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Transforming traditional rice farming: the Surinam experience

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Summary

Survey data from diverse types of rice farms in Surinam were fitted into a theoretical model representing the economic development of famliy rice-farming. In the course of analysis of the possible causes underlying the transformation from traditional through transitional towards commercial family enterprises, two hypotheses are presented. The first one attributes the differences to the human factor; the second hypothesis asserts that techno-economic factors are mainly responsible for the presence of various stages in farm development. Available evidence suggests that water control and farm size are of crucial importance. In traditional farming the use of resources is not inefficient but improvement of this type through the use of new inputs is mainly impeded by lack of water control. These results accord with recent research findings in several rice-growing areas of South-East Asia.

Introduction

Rice was one of the less important crops in Surinam, before the immigration of indentured Hindustanis and Javanese in the period 1873–1939. These labourers, whose staple was rice, were encouraged to stay in the country after their contracts had expired. The Colonial Government of the time offered them smallholdings of about 1 hectare. These holdings were laid out usually adjacent to existing estates, to stimulate workers to seek additional income from these plantations. Gradually ex-labourers were also allotted farms on virgin land, some of which was empoldered by the Government. This socio-economic policy kept investment per family to a minimum and resulted in many smallholdings. This pattern still exists today in most of the country's rice-growing areas.

In the past these small riceholdings were by no means economically unattractive. Farmers worked with simple hand-implements and so could handle only small areas. With hand-cultivation much labour is required, especially for field preparation, planting and harvesting, which have to be carried out in short periods.

Ploughing was introduced to Surinam in the early twenties, but developed slowly. Mechanical rice-farming was introduced in 1933, when a Dutch settler started cultivating rice on a large scale in the country's westernmost district, Nickerie. But it was not until 1945 that the first smallholder bought a tractor and a plough. Gradually mechanization spread in the District of Nickerie, first among the big holdings (larger than 10 ha) but later among smallholdings. Smallholders used the machinery mainly for contract-ploughing on other smallholders' farms.

A large-scale highly mechanized rice project, named Wageningen Rice Scheme, was started in the early fifties in the Nickerie district. The scheme was set up jointly by the Dutch and Surinam governments. Towards the end of 1964 a number of medium rice-farms (24 ha) were established in a polder adjacent to the Wageningen Scheme. Farms have been allotted to experienced indigeneous rice-farmers who are most advanced technically.
Still, technical development in the country's rice-farming has been very uneven. While field preparation, threshing and sometimes harvesting is mechanized in the Nickerie District, this is certainly not true in other rice-growing areas, where plough-farming and sometimes even hand-tillage is still found. Thus under similar natural conditions family rice-farming occurs at diverse stages of technical development.

Peasant rice-production in Surinam

With the arrival of the Asian contract-labourers a large demand for rice developed and in the early years it had to be imported. Peasant rice-production could not meet the consumption requirements until about 1930, whereafter Surinam became self-sufficient for this commodity. The country then even began rice exporting which reached a peak in the early fifties.
Owing to a slightly decreasing peasant production and a steep population increase the surplus between peasant production and local consumption dwindled to zero in the mid-sixties. This recent decrease was entirely caused by a decline in the paddy area. Yields per hectare (ignoring the influence of the weather) during the last 10 years remained almost constant.
The growth of the country's peasant paddy production is shown in Table 1. Annual

Table 1 Peasant paddy production (in tonnes)

Year	*Paddy production*	*Year*	*Paddy production*
1887	10	1926–30	18,600
1892	24	1931–35	22,400
1897	134	1936–40	36,225
1902	374	1941–45	37,270
1906–10	1,730	1946–50	48,980
1911–15	3,400	1951–55	57,000
1916–20	9,300	1956–60	55,090
1921–25	13,150	1961–65	49,695

averages per 5-year period have been calculated from 1906–1910 onwards, to level out fluctuations from the vagaries of the weather. The 6,000-hectare Wageningen Rice Scheme has enabled Surinam to increase its export of rice in the last decade.

The transformation process

The economic transformation of a low-income into a high-income economy is a very broad subject for discussion; we have restricted ourselves to the agricultural sector only. Economists have often felt tempted to view this process from the point of

modelbuilding and accordingly they have tried to 'stage' agricultural development. One such model by Hill and Mosher (1963) which concentrates on the individual peasant farm describes the transformation process in three stages: traditional, transitional and commercial agriculture. These stages could be briefly described as follows:

Stage I: Traditional agriculture. Techniques of production are static and traditional. There is a close-knit relation between farm and household. Produce is used almost exclusively for physical maintenance of the family; there is hardly any marketable surplus. Rates of return on production factors are low. The near absence or the imperfect operation of institutions such as research, extension, credit, marketing and education is characteristic.
Stage II: Transitional agriculture. The whole system is continually subject to change. More of the produce is sold on the market than in traditional agriculture. There is an increased use of purchased inputs in farming. The rate of return on production factors is somewhat larger. Research, extension, credit, marketing and education play a more important role.
Stage III: Commercial agriculture. The relation between farm and household has weakened or ceased. Production is mainly for the market and decisions are based on money cost. Most inputs are purchased and the rate of return on production factors is normally high. The infrastructural institutions are well-developed and are a great support to the farmer.

This scheme has been used for empirical testing. Detailed input-output data representative of different conditions in Surinam rice-farming were collected over 1965 and 1966 in three of the country's most important rice-growing districts. During the analysis it was found that the Surinam farm data fitted quite well into the scheme and deviations were of minor importance only.
The final grouping was made as follows:

I *Traditional rice-farmers:*
Javanese farmers (35 households) living in the Saramacca District.
II *Transitional rice-farmers:*
A. Hindustani farmers (39 households) living in the Surinam District [1].
B. Hindustani farmers (10 households) in the Saramacca District.
C. Hindustani farmers (53 households) in the Nickerie District.
These three groups seem to represent different substages of transitional agriculture.
III *Commercial rice-farmers:*
Creole, Hindustani and Javanese (8 households) settled in a new polder next to the Wageningen Rice Scheme.

To improve the comparison, sampling was stratified. Those farms were included which cultivated between 2 and 3 hectares of rice; this applies to groups II A, B and C. This was not possible for the traditional Javanese group as rice was restricted to about 1 hectare per household. Farmers in stage III all had 24-hectare rice-farms.

[1] The district surrounding the capital of Paramaribo is named Surinam District. It should not be confused with the country.

The economic structure of rice farming in transformation

Output

The frequency distribution of yields per hectare for the sampled farms is presented in Table 2. Variations between years in each area are less important than those

Table 2 Number of farms with different paddy yields (in bags of 70 kg) per ha

Yield in bags	*Traditional Group I 1966*	*Transitional*				*Commercial Group III 1965–1966*	*Total*
		Group II A		*Group II C*			
		1965	*1966*	*1965*	*1966*		
5–10	1	—	—	—	—	—	1
10–15	7	3	1	—	—	—	11
15–20	1	6	6	—	—	—	13
20–25	2	8	8	—	—	—	18
25–30	9	15	8	2	1	—	35
30–35	6	5	9	1	1	4	26
35–40	4	2	4	9	7	4	30
40–45	3	—	2	10	11	2	28
45–50	2	—	1	8	16	4	31
50–55	—	—	—	8	4	4	16
55–60	—	—	—	7	8	1	16
over 60	—	—	—	8	5	—	13
Total	35	39	39	53	53	19	238

between areas. Lack of irrigation seems to limit output per hectare. Absence of water-control, leading to drought or flooding, is the main reason for the uneven yield distribution amongst the traditional smallholders. There is not such contrast in yields between the transitional farmers of Nickerie and the commercial ones of Wageningen.

Inputs

Land. In rice farming, productivity of the land depends on water control. The average productivity of land for this sample of farms has been calculated per group. Use has been made of the 'residual method', i.e. all costs but landrents have been deducted from the gross value of production. The result is shown in Table 3. The

Table 3 Average land productivity and actual Government landrents (in Surinam guilders [1])

Group	*Residual value of land/ha*	*Actual government landrents and water rights*
I 1966	— 111.5	2.0
II A 1965	— 75.2	10.0
1966	— 33.6	10.0
II B 1965	87.2	10.0
II C 1965	142.0	10.0
1966	178.4	10.0
III 1965	175.4	47.3
1966	77.3	44.0

[1] 1 Surinam guilder is about US $ 0.53.

table indicates that there is a tremendous range in the productivity of land and the contrast between the productivity of unirrigated and irrigated land is particularly striking. The calculation of the value of family labour presented the usual difficulties. With an eye on the locally paid rates for labour and the opportunities for other use of labour, family labour has been assessed at *f* 2 per man-day for traditional agriculture, *f* 3 for transitional agriculture and at *f* 8 for commercial farmers. Nevertheless, negative figures have been found in the unirrigated areas. Admittedly, this could be caused by the deduction of an imputed value of family labour which in fact had a zero-opportunity return. These are often inextricable problems. But socially, where there are no other possibilities including migration, these people should be given some return on their own labour.
As can be deduced from the last column of Table 3, official land and water rents are very cheap (in fact these of Surinam and Nickerie districts date back to 1852) and this means that farmers at Nickerie and Wageningen make handsome profits.

Labour. The use of family labour is closely connected with the technical conditions and the use of capital services. In traditional agriculture much of the field preparation and threshing was done by hand; planting also required much labour, since lack of water control caused transplanting of rice to coincide with the weeding. The differences in labour input per hectare for the various operations is shown in Table 4.

Table 4 Average number of man-days worked on various rice operations in 1966 (man-days/ha)

Group	*Field preparation*	*Planting*	*Weeding*	*Harvesting*	*Threshing*	*Total*
I	38.0	42.0	10.5	118.0	29.5	238.0
II A	4.0	20.0	4.0	53.5	10.5	92.0
II C	5.0	15.0	3.0	20.5	3.0	46.5
III	—	—	—	—	—	7.5

Since the labour required for harvesting and threshing depends largely on output, labour requirements have been based on a yield of 3500 kg paddy per hectare for all areas. The differences for harvesting is partly because the Javanese prefer the rice knife, whereas the Hindustanis use the sickle. But generally harvesting on unirrigated land takes much labour, as Table 4 indicates. This seems to be related to the very uneven ripening on unirrigated fields. Hence, farmers have to return several times to the same field.
The pattern of labour input on the commercial farm has not been compared. The total labour input is only 7 or 8 working days per hectare, more than a third of which was devoted to such miscellaneous activities as supervision, administration and the maintenance of vehicles. In contrast with the other types of farmers, commercial rice-farmers have had a one-year practical training course.
The average productivity of family labour per hectare and per man-day, using the residual method, has been presented in Table 5. The least productive family labour per man-day was in the traditional sector, the highest in commercial farming: they differed by a factor of about ten. The picture is different for the labour productivity per hectare, which is quite high in traditional agriculture. Detailed study suggests that both Javanese and Hindustani farmers in Saramacca District (Groups I and II B) made use of the abundant resource, labour.

Table 5 Average productivity of family labour per group (in Surinam guilders)

	Group I	*Group II A*		*Group II B*	*Group II C*		*Group III*	
		1965	*1966*		*1965*	*1966*	*1965*	*1966*
per hectare	166.9	93.8	108.7	304.2	240.5	261.7	178.8	79.2
per man-day	1.19	1.50	2.08	3.90	5.73	7.10	22.25	11.31

Capital. Data on the stock of capital/hectare on the various types of rice farms are summarized in Table 6. The capital assets are small in traditional agriculture and

Table 6 Estimated value of capital assets per hectare (in Surinam guilders)

Group	*Barn*	*Oxen, small implements*	*Tractor, other machinery*	*Total*
I	18	12	—	30
II A	14	65	133.5	212.5
II B	44	37	—	81
II C	38	4	171.0	213
III	—	5	286.0	291

much larger in other stages. The low figure for the irrigated Saramacca farms (Group II B) is caused by a differing input-input combination, as labour is a more abundant resource. Although commercial farms are over 10 times as large as transitional farms for the Surinam and Nickerie districts (Groups II A and II C), the amount of capital per hectare is similar [2]. Tractor-owners on these smallholdings supply ploughing and other machinery services to neighbouring farms, thus avoiding the bottleneck of 'lumpiness of capital', such a common phenomenon on smallholdings.

An interesting aspect for comparison is the use of *yield-increasing* inputs, i.e. fertilizers, insecticides, pesticides and new varieties. The traditional farmers in the sample used very little of them (*f* 0.40 per hectare on average), there was little on transitional enterprises (less than *f* 2 per hectare) but a large amount was put into effect by the commercial farmers (about *f* 40 to *f* 50 per hectare sown).

So far I have analysed production factors in isolation. A much better insight into farmer's decisions is obtained from input-input relations. A comparison of tractor-ploughing with ox-ploughing and hand-cultivation, as encountered in the various groups, revealed that these greatly differing methods are almost equally efficient in their respective areas. This is caused by differences in relative prices of labour and capital assets. A similar example of capital substitution for labour was threshing. While this operation was done by hand in one area, oxen were used in another, and threshing machines were economically justified in a third area (Luning, 1968).

The evidence showed that the sampled farmers combined inputs to approach least cost, hence varying proportions in the actual use of labour and capital inputs. This is illustrated in Figure 1.

[2] On the 24-hectare commercial farm doublecropping was possible in the same year. The area cultivated per year averaged 36 hectares.

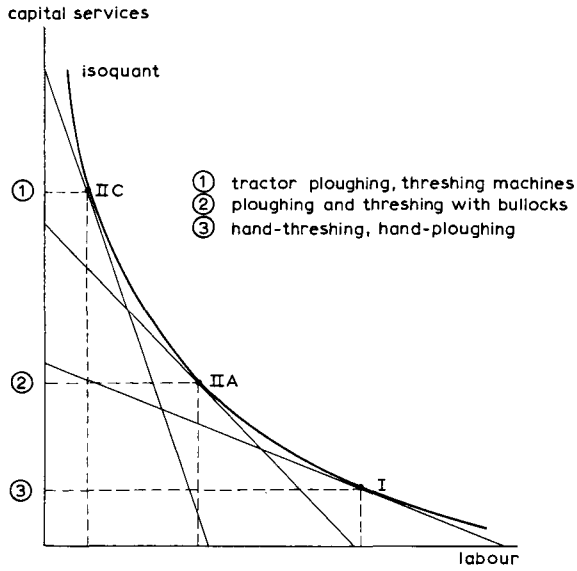

Fig. 1 Input substitution in Surinam rice-farming

Cost of rice production

Generally speaking, a cost-accounting analysis should be based on data of a number of years, so that both inputs and outputs can be standardized. In agriculture this is particularly true for outputs, as yields may vary greatly between years. But in most low-income countries (including Surinam) such a series of data does not exist and what is available must be used.

Table 7 presents costings for one or where possible two years for the groups studied. Calculations are based on an imputed family-labour cost of *f* 3 per man-day except for the Javanese (*f* 2) and for the commercial farmers (*f* 8).

Table 7 Average costs in cents per kg paddy and yields in kg per ha

	Group I	*Group II A*		*Group II B*	*Group II C*		*Group III*	
		1965	*1966*		*1965*	*1966*	*1965*	*1966*
Water control	*none*	*drainage*		*drainage + irrigation*	*drainage + irrigation*		*drainage + irrigation*	
Cost price	20.8	16.3	13.7	9.5	8.0	7.2	8.0	10.0
Yields	1850	1750	1940	3500	3420	3630	3660	2920

Although production may have been carried out at *least cost* in each group, Table 7 shows that paddy has been produced at absolute *minimum cost* on the irrigated farms, followed by those on which drainage was possible. Those with no water-control incurred the highest costs. This result derives largely from yields per hectare.

Factors affecting the transformation process

Now that I have analysed the transformation process and established the large variation in use and productivity of resources I must further explore two possible causes for this variation. The first one is that the human factor is mainly responsible for this state of affairs. The second is that the differences in stage of development depend on techno-economic conditions.

The human factor. The economist's chief task is to study economic variables in explaining particular economic activities, leaving cultural and other differences to others. But in low-income countries the economist is often alone and has to evaluate variables usually dealt with by sociologists or other experts. The problem here is whether ethnic differences between Hindustani and Javanese are reflected in the economics of rice farming. For this we will turn to the social anthropologist for enlightment.
In a study entitled The Javanese of Surinam, De Waal Malefijt (1963, pp. 66–67) observes: 'The Javanese value system' in Surinam "with its emphasis on equality and harmony tends to underplay all differences arising from such external factors as possession of material goods . . . ; the social structure seems to lack a technique to deal with differential prosperity, but the value system reinforces the dichotomy by equating the acquisition of material goods with westernization and westernization in turn with a forsaking of the Javanese culture".
This quotation suggests that the Javanese are impeded by their particular value system in making use of new opportunities and the impression is given that it is no mere coincidence that the Javanese are in the stage of traditional agriculture. But this impression is not corroborated when other groups of farmers are drawn into the analysis. There are also Hindustani farmers in the rural areas of Surinam who would be classed as traditional farmers. Yet Javanese commercial farmers in the Wageningen sample seem to pursue economic goals similar to those of their Hindustani and Creole neighbours. There is a group of transitional Javanese farmers in the polders around Nickerie, under study (1968), similar to the surrounding Hindustanis in resource use and other economic criteria. Of course we should not ignore the human element, but it seems not always as important as some anthropologists want us to believe. The Javanese as a group may well be slower in making use of new economic opportunities. In Surinam this could be connected with the fact that many Javanese live in villages (especially set up formerly by the Colonial Government) where community ties are stronger. Hindustanis are more independent.
Broadly speaking, unqualified statements of this sort should be carefully vetted. Another example may illustrate this: extension officers and others frequently state that the large number of tractors in the rice polders of the Nickerie district is not justified economically and that tractors are primarily status symbols. Economic investigations have recently supplied evidence that unsettles the above statement.
To sum up, there are undoubtedly ethnic differences. I already mentioned the use of the harvesting knife by the Javanese, which requires more labour than the Hindustani's sickle. But the available evidence implies that other factors must exist to explain such a bewildering number of stages in rice farming. It is only partly attributable to the human element.

Techno-economic factors. As has been demonstrated quite clearly in Table 7, water control is an important determinant of yields per hectare and subsequently of the

methods and cost of production. The various types of farms which were discerned earlier lie on different production functions, since similar cost structures lead to different levels of output. The available farm data suggest the relation of production functions to be as in Fig. 2 for smallholdings a) without water control, b) with drainage only, and c) with both drainage and irrigation.

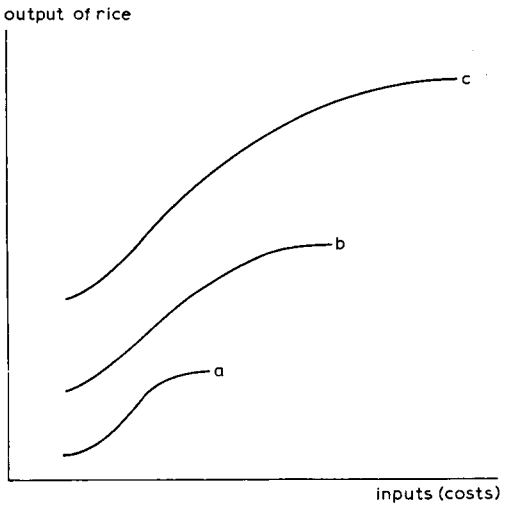

Fig. 2 The position of production functions for rice under different conditions of water control

The earlier discussion on economic performance has revealed that rice production for each type is carried out at least cost. Assuming efficient farming, further efforts *along* these production functions cannot therefore be recommended. Another question is whether agricultural research efforts could substantially change the *position* of these functions.

As has been strongly argued in recent years by agricultural economists (e.g. Schultz, 1965), the lack of intensive investment in agricultural research may be an important missing link in the process of agricultural development. In this connection we should briefly examine the support given by research to Surinam rice-farming. The country has had quite a long history of agricultural research. Its Agricultural Research Station was founded in 1903. Research reports from the first decade of this century mention yields of between 700 and 1750 kg paddy per hectare. A large share of the production increases, which occurred in the first two decades can be ascribed to an expansion of the area planted but there were also some increases in yield. For instance, by the mid-thirties yields per hectare had increased to 2000 to 3200 kg, thanks to selection and seed inspection. Further research on selection and seed improvements, done by both Government and the Wageningen Rice Scheme in the fifties led to yields of 3500–4000 kg of paddy per hectare on the irrigated land.

As regards the contribution of rice research to a shift in the production function, attention should be paid to recent field trials lasting some years on *unirrigated* rice fields of Surinam district. Hasselbach and Ubels (1966) found that an average increase in yield could be expected with 450 kg paddy per ha through the application of

200 kg of natural phosphate. But an *economically* profitable effect could be demonstrated only in 45.3% and 63.0% of the fields in 1960 and 1963, respectively. For the same district and similar circumstances (no irrigation) Hasselbach and van Amson (1965) found that on average an increase of 300 kg paddy per ha could be achieved by ploughing in the dry season. But an *economically* profitable effect could be shown only on 47.8 and 51.4% of the fields in these years. The implication is that farmers take heavy risks with drainage only, if they wish to use these so-called improvements. On riceland without water control uncertainties would undoubtedly have been even greater. Thus a shift of these production functions is possible only through removing the limiting factor, i.e. lack of water control. These traditional and transitional farmers are in fact in such a stage just because of these technical limitations. In rice farming the use of new yield-increasing inputs depends on the possibilities of irrigation. This applies for example to chemical control of snails, broadcasting of seed and use of combines. These methods are indeed increasingly used in the irrigated polders. Still, even on these irrigated farms there are bottlenecks. The use of new inputs on these transitional enterprises is impeded because of the smallness of farms, which date back to colonial times. The majority of these farmers have to earn about half their annual net income off the farm (Luning, 1967, p. 100). This certainly affects the use of more inputs in this stage. Another possible drawback is that most research on irrigated rice has been carried out on the large commercial Wageningen Project. The latter research findings cannot always be merely transferred to the situation on the peasant farm, as has been demonstrated quite clearly by Hasselbach (1966).

Discussion and conclusions

Though this research paper merely presents a case study in a small country, the implications may have a more general application. Thus, in a recent study on the growth of rice production in the Philippines and Thailand, Ruttan et al. (1966) reached similar conclusions. In these countries, average yields for rainfed rice rarely exceed 1,500 kg/hectare, but in fully irrigated areas it is not uncommon for average yields to exceed 3,000 kg/ha. Figures for Surinam were of a similar order (Table 7). Their main conclusion is that differences in yields can hardly be explained by such factors as new varieties, better cultural practices, the more intensive use of fertilizers and insecticides. Also economic and social differences among regions and between Thailand and the Philippines do not prove important. But here again the achievement of effective water control was the primary factor in development. As in Surinam this factor was outside the control of the individual farmer.

For Surinam 'traditional' and 'transitional' farming are undoubtedly stages which need help through public investment. Whether the irrigation could be provided in these areas as a first step is a little known techno-economic factor. So far a study to compare the economics of reclamation and improvement of existing rice polders with the establishment of new polders appears to be lacking. But this is not entirely the country's fault. Money loans and other development aid is often tied to the establishment of new projects, while it is much more difficult to find funds for the improvement of existing areas.

The second point, once irrigation is established, concerns the size of the farm. In farm planning *the economics of farm size* (under known techniques) and *income parity*

should be given ample emphasis. For this new type of farm, farm planning is important. In using this forward-looking approach, farm management research should be closely associated with technical agricultural research. Our conclusions are, firstly that in the past too much of this technical rice-research for peasant farming in Surinam has been concentrated on unirrigated areas. In retrospect this appears to have been almost a waste of time. Secondly, new inputs can only be effectively used on irrigated farms. Thirdly, changing the strategy of rice research in that direction is now called for.

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