World Development*, xx, xxx-xxx. doi: org/10.1016/ j.worlddev. 2016. 03. 017.
- Ejembi, S. A., & Obekpa, H. O. (2017). Effects of socio-cultural factors on effective agricultural training programs for farmers by the benue state agricultural development authority in Zone C. *Journal of Asian Rural Studies*, 1(1), 60-69.
- Giroh, Y. D., Umar, H.Y., & Yakub, W. (2010). Structure, conduct, and performance of farm gate marketing of natural rubber in Edo and Delta States, Nigeria. *African Journal of Agricultural Research*, 5 (14), 1780-1783.
- Harmaakorpi, V. (2006). Regional development platform method (RDPM) as a tool for regional innovation policy. *European Planning Studies*, 14(8), 1085-1104.
- doi:10.1080/09654310600852399.
- Harmaakorpi, V, & Pekkarinen, S. (2003, August, 27-31). The concept of the regional development platform and regional development platform method (RDPM) as a tool for regional innovation policy. 43rd Annual Conference of European Regional Science Association. Jyväskylä, Finland. Retrieved from <https://www.jyu.fi/ersa2003/cdrom/papers/392.pdf>.
- Indraningsih, K. S. (2011). Pengaruh penyuluhan terhadap keputusan petani dalam adopsi inovasi teknologi usahatani terpadu (Effects of extension to farmers' decision in adopting integrated farming technology). *Jurnal Agro Ekonomi*, 29(1), 1-24. doi: 10.21082/jae.v29n1.2011.1-24.
- Janković, D. (2012). Territorial approach to regional rural development. *Economics of Agriculture*, 59 (4), 675-686.
- Jovovic, R., Draskovic, M., Delibasic, M., & Jovovic, M. (2017). The concept of sustainable regional development-institutional aspects, policies and prospects. *Journal of International Studies*,10(1), 255-266. doi:10.14254/2071-8330.2017/101/18.
- Kim, E., Hong, S.W., & Ha,S.J.(2003). Impact of national development and decentralization policies on regional income disparity in Korea. *The Annals of Regional Science*, 37 (1), 79-91. doi: 10.1007/s001680200111.
- Kizito, A. M. (2011). The structure, conduct, and performance of agricultural market information systems in sub-Saharan Africa. Dissertation of Michigan State University. Michigan (US). Retrieved from <https://pdfs.semanticscholar.org/fcfa/8468816f56b5514860ebbc-c55848d0528742.pdf>
- Koomen, E., Stillwell, J., Bakema., & Scholten, H. (2007). Modelling land-use change: progress and application. *The Geo-Journal Library*, 90. doi: 10.1007/978-1-4020-5648-2.
- Mahananto., Sutrisno, S., Ananda, C, F. (2009). Faktor-faktor yang mempengaruhi produksi padi, studi kasus di Kecamatan Nogosari, Boyolali, Jawa Tengah (Analysis of influencing factors in increasing rice production, case study in the Nogosari Subdistrict, Boyolali Regency, Central Java Province). *Wacana, Jurnal Sosial dan Humaniora, Indonesian Journal of Social and Humanity Study*, 12 (1), 179-191.
- Mangkuprawira, S. (2010). Strategi peningkatan kapasitas modal sosial dan kualitas sumber daya manusia pendamping pembangunan pertanian (Strategies to



- improve social capital capacity and human resources quality as facilitator in agricultural development). *Forum Penelitian Agro-Ekonomi*, 28(01). doi: 10.21082/fae.v28n1. 2010.19-34.
- Mohammed, M. (2016). Towards a diversified Nigerian economy, the contribution of agriculture to GDP of Nigeria. *International Journal of Economics, Commerce and Management*, 4 (4), 581-590.
- Nainggolan, H. L., Sihombing, M., Tavi, S., & Ma'ruf, T. (2017, October 25). Regional development based on system integration paddy rice farming and livestock buffaloes in Humbang Hasundutan District. *International Proceeding. Advances in Economics, Business, and Management Research*, 46. 1st Economics and Business International Conference 2017 (EBIC 2017). doi.org/10.2991/ebic-17.2018.16.
- Nainggolan, H. L., Sihombing, M., Tavi, S., & Ma'ruf, T. (2019). Regional development: through a structural model approach on the effect of internal conditions on integrated agricultural systems of rice field-buffalo livestock in Humbang Hasundutan District. *International Journal of Civil Engineering and Technology (IJCIET)*, 10 (01), 1040-1050.
- Niemmanee, T., Kaveeta, R., & Potchanasin, C. (2015, February 05-07). Assessing the economic, social, and environmental condition for the sustainable agricultural system planning in Ban Phaeo District, Samut Sakhonn Province, Thailand. *Procedia - Social and Behavioral Sciences*, 197, 2554–2560. doi:org/10.1016/j.sbspro.2015.07.621.
- Nuraeni., Muchdar, A., Basri, L., Jusoff, K., & Basri, M. D. (2012). The influence of internal and external factors on farmers' perception and participation in Jeneberang watershed conservation. *World Applied Sciences Journal*, 22(11), 1639-1643, doi: 10.5829/idosi.wasj.2013.22.11.13028.
- Pedrosa, M. C., & López, C. J. A. (2012). Model for decision-making in agricultural production planning. *Computers and Electronics in Agriculture*, 82, 87–95. doi:10.1016/j.compag.2011.12.004.
- Perdinan., Dewi, N.W.S.P., & Dharma, A. W. (2018). Lesson learnt from smart rice actions in Indonesia. *Future of Food: Journal on Food, Agriculture and Society*, 6 (2), 9-20. doi:10.17170/kobra-2018122067.
- Prabowo, P.D., Bachri, S., & Wiwoho, B. S. (2017). Prediksi perubahan penggunaan lahan dan pola berdasarkan citra landsat multi-waktu dengan land change modeler (LCM) IDRISI SELVA 17: Studi Kasus Sub-Das Brantas Hulu (Prediction of land use changes and patterns based on multi-time landsat images with the current land change modeler (LCM) IDRISI SELVA 17: case study Sub-Das Brantas Hulu). *Jurnal Pendidikan Geografi*, 22 (1), 32-48. doi: 10.17977/um017v22i12017p032.
- Prowse, M., & Chimhowu, A. (2007). Making agriculture work for the poor. *Natural Resource Perspectives*, 111. Retrieved from <https://pdfs.semanticscholar.org/53e1/69b45dc968d07c656be295a33403c7d503b2.pdf>.
- Reinbott, A. (2013). Improvement of food security in Bangladesh through socio-economic empowerment of women. *Future of Food: Journal on Food, Agriculture and Society*, 1(1), 7-12.
- Resosudarmo, B. P., Yusuf, A. A., Hartono, D., & Nurdianto, D. A. (2011). Regional economic modelling for Indonesia: implementation of IRSA-Indonesia5. *Journal of Indonesian Economy and Business*, 26 (3), 287–309. doi:org/10.22146/jieb.6259.
- Rich, K. M., Rich, M., & Dizyee, K. (2018). Participatory systems approaches for urban and peri-urban agriculture planning: the role of system dynamics and spatial group model building. *Agricultural Systems*, 160, 110-123. doi:10.1016/j.agsy.2016.09.022.
- Rudiarto, I., & Doppler, W. (2013) Impact of land use change in accelerating soil erosion in Indonesian upland area: a case of Dieng Plateau, Central Java-Indonesia. *International Journal of AgriScience*, 3(7), 558-576.
- Sertoglu, K., Ugural, S., & Bekun, F. V. (2017). The contribution of agricultural sector on economic growth of Nigeria. *International Journal of Economics and Financial Issues*. 7(1), 547-552.
- Soni, R.P., Katoch, M., & Ladohia, R. (2014). Integrated farming systems - a review. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 7(10), 36-42.
- Shek, D. T., & Yu, L. (2014). Use of structural equation modelling modeling in human development research. *International Journal of Disability and Human Development*, 13, 157–67. doi: 10.1515/ijdh-2014-0302.
- Simamora, A. P., Sirojuzilam., & Supriadi. (2013). Analisis potensi sektor pertanian terhadap pengembangan wilayah di Kabupaten Humbang Hasundutan (Analysis of the potential of the agricultural sector towards regional development in Humbang Hasundutan District).



Jurnal Ekonom, 16(2), 54-66.

Sinurat, T. P., Munibah, K., Baskoro, D. P. T. (2015). Pe-modelan perubahan penggunaan lahan Kabupaten Humbang Hasundutan menggunakan Clue-S (Modeling land-use change in Humbang Hasundutan District using Clue-S). *Jurnal Tanah Lingkungan-Journal of Soil Science and Environment*, 17(2), 75-82. doi:org/10.29244/jitl.17.2.75-82.

Snieska, V., & Simkunaite, I. (2009). Socio-economic impact of infrastructure investments. *Inzinerine Ekonomika-Engineering Economics*, 63(4), 16-25. doi:org/10.5755/j01.ee.63.4.11638.

Spangenberg, J. H. (2002). Environmental space and the prism of sustainability: frameworks for indicators measuring sustainable development. *Ecological Indicators* 2, 295-309. doi: 10.1016/S1470-160X(02)00065-1.

Srinivasu, B., & Rao, P. S. (2013). Infrastructure development and economic growth: prospects and perspective. *Journal of Business Management & Social Sciences Research (JBM&SSR)*, 2 (1), 81-91.

Sultani, A. M. 2016. Pengembangan wilayah berbasis pendekatan sosial ekonomi di Kabupaten Barru Provinsi Sulawesi Selatan (Regional development based on socio-economic approach in Barru District, South Sulawesi Regency). *Plano Madani, Jurnal Perencanaan Wilayah dan Kota*, 5 (1), 8-17.

Sunarsih., Swastika, D. K. S., Iqbal, M., Ariani, M., Prase-tyo, B., & Azis, M. (2014). Analisis peran modal sosial dalam mendukung pembangunan pertanian di kawasan perbatasan (Analysis of the role of social capital in supporting agricultural development in the border region). Pusat Analisis Sosial Ekonomi dan Kebijakan Pertanian. Badan Penelitian dan Pengembangan Pertanian. Kementerian Republik Indonesia (Agricultural Research and Development Agency. Ministry of Republic of Indonesia). Jakarta. Retrieved from http://pse.litbang.pertanian.go.id/ind/pdf/files/LHP_SNR_2014.pdf.

Suroyo, B. T., & Handayani, W. (2014). Pengembangan kawasan agropolitan di Kabupaten Kulonprogo, Daerah Istimewa Yogyakarta (Development of agropolitan area in Kulonprogo District, Yogyakarta). *Jurnal Perencanaan Wilayah dan Kota*, 25 (3), 243-261. doi:org/10.5614%2Fjpwk.2015.25.3.5.

Susilo, K. (2006). Kebijaksanaan pengembangan wilayah di masa yang akan datang dan implikasinya terhadap kebutuhan analisis dengan memanfaatkan

sistem informasi geografis (Regional development policy in the future and its implications for the need for analysis by utilizing geographical information systems). Direktorat Jenderal Penataan Ruang dan Pengembangan Wilayah, Departemen Pemukiman dan Pengembangan Wilayah Republik Indonesia. Jakarta. Retrieved from <https://www.scribd.com/doc/66623755/Prospek-Gis-Itb>.

Szajnowska, A., & Wysocka. (2009). Theories of regional and local development- abridged review. *Bulletin Of Geography Socio- Economic Series*, 12. doi: <http://dx.doi.org/10.2478/v10089-009-0005-2>.

Tali, J. A., Divya, S., & Murthy, K. (2013). Influence of urbanization on the land use change: a case study of Srinagar City. *American Journal of Research Communication*, 1(7), 271-283.

The Central Bureau of Statistics/CBS (Badan Pusat Statistik/BPS), Humbang Hasundutan in Figures (Kabupaten Humbang Hasundutan Dalam Angka), (2016). Dolok-sanggul.

The Central Bureau of Statistics/CBS (Badan Pusat Statistik/ BPS), North Sumatra in Figures (Propinsi Sumatera Utara Dalam Angka), (2016). Medan.

Tullo, E., Finzi, A., & Guarino, M. (2019). Review: Environmental impact of livestock farming and precision livestock farming as a mitigation strategy. *Science of the Total Environment*, 650 (2), 2751-2760. doi: org/10.1016/j.scitotenv.2018.10.018.

Ugwumba, C. O. A., Okoh, R. N., Ike, P. C., Nnabuiife, E.L.C., & Orji, E.C. (2010). Integrated farming system and its effect on farm cash income in Awka South Agricultural zone of Anabra State Nigeria. *American-Eurasian Journal Agricultural and Environ Science*, 8 (1), 01-06.

Wahyudi, W. W., Priyarsono, D. S., & Rifin, A. (2014). Perencanaan pembangunan ekonomi wilayah berbasis sektor unggulan, kasus: Kabupaten Pasaman pasca otonomi daerah (Regional economic development planning based on leading sectors, case: Pasaman District after regional autonomy). *Jurnal Agribisnis Indonesia*, 2 (2), 159-176. doi: org/10.29244/jai.2014.2.2.159-176.

Wantu, S., Moonti, U., & Wantu, A. (2018). Policy of agriculture development and agriculture field on resource farmers Gorontalo-Indonesia. *International Journal of Management and Business Research*, 8 (1), 2228-7019.

Wang, Z., Chai, J., & Li, B. (2016). The impacts of land use



change on residents' living based on urban metabolism: a case study in Yangzhou City of Jiangsu Province, China. *Sustainability*, 8 (10), 1-17. doi:10.3390/su8101004.

Waroko, T. K., van Schalkwyk, H. D., Alemu, Z. G., & Ayele, G. (2008). Producer price and price transmission in a deregulated Ethiopian coffee market. *Journal of Agriculture*, 47(4). doi: 10.1080/03031853.2008.9523812.

Wibisono, G. M. A., & Darwanto. (2016). Strategy of strengthening social capital of farmer group in agricultural development. *Jejak-Journal of Economics and Policy*, 9 (1), 62-81. doi:http://dx.doi.org/10.15294/jejak.v9i1.7187.

Willmore, L. (2017). Scott, James C. – Against the Grain: A deep history of the earliest States. Book review. *States* Yale University Press. doi: org/ 10.1111/ padr.12152.

Withanachchi, S. S., Kopke, S., & Frettsome, D. (2013). Building non-hegemonic political culture for sustainable rural development. *Future of Food-State of the Art, Challenges and Option for Action*. DBU Environmental Communication, 2, 230-241. doi: 10.13140/2.1.2597.4082.

Wu, Q., Li, H., Wang, R., Paulussen, J., He, Y., Wang, M., Wang, B., & Wang, Z. (2006). Monitoring and predicting land use change in Beijing using remote sensing and GIS. *Landscape and Urban Planning*, 78, 322-333. doi: 10.1016/j.landurbplan.2005.10.002.