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A Revolution in Indonesian Agriculture? A Long-Term View on Agricultural Labour Productivity

Abstract

Labour productivity is a more reliable indicator for the development of rural income than per capita rice production. Taking Engels' law as a starting point, it is shown that up to 1970 labour productivity in food agriculture hardly increased but this did not imply economic stagnation. Off-farm income was and still is an important source of rural income, integrating the household and market economies. Labour productivity as a whole increased due to growing production of cash crops. The Green Revolution in rice agriculture was foremost caused by a re-allocation of labour, whereas since 1970 the high opportunity cost of labour has caused a further shift towards off-farm income opportunities.

1. Introduction [1]

A 'Green Revolution' has swept through Asian rice agriculture during the past three decades. Its success is generally measured in terms of land productivity, in particular gross rice yields per harvested hectare. The adoption of Green Revolution technology has indeed raised land productivity considerably in many land-scarce areas in Asia. Indonesia has been no exception to these dramatic changes. Rice yields per hectare, which had long been stagnant, have risen during recent decades (Van der Eng, 1994b).

The long stagnation of rice yields in Indonesia's core island of Java has been interpreted as an indication of stagnation in per capita rural income. Rice has always been the main food crop in Indonesia, which may be a reason that per capita rice production is used as an indicator of rural income. But this glosses over the role of non-rice food crops. It also ignores the fact that the income elasticity of demand for food decreases during a process of economic development. Perhaps the most important omission is the fact that not land productivity but labour productivity is the key factor in a process of economic development.

This article assesses the evidence available about long-term changes in agricultural labour productivity in Indonesia in order to address the question of whether the absence of a Green Revolution in Indonesian rice agriculture up to 1970 can be taken as an indication of economic stagnation.

2. A two-sector model of the economy

This section provides a very brief explanation of the relevance of analysing changes in agricultural labour productivity on the basis of a neo-classical two-sector economy model. The transformation of the structure of production and employment are two of the most basic stylized facts in economic growth (Kuznets, 1966; Johnston, 1970). During this process the share of agriculture in total production and employment falls. In a closed economy, this can be explained on the demand side by Engel's Law (cf. Warr, 1992). The law dictates that when income increases, individuals or households will spend a declining share of their income on food, and therefore on agricultural products. Engel's Law is valid for individuals, households and countries alike. An increase in average income and a decline of the share of expenditure on agricultural products necessarily denotes a decline in the share of agriculture in total production.

Assuming that production in all economic sectors grows at the same rate ('balanced growth'), Engel's Law implies on the supply side of the economy that an increasing average income generates a fall in the price of agricultural commodities relative to the price of non-agricultural goods and services, because of the decline in the relative demand for agricultural products. Increasing average income therefore generates a decline in the terms of trade of agriculture. This leads the agricultural sector to shed resources, in particular labour and capital, because the returns on the productive use of these resources in agriculture will decrease relative to their use outside agriculture. The pace at which labour and capital will be discarded will depend on the difference in marginal returns, or the opportunity cost of productive resources used in agriculture.[2] The transfer of labour out of agriculture will have to be accompanied by an increase in agricultural labour productivity. If not, food supply per capita will be impaired, thus improving the terms of trade of agriculture and reversing the process.

3. Labour productivity in Indonesian agriculture and economic stagnation

Detailed estimates of productivity in Indonesian agriculture since 1880 will soon become available (Van der Eng, 1993a). These include estimates of value added

[2] Without further discussion, it is postulated that developing countries with very low labour productivity do not experience 'backward bending supply curves' of labour. Joosten has refuted this incongruous perception (Joosten, 1960).

per worker. The procedures used to obtain these estimates will not be discussed here but it should be pointed out that the estimates of total value added cover 70–75 per cent of total agricultural production in Indonesia in 1971 and 1980. For instance, vegetables and fruits are omitted, because of the absence of data on which to base long-term estimates. Fragmented evidence suggests that the growth of the production of vegetables, fruits and other products with a relatively high value added has accelerated only relatively recently. It is therefore very likely that the trend in the total real value of the products covered reflect the trend in total agricultural production.

Figure 1 contains the evidence available about changes in labour productivity in Indonesia for the century between 1880 and 1990. The chart distinguishes between the Indonesian core island of Java and all the other islands together, and between total agricultural production and food agriculture only. The first distinction is made for two reasons. Statistically, the estimates of food production in the Outer Islands are informed guesstimates up to 1952, obtained from assumptions about average food consumption and population growth, whereas the data on food production in Java have a much stronger statistical base. Demographically, the population density in Java has always been very much higher than in the Outer Islands. This has significant consequences for the choice of products and production technology in each area. For instance, land-scarce Java relies much more on irrigated rice production than the rest of the country. Lumping both parts of the country together impedes an adequate interpretation.
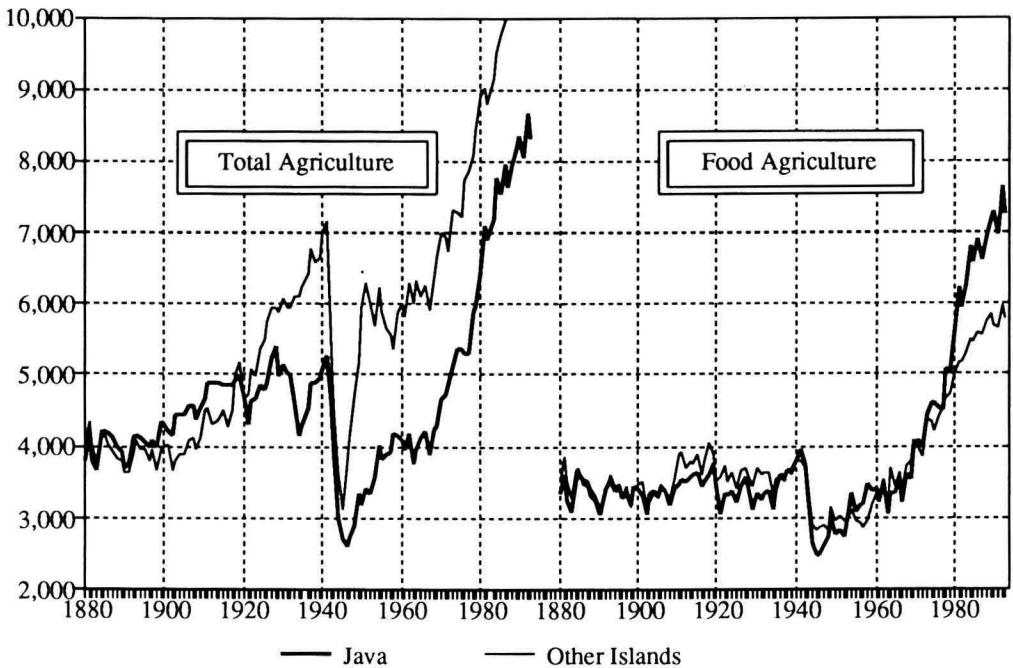

Figure 1. *Gross Value Added per worker 1880–1990.*

The sector 'food agriculture' is defined as value added from food production (rice, maize, cassava, sweet potatoes, soyabeans and peanuts) and animal husbandry. Total agricultural production includes 'food agriculture' and value added from the production of cash crops and plantation crops (coffee, copra, palm oil, rubber, sugar, tea and tobacco). The reason is the distinction between 'food agriculture' and total agricultural production is that the first can be regarded as an approximation of subsistence agriculture, given that Indonesia's foreign trade in food products has always been small relative to total food production. Cash crops and plantation crops were to a large extent, but not exclusively, produced for export. In that sense they do not fit the two-sector economy model, which regards agricultural producers as mere suppliers of food products.

Although the output data differentiate between food agriculture and cash cropping, the data on employment in agriculture do not. This is an almost impossible task, as is explained below (sections 5 and 6). On the whole, the error which is introduced by not differentiating employment is very small and hardly affects the trends in both parts of Figure 1.

As explained above, long-term changes in labour productivity in agriculture may be taken as indications of the rate of structural change in the Indonesian economy at large. Looking at the right hand panel of Figure 1 first, it is obvious that up to 1970 labour productivity in food agriculture changed only marginally and does not show any trend in either direction. The main break in the series concerns the 1940s, and was largely due to the fateful impact of the Japanese occupation (1942–1945) and the war of Independence (1945–1949) (Van der Eng, 1994c). Details about crop failures and food policies can shed light on other small changes. The main characteristic in the chart is that labour productivity in food agriculture did not increase until after the onset of the Green Revolution in Indonesian rice agriculture. The situation is not much different for either Java or the Outer Islands. The gap in labour productivity widened only after 1980, possibly because of a decline in the relative profitability of rice production in the Outer Islands.

With reference to the previous section, the righthand panel of Figure 1 suggests that growth and structural change in the Indonesian economy at large stagnated until the 1970s. Additional evidence is obtained from Table 1, which contains data on the changes in the structure of employment over 60 years. Before the 1970s, 70–85 per cent of males or females were occupied in the agricultural sector. The data on female employment are not entirely comparable. The crude activity rates may indicate that female participation was underreported, in particular in 1930 and 1961. There are no reasons to assume that male employment in agriculture was very much higher than the 70–80 per cent indicated before the 1970s. Only in the most destitute contemporary developing countries is the share of agricultural employment around 90 per cent (Human Development, 1992: 159). By 1930 Indonesia was very probably beyond that stage of development (Van der Eng, 1994a).

There is certainly no reason to assume that the shares of both female and male agricultural employment were lower than indicated before 1930. Fernando

Table 1. *Sector shares in employment, 1930–1990.*

	1930	1961	1971	1980	1990
MALES					
Java:					
Agriculture	74.4[b]	71.2	62.5	52.6	46.5
Industry[c]	1.6	9.1	10.7	15.3	20.2
Services	14.0	19.7	26.8	32.1	33.3
Crude activity rates	53.1	50.5	45.7	48.9	49.3
Outer Islands:					
Agriculture[a]	81.0[b]	79.9	73.6	65.5	61.8
Industry[c]	9.6	5.3	6.8	10.0	11.8
Services	9.4	14.8	19.6	24.5	26.4
Crude activity rates	46.6	48.3	43.4	43.7	46.5
FEMALES					
Java:					
Agriculture[a]	72.9[b]	64.3	58.0	46.6	42.7
Industry[c]	12.6	9.4	13.2	15.2	17.9
Services	14.5	26.2	28.8	38.2	39.5
Crude activity rates	17.9	18.2	22.5	23.8	27.0
Outer Islands:					
Agriculture[a]	79.0[b]	84.4	78.5	68.1	61.9
Industry[c]	12.1	6.6	8.6	9.3	10.5
Services	8.8	9.0	12.9	22.6	27.6
Crude activity rates	18.2	17.7	20.2	20.8	26.4

Notes:
a) Includes fisheries and forestry.
b) Includes 'insufficiently definable occupations'.
c) Includes mining and construction.

Sources:
Volkstelling, 1936: vol. 8, table 18; Hugo, 1987: 263–264; Penduduk Indonesia, 1992.

estimated that 76.4 per cent of Indonesian males in Java was occupied in agriculture in 1880 (Fernando, 1993: 101). Estimates for the total male population in Java for 1895, 1900 and 1905 suggest 81–83 per cent (Van der Eng, 1993a: 29). The data on male employment in particular indicate that the share of employment in agriculture did not start to fall significantly until after 1961, presumably since the late 1960s. Before the 1970s the share of employment in agriculture was most likely stagnant at a high level, which is not indicative of major structural changes in the economy at large.

4. Indicators of economic growth in Indonesia

This evidence of economic stagnation hardly fits the image of a country which is known to have been relatively successful in the development of its foreign trade since the nineteenth century (Van Ark, 1988; Booth, 1992). Does stagnant labour productivity in food agriculture indeed imply overall economic stagna-

tion until the 1970s? A comparison of both panels of Figure 1 immediately indicates that this was not necessarily the case. Sections 5 and 6 will elaborate on the point in more detail, but it should be made clear that farmers were not only engaged in the production of food crops but also in the production of cash crops, while some even worked on plantations at times. Hence, the left hand panel of Figure 1 is a more adequate approximation of changes in rural income. This panel suggests a much more dynamic change in rural Indonesia, based on the increasing production of cash crops and plantation crops, which apparently was not detrimental to labour productivity in food production.

Without going into details, the growth of labour productivity in Java before World War II was largely due to the rapid growth in the production of sugar-cane and sugar, just like the stagnation until 1970 was to a large extent caused by the demise of sugar production in Java. The pre-war growth of agricultural labour productivity in the Outer Islands was almost exclusively due to the growth of rubber production by both smallholders and plantations, just like the stagnation until 1970 was to a large extent caused by the stagnation in rubber production. Sugar was produced mainly for export until the 1940s, while the bulk of the rubber has always been produced for export. Both products were Indonesia's main export commodities until petroleum took over in the early 1970s, followed by manufactured goods in the 1980s.

It is difficult to provide conclusive quantitative evidence to indicate the rate of growth and structural change in the Indonesian economy. Table 1 includes tentative estimates of real Gross Domestic Product (GDP) per capita. These estimates are necessarily rough, largely because the statistical sources available contain little information on the 'informal' economy, in particular the overall value of trade and transport services. For this reason Table 2 includes several other indicators of economic change in Indonesia (Booth, forthcoming).

Some indicators may raise more questions than can be answered here. Some seem ambiguous. For instance, the enormous post-war falls in boat and rail passenger transport seem to indicate economic decline, rather than advance. This is easily explained by the exuberant growth of motorized road transport. But on the whole the indicators support what is evident from the GDP estimates: the Indonesian economy has experienced dynamic economic change for more than a century. A broad periodization indicates that 1900–1929 and 1970–1985 were both periods of economic expansion, while 1880–1900 and 1929–1970 were periods of stagnation. This periodization conceals major short-term changes within each period, but it serves to refute suggestions that per capita economic growth was close to zero until the 1970s.

Given that most goods and services were produced in the rural economy, there appears to be a major contradiction between the evidence of overall economic growth in Table 2 and the evidence indicating economic stagnation discussed in section 3. One possible explanation is that economic growth did not benefit those Indonesians who depended on indigenous agriculture, or who were working on Western enterprises, because the 'economic surplus' produced in the economy was 'drained' as a consequence of the colonial status of Indonesia.

Table 2. *Indicators of economic change in Indonesia, 1880–1985.*

	1880	1900	1913	1929	1940	1950	1970	1985
Gross Domestic Product (thous. 1983 rupiah per capita)	174	184	227	283	268	218	252	466
Food supply (kcal per capita)	1,594	1,608	1,954	1,920	2,132	1,670	1,816	2,461
Children at primary schools (per 100,000)	334	407	1,406	2,713	3,352	1,897	11,883	15,901
Haji (per 100,000 muslims)	201	282	426	608	464	291	260	486
Bicycles and motor cycles (per 100,000)	0	7	272	1,004	994	429	2,629	4,234
Postal items (per 100 people)	18	43	87	145	155	174	192	319
Credit (1929 guilders, per 1,000)	-	9[a]	1,384	4,287	2,533			
Imported textiles (tons per 100,000)	66	103	188	271	174	-	-	-
Domestic boat passengers (per 100,000)	309	454	1,336	2,180	736	808	-	566
Railway passengers (per 100)	9	87	215	245	133	82	31	19
Registered motor vehicles (per 100,000)	-	-	-	117	81	76	314	1,258

Notes:
a) 1902
About 85–90 per cent of Indonesia's population were Muslim. The stock of *haji* after 1893 was calculated by adding annual arrivals in Jeddah to the stock in the previous year, assuming a 4 per cent mortality rate. The number of bicycles and motor cycles is calculated as the cumulative number of imported bicycles and motor cycles only, assuming a working life of 20 years. For 1900–1914 the quantity of imported bicycles was estimated at the total value of imported bicycles and the 1915 unit price of bicycles. Credits refer to loans from government controlled village banks and pawnshops, deflated by an index of retail prices. For 1880–1914 the quantity of imported textiles was estimated with the value of textile imports and the 1915 unit price, which was linked for 1880–1914 to the price of *madapolam* and *calicot* from the Netherlands. Boat passengers are passengers on KPM and PELNI liners. Food supply is calculated with main food products only and refers to Java for 1880–1950. Food supply and GDP per capita are three-year averages of which the first year is given.

Sources: Calculated from: Koloniaal Verslag, 1880–1913; Statistisch jaaroverzicht, 1922/23–1929/30; Statistiek Indonesia, 1993. Population, GDP and retail price index from: Van der Eng, 1993a: 267–272, 297–305; Van der Eng, 1992. Food supply figures from: Van der Eng, 1993c; Textile prices from: Historische prijzen, 1938.

Some 'drain' cannot be denied, but on the whole the 'colonial drain' hypothesis falls short as an explanation of economic underdevelopment (Van der Eng, 1993d). Rather than dismiss the evidence on overall economic growth, the apparent discrepancy between the evidence of dynamic economic change and economic stagnation in Indonesia, requires a reconsideration of the model outlined in section 2.

5. Agricultural income and rural income

The two-sector model (section 2) has two main weaknesses. First, it fails to take account of the seasonality of agricultural labour and the importance of off-farm income for agricultural households. Second, it ignores the interaction between the market economy and the household economy.

Unlike most non-agricultural employment, agricultural employment is highly seasonal. This means that the marginal productivity of labour in agriculture rises very significantly during the main cropping season, especially during the preparation of the fields and during the harvest (Collins, 1974; Oshima, 1987). This seasonal rise makes it unlikely that workers will leave agricultural production entirely, as soon as the terms of trade of agriculture start to fall.

The two-sector model does not take into account the fact that agricultural production is usually not the only activity determining the total income of farm households (Usher, 1966). Although agricultural households have their base in the production of food for subsistence or cash crops for the market, they are also engaged in a wide variety of occupations. It is therefore difficult to take labour productivity in agriculture as an indication of the income of rural households in general, or to assess the specialization of labour and the shifts in the occupation structure with employment data in early stages of development.

Rather than leave agricultural production, it is more likely that farm households will first seek to off-set the widening gap in labour productivity between agriculture and non-agriculture, while maintaining their livelihood base in agricultural production (cf. Ohkawa, 1989). The increasing gap implies a growing opportunity cost of labour, which challenges such households to divert available labour away from activities within the household to activities which yield higher returns on labour. Small agricultural savings are used during the off-season to grasp off-farm income opportunities in a range of activities, such as processing and marketing of agricultural products, petty trade and cottage industry. This suggests that the importance of off-farm income in the budget of agricultural households will increase with the fall in the terms of trade of agriculture. There is another side to this process. People who do drop out of the agricultural sector may well continue to work as wage labourers in agriculture during the harvest season of particular crops, when the marginal productivity of such labour rises above the current wage rate outside agriculture. The extent to which the possible substitution of household labour for wage labour affects this re-interpretation is beyond the scope of this article.

Some farm households will optimize the use of available labour by increasing the hours worked per arable hectare in order to expand agricultural production per worker and increase their marketable surplus. Multiple cropping of irrigated land is one technique which facilitates such an increase. Other households will decrease the hours worked per crop by employing simple capital-extensive technological improvements, such as hand tools with a higher working capacity. Average crop yields and production per worker per crop will remain the same, but time is saved for productive use in off-farm activities.

This indicates that decisions about labour allocation within rural households are related to changing circumstances and growing opportunities in the market. Such change affects the decision to re-allocate labour to activities producing a marketable surplus. But it will also affect the decision to re-allocate labour to activities within households for subsistence production. After all, even subsistence households are engaged in a wide range of activities, apart from food production.

It is only at a later stage that the growing gap in marginal productivity of labour in and outside agriculture will put such pressure on the labour resources of farm households that two further effects are generated. First, members of farm households will be encouraged to abandon agriculture altogether in order to specialize in non-agricultural production. Second, other members will start to concentrate their efforts on agricultural production, using more capital-intensive, labour-saving technologies to increase labour productivity and bridge the productivity gap between agriculture and non-agricultural production. In a more advanced stage of economic development the importance of off-farm labour will therefore decline.

Hence, the historical process of economic development involves more than the mobilization of redundant labour, as some two-sector models of development sometimes suggest (Lewis, 1954). Judging from the contemporary situation in many developing countries, even self-sufficient farm households are generally occupied full-time in the production of other goods and services for consumption by the members of the household or local community. One major neglected element is the likely shift from inferior methods of home production to superior methods with a higher labour productivity, based on specialization of production and on the exchange of goods.

The dynamic role of the farm household in the wider economy is acknowledged by social scientists studying contemporary developing countries. A body of research substantiates the claim that goods and services produced in households contribute significantly to total produce available for consumption in both developed and developing countries (Goldschmidt-Clermont, 1985; 1987). Research on both the theoretical relevance and the practical evidence of the household economy continues (Quah, 1989). Likewise, the volume of contemporary research into the relevance of off-farm income to Asian agricultural households has grown considerably recently (Shand, 1986). But the body of historical research on the dynamic interaction of household and market economies during long-term processes of economic development is small (cf. Snooks, 1994). Given the paucity of readily available data on this point for Indonesia, much of the following section can be only tentative.

6. Taking up a labour slack or re-allocation of farm household labour?

The preceding discourse leaves three questions to be addressed in the Indonesian context. First, what was the relevance of off-farm income to farm households?

Second, to what extent did agricultural households mobilize unused labour for productive purposes? Third, to what extent did a re-allocation of farm household labour take place, *i.e.* to what extent was household labour indeed directed to more efficient uses?

Like many other aspects of Indonesian economic history, the role of off-farm labour in the rural economy and the role of off-farm income in farm households is a neglected area of research. Recent historical research stresses the fact that the rural economy did not consist of an amorphous mass of small farmers, but was in fact far more diversified than the older literature suggested (Alexander & Alexander, 1990; Boomgaard, 1991). Although this correction of existing stereotypes is very useful, this research has stressed the relevance of non-farm employment in the rural economy, not the role of off-farm income opportunities.

Historical research on off-farm income is still piecemeal. Although the available evidence is largely qualitative and fragmented, Fernando's research especially suggests that income from off-farm employment was significant in late-colonial Java (Fernando, 1986; 1989). Research into the contemporary situation confirms the relevance of off-farm income in total farm income, although there is disagreement over the question of whether wage rates in agriculture are higher than earnings from other jobs in rural areas (Rietveld, 1986; White, 1991). Perhaps this dispute is caused by the fact that agricultural wages are paid largely during the main cropping season, when farmers jockey to attract wage labour. Non-agricultural jobs are available throughout the year and earnings tend to be less subject to seasonal fluctuations.

There is little evidence to suggest that farm households specialized in agricultural production. Even in 1983/84 farm households engaged in the production of lucrative cash crops did not specialize (Table 3). A plausible reason is that the volatility of international demand implied a considerable risk

Table 3. *Annual income of farm households engaged in cash crop production, 1983/84.*

Main cash crop	% of all households involved	Percentage shares in household income			Total (thous. rupiahs)
		Main cash crop	Other agricultural products	Other income	
Rubber	3.5	43.0	21.2	35.7	975
Coffee	5.0	28.3	34.6	37.1	882
Copra	9.4	20.6	36.4	43.0	874
Tobacco	5.4	15.8	37.9	46.3	784
Sugar-cane	1.8	25.2	26.7	48.0	1,107
Cloves	10.0	15.2	40.4	44.4	863
Pepper	0.4	45.4	22.1	32.5	1,098
Total	35.3[a]	22.4	35.6	42.0	826

Note:
a) Disregarding double counting.

Sources:
Weighted averages from: Sensus Pertanian, 1983.

to small family farms, which they evaded by diversifying production and sources of income. Given that in Indonesia most goods and services were produced in the rural economy, and that most people continued to be employed in agriculture, it seems likely that most of these goods and services were produced by agricultural households in addition to the production of food for subsistence.

The second issue is also difficult to substantiate conclusively. Figure 1 used a stock concept to measure labour input, because insufficient data are available to approximate total hours worked in agriculture. That means that Figure 1 ignores the impact of changes in the flow of labour, *i.e.* the average hours which agricultural workers worked per hectare of arable land.

There may have been some labour slack. After all, it is likely that the opportunity cost of leisure was low for a long time, given the low rate of general development. Still, as explained above (section 4), there are likely to have been significant economic changes during 1900–1929. For instance, data in Table 1 testify that new transport facilities may have lowered transaction costs and generated new income opportunities, which in turn have raised the opportunity cost of leisure and changed the balance between leisure and work.

Further research is required, but the significant increase in per capita food supply during 1900–1929 can be linked to an expansion of employment requiring the input of physical labour. The growth of food supply may have been caused by the mobilization of a labour slack and an intensification of the use of labour already in employment, either in the market or in the rural household economy (Van der Eng, 1993c: 28–31). A similar, but more elaborated argument has been put forward by Fogel in his Nobel Prize lecture. He has suggested that improved nutrition may account for 30 per cent of the growth of per capita income in Britain between 1790–1980. The growth of food production in Britain raised the participation rate in the labour force and enabled an intensification of the workload of those already in the labour force (Fogel, 1994). It is likely that an initial expansion of income opportunities primarily involved physically demanding work, which required a higher average supply of calories. Moreover, the other side of the coin enhances the point made here. The income elasticity of the demand for food is high at very low levels of living, possibly 0.5 to 0.7. This implies that an increase in average income translated to a large extent into an increase in the demand for food, which is indeed what seems to have happened in Indonesia during the periods 1900–1929 and 1970–1990. It is only at later stages that the marginal demand for other goods increases and the income elasticities of staple foods tend to decrease (Ito, 1989).

The third point is again difficult to corroborate. Table 4 shows long-term changes in labour input in rice agriculture in terms of hours worked per rice crop in Java. Despite the fall in labour input, labour productivity remained constant during the colonial period and started a significant increase after World War II. However, the growth of labour productivity was insufficient to prevent a fall in rice production per head in Java until the 1970s. The decline in rice production per head may seem to contradict the data presented on food supply in Table 2. The decline in rice production was more than compensated by the

Table 4. *Productivity in irrigated rice agriculture in Java, 1875–1992.*

	Labour input (hours/ha)	Average rice yield (ton/ha)	Gross return per hour	Per capita rice production (kg)
1875/80	1,856	1.20[a]	0.65	104[a]
1923/30	1,676	1.16	0.69	84
1955/61	1,511	1.28	0.85	78
1968/69	1,330	1.51	1.14	75
1977/80	1,215	2.31	1.90	105
1987/92	931[b]	2.93	3.15	144

Notes:
a) 1880/84.
b) Calculated from days worked, assuming 8 hours per day.

Sources:
1875–1980: Van der Eng, 1993a: 163, 267–272, 282–291.
1987–1992: Palacpac, 1991: 278; Collier, 1993: III:26–III:28; Statistik Indonesia, 1993.

growth in the production of other food crops, in particular cassava (Van der Eng, 1993a). The growth of rice production per hour worked obviously accelerated after 1970 on the basis of the increase in average rice yields.

The point here is that farm households adopted subtle labour-saving changes in the production, harvesting and processing of rice over time. Most labour in rice production was female labour, which means that women especially experienced the consequences of these changes (Locher-Scholten, 1989). Assuming that women continued to do most of their work in the farm household, it is not implausible to deduce that available female labour especially was continuously re-allocated within the farm household and perhaps from the household to the market economy.

Although the evidence presented in this section is patchy, it suggests that off-farm income has always been important to farm households during the 110 years covered in Figure 1. There are reasons to suggest that farm households managed to grasp new income opportunities and raise the productivity of labour available in the household through the mobilization of redundant labour and the re-allocation of labour from the household to the market sector and within the household. However, more research is required before more definite conclusions can be reached.

7. Green Revolution and labour productivity in food agriculture

How does this interpretation help to address the fact that the Green Revolution in rice agriculture formed the basis of the rapid growth of labour productivity in Indonesian food agriculture after 1970? The key factor to bear in mind is not the technological success of the Green Revolution; the fact that farmers adopted and made use of superior rice varieties, chemical fertilizers and pesticides, improvements in irrigation facilities and so forth. The key factor is that, by and

large, it became economically viable for increasing numbers of farmers to concentrate surplus production on rice agriculture. To some extent, because there is evidence to suggest that many farmers did not have any choice about participating in the rice-intensification programmes. However, on the whole it is difficult to deny that the profitability of rice production increased in irrigated areas, to which the new technologies were best suited (Van der Eng, 1994b).

A large part of the spectacular adoption of the new rice production technologies can be explained by government outlays aimed at furthering agricultural productivity and rural incomes and effectively increasing the profitability of rice production. Total government expenditure has been 9–10 per cent of total Gross Value Added in Indonesian agriculture during 1975–1985 (Van der Eng, 1993a: 141–149). Most of this was aimed at rice production, which translates into 23 to 26 per cent of Gross Value Added in Indonesian rice agriculture. This is a considerable implicit agricultural subsidy for a developing country.

The mere availability of new production technology would undoubtedly have generated an increase in agricultural labour productivity without this government commitment. But it seems unlikely that the government of Indonesia would have been able to trigger the same effect if farm households would have had to pay the full cost of inputs in rice production.

The increase in the profitability of rice production may have induced farm households to re-allocate labour, for instance from the production of traditional cash crops to the production of rice as a cash crop. It is unlikely that this was the only factor furthering labour productivity in the regions outside Java, where the growth of labour productivity in the whole agricultural sector has been stronger than the growth of labour productivity in food agriculture, as Figure 1 testifies. But this may have been the case in Java, where the growth of total labour productivity in agriculture was largely generated in food production after 1970.

The re-allocation of labour was not entirely a matter of shifting labour resources to rice production, because the gap between labour productivity in the food sector and the agricultural sector as a whole remained roughly the same in Java. Moreover, Table 4 showed that labour input per rice crop has actually fallen in Java. Hence, it is very likely that more household labour was mobilized for market production, that the available household labour was used much more efficiently, and perhaps even that households withdrew labour from the market in order to specialize more on the production of food crops.

There is little evidence with general validity to substantiate these arguments convincingly. But there are certainly indications of a relative labour shortage in rural Java. At a much higher rate than in East Asia in a more distant past, farmers in the rest of Asia, including Java, have recently increased the adoption of mechanical and chemical labour-replacing technologies in rice production as part of cost reduction (Jayasuriya & Shand, 1986). The evidence may be somewhat ambiguous, because the adoption of this technology is to some extent influenced by policies which reduce the price of such mechanical and chemical

technologies. But, abstaining from this effect, the adoption of labour-replacing technologies may indicate that the marginal cost of labour has been increasing in Java, which could be interpreted as an advance in the opportunity cost of labour. In addition, there are some indications that farmers are increasingly 'too busy to farm'. The opportunity cost of labour is sometimes so high that farm land remains uncultivated (Preston, 1989/90).

Despite the acceleration in the growth of rice production since 1970 and the rise in labour productivity, the agricultural sector has continued to shed jobs, both in Java and, to a lesser extent in the Outer Islands. However, Table 1 does not show that absolute employment in agriculture has continued to grow, albeit that growth has slowed down considerably and may soon become negative. Hence, it is likely that especially new entrants in the rural labour market decided to drop out of the agricultural sector permanently.

The strong growth of the non-agricultural sectors of the economy after 1970 generated an increasing demand for non-agricultural labour. The promise of a steady non-agricultural income, rather than a highly seasonal agricultural income, may well have induced people to leave the agricultural sector, despite the fact that government policies have enhanced the profitability of agricultural production. However, there are suggestions that the flow of labour out of agriculture has been generated rather by a 'push' effect, on the basis of the fact that Java is one of the most densely populated areas in the world, where arable land had already run out in the 1920s. Dropping out of agriculture may indeed have been a very difficult decision with far-reaching consequences for the people involved. In many cases a meagre existence in agriculture was exchanged for a meagre livelihood and long working-hours in either formal non-agricultural employment or in the 'informal' sector.

It is obvious that both 'pull' and 'push' forces were at work in generating the fall in the share of agriculture in total employment and that it is difficult to strike a concise balance. The controversy on this issue largely concerns the interpretation of diverse micro-level studies (Rietveld, 1986; White, 1991). However, an attempt to strike a balance on the basis of macro-economic data suggests that 'pull' factors have dominated the process (Warr, 1992, Warr & Martin, 1993).

Hence, it is possible to argue that the rural household economy has increased the rate at which it has shed labour to the market economy since 1970, despite the 'pull-back' generated by agricultural policies. In the interpretation of the dynamic relation between the farm household and the market economy, this must also have implied the re-allocation of rural household labour to take advantage of off-farm income opportunities and to optimize the use of household labour for subsistence in reaction to the increasing opportunity cost of labour.

The historical interpretation of the Green Revolution in this article, on the basis of the dynamic interaction of household and market economies, has important consequences for other historical interpretations hitherto given. In particular for the deterministic view that the reliance of Asian economies on rice as

their main staple product, and the presumed absence of economies of scale in rice production, inhibited growth and development of the wider economy in Asian countries (Oshima, 1983; Bray, 1983; 1986: 111–139). This view presupposes that only the Green Revolution with its land-replacing technologies could generate the growth of food production which allowed the agricultural sector to shed jobs, whilst not endangering the supply of food to society as a whole.

The interpretation presented here is that not technical inhibitions inherent in Indonesian rice production, or in Indonesian food agriculture in general on the supply side, but checks on the development of domestic demand have determined the limit of the rates of structural change and growth in the Indonesian economy at large. The growth of labour productivity in the farm household economy was limited by the slow development of income opportunities in the wider economy. The growth of labour productivity in food agriculture was also limited by the fact that farm households first chose to re-allocate labour to take advantage of off-farm income opportunities. In other words, the supply of Green Revolution technology to rice producers before 1970 may have generated some positive impact on labour productivity in food agriculture, but would not have been a sufficient stimulus for a comparable acceleration of the rate of structural change and economic growth in the Indonesian economy at large.

8. Conclusion

This article interprets observed long-term changes in labour productivity in Indonesian agriculture. The evidence on stagnant labour productivity in Indonesian food agriculture during 1880–1970 is at odds with evidence suggesting more dynamic changes in the economy at large. The evidence presented in support of this interpretation is necessarily conjectural, given the present state of research into the economic history of Indonesia. The article hypothesized that stagnant labour productivity in food agriculture is likely to conceal dynamic changes in the economy of farm households, where a re-allocation of labour may have occurred in order to take advantage of growing income opportunities outside food production. The production of cash crops and wage labour in plantation agriculture formed one category of additional income opportunities, but it is very likely that there were other opportunities in the rural economy outside agricultural production.

The re-allocation of household labour in order to capture these opportunities has implied both the use of labour in off-farm jobs and the re-allocation of labour within the household. This article suggests that the productivity of all labour available in farm households thus increased, while labour productivity in food agriculture remained stagnant until the acceleration of economic growth in Indonesia and the introduction of policies which enhanced the profitability of rice production after the 1960s. Until that moment the changes occurred without generally endangering food supply, and without generating a noticeable specialization of labour in the market economy.

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