Geographic determinants of rice self-sufficiency in Southeast Asia

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Abstract

Rice self-sufficiency is a key objective of most Asian governments, yet attaining that objective has been elusive for several countries over extended periods of time; long-term status as an exporter or importer is relatively constant, and is altered only by revolutionary events (i.e., major changes in policy or technologies). Traditional rice importers tend to eat less rice (and more wheat) than traditional exporters, so the determining factors behind rice self-sufficiency must lie on the supply side. This paper finds that the main determinant of (per capita) rice production is not rice yield per hectare, but rather the amount of per capita rice area harvested, which in turn is determined largely by the proportion of land that is well-suited for growing rice. Thus, countries with ample (per capita) supplies of water and flat land (i.e. those with dominant river deltas on the mainland) are self-sufficient in rice, and countries with more varied landscapes are not.

Key words: rice, self-sufficiency, Southeast Asia
JEL Code: Q18

[1] Helpful comments from Tom Slayton, Peter Timmer and Keith Wiebe are very gratefully acknowledged, of course with the usual disclaimer.

1. INTRODUCTION

Most Asian countries have a strong desire to be self-sufficient in rice. The roots of this preference run deep, as rice has been planted and consumed for thousands of years in the region, making it a fundamental part of local culture. Even today, it is still the most widely planted crop in the region, and is by far the most important expenditure item for poor households (Dawe et al, 2010). Most Asians would scoff at the importance of each person or household being able to grow enough rice to feed themselves without buying any from the market, but feelings at the national level are different. There seems to be a certain pride in being able to feed the nation without relying on supplies from other countries.

Within Asia, rice is particularly important in Southeast Asia. Unlike South and East Asia, no wheat is grown in this region, so rice cultivation is dominant. Thus, the analysis in this paper focuses on Southeast Asia. This region includes two of the world's top three exporters (Thailand and Viet Nam), but it also includes two of the world's largest importers (Indonesia and the Philippines). In addition, these countries are closely linked through the Association of Southeast Asian Nations (ASEAN) and the ASEAN Free Trade Area (AFTA). While barriers to rice trade under AFTA remain, there is pressure to reduce these barriers in the future.

In addition to culture and pride, there are economic and political reasons for wanting to be self-sufficient. Importing countries, especially those that import a large share of domestic consumption, are particularly exposed to export restrictions and world price spikes because they rely on that market for supplies. While domestic price instability can just as easily be caused by domestic factors as by world price shocks (Rapsomanikis and Sarris, 2008; FAO, IFAD and WFP, 2011), there is no denying that world price shocks can affect local prices, thereby prompting protests and sometimes riots (Arezki and Bruckner, 2011).

Self-sufficiency is the outcome of both domestic supply and demand, i.e. production minus consumption. Thus, efforts to achieve self-sufficiency can be through either the demand side or the supply side. On the demand side, self-sufficiency ratios can be improved if people derive more of their dietary energy supply from cereals other than rice. There is also some potential to cut down on food waste, although recent work by Reardon et al (2012) suggests that post-harvest losses in Asian rice marketing systems are lower than commonly believed.

But most efforts to achieve rice self-sufficiency focus on the supply side – how to produce more rice. Rice production can be increased through irrigation investments, use of new seeds, more or improved application of fertilizer, greater use of mechanization and higher support prices. These supply side efforts have been at the forefront of the renewed emphasis on self-sufficiency since the world food price crisis of 2007-08. With that in mind, this paper attempts to explain differing levels of per capita rice production across Southeast Asian countries. Per capita rice consumption will also be discussed, but it tends to be *lower* in importing countries, meaning that exporting countries are not self-sufficient simply because they eat less rice. This is why the focus in this paper is on per capita rice production.

The paper is organized as follows. First, the pattern of rice self-sufficiency in Southeast Asia across countries and over time is described, noting the strong correlation with per capita rice production. Next, patterns in per capita production are explained using an accounting approach that breaks that variable into its components. Finally, in the conclusions, some of the consequences of the drive for self-sufficiency are described.

2. SELF-SUFFICIENCY OVER THE LONG-TERM

An examination of long-term trade data shows that Indonesia, the Philippines and Malaysia have been more or less consistent importers of rice for more than a century (Dawe 2008; Figures 1a, 1b; an exceptional period of a few years in the 1980s will be discussed later). Rice exporters (e.g. Thailand, Viet Nam, Myanmar) also tend to be consistent over long periods of time, although this consistency can be interrupted by wars or major shifts in economic policy. For example, the nationalization of the economy on the 'Burmese Way to Socialism' under General Ne Win sharply reduced rice exports from Myanmar for several decades, although recent reforms may lead to greater exports once again. War in the old French Indochina (Viet Nam, Cambodia, Lao PDR) during the 1960s and 1970s followed by a repression of the private sector led to rice imports that were only reversed with the 'Doi Moi' opening of the economy starting in 1986 in Viet Nam (Pingali and Xuan, 1992).[2]

[2] Viet Nam became a significant rice exporter (once again) in 1989.

Figure 1a. Net trade status, consistent rice importers, 1904-2010.

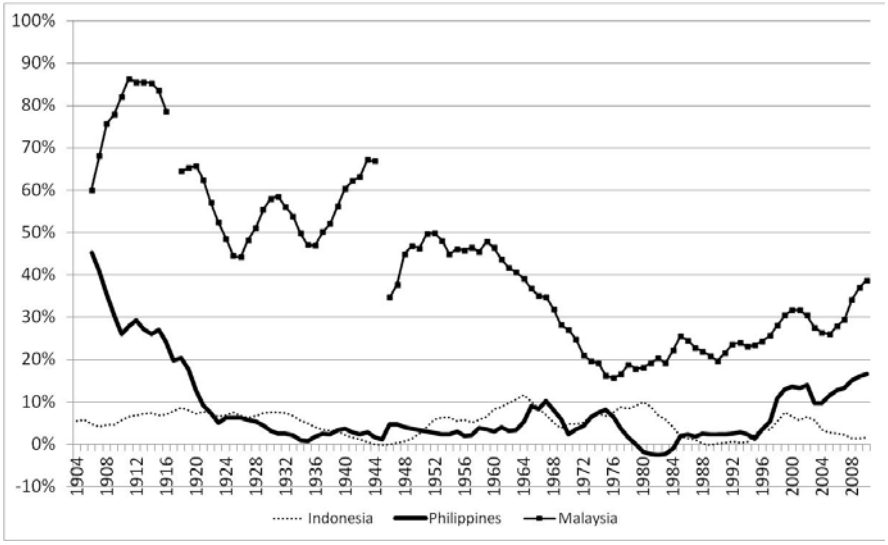
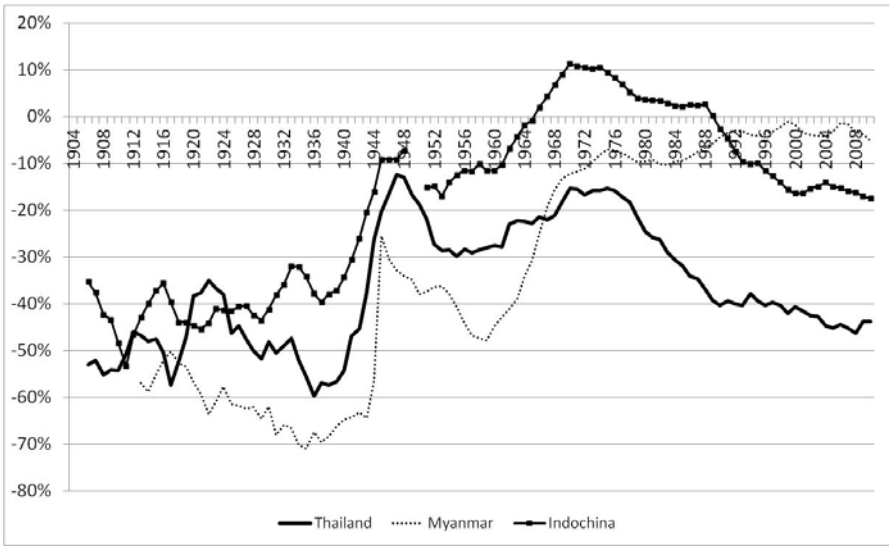


Figure 1b. Net trade status, consistent rice exporters, 1904-2010.



Sources of raw data: Rose (1985), van der Eng (1996), FAO (2013), USDA (2013).

Notes: Values shown are lagged five year moving averages in order to smooth fluctuations. When imports exceed exports (+), net trade status is expressed as a percentage of consumption. When exports exceed imports (-), net trade status is expressed as a percentage of production. This convention avoids reporting values greater than 100% (in absolute value). Gaps indicate missing values.

In addition to consistency over time, the spatial distribution of rice importers and exporters is quite striking, and highlights the major role geography plays in determining agricultural comparative advantage. It can be noticed that members of the exporters club are on the mainland, while those in the importers club are on islands or narrow peninsulas. Indeed, this is true for other consistent Asian rice importers as well – Korea, Japan and Sri Lanka.

Why might different locations make a difference to net trade status (i.e. exporter or importer) and competitiveness? The answer is that the countries on the mainland have dominant river deltas that provide ample water and flat land (important for easier control of that water). Such an environment is particularly suitable for cultivating rice, which unlike wheat and maize, has a semi-aquatic ancestry and is thus particularly sensitive to water shortages (IRRI 2013a). The importance of geography can also be seen at sub-national levels: southern Thailand, a narrow peninsula, produces insufficient rice to feed its population and must 'import' from the rest of Thailand, while Central Luzon in the Philippines, fed by the Pampanga River, produces more than enough rice for its own needs and 'exports' rice to Manila.

The next section examines this pattern more quantitatively by looking at rice production per person and its components.

3. RICE PRODUCTION PER PERSON AND ITS DECOMPOSITION

There is a strong correlation between rice self-sufficiency and per capita rice production. Among the eight major ASEAN rice producers,[3] the three traditional importers have the three lowest levels of rice production per person (Figure 2).[4][5]

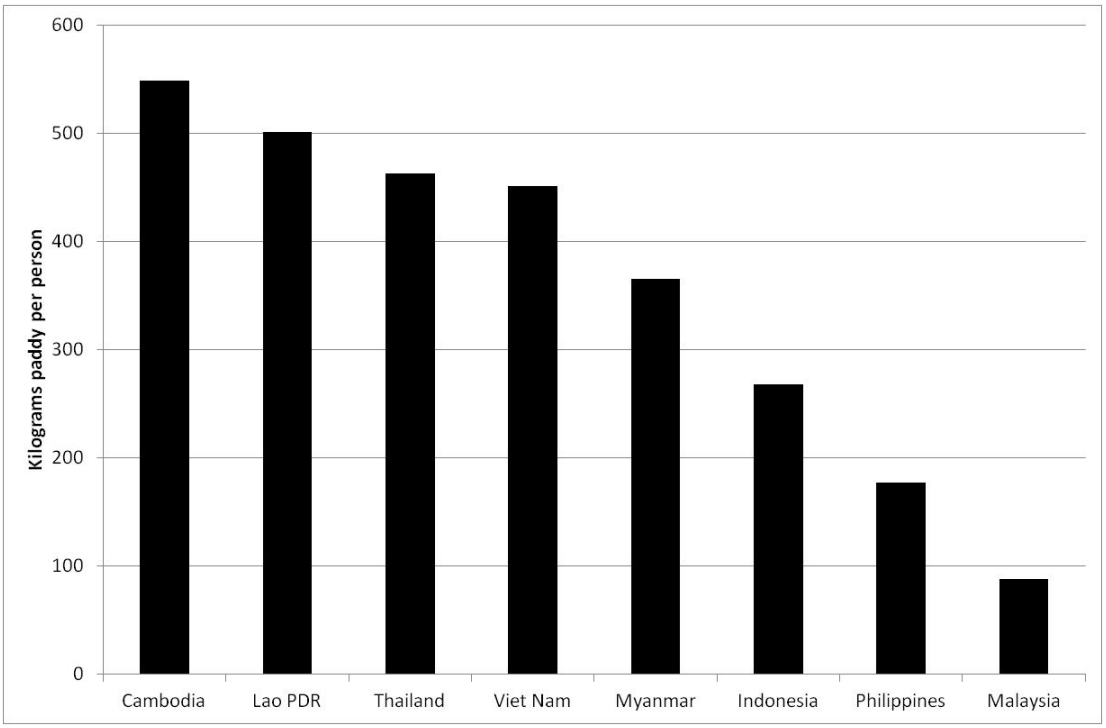
The most interesting feature of the graph is perhaps not so much the rank of the importers, but rather how quantitatively far behind they are from the five exporters. The population-weighted average of production per person (weights are used to give more importance to Indonesia than, e.g. Malaysia) in the five exporters is 444 kg per person, nearly double the level in the importers (231 kg).

[3] This includes all ASEAN members except for Singapore and Brunei. These two countries will be excluded from the analysis because they have such limited agricultural sectors. Both of these countries are rice importers, and have the lowest values of per capita production of any ASEAN countries. Thus, inclusion of these countries would reinforce the conclusions emerging from Figure 2 and subsequent analysis in the paper. Nevertheless, these two countries are sufficiently different than the others that it makes sense to exclude them from the analysis.

[4] Throughout this paper, unless otherwise specified, data are from FAO (2013), which publishes the data provided by national statistical agencies. The only exception are data on rice area harvested, rice yield, rice production and rice trade from Myanmar, for which data published by USDA (2013) are used. This adjustment has been made because the official production and trade data in Myanmar are widely acknowledged to be unreliable.

[5] According to official statistics from both FAO and USDA, Lao PDR is a rice importer. The official data do not take into account informal cross-border trade, however, and a recent detailed study estimates that Lao PDR is actually a small net exporter of rice (Eliste and Santos, 2012). Furthermore, even if the official trade data are accepted, the share of imports in consumption is very low at just 1.5% on average from 1999 to 2010.

Figure 2. Rice production per person, ASEAN countries



Notes: Data are averages for 2008-2010. Raw data from FAO (2013) and USDA (2013).

What lies behind the low level of production per person in the three importing countries? This question can usefully be explored by noting that production per person is determined by rice area harvested per person and yield per hectare:

$$\frac{Prod}{POP} = \frac{RA}{POP} * \frac{Prod}{RA} \qquad (1)$$

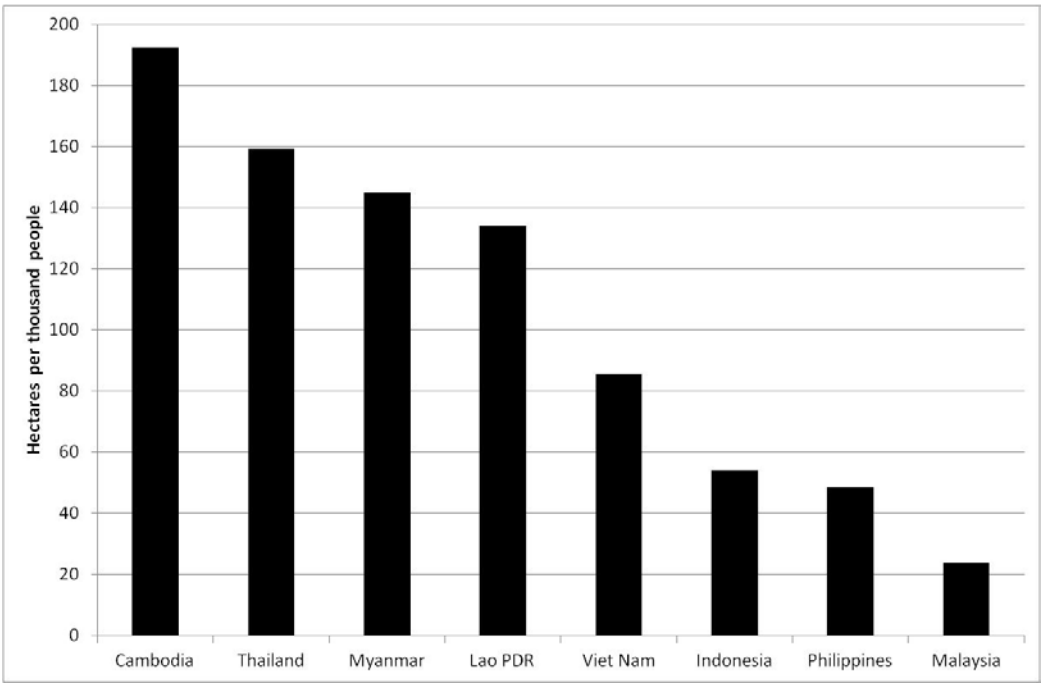
Where Prod = rice production (measured here in paddy terms);
POP = total population (not agricultural or rural population)
RA = Rice area harvested

How do the exporters and importers compare on these two measures?

For area harvested per person, the three importers are again the three lowest ranked, and again there is a large quantitative difference between the exporters and importers (see Figure 3). In fact, the quantitative difference between the two groups is even larger in terms of area per person than production per person. The population-weighted area harvested per person in the

exporters is 0.129 hectares per person, compared to just 0.05 hectares per person in the importers, a difference of 157%.

Figure 3. Rice area harvested per person, ASEAN countries



Notes: Data are averages for 2008-2010. Raw data from FAO (2013) and USDA (2013).

In terms of yield, the picture that emerges is much different. First, the cross-country pattern is not as consistent as it is with production and area, with the top four countries including two importers and two exporters. Second, as a group (i.e. total production summed across countries divided by total area harvested summed across countries), the average yield in the importers is 4.60 tons paddy per hectare, compared to just 3.44 tons paddy per hectare in the exporters.

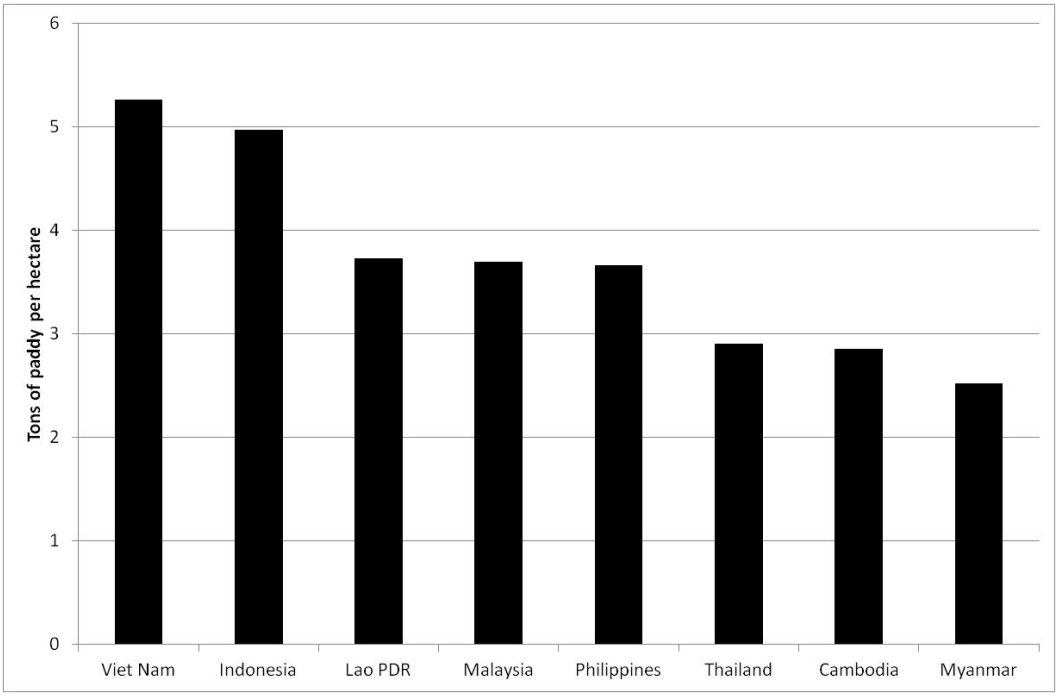
In some respects, this is not surprising – the higher yields in the importers are consistent with Hayami and Ruttan's (1985) theory of induced innovation, in which countries with scarce land (rice land in this particular case) tend to develop in a direction of increasing production per unit of the scarce resource. Indeed, the share of rice area that is irrigated is uniformly higher in the three importers (where it ranged from 54-66% in the mid-1990s; data from Huke and Huke, 1997) than it is in the exporting countries (where it ranged from 7-51% in the mid-1990s). This expansion of irrigation in the importing countries is an attempt to increase the

productivity of the scarce resource, which in this case is land that is well-suited to growing rice.

But, as noted by Van der Eng (2004), the direction of technological change depends on the relative scarcity of labor and land, and in mainland Southeast Asia, land was the relatively abundant resource. Thus, rice production in mainland Southeast Asia historically developed along different lines: more work animals, broadcasting of seed instead of transplanting, and less intensive use of fertilizer. These considerations of relative factor scarcities explain why the importers actually have higher yields than the exporters, despite their lower levels of per capita production.[6]

The greater importance of variations in rice area harvested per person (RA/Pop) in explaining rice production per person (Prod/Pop) is confirmed by a simple regression of rice production per person on each of the two right-hand side variables in equation (1) separately. A regression of Prod/Pop on RA/Pop gives an R^2 of 0.78, while a regression of Prod/Pop on Prod/RA gives an R^2 of just 0.03.

Figure 4. Rice yield, ASEAN countries



Notes: Data are averages for 2008-2010. Raw data from FAO (2013) and USDA (2013).

[6] Yields are also influenced by the type of varieties sown. It should be noted that lower yielding (but high value) fragrant rice leads to lower yields for both Thailand and Cambodia.

Thus, to summarize so far, rice self-sufficiency is largely determined by rice production per person. The top five countries according to this metric are all exporters, while the bottom three are all importers. Rice production per person in turn is determined by rice area harvested per person. But why is rice area harvested per person different in different countries? In order to explore that relationship further, the following identity is helpful:

$$\frac{RA}{POP} = \frac{RA}{TCA} * \frac{TCA}{AA} * \frac{AA}{LA} * \frac{LA}{POP} \qquad (2)$$

Where:
RA = Rice Area harvested
TCA = Total Crop Area (sum of area harvested for all crops)
AA = Agricultural Area (land under annual agricultural crops, perennial agricultural crops, or permanent meadows and pastures; this measure counts multiple cropped areas only once)[7]
LA = Land Area (total area of the country excluding area under inland water bodies)
POP = Population

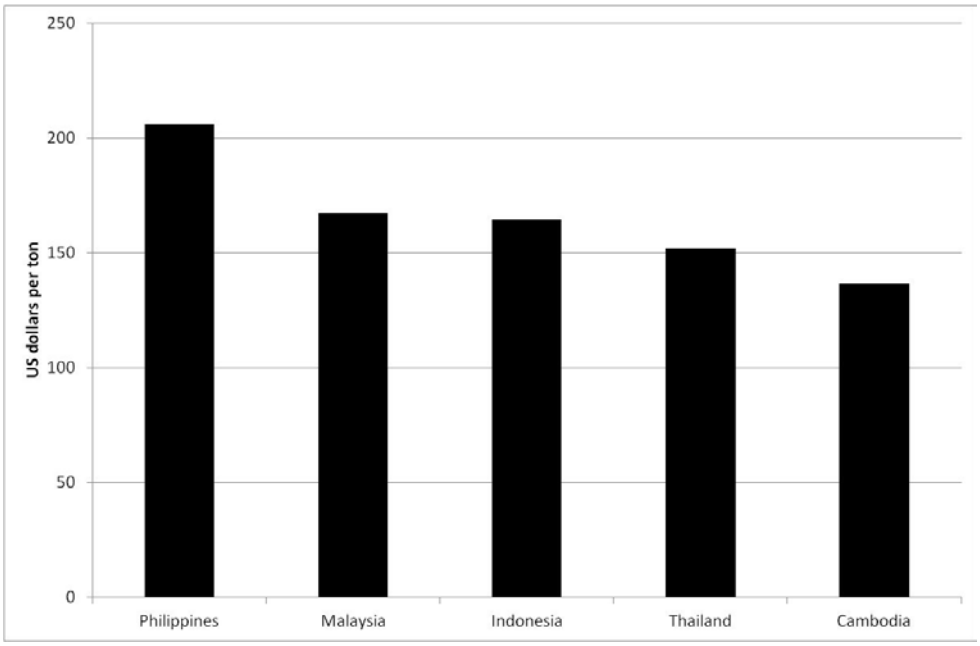
The ratio of rice area harvested to the area harvested of all crops is a measure of the suitability of crop land to growing rice (thus, it is labelled 'suitability for rice' in Table 1). Countries on the mainland of Southeast Asia have high percentages of crop area devoted to rice (ranging from 41 to 76%), while island and peninsular countries (Malaysia, Indonesia and the Philippines) have more diversified cropping patterns, with rice area being 33% at most. Because rice grows best with ample supplies of easily controllable water, these figures are consistent with the presence of dominant river deltas (many of them originating in the Himalayas) on the mainland, and the absence of such in archipelagic and peninsular countries.

The ratio of rice area harvested to area harvested for all crops is admittedly an imperfect measure of the suitability of land for growing rice, as government price policies can encourage farmers to grow rice in areas where the land is more suited for other crops. However, rice prices are highest in the importing countries, at least partially due to the import

[7] For more details on the definitions of AA and LA, see http://faostat3.fao.org/home/index.html#METADATA_GLOSSARY

restrictions in place in each of the three importing countries (Figure 5).[8] Thus, the measure shown in column (1) of Table 1 actually understates the difference between importing and exporting countries – were it not for active price policy in the importing countries, the proportion of total crop area harvested to rice would be even lower in those countries.[9]

Figure 5. Average nominal domestic paddy prices, farm level, 1991-2006.



Source of raw data: FAO (2013).

Note: Lao PDR, Myanmar and Viet Nam excluded due to lack of data.

The ratio of total area harvested for all crops to agricultural area gives a measure of cropping intensity. Because the numerator counts multiple cropped areas multiple times, while the denominator is a measure of physical area and counts multiple cropped areas only once, the ratio can be greater than one, and in fact it is in Myanmar, the Philippines and Viet Nam. The pattern across countries on this measure is less obvious, although there is a slight ($p = 0.19$; not statistically significant at conventional levels) negative correlation with the measure in the final column of Table 1 (discussed below).

[8] Even in the absence of government price policies, domestic prices would tend to be higher in importing countries because exporting countries must incur transport costs to move rice to importing countries. Thus, the latter group receives some degree of "natural" price protection.

[9] In recent years, farm prices in Thailand have increased substantially, so that they are now much closer to farm prices in importing countries. However, Thailand has been exporting rice for hundreds of years; its status as an exporter is not due to the recent level of high prices. Indeed, ironically, the high prices have increased production but depressed exports as the Thai government is reluctant to openly export supplies at a large loss.

The ratio of agricultural area to country land area compares two measures of physical area, so this ratio must be less than one. This ratio is more difficult to label in terms of giving it an appropriate name. In one sense, it is a measure of the suitability of a country's land for agriculture in general (thus it is labelled 'suitability for cropping' in Table 1), but it is also a measure of intensity, as population pressure could force agriculture into marginal areas. Indeed, the correlation of this measure with (the inverse of) population density (the fourth column of numbers in Table 1) is strongly negative at -0.87 ($p < 0.01$). Some of this correlation is due to the fact that country land area is in the numerator of one value and in the denominator of the other value, but this does not in and of itself guarantee a high negative correlation (the correlation coefficient between the numbers in columns (2) and (3), with agricultural area in the numerator of one and in the denominator of the other, is actually +0.25).

Finally, in column (4), the ratio of land area to population is the inverse of population density – higher values indicate lower population density and lower population pressure.

Table 1. Various components of rice area harvested per person

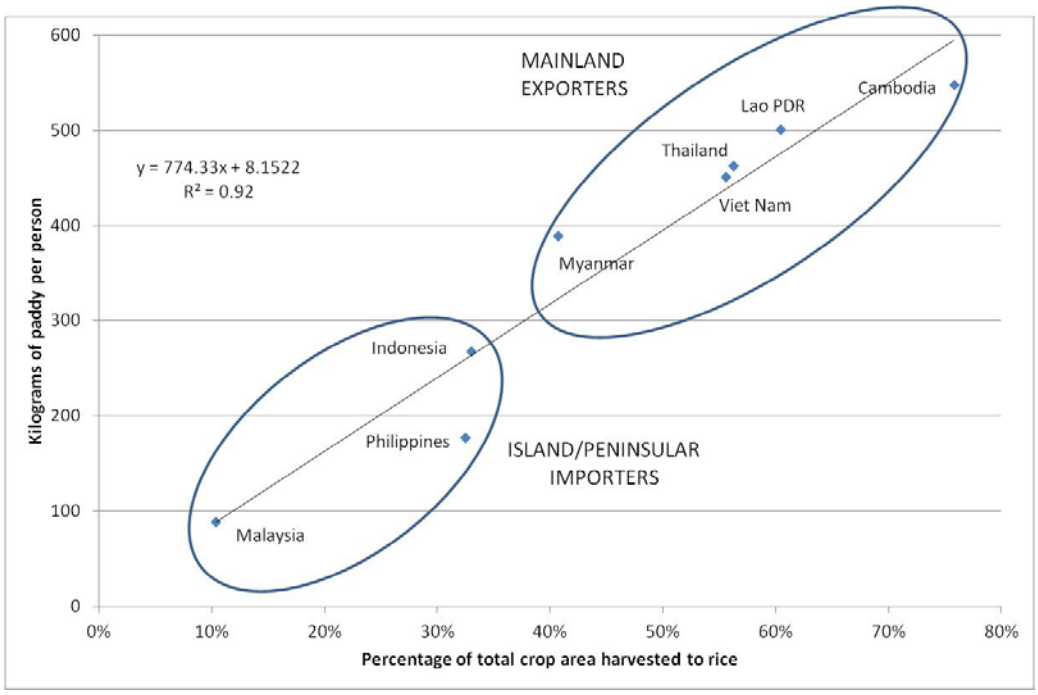
	RA/TCA Suitability for rice	TCA/AA Cropping Intensity	AA/LA Suitability for agriculture	LA/POP Inverse of Population pressure
	(1)	(2)	(3)	(4)
Cambodia	76%	0.64	0.31	1.26
Indonesia	33%	0.72	0.30	0.76
Lao PDR	60%	0.58	0.10	3.78
Malaysia	10%	0.82	0.24	1.18
Myanmar	41%	1.46	0.19	1.37
Philippines	32%	1.15	0.40	0.33
Thailand	56%	0.98	0.39	0.74
Viet Nam	56%	1.31	0.33	0.36

For ASEAN as a group, how do these four factors explain rice area harvested per person? Of the four components, the share of rice area harvested in total crop area harvested has by far the most explanatory power. The R^2 of a regression of RA/POP on RA/TCA is 0.74, while the R^2 of a regression of RA/POP on each of the other three variables individually never reaches

more than 0.11. Even regressing RA/POP on the other three variables jointly gives a negative adjusted R^2 (compared to an adjusted R^2 of 0.70 for RA/TCA).

To summarize once again, rice production per person is primarily determined by rice area harvested per person (not yield), and rice area harvested per person is in turn determined primarily by the share of rice area harvested in total crop area harvested. Combining these two observations, a scatter plot of rice production per person versus RA/TCA shows a very high R^2 of 0.92 (Figure 6).

Figure 6. Rice production per person versus share of crop area devoted to rice, ASEAN countries

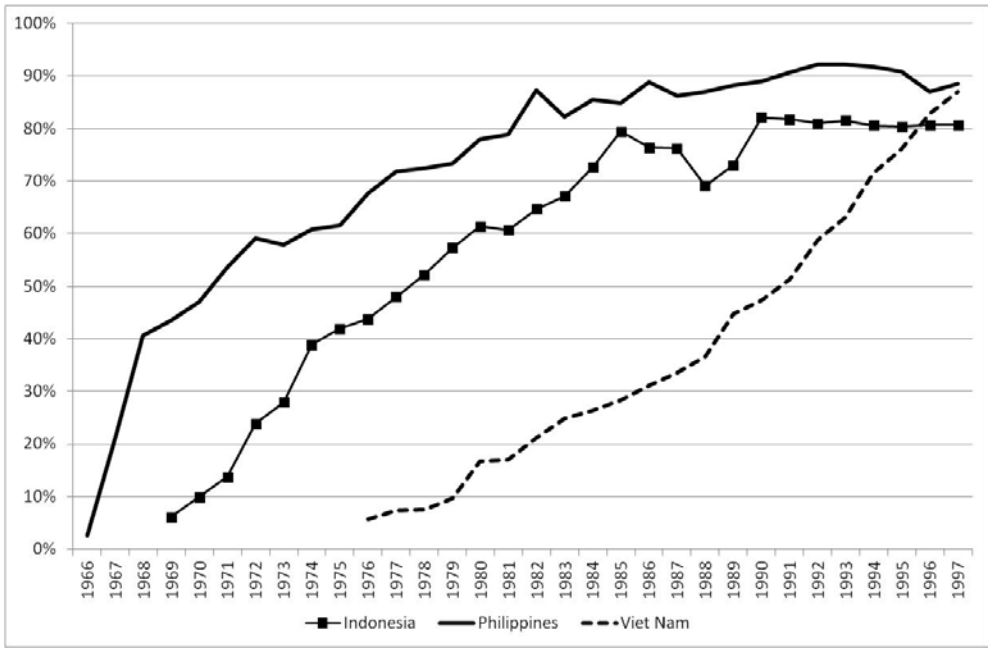


Notes: Data are averages for 2008-2010. Raw data from FAO (2013).

Given these natural disadvantages, how did the Philippines and Indonesia become self-sufficient in rice for a short period of time in the early 1980s? Basically, it was the early adoption of a game-changing technology – the Green Revolution – that increased yields and cropping intensity. During the Green Revolution, the earliest adopters of the modern varieties were traditional importing countries such as the Philippines and Indonesia, while traditional exporters such as Viet Nam adopted the modern varieties much later (see Figure 7). Adoption was probably earlier in the importing countries for several reasons, including more receptive policies and induced innovation. Furthermore, in the case of the Philippines, closer

geographic proximity to the source of the new seeds likely also played a role (the International Rice Research Institute is located in the Philippines).

Figure 7. Adoption rates of modern varieties in selected countries, 1966–1997



Source of raw data: IRRI (2013b).

What about the future? Will history repeat itself? Given the interconnected nature of today's world, it seems less likely that a breakthrough technology will be confined to a small group of countries. It is possible that climate change might lead to major changes in glacial melt in the Himalayas, thus affecting the river deltas on the mainland but not the archipelagic and peninsular rice economies. On the other hand, the new submergence tolerant varieties with the sub1 gene are, within Southeast Asia, more likely to benefit exporters than importers, as deepwater rice environments have historically been more common in mainland countries than in archipelagic or peninsular nations (Huke and Huke, 1997).

4. CONSEQUENCES OF THE DRIVE TO SELF-SUFFICIENCY

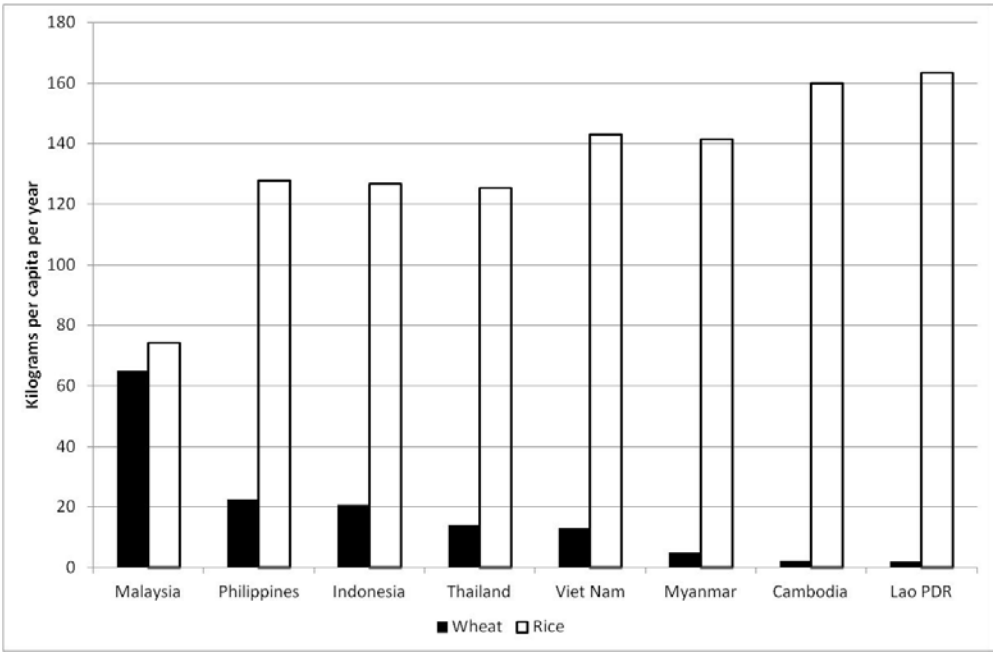
The strong desire of the traditional rice-importing countries to reduce reliance on the world market and achieve self-sufficiency has had several important consequences. First, domestic prices in the rice-importing countries tend to be higher than in the rice-exporting countries (see Figure 5 earlier). These higher prices are the direct result of trade restrictions on rice – the governments of Indonesia, Malaysia and the Philippines all restrict the quantity of rice

imports that are allowed. Higher domestic prices encourage production and discourage consumption, both of which reduce imports and thus reliance on the world market.

Second, higher domestic prices, coupled with the relative shortage of land suitable for growing rice, has led to more irrigation and higher rice yields than in the rice-exporting countries, as shown above.

Third, higher prices have encouraged diversification of staple foods, with lower rice consumption and greater wheat consumption in the importing countries than in the exporting countries (Figure 8). Some of the greater consumption of wheat in the rice-importing countries may be due to higher per capita incomes in the importers than in the exporters, but note that Thailand, with a higher per capita income than either Indonesia or the Philippines, eats less wheat.

Figure 8. Per capita rice and wheat consumption, 2007-2009, ASEAN countries



Source of raw data: FAO (2013)

Fourth, the higher domestic prices in the importing countries increase poverty rates. While there is no available evidence on this account for Malaysia, there is ample evidence that higher rice prices increase poverty and malnutrition in both Indonesia (Block et al, 2004; McCulloch 2008) and the Philippines (Balisacan 2000; Dawe et al, 2006). In both of these latter two countries, there are more net buyers of rice than there are net rice sellers, especially

at the bottom of the income distribution. In addition, a large proportion of the net sellers (those who benefit from higher prices) are relatively well-to-do: in the Philippines, Dawe et al (2006) estimated that the wealthiest 40 percent of rice farm households account for two-thirds of the marketed surplus.

5. CONCLUSIONS

In terms of achieving rice self-sufficiency, island countries have a natural disadvantage. Less of their land is suited to growing rice, and as a result they cannot compete at the margin with the mainland rice exporters. On the best land, operating with the best technology, farmers in different countries are relatively similar. But importing countries simply have less of that land than do the exporting countries.

Should importing countries try to mimic the exporting countries and increase the proportion of cropped area devoted to rice? The problem with such a strategy is that there is a very good reason why fewer farmers grow rice in the importing countries – namely, other crops are more profitable. Forcing farmers to grow rice will reduce their incomes, which will work against household food security.

Thus, the importers face a trade-off between national self-sufficiency (which is often equated with national food security) and household food security. If they restrict imports to achieve national self-sufficiency and reduce reliance on the world market, this policy raises domestic prices, which in turn reduces household food security because most of the poor have to buy their rice on markets and are hurt by higher prices. Higher domestic prices also result in other costs, such as reduced farm diversification, poorer nutrition and reduced competitiveness in other sectors of the economy to the extent that higher rice prices lead to higher wages (Dawe et al, 2006).

Both Indonesia and the Philippines have attempted to cope with some aspects of this dilemma (i.e. the increased poverty rates) by implementing rice distribution programs through the respective state food agencies, but these programs have many difficulties and have been a drain on fiscal resources (Olken 2006; Clarete 2008; Jha and Mehta 2008).[10] In conclusion,

[10] The Philippines has been experimenting with a new program (*Pantawid Pamilyang Pilipino Program*) that provides conditional cash transfers instead of rice subsidies. Experience to date has been encouraging (Velande and Fernandes, 2011).

the food security and nutrition dilemmas created by the drive to achieve rice self-sufficiency have not been satisfactorily resolved.

REFERENCES

Arezki R, Bruckner M. 2011. *Food prices and political instability*. International Monetary Fund Working Paper 11/62. Washington, DC, International Monetary Fund.

Balisacan A. 2000. *Growth, inequality and poverty reduction in the Philippines: a re-examination of evidence*. University of the Philippines, Quezon City.

Block S, Kiess L, Webb P, Kosen S, Moench-Pfanner R, Bloem MW, Timmer CP. 2004. Macro shocks and micro outcomes: child nutrition during Indonesia's crisis. *Economics and Human Biology*, 2(1): 21–44.

Clarete, Ramon L. 2008. Options for Philippine Food Authority Reforms. *In* Rashid, Shahidur, Ashok Gulati and Ralph Cummings Jnr., *From Parastatals to Private Trade*, IFPRI and John Hopkins University Press, Baltimore.

Dawe D. 2008. 'Can Indonesia still trust the world rice market?,' *Bulletin of Indonesian Economic Studies*, 44(1):115-132.

Dawe D, Moya P, Casiwan C. (eds.). 2006. *Why does the Philippines import rice? Meeting the challenge of trade liberalization.* Manila (Philippines): International Rice Research Institute, and Science City of Muñoz (Philippines): Philippine Rice Research Institute. 166 pp.

Dawe D, Pandey S, Nelson A. 2010. 'Emerging trends and spatial patterns of rice production,' Chapter 1.1 in *Rice in the Global Economy: Strategic Research and Policy Issues for Food Security*. Pandey S et al, eds., International Rice Research Institute.

Eliste, P, Santos N. 2012. Lao *People's Democratic Republic Rice Policy Study*. FAO, World Bank, IRRI.

FAO, IFAD & WFP. 2011. *State of Food Insecurity in the World: How does international price volatility affect domestic economies and food security?* Rome.

FAO. 2013. FAOStat online. http://faostat3.fao.org/home/index.html#DOWNLOAD

Hayami Y, Ruttan V. 1985. *Agricultural Development: An International Perspective*. The Johns Hopkins University Press. Baltimore. 506 pp.

Huke, R.E., and Huke, E.H. 1997. Rice area by type of culture: South, Southeast, and East Asia, Database, International Rice Research Institute, Manila.

IRRI (International Rice Research Institute). 2013a. Rice production and processing. Webpage, accessed 9 May at http://www.irri.org/index.php?option=com_k2&view=item&layout=item&id=9151&lang=en.

IRRI (International Rice Research Institute). 2013b. World Rice Statistics online, accessed May 9 at http://irri.org/index.php?option=com_k2&view=itemlist&task=category&id=744&Itemid=100346&lang=en

Jha, Shikha & Aashish Mehta. 2008. *Effectiveness of Public Spending: The case of rice subsidies in the Philippines*. ADB Economic Working Paper Series, 138, Asian Development Bank, Manila.

McCulloch N. 2008. Rice prices and poverty in Indonesia. *Bulletin of Indonesian Economic Studies* 44(1): 45-64.

Olken, B. 2006. Corruption and the costs of redistribution: Micro evidence from Indonesia. *Journal of Public Economics* 90, pp. 853-870.

Pingali, PL, Vo Tong Xuan. 1992. Vietnam: De-collectivization and Rice Productivity Growth. *Economic Development and Cultural Change* Vol. 40 No. 4, pp. 697-718.

Rapsomanikis G, Sarris A. 2008. Market integration and uncertainty: the impact of domestic and international commodity price variability on rural household income and welfare in Ghana and Peru. *Journal of Development Studies*, 44(9): 1354–1381.

Reardon T, Chen K, Minten B, Adriano L. 2012. *The Quiet Revolution in Staple Food Value Chains*. Asian Development Bank.

Rose, B. 1985. *Appendix to The Rice Economy of Asia*. Resources for the Future, Washington DC, 404 pp.

USDA (United States Department of Agriculture). 2013. Production, Supply and Distribution online. Available at: http://www.fas.usda.gov/psdonline/psdquery.aspx

Van der Eng, P. 1996. *Agricultural growth in Indonesia: Productivity Change and Policy Impact since 1880*. St. Martin's Press, New York.

Van der Eng, P. 2004. Productivity and Comparative Advantage in Rice Agriculture in South-East Asia since 1870. *Asian Economic Journal* 18(4): 345-370.

Velande, R. and Fernandes L. 2011. *Welfare and distributional impacts of the Pantawid Pamilyang Pilipino Program*. Social Protection Note No. 63418, World Bank and Australian Aid, Manila.