Strategy for Transforming Indonesian Agriculture

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Traditionally, a major role of agriculture has been to provide food security through the intensification of the farming system. Today, however, agriculture is expected to contribute to reaching multiple development goals, including in Indonesia. First, since the wage rate has been increasing in high-performing Asian countries such as Indonesia, farm size expansion with labour-saving mechanisation must be promoted to reduce production costs and maintain food security, particularly in rice farming. Second, the intensification of oil palm production without extensification is crucial, considering that Indonesia produces more than half of the world's palm oil, that demand for palm oil is increasing and that global concern over the loss of forests continues. Third, Indonesian farmers are responding to increasing demand for high-value agricultural products (HVPs), such as fresh fruit and vegetables and livestock products, as consumers seek better nutrition and health. Hence, agricultural resources must be shifted to the production of these products. Fourth, considering that urban areas are excessively

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congested, rural areas must provide more employment opportunities by promoting rural industrialisation. Based on a review of the literature on agricultural development in Asia, this article proposes strategies to (1) increase production efficiency in rice farming, (2) sustainably intensify oil palm production, (3) increase the production of HVPs, and (4) promote rural industrialisation.

Keywords: *Indonesian, agriculture, oil palm, palm oil, farm intensification, high-value products, sustainability*

JEL classifications: Q01, Q10, Q13, Q15, Q16, Q17, Q18, Q19

I. INTRODUCTION

In tropical Asia, where agricultural land is generally scarce, a major role of agriculture has been to produce enough staple crops to ensure food security. Today, however, agriculture must help countries such as Indonesia to achieve multiple development goals, including not only food security but also employment generation, environmental sustainability, and the reduction of poverty and malnutrition (Otsuka and Fan 2021). Indonesia is endowed with rich natural resources, and its development path is unique in Asia. Since independence, the Indonesian government has been concerned not only with achieving self-sufficiency in rice production for food security but also with encouraging resource-based industrialisation, or the downstream processing of tree crops, such as rubber, coffee, cocoa and oil palm, for rural development, employment generation and poverty reduction (Neilson and McKenzie 2016; Pramudya, Hospes and Termeer 2017; Neilson et al. 2020). The promotion of better health and nutrition does not appear to be an integral part of Indonesia's agricultural policies. Furthermore, policy support for the development of oil palm production has decreased.

Since the world has been changing rapidly, agriculture must change. First, as the wage rate has been increasing in high-performing Asian countries such as Indonesia,

labour-saving mechanical technology, such as tractors and combine harvesters, must be adopted. To facilitate this mechanisation, farms must expand in size (Otsuka 2013). Otherwise, agriculture, particularly the farming of staple crops such as rice, will lose comparative advantage, owing to the dominance of small, inefficient farms in Indonesia and other high-performing Asian countries.[2] Second, considering the increasing demand for nutritional and healthy high-value agricultural products (HVPs), such as livestock products and fresh fruit and vegetables, resources must be shifted from the production of staple crops to that of HVPs (Otsuka, Nakano and Takahashi 2016). Otherwise, nutritional security cannot be assured. Third, the intensification of tree crop production, especially oil palm, whose demand will continue to rise, must be promoted without sacrificing forests and the environment. Fourth, to encourage resource-based industrialisation and the production of HVPs, policy must promote the development of the agro-processing industry (Otsuka and Ali 2020). I note that HVPs, not to mention commercial tree crops, must be processed before they can be marketed. Another crucial consideration is that firms in developing countries are typically poorly managed and, hence, their management must improve to fully realise the potential of industrialisation

[2] The production methods of small farms are necessarily labour intensive. Small farms are not inefficient compared with large farms when wage rates are low—as argued by Feder (1985) and Binswanger and Rosenzweig (1986)—but they are inefficient when wage rates are high (Otsuka 2007, 2013). See section 2 of this article for further discussion.

(Otsuka 2020).

Drawing on a review of the literature, this article proposes strategies to (1) increase production efficiency in rice farming, (2) facilitate the shift of resources from rice production to the production and processing of HVPs, and (3) promote oil palm production that does not sacrifice environmental sustainability and social equity. Special attention is paid to roles of the private sector in agro-industrialisation and of the public sector in extension activities for smallholders and in assuring land rights security for stimulating the production of oil palm.

The structure of this article is as follows. Section 2 discusses why farm size expansion and agricultural mechanisation are crucial for maintaining production efficiency in rice farming in Indonesia. Section 3 provides a strategy to develop HVP-oriented agriculture while paying special attention to the roles of contract farming, agricultural extension and the development of agro-processing industries. Section 4 explores how to intensify smallholder oil palm production without accompanying extensification and forest degradation. Finally, conclusions and the policy implications are discussed in section 5.

NEED FOR FARM SIZE EXPANSION IN RICE FARMING

Farm Size Expansion and Productivity

The relationship between farm size and productivity has long been debated in the agricultural economic literature. The dominant view for developing countries is that there is an inverse relationship between farm size and productivity—that is, the larger the farm, the less productive (see Lipton 2012). As noted by Feder (1985) and Binswanger and Rosenzweig (1986), small farms are more productive than large farms mainly because small farms use family labour intensively while large farms generally rely on hired labour, which may be more prone to shirking in the absence of close supervision. Labour markets in care-intensive agricultural activities—such as land preparation, water management and the application of fertilisers—seldom work well, because of the difficulty in monitoring hired labour in spatially dispersed and ecologically diverse agricultural environments (Hayami and Otsuka 1993). If land sale or tenancy markets function, however, to transfer cultivation rights from land-rich and labour-scarce large farms to land-poor and labour-abundant small farms, the inverse relationship may be reduced or eliminated (Otsuka 2007).[3] Therefore, the inverse relationship tends to be found in countries where land markets are suppressed by land

[3] My argument, which favours land rental transaction, presupposes that land rights are firmly established. If land rights are weak, a land rental market does not work. Indeed, individual land rights are not established in transition economies, such as China, Vietnam and Myanmar, and in economies where land rights are weakened by land reform laws, such as India and the Philippines.

reform laws, such as India.

According to a recent meta-review of the literature by Garzón Delvaux, Riesgo and Paloma (2020), the inverse relationship is widely observed between land productivity (crop yield or value of production per hectare) and farm size in developing countries, whereas the relationship is less clear between profit per hectare and farm size. While profit is theoretically an appropriate measure of production efficiency, its measurement is subject to errors because of the difficulty in imputing the cost of unpaid family labour (Otsuka 2021). The fact that large landowners tend to lease land to small and landless farmers indicates that the profitability of farming is higher on small farms than on large farms. The two downward-sloping curves portrayed in figure 1 illustrate the inverse relationships of yield and profit per hectare with farm size.

As I have argued in the past, the advantage of small family farms tends to erode in economies where rising wage rates increase the cost of labour (Otsuka 2013). This idea is illustrated by the flattened profit curve in figure 1, which reflects sharper rise in labour cost for smaller farms. Furthermore, the advantage of using labour-intensive technology declines relative to capital-intensive mechanical technology, which is shown by the higher profitability of capital-intensive technology after the wage growth.[4] The

[4] For simplicity, both yield and profit curves with capital-intensive technology are assumed to be

advantage of capital-intensive technology is pronounced on large farms, as scale economies arise with mechanisation, which entails significant fixed costs. The positive relationship between farm size and productivity prevails in high-wage economies such as Japan, and sometimes a U-shaped relationship is observed in transition economies where both labour-intensive and capital-intensive technologies are adopted simultaneously (Otsuka 2021). A cross-country regression analysis confirms the weakening inverse relationship and the emergence of the positive relationship between farm size and productivity (Otsuka, Liu and Yamauchi 2013). A crucial observation is that self-sufficiency of grain production has plummeted in Japan, South Korea and Taiwan, where small-scale farms have been preserved in the face of high and rising wages, indicating that these countries have been losing comparative advantage in the production of staple food crops (Otsuka, Liu and Yamauchi 2016).

Small and Shrinking Farm Size in Indonesia

The average farm size in Indonesia is smaller than the average in most other Southeast Asian countries (figure 2). Moreover, it has been declining. This is likely to become a serious problem because the advantage of small farms is bound to decrease in Indonesia, given the rising wage rate.

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fixed. Strictly speaking, both the yield and profit curves will shift downwards when the wage rate increases, other things being the same.

Liu and Yamauchi (2014) found that large farms maintain advantages in farming in Indonesia. Moreover, Yamauchi (2016) found the emergence of a positive relationship between farm size and productivity in Indonesia, because large farms expanded their farm size through land renting on outer islands and adopted mechanisation. This indicates an evolution of the relationship between farm size and productivity in Indonesia, from being inverse to positive.

Yet farm size on major islands in Indonesia did not change significantly from 2003 to 2018, as is shown in table 1. Farms on Java are particularly small, indicating that the island is not suited to mechanised rice production, which is widely taking place in Asia (Otsuka 2021). Since significant farm size expansion and large-scale mechanisation are unlikely to take place on this island, its farmers should specialise in production that requires knowledge-intensive and careful management but not extensive farmland, such as the production of vegetables broilers and other high-value agricultural products. Even if major crops are shifted from rice to other crops in Java, farm size expansion through land consolidation must be promoted. More research is badly needed on such consolidation and its effects on agricultural productivity in Java.

Performance of the Rice Sector in Indonesia

Indonesia's paddy yield is high among the yields of other Southeast Asian countries. As is shown in figure 3, paddy yield in Indonesia increased significantly during the Green Revolution in the 1970s and 1980s and it was highest in Southeast Asia until the late 1990s. Paddy yield, however, stagnated somewhat in the 2010s. Given the limited room to expand paddy land in Indonesia, constrained rice production is expected to continue in coming years.[5] However, the self-sufficiency ratio for rice production has been close to unity in Indonesia, according to figure 4. Note that a rice self-sufficiency ratio higher than unity indicates that a country is a net rice exporter, and one lower than unity a net rice exporter. Also, self-sufficiency does not guarantee food security, because the latter depends on rice prices and the vulnerability of production to changes in the climate and the availability of key inputs such as fertiliser and pesticides. As such, the ratio should not be regarded as an accurate measure of food security.

The rice self-sufficiency ratio is high and exceeds unity in Thailand (figure 4), where farms are large (figure 2), though paddy yield is low (figure 3). The self-sufficiency ratio is also high in Vietnam, though its farms are small. Although not shown, the size of rice farms in Vietnam's Mekong Delta is large and increased from 1.0

[5] There seems to be a consensus among economists interested in Indonesian agriculture that investment in agricultural research is insufficient, though the rates of return for such investment would likely be high (Warr 2012).

hectare in 1996 to 1.4 hectares in 2009 (Estudillo and Otsuka 2016). In contrast, the self-sufficiency ratio is low and declining in Malaysia, where farms are small. It seems that Malaysia is following the path taken by advanced countries in north-eastern Asia. These observations support my argument that a country loses comparative advantage in grain production amid increasing wages if the average farm size remains small and, hence, large-scale mechanisation is difficult or is not effective in reducing labour use (Otsuka 2013).

Indonesia maintained rice self-sufficiency in most years without significantly relying on imports, essentially because it used rice import restrictions. This is reflected in the widened gap between the world rice price, represented by 5% broken f.o.b. (free on board) Thai rice, and the domestic price, as shown in figure 5. Before the world food crisis of 2008, the domestic rice price was near the world price, as Indonesian rice policy had sought to stabilise the domestic price (Timmer 1993; Dawe 2001; Dawe and Timmer 2012). However, in recent years, the domestic price has been roughly double the world price, which has been detrimental to the welfare of rice consumers and overall economic growth in Indonesia.[6] Similar protectionist policies were also adopted by

[6] The Indonesian government also provides a fertiliser subsidy. Warr and Yusuf (2014) argue that this policy is more desirable than rice price support in terms of the impact on social welfare.

Malaysia and the Philippines in Southeast Asia (Hoang and Meyers 2015).

Price support measures have a significant adverse impact on farm size expansion because they tend to preserve inefficient small farms, according to the Japanese experience (Hayami 1988). If the rice price is supported, paddy land prices and rental fees increase, which can discourage land transfers from inefficient small farms to efficient large farms. As a result, the average farm remains small, which tends to prevent large-scale mechanisation from reducing labour cost. In Indonesia, the loss of comparative advantage is excessive. To maintain rice self-sufficiency, further protection becomes necessary, resulting in a vicious circle in which inefficient small farms are preserved. A loss of comparative advantage is not necessarily bad, but a loss of comparative advantage due to the preservation of inefficient small farms by policy means is.

Promotion of Farm Size Expansion

The foremost and most fundamental policy option to promote farm size expansion is to abolish price support. Given their tininess, Indonesian farms cannot feasibly expand in size much unless land prices and rental fees decline significantly. The government may find abolishing policy for price support politically difficult, but it should clearly

understand that continuing the support will significantly harm the economy. So far as land and machineries complement each other, mechanisation is promoted by farm size expansion. The second policy option is to shift rice production areas from Java to Indonesian islands where the population is less dense, the average farm is larger and room exists for further farm size expansion. This may be realised through the promotion of products that are more profitable than rice in Java, such as vegetables. Since such products must be marketed while they are fresh, Java has an advantage in production because it has better access to urban markets. The third policy option is to facilitate land renting by strengthening the land rights of owners. Finally, large-scale mechanisation should be promoted by encouraging the enlargement of plot size and the consolidation of scattered land holdings.[7] Unless significant farm size expansion and large-scale mechanisation take place, the production cost of rice farming will continue to rise in Indonesia, resulting in more imports of rice or the expansion of costly protectionist policies for rice farming.

It is true that mechanisation will reduce employment in agriculture, which will exert downward pressure on the wage rate, potentially worsening poverty. However, it

[7] According to Nguyen and Warr (2020), land consolidation has enhanced the production efficiency significantly in Vietnam.

must be recognised that large-scale farming achieved through mechanisation will reduce the rice price, which will help to improve welfare, particularly of the poor, who spend a relatively large share of their income on rice. Furthermore, increased mechanisation in the rice sector will help to reduce the sector's budgetary support, such as the fertiliser subsidy, by reducing the cost of producing rice. In relation to the potential for mechanisation to worsen poverty, below I discuss promoting rural industrialisation to increase employment opportunities.

To increase the production of rice, among other crops, the Indonesian government has attempted to establish large-scale 'food estates' on outer islands (Rahman 2020). I argue that food estates are bound to fail because of the high cost of monitoring labour. Some argue that introducing the system of rice intensification (SRI) may increase rice production significantly. The SRI is potentially high-yielding but is labour intensive, so it is adopted in remote places where the availability of non-farm jobs is limited (Takahashi and Barret 2016). Considering that the wage rate will continue to rise in Indonesia, wide adoption of the system is highly unlikely in the country. Since many farmers are getting old and most young people are less interested in farming in Indonesia than previous generations, fewer young farmers are likely to help expand farm size and improve farm management. To expand the farm size in

Indonesia, strengthening individual land rights are essential, because secure individual land rights facilitate land transfers through renting and selling as well as intensification of farming (Grimm and Klasen 2015).[8]

II. PROMOTION OF HIGH-VALUE PRODUCTS

Neglect of HVPs

Responding to income growth and urbanisation, the demand for HVPs has been rapidly increasing alongside the demand for better nutrition and health in developing countries such as Indonesia. Yet, in general, the supply of HVPs has failed to keep pace with the demand, resulting in a high relative price (Headey and Masters 2021). According to table 2, the harvested area of fruit and vegetables on Indonesia's major islands from 2003 to 2018 increased only slightly, continuing to make up only a tiny share of total agricultural area.[9] Observing slow growth in the production of HVPs, Reardon et al. (2015) argued that 'If Indonesian farmers cannot access the supply chains that meet domestic consumer demand, foreign farmers will'. Consequently, Indonesia is a large

[8] It is, however, difficult to implement land rights policy, because of the high cost of plot surveying and certification. The number of issued certificates increased from 12 million in 1992 to 27.5 million in 2013. But the number of land plots was estimated to be 85 million. The problem has been the slow pace of certification (Van der Eng 2016)

[9] Harvested area of fruit covers all kinds of fruit production areas, whereas that of vegetables includes only major vegetable items (i.e., shallots, chilli, potatoes, cabbages, Chinese cabbages and tomatoes), meaning that its harvested area is underestimated.

net importer of vegetables, unlike Thailand, Vietnam and the Philippines, and Indonesia's importation of fruit and vegetables has been rising (figure 6).[10]

The increasing production of HVPs has been assisted by the 'supermarket revolution' in many parts of developing countries (Reardon and Minten 2021). Yet the impact of the emerging modern food value chain on the production of smallholders in Indonesia has been limited (Minot et al. 2015). Toiba, Umberger and Minot (2015) note that retailing by supermarkets does not contribute to the consumption of healthy food. Although Hernández et al. (2015) point out that West Java transitioned from being a major rice bowl to a major vegetable basket, such transformations do not seem to be widespread in Indonesia, unlike in many other developing countries in Asia. Indonesia clearly needs to produce more HVPs to improve the health and nutrition of its population.

Role of Contract Farming

HVPs are high-quality and input-intensive and so they are generally new to farmers. Therefore, the markets of new inputs for HVPs—such as new, superior seeds and safe pesticides—are either missing or imperfect, the system of disseminating new

[10] Indonesia is a net exporter of fruit, and so the net import of vegetables is larger than that of fruit and vegetables combined.

technology and management knowledge is weak for the production of HVPs, and as is often the case, the credit market does not work to support the purchase of new inputs for the production of HVPs. Furthermore, consumers cannot easily verify the quality and safety of HVPs visually. This can constrain the effective marketing and product differentiation of HVPs. Another issue is price risk, as the prices of HVPs tend to fluctuate greatly. Risk-averse smallholders may be reluctant to produce HVPs in the absence of relevant insurance programs.

In countries other than Indonesia, the above market failures for HVPs have sometimes prompted contract farming.[11] Broadly, there are two types of farming contracts: a production contract and a marketing contract. Under the production contract, a contractor, often a supermarket or agro-processor, often provides purchased inputs to the farmer on credit, and technological support for production management, in return for supply of a certain quantity and quality of products at an agreed time and price. The contractor also closely supervises the production of the products to ensure they are high-quality, and it tries to prevent the use of the provided inputs for other purposes such as the 'side-selling' of products to marketing agents, not the contractor.

[11] Otsuka, Nakano and Takahashi (2016) conducted a comprehensive literature review, whereas Otsuka and Zhang (2021) provided an updated review.

Under the second type of agreement, the marketing contract, the contractor specifies the inputs and provides advice on cultivation practices, while leaving most of the production decisions to the farmer. Thus, farmers have more autonomy in decision-making under the marketing contract than under the production contract. In both cases, however, the contractor markets the HVPs. Thus, the marketing channels are short, unlike in the traditional marketing system in which village-based collectors, township traders and urban traders are linked, connecting farmers with urban markets (Hayami and Kawagoe 1993).

In Indonesia, the production contract has been adopted for the production of hybrid seed corn, seed rice and broilers (Simmons, Winters and Patrick 2005; Winters, Simmons and Patrick 2005) and specialty coffee (Vicol et al. 2018).[12] These products are generally high-quality products subject to quality uncertainty. The production contractors are usually foreign agro-dealers and agro-processors who aim to improve product quality by providing improved seeds and cultivation practices. On the other hand, marketing contracts in Indonesia seem to be used for agreements between traders or wholesalers and farmers in the production of tomatoes (Hernández et al. 2015), shrimp (Yi and Reardon 2015), chillies (Sahara et al. 2015) and potatoes (Umberger et

[12] Contract farming is also practised for oil palm production. I discuss it separately in section 4.

al. 2015). Under these marketing contracts, traders and wholesalers assemble, grade, sort and pack contracted products, occasionally providing technical support and selling the products to supermarkets and restaurants in urban areas.[13] Although it is unclear how common contract farming is in Indonesia as a whole, contract farming can surely contribute to the growth of HVP production in Indonesia.

Shortfall of Contract Farming

Since contract farming introduces new seeds, products and production methods, it can contribute to the modernisation of agriculture in developing countries. Thus, the World Bank (2007) strongly advocates contract farming for introducing HVPs into agriculture in such countries. However, whether farmers significantly benefit from contract farming is debated in several empirical studies. Ton et al. (2018) used meta-analysis to show that assessments of the income effect of contract farming can be upwardly biased. They showed that this bias may be due to researchers' mechanically excluding failed contract farming arrangements and due to the tendency of published articles to primarily report successful arrangements. The authors are sceptical about large effects of contract farming on the income of farmers. As I argued in a summary of the empirical literature,

[13] To my knowledge, such contract farming led by traders and wholesalers is not practised in other countries.

farmers cannot expect to receive large benefits from production contracts, because they *passively* accept inputs and production instructions without making any major management and marketing decisions (Otsuka, Nakano and Takahashi 2016). This means that farmers cannot receive significantly high income unless they make entrepreneurial decisions superior to those of other farmers. According to an updated review of the literature (Otsuka and Zhang 2021), several recent studies support this conclusion.

For farmers to be significantly better off in general, they must learn about improved technology, cultivation methods, and marketing so as to transform from subsistence farmers into entrepreneurs who can make critical commercial decisions (Otsuka and Fan 2021). Unless farmers can make decisions appropriate for making profits in a dynamic setting where technology, the availability of inputs and the structure of product demand change, they can hardly expect to receive substantial income gains accrued to such decisions.

The literature on contract farming seldom distinguishes between production and marketing contracts. However, most existing studies on contract farming appear to deal with production contracts. Under this kind of contract, the contractor closely monitors contracted farmers to ensure they produce high-quality products. Under

marketing contracts, however, the farmers largely retain their decision-making autonomy, and the contractor provides only broad instructions for production. Thus, farmers' knowledge of how to produce *new* high-quality products will obviously be limited under the marketing contract. Therefore, the introduction of the marketing contract cannot conceivably make farmers significantly better off than before, unless new production and management knowledge is provided by public-sector agents.

Strengthen Extension and Support for Agro-processing Sector

There are two fundamental requirements for improving the efficiency of farming and the well-being of farmers, given the introduction of contract farming (Otsuka and Ali 2020). The first is to strengthen the agricultural extension systems for HVPs. Since HVP production is new to most farmers, they or their farmer groups need to be given appropriate information on technology, cultivation methods and marketing. This may be partially achieved through the production contract, but in this case profits due to superior entrepreneurial decisions will accrue for contractors, not farmers. Thus, farmers' income is unlikely to increase significantly. Strengthening the extension system for HVPs is not easy, however, because of the lack of researchers and extension workers specialising in HVPs. Therefore, a major reform of research and extension systems is often required.

I must also note that public-sector extension is often inefficient due to a lack of work incentives for extension workers and the absence of farmers' demand for their services. Information about the availability of new, useful technology and cultivation practices must be given to farmers in order to stimulate their demand for extension services. Also helpful may be farmers' field schools and other methods of information dissemination, such as farmer-to-farmer extension (Takahashi, Muraoka and Otsuka 2020).

The second requirement is the nurture of agro-processing firms by investing in the human capital of their entrepreneurs (or that of the managers and owners of local firms). Managerial ability is crucial for innovation and widely recognised as a major factor missing from the development of manufacturing firms in developing countries (Bloom and Van Reenen 2010; Sonobe and Otsuka 2011; Otsuka, Jin and Sonobe 2018; McKenzie 2020). Because of the imitation of innovation by rival firms through information spillovers, the social rate of return for investing in human capital to acquire new production and management knowledge is higher than the private rate of return. As a result, the amount of investment in human capital tends to fall short of what is needed to attain the social optimum. Consequently, manufacturing firms in developing countries are generally poorly managed and not sufficiently innovative.

Therefore, the government ought to organise training programs that develop the local agro-processing sector by encouraging it to uptake new technology and management methods (Otsuka 2020). Otherwise, the development of agricultural sectors that produce HVPs will be constrained by the lack of productive agro-processors. I note that fresh fruit and vegetables are shipped to supermarkets in urban areas after the crops have been fumigated and the produce washed, graded and packed at partly mechanised packhouses. This involves many workers and, as such, activities at packhouses should be considered as important industrial activities in rural areas.

III. INTENSIFICATION OF OIL PALM PRODUCTION

Indonesia produces a range of tree products, including rubber, coffee, cocoa and palm oil. Among them, palm oil is harvested from trees over the largest area, which more than doubled from 2003 to 2018 (see table 2). Moreover, many studies on oil palm production provide useful insights that may inform an analysis of this agricultural sector in Indonesia.

Plantation versus Smallholder Farms

Many tree products as well as some varieties of tropical fruit and sugarcane are produced on plantations. In Indonesia, the oil palm was produced primarily by state-

owned plantations before 1995, when the state began handing over the management of plantations to the private sector (Pramudya, Hospes and Termeer 2017). Since then, state intervention in the oil palm sector has declined significantly. The Indonesian government also obligated the private plantations to offer contract farming to smallholders to cultivate a part of plantation's land (Cahyadi and Waibel 2016; Euler et al. 2016b; Gatto, Wollni and Qaim 2015; Gatto et al. 2017; Krishna et al. 2017). Gradually, the production by smallholders increased, and by 2016, they occupied 42% of the 11.2 million hectares of oil palm in Indonesia (BPS 2020). Importantly, the independent smallholders who had never had contracts with plantations grew in operational size and increased dramatically in number. As a result, their number has far surpassed that of contracted smallholders, whose number and operational size have remained largely unchanged since the end of the 1990s (Euler et al. 2016b). The question arises as to whether plantations produce oil palm more efficiently than smallholders.

Binswanger and Rosenzweig (1986) argue that the plantation has an advantage in processing, which is subject to scale economies, because the plantation can coordinate agricultural production activities such that processing facilities are operated at full capacity. They also argue, however, that the plantation has a disadvantage

compared with smallholders or family farms in agricultural production, because the plantation faces high costs of monitoring hired workers. The logic behind this argument is the same as for the inverse relationship between farm size and productivity, although labour monitoring is less costly for monocultural production by plantations. Hayami (2001) concurs with Binswanger and Rosenzweig that smallholder production can be more efficient than plantation production. With reference to pineapple and sugarcane production in Thailand and the Philippines, Hayami noted that smallholders engaged in contract farming in Thailand increased their production much faster than plantations in the Philippines.

Discussing plantation crops such as tea, rubber and oil palm, Byerlee (2014) argued that 'Although the production of all these commodities was initiated in the colonial period on large plantations, over the course of the 20th century, most transited to smallholder systems…. smallholders overwhelmingly dominated perennial crop exports, except possibly oil palm'. He also noted that the structure of oil palm production has been shifting in favour of smallholders in Indonesia. Plantations may have been more efficient than smallholders back when producers faced the huge pioneering costs of clearing fields and investing in initial transport and communication infrastructure. But once such infrastructure has been developed and fields have been

cleared, the advantage of the plantation is likely to be lost. Oil palm production, however, is highly capital intensive (Krishna et al. 2017) and, hence, large plantations that have good access to finance may have had some advantage over smallholders. The share of oil palm production by plantations in Indonesia, however, had gradually declined to nearly one-half of the total production by the mid-2010s, as smallholders increased their production. While the returns from palm oil production are shared in many ways among contracted smallholders, investors in plantations, and government, there has been 'a remarkable shift away from the terms enjoyed by earlier generations of Indonesian oil palm smallholders' (Cramb and McCarthy 2016). Once plantations are established, it is difficult to dissolve them, because land sale markets seldom function well. Yet it seems clear that oil palm production by smallholders is more efficient than plantations in Indonesia.

Contract Farming and Smallholder Oil Palm Production

When the Indonesian government privatised plantations in the mid-1990s, it obligated private plantations to help a certain number of farmers to establish oil palm smallholdings and to provide inputs, credit and technical assistance (Cahyadi and Waibel 2016; Euler et al. 2016b; Gatto, Wollni and Qaim 2015). Contract farming also supports the establishment of oil palm fields in various ways, including by providing

credit, which helps smallholders because planted trees take years to bear fruit. Furthermore, the contractor incurs lower coordination costs under a production contract than under an arrangement in which it procures oil palm fruit through market transactions that cannot assure its stable supply.

Usually groups of farmers, rather than individual farmers, enter into contracts with private plantations. This arrangement is widely observed in developing countries and reduces the transaction cost for plantations since they have commercial dealings with fewer parties (Otsuka, Nakano and Takahashi 2016). If community ties are loose, however, group-based contracts may not lead to significantly reduced transaction costs. Also, elite capture may occur in the case of such contracts (Vicol et al. 2018).

Several studies find that contract farming has a positive effect on smallholders' well-being (Gatto et al. 2017; Krishna et al. 2017; Santika et al. 2019).[14] Other research, including by Cahyadi and Waibel (2016), finds no significant positive effect. Nevertheless, contract farming, particularly farming under production contracts, undoubtedly triggered the development of smallholder oil palm production in Indonesia.

Expansion of Independent Smallholders' Production

[14] Santika et al. (2019) found a positive effect in market-oriented villages but a negative effect in subsistence-based villages. Considering that contract farming is chosen by farmers, it is not clear why it had negative welfare effect.

Oil palm production by independent smallholders has grown much faster than that by contracted smallholders (Euler et al. 2016b; Gatto et al. 2017). According to Gatto et al. (2017), about 74% of their sample smallholder households growing oil palm in Sumatra were independent in 2012, compared with only 5% in the early 1990s. Euler et al. (2016b) also reported that 75% of their sample households growing oil palm were independent. Somewhat puzzling is that the yield per hectare of the independent smallholders in the 2010s was much lower than the supported smallholders (Euler et al. 2016a). Pramudya, Hospes and Termeer (2017) reported that independent smallholders 'started their plantations with their own money' and, 'because they had limited capital, used seeds from fallen fruit or bought uncertified seeds and relied on knowledge from friends or family who had plantations or had previously worked for an estate company'. Gatto et al. (2017) also found that independent growers learned production technology from contracted growers. Euler et al. (2016a) note that independent smallholders use little fertiliser, have a low rate of plant mortality and have an excessively long harvesting cycle. In short, their production management is inefficient.

This prompts the question of why inefficient smallholders have expanded their oil palm production. Gatto et al. (2017) argued that credit and input markets have developed and access to palm oil mills has improved, which has stimulated production

by independent smallholders. If this is true, the advantage of contract farming arising from market failure will decrease over time. Another important factor is the presence of secure land rights: independent smallholders are often transmigrants, or the descendants of the farmers who received land titles and converted rubber fields and fallow land into oil palm fields (Gatto et al. 2015). Since land titles can be used as collateral, land title holders have good access to credit, which can lead to higher yields and profitability (Krishna et al. 2017).

In my view, because the quality of the oil palm fruit is uniform, smallholders can sell it without regards to the quality. As I have argued, one of the advantages of contract farming is that quality uncertainty is reduced by agro-dealers and supermarkets. In the case of oil palm, the quality difference is minimal. Thus, the advantage of contract farming over arms-length marketing transactions is low. Partly because of this and partly because of the development of input, output and credit markets, the advantage of contract farming, if it has any, must have decreased. These considerations help to explain why independent smallholders dominate oil palm production, compared with contracted smallholders, though there is a possibility that the favourable price of palm oil relative to coconut oil and rubber in the last 20 years has also benefited independent smallholders.

Support Independent Smallholders by Extension and Land Titling

Similar to the requirements for promoting HVPs, three fundamental steps can improve the efficiency of oil palm production in Indonesia. The first is to strengthen extension systems for independent smallholders (Euler et al. 2016a). As mentioned, farming by smallholders is often inefficient, though it is usually more efficient than farming under production contracts, not to mention farming by private plantations. Obviously, smallholders need information on how to improve their production methods in order to enhance their overall efficiency. According to Cramb and McCarthy (2016), smallholders who have received technological assistance by the extension program have improved their yields and income from oil palm production significantly in Malaysia. We can also learn from the experience of cocoa sector development in Sulawesi, in which the government, private grinding firms and NGOs provide training and conduct experiments and demonstrations (Neilson and McKenzie 2016).

As for HVPs, the second requirement is to invest in human capital by training managers and owners of palm oil mills. It is a mistake to assume that private enterprises are managed as efficiently as they ought to be. Several authors have demonstrated that management training helps to improve the management efficiency of manufacturing enterprises in developing countries (Bloom and Van Reenen 2010; Sonobe and Otsuka

2011; Otsuka, Jin and Sonobe 2018; McKenzie 2020).[15]

The third requirement is the availability of secure land rights. These rights are a fundamental condition for the sustainable management of natural resources, including tree crops (Otsuka and Place 2001; Place, Meinzen-Dick and Ghebru 2021). If land rights are not secure, incentives to invest in tree management may be thwarted. Land titling, however, may not lead to secure land rights, if collective family ownership of land prevails because family members have to choose an individual owner of their collective land to receive the individualised land title. Fortunately in Sumatra, where oil palm is most actively grown in Indonesia, ownership of formerly family-owned land has been individualised, even in native communities (Suyanto, Tomich and Otsuka 2001). Therefore, I support the argument of Gatto, Wollni and Qaim (2015), Krishna et al. (2017), and Pramudya, Hospes and Termeer (2017) that land titles should be granted to independent smallholders as a precondition for the intensification of oil palm production.[16] I do recognise, however, that the provision of land titles is difficult and costly. As in the discussion of land rights for large-scale rice farming, it may be more

[15] There is concern with polluted runoffs from oil palm production and emission of waste from palm oil mills. Needless to say, such negative externalities must be regulated properly.

[16] Although I did not discuss concerns about the extensification of oil palm production at the expense of forests, it is certainly desirable to regulate this extensification, from the global environmental point of view.

cost-effective to provide secure land rights to a relatively small portion of the community, which provides individual land rights for community members and protects them, than a large number of individual smallholders.

IV. CONCLUSIONS

Indonesian agriculture is at crossroads in four respects. First, it may either continue to lose comparative advantage in rice farming by protecting smallholders, or it may restore such advantage by facilitating farm size expansion and mechanisation. Second, it may continue to neglect the production of HVPs, or it may increase the production of HVPs for the benefit of both producers and consumers. Third, Indonesian agriculture may continue its inefficient production of oil palm by plantations and contracted smallholders, or it may strengthen the efficiency of independent oil palm growers. Fourth, it may continue to idly witness the lack of non-farm employment opportunities in rural areas, or it may create such opportunities by vitalising agro-processing industries, including packhouse activities.

I propose the following strategies to transform Indonesian agriculture. First, the government should support farm size expansion and mechanisation in rice farming by abolishing price protections while supporting rice production on outer islands where the

room for farm size expansion is larger than on Java. Second, the government must strengthen public-sector extension systems for HVPs and oil palm production by smallholders. Third, the government should grant land titles to independent oil palm-growing smallholders for the sustainable and efficient management of oil palm production. Last, the government should promote rural industrialisation by investing in the human capital of agro-processors and managers of packhouses and palm oil mills. Clearly, major shifts in agricultural policies are needed to achieve the efficient, equitable and sustainable growth of agriculture and rural areas in Indonesia.

Before concluding, I must point out the potential role of agricultural research. Since few recent studies on agricultural research exist, I had difficulty obtaining relevant information the returns on investment in agricultural research. However, Warr's (2012) finding that the returns on investment in agricultural research are significantly high suggests a need to increase such investment. Also, the pay-offs from agricultural extension tend to be low when agricultural research—and therefore new and useful information—is lacking. The role of agricultural research in the transformation of Indonesian agriculture is an issue that needs the renewed attention of researchers.

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Table 1 Average Farm Size (hectare) on Major Islands in Indonesia in 2003 and 2018

	2003			2018		
	Paddy	Upland	Total	Paddy	Upland	Total
Java	0.19	0.19	0.38	0.18	0.16	0.33
Sumatra	0.23	0.96	1.19	0.15	1.05	1.20
Kalimantan	0.36	1.21	1.57	0.27	1.43	1.69
Sulawesi	0.26	0.89	1.14	0.27	0.75	1.02
Indonesia	0.21	0.51	0.72	0.18	0.55	0.73

Source: Source: BPS (2003a, 2018a)

Table 2 Planted Area of Rice and Tree Crops and Harvested Area of Fruit and Vegetables (million hectares) on Major Islands

	2003					2018				
	Paddies	Tree crops[a]	Fruit[b]	Vegetables[c]	Total[d]	Paddies	Tree crops[a]	Fruit[b]	Vegetables[c]	Total[d]
Java	3.3	0.4 (0.0)[f]	0.3	0.3	4.3	3.5	0.5 (0.0)[f]	0.5	0.4	4.9
Sumatra	2.3	7.3 (4.0)[f]	0.2	0.1	9.9	1.5	11.8 (8.0)[f]	0.1	0.2	13.6
Kalimantan	0.9	1.9 (1.0)[f]	0.0	0.0	2.8	0.7	6.6 (5.6)[f]	0.1	0.0	7.4
Sulawesi	0.9	0.9 (0.1)[f]	0.1	0.0	1.9	1.0	1.5 (0.4)[f]	0.1	0.1	2.7
Indonesia[e]	7.9	10.8 (5.6)[f]	0.8	0.5	20.0	7.1	20.9 (14.3)[f]	1.1	0.7	29.8

a. Tree crops include oil palm, rubber, cocoa and coffee.
b. Fruit includes all kinds of fruit trees.
c. Vegetables include shallots, chillies, potatoes, cabbages, Chinese cabbages and tomatoes.
d. Total is the sum of areas of paddies, tree crops, fruit and vegetables.
e. The data refer to Indonesia as a whole, not the sum of areas on the four major islands.
f. Oil palm area.
Source: BPS (2003b, 2018b).

Yield and profit per hectare (ha)

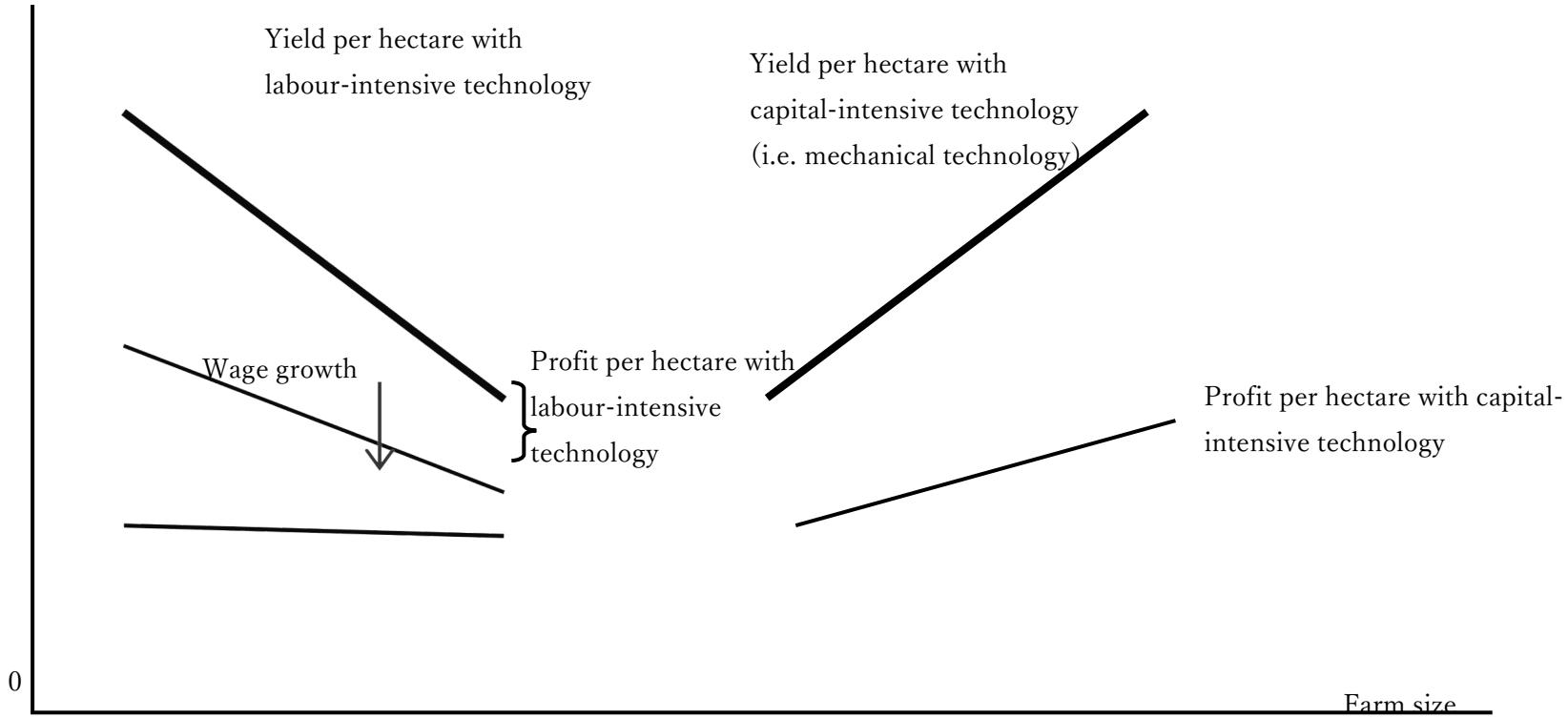

Figure 1 Conceptual Relationships between Farm Size and Productivity

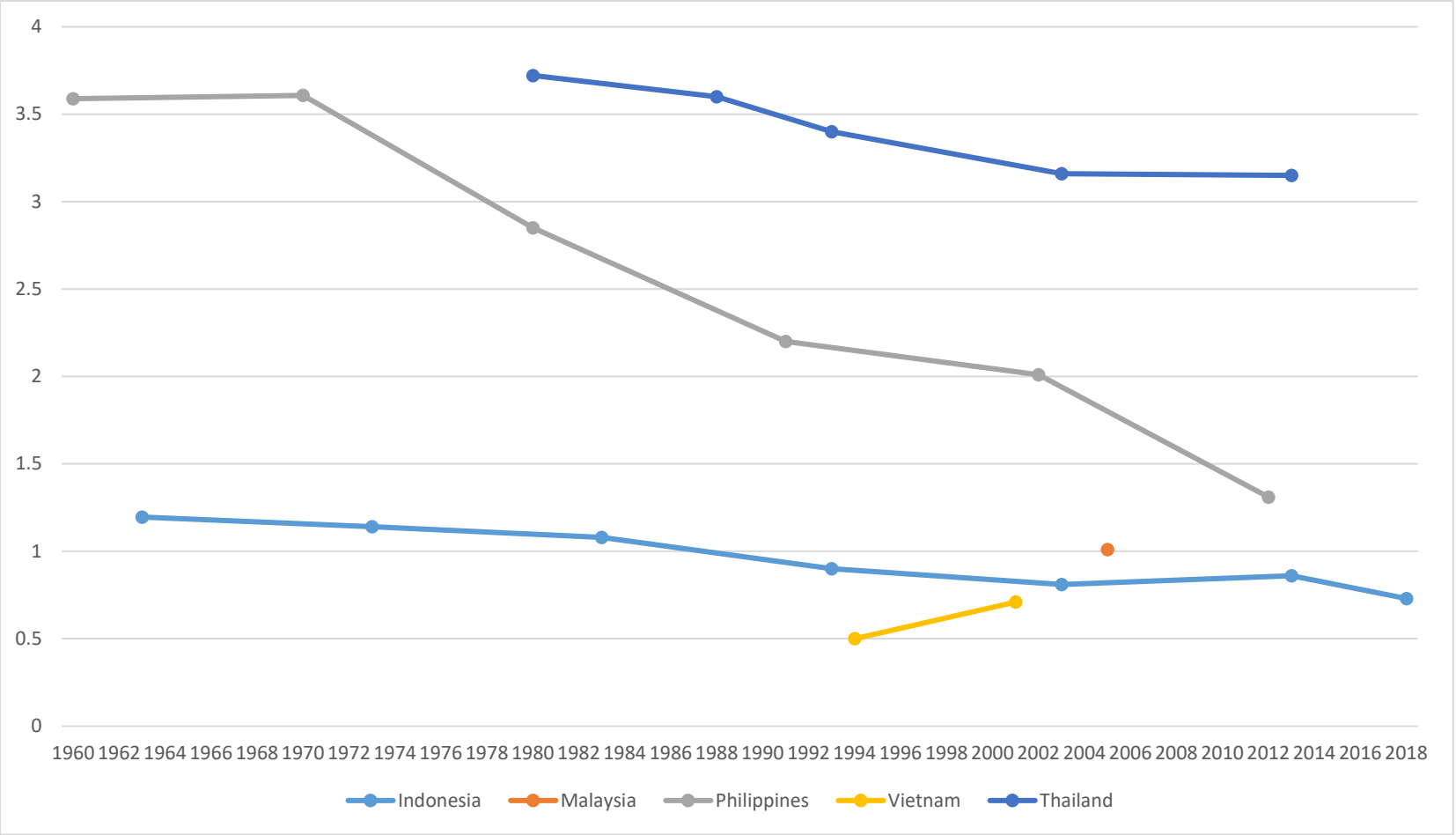

Figure 2 Average Farm Size (hectares) in Selected Southeast Asian Economies

Source: FAO (1960, 1970, 1980, 1990, 2000, 2010) and BPS (2003a, 2013, 2018a).

Note: Census years are different in different countries.

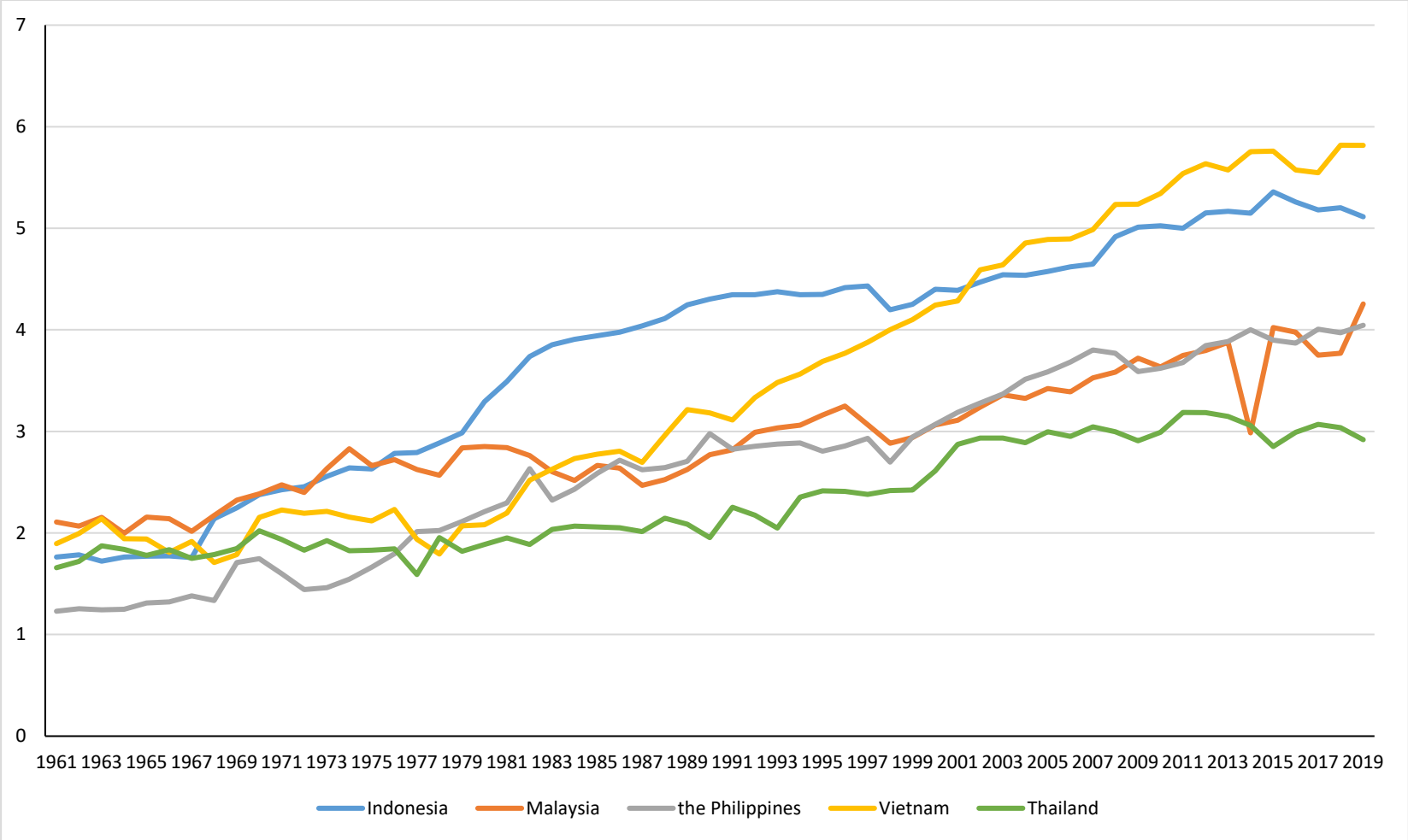

Figure 3 Paddy Yields (tonne/hectare) in Selected Southeast Asian Economies

Source: FAO（2021）.

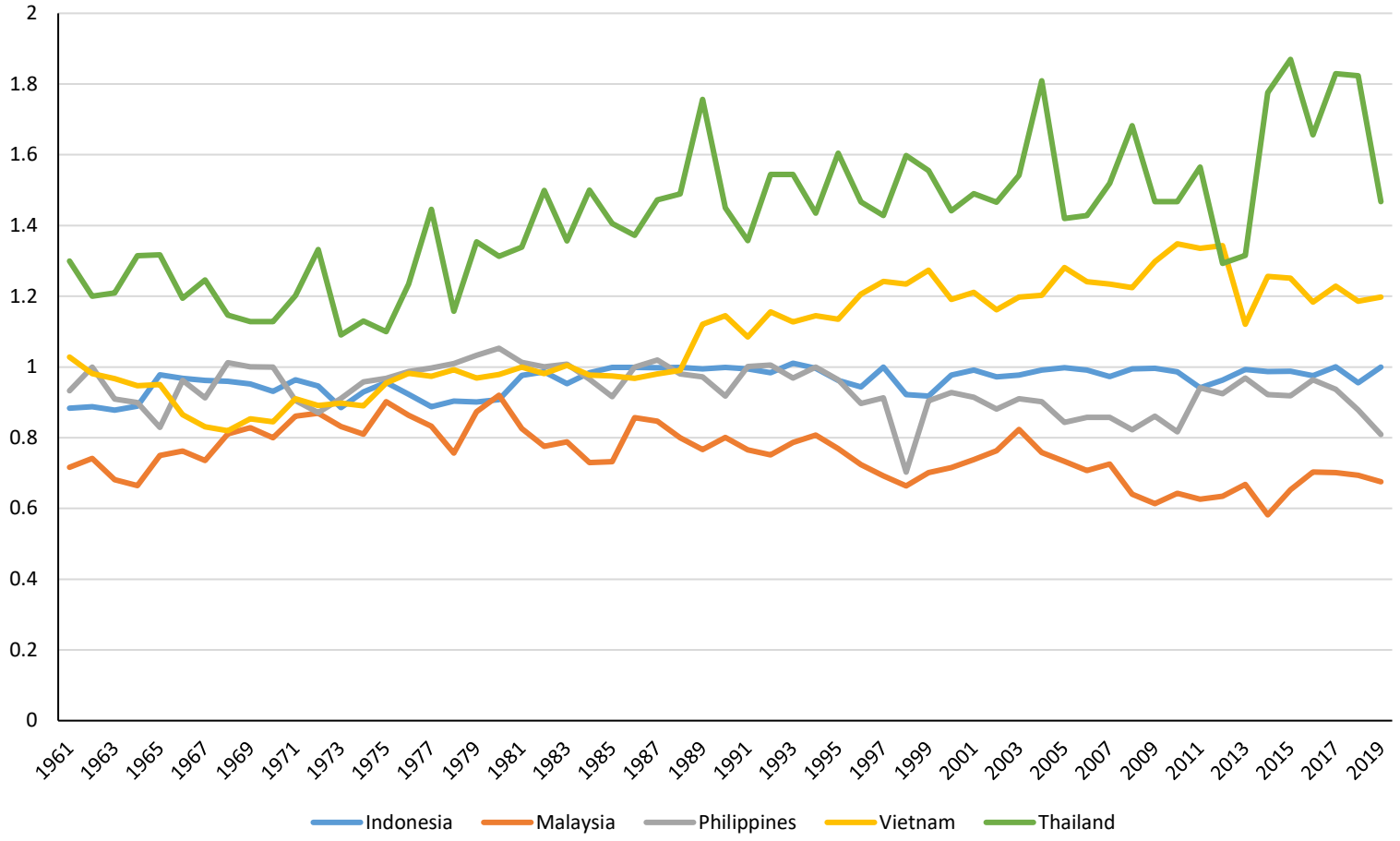

Figure 4 Rice Self-Sufficiency Ratios in Selected Southeast Asian Economies

Note: A ratio higher than unity indicates that a country is a net rice exporter, and one lower than unity that it is a net rice exporter.

Source: FAOStat

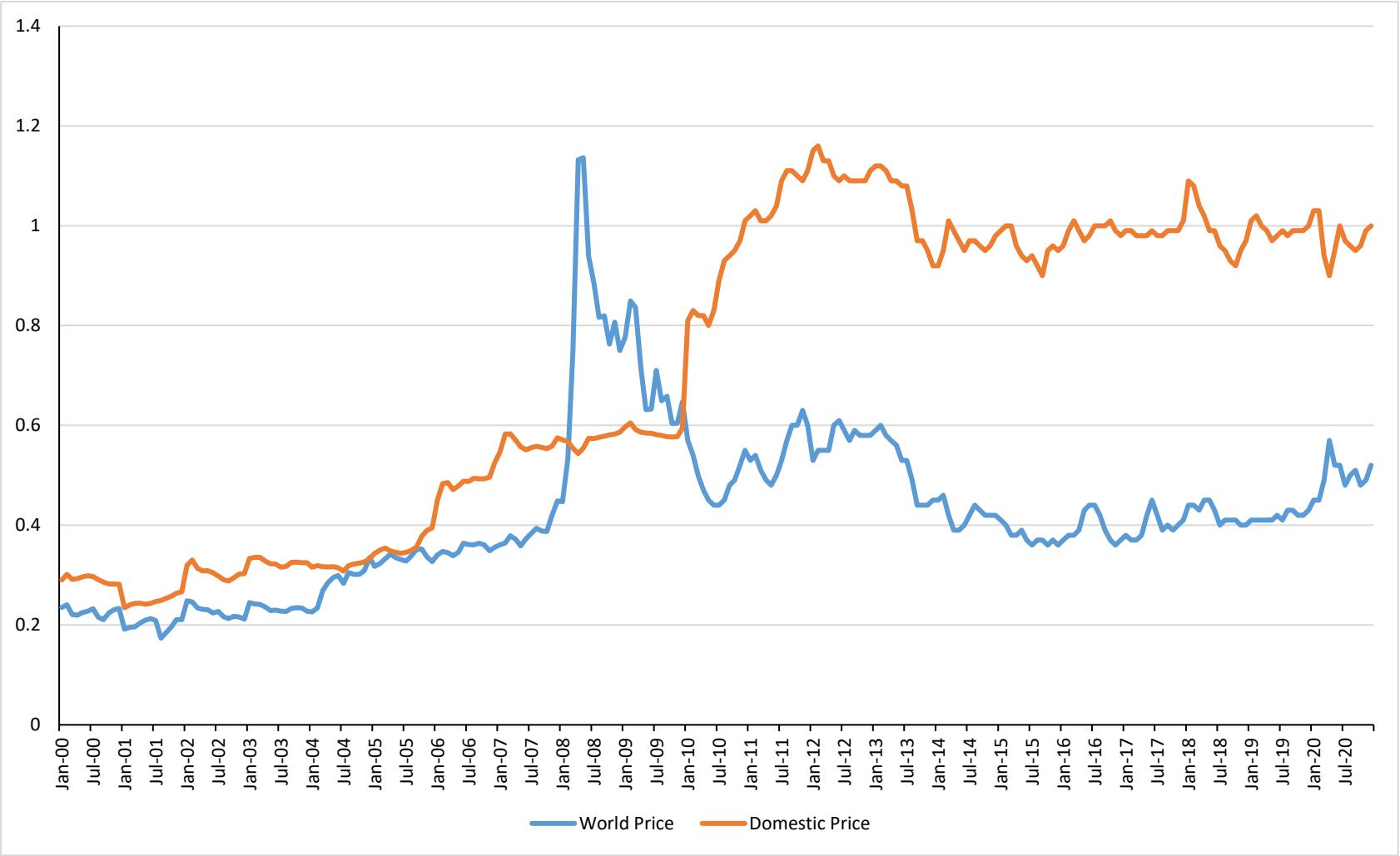

Figure 5 World and Domestic Rice Prices in Indonesia ($/kg)

Source: BPS (2000–09 [please add corresponding reference list entry]); World Bank (2021).

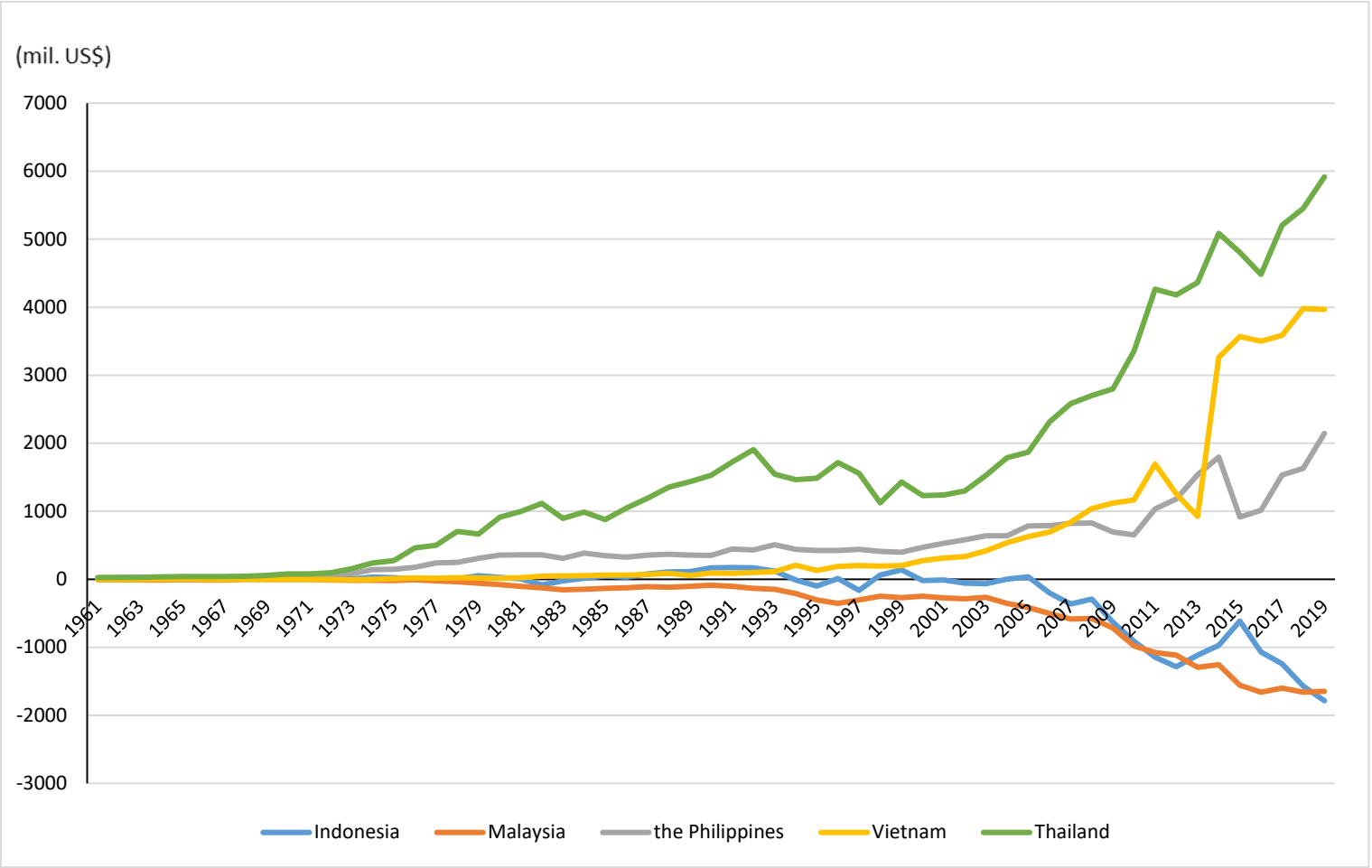

Figure 6 Net Export or Net Import of Fruit and Vegetables ($ million) in Selected Southeast Asian Economies

Source: FAO (2021)