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Rice Cultivation in Southern Vietnam (1880-1954) : A Re-evaluation of Land Productivity in Asian Perspective

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Introduction

The conventional interpretation of Asia's agricultural transformation during the 20th century is that land productivity and land/labor ratios, which were both initially comparatively low, increased as a result of technological change. As pointed by Van der Eng (2004), output, acreage, and labor input in rice cultivation available for a number of Asian countries, mostly Japan, Korea, Taiwan, China, India, and the Philippines, have usually been interpreted as showing an Asian process of transformation that follows a land-replacing path described as the 'Ishikawa-curve' (Ishikawa 1981)[1].

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However, as Van der Eng (2004) has shown, Ishikawa's interpretation is biased towards East Asia, providing an adequate description of the experience of Japan, Taiwan, and Korea but not of the mainland Southeast Asian countries. He produces evidence showing that the land/labor ratio was much lower in Japan than in Thailand, Burma (Myanmar), Co-chin China (present-day southern Vietnam), and Cambodia. These countries or regions, which had a sizable exportable surplus before W.W.II, accounted for the bulk of world rice exports during that period. Although land productivity was significantly lower in these regions than in Japan, rice yields were only one third of the Japanese level[2], labor productivity was about 70% higher than in Japan due to favorable land/labor ratios (Van der Eng 2004, Table 3).

Van der Eng convincingly argues that mainland Southeast Asian countries had a comparative advantage in rice cultivation that explains their domination of the world rice market during the interwar period. In terms of land/labor ratios, the gap between these countries and Japan is well documented. However, considering the important ramifications of his results for our understanding of Asian countries' economic development since the late 19th century, it is worth scrutinizing the reliability of rice output data and implied rice yields, and the magnitude of the land productivity differential between Japan and the different countries of mainland Southeast Asia. In other words, were

1) Hayami and Ruttan (1985) propose an interpretation of agricultural transformation that considers, as alternative to the land-replacing path, a labor-replacing one. Van der Eng (2004, Figure 4, p. 353) elaborates a schematic representation taking into account these alternatives, labeled as 'extended Ishikawa-curve'.

2) Average rice yields in the 1930s (measured in terms of husked rice) were only 1.1 tons per ha in Java, 0.9 tons in Burma, Cambodia, Thailand and southern Vietnam, and 1.4 tons in northern Vietnam, compared with 2.7 tons per ha in Japan (Van der Eng, 2004, Table 3, pp. 355–356).

there no exceptions among these countries to the picture of low rice yields?

In the case of southern Vietnam, Van der Eng relied on output and acreage figures for the period 1910–1954 published in official sources, the Annuaire Statistique de l'Indochine (Statistical Yearbook of Indochina)[3], and the Annuaire Statistique du Vietnam (Statistical Yearbook of Vietnam) that seem implausibly low in comparison with average yields recorded in the late 19th century and in the late 1950s. The purpose of this paper is to investigate the yield series implied by late 19th century official sources and by micro-data collected by the French colonial administration, and to propose a re-evaluation of paddy output[4]. The results show that, in southern Vietnam, initial conditions were not only characterized by high land/labor ratios but also by comparatively high land productivity. It appears, therefore, that the path of southern Vietnam's transformation of rice cultivation differs markedly from the received wisdom expressed by the 'Ishikawa-curve'.

Paddy is by far the most important crop in southern Vietnam's agriculture: it accounts for the largest share in value added in agriculture and rural income (and of course in food consumption). It is also one of the crops for which quantitative information is the most abundant. However, average yields estimated by the Division of Agriculture of the Government of Indochina during the first five decades of the 20th century are at odds with micro-data recorded during the same period. In addition to the underestimation of output, it seems that paddy field

3) These data are also reported in Henry (1932), for the 1920s.

4) The estimation of new series or paddy field acreage and paddy output volume for southern Vietnam presented in this paper has been undertaken as part of the Asian Historical Statistics (ASHSTAT) Centre of Excellence Project of the Japanese Ministry of Education (Team Leader: Professor Konosuke Odaka).

acreage were also underreported before the 1950s. A detailed investigation of cultivation techniques and data sources is required in order to evaluate to what extent series of paddy output volume should be revised upward.

Part of the official provincial level data that can be used for estimating time series has been collected and published in the study by Takada (2000) for the period 1910–1945. However, she made no attempt to investigate the reliability of these data and did not take into account official sources for the late 19th century. Giacometti (2000a) offers a critical review of official figures published during the interwar period by the Agricultural Division of the Government of Indochina regarding paddy cultivation. While reaching similar conclusions as Giacometti regarding the underestimation of acreage and official sources, the present study goes much further in the upward revision of output figures.

The remainder of the paper falls into five sections. Section 1 offers some background information regarding rice varieties and cultivation techniques. Section 2 provides evidence suggesting that the series reported in official statistical yearbook are implausible. Section 3 outlines the micro-data available on rice cultivation in southern Vietnam before WWII. Section 4 proposes new estimates of paddy output, relying on the reconstruction of provincial level yields. Section 5 concludes.

1. Preliminary Remarks: the Diversity of Rice Varieties and Cultivation Techniques in Vietnam

Although a number of official publications before WWII suggest that

land productivity in Vietnam was low, available qualitative information on cultivation techniques shows that, by Asian and international standards of the time, land productivity was actually high. Before examining the entire set of quantitative data on acreage and output, it is worth considering the different subspecies and techniques of paddy cultivation in Vietnam, the potential yield of traditional varieties, the periods of cultivation, and the extent of double and triple cropping.

Different subspecies and techniques

Four different types of subspecies of rice (Oriza sativa lin.) were and still are cultivated in Vietnam using different techniques (Brenier 1914, Lecoq 2001) :

- Irrigated rice cultivated in wet fields for the production of paddy to be consumed as steamed rice (in Vietnamese: lua te) that accounted for about 90% of total output throughout the period, probably with a rising trend. Even before the 19th century, irrigation was the dominant cultivation technique, especially among ethnic Vietnamese. In most area, cultivation relied upon transplantation (simple or double transplantation depending on the area and the labor force available). However, in the southern part of central Vietnam, which has a comparatively dry climate, direct plantation also existed, possibly as a continuation of pre-Vietnamese (that is, *Cham*) cultivation techniques.
- Floating rice (in Vietnamese: lua noi) was cultivated in southern Vietnam, in the area close to the Cambodian border, particularly in Chau-Doc province. The cultivation techniques were comparable to those used in Cambodia and central Thailand. Floating rice techniques were practiced in this area by ethnic Khmers before the

occupation of the region by ethnic Vietnamese. Yields tended to be significantly lower than for irrigated rice. The area under floating rice cultivation declined gradually during the 20th century as irrigation became more common.

- Glutinous rice (Oryza sativa, var. glutinosa), like in Laos itself, was the most common variety along the Laotian border. Glutinous rice varieties, called nep in Vietnamese, are also cultivated by ethnic Vietnamese for alcohol production and for the preparation of pastries. Glutinous rice varieties cultivated by ethnic Vietnamese generally require irrigation.
- Dry rice (Oryza sativa var. montana) was dominant among ethnic minorities in the midlands and highlands of central and northern Vietnam. A number of dry rice varieties exist for use as steamed or glutinous rice, with the latter use being the most common. It should be noted that ethnic minorities also practiced irrigated rice cultivation when economically feasible, especially among ethnic Thais of northern Vietnam, and appreciated very much this cultivation technique, even before WWII (Gourou 1940). Although dry rice is usually associated with slash and burn cultivation, it can also be practiced in permanent dry fields. Depending on local conditions and techniques, land productivity can be fairly high in slash and burn cultivation but, on average, yields are lower than with irrigation.

The diversity of varieties and potential rice yields

When investigating the reliability of land productivity data reported during the first half of the 20th century, we have to take into consideration that high-yield varieties have been introduced from the 1960s as

part of the Green Revolution. Before that period, an extremely large number of traditional local varieties were cultivated, including in the relatively new paddy cultivation area populated by ethnic Vietnamese in the Mekong delta. Although it is widely believed that the diversity in rice varieties was associated with differences in yields, there is no strict relationship. Field studies undertaken in northern Vietnam by Dumont (1935) suggest that the diversity was a result of local mass selection aimed at adaptation to local conditions: soil, average temperatures, rainfall during the period of cultivation, and the frequency of natural hazards (droughts, floods, heavy rainfall, and also cold wind in northern Vietnam).

These local varieties were not varieties in the strict sense, i.e., individual strains with identical genetic characteristics, but rather stable populations composed of different strains with similar yield and other characteristics. Local varieties were regarded as well-suited to yearly variations in the duration of the relatively dry season and to the total amount and distribution of rainfall during the wet season. They were therefore capable of withstanding drought, frost, and/or flood, producing a modest yield in unfavorable circumstances and avoiding a total loss of harvest. The response of local varieties to the use of fertilizers was weak for urea (nitrogen), but rather good for potash and phosphoric acid. The potential yield of each type of traditional local variety of rice in Vietnam has been estimated as follows (Lecoq, 2001) :

- Around 2.5 to 3.5 tons of paddy per ha for irrigated rice.
- Around 1.5 ton of paddy per ha for floating rice.
- Around 1 ton of paddy per ha for dry rice.

The potential yield for the new varieties introduced after the mid-1960s is regarded as close to 6 tons per hectare.

As irrigation was the dominant cultivation technique, 3 tons of paddy per hectare can be regarded as the average figure for an exceptionally good harvest. It is obvious that this level can only be observed at the scale of a small area, and certainly not as an average for the whole country, or not even for a region or province. Available information suggests that yield volatility resulting from natural hazards, particularly drought and typhoon, was especially high in central Vietnam (Giacometti 2000b), less so in southern and northern Vietnam.

Glutinous rice varieties generally yield lower output per hectare (about 10% lower on average) but these varieties accounted for only about 4% of the acreage in northern Vietnam and about 2% in southern Vietnam circa 1930 (Nguyen 2000). Available information suggests that glutinous rice commanded a premium: the unit price of glutinous rice was and still is higher than for non-glutinous rice. Thus, the price differential compensates for the lower output in volume and even yields a higher output value per hectare. As yield differentials are not very large, rather than reconstructing time series of glutinous rice acreage and unit-price, it is more convenient and easier to assume the same yield and price as for non-glutinous rice.

Periods of cultivation and multiple cropping

A complication encountered when using yield data is the prevalence of double cropping in Vietnam. Under favorable conditions, a given plot of paddy field can be harvested twice a year. In that case, yield per cultivated acreage, that is output relative to total acreage, is higher than yield per harvested acreage. At least since the late 19th century, rice cultivation by ethnic Vietnamese was undertaken in different periods of the year in all the regions of Vietnam, depending on local

natural conditions and the development of irrigation infrastructure. The different periods of rice cultivation are always described in the same pattern since the late 19th century (Thorel 1873: Brenier 1914; Henry 1932; Dumont 1935; Gourou 1936; Lecoq 2001; Nguyen 2001) :

- In the summer-autumn rice season (in Vietnamese, lua mua), seeds are sown in May or June, young plants are transplanted in July, and paddy is harvested in September in central Vietnam, in October-November in the northern part of the country, and from December to February in the southern part. This harvest is also called "rice of the tenth month". This was traditionally the most important rice season, especially in southern Vietnam. As cultivation is undertaken during the wet season, it does not require a sophisticated irrigation system when paddy fields are on relatively high land. In the lowest part of the plains, especially in the Mekong delta of southern Vietnam, cultivation is possible only when the infrastructure of dikes and canals is preventing floods.
- In the winter-spring rice season (in Vietnamese, lua chiem), seeds are sown in November, young plants are transplanted in December, and paddy is harvested in May in northern Vietnam and in April in central Vietnam. This harvest is also called "rice of the fifth month". As cultivation is undertaken during the dry season, irrigation is necessary in the higher parts of the plains. Only a small percentage of paddy fields were suitable for cultivation in the winter season in southern Vietnam before the 1960s.

In most areas of the lowlands, that is areas occupied by ethnic Vietnamese using labour intensive production techniques and, crucially, irrigation, it is technically possible to obtain two harvests in the same paddy-field when the hydraulic infrastructure is adequate. However,

areas of double cropping expanded only gradually before WWII, mostly in the northern half of Vietnam. One of the main reasons is that the rice frontier was still open, including in the northern half of the country, and even in some coastal areas of the Red River Delta. It appears that double cropping increased rapidly during the 1920s and 1930s to about 40% of paddy fields in the Red River Delta around 1935 (Gourou 1936). Double cropping existed in southern Vietnam in some areas around Saigon, even as early as the 1880s,in spite of the abundance of uncultivated land suitable for reclamation as paddy fields in surrounding provinces. Paddy field acreage expanded rapidly in southern Vietnam until the late 1920 and then at a slower pace thereafter, but the land frontier remained open until the 1970s. Double cropping expanded in southern Vietnam only during the last decades of the 20th century.

In some limited areas, where excellent conditions of irrigation and drainage prevailed, triple cropping was practiced. In the Red River Delta, this was the case even before WWI ("Three Moons Rice" i.e., with a cycle of three months). This technique did not become widespread before the 1990s. It has been introduced in southern Vietnam as well, during the same period.

2. The Implausibility of Part of the Colonial Data Concerning Paddy Yields in Early 20th Century Vietnam

Most paddy yields implied by paddy field acreage and output volume data reported by the colonial authorities in official reports and statistical yearbooks during the early 20th century are implausibly low. Some discrepancies are observed among official data, although implied yield figures are in the same range. The lowest official figures for paddy

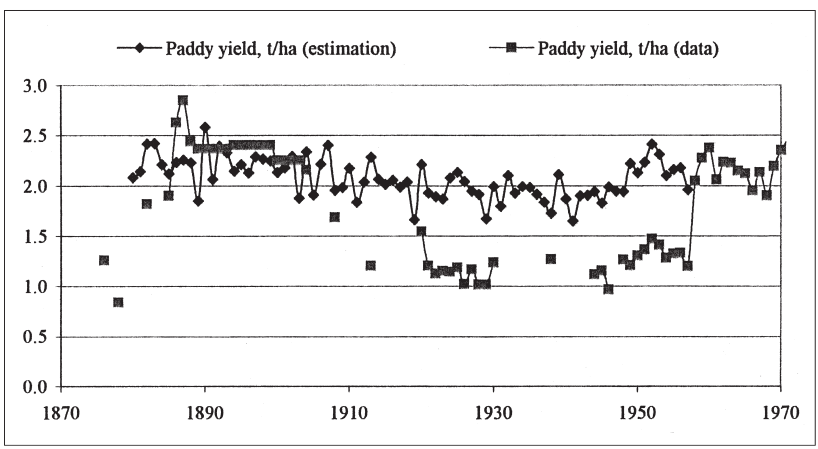
yields were about 1.2 to 1.3 ton per ha in a normal year. The highest figures were about 1.3 to 1.5. These discrepancies represent a relatively minor problem that has been analyzed and carefully explained by Giacometti (2000a). The lowest figures have been widely used in historical studies dealing with agriculture and more generally with economic change in colonial Vietnam, especially by Marxist historians (e.g., Murray 1980), as evidence of economic stagnation and, considering the large volumes of rice exported, of colonial exploitation. Even adopting the highest figures would imply that, at that time, paddy yields were significantly lower in Vietnam than in Southern China, Taiwan, Korea, Java, and Southern India. Furthermore, if these figures were accepted, paddy yields in Vietnam would be barely higher than in Cambodia, Thailand, or even Laos, which is particularly puzzling.

The unexplained drop in paddy yields in southern Vietnam during the early 20th century

The need for a reassessment of paddy output and a much more substantial upward revision than suggested by Giacometti (2000a) become obvious when comparing official series for southern Vietnam published in different official sources between 1878 and 1972. Official sources suggest a drastic decline in yields at the turn of the 20th century for southern Vietnam, which does not seem attributable to declining factor productivity, but, rather, due to a disruption in data collection. A sudden rise in rice yield is observed in both South and North Vietnam during the years following independence and partition in 1954, although in South Vietnam the introduction of high yield varieties did not occur before the mid-1960s[5]. It seems that there is no other possible explanation for this increase than a rapid improvement in the monitoring of

rice output by local administrations or, more likely, in the transmission of information to the central government. Figure 1 allows a visual inspection of available average yield data reported in official sources and a comparison with estimates of paddy yields for the same region proposed in this paper (Section 4).

Figure 1 : Comparison of officially reported and estimated rice yields in southern Vietnam for the period 1870-1972 (tons per ha of cultivated land).



Sources: Official data: Etat de la Cochinchine Francaise (1878-1908), Bulletin Economique de l'Indochine (various years), Annuaire Statistiaue de l'Indochine (1913-1946), Annuaire Statistiaue du Vietnam (1947-53), Vietnam Statistical Yearbook (1954-1972). Estimates: See Section 4 for a description of estimation procedures.

The most likely explanation of declining paddy yields in southern Vietnam around 1904 and of the sudden increase from 1958 onward as recorded in official publications lies in the fact that these figures have been produced through a process of data collection by local Vietnamese

5) Statistical yearbooks of South Vietnam provide data on average yields in 1971 and 1972 for the areas corresponding to former Cochinchina (southern Vietnam). Figures in tons per ha were 1.96 and 1.78 tons for local traditional varieties against 3.95 and 3.67 tons per ha for high yield varieties. About 71% of the paddy field acreage was cultivated with local varieties (Vietnam Statistical Yearbook 1972; 304-305).

authorities and compilation at the central level. French colonial administrators were well aware of the dissimulation of a significant part of the output by the local village or provincial administration. Until around 1904, the dominant method has been direct estimation under the supervision of French colonial officers present in the different provinces (as heads of provinces and districts), or data collection under the direct supervision of colonial services. After the establishment of the central administration of the Government of Indochina with headquarters in Hanoi, in 1898, the number of top ranking bureaucrats present in southern Vietnamese provinces declined. The attention of the French colonial administration focused on the improvement of data monitoring in northern and central Vietnam, where available information was regarded as highly unreliable. As a consequence, a margin of error was accepted, for southern Vietnam, as a necessary evil. Data collection relied increasingly on the local administration. As rice was by far the easiest agricultural product to tax, local civil servants, who were generally socially close to landlords, or were landlords themselves, had strong motives for understating rice output.

An additional explanation is that the establishment of a central government in Hanoi implied a transfer of tax revenues collected by local authorities in southern Vietnam, and until that date mostly used in this region, for public expenditure in central and northern Vietnam. We may even suspect an informal agreement with the local elite of landlords and local Vietnamese authorities, since the new administrative framework of French Indochina implied a massive transfer of resources collected through taxation in the south for investment in the north. The average tax revenue per capita was already much higher in southern Vietnam, which may explain the reluctance by the local elite

and administration to admit the actual degree of tax evasion, and rice output was obviously the best possible indicator for this purpose.

3. Available Micro Data Concerning Paddy Yields during the Period 1900-1940

Detailed quantitative information on paddy yields of local rice varieties cultivated in different provinces of southern Vietnam in 1910 have been reported for the colonial exposition held in Marseilles in 1911. These figures were not based on monitoring by the colonial administration but on declaration by Vietnamese local authorities, who had every reason not to exaggerate the level of land productivity. This set of information suggests that the average yield was in the range of 1.5 to 2 tons per ha in southern Vietnam as a whole. But it reached between 2 and 2.5 tons per ha in Can-Tho, Sa-Dec and Soc-Trang provinces, which were among the major rice producers at that time (Table 1).

For several varieties, cultivated in Soc-Trang, Bac-Lieu, and Sa-Dec provinces, yields of more than 3 tons per ha are reported, which is higher than the average yield for the best harvests recorded in southern Vietnam during the 1960s and early 1970s after the introduction of Green Revolution techniques. It should also be noted that many of the lowest yields were observed in the Chau-Doc province, which was an area of floating rice cultivation, explaining therefore relatively low yields, and in Thu-Dau-Mot and Tay-Ninh provinces, which did not produce much rice.

The decline in rice yields in southern Vietnam at the turn of the 20th century can be partly explained by the extension of paddy cultivation and therefore by lower yields in newly reclaimed paddy fields. However, this explanation does not fit well with available data at the

Table 1 : Distribution of average paddy yields (ton per ha) for 327 traditional varieties of rice cultivated in southern Vietnam around 1910 (excluding glutinous rice).

Provinces	＜1.0 tons	1.0 to 1.5 tons	1.5 to 2.0 tons	2.0 to 2.5 tons	2.5 to 3.0 tons	＞3.0 tons
Chau-Doc	11	11	3			
Rach-Gia				6		
Can-Tho				9		
Soc-Trang			1	45	23	2
Bac-Lieu	3	2	1	2	1	2
Cholon	25	3	43	8	1	
Ta-Nan		2	3	2		
Sa-Dec			1	2	2	2
Vinh-Long	2	43	32	5		
Tay-Ninh	1	2				
Thu-Dau-Mot	18	6	2			
Total	60	69	86	79	27	6

Source: Baillaud (1912); quoted in Giacometti (2000a, 57).

provincial level. In the late 1920s and late 1930s, and also in 1950, in the provinces corresponding to the most ancient paddy fields where double cropping has been relatively common since at least the mid 19th century, reported rice yields were lower than 1.5 ton per ha. The few exceptions are Can-Tho with 1.59 in 1928 and 1.8 in 1950, Go-Cong with 1.55 in the late 1930s, and Sa-Dec with 2.00 in 1950 (Bulletin Economique de l'Indochine, quoted in Takada 2000, 135). Still, the possibility of declining fertility of marginal land cannot be entirely dismissed. In order to tackle this problem, paddy output and cultivated area data are estimated at the provincial level.

Information on paddy yields in northern and central Vietnam

Samples of rice varieties cultivated in northern Vietnam were also

presented at the colonial exposition of 1911 (Table 2). Here again, reported paddy yields were in the range of 1.8 to 2.2 tons per ha, with an average of about 2.0. As rice yields are similar for the winter rice and the summer rice, around 2 tons per hectare for each harvest, paddy field suitable for double cropping may have yielded as much as 4 ton per ha per year. This is consistent with paddy yields for glutinous rice varieties reported by a French settler around 1912 (Table 3). It should be noted that the techniques used in rice plantations that were part of land concessions to French settlers in Vietnam where almost identical to those used by ethnic Vietnamese in surrounding areas. Rice was cultivated by ethnic Vietnamese tenants.

Comparable levels of land productivity were achieved, in 1906–1910, in Thanh-Hoa province (in the northern part of central Vietnam) at the Yen-Dinh agricultural station (Table 4). Cultivation techniques were similar in Thanh-Hoa to those implemented in the Red River Delta. The average yields of the different types of varieties for the 1906–1910 period are 2.02, 1.66 and 2.00 tons per ha, respectively, with an unweighted average of 1.89. Even when taking into consideration that average paddy yields are slightly lower in an agricultural station than in ordinary paddy fields, these data are in clear contradiction with official figures for central and northern Vietnam. The high volatility is not surprising, especially in central Vietnam, due to the frequency of natural hazards (droughts and typhoon induced floods). We would expect volatility to be lower in the Red River Delta, with figures for poor harvests much higher.

When using this information, we have to take into account the fact that these figures are not yields per year but per harvest. Assuming double cropping on 40% of the paddy field area, we obtain 2.5 tons par

Table 2 : Paddy yields of different varieties of the summer and winter rice seasons in northern Vietnam around 1910

Local name of the variety	Yield (ton per ha)	Sowing	Trans-planting	Harvest
Gao chiem say	1.8	Nov	Dec	May
Gao chiem trang	1.8	Nov	Dec	May-June
Gao mua, 1st quality	2.0	May	July	Nov
Gao mua, 2nd quality	2.0	May	July	Nov
Gao mua, low quality	2.0	May	July	Nov
Gao mua say	2.0	May	—	Nov
Gao nep ruou say*	2,2	May	—	Nov
Gao tam thom**	2.0	May	July	Nov
Thoc di trang	2.0	May	July	Nov
Thuoc mua so	2.0	May	July	Nov
Thoc nep	2,2	May	July	Nov
Thuoc rung***	1,8	May		Oct

Source: E. Baillaud, "Les riz indochinois a l'exposition de 1911 de l'Institut Colonial Marseillais", BEI 1912, 96, pp. 424-425). Echantillons de varietes expediees par la Chambre d'Agriculture de Tonkin et Nord-Annam
Notes: *glutinous rice; **high quality rice; ***mountain rice.

ha, which is about twice as high as the figure recorded in official sources as the average for central Vietnam. However, taking into account the possibility of lower yields outside the agricultural station and also in northern Vietnam and the central Vietnamese midlands, these two corrections should compensate each other. Thus, we can conclude that the average yield was around 1.5 to 2.0 tons per ha and per year —— probably closer to the latter.

The underestimation of paddy field acreage and harvested acreage in colonial reports

In addition to the underestimation of yields, we have to take into

Table 3 : Glutinous rice yields observed on a French rice plantation in Tonkin

Local name of the variety	Yield (ton per ha)	Sowing	Trans-planting	Harvest
Nep cai	2.10	May	June	Oct
Nep cai	2.10	May	June	Oct
Nep chiem	2.10	Oct	Nov	May
Cao gie	2.05	May	June	Oct
Gi	2.00	May	June	Oct
Nep ong lao	2.10	Oct	Nov	May
Nep vai	2.10	Oct	Nov	May

Sources: "Echantillons de varietés expédiées par M. Louis Dubourg, colon à Hung-Yen" (Tonkin), BEI 1912, 96, mai-juin, p. 424.

Table 4 : Rice yields in tons per ha at Yen-Dinh agricultural station (Thanh-Hoa province, Central Vietnam) in 1906–1910.

	1906	1907	1908	1909	1910	Average
Winter rice (a)	1.021	2.700	1.999	2.290	2.090	2.02
Summer rice (b)	0.848	1.862	2.305	0.970	2.325	1.66
Summer rice (c)	1.067	2.478	1.999	2.296	2.145	2.00

Source: Brenier (1914, 148).
Notes: Data effectively recorded on paddy fields of 2 to 9 ha. (a) Rice of the fifth month; (b) rice of the tenth month; (c) rice of the tenth month with a shorter cycle (sown in June).

account the underestimation of cultivable area, i.e., the acreage of paddy fields, and less important for southern Vietnam, the underestimation of double cropping[6]. The first source of error is explained by the fact that paddy field was recorded for the purpose of land tax collection. As new paddy fields on reclaimed land were exempted from the land tax, usually during the first five years of cultivation, the underestimation of cultivated area was unavoidable, especially in southern

6) Giacometti (2000a) discusses these problems and proposes to revise upward official figure on acreage by 30%, 25% and 10%, for Tonkin, Annam, and Cochinchina, respectively. The present study uses almost similar coefficients for estimating paddy field acreage, but with a much higher upward revision of yields; see below for details.

Vietnam where land reclamation was proceeding at a rapid pace. In northern Vietnam, land reclamation of tidal marshlands continued until the mid-20th century in the coastal areas of the Red River Delta as well as in several peripheral provinces of northern Vietnam, where public irrigation infrastructure works have permitted the extension of rice cultivation during the first decades of the 20th century. In the hinterland of central Vietnam originally occupied by ethnic minorities, the construction of roads permitted the migration of ethnic Vietnamese settlers during the 1920s. In Vietnam as a whole, the rice frontier did close before the 1970s in the lowlands, but was still marginally open in the 1990s in the midlands and the highlands.

Why did the colonial central government publish underestimated paddy output data?

The first answer, already mentioned earlier, is that the colonial central government was unable to monitor actual paddy output in the different provinces. A possible second and complementary answer is that although the authorities suspected underestimation, the consensus among French and ethnic Vietnamese civil servants was that the tax pressure on agriculturalists was already high enough and that fiscal policy should be aimed at extracting more revenues from the well-off, particularly from ethnic Chinese traders. A third explanation is that the French civil servants of the colonial administration and the scholars who studied paddy cultivation in Vietnam before WWII (Henry 1931; Gourou 1936) relied on two complementary methods that pointed to similar results and suggested that output data were consistent with consumption estimates. Output was derived from estimates of cultivated area and yields officially recorded, with a significant upward

revision of acreage and a limited one of rice yields (less than 10% higher).

Consumption figures for the Red River Delta, were calculated by Bournier (1925) and Gourou (1936) relying on population data, per capita rice consumption observed in various micro-surveys, rice alcohol production based on fiscal sources, estimates of seeds required, and rice export data[7]. The results of their field surveys were almost identical: 268 kg of paddy per capita according to Bournier (1925) and 277 according to Gourou (1936). These results were based, in Bournier's (1925) case, on an assumed average daily consumption of 0.948, 0.868 and 0.454 kg equivalent paddy for male adults, female adults, and children, respectively; Gourou (1936) measured 0.76 kg of equivalent paddy per day on average, which is almost the same[8]. Domestic consumption other than human was also estimated for the year 1925 and was found to account for less than 7% of human consumption in northern and central Vietnam, and 14% in southern Vietnam (Table 5).

The major shortcoming of this method is that, if the population series obtained using a backward projection method are accepted[9], pre-W.W. II rice consumption figures would be derived from population data that were significantly underestimated (Banens 2000). This may explain the inconsistency between micro-data on rice yields, slightly less than 2 tons, and implicit yields described in official output estimates, about 1.4 tons per ha. Although 0.76 kg of paddy per day may seem high by East

7) See Giacometti (2000a) for a more detailed discussion.

8) As most of the rice consumed in rural areas of northern Vietnam was processed locally (sometimes by the consumer themselves, usually by specialized workers in the same village), the coefficients of conversion of paddy into husked brown rice are those observed when using traditional techniques of rice milling.

9) Based on Banens (2000), slightly revised.

Asian or Southeast Asian standards, it should be taken into account that possible substitutes such as maize were only marginally cheaper[10]. Bournier and Gourou were well aware of the fact that living standards were low, especially in rural areas of central and northern Vietnam. Revising rice output upward in order to make estimates consistent with observed yields would have implied a very high per capita consumption of paddy, either as human consumption of rice or for animal feeding, implying, in turn, a much higher consumption of poultry and eggs.

The explanation presented in semi-official reports of the colonial administration, in an attempt to reconcile the different pieces of information was that, on average, natural hazards occurring almost every year reduced rice yields to about 30% lower than "normal" yields. Thus, yields close to about 2 tons per ha, observed in field reports, were figures for bumper harvests (Henry 1928). This is a distortion of the picture shown by micro-data reported in the early 20th century as well as average paddy yields implied by late 19th century. Thus, there does not seem to be any justification for the downward revision of 30% proposed by Henry (1928).

The estimation procedures used for reconstructing paddy field acreage and output volume series fall into four stages. First, acreage figures are revised upward on the basis of information regarding the degree of underestimation in official data used for land tax collection (and some information regarding the extent of concealment by landowners).

10) Owing to cultural preferences, maize, sweet potatoes, and cassava were not regarded as acceptable substitutes for rice but rather as snacks; only the poorest rural households of the Red River Delta would not use rice as the main staple (Gourou 1936). It should be noted that scientific knowledge of nutritional content allows identifying retrospectively a rationale for these popular prejudices: although more expensive per kg, rice was usually cheaper per caloric unit than sweet potatoes.

Table 5 : Domestic consumption of rice in Vietnam in 1925 in thousand tons (in parentheses: as a percentage of human consumption)

	Northern and Northern Central Vietnam	Central (excluding Northern Central)	Southern Vietnam
Human consumption	2360 (93.6)	680 (93.5)	1060 86.0
Animal feeding	3.5 (0.1)	2 (0.3)	3 (0.2)
Seeds	124 (4.9)	40 (5.5)	144 (11.7)
Alcohol	34 (1.3)	5.5 (0.8)	25 (2.0)
Total	2521.5 (100.0)	727.5 (100.0)	1232 (100.0)

Source: SSG (Bournier 1925), quoted in Giacometti (2000a, 50).

Second, yearly series of normal yields are reconstructed. Normal yields here are defined as average yields taking into account the negative impact of natural hazards and the positive influence on harvests of favorable weather conditions. Third, “normal” (or expected) output volume yearly series are then derived from the estimated acreage and “normal” yields.

Yearly series of acreage and yields are estimated separately for each of the 20 provinces of southern Vietnam for 1880-1954. A specific procedure is devised in order to evaluate to what extent the extension of the rice frontier to marginal land did induce a decline in average yields for the whole region. Provincial level acreage and yield time series are then combined for estimating output.

4. New Estimates of Paddy Field Acreage and of Output Volume for Southern Vietnam

The estimation of paddy field acreage

Data on provincial paddy acreage are available for 43 benchmarks years between 1880 and 1954 (1880, 1883, 1888, 1890-1898, 1900, 1902, 1906-1911, 1913, 1920-1924, 1926-1931, 1938, 1944-1947, and 1950-1954)[11]. Paddy field acreage in each province is derived from official series[12]. For several years, the information reported in official sources (cf. figure 1) should be regarded as unreliable, either because the figures imply an excessively high growth in acreage (1880, 1883, 1888, and 1906-1908) that probably reflects the rapid improvement in the monitoring by the colonial administration, or because an unexplained drop is observed in most province, which is inconsistent with export data (1892-1894, 1910-1913, 1927-1930, and 1946-47). Thus, information is regarded as most reliable for 1890-1891, 1895-1898, 1900, 1902, 1909, 1913, 1920, 1926, 1931, 1938, 1944-47, 1950-1954.

An upward correction of 10% is introduced for the years before 1920. This is justified by the under-registration of paddy field acreage as a

11) Data for 1920 are actually averages for the period 1919-1922; those for 1926 are averages for 1923-29; those for 1931 are averages for 1925-1930; and those for 1938 are averages for 1936-1940. The rationale for using the averages for the period 1925-1930 for the year 1931 is that paddy field acreage did not decline immediately at the outbreak of the World Depression and that an upward trend is observed in most provinces between 1926 and 1930 in the data reported by Takada (2000).

12) Although double cropping of paddy existed in some areas around Saigon before 1954 (and even in the 19th century), it was marginal and can therefore be neglected when reconstructing acreage under cultivation.

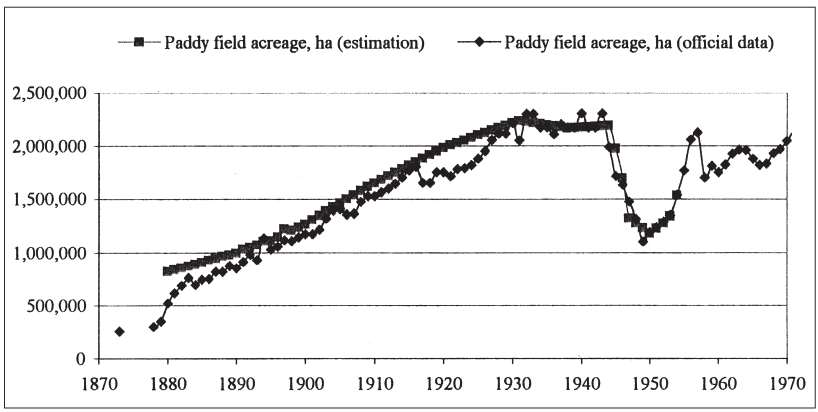
result of the exemption of new paddy fields from land taxes for five years[13]. On average, acreage expended by about 10% for every five-year period until the 1920s. The year 1930 is the historical peak in acreage in most provinces (for the period 1880–1954). For this reason, it does not seem necessary to revise upward acreage data for selected benchmark years thereafter. Also, there is no need for a correction for the years 1920 and 1926 because official data for these years were already revised upward for publication in the Annuaire Statistique de l'Indochine.

Missing data are generated by using linear interpolation between benchmark year data, and extrapolated backward for the period 1880–1889, assuming a constant growth rate of acreage of 2% per year in all the provinces. This is broadly equivalent to the growth rate of acreage during the 1890s in southern Vietnam. Figure 2 offers a comparison of the total of paddy field acreage, based on estimations at the level of the 20 provinces, with series for southern Vietnam reported in official sources. The new estimates differ markedly from official series during the 1920s. The drop in acreage in official series after 1916 is inconsistent with narrative evidence and export series. As linear interpolation is used between 1931 and 1938 and between 1938 and 1944, official series are slightly higher than estimates for several years. It appears preferable to adopt a conservative approach in order not to overestimate the standard of living during the 1930s. An additional consideration is that several newly reclaimed paddy fields recorded as productive, from the viewpoint of the tax collection, were actually left uncultivated due to a

13) It is likely that landowners tended to conceal part of the taxable paddy field acreage but this aspect of understatement of cultivated area in official sources is not taken into account.

sharp decline of paddy prices.

Figure 2 : Paddy field acreage in Southern Vietnam, 1870-1970



Sources: See Figure 1.

The estimation of rice yields at the provincial level

Official figures of output by province are recorded for 25 years between 1880 and 1954 (1880, 1883, 1892, 1897-1898, 1913, 1920-1924, 1926, 1928-1930, 1938, 1944-1947, 1950-1954; data for 1938 are actually averages for 1936-40). As official acreage figures are reported for all these years, it is possible to calculate implicit average yields by province for 25 benchmark years.

In addition, a classification of paddy fields along three fiscal categories is available for the years 1880, 1883, 1892, 1997 and 1898 in Etat de la Cochinchine Francaise (ECF), along with average yields for southern Vietnam as a whole for these years. To a certain extent, this fiscal classification was arbitrary and, at a micro-level, it probably depended on the bargaining power of each landlord vis-a-vis the local administration. Still, it reflected significant difference in land prices

(ECF, various years) and can therefore be regarded, at a provincial scale, as an indicator of differences in land productivity. Assuming normal yields of 2.6, 1.8, and 1.5 tons of paddy per ha for three classes of paddy field[14], and combining this with information on paddy field acreage, average yields of about 2.12 to 2.37 tons per ha are obtained for these years. This is consistent with the average yields for southern Vietnam as a whole implied by the output volume reported in ECF for this period. By relying on the share of the three fiscal classes of paddy fields in each province, it is possible to calculate average yields in these different provinces for these five benchmark years. Given that these figures are obtained on the basis of detailed information, these yields can be regarded as more reliable than averages calculated based exclusively on total acreage and total output.

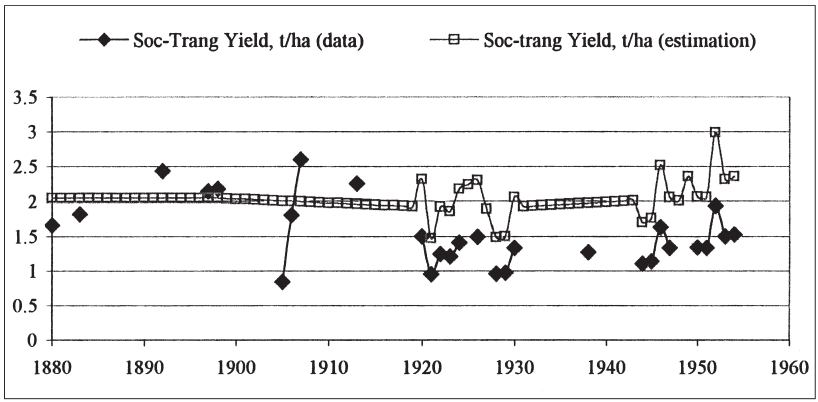
As noted for official data regarding southern Vietnam as a whole, implied yields were lower during the interwar period than in the 1890s. Part of the decline in yields may be genuine, resulting from the expansion of the rice frontier westward bringing under cultivation land of lower natural fertility or located in areas more exposed to natural hazards (mostly floods) and destruction by the local wild fauna (rats, birds, wild boars, etc). In order to evaluate the influence of natural conditions, we can rely on information for the provinces in which acreage did not increase much. These were the most populated areas that had the most ancient paddy fields. In these provinces, we would expect that "normal" yields remained relatively stable after 1900, although yields reported in official publications were much lower.

14) Henry and DeVisme (1928 : 52). These are figures for normal yields unaffected by the impact of natural hazards, which are broadly consistent with the consensus among biologists regarding the potential of traditional varieties. The authors also mention "normal" yields of 2 tons per hectare for floating rice, which seems extremely high.

Soc-Trang province is used a benchmark because it was the province in which acreage increased the least after 1900. According to official statistics, paddy field acreage in Soc-Trang province had already reached 173,000 ha in 1913, close to the pre-1954 peak of 200,000 (in 1920). A figure of 2.25 tons per ha was still reported for 1913 in official sources (Brenier 1914), but the average of available data for the period 1920–1954 is 1.32 (calculation based on data for 18 years). The difference between the average yield of the period 1920–1947 and the average for 1880–1898 (1.32 versus 2.00 tons) is 0.68 (implying an underestimation of about 34% during the period 1920–1954). It is assumed that this number corresponds to the extent of underestimation of rice yields due to the disruption of monitoring by the central administration between 1905 and 1954, and that it was broadly the same in all provinces.

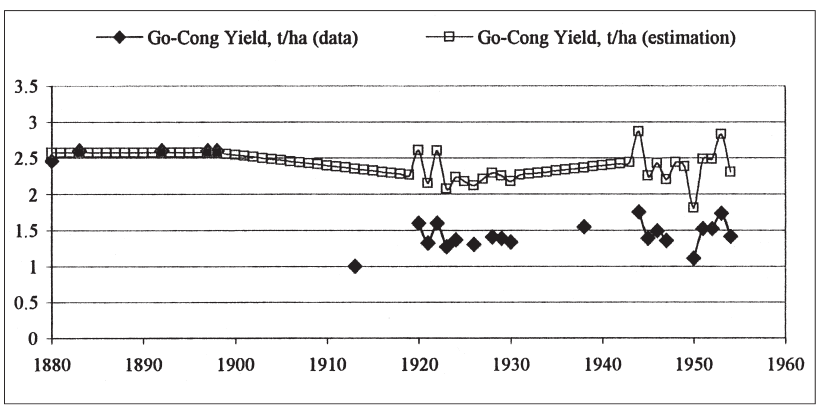
Similar ratios are calculated for all the other provinces. They are higher than for Soc-Trang province, except in Rach-Gia province which has a ratio of 0.31 (suggesting perhaps that, in this province, newly reclaimed land had a natural fertility higher than ancient paddy fields). In general, the gap between the ratio observed for Soc-Trang and that measured for the other provinces was narrower for the provinces where ancient paddy fields accounted for a large share of cultivated acreage (for instance, the ratio was 0.44 in Go-Cong). The gap was wider for provinces where large tracts of forest and marshes were opened for rice cultivation during the late 19th and early 20th century, (for instance, the ratio was 0.51 in Bac-Lieu). The difference between the ratio obtained for a given province and that for Soc-Trang indicates the percentage of decline in rice yields attributable to the extension of rice cultivation in new paddy fields of lower natural fertility (in the case of Rach-Gia, the negative difference can be interpreted as implying that new paddy

Figure 3-1 : Rice yields in Soc-Trang province 1880-1954 (tons per ha).



Note : Dots reported as data for 1880, 1883, 1892, 1897 and 1898 are actually based on the calculation of average yields using the fiscal classification of paddy fields.

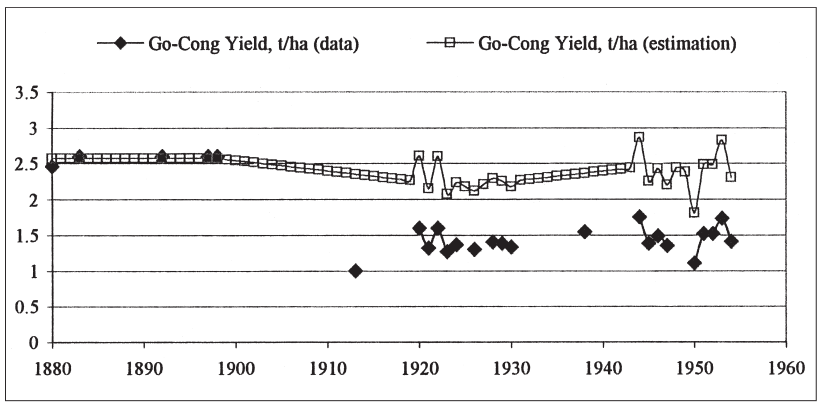
Figure 3-2 : Rice yields in Go-Cong province 1880-1954 (tons per ha)



Note: See Figure 3-1.

fields had a higher fertility than old ones). For each province, the difference in the ratio to that for Soc-Trang is used to correct upward the yields reported in official sources of the period 1920-1954. Average yields for the period 1890-1898 are used as a proxy for 1880-1898 and missing values are interpolated. Figures 3-1, 3-2, and 3-3 provide three

Figure 3-3 : Rice yields in Bac-Lieu province 1880-1954 (tons per ha)



Note: See Figure 3-1.

examples of the result of upward revision of rice yields, showing the cases of Soc-Trang, Go-Cong and Bac-Lieu provinces.

The estimation of output volume taking account of yearly variations due to natural hazards

Yearly time series of normal yields are combined with estimated values of acreage in order to generate series of paddy output volume for each province. For the years 1920-1924, 1925-1930, 1944-1947 and 1950-1954, for which the yearly fluctuation of rice yields is derived from original series, yields implied by official output and acreage series are revised upward using a ratio specific to each province. However, for all the other years, the output estimates are average levels for normal years.

In order to obtain plausible consumption series (derived from output figures and export data; see chapter 6), it is desirable to evaluate yearly fluctuations of yields due to natural hazards. Considering the fragmentary nature of information on natural hazards in each province, it

appears preferable to estimate yearly variations in output for southern Vietnam as a whole rather than at the province level. Yearly variations of rice exports from southern Vietnam (taking into account the transit of rice from Cambodia via Saigon) provide an indicator of the impact of natural hazards on paddy harvests. A fall in the ratio of the export volume of the year to the average of the two last years is used as an indication of occurrence of natural hazards[15]. This ratio fluctuates within a range between 0.85 and 1.15 with an average value of 1.01 during the period 1880-1940. This is comparable to the fluctuation observed in the years for which official yields have been used.

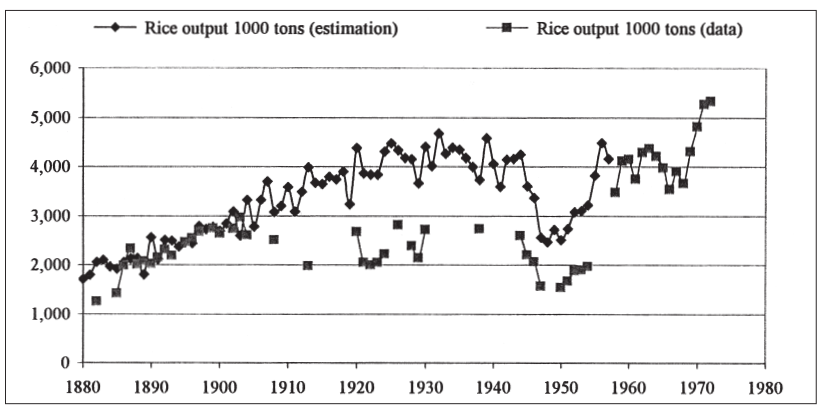
The new output estimates for the period 1880-1954 are then linked with series that are available for the period 1955-1972 for the part of South Vietnam corresponding to southern Vietnam. For the sub-period 1955-1957, paddy yields reported in official sources are at the same low level as those reported between 1913 and 1954 in the statistical year-books of Indochina and other colonial reports (1.32, 1.33, and 1.20 ton per ha in 1955, 1956, and 1957, respectively). However, between 1958 and 1972, all the numbers are above 2 tons per ha (except in 1966, when the value was 1.95). The average for the new estimates of paddy yields for 1950-1954, 2.24 tons per ha, is almost identical to the average reported in official sources for the period 1958-1965 (2.18 ton per ha). Therefore, it appears safe to use the same correction as for 1950-1954 in order to revise upward rice yields for 1955-1957. Official data regarding acreage

15) The formula used here is $Ye_t = Yn_t . (X_t / av(x_t, x_{t-1}) + 1)/2)$, where Yet is the estimated effective yield in year t, Ynt the estimated "normal" yield in year t, Xt rice export in year t, and av (X_t, X_{t-1}) the average of rice export in years t and t-1. The justification for the reduction by half of the magnitude of the fluctuation is that about half of the output was used as domestic supply. It is assumed that the yearly volatility of domestic consumption was negligible.

after 1954 are used without any revision.

Estimates of acreage and paddy yield series taking into account the short-term volatility of harvests are finally combined for calculating output volume series. Figure 4 compares these new output series with data published in official sources. It should be emphasized that although the upward revision of output for 1908-1940 may at first sight seem excessive, the result is consistent with the fact that southern Vietnam was one of the three major Asian rice exporters before WWII and that rice exports almost completely ceased after 1945.

Figure 4 : Paddy field acreage and output volume in southern Vietnam 1880-1972.



5. Conclusion

The results presented above indicate that the level of land productivity reached in southern Vietnam before the Green Revolution of the 1960s, although lower than in Japan, was significantly higher than in Burma, Cambodia, Thailand, and even Java. Southern Vietnam appears therefore as a notable exception to the initial conditions implied by the

'Ishikawa curve', as both the land/man ratio and land productivity were comparatively high before WWII.

The upward revision of rice output figures for the interwar period by about 100% does not imply a proportionate upward revision of per capita food supply or agricultural workers' living standards. Population also was underestimated before the 1960s, albeit to a lesser extent. Population estimates proposed by Banens (2000) for the interwar period are about 30% higher than official figures reported in various issues of the Annuaire Statistique de l'Indochine (Statistical Yearbook of Indochina). Also, available information suggests that the magnitude of understatement of output in official sources was higher for rice than for most other crops.

In addition, figures for labor productivity in rice cultivation, which can be obtained from land/man-ratio and land-productivity estimates, should be used cautiously when attempting to measure the standard of living. As double cropping was practiced in only a tiny proportion of paddy fields, relatively few job opportunities existed in the slack season during the dry period of the year (about 6 months). In those regions of mainland Southeast Asia where population densities were initially low, the demographic growth of the mid-20th century led to a decline in the land/man ratio before the Green Revolution of the 1960s, particularly in southern Vietnam where paddy field acreage did not increase much after the early 1930s and, in fact, even temporarily fell by as much as 50% during the Indochina War (1945–1954).

The introduction of Green Revolution techniques, such as high yield varieties and industrial fertilizers, which occurred during the 1960s in southern Vietnam, contributed to a rise in land productivity. In terms of labor productivity, however, the positive impact was partially offset by

the decline of the land/man ratio resulting from the acceleration of population growth. The decisive factor leading to an increase in land and labor productivity during the last two decades of the 20th century was the rise in the harvested land/man ratio resulting from investment in drainage and irrigation infrastructures that allowed the shift to double cropping.

The quantitative information obtained when combining the population series estimated by Banens (2000) with the revised paddy field acreage and rice output series for southern Vietnam presented above shows that, until the late 20th century, the path of transformation in rice cultivation did not follow the 'Ishikawa-curve'. The land/man ratio was on a declining trend during the entire 20th century, especially so after the 1930s. This may be seen as consistent with the initial phase of the 'Ishikawa curve'. However, land productivity did not improve much before the late 1980s and probably even declined slightly before the 1930s as a result of reclamation of marginal lands. It seems that the diffusion of Green Revolution techniques, that occurred during the 1960s, did not induce more than a recovery to the levels seen in the late 19th century.

The period of the shift to double cropping, which during the last two decades of the 20th century allowed a significant rice in land productivity, could be interpreted as the true start of the 'Ishikawa-curve' in southern Vietnam. But it occurred from a comparatively high level of land productivity. These results suggest that it is worth considering whether other Asian countries or regions, such as Burma, Korea, Thailand, or Northern Vietnam, experienced a similar initial phase of stagnation or decline in land productivity in the 19th or 20th century and, as a result of population growth more rapid than that of land

reclamation, a fall in the land/labor ratio that led to a decline in labor productivity.

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Appendix (available upon request in electronic format): Paddy field acreage, paddy output, and population in Southern Vietnam (1880–1960).

Rice Cultivation in Southern Vietnam (1880–1954) : A Re-evaluation of Land Productivity in Asian Perspective

Jean-Pascal BASSINO

《Abstract》

The conventional interpretation of Asia's agricultural transformation during the 20th century is that land productivity and land/labor ratios, which were both initially comparatively low, increased as a result of technological change. Data available for a number of Asian countries have usually been interpreted as showing as a land-replacing path described as the 'Ishikawa-curve' (Ishikawa 1981). However, as Van der Eng (2004) has shown, Ishikawa's interpretation is biased towards East Asia, providing an adequate description of the experience of Japan, Taiwan, and Korea but not of the mainland Southeast Asian countries. He produces evidence that the land/labor ratio was much lower in Japan than in Mainland Southeast Asia.

The purpose of this paper is to investigate the yield series implied by late 19th century official sources and by micro-data collected by the French colonial administration, and to propose a re-evaluation of paddy output. The results show that, in southern Vietnam, initial conditions were not only characterized by high land/labor ratios but also by comparatively high land productivity, and therefore high level of labor productivity. It appears, therefore, that the path of southern Vietnam's transformation of rice cultivation differs markedly from the received wisdom expressed by the 'Ishikawa-curve'.