

## Pathway analysis of vegetable farming commercialization

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### Abstract

High-valued vegetable farming can increase farmers' income if the vegetables are cultivated in commercial manner. This paper analyses factors that determine farmers' intention to commercialize vegetable farming; and the effect of commercialization on farmers' income. The study used structural equation model to estimate paths affecting farmers to engage commercial farming and its impact of commercial on households' income. Household and farm characteristics, business environment, and market support were hypothesized to influence farmers to commercialize vegetable farming. Data for this study were compiled from a quantitative survey of 360 farm households located in four major vegetable producing regions of Eastern Indonesia. Results indicate that commercial vegetable farming provides economic advantage in terms of increased income. To encourage commercial vegetable farming, vegetable agribusiness terminal with all market infrastructures should be established in the potential vegetable producing regions of Indonesia.

### Abstrak

Budidaya sayuran bernilai tinggi dapat meningkatkan pendapatan petani jika sayuran dibudidayakan secara komersial. Makalah ini menganalisis faktor-faktor yang menentukan niat petani untuk mengkomersialkan usaha tani: sayuran dan dampak komersialisasi terhadap pendapatan petani. Penelitian ini menggunakan model persamaan struktural untuk memperkirakan jalur yang mempengaruhi petani melakukan usahatani secara komersial dan dampaknya terhadap pendapatan rumah tangga petani. Karakteristik rumah tangga dan usahatani, lingkungan bisnis, dan dukungan pasar diduga mempengaruhi petani untuk mengkomersialkan usahatani sayuran. Data penelitian ini dikumpulkan dari survey kuantitatif terhadap 360 rumah tangga petani yang berada di empat daerah penghasil sayuran utama di Kawasan Timur Indonesia. Hasil penelitian menunjukkan bahwa usahatani sayuran komersial memberikan keuntungan ekonomi dalam bentuk peningkatan pendapatan. Untuk mendorong usahatani sayuran komersial, terminal agribisnis sayuran dengan semua infrastruktur pasar harus didirikan di daerah penghasil sayuran potensial di Indonesia.

### Introduction

Vegetable production is an important sector in global agribusiness; it can lead to increased farm productivity and higher farm-gate values compared to cereal and other staple crops (Johnson, Weinberger, & Wu, 2008). Because of the high profitability of commercial vegetable production compared to paddy rice and other cereal crops, the potential exists for higher household income diversification if more land can be devoted to intensive vegetable production.

In Indonesia, high-value vegetables such as chilli, shallot, and tomato are an important part of daily diets and livelihoods, and play an important role in the overall economy of the country. The household supply of the major staple, rice, is considered sufficient only when it is complemented with other foods such as vegetables.

In Indonesia, a study confirmed that farmer incomes can double agricultural inputs, and products in the market can increase substantially when farmers shift from rice farming to intensive chilli farming (Mariyono & Bhattarai, 2011). The intensification triggers rural markets, particularly through enhanced value chains of agricultural products since it also leads to an increase agrochemical inputs (Mariyono, 2015). Because vegetables are high valued cash crops and need more inputs (particularly labour and chemicals) than cereals or other staple crops (Mariyono & Bhattarai, 2011), vegetable cultivation undoubtedly provides income, employment, and nutritional benefits to millions of smallholder farmers, rural labourers, and consumers.

Despite the significant growth of vegetable production in Indonesia, its global share of the vegetable industry is quite low. Improvements in cultivation practices, availability of improved crop varieties, and improvement in irrigation infrastructure are some of the reasons for the recently observed increase in vegetable production (Mariyono & Sumarno, 2015). There is enough room to expand vegetable production in Indonesia by promoting a commercial mind-set among farmers who have yet not adopted this approach to agriculture (Mariyono, 2017). The adoption of intensive farming methods is necessary for agricultural commercialization in Indonesia.

Based on the previous studies, the main factors affecting farmers to move on better conditions include household, business environment, market and institutional factors. The reviews of selected literatures below are expected to justify this study.

Household factors consist of education, experience and age. Education level of the household head reflects human capital. Higher level of human capital leads to more rational decision-making. Many studies have used this variable to explain the adoption of agricultural technologies (Wang, Rozelle, Huang, Rearson, & Dong, 2006). Experience in vegetable farming represents a farmer's familiarity with vegetable production, which is considered more complex than for cereal crops. A more experienced farmer in vegetable farming is expected to commercialize farming activities at a higher level. A study by Kuntariningsih & Mariyono, (2013) used this variable in explaining farmers' decisions to select specific agricultural technologies in chilli production. Age of household head represents maturity, emotional adulthood and physical ability. In general, the effect of age on technology adoption is in a parabolic form, meaning that positive impact occurs at certain ages, and becomes negative after a critical point when farmers are getting older. This variable has been widely used as an explanatory variable in studies on adoption of agricultural technologies of chilli in Indonesia (Kuntariningsih & Mariyono, 2013).

The number of family members in productive age determines the availability of family labour devoted to drudgery farming. Since vegetable farming is labour intensive (Mariyono & Bhattarai, 2011), a higher number of family members is expected to support commercial farming. Fernandez-Cornejo, Beach, & Huang, (1994) show the significant contribution of this variable to the adoption of agricultural technology.

Farm size represents scale of farming. It is expected that large farm size would most likely to lead to increased adoption. Studies by Fernandez-Cornejo, Daberkow, & McBride, (2001), and Roberts, English, & Larson, (2002) confirm the observation that farm size significantly affects adoption of agricultural technology. Farm size also contributes to wealth and status in the community. Because intensive vegetable farming is very costly, farmers with a higher wealth ranking are expected to engage more in commercial agribusiness ventures. A study shows that comparatively, richer farmers tend to adopt new technology more easily (Jayasinghe-Mudalige & Weersink, 2004).

The number of plots within the same piece of land represents land fragmentation of the household. When land is fragmented into separate plots, it will be less efficient in operating intensive farming, and the farmer will become discouraged. In India, fragmented landholdings are a major burden to the adoption of commercial agribusiness (Firdaus & Ahmad, 2010). In Ethiopia, (Melesse, 2016) suggests that land fragmentation should be reduced since it lowers performance of commercial farming. Type of crops grown by farmers determines commercialization. As the goal of commercial farming is cash-flow, the crops that can be harvested quickly will play significant roles. This relates to scheduling of cultivation (Dey, 2001).

Use of mobile phones enables farmers to access information related to vegetable-based agribusinesses. With access to more complete market information, farmers can conduct their own business management activities. The effect of mobile phone usage on the commercialization of agriculture has been studied by Bresnayan (2008) and Kuntariningsih & Mariyono (2013), who indicate that the use of mobile phones leads to greater prospects for technology adoption. Agricultural technology related to vegetable farming enables farmers to operate efficiently. The greater the number of agricultural technologies applied in farming, the more efficient farming will be. With the availability of agricultural technology, farmers are more likely to engage in agribusiness ventures (Kafle, 2010; Raut, Sitaula, Vatn, & Paudel, 2011).

Access to credit enables farmers, regardless if rich or poor, to obtain adequate cash to finance intensive commercial agriculture. This variable has attracted particular research attention in the commercialization of agriculture around the world (Kafle, 2010; Kumar, 2009; Kuntariningsih & Mariyono, 2013; Raut et al., 2011; and Zeller, Diagne, & Mataya, 1997).

Agricultural training equips farmers with technical skills and practical knowledge. Participation in agricultural training enhances human capital and becomes an important factor in the adoption of agricultural technology in general. In Thailand, farmer's knowledge is an important factor affecting a farmer's ability to apply good agricultural practices (Athipanyakul & Pak-Uthai, 2012). Mauceri, Alwang, Norton, & Barrera (2005) and Yang et al., (2008) show that agricultural training influences the level of technology adoption. Like training program provided by the government, a specific program on vegetable production can be a significant factor in farming commercialization. The program of sustainable food reserve was conducted to encourage farmers to grow vegetables and other high-valued agricultural products in order to increase households' income. The program was conducted in several villages of sub-district. Several samples in this study got exposed from the program, thus these variables could be included in analysis.

Access to information about markets and agricultural technology reduces asymmetric information between farmers and traders, and increases the possibility of enhancing farmers' productivity. Asymmetric information such as lack of knowledge about prevailing prices, demand, and preferred quality between producers on one hand and other key actors (e.g., retailers, wholesalers, consumers) in the value chain, has caused farmers to have relatively low bargaining power (Soviana & Puspa, 2012). In sub-Saharan Africa, lack of available technology is the main constraint hindering adequate input supply in vegetable production (Chagomoka, Afari-Sefa, & Pitoro, 2014).

Distance to market represents the cost-effectiveness of marketing of product. Vegetables are perishable, thus the distance to vegetable markets is a critical determinant of marketing success. Many studies have shown that distance to market is the significant driving force to adoption of agricultural technology (Raut et al., 2011). The closer farmers are to vegetable markets, the more likely it is that they will engage in commercial farming.

Based on the importance of farming commercialization, this study aims to analyse factors affecting farmers to shift from subsistent farming to market-oriented farming. Vegetable crops were selected in this study is because of higher profitability than other cereal crops. This current study uses all such factors to determine driving forces and paths of commercialization of vegetable farming.

On the basis of recent policy dialogues, agricultural commercialization is seen as a key element for achieving economic growth and poverty reduction in developing countries, including Indonesia. Agricultural specialization, the development of markets and trade are fundamental to economic growth (Von Braun, Bouis, & Kennedy, 1994). Agribusiness aims to move crop producers from subsistence to commercialized agriculture; the government thus should encourage smallholder farmers to participate in market-oriented farming. Agricultural commercialization is an important process of agricultural transformation (Pingali, 1997); despite the fact that subsistence agriculture has an important role in transition countries. The subsistence agriculture plays a buffering role and provides beneficial impacts on the agricultural sector when the resources it employs are unacceptable to the commercial sector (Kostov & Lingard, 2004).

Drivers of agricultural commercialization include population growth, technical change, enhanced market access, crop intensification, and asset accumulation (Leavy & Poulton, 2007). More comprehensively, commercialization of agriculture requires a series of certain attitudes: a commitment to farming and new technologies; a low threshold of risk aversion; willingness to invest in land and soil fertility improvement practices; better access to rural financial markets; improved skills in managing business relations; better price negotiation; reduced time spent in markets; better product and process quality control and assurance; continuous improvement; and efficiency enhancement, starting from production to final product (Poole, Chitundu, & Msoni, 2013). Group activity to bring about commercialization has inherent operational and management challenges, yet is necessary to reduce transaction and transformation costs, and involves significant individual and organizational learning. Another important factor affecting commercialization is education level. Education is one of important determinants in improving rural households in Mexico (Yúnez-Naude & Taylor, 2001).

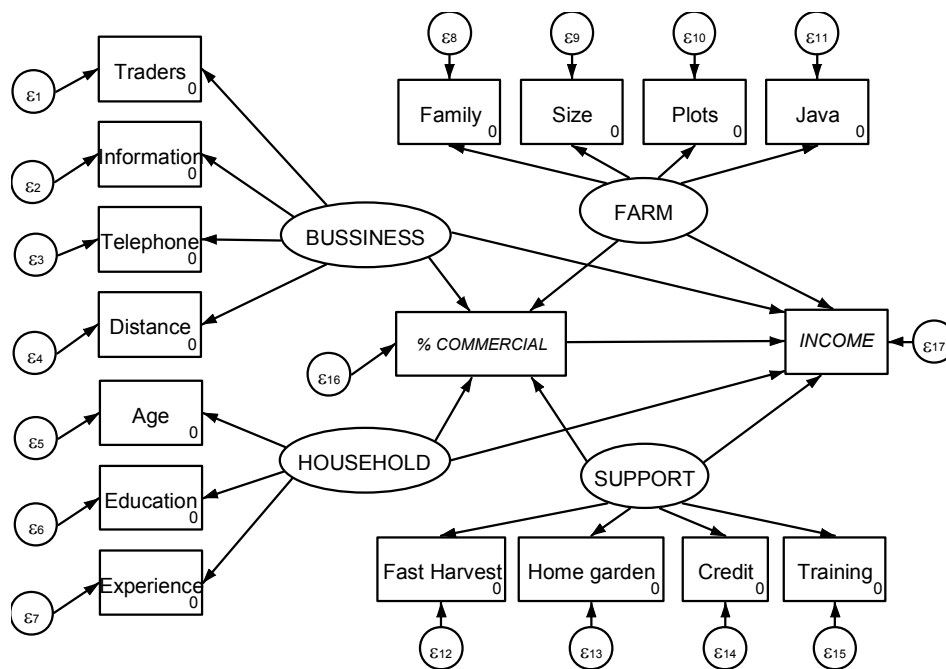
Farming is a risky business, and a low threshold of risk aversion is one of the critical factors for successful agribusiness (Ikerd, 2011). Agricultural diversification is one option to reduce economic and ecological risks, as well as to increase farm profitability (Mariyono, 2007). Agricultural diversification with high-value crops is one of the several pathways to agricultural development (Kumar, 2009). Availability of

farming technologies becomes important to support the commercialization process. Investment in land use intensification is only possible by replenishing soil nutrients to sustain productivity. In subsistence societies, the soil nutrient supply is replenished by farmyard manure. Without chemical fertilizers, a commercially oriented agricultural production system is not possible (Pingali & Rosegrant, 1995). In the case of cassava in Africa for example, unavailability of adequate agricultural technologies such as disease-free planting materials and disease-tolerant varieties has impeded the adoption of otherwise sound commercialization technologies (Mulu-Mutuku, Odero-Wanga, Ali-Olubandwa, Maling'a, & Nyakeyo, 2013).

Technological change drives diversification with high-value crops and commercialization of agriculture (Pingali & Rosegrant, 1995). Throughout history, changes in agricultural technology have been an important component in the progress of human societies, particularly the development of modern agriculture with a range of technologies (Huang, Hu, van Meijl, & van Tongeren, 2004) and 'successful adoption of technology can be a powerful force in reducing poverty' (deJanvry & Sadoulet, 2002). New technology seems to provide opportunities to increase production and income substantially (Selvaraj, 2009). To enhance productivity of diversified farming systems, technologies that reduce costs and help farmers manage and optimize input allocation in multiple crop systems must be introduced and adopted. These technologies are costly, however, and the development of innovative low-cost, practical strategies that reduce production costs in diversified farming systems in the developing world will be necessary and should be widely disseminated (Bowman & Zilberman, 2013).

**Research Method**

The analytical framework employed for this study involved a model to estimate factor affecting commercialization and eventually the commercialization influences household's income. An approach of structural equation modelling (SEM) was utilized in this study as an analytical tool. The tool is a powerful multivariate technique that enables to measure indirect and indirect effects with multiple dependent variables and also use several simultaneous regression equations.



**Figure 1.** Analytical framework using structural equation modelling

The framework for the study is represented in Figure 1. Farmers to engage in commercial agribusiness in the market or continue with subsistence-oriented farming operations depends on four latent variables: household factors, business environments, farm factors, and other supports. The latent variables are constructed by observed variables. All variables simultaneously affect farmers' decision, such that some farmers engage more intensively in commercial agribusiness ventures than others. Subsequently, when farmers engage more commercial farming, they will gain higher incomes resulted from market-

oriented farming. Each factor has different power to influence farmers. All coefficients of factors are measured in standardized terms. A standardized coefficient compares the strength of the effect of each individual independent variable to the dependent variable. The higher the absolute value of the coefficient, the stronger the effect. Standardized coefficients have standard deviations as their units. This means the variables can be easily compared to each other (Freedman, 2009).

**Table 1.** Definition, measurement and summary of selected variables

Variables	Definition	Measure	Mean	SD
<b>Dependent variable:</b>				
Household' income	Profit gained from a hectare of farming	000 IDR	5040	5055
Level of commercialization	Percentage of number of vegetable crops for sale to total crops grown	Percentage	68.31	23.58
<b>Latent variables</b>				
<b><i>Household characteristics:</i></b>				
Age	Age of household head	Year	42.32	11.55
Education level	Length of formal education of household head	Year	8.31	2.96
Experience in vegetable	Time spent on vegetable farming	Year	16.85	11.54
<b><i>Farm characteristics:</i></b>				
Size of farm	Total area cultivated to crop	Hectare	0.70	0.77
Number of plots	Number of plots	Numeric	3.80	3.63
Family member	Number of family members in a household	Numeric	3.94	1.34
Location: Java	Farming in Java	1=yes; 0=no	0.52	0.50
<b><i>Support</i></b>				
Fast harvest crops	The age of crops to be harvested	Month	5.13	1.26
Access to credit	Whether farmers access credit for farming	1=yes; 0=no	0.20	0.40
Agricultural training	Participation in agricultural training program.	1=yes; 0=no	0.21	0.41
Home garden	Whether farmers get exposed to government program of home garden.	1=yes; 0=no	0.36	0.48
<b><i>Business</i></b>				
Traders	Number of traders to sell the produces	Numeric	1.48	0.50
Use of mobile-phone	Whether farmers use mobile phones in farming business activities (for marketing)	1=yes; 0=no	0.30	0.46
Distance to market	Distance to nearest local market or fixed traders to sell vegetables	Kilometre	16.82	14.12
Sources of market information	Number of sources of market information and agricultural technology	Numeric	1.58	1.41

This study uses a cross-section data set collected from a field survey of 360 farm households conducted in 2014 in Java and Bali, Indonesia. The samples were selected using a stratified random sampling approach at farm level in four main regions. Household level data were collected using individual interviews supported with qualitative data collected through group discussions with selected key farmers. Definition of selected variables, unit of measurement and summary statistics are provided in Table 1.

## Results and Discussion

The result of estimated structural equation model is reported in Figure 2. We can see that the selected factors are expected to explain what drives farmers to commercialize vegetable production and the commercialization lead to change in farmers' income. The result shows that four latent variables highly influenced farmers to engage commercial farming. The highest impact came from farm characteristics, and the lowest impact came from institutional support. Eventually, the commercialization led to higher income. This is sensible because when farmers engaged profit-oriented farming, they would gain more income, as vegetables are high-valued horticultural crops. Note that the latent variables also provide direct impact on farm-

ers' income, but the magnitude of impacts is tiny. This means that latent variables led to better farmers' income through mediation of commercial vegetable farming.

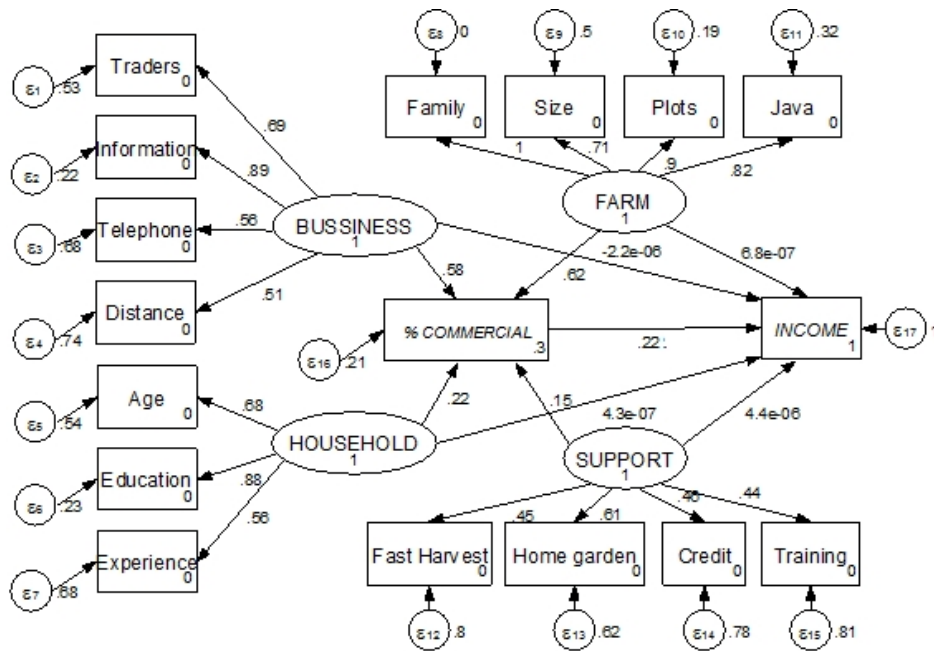


Figure 2. Estimated structural equation modelling

Let us to discuss the factors that construct latent variables that indirectly led to higher income via mediation of commercial vegetable farming. Household is highly characterized with age, education and experience. This means that when the farmers are more educated, experienced and mature they are encouraged from engaging in commercial farming.

Business environment is positively constructed with distance, use of telephone, access to information and number of traders. Distance to market vegetables represents cost-effective and efficient transportation for selling the produce. The further away farmers are from the market, the less likely they are to engage in commercial farming. Conversely, better transportation infrastructure can reduce transport and transaction costs and reduce the distance between farmers and markets for remote, rural communities (Bresnyan, 2008), as rural roads can increase market access (Jouanjean, 2013). In Indonesia, a reduction in trade and transport margins can reduce interregional agri-food prices (Rum, 2011). Farmers can use mobile phones to get more accurate market information, such as prevailing prices at markets and vegetable production in other regions. In many cases, farmers with mobile phones obtain price information by calling 2-3 traders before selling their produce the following day. Thus, access to mobile phones has dramatically changed the flow of market information in Indonesia's vegetable production areas. To a large extent, knowledge obtained through mobile phones has strengthened the farmers' price bargaining position. Furthermore, when market information is available and accessible to farmers, vegetable farming becomes less risky, and farmers have stronger bargaining power, particularly in negotiating produce prices. The number of vegetable-related technologies available in the local market, such as hybrid seeds, modern fertilizers, and crop protection inputs also significantly lead to the creation of commercial vegetable farming enterprises. Such technologies contribute to an environment conducive for engaging in vegetable-related agribusiness. (Prabha & Chatterjee, 2009), for example, show positive impacts of agricultural technologies such as modern fertilizers and high yielding varieties on agricultural productivity. In India, the lower availability of appropriate technologies for chilli production is the main factor associated with a decline in chilli-cultivated area (Rajput, Supe, & Chinchmalpure, 2007).

Farming characteristic is substantially constructed with family members, size of farm, number of plots and location. The number of family members in productive age determines the availability of family labour devoted to drudgery farming. Farmers with larger farms are wealthier, and can more easily procure operating capital than farmers with small landholdings can. Farm size also represents wealth status in the community. Location determined farmers in Java to more intension to commercialize their farming than

those in Bali. Different marketing channel in Java and Bali could be the cause, where Java has direct marketing channel to food processing industries.

A support is highly constructed with training, credit, type of crops and home garden program. Training leads farmers to improve their technical knowledge and understanding of sophisticated production methods. Farmers who can access credit have a higher level of commercialization than those that cannot. Farmers can obtain the operating capital needed for intensive vegetable farming from credit. Larger farm size and higher wealth status of the household increase the likelihood of farmers commercializing vegetable production. This finding confirms previous studies in Indonesia and other developing countries (Mariyono & Sumarno, 2015; Raut et al., 2011). The longer time to harvest, the lower intention for farmers is to engage commercial farming. Longer time to harvest become is the most important variable in affecting farmers to engage commercial farming. This is reasonable because the financial return of agribusiness can be gained shorter when farmers grow quick-harvesting crops. Farmers seek to vegetable crops that can be harvested soon. Farmers who got exposed government program on sustainable food reserve have more intention to engage commercial vegetable farming. The program aims to promote commercial vegetables and other high-valued crops to increase income.

The increased growth of vegetable production in Indonesia is understandable because of a favourable business atmosphere. Development of telecommunication technology has provided farmers with affordable access to mobile phones. The government and private sectors have provided farmers with easy access to credit, in collaboration with rural cooperatives. In nearly every month of the major planting seasons, mobile banks open to provide banking services in rural areas. Markets and supporting infrastructure have been established close to existing vegetable production regions, to make it easy for farmers to sell their produce. In collaboration with international agricultural research centres, national research and development institutions have been discovering and disseminating vegetable-related technology over the past decade. All these factors have simultaneously led to the expansion of commercial vegetable production in East Java and Bali in particular, and Indonesia in general; and eventually farmers have gained higher income.

## Conclusion

It is clear that intensive commercial vegetable farming provides more income and benefits the whole rural community. There is enough scope to increase the number of smallholder farmers in commercial vegetable farming. There are some major factors affecting farmers' ability to engage in intensive vegetable farming in East Java and Bali.

In response to increasing expansion of vegetable production in other regions, it is recommended that intensive vegetable farming technology should be introduced in communities where farmers have easy access to credit, are relatively mature, and have good experience in vegetable farming. In such communities, intensive vegetable farming will be adopted widely by farmers as a process of commercialization. Where farmers are already familiar with use of mobile phones, they will adopt commercial vegetable farming, as they will have access to accurate market information. Vegetable market and agronomic technology that support intensive vegetable farming should be provided, and market information should be regularly updated. In terms of agronomic technology, the government in collaboration with private sectors need to provide more choices of fast-harvesting cultivars. Providing vocational education and training—particularly on agricultural subjects—in rural areas will encourage youth to engage in promising agribusinesses.

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