

**Long Hours for High Yields; Agricultural Productivity in Pre-Industrial
Java (Indonesia)**

by

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Introduction

Detailed agricultural statistics for Indonesia prior to 1960 are rather rare regarding areas outside the island of Java. However, as if to compensate for this lack of nation-wide historical statistics, the data on Java are quite detailed and reliable for the years between 1880 and 1940, coinciding with what has been termed the period of the late colonial state. Much less detailed and reliable are the data for the period when the colonial state was younger, namely the years between 1815 and 1880. Nevertheless, even the data of the years around 1815/20 are good enough to be used for productivity estimates, although they need quite some 'restoring' before we can use them for our calculations. Agricultural statistics going back as far as the early nineteenth century are probably unique for an area so near the equator.

It is most fortunate that data for these years are available. They may be taken to represent Java not only prior to industrialisation (in the sense of the arrival of a European-type manufacturing industry), but also to the implementation of the so-called Cultivation System (1830), which introduced plantation-type agriculture on a scale until then unknown on the island. So I take the years around 1815/20 to reflect pre-industrial and pre-plantation Java, although it be far from me to argue that this was some sort of 'pristine' peasant Java, untouched by outside influences. The Spanish, the Portuguese, and the Dutch had established themselves in the area since the early sixteenth century, a presence that had led to the introduction of many important new crops, of which I only mention maize (corn), sweet potatoes, and coffee.

This paper is not the place for a detailed discussion of how the figures encountered in the sources, which are almost always underestimates, have been corrected in order to obtain more 'realistic' data. For such a discussion I refer the reader to the literature to be found in the notes. However, occasionally these more technical points cannot be avoided entirely.

Farms

What did a Javanese farm look like and how big was it?¹ Usually the literature on the nineteenth century distinguishes between three main types of fields. The most well known type, and also the one claiming the largest share of the arable lands, is the wet rice field or *sawah*. These are permanently cultivated fields surrounded by a low dike or embankment. These fields are constructed to hold water during the growth of the (rice) crop, either water from heaven (rain) or water from an irrigation ditch.² During the dry season (Java has a monsoon climate), the fields that could be irrigated were used for secondary crops that were not inundated (as during the wet season), but just needed some moisture, as crops do all over the world. The second type was the more or less permanently cultivated 'dry' field, called *tegal*, very much

¹ More information on types of arable lands in Boomgaard 1989, 78-80; Boomgaard & Van Zanden 1990, 13-4.

² In the literature on Oceania, where these fields are used for growing taro, they are called, quite nicely and properly, 'pondfields'.

like the arable lands of a European farm. The third type, *gaga*, was cultivated for one or two years, after which it was abandoned for a long time, a system generally known as slash-and-burn or shifting cultivation.

Around 1815 an average landholding household had about 1 hectare of sawah at its disposal, in addition to 0.4 ha of non-sawah (tegal, plus *gaga*, plus sawah cultivated as 'dry' fields in the dry season).³

In the eyes of most 'Western' observers, this was and is a tiny amount of land for a cultivator. In Europe owners of such small plots would be regarded as 'dwarfholders'. In Southeast Asia it would appear that this was nothing out of the ordinary, although statistics on average landholdings covering entire countries or major regions in the nineteenth century are rather rare. I found a figure for the Philippines, taken from the 1903 census there, suggesting an average size of all farms of 1.59 hectares. That figure included the large *haciendas*, of 50 ha and over. Such holdings were not included (or at least not as such) in the arable figures for Java around 1815.⁴ If we leave the *haciendas* out, the average Philippine holding, which now comes close to the peasant holding we are dealing with in Java, measured slightly more than 1.25 ha (Corpuz 1997, 158-9).

In addition to the arable lands, peasant households in Java also had a home garden or compound (*pekarangan*), planted with various crops. Specific groves or orchards (*kebonan*) were less ubiquitous. In 1815 the sum total of all lands (arable, plus gardens, plus orchards) must have amounted to almost 1,8 million ha; given a total indigenous population of 7,9 million, the average amount of cultivated land per capita was 0,225 ha.⁵

Finally, I should mention the grazing lands to be found around many villages. They cannot be regarded as formal and privately owned meadows, but rather as some sort of village commons. There are no quantitative data on pasture prior to 1892, in which year the ratio of pasture to arable was one to nine. After the main rice harvests, sawahs also doubled as pasture, which of course at the same time provided the fields with manure (Boomgaard 1989, 80).

In the light of these fairly detailed statistics it is somewhat amazing that descriptions of actual agricultural properties prior to 1900 are lacking. Only around the turn of the century do we find data on the composition of individual farms. I assume that the situation around 1800 was rather similar. It is shown in a number of sources that many landholders had both sawah and tegal, in addition to a home garden. In some areas all sawah owners also had tegal fields, but that is not a universal feature. In fact, we find four combinations:

³ Taken from Boomgaard 1989, 85; detailed arable statistics in Boomgaard & Van Zanden 1990, 55-92. According to my estimates, 71% of all households (containing on average 4.6 people) were landholding, or about 1.2 million households, while 85% were engaged in agriculture (Boomgaard 1989, 85, 172, 218). If we compute landholding per (adult) male actively engaged in agriculture (as do Clark & Haswell 1967, 143-4; and Bairoch 1999, 83), the average holding would be even somewhat smaller, namely 1.0 ha.

⁴ There were so-called private estates (*particuliere landerijen*) to be found in Java, but their area figures are only included in the statistics quoted in this paper in so far as they refer to the landholdings of the peasantry on these estates.

⁵ See Boomgaard & Van Zanden 1990, 39. Population data in Boomgaard 1989; Boomgaard & Gooszen 1991.

1. sawah + tegal + pekarangan;
2. sawah + pekarangan;
3. tegal + pekarangan;
4. pekarangan only.

The tegal fields were usually found in upland areas or regions where irrigation was otherwise difficult or impossible.⁶

Areas with gaga fields (slash-and-burn) were usually sparsely populated regions, far from the cities and other centres of commerce, and I have not seen evidence of people who had both gaga and sawah.

It is, therefore, a bit difficult to present a 'model' farm. In Java at the beginning of the nineteenth century we encounter either some combination of sawah, tegal, and pekarangan, or, in the more remote regions, gaga (and pekarangan).

Be that as it may, sawahs constituted around 1815 some 75% of all arable lands, and in that sense a Javanese 'model' farm of around 1815 would have consisted mostly of sawah.

Crops and animals

At the beginning of the nineteenth century almost all sawahs were planted with rice during the wet monsoon. This was such a ubiquitous combination that the terms sawah and rice field were more or less interchangeable. Rice occupied the sawah for three to seven months, depending on the rice variety and the altitude of the field. A second rice crop could be grown on a sawah if during the dry season sufficient water was available, but it was rather exceptional. Often a second crop was planted which, although in need of some moisture, did not require inundated fields. The collective name for these second crops (except rice) was *palawija*. The same palawija crops could be and often were grown on tegal and gaga fields.

If we take all 'dry' fields (dry monsoon sawah, plus tegal, plus gaga) together, we find around 1820 that almost 20% was occupied by maize, slightly over 20% by roots and tubers, and 35% by pulses. Non-food crops, mainly cotton, tobacco, indigo and the castor-oil plant took up around 20%.

If we look at the total amount of land under crops in one year, double-cropped land included, we find that in 1820 around 80% were planted with rice, first and second crops together. The cropping ratio was 110, which means that 10% of the fields with a wet monsoon crop also had a dry monsoon harvest.

Rice was also grown as a 'dry' crop in shifting cultivation (gaga), but much less on permanent 'dry' fields (tegal). On double-cropped fields, crop rotation was usual. On 'dry' fields, intercropping was often reported.⁷

Around 1820, livestock consisted of (water) buffalo (670,000), cattle (310,000), horses (150,000), goats (80,000), and sheep (20,000). This boils down to one piece of livestock per landholding household, but given the fact that the reported livestock figures should be corrected upwards (whereas I used already corrected population data), a number of 1.5 livestock per landholding household is more likely.⁸

⁶ Sollewijn Gelpke 1885, 31; *Ver slag* 1903; Van Moll & 's Jacob 1914, I, 22.

⁷ All this is dealt with in much more detail in Boomgaard 1989, 73-108; Boomgaard & Van Zanden 1990, 13-20.

⁸ These figures, which are almost certainly too low, were never published, but I discussed them in a paper (Boomgaard 2001, 11). The main source of the figures is

The buffaloes were used for ploughing the sawahs and for other forms of traction (carts); cattle were also used for ploughing (of dry fields) and as beasts of burden; horses were also employed as beasts of burden and for transporting people (not for ploughing). Most animals were eventually eaten, but cattle were not used for milk and butter production.⁹ Finally I should mention chickens, kept for meat and eggs. They were probably to be found in most farmyards, but figures are not available.

Production per hectare

One way to measure agricultural productivity is to calculate production per unit of land. As rice was the main crop, and as we have some historical data on rice yields in other areas as well, but hardly on other crops, I will present only data on rice yields here. Elsewhere, I have calculated Java's rice production in kilograms *padi* (or paddy, that is rice in the husk) per hectare (first crop only) for 1815. This figure is presented in table 1, along with a number of comparable data.

Table 1 Rice production per hectare, in kilograms, for various Southeast Asian regions and periods.¹⁰

Region	Kg padi per ha	year
Java	1,650	1815
Burma	1,430	1930
Indo-China	1,560	1910
Thailand	1,630	1930

It seems to be an almost universal law that, generally speaking, yields per hectare increase over time. If that applies to Southeast Asia as well, around 1815 rice yields in Burma, Indo-China and Thailand must have been lower, perhaps considerably lower, than the figures presented here, dating from the first half of the twentieth century. This would mean that around 1815, Java was cutting a fine figure as regards rice yields, at least in a Southeast Asian setting. However, compared to Japan, with an average yield of over 3,000 kg around 1910 (when Java's rice yield per ha was only 2,000), Java was probably doing poorly around the beginning of the nineteenth century as well.¹¹

It has to be emphasised that I am quoting average yields, and that, therefore, maximum yields were much higher locally. I suspect that the rather high rice yields for areas on the Malayan peninsula (the western part of today's Malaysia),

Algemeen Rijksarchief (General State Archives, The Hague), *Archief Ministerie van Koloniën* (Archives of the Ministry of Colonies), Collection Schneither 83-100.

⁹ The Chinese population (some 65,000 people in 1820) in or around the big cities (mainly Batavia) kept pigs, which were unclean to the Muslim Javanese.

¹⁰ The data were taken from Boomgaard & Van Zanden 1990, 41 (Java) and Cheng 1968, 28 (all other areas).

¹¹ Broadly similar conclusions can be drawn from Van der Eng 1996, 23, where rice yield figures for slightly different benchmark years are presented for most Southeast Asian countries and Japan (but not for Java prior to 1875).

published by Ronald Hill for the mid-nineteenth century, varying between 1,350 and 2,400 kg per ha, represent (maximum?) yields in good years, not averages.¹²

Productivity of labour

Measuring productivity of labour appears to be wrought with more difficulties than calculating yields, although the latter is, as we have seen, not unproblematic either.¹³

Expressing agricultural labour productivity in terms of money is perhaps a good idea when we are dealing with data on the last 50 years or so, a period with sophisticated statistics. As we go back in time, this option becomes much less attractive, partly because the monetisation of so many, particularly non-Western economies was still rather weak. A more attractive method could be expressing production per unit of labour in terms of the most important crop, such as wheat or rice. However, we then face problems when we want to compare rice and wheat economies, or when we are faced with economies that do not have a main staple crop.

A third possibility is to express all agricultural production in calories. That would make comparison between countries or regions a lot easier.

One of the difficulties with this method is that not all agricultural produce is consumable. In the case of Java, we found non-food items such as cotton and tobacco being cultivated on a significant proportion of the arable lands, while perhaps as much as half the produce of the home garden consisted of non-consumables. According to Bairoch, this category is negligible in developed economies. For Europe around 1910 it was only 0.3% of total agricultural production (Bairoch 1999, 168). However, according to my calculations the share of non-consumables in Java's agricultural production was probably nearer to 15%, and therefore far from negligible.¹⁴ In such a case two sets of data could be presented (one with and the other without non-consumables), which will enable other researchers to make their own choice if they want to make comparisons.

Another problem is the way livestock should be dealt with. If one is interested in the calorific value of the diet of agriculturalists, estimates of the percentage of all livestock annually slaughtered, and assumptions about slaughter weight will suffice. However, if one is interested in the production side or, in what Bairoch called 'direct calories', the estimate we just arrived at has to be multiplied by a

¹² It is also possible that my conversion of *gantangs* per acre into kg per ha is faulty. The Malayan gantang was around 1880 standardised and equated to an Imperial gallon, which equals 4.54 litres. However, I am not entirely sure that Hill was quoting standardised gantangs. Another potential source for errors is the conversion of litres to kilograms, which, following Hunt, has been done at the rate of 0.6 kilogram to the litre. However, Mears, who converted units of milled rice from litres to kilograms (whereas I converted units of unmilled rice) used a conversion factor of 0.8 (Mears 1961, 188; Hill 1977, 121, 134, 202; Hunt 2000, 269). This conversion factor would yield even higher figures.

¹³ The following discussion has benefited greatly from Clark & Haswell 1967; Bairoch 1999; and the notes produced by Robert Allen for the 'Agricultural Productivity' workshop for which this paper was written.

¹⁴ Conversion from production data of non-consumables into calories can be done by taking the total monetary value of these crops, which then can be expressed in rice equivalents (by way of the rice price), of which the calorific value can be computed. Data on the proportion of non-food products for 'modern' developing countries in Clark & Haswell 1967, 72-3.

factor that expresses the amount of plant vegetative calories that had to be consumed for the production of one animal calorie. This varies between animals, but the FAO uses one coefficient for all (hoofed) livestock, namely seven. In the case of Java it does not make much of a difference, as the Javanese were no big meat eaters anyway. Turning indirect animal calories into direct ones would add some 3% to the total agricultural production expressed in calories.

Elsewhere, I have calculated gross production figures, but many publications use net figures. This means that seed and (cost of) fertiliser have to be subtracted. As the use of (bought) fertiliser was negligible in Java around 1815, an estimate of seed use may suffice. As seed/yield ratios for rice are much higher (higher yields in relation to seed inputs) than those for European cereals in pre-industrial times, the importance of this subtraction is less for rice producing areas.¹⁵ I follow Pierre van der Eng, who used a seeding rate of 55 kg/ha for a later period. One should also deduct a small percentage for grain fed to chickens, for which I have taken Clark & Haswell's 40 kg per chicken. As the assumption of one chicken per ha on average seems reasonable, 40 kg/ha of rice will be subtracted.¹⁶ According to my estimate the total amount thus subtracted constituted 3.5% of total agricultural production. I have assumed that fodder for other farm animals does not have to be subtracted from the agricultural produce of the farm. The animals were grazing the commons or were given leaves and stalks of crops, parts that otherwise would have been thrown out.

Thus we have taken care of all problems bar one. I am referring to the problem of expressing 'labour' in quantitative terms, as we are interested in the productivity of labour. One solution would be calculating agricultural production per capita, that is per head of total population. However, that includes the non-agricultural population, a proportion of total population that varies enormously between countries and periods.¹⁷

It is, therefore, more appropriate to relate agricultural production to agricultural labour. It appears to be more or less accepted practice to compute agricultural production per (adult) male agricultural labourer. Of course, scholars are nowadays fully aware of the share of women and children in agricultural production, but historical statistics usually do not allow us to take this type of labour into account (e.g. Bairoch 1999, 162-3).

The next problem is how to compute the share of the adult male population in the total population. According to Paul Bairoch this proportion turns out to be rather uniform during the early nineteenth century in the developed economies, gravitating towards 30%.¹⁸ Data for Java suggest that this proportion was lower there during that period, probably more near 25%. Here, I will apply the percentage found by Bairoch in order to facilitate comparison.

Finally, we are only interested in the agricultural labour force. Elsewhere I have calculated that around 1815 85% of the total population was engaged in agriculture. For my calculations here I will apply that percentage to the adult male labour force as well. Thus we arrive at 85% of 30% of 7.9 million, or 2 million adult males actively engaged in agriculture. The results of all these considerations are given in table 2.

¹⁵ Seed/yield ratios for European cereals varied from 1:3 to 1:11 between 1500 and 1800 (Slicher van Bath 1960, 26-30)

¹⁶ Clark & Haswell 1967, 62; Van der Eng 1993, 257; Bairoch 1999, 165-7.

¹⁷ E.g. Clark & Haswell 1967, 206-8; Grigg 1982, 109; Bairoch 1999, 32.

¹⁸ Bairoch 1999, 170-2; other percentages in Clark & Haswell 1967, 136-7.

Table 2 Productivity of labour, expressed in millions of calories per capita and per adult male agricultural labourer, Java, c. 1815.¹⁹

Product	Per capita	Per male agr. labourer
Gross in direct calories	0.84	3.3
Gross in indirect calories	0.82	3.2
Without non-consumables	0.70	2.7
Net in direct calories	0.81	3.2
Net in indirect calories	0.79	3.1
Without non-consumables	0.68	2.6

The figure comparable to the data presented by Bairoch for the developed world is to be found in the last column of the fifth row of table 2. This figure means that in Java around 1815, a male agricultural labourer produced on average 3.2 million net direct calories. 'Direct' means that 'indirect' animal calories have been converted into direct 'vegetative' calories, and 'net' means that we have deducted seed and fodder from the gross figures. In this figure, non-consumables have been converted into calories by making use of prices and the caloric value of the rice equivalents thus calculated.

Comparing this figure to the data Bairoch published, we find that around 1800, Portugal (3.2) showed the same labour productivity as did Java, while Finland (4.1), Sweden (4.2), Spain (4.3), and Norway (4.5), were somewhat better off. All other European countries were doing much better, led by the United Kingdom (13.2) (Bairoch 1999, 136).

Calories consumed per capita

These calculations made, the question should be asked whether we should take exports and imports of foodstuffs into account. In the case of Java around the beginning of the nineteenth century we would be mainly concerned with exports of rice. There are, to my mind, various arguments in favour of leaving data on trade out. In the first place we are measuring total agricultural production, not consumption. In the second place, the rice that was exported was first sold by the producers, who then may have bought consumables that do not (or not sufficiently) show up in these production statistics. The best example of such products is edible commodities gathered in the forests and other 'wastelands'. At that period Java was still a game-rich region, and hunting, and particularly trapping of wild animals, was a remunerative sideline. Such data never show up in statistics, what also goes for all other foraged products such as wild roots and tubers, fruits, nuts, etcetera. So even if someone wants to measure consumption per capita, a case can be made for not subtracting rice exports, as they may be assumed to have been traded for other consumables.

¹⁹ The basic data were taken from Boomgaard 1989, 220-222; and Boomgaard & Van Zanden 1990, 51. A small amount of fish is included (20 calories per capita per day). Strictly speaking this is not agricultural production, and purist can remove it from the totals presented here.

If we accept that assumption, and also assume that all products that could not be consumed had been converted on the market in eatables, we can find the answer to the question of calorie consumption per capita in table 2, column 2, row 6. Here we find 0.79 million net indirect calories per capita per year, and therefore 2,165 per day. If this figure could be taken to be the average calorie intake per day, it would not compare unfavourably to present-day figures.

However, not all income was eaten, and we should at least subtract 15% for things like clothing and other necessary non-food items, which would bring the figure down to 1,840 net indirect calories per day. Not very good, but not very bad either.²⁰

On the other hand, not all income was agricultural income. As the figures calculated above are based on agricultural products, non-agricultural income is not represented in the figures used here. We know that most if not all Javanese peasant-cultivators (men, women, and children), were engaged in off-farm and non-farm labour, though we do not now what proportion of their total labour input was thus spent c. 1815. Around 1900, this was somewhere in the neighbourhood of 25% of agricultural labour (Boomgaard 1991, 36). If it were 15% at the beginning of the nineteenth century it could have been just enough to buy all non-food items, and the average amount of calories consumed per capita would then be back at 2,165 calories per day.

Days and hours worked

As we have seen above, the notion of 'labour', used here and in many other studies to calculate productivity of labour is a bit fictitious, as it just takes the potentially economically active male agricultural population. Somewhat more precise, but of course much more time-consuming and difficult, would be estimates of labour inputs per crop and per activity, which should then be added to arrive at average annual labour input per ha and/or per agricultural household.

Elsewhere (Boomgaard 1989, 98) I have calculated that in 1815 the average agricultural household (of 4.6 people) spent about 440 labour days (of 7 hours) on work on the farm. If corvée labour and the time it takes to market the products (almost entirely female labour) would be included, the household would spend 592 days. Expressed per capita, this would be 100 and 130 days respectively. Marketing the products aside, off-farm and non-farm labour of the household have not been taken into account.

We can then calculate production per hour and per day worked, expressed in net direct calories, for which the basic information was presented in table 2 (column 2, row 5). The outcome is given in table 3.

Table 3 Net direct calories (per capita) per hour and per day worked, with and without corvée labour and marketing, Java, 1815.

Calories	Without corvée and marketing	With corvée and marketing
Per day worked	8,100	6,230
Per hour worked	1,160	890

²⁰ On present-day calorie requirements, depending on age, sex, body weight and climate, see e.g. Clark & Haswell 1967, 1-23.

Finally, we are now also in a position to calculate how many hours went into the production of a certain quantity of rice. This is an interesting exercise, because there are comparable data for other crops. According to my calculations, 300 days or 2,100 hours went into the tillage of a hectare of wet rice, with a yield of 1.65 metric tonnes of padi (all this c. 1815). This implies that a tonne of padi was the product of 1,275 hours of labour. Around 1800, a metric tonne of wheat took 140 hours to produce in the US of A, and a tonne of maize (corn) was the product of 135 hours of labour input. A tonne of cotton, on the other hand, needed the input of 2,775 hours.²¹ Nevertheless, the figures for wheat and corn make it abundantly clear that around 1800, the Javanese spent much more time producing one unit of their staple food crop than did the Americans with theirs.

Now my figure (1,275 hours work for 1 tonne of padi) seems to be rather high. Pierre van der Eng calculated, on the basis of the figures produced by Sollewijn Gelpke, that around 1880, Javanese peasant cultivators produced 1 metric tonne of padi in slightly over 800 hours. W.R. Geddes, who did fieldwork among the Land Dayaks of Sarawak (Borneo) around 1950, found that 1 tonne of padi was the product of 830 hours of work.²²

In his case he was talking about slash-and-burn agriculture, which is, indeed, supposed to be less time consuming than sawah cultivation. Van der Eng, however, was talking about sawah rice, so the difference between him and me needs some explaining. To my mind, the major explanation is that he has not taken into account that the buffaloes used for ploughing also represent labour input. I suspect that livestock has not been taken into account in the American calculations either.

But even if one would prefer Van der Eng's figure, or some figure between his and mine, and if one corrects the American figures, it remains crystal clear that the Javanese needed many more hours than the Americans for the production of one unit of weight of their main staple food crops.

On the other hand, if we look at yields per hectare around 1800, rice in Java was doing better than wheat in Europe or the US. Java was producing 1,650 kg rice per ha, while the USA produced 960 kg and Europe 860 kg wheat per ha (Bairoch 1999, 101). Even at a conversion rate of 0.8 to 1 between rice and wheat (Clark & Haswell 1967, 222), Java was still doing much better per unit of surface area. The Javanese obtained high yields, but at the cost of long hours.

Conclusion

At the beginning of the nineteenth century, before modern industry and the so-called Cultivation System with its quasi-plantations had transformed Java's economy, agricultural production in terms of calories per adult male agricultural labourer was on the same level as that of Portugal.

Calorie consumption per capita was probably modest though satisfactory, in all likelihood in excess of 2000 calories per day.

It took the Javanese much longer to produce a metric tonne of rice than it did the North Americans (and the Europeans too, no doubt) for the same amount of wheat or maize.

However, rice yields per hectare were much higher than those of the European and North American staple food crops.

²¹ Bairoch 1999, 44. I am not entirely sure whether the tonnes of wheat and maize are the product as harvested, as are the tonnes of rice I quote.

²² Geddes 1954, 68; Van der Eng 1993, 163.

References

- Bairoch, P., 1999, *L'Agriculture des Pays Développés 1800 à nos jours; Production, Productivité, Rendements*. Paris: Economica
- Boomgaard, P., 1989, *Children of the Colonial State; Population Growth and Economic Development in Java; 1795-1880* [CASA Monographs, 1] Amsterdam: VU University Press
- Boomgaard, P., 1991, 'The non-agricultural side of an agricultural economy, Java, 1500-1900', in P. Alexander, P. Boomgaard & B. White (eds.), *In the shadow of agriculture. Non-farm activities in the Javanese economy, past and present*. Amsterdam: KIT, pp. 14-40
- Boomgaard, P., 2001, 'The Age of the Buffalo; The Maritime Trade in Livestock in Asia, Particularly Indonesia, 1500-1850', paper for the panel "History of Foodcrop Production and Animal Husbandry in Southeast Asia", 3rd Euroseas conference, London, 6-8 September
- Boomgaard, P., & A.J. Gooszen, 1991, *Population trends 1795-1942* (Changing Economy in Indonesia, Vol. 11) Amsterdam: KIT
- Boomgaard, P., & J.L. van Zanden, 1990, *Food crops and arable lands, Java 1815-1942* (Changing Economy in Indonesia, Vol. 10) Amsterdam: KIT
- Cheng Siok-Hwa, 1968, *The Rice Industry of Burma 1852-1940*. Kuala Lumpur/Singapore: University of Malaya Press
- Clark, C., & M. Haswell, 1967, *The Economics of Subsistence Agriculture*. London, etc.: Macmillan [1st ed. 1964]
- Corpuz, O.D., 1997, *An Economic History of the Philippines*. Quezon City: University of the Philippines Press
- Eng, P. van der, 1993, *Agricultural Growth in Indonesia since 1880*. Unpublished PhD dissertation, University of Groningen
- Eng, P. van der, 1996, 'Production Technology and Comparative Advantage in Rice Agriculture in Southeast Asia since 1870', paper presented at the Association for Asian Studies Conference, Honolulu, Hawaii, 11-14 April
- Geddes, W.R., 1954, *The Land Dayaks of Sarawak; A Report on a Social Economic Survey of the Land Dayaks of Sarawak presented to the Colonial Social Science Research Council*. [London]: Her Majesty's Stationary Office
- Grigg, D., 1982, *The Dynamics of Agricultural Change; The Historical Experience*. London, etc.: Hutchinson
- Hill, R.D., 1977, *Rice in Malaya; A Study in Historical Geography*. Kuala Lumpur, etc.: Oxford University Press
- Hunt, R.C., 2000, 'Labor Productivity and Agricultural Development: Boserup Revisited', *Human Ecology* 28/2, pp. 251-77
- Mears, L.A., 1961, *Rice Marketing in the Republic of Indonesia*. Djakarta: P.T. Pembangunan
- Moll, J.F.A.C. van, & H. 's Jacob, 1914, *De desa-volkshuishouding in cijfers*. Amsterdam: Algemeen Syndicaat van Suikerfabrikanten in Nederlandsch-Indië [2 Vols.]
- Slicher van Bath, B.H., 1960, *De agrarische geschiedenis van West-Europa (500-1850)*. Urecht/Antwerpen: Het Spectrum [translated into various languages]
- Sollewijn Gelpke, J.H.F., 1885, *Gegevens voor een nieuwe landrente-regeling. Eindresumé der onderzoekingen bevolen bij Gouvts. Besluit van 23 Oct. 1879 No. 3*. Batavia: Landsdrukkerij
- [Verslag], 1903, *Verslag over den waters- en voedingsnood in de Residentie Semarang*. Buitenzorg: Buitenzorgsche Drukkerij