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Rural modernisation through intensive vegetable farming agribusiness in Indonesia

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ABSTRACT

Traditional farming that changes to profitable agribusiness can serve a machine for rural modernisation. This article assesses factors that determined the decision of smallholder vegetable producers to participate in vegetable-based agribusiness and analyses the impact of agribusiness participation and other determinants on the economic returns. Structural equation modelling was employed to show a proposed model of cumulative causation theory. Data were compiled from a quantitative survey of 357 selected farm households located in major vegetable-producing areas of Bali and Java, Indonesia. Results show that human capital and household endowment motivated farmers to participate in vegetable-based agribusiness. Women's participation significantly contributed to agribusiness participation and agribusiness participation led to income generation. Opportunities exist to expand vegetable-based agribusiness and increase farmers' income by providing adequate access to transportation infrastructure, an advantageous agribusiness environment, and investing in human capital through training and extension services.

KEYWORDS

agribusiness engagement; profit-oriented farming; income generation; agribusiness environment; structural equation modelling; women farm participation

Introduction

In the process of rural modernisation, an agribusiness goal is to encourage farmers to move from conventional subsistence farming to modern profit-oriented agriculture. In Indonesia, government encourages smallholder farmers to participate in profit-oriented farming to improve their farming performance. This movement is in line with recent policy discourses where a process of commercialisation, or market participation of agriculture in developing countries, is a key element for improving economic development through poverty reduction and economic growth in rural areas. Historically, agricultural commercialisation has been identified as an engine of agricultural development (Coward, 1969). Specifically, agribusiness ventures can help smallholder farmers in the process of rural development (Goldsmith, 1985). This topic remains important today, linking rural development, resilience, and farm modernisation (Bjørkhaug & Knickel, 2018).

This study assesses the effect of market participation of vegetable farming in Indonesia on farmers' income, along with other factors coming from an agri-market environment,

and evaluates farmers' decision-making about engaging in market-oriented vegetable production. The term "agribusiness" is delineated as active participation in a profit-oriented intensive farming system that takes agribusiness information into account. Household members who operate intensive vegetable farming and sell the produces for profit are considered as agribusiness actors. The main feature of this study, compared with existing literature, is the involvement of female farmers in agribusiness. The significant role of women in rural Indonesia is sociologically vital because it represents a stage of development (Stockemer & Sundström, 2016). In developed countries, there are balanced roles and rights between male and female in societies (Mariyono & Kuntariningsih, 2009). Findings are expected to provide answers to the research question, Why are some vegetable farmers more willing to have a vegetable-based agribusiness venture, while others remain at subsistence and semi-subsistence farming levels?

Literature review and theory

In Indonesia, commercialised vegetables like chilli, shallot, and tomato are a vital part of daily diets and livelihoods, as well as play an essential role in the overall economy of the country. These high-valued vegetables are cash crops that contribute to the local and national economy through the multiplier effect in income and employment generation, and serve as a source of raw material for processing industries. As these vegetables are farmed mostly for daily consumption (Keatinge, Yang, Hughes, Easdown, & Holmer, 2011), their demand, as commodities, tends to increase along with population growth. Vegetable production, however, exhibits seasonal patterns in two major production seasons. The year-round model of vegetable products indicates a sigmoid shape, meaning that supplies of the commodities tend to potentially oscillate (Wijayanto, Sumer-tajaya, Fitrianto, & Wahyuni, 2014) and variations in weather, planting, and other factors can exaggerate seasonal output effects (Webb, Kartikarsari, & Kosasih, 2012).

Whereas, seasonality in the production of different crops usually induces price volatility, there are normally no ceiling or floor prices for vegetable commodities. Vegetable prices are strongly dependent on the equilibrium of supply and demand in the market (Artika, Firdaus, & Irawan, 2019; Zaremba, 2017). The intervention of the Indonesian Government, both at central and local levels, related to price regulation is weak in comparison to food crops such as rice. While sometimes the government intervenes when the prices of vegetables are extremely high by conducting a market operation, this intervention is intermittent. Thus the reduction of product seasonality offers a way to stabilise vegetable prices. The government provides technological intervention and accurate market information that enables farmers to grow vegetables during the off-season and various off-season technologies, including integrated crop management, integrated pest and disease management, fertiliser application, and improved cultivars, have been disseminated to farmers. Transitioning from rice farming to commercial vegetable production thus makes rural economies more vibrant by intensifying the use of labour and other inputs in Indonesia because the intensification triggers local markets, mainly through enhanced value chains of agricultural inputs and products.

At the global level, the highest contributor to vegetable production is China, which contributes about 16.93% of the market share. Recent statistics show the production of vegetables in China was 163,466,379 t, and the averaged productivity was 16.2 t/ha, while the

share of Indonesian production was only 0.07%; aggregately, the national production of vegetables was 629,550 t, and the averaged productivity 10.3 t/ha (FAOSTAT, 2015). Although Indonesia gained US\$17.15 million in 2014 from seasonal vegetables (BPS, 2014), Indonesia also imports several vegetables, with the total value of vegetable imported higher than exported leading to the deficit in 2014 doubling the value of exports (BPS, 2015).

Figure 1 shows the increase in the production of the top five vegetables, which include chilli, cabbage, shallot, tomato, and eggplant, in Indonesia. Chilli underwent the highest growth rate, due primarily to a beneficial market, agronomic technology and government supports. Currently, the use of modern agronomic technologies leads to the high performance of vegetable cultivation (Mariyono, 2019a; 2019b). In their 2018 analysis which focused on production centres, Mariyono (2019a, 2019b) report an increase in vegetable profits per hectare, whereas chilli farmers accrued the highest profits of up to 3490USD, surpassing the profits experienced in the production of eggplants, tomato and yard-long bean which were 1354, 1289 and 211 USD respectively. Such insights are also shared by BPS (2015) who reports a profit of USD2272 per hectare for chilli production at the national level. Regarding profit level, chilli farming yielded the highest profit nationally, US\$2272 (BPS, 2015), which was lower than that noted by Mariyono's (2018) focus on production centres.

The economic share of vegetable farming in the vegetable-producing regions in eastern Java is displayed in Figure 2.

Eggplant and big chilli contributed an almost similar share of profit, which accounted for around 45%, meaning that, in relative terms, both vegetables were superior compared to other vegetables. Yard-long beans had the lowest net return, which accounted for (15%), small chilli and tomato provided similar shares, which accounted for 30%, labour had the highest share in small chilli farming, and long bean farming had the highest share

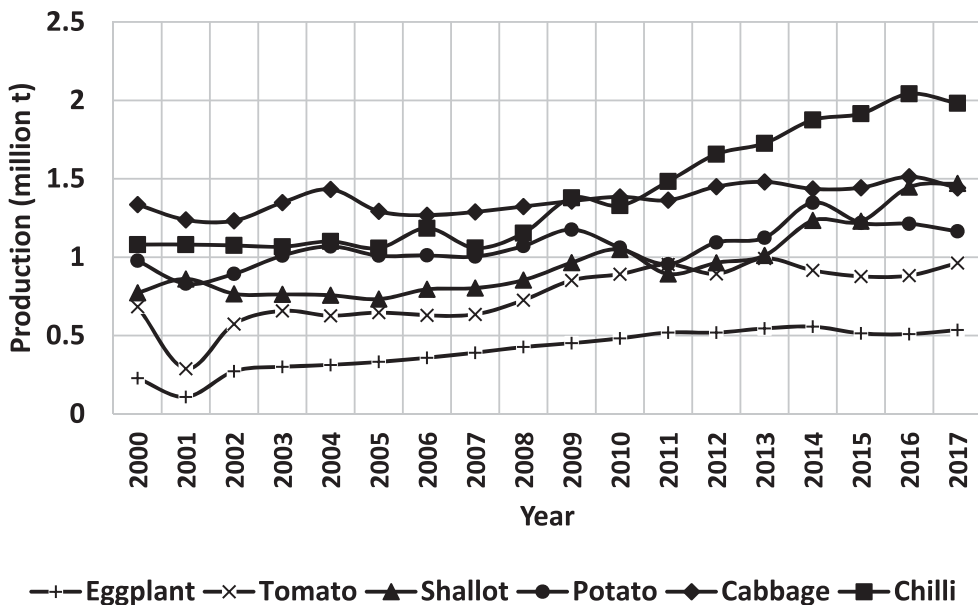


Figure 1. The dynamic trend of major vegetable production in Indonesia. Source: BPS (2018).

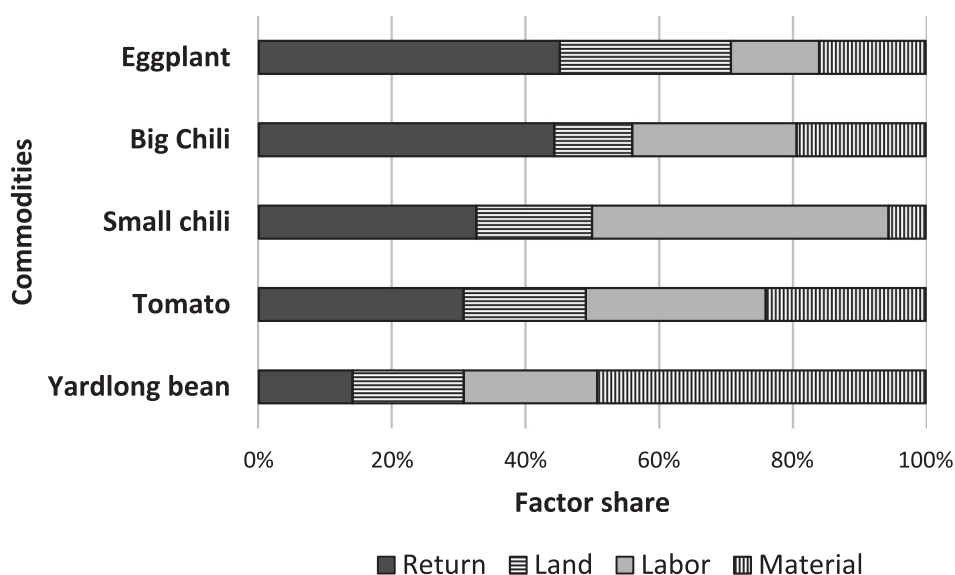


Figure 2. Factor share of vegetable farming in eastern Java, Indonesia. Source: Mariyono (2018).

(Mariyono, 2018). Considering these factors, eggplant and big chilli farming were superior in terms of relative profitability. The main component of material input was agrochemicals that have been used since the Green Revolution (Resosudarmo & Yamazaki, 2010).

There is a potential to market these vegetables, which generates income to support rural economic development. The process starts with agricultural growth causing an increase in the purchasing power of smallholder farmers. These farmers circulate cash through the economy, stimulating demand and employment growth in non-farm sectors until, eventually, rural and urban labour forces provide a market for each other by increasing the need for food and other farm products (Jayne, Haggblade, Minot, & Rashid, 2011). Despite the sizable growth of vegetable production in Indonesia, its global share of the vegetable industry remains very small. Improvements in cultivation practices, availability of improved crop varieties, and improvement in agricultural infrastructure are some of the reasons for the recently observed increase in vegetable production. There is still room, however, to expand vegetable production in Indonesia by promoting a profit-mindset among farmers who have yet not adopted a commercial approach to agriculture. Intensive vegetable farming can escalate farmers' income and this encourages other subsistence farmers to step up to commercial agriculture.

The present study focuses on vegetables because vegetable farming is operated in small-scale and in subsistence and semi-subsistence in fashion. Thus if the subsistence condition can shift to profit-oriented farming, then households can earn more cash. Changing from subsistence to profit-oriented farming is considered as a pivotal point of rural modernisation. This study employs the fundamental theory of cumulative causation (Myrdal, 1957) to rationalise the paths in which farm households' intend to move from subsistence to profit-oriented farming through agribusiness participation. The theory describes a multi-causal pathway of core variables and their linkages (Bartoletti, Cimoli, Pinna, & Zunino, 2015; Fujita, 2007; Myrdal, 1957). The verification of the theory has shown the

process of development in many countries occurs through a circular interrelationship (Bartoletti et al., 2015; Fujita, 2007). Application of the model has explained a solution to an Indonesian style of poverty that previously remains unresolved (Mariyanti & Mahfudz, 2016). The idea underlying the model is that a change in one form of a foundation will lead to following changes in other establishments. The model has been successful to show that many significant variables have impacts on poverty reduction.

Based on this theory, this study proposes that the proportion of resources allocated to intensive vegetable farming by producers is a result of various responses from the market atmosphere, resource endowment, and acquired knowledge through a process of cumulative causality. In practice, endogenous variables are consecutively interrelated in creating effects between variables in a state of complex interrelations (Choudhury, Hossain, & Hossain, 2011). The endogenous action–reaction relationship among selected relevant variables of various sectors is, therefore, a fundamental feature of cumulative causation (Choudhury et al., 2011). Agribusiness participation, which is represented by the share of products of farming sold for profit in the market, is the central variable. Farmers, as agribusiness actors, directly and indirectly, react toward supporting factors through a process of cumulative causation. The participation in intensive vegetable farming agribusiness leads to increased net revenue. Agribusiness participation and net revenue are induced by exogenous variables directly and indirectly through several variables as mediators. The mediating variables are also considered endogenous. The exogenous variables are independent of the market process and, in this case, the exogenous variables are external factors. Based on the theoretical framework and the concept of cumulative causation, this study adopts and adjusts the concept of farmers' decision to devote resources to intensive vegetable production as integral parts of agribusiness activities. The endogenous interrelationship among variables establishes consecutive causation in intensive vegetable production, which can be expressed in [Figure 3](#).

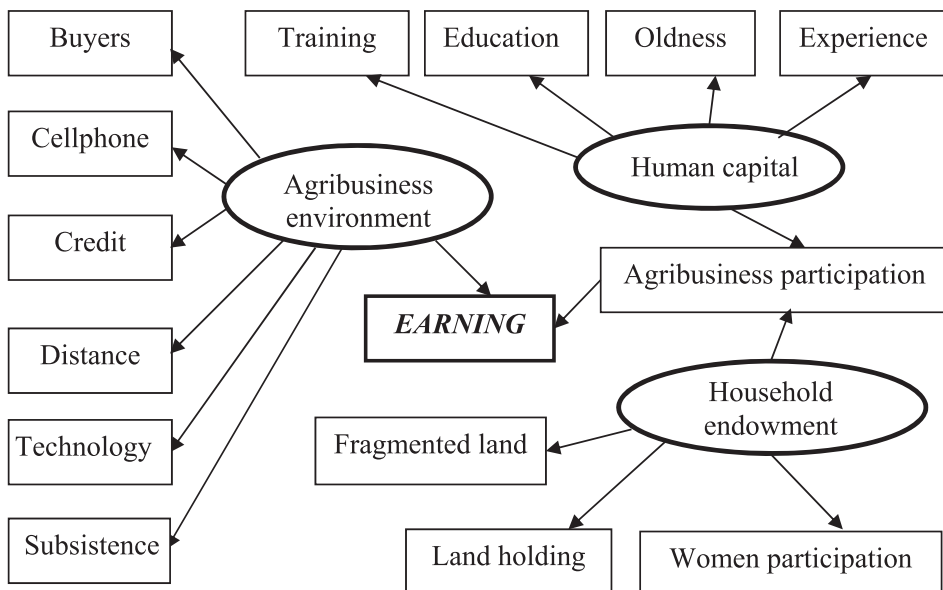


Figure 3. Conceptual framework for analysis.

Table 1. Mathematical formulation of conceptual framework.

$Y_1 = \alpha_0 + \alpha_1 Y_2 + \alpha_2 X_3 + \varepsilon_1$	(1)
$Y_2 = \beta_0 + \beta_1 X_1 + \beta_2 X_3 + \varepsilon_2$	(2)
$Z_1 = \delta_0 + \delta_1 X_1 + \varepsilon_{15}$	(3)
$Z_2 = \phi_0 + \phi_1 X_1 + \varepsilon_3$	(4)
$Z_4 = \eta_0 + \eta_1 X_1 + \varepsilon_4$	(5)
$Z_3 = \gamma_0 + \gamma_1 X_1 + \varepsilon_5$	(6)
$Z_5 = \varphi_0 + \varphi_1 X_2 + \varepsilon_6$	(7)
$Z_6 = \kappa_0 + \kappa_1 X_2 + \varepsilon_7$	(8)
$Z_7 = \lambda_0 + \lambda_1 X_2 + \varepsilon_8$	(9)
$Z_8 = \mu_0 + \mu_1 X_3 + \varepsilon_{14}$	(10)
$Z_9 = \pi_0 + \pi_1 X_3 + \varepsilon_9$	(11)
$Z_{10} = \theta_0 + \theta_1 X_3 + \varepsilon_{10}$	(12)
$Z_{11} = \rho_0 + \rho_1 X_3 + \varepsilon_{11}$	(13)
$Z_{12} = \sigma_0 + \sigma_1 X_3 + \varepsilon_{12}$	(14)
$Z_{13} = \tau_0 + \tau_1 X_3 + \varepsilon_{13}$	(15)

Specifically, Y_1 is Earning, Y_2 is Agribusiness participation, X_1 is Human capital, X_2 is Household endowment, Z_1 is Training, Z_2 is Education, Z_3 is Oldness, Z_4 is Experience, Z_5 is Fragmented land, Z_6 is Land holding, Z_7 is Women participation, Z_8 is Buyer, Z_9 is Cellphone, Z_{10} is Credit, Z_{11} is Distance, Z_{12} is Technology, and Z_{13} is Subsistence. Symbols of α , β , δ , ε , ϕ , γ , η , φ , κ , λ , μ , π , θ , ρ , σ , and τ represent the coefficient of regression and ε represents the error terms.

Figure 3 shows two endogenous variables, namely agribusiness participation and earning. Exogenous variables comprise three latent variables, namely human capital, household endowment, and agribusiness environment. Human capital represents training, education, age (oldness), and experience. The household endowment construct consists of land holding, fragmented land, and women's participation. The agribusiness environment construct consists of distance, having a mobile (cellphone), credit, buyers, short crop, and subsistence. Human capital and household endowment directly affect agribusiness participation and indirectly affect earning. Simultaneously, earning is directly affected by agribusiness participation and agribusiness environment. The model of analysis described in Figure 3 can be mathematically formulated as shown in Table 1.

Methods

Research design and sample

This study utilised a cross-section dataset collected from a field survey of 357 farm households. The survey was conducted in the 2014 production season in four vegetable-producing areas of Bali and East Java provinces, Indonesia. The samples of households were selected using a purposive-stratified random sampling approach at the farm level in three main regions by purposively selecting vegetable growers as the population, then stratifying them based on land holding size, and, finally, randomly selecting each stratum. Household-level data were collected using individual interviews augmented with qualitative data prompted through a series of group discussions with selected representative farmers. Focus group discussion (FGD) was conducted once in every region to obtain a

Table 2. Study variables, unit measurement, means and standard deviations.

Variables	Description	Unit	Mean	SD
Endogenous variables				
Agribusiness participation	Marketed products for commercial purposes	%	71.24	28.36
Earning	Net return generated from one cycle of farming (crop season)	million IDR/ha	5.12	4.92
Constructs of latent variables				
Oldness	Household head's age	year	45.14	12.82
Education	The highest formal education attained by household head	year	7.93	2.24
Experience	Number of years spent vegetable farming	year	17.12	12.33
Women participation	Proportion of female family members who actively engage in agribusiness activities	%	41.94	19.34
Land holding	Total land planted with vegetables	ha	0.75	0.68
Fragmented land	Number of separated pieces of land	integer	3.65	3.57
Credit	Farmers' access to loans for agricultural purposes	dummy, 1: yes; 0: otherwise	0.34	0.38
Training	Number of training programs attended by farmers	integer	2.14	1.24
Cellphone	Use mobile (cell phones) for supporting farming business activities	dummy, 1: yes; 0: otherwise	0.36	0.52
Buyers	Number of buyers contacted before harvesting produce	integer	1.82	0.63
Distance	Position of farm distant to local market where farmers usually sell their produce	km	19.11	15.24
Technology	Seed technology indicated by age of crops ready for harvesting	month	4.87	2.21
Subsistence	Current status of farming mostly for home consumption	dummy, 1: yes; 0: otherwise	0.29	0.35
Latent variables				
Human capital	Capability and capacity of farmers, constructed by level of formal education, age, and training			
Household endowment	Resources held by farmers' households, constructed by women's participation, land holding, and fragmented land			
Agribusiness environment	Supporting agribusiness, constructed by buyers, cellphones, credit, distance, short crop, and subsistence			

Source: Analysis output of 357 research participants.

general overview of aspects of vegetable production. The participants of FGD were farmer leaders, chairmen of farmers' association, female farmers, and local vegetable traders. Approximately 10 individuals participated in each FGD.

Variable selection was based on prior research literature (Mariyono, 2017, 2018; 2019b; Raut, Sitaula, Vatn, & Paudel, 2011; Selvaraj, 2009). Table 2 defines the current research variables and units of measurement, as well as provides means and standard deviations.

Hypothesis formulation

This study utilised a method of structural equation modelling (SEM) as an analytical tool. SEM is a powerful multivariate technique that enables performing test models with multiple dependent variables and several simultaneous regression equations (Alavifar, Karimi-malayer, & Anuar, 2012). This study tests a series of hypotheses, which can be stated as follows:

H₁: Human capital and household endowment leads to a higher level of agribusiness participation.

H₂: Agribusiness participation and agribusiness environment lead to a higher earning.

H₃: Many factors support human capital, household endowment, and agribusiness environment.

Formally, all hypotheses can be statistically formulated as:

$$H_0: \alpha = \beta = \delta = \varepsilon = \phi = \gamma = \eta = \varphi = \kappa = \lambda = \mu = \pi = \theta = \rho = \sigma = \tau = 0$$

H_a: The H₀ is false.

The hypotheses proposed here were statistically tested at least at a 95% confidence interval. The analysis also provided goodness of fit and overall tested for the structural model. Every coefficient estimated here is reported in actual and standardised forms, the later comparable to one another due to the standardisation of unit measurement (Freedman, 2009). Statistical software was used to establish and estimate the model of analysis (StataCorp, 2013).

Research limitations

This study has several limitations related to the sample size, sampling method, and number of variables. Further, the article conceptualises that “profit” is the core goal of agribusiness. Indicators representing agribusiness participation represent only a share of products sold for profit in the market. The number of variables related in SEM is small because of missing (incomplete) data when the variables are disaggregated to more detailed variables. The analysis that shows statistically significant results has been modelled, which are shown by high coefficient determination.

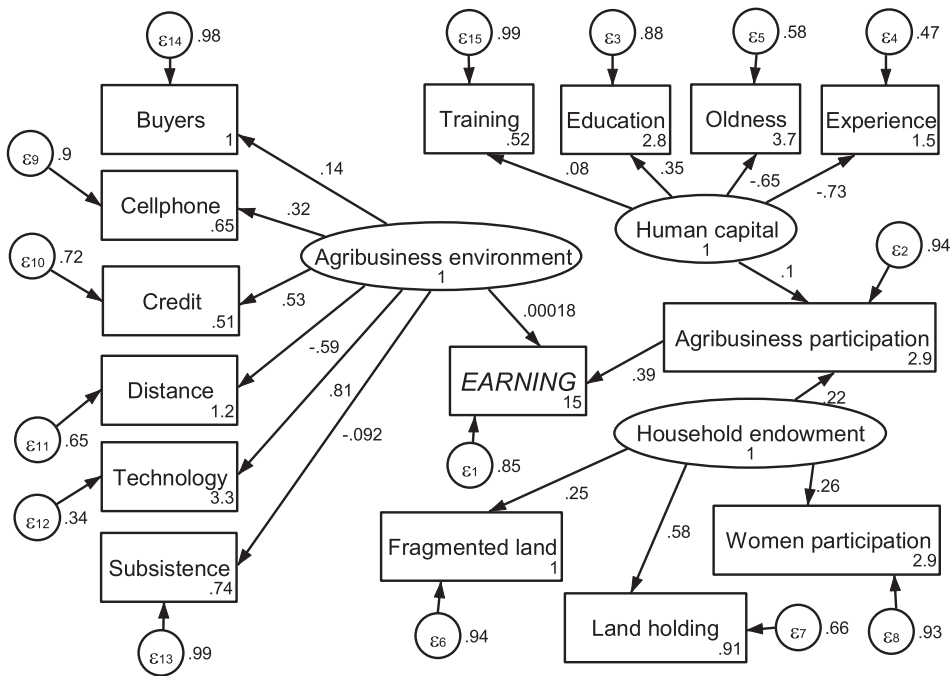


Figure 4. Estimated model of analysis.

Findings and discussion

The complete estimated structural equation model is presented in [Figure 4](#). Numbers adjacent to the path (arrow) represent the standardised effect. The larger the absolute value of the number, the more important the effect (Freedman, 2009). The main finding of the model is that agribusiness participation based on intensive farming of vegetables has been able to increase net revenue earned by farmers' households. Household members who actively participate in agribusiness enjoyed higher earnings than those who cultivated vegetables just for fulfilling home consumption or in a subsistence manner. There were about 25 vegetable crops grown by farmers in Indonesia, of which half have potential to generate cash if farmers utilise them in an agribusiness environment. In this study, farmers participating in agribusiness grow selected vegetables that potentially meet market demand, which is dependent on local markets. Agribusiness environment directly influenced the income generated from farming. The business environment consisted of many internal and external elements affecting farming profitability. If farmers already participated in agribusiness, but the business environment was discouraging, then the profitability of agriculture was sub-optimal. This finding furthers literature finding that business environment supports increased performance in terms of competitive advance (Rezazadeh & Mahjoub, 2016).

Farmers' decision to engage in market-oriented farming, or an agribusiness venture, was affected by endowment of farmers' households. In this case, household endowment represents available resources owned by households to support commercial farming. Because intensive vegetable farming required high operating capital (Mariyono, 2019a), farmers with more resources cultivated more vegetables for commercial sales. Human capital that measures the capability and capacity of farmers to run intensive farming and other agribusiness activities slightly influenced the farmers' decision, as agribusiness based on intensive vegetable farming is a complex business, only those with sufficient human capital were more likely to engage in such a business venture.

[Table 3](#) shows the magnitude and significance of the estimated structural equation model. Participation in agribusiness significantly increased earnings. The effect suggests that a percentage point increase in agribusiness participation led to an increase in earnings by 2%, keeping everything else constant. Adding the proportion of agribusiness participation was insignificant, likely because farmers already have the resources necessary to

Table 3. Estimated structural equation model.

Variable	Effect	Standardised	Robust s.e.	z-Value
Earning <-				
Agribusiness participation	0.0151	0.3897	0.0466	8.37***
Agribusiness environment	1.0000	0.0002	0.0000	18.45***
Constant	14.0086	15.3387	0.6583	23.30***
Agribusiness participation <-				
Human capital	1.0000	0.1020	0.0607	1.68
Household endowment	5.7068	0.2179	0.1121	1.94*
Constant	68.3077	2.8980	0.0771	37.59***
Number of observations	=	357		
Log pseudo-likelihood	=	-10,698		
R-squared overall	=	0.9510		
LR-test for overall, $\chi^2(105)$	=	1397.10***		

Note. *significant at .05, **at .01, ***at .00.

expand their business. The nominal value of earning that can be gained is about IDR100,000 (US\$9), which is a valuable monetary gain in rural areas. When the agribusiness environment is conducive, then increased household earnings is significantly augmented. The effect of agribusiness environment on earnings was large and statistically significant. If the conduciveness of the business environment improves by one standardised unit, then farmers' income doubles. Although a favourable agribusiness environment produced high revenue for farmers in vegetable-based agribusiness, developing a business environment needs further inputs since it is comprised of many components and household endowment and human capital affected farmers' decision to engage in agribusiness ventures. The role of household endowment, which provided land and labour resources for intensive farming, was higher than human capital in magnitude and significance. Despite its lower significance than household endowment, the role of human capital, however, was not negligible. Increase in human capital by one standardised unit enables the intensity of agribusiness participation to double. Treatments to improve human capital need careful formulation because human capital consisted of contradicting elements. Finally, an increase in household endowment by one standardised unit led to a five-percentage increase in intensive farming.

Table 4 shows the magnitude and significance of the estimated measurement of the latent variables. Human capital significantly constructed education, oldness, and experience; formal education contributed to farmers' knowledge and rational thought while, as farmers got older and more experienced, human capital declined because older farmers were less likely to be active in intensive farming that required drudgery. The implication of this finding in Indonesia, which has prioritised effective and efficient formal education that integrates practical knowledge and technical skills appropriate to its rural framework, means that policy will enable the rural youths to participate in the development of rural areas, as also suggested by Poole, Álvarez, Penagos, and Vázquez (2013). Regarding the negative effect of experience, one possible reasons for this observation is that most of the experienced farmers in this study had prior negative experiences in business ventures and, thus, less ability to participate in intense vegetable-based agribusiness. Another factor which research literature shows having a negative effect among older farmers is their higher risk aversion (Feder & Savastano, 2017).

Training was insignificant in constructing human capital. This finding may be due to the topics covered by the training being too general. Intensive vegetable farming requires training about specific issues. Another possible reason for this finding is that farmers received the same materials during regular extension activities. Field school for farmers with a special focus on vegetable production has been shown to be one of the best alternatives because training increases vegetable productivity (Luther, Mariyono, Purnagunawan, Satriatna, & Siyaranamual, 2018).

Household endowment significantly constructed land holding, fragmented land, and the women participation in agribusiness activities. The quantity of properties represents the scale of farming. Farmers with larger scale of farms were wealthier, and can more certainly procure operating capitals than those with small landholdings. The number of fragmented lands also represents farming scale, but the farm was shattered in different sites. Theoretically, farmers with more fragmented lands tend to be subsistence as farmers need to monitor intensive vegetable farms regularly. Fragmentation of land is also the cause of farm efficiency (Al-Amin, Rahman, Hossain, & Sayem, 2016). Despite contemporary

Table 4. Estimated measurement of latent variables.

Variables	Effect	Standardised	Robust s.e.	z-Value
Education <-				
Human capital	0.4290	0.3486	0.0466	7.48***
Constant	8.3081	2.8094	0.2155	13.04***
Experience <-				
Human capital	-3.5015	-0.7304	0.0767	-9.52***
Constant	16.8459	1.4624	0.0523	27.99***
Oldness <-				
Human capital	-3.1043	-0.6471	0.0726	-8.91***
Constant	42.3165	3.6705	0.1242	29.54***
Training <-				
Human capital	0.0137	0.0803	0.0777	1.03
Constant	0.2129	0.5201	0.0337	15.45***
Fragmented land<-				
Household endowment	1.0000	0.2483	0.0840	2.96*
Constant	3.7983	1.0482	0.0508	20.64***
Land holding <-				
Household endowment	0.4955	0.5808	0.1874	3.10**
Constant	0.6978	0.9089	0.1092	8.32***
Women participation <-				
Household endowment	0.3828	0.2563	0.1148	2.23*
Constant	3.9384	2.9308	0.1132	25.89***
Cellphone <-				
Agribusiness environment	829.91	0.3164	0.0840	3.77**
Constant	0.2969	0.6499	0.0377	17.24***
Credit <-				
Agribusiness environment	1223.3	0.5283	0.0809	6.53***
Constant	0.2045	0.5070	0.0333	15.22***
Distance <-				
Agribusiness environment	-47735	-0.5898	0.0380	-15.53***
Constant	16.821	1.1933	0.0369	32.37***
Technology <-				
Agribusiness environment	6101.0	0.8111	0.0708	11.45***
Constant	4.2851	3.2707	0.0489	66.95***
Subsistence <-				
Agribusiness environment	-254.11	-0.0925	0.0773	-1.20
Constant	0.3557	0.7431	0.0411	18.07***
Buyers <-				
Agribusiness environment	404.87	0.1412	0.0645	2.19*
Constant	0.5210	1.0429	0.0553	18.85***

Note: *significant at .05, **at .01, ***at .00.

farming practices showing pest and disease management, and other farm operations, will be easier if crops are grown on consolidated plots than on dispersed pieces of land, findings showed most farmers operated intensive farming on assembled plots. Plots were rented that are located close to the main farm while those far away were left uncultivated. Thus larger farm size increased the likelihood of farmers intensifying vegetable production. These findings are also supported by previous studies in Indonesia and other developing countries (Raut et al., 2011).

Women's farming participation had a significant positive effect on agribusiness activities lending further support to research finding that when women own more businesses, their business is positively associated with improved household welfare (Seshie-Nasser & Oduro, 2018). Further, when women are provided business opportunities, they are more entrepreneurial than men, identifying opportunities, planning, sociability, and leadership which prior research aligns with feminine characteristics of being patient, fastidious, and economical (Ramadani, Hisrich, Anggadwita, & Alamanda, 2017). Others note women's

entrepreneurial success is higher than men's (Chatterjee, Das, & Srivastava, 2018), supporting the hypothesis that women's entrepreneurial profile positively influences their entrepreneurial intentions (Krakauer, de Moraes, Coda, & Berne, 2018). Many aspects of vegetable farming agribusiness are carried out by women farmers. On average, about 50% of agribusiness activities are conducted effectively by women. These include sowing seeds, transplanting, weeding, harvesting and post-harvest handling. In marketing, women are also dominant. This finding relates to the re-appropriation of work and organisation of work by women entrepreneurs and its emancipatory potential for the division of labour (St-Arnaud & Giguère, 2018). It has been identified that entrepreneurship training and education are essential elements affecting women's entrepreneurial intentions (Srivastava & Misra, 2017). A positive moderating factor exists for women and education (or training); when women are provided with better education, they are more innovative in business (Garba & Kraemer-Mbula, 2018), particularly young women (Karki & Xheneti, 2018). Involving women in entrepreneurship leads to higher performance of firms (Moreno-Gómez & Calleja-Blanco, 2018) and, when women play a role in top management, such as female managers, this has a positive and strong association with a firm's performance (Pasaribu, 2017).

Agribusiness environment significantly constructed all elements in the present study, except subsistence. Having more buyers (customers or fixed collectors) enabled farmers to get better prices for their produce. Vegetable markets were highly competitive. Farmers traded their produce to many buyers, facilitated by using mobile phones to get more accurate market information, such as prevailing prices at markets and vegetable production in other regions, which improved net revenue. Farmers often called 2–3 buyers before harvesting their produce. Mobile phone availability has dramatically changed the flow of market information in Indonesian rural areas, strengthening farmers' bargaining position to negotiate prices in marketing or trade opportunities and reducing information asymmetries (Jensen, 2007). Thus, findings further research showing multiple benefits of mobile phones for rural poverty reduction (Bhavnani, Won-Wai, Janakiram, & Silarsky, 2008).

Farmers who accessed micro-credit financed more advanced technology, enabling their farming to become more efficient than those who did not get credit. These improvements in technological changes boosted net revenue by cutting costs and increasing yields. Credit provided the highest contribution to the agribusiness environment, escalating prosperity directly and indirectly. Micro-credit increasing farmers' income enters productive process sectors other than agriculture and serves as a catalytic agent that facilitates technology adoption in intensive farming. Pinder and Wood (2003) assert that, at the micro-level, policies need to improve access to credit and inputs. In Indonesia, improving access to micro-credit will help farmers who plan to operate commercial agribusinesses become involved in producing high-valued vegetable crops. The position of farming distant to vegetable markets also affects profit. Farmers closer to markets were more likely to get higher profits than those located further away. These findings are consistent with research finding better transportation infrastructure reduces transport and transaction costs and shortens the distance between farmers and markets for remote, rural communities (Bresnayan, 2008), with rural roads increasing market access (Jouanjean, 2013). As prior research shows, interregional trade provides a stabilising price effect, allowing farmer associations to hedge against price risk (Bresnayan, 2008), and efficient transportation decreases trade

costs and interregional price gaps, increases interregional and international trade, and, eventually, increases real income (Donaldson, 2018).

Seed technology promoting fast-harvesting increased farmers' income and reduced economic and agricultural risk exposure to pests, diseases, flood and drought, and volatile prices. Further, when farmers have a limited growing season, technology helped maximise farming output by creating more cropping cycles in the same period. Subsistence, in contrast, was insignificant in constructing market environment. Subsistence in this study was defined as exposure to a self-sufficiency programme that encouraged households to grow crops for domestic consumption. Although this activity is considered necessary, particularly during the off-season, the program is not recommended for communities in vegetable-producing rural areas. As vegetable production substantially contributes to the rural economy, agribusiness is needed for rural modernisation. Drivers of agricultural commercialisation consist of technology improvement, farm intensification, market access, capital accretion, and market demand as populations increase (Leavy & Poulton, 2007). Poole et al. (2013) suggest that other factors include continuous enhancement of efficiency, commitment to intensive farming and new technologies, a low threshold of risk aversion, price bargaining power, skills in managing business relations, willingness to invest in land and soil fertility improvement practices, access to rural financial institutions, and time spent in markets.

Agronomic technologies are indispensable to support the process of agricultural commercialisation. Agricultural intensification is achievable when soil nutrients to support sustainable productivity are restocked. For example, using the case of cassava in Africa, farmers approach to commercialisation has been inhibited by the unavailability of suitable agricultural technologies, such as disease-tolerant varieties and disease-free planting materials (Mulu-Mutuku, Odero-Wanga, Ali-Olubandwa, Maling'a, & Nyakeyo, 2013). Whereas subsistence farmers practice agriculture "as is", by using farmyard manure to replenish soil nutrient supply, environmentally-friendly chemical fertilisers make it

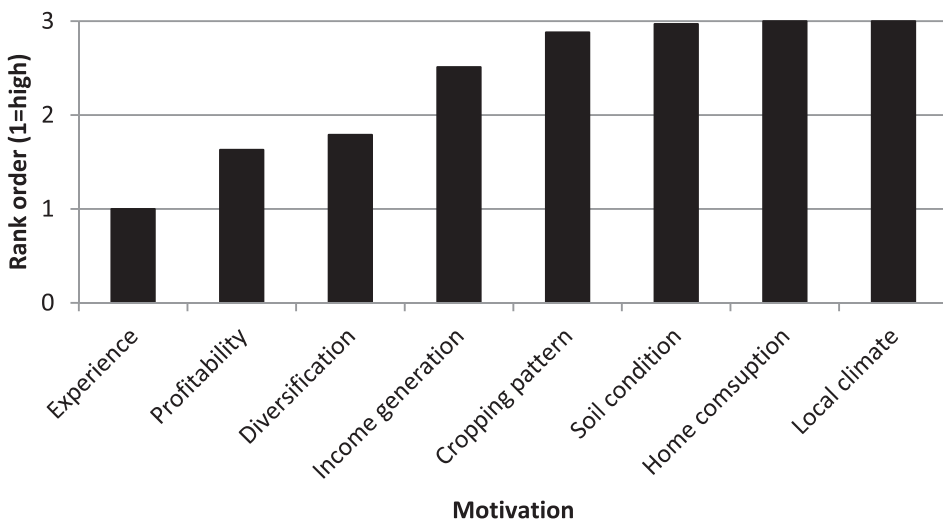


Figure 5. Motivations for agribusiness participation. Note: The lower the rank order, the more important the motive.

possible to generate a commercially-oriented agricultural production system (Pingali & Rosegrant, 1995).

Results of the structural equation modelling are partially consistent with findings from the FGD on the motivation of farmers to intensively grow vegetables for agribusiness purposes. Figure 5 shows that experience was the most important motive.

FGD revealed adverse experience made farmers less likely to engage in agribusiness based on intensive vegetable farming. Economic motives dominated farmers' intention to participate in vegetable-based agribusiness. This finding is in line with research conducted in China and Vietnam (Zhu, Kara, & Zhu, 2018), and India (Mehtap, Ozmenekse, & Caputo, 2018); the main motivators for intensive farming are the contribution agribusiness may make to increasing household income and generating profit. Agroecological aspects, where vegetable farming needs specific requirements related to soil, water, and light to achieve full production potential, were perceived by farmers to be manageable and farmers grew vegetables all year round to accomplish steadily increasing demand.

Conclusion

Vegetable-based agribusiness in Indonesia provides more income and benefits than other cereal crops in rural communities. Approximately 85% of people who stay in rural Indonesia strongly rely on the agricultural sector as their main source of income. Indonesian farming businesses, however, are operated by a small proportion of farmers who earn high profit margins. agricultural modernisation and rural modernisation is an almost identical topic in supporting rural development process. Encouraging more smallholder farmers to adopt highly profitable agribusiness is affected by several factors. Findings showed farmers' ability to adopt intensive vegetable farming in Indonesia include access to economic factors, such as micro-credit, and social factors, such as education. Private sectors play an important role in rural modernisation (Goldsmith, 1985). Currently, the number of farmers who access formal financial institutions is low, due mainly to rigid requirements, and farmers lacking either collateral or loan guarantees needed to acquire sufficient capital to commence agribusinesses. The more actors who become involved in governance, the faster the process of aligning sustainable rural development farm modernisation may progress (Koopmans, Rogge, Mettepenningen, Knickel, & Šūmane, 2018).

The present study found the more educated and younger farmers are, and the closer they are to vegetable markets, the more likely farmers will run a commercial business. Other significant factors affecting agribusiness adoption included farmers' willingness to learn from previous bad experiences in vegetable production and to apply their knowledge to start a new vegetable-based agribusiness. Farmers were interested in running intensive vegetable farming because of higher economic returns and the existence of a conducive agro-climate, yet the availability of technology related to vegetables, market information, and credit for farmers also were factors necessary to create a favourable market environment. Although vegetables are high-value commercial crops, intensive agriculture requires higher inputs than cereals or other staple crops. Nationally, vegetable cultivation provides income, employment, and nutritional benefits for millions of smallholder farmers, rural labourers, and consumers. Based on the article's findings, the existence of a vegetable market, or agribusiness terminal, that is relatively close to vegetable production areas, improved transportation, and infrastructure in rural areas would enhance Indonesia's

vegetable industry development. Such findings further research noting poor agricultural infrastructure is a limiting factor to sustaining commercial agricultural production (Munyanji, 2013). Information technology accessible to everyone, including farmers, at an affordable price and training on specific agribusiness topics may also increase vegetable farmers' capacity. Further, because female family members play an essential role in agribusiness, findings identify they must be involved in training and that intensive vegetable farming technology would benefit from being introduced in the community by mature farmers who have access to credit and have had a good experience in vegetable farming. Finally, developing off-season technology that allows farmers to grow vegetables during the rainy season would reduce the volatility of production and prices, and formulating/executing policies to accelerate intensive vegetable farming, communication, and telecommunication technology provided to everyone (including farmers) would further Indonesia's rural modernisation.

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