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The economic transformation of family rice-farming in Surinam

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Preface and acknowledgments

Any author should ask (preferably beforehand!) whom he wishes to read his story; it applies even to the writer of a mere report on agricultural research.

This report will probably interest two groups. Firstly there are those who are concerned with the mechanism of agricultural development. Great strides have been made during the last decade. This applies especially to the theory of agriculture in the economic development of low-income countries, pioneered by such workers as Schultz, Johnston and Mellor.

Quite a bit of the theoretical frame has now been erected and the time has come to give it some flesh. For example, the concept by Schultz and others of the transformation of low-income agriculture has stimulated much rethinking but like any concept it needs the backing of actual case studies. The following monograph is intended as such a case study, illustrating this transformation. Farm management data which were collected on family rice-farms in Surinam during 1965 and 1966 have been tailored to this concept.

Secondly, there are those in Surinam who are concerned with the actual planning of agricultural development and its implementation. Until very recently most of the agricultural planning in Surinam had to be done without detailed micro-data available. This does not mean that planning had been entirely without facts but certainly lack of data has hampered development of the country's agriculture as recent evaluation studies on some agricultural projects have clearly shown.

The purpose of this study is therefore to provide some local detailed information. This study is not an exercise in farm planning. I have emphasized the present situation, not in order to give any detailed description of present farming (although this basic function of collecting data should not be neglected) but to study and explain the presence close together of so many stages in rice farming, from the traditional to the commercial. Why and how do they occur together in the same natural environment? Admittedly the major use of farm management data is in the forward-looking approach of farm planning, but first some spade work must be done. In Surinam it was considered necessary to compare the various systems in rice farming in order to establish standards from which to start and to decide which type to develop through government policy measures.

My study has a modest purpose: the next step will be evident in a forthcoming work by Ir J. T. Sital, wherein farm planning for rice-smallholding in Surinam will receive central attention.

The field work for this study was carried out during the years 1965 and 1966 while

the author was attached to the Centre for Agricultural Research in Surinam (CELOS), an annex of the State Agricultural University, Wageningen, the Netherlands.

In expressing my gratitude to those who helped in this research, my first thoughts go to the rice farmers, who so patiently bore our continuous questioning throughout these two years. Close contact with them was a stimulating and refreshing experience. Those who actually collected farm data, Messrs Adhin, Bhansing, Kalika, Kaspan, Idoe, Jainandunsingh, Sampan, Sewnarain, Sewraisingh and Sital Jr were of invaluable help to me. In the supervision of the field work, an important contribution has been made by senior students from Wageningen: W. G. Cath, H. J. Hoefman, D. Quik, A. V. E. Slangen, A. Tempelman and K. J. Vuursteen.

I received much help from the Director of Agriculture, Surinam, Ir G. P. Tiggelman and his staff, of whom I especially like to mention D. H. J. Ferrier, M.A.

I am grateful to Prof. Joosten, Drs Klaasse Bos, Prof. van Riemsdijk, Dr Ruinard and Ir Sital for reading earlier drafts of this paper. I have benefited much from their constructive criticism. Final responsibility is of course solely mine.

Mr J. C. Rigg's suggestions to improve the English of the text are gratefully acknowledged. Last but not least I wish to thank Mrs de Groot and Mrs Werner for their able secretarial assistance.

Summary

In the coastal plains of Surinam, the sophistication of techniques in family rice-farming is diverse. Sometimes there is little or no farm machinery or other new inputs; elsewhere family farming is commercial.

This study concentrates on factors responsible for differences in development of rice farming in a similar natural environment. To dissect the process of agricultural development, exemplified by rice, a staging model by Hill & Mosher has been used. Farm survey data have been grouped into three categories bearing the characteristics of traditional, transitional and commercial family rice farming.

After a brief history of rice cultivation in Surinam (Chapter 1), the actual farm management data are presented in Chapter 2 for the various types of family rice farms in transformation. Problems of data collection, more specifically the measurement of inputs and output, are discussed.

Chapter 3 compares the economic structure of these types of rice farms. After a discussion on resource use and productivity and the factors affecting them, the cost structure for an average farm of each type is analysed.

The cost-accounting analysis discloses a great variation in cost price but this cannot be attributed merely to varying economic performance. The available evidence suggests that the sampled farmers in all stages of development combined inputs to approach least cost. Labour and capital are combined in various proportions according to their relative prices in each area.

The final chapter further scrutinizes the factors affecting this transformation process. Ethnic differences between groups cannot be held to induce the change from traditional to commercial agriculture. A sociological phenomenon involved in traditional and transitional farming is limited aspirations (Section 4.1). But techno-economic factors are undoubtedly mainly responsible for the stage of development. Of these the primary factor is the absence of drainage or irrigation. In the areas *without* irrigation and drainage yield-increasing inputs and other farm investments are often not economic. This lack of inducement suggests that such rural institutions as the extension service, agricultural education and credit are of little influence while this state of affairs continues.

The second factor determining the position of the farm type on the transformation continuum is the farm size. The small farm dates back to colonial times. Most small farmers on irrigated land have to earn half their annual net income off the farm. This certainly limits the use of more farm inputs.

Finally, the Government's role in stimulating the transformation process is dis-

cussed. It is suggested that solutions are not so much to be sought in a new price policy for rice. The Government should either improve existing facilities or provide alternatives (citrus, cattle) in the technically backward areas. A different approach is proposed for areas with irrigation, such as Nickerie. An increase in area per farm is called for. In the areas where families have large rice-farms, more attention should be paid to a system of economic water and land rents to prevent increased social inequality.

In the past too much technical research for peasant rice-farming has been done in the unirrigated areas. New inputs can only be effectively used on irrigated farms. Future research on this subject should therefore be concentrated on irrigated areas.

It is recommended that the economics of reclamation and improvement of existing polders be compared with that of establishing new polders.

Though this monograph merely presents a case study in a small country, its findings may have a more general application. Our results tally with the recent study by Ruttan *et al.* in Thailand and the Philippines. As in Surinam, differences in yield could hardly be explained by such factors as new varieties, better cultural practices, the more generous use of fertilizers and insecticides. Also in those countries effective water-control proved to be the primary factor in rice development.

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1 Brief history of rice cultivation in Surinam

1.1 The setting

Surinam is situated at the north-eastern coast of South America, between French Guiana and (formerly British) Guyana. Bordered by the Atlantic Ocean in the north and by Brazil in the south, it covers an area of about 143,000 square kilometres. The main centre of population is the coastal plain; over 90% of the country's population (total 330,000 in 1964) live there. The soil in this plain is mostly heavy clay and the larger part along the coast consists of swamps, covered with forest and grass.

Surinam has a tropical rainy climate; there is one long wet season from the end of April until the beginning of August and a short one from December until February. The long wet season is the main cropping period for lowland rice. Figure 1, depicting the northern part of Surinam, shows the major rice-growing areas.

The country was discovered by the Spanish at the end of the 15th century. In the first half of the 17th century the British established a colony on this coast but they were expelled by the Dutch in 1667, when it became a Dutch possession. Large-scale

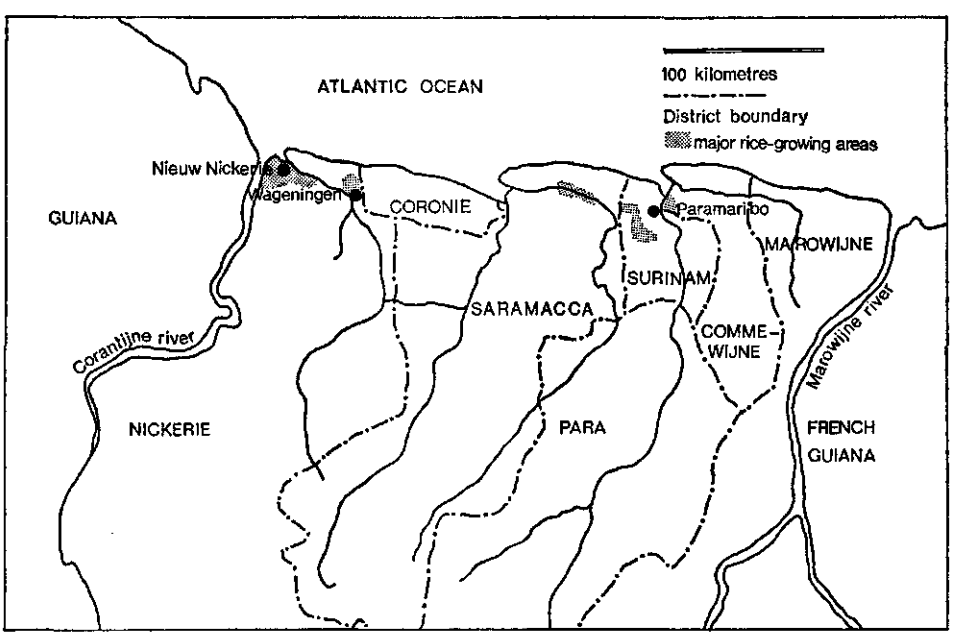


Fig. 1. The northern part of Surinam.

exploitation of the country's resources started under the Dutch Governor van Aerssen van Sommelsdijk (1683–1688); under his leadership began the prosperity of the plantations, which were managed mainly by British, Dutch and French Huguenot entrepreneurs.

The original inhabitants, the Amerindians, lived (and still do) in scattered settlements in the interior and lived by hunting and fishing. These people were clearly unsuitable as plantation labour and there were few of them. Soon after the occupation of the Guiana Coast, the estates started recruiting negro slaves from the West African coast.

This system of slave labour with its concomitant human misery brought great prosperity to this colony during the 18th century; the main estate products were sugar, coffee, cocoa and cotton. Towards the end of the 18th century, it declined gradually, mainly because of shortage of capital, increasing competition from agricultural production elsewhere, mismanagement and labour unrest.[1] Surinam's position became even worse after the opening of the Suez Canal, whereafter the cheaper agricultural products from South-East Asia flooded the West European markets. A final blow was brought about by the abolition of slavery in 1863; the majority of the freed negroes were not willing to continue working on the estates.

Hence, many attempts were made to meet the labour shortage by attracting immigrants. Labourers were then imported from the Indian Subcontinent (between 1873 and 1916) and from Java (between 1890 and 1939) on 5-year contracts. About 34,000 immigrants from India entered Surinam and almost the same number from Java. Especially in the early period of immigration, a large part of these indentured labourers (in total a third of the Hindustani and about a quarter of the Javanese) left Surinam after the expiracy of their contracts. Obviously, the country offered few attractions to these people.

About 1890 the Government attempted to counteract this labour drain by encouraging permanent settlement on plots of old abandoned estates and by payment of a premium, if the labourer waived his right to free expatriation. Smallholdings, ad-

Table 1. Percentages of total agricultural output (in monetary terms) from plantations and peasants

	Plantations	Peasants
1900	90	10
1910	72	28
1920	29	71
1930	29	71
1940	17	83
1950	10	90

Source: PANDAY (1959, p. 174).

[1] For a full account of the history of agriculture in Surinam, see PANDAY (1959)

jacent to existing plantations, were allotted. The Government wanted to form a labour reservoir for the plantations, as the smallness of these peasant holdings (1–2 hectares) would induce the workers to seek additional income.

The origin of *peasant* agriculture (as against *estate* agriculture) can be set at around 1860, when a number of freed Negro slaves were resettled on the abandoned Totness Plantation in the Coronie District. More of these schemes were initiated in later years for the Creole farmers, who mainly concentrated on cocoa farming. The Creole smallholders flourished around 1895, the year wherein their cocoa constituted 13% of the Surinam export (KRUYER, 1960, p. 175). At the turn of the century the outbreak of witch's broom disease was a heavy blow to the cocoa industry and gradually caused the Creole farmer to loose interest in peasant agriculture.[2]

A second more successful period for peasant agriculture began in 1895 with the allotment of the old Alkmaar Plantation to the first Hindustani ex-contract labourers. This was soon followed by other settlements, set aside for Hindustani and Javanese workers. Because of the further decline of the plantation economy in the present century, the need for plantation labour diminished and the Surinam Government decided to settle the former labourers also on virgin land; owing to its swampy character, this new land had to be empoldered. Broadly speaking, the present pattern of peasant agriculture is the outcome of this policy.

The decline in estate economy as against peasant farming is illustrated in table 1. In a period of fifty years the relation of the two sectors was completely reversed.

1.2 Peasant production and local consumption of rice

The main diet of the immigrants from South-East Asia consisted of rice. Though some rice had been cultivated by freed slaves before the influx of these immigrants, the total production was almost negligible. When these Asian workers arrived, a heavy demand developed for it and rice had to be imported. High prices put these contract-workers into a difficult position: their low income scarcely enabled them to buy what would normally be a cheap commodity. Not surprisingly the newly settled former labourers turned to the cultivation of rice. With the continuous flow of Asian immigrants and with the prevailing high natural increase in population (about 3% annually), there was a ready market encouraging its cultivation. A special stimulus was provided by the First World War. As pointed out by PANDAY (1959, p. 197), over 4000 tonnes were imported annually between 1895 and 1915, but the war put a stop to it. The rapid expansion of peasant rice-production, especially during the period 1917–1937, is clearly visible from table 2.

In 1919 the Surinam Government first established a guaranteed minimum price.

[2] Nowadays there is a preponderance of Hindustani and Javanese in Surinam agriculture. Whereas the Creoles, Hindustani and Javanese form roughly 40%, 40% and 20%, respectively, of the population, the racial distribution of the peasant farmers is as follows: Hindustani 52%, Javanese 38%, Creoles 10% (Ministry of Agriculture, 1960).

The paddy price was high during the years 1916–22, on an average 10 cents per kilogramme, but thereafter it gradually declined to 2.5 cents in 1937. Despite this decrease, production increased sharply during the decade before the Second World War. Probably because prices of all agricultural products declined drastically during the thirties farmers did not turn to other crops in a period of declining paddy prices. Anyway, the cultivation of rice, as opposed to other crops, was stimulated by the introduction of new techniques in precisely this period 1928–1938 (see section 1.3). To achieve an income similar to that of the days of high paddy prices, the farmer was compelled to cultivate a larger area; the timely technical development enabled him to do so and resulted in a larger total rice production.

Table 2. Peasant paddy production (in tonnes) in selected years

	Production		Production
1887	10	1922	12,936
1892	24	1927	14,899
1897	134	1932	25,049
1902	374	1937	35,355
1907	1,511	1942	40,359
1912	2,659	1947	39,408
1917	5,338	1949	50,204

Source: PANDAY (1959, p. 197).

During the years 1926 to 1930 Surinam became self-sufficient in rice as can be deduced from table 3. Exports started during the Great Depression. During 1939, the War caused the Government to restrict rice exports, so prices fell and less paddy was produced in 1940. The Government reacted by guaranteeing a minimum price of 3 cents per kg paddy for 1941 and production reached an unprecedented high level in the same year.

Prices of agricultural products in general rose during the years 1942–5. The Surinam authorities then felt forced to fix maximum prices for rice. Because of the War, labour became scarce and rice production was low during 1942–5. After 1945, peasant rice production regained its prewar growth until a peak was reached in the mid-fifties.

In the period 1950–65 prices of paddy were rather low (7 to 10 cents per kg paddy)

Table 3. Production, imports and exports of rice during the period 1921–35 (annual averages in tonnes of rice)

	Production	Imports	Exports
1921–25	7,892	1,329	85
1926–30	11,213	586	773
1931–35	13,779	353	1,838

Source: DE VRIES (1965, p. 121).

Table. 4. Population growth of Surinam and its capital in the period 1883–1963 (in thousands)

	Total (coastal)	Paramaribo
1883	52	24
1893	59	29
1903	74	33
1913	86	35
1923	113	45
1933	143	50
1943	168	61
1953	210[1]	85[1]
1963	305[1]	110[1]

[1] Estimate
Source: PANDAY (1959, p. 171).

in relation to other products and gradually farmers reallocated their resources to other production purposes. This point is further discussed in Chapter 3.

Meanwhile, since the arrival of the immigrants whose staple was rice, the internal market for this crop grew ever larger. Moreover, the rapid population increase in the country's only urban centre, Paramaribo, provided an additional market incentive. Table 4 shows the growth of this internal market.

Figure 2 shows the trend in population growth and peasant rice production for the

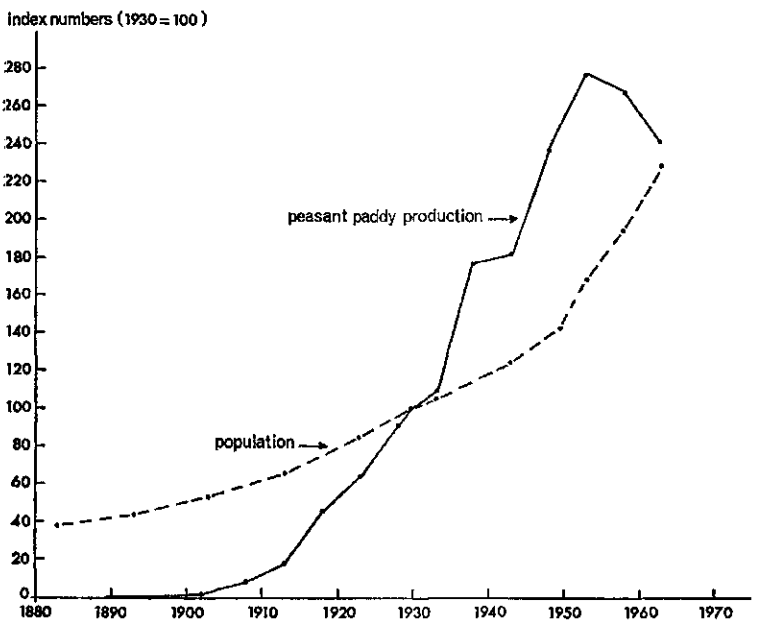


Fig. 2. Trends in population and peasant paddy production 1885–1965

period 1885–1965. The first year of self-sufficiency in rice, 1930, has been taken as the base year (index number 100) for both production and population. In the calculation of paddy production, annual averages per 5-year period have been calculated from 1906–1910 onwards, to smooth out fluctuations due to the vagaries of the weather. Indications of deficits and surpluses are sufficiently large to draw some conclusions, though it should be noted that population trends do not always coincide with the consumption pattern. For instance, after 1918 a change in diet occurred amongst the Creoles, whereby the plantain (*Musa* sp.) was replaced by rice as the staple food (VAN LIER, 1949, p. 236).[3]

Anyhow, as Figure 2 indicates, there was a deficit in the early years, which turned into an export surplus from 1930 onwards. This surplus reached its peak in the early fifties, since when a lower peasant production and a steep increase in total population caused the surplus to dwindle and disappear in the mid-sixties.[4] Meanwhile, since the early fifties, major developments took place in rice cultivation outside the peasant sector.

1.3 Some notes on technical change in Surinam

In the early days, rice was cultivated on the impermeable clays in the lower-lying parts of the resettlement farms, which the former contract workers obtained on Government lease. In addition, some Hindustanis cleared plots in the surrounding virgin swampland, on which they were given property rights after cultivating it for six years. These fields lacked irrigation and sometimes even drainage was not possible. Hence, rice cultivation was completely dependent on rainfall. Yields per hectare were low to moderate (between 700 and 1750 kg paddy per hectare), according to natural environment. The land was tilled by hoe; often the fields were merely weeded before planting. To minimize risks the seedlings were transplanted from a specially prepared seedbed.[5] Since the early days local varieties of the *indica* type have predominated; these seem to be well adapted to prevailing risks and uncertainties.[6] Rice was reaped with a harvesting knife or sickle, and threshed on threshing tables or by stamping.

With simple techniques, rice demands much labour especially in planting and harvesting which cannot be spread over a longer period because of natural conditions;

[3] No information is available on the early period. According to KOENRAADT (1967), the flour consumption *per capita* in Surinam increased significantly in the period 1954-'65, but there was no statistical proof that rice consumption per head decreased simultaneously. This seems connected with the continuing change of some ethnic groups consuming root crops (the bush negroes for instance) to rice-eating. The influence of income on rice consumption is quite small, as indicated by the 1953 Household Survey (KOOL, 1964, p. 120); income elasticities for rice were low or negative.

[4] For such evidence, see LUNING (1966).

[5] Another method was dibbling, practised on riceland rich in organic matter (UBELS, 1961, p. 17).

[6] To meet the wishes of Hindustani farmers, rice varieties were imported from India in 1907 but they did not become established and gradually disappeared again (Inspectie van de Landbouw in West-Indië, 1907). A similar procedure was followed for the benefit of the Javanese, who nowadays still cultivate some rice of Javanese origin. See also section 2.1.

without outside help the size of farm business is restricted to the area which the available family labour can handle. For Surinam BÜRER (1956) has calculated that this system of hand-farming requires about 145 man-days per hectare rice. Assuming a harvest period of 14 days[7], one man can handle only 0.4 hectare annually. In practice, this worked out to about 1 or 2 hectares per family.

The increasing demand for rice in 1910–20 and the high prices paid towards the end of this period encouraged new methods of increasing the area. In that decade the Government Agricultural Experiment Station (founded in 1903) paid increasing attention to rice cultivation. The Department of Agriculture imported bullocks for plough-farming from Demarara in the former British Guiana in 1919. This innovation enabled the farmers to extend their rice area especially in the Nickerie District, where local farmers in co-operation with the Government had started to empolder large stretches of swampland (1915–28).

Until the Second World War, plough-farming developed slowly as it was expensive. This was mainly due to the scarcity of oxen, because there was little grazing in the dry season. Besides, these animals had little use for transport, as most of the traffic then went by boat on polder canals. In 1943, for instance, the rice area in Surinam amounted to 11,656 hectares and there were 1678 oxen or on average one team per 14 hectare (Departement van Landbouw-Economische Zaken, 1942–4, p. 29), the majority in the Nickerie District. In Nickerie District some farmers managed to cultivate 15–25 hectare of rice per season with oxen in the thirties.

Meanwhile, the Agricultural Extension Service (started in 1906) became an important disseminator of information on seed, quality and cultivation methods. Selection and seed control became vital issues when Surinam started to export rice in the late twenties. It became evident then that the rice was far from uniform, due to a mixture of varieties, which caused great difficulties in milling. Moreover, local milling was often not carried out properly. An export quality control was enforced in 1932 and the results for the first year showed that only 3% of the exported rice reached standard grade, while the remainder was low grade. After 1936 the Government took part in the issue of improved seed and it also provided credit facilities for the purchase of a plough and bullocks. These measures were gradually adopted by the farmers and paddy yields per hectare reached the 3000 kg mark on irrigated and between 2000 and 2500 kg on unirrigated land (with drainage facilities) during the thirties. Initial soil fertility was high and the use of fertilizers and dung was not then justified economically.

Though some abortive attempts were made previously, mechanical rice-farming did not obtain a foothold in Surinam until 1933 when a Dutch settler received permission (and a small government subsidy) to set up an experimental farm for large-scale rice-cultivation in Nickerie, the western-most district of Surinam. After a few years this farm gradually developed into a commercial enterprise of 700 hectares with a rice mill and a farm-machinery import business. At the request of an enterprising local farmer in Nickerie, some of his fields were ploughed by this settler in 1944. In 1945

[7] A long period results in suncracks and shedding.

this farmer bought a tractor with plough and this became the starting-point of a new era in Surinam's peasant rice-cultivation. Tractors, disc-ploughs and harrows, threshing machines and even combine-harvesters were gradually purchased in this district. At first, only farmers who cultivated 10–25 hectare bought farm machinery but later small farmers also became interested. Some small farmers used this machinery mostly for contractwork. In the other districts of Surinam with considerable areas under rice, this precedent was followed more slowly.

Spectacular developments in large-scale rice-farming occurred after the Second World War. In 1949 the Foundation for the Development of Mechanized Agriculture in Surinam was set up jointly by the Dutch and Surinam Governments. After preliminary studies a site was chosen in the Nickerie District. Reclamation work started in 1953; 450 hectares were sown in 1954; by 1958 the polder was completed and 6,000 hectares were cultivated (DE WIT, 1960, Chap. 8). This Wageningen Scheme, financed by the Dutch Government, was originally intended to provide land for Dutch farmers, but after a few years it was decided to operate it as a large-scale highly mechanized undertaking. Rice is grown in monoculture; the land carries three crops in two years.

In the early sixties plans were made by the Department of Agriculture to establish a number of medium-sized (24 ha) farms in a newly empoldered area adjacent to the Wageningen Polder. As a first step to integrate the Wageningen Project, which leans heavily on Dutch technicians, it was considered politically expedient to establish such farms. As stated in a planning study by the Surinam Ministry of Agriculture (1964, p. 117): "The question arises whether it would be better to convert part of the Wageningen Project gradually into medium-sized selfsupporting rice-farms while a limited part would be left to the Foundation. This is considered the best way to provide a larger contribution to agricultural development rather than the exploitation of an estate of about 10,000 hectares". Towards the end of 1964 a few 24-ha farms were set up in the adjoining polder, and more have been established since.

This account may have left the impression that technical development in Surinam rice-farming moved from stage to stage in consecutive periods. As in many low-income countries, development has been irregular. Surinam contains a complete range of family rice-farms from the type employing little or no agricultural machinery and without drainage and irrigation facilities to the technically skilled capital-intensive farms, like those adjoining the Wageningen Project.

2 The transformation from traditional to commercial rice growing

2.1 Stages in the process of agricultural development

From the post-war effort to develop the agriculture of low-income countries have ensued a number of theoretical models which attempt to 'stage' this process of agricultural development.[8] For my purpose, an analytically useful classification seems to be the model by HILL & MOSHER (1963), especially since it stresses the development of the individual farm. The characteristics of this model, which distinguishes three stages in the development process, are briefly as follows:

Stage I: Traditional agriculture Techniques of production are static and traditional. There is a closely knit relation between farm business and household.

Agricultural produce is used almost exclusively in the family; as a rule there is only a small marketable surplus. The labour/capital ratio is high and the purchase of inputs is virtually unknown. As shown by SCHULTZ (1964), the rates of return on production factors are low. The near absence or the imperfect operation of infrastructural institutions (for the benefit of agriculture) is another characteristic.

Stage II: Transitional agriculture The system is continually subject to change. More of the agricultural produce is sold on the market than in traditional agriculture. More capital is invested per unit of labour. The rate of return on the factors of production is somewhat larger. 'Non-conventional' inputs (JOHNSTON & MELLOR, 1961), such as agricultural research, extension, credit, marketing and education, play a more important role.

Stage III: Commercial agriculture The relation between farm business and household has become weak or ceased. Agricultural production is mainly for the market and decisions in production directed primarily to money cost. The relation labour/capital is low and most inputs are purchased. The rate of return on the factors of production is high under normal circumstances. The infrastructural institutions are well developed and are a great help to the farmer.

Any model has its limitations and it usually is merely an approach to reality. All the same, the scheme is a useful starting point in dissecting the process of economic transformation.

[8] For a brief review, see WHARTON (1965).

The farm-management data, which will be presented in the remaining part of this chapter, have been collected from different places in Surinam. The farming conditions, met amongst various groups, suggest that the classification into three stages of development is useful. Obviously the Surinam farm data cannot be fitted *perfectly* into the scheme but deviations are of only minor importance.

In the traditional stage are Group I: a community of Javanese farmers, living at Sidodadi in Saramacca District (Section 2.3). In the transitional stage have been grouped:

IIa. Hindustani rice-farmers living near Paramaribo (Leidinggebied, Surinam District[9]);

IIb. Hindustani farmers in the Calcutta Polder, Saramacca District;

IIc. Hindustani farmers in the polders of Nickerie District.

These three groups appear to be in different substages of *transitional* agriculture (Section 2.4).

Finally Group III: commercial farmers, comprising Creole, Hindustani and Javanese families (Section 2.5).

A staging model should not be designed merely to categorize the descriptive characteristics of the transformation process. It is also necessary to find whether it is analytically relevant. In Surinam, the foremost question is *why* there are such differences in the development of rice farming. Should these differences be attributed to ethnic culture, distance to markets, economic activities in non-agricultural sectors, technical conditions facing the farmers, education, to mention a few? Answering these quesions should throw light on the underlying causes of economic development within family rice-farming.

2.2 Data collection and measurement problems

Collection of agricultural data is quite well organized in Surinam, but the available statistics were not detailed enough for the present purpose. To study the process of economic transformation in family rice-farming, some farm-management studies were initiated during 1965 and 1966.[10]

The periods of field surveys were as follows for the various groups:

Group	District	Ethnic group	Period of survey
I	Saramacca	Javanese	Mar. 1966–Mar. 1967
IIa	Surinam	Hindustani	Apr. 1965–Apr. 1967
IIb	Saramacca	Hindustani	Apr. 1965–Apr. 1966
IIc	Nickerie	Hindustani	Apr. 1965–Apr. 1967
III	Nickerie	Mixture of Creoles, Hind. and Javanese	Oct. 1964–Oct. 1966

Except for the last group, most farmers are semiliterate; besides, they were not very

interested in book-keeping. The survey was therefore by the cost-accounting method. Each of the interviewers dealt with about nine farmers and visited them twice a week after normal working hours to collect the required data. Group III with large mechanized farms did their own book-keeping and, apart from checking and cross-checking, the existing material could be used immediately for analysis.

To compare farms in economic transition somewhat better, those were taken which had between 2 and 3 hectares under rice; this comparison applies to groups IIa, IIb and IIc. For the Javanese this was not possible as they had only about 1 hectare per farm under rice.

Apart from Group III, which contained only a few farms, the other groups were chosen by sampling within the group of uniform rice area. In practice this sometimes proved difficult as farmers occasionally leased or lent farm plots without giving prior notice. Sampling had to be selective where the homogeneity in resource use (for example, differences in initial soil fertility) was endangered, which otherwise might have hampered comparisons between groups.

The reliability of the collected information is always an important question. The data presented do not seem to deviate from the picture, obtained on the spot through continuous personal observations. Experience from my earlier farm-management studies has yielded several points for cross-checking, which were applied to the original material. I closely supervised and guided two graduate students in agricultural economics during the entire period of the fieldwork.

Some brief comment is needed on the measurement of inputs and output in rice farming.

Land The net area under rice has been measured for each field, the gross area being known to the farmer. Fields are of a regular, rectangular form and measurement through pacing yielded reliable results. The local practice is to measure land in square chains (a chain being about 20 metres) making 25 square chains to the hectare.

The quality of land was quite uniform in irrigated areas (Groups IIb, IIc and III), but this was not so in the unirrigated areas (I and IIa). This uniformity has not so much to do with the land itself but with the total water-soil complex. For instance, for farmers of Groups I and IIa microrelief is of great importance in the absence of irrigation. Where the land is uneven it particularly limits output of rice for the farmers of group I and IIa, as will be discussed in sections 2.3 and 2.4.

Labour The actual labour use was measured, not the amount available. To establish a common denominator, the quality of the family labour force was related to an

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

[10] Conclusions based on a one-year study of agriculture usually cannot be considered satisfactory. In view of the vagaries of the climate and other uncertainties, observations should continue over at least two farming seasons. In Saramacca this was not possible but this rule has been observed for the surveys in Surinam and Nickerie districts.

average adult man, who was taken as a standard for the work effort. To further aggregate the labour input, another standard was devised, the *man-day*.[11] This is defined as the amount of work done by an average adult man during a day. The working hour is hardly relevant to peasant farming as the length of a man-day varies with the pressure of work. Adding up the number of hours and then dividing them by eight is permissible only when a constant length of working day is envisaged. This concept of a man-day may conceal the phenomenon of work-spreading, for instance when short working days are considered as full days during the slack season. But this has to be recognized as inherent to the working pattern of peasant agriculture.

Capital A survey was made of the actual stock of capital, used in rice cultivation. This stock was valued by one graduate student on all farms, thus avoiding bias between areas. Besides, records were kept twice a week of the actual use of capital services (flow). The particular items of these services have been listed for each group separately.

Management Though differences in management, as indicated in cross-sectional samples is recognized, little headway has been made so far in the quantification of this aspect. Farmers of Group IIa, b and c have been picked selectively by including only farmers of a particular age group (25–50 years). It is conceded that this method may have limited value as it stresses (rather vaguely) management potential rather than actual behaviour.

As for group I, the population sampled was rather small and it was not feasible to limit the sample entirely to farmers of a particular age-group. Whereas no agricultural training was received by the farmers of Groups I and II (apart from the passing down of farming knowledge within the family), Group III had obtained experience in mechanical rice-farming for some years, before being granted this 24-hectare farm. This outstanding difference from the earlier groups should be recognized in comparing these groups in the economic transformation process.

Output The physical measurement of the output was in bags of paddy, each bag usually containing 70 kg dry, cleaned paddy.

Pricing The pricing of inputs and output will be discussed under relevant headings.

2.3 Economic analysis of rice enterprises in traditional agriculture: the Javanese farmer

The Javanese community of Sidodadi was established by the Colonial Government some thirty years ago as a village settlement for labourers whose contracts had ex-

[11] In transplanting rice, 'woman-days' are equivalent to 'man-days', as women do most of this work and their working performance is similar to that of men.

pired. Most settlements in Surinam have a mixed population but a few, such as Sidodadi, are exclusively Javanese. This is the outcome of an experiment by Governor Kielstra (1933–1943) to recruit and afterwards resettle whole families from Java, while trying to keep intact the old village's social organization.

The Javanese showed a keen preference for growing both sawah rice and dry crops (groundnuts, beans), so settlements were, as far as possible, designed to meet their wishes. Individual farms were laid out in such a manner that a sandy ridge[12] and swampland were both included. Roads and houses in Sidodadi have been built on this ridge. Around the house groundnuts, soya and other beans, vegetables, fruits and spices are cultivated. The Javanese (both in Java and in Surinam) are renowned for their compound farming.[13]

In Sidodadi, the higher part of the farm plot is usually 0.5 to 1.0 hectare, according to the width of the ridge. The lower part of the farm, where the paddy is cultivated, is between 1.0 and 2.0 hectares; the total plot thus amounting to 1.5 to 3.0 hectares.

The total number of families who participated in the survey was 35; the average family contained 4.3 persons, which is rather small.[14] The age composition of the 151 persons in the sample is presented in table 5. The population pyramid is atypical for Surinam Javanese in general. There is a preponderance of very young children and old people [15] but young couples are notably absent. We will discuss this conspicuous feature later.

Table 5. Age composition of the sampled Javanese households (1966)

Age in years	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Number of persons	52	20	15	21	11	11	19	2

Rice farming is the most important business and labour requirements for this crop set the pace for other work. There are two extremely busy periods for the rice during transplanting and harvest. Between these periods the Javanese work on groundnut crops. Groundnuts are cropped twice, sometimes thrice a year on the same field. Most other crops do not require intensive care in short periods and work on them can be fitted in more easily. Part-time farming is very common amongst the Javanese of Sidodadi and many of the men have to turn to non-farm work to supplement their

[12] The soils on the coastal plains consist mostly of heavy clay, usually interspersed with narrow sandy ridges.

[13] See, for instance, the detailed survey of compound farming in Java by Ochse & Terra (1937).

[14] For a sample of 100 Javanese rural households in Surinam, De Waal Malefijt (1963, p. 47) found an average of 5.84 persons.

[15] As has been observed by De Waal Malefijt (1963, p. 46): 'No household is complete without children' is a frequently heard statement. Children are loved and enjoyed, and wanted by young couples as well as by elderly people. A large-scale distribution of children is the result. The most common pattern is that a child is given to its grandparents."

meagre farm incomes, as can be deduced from table 6.

Table 6. Part-time farming amongst Javanese workers (number of men between 17–55 years)

Total labour force	(a)	26
Number of (a) with full-time non-farm occupation	(b)	11
Number of (a) with part-time non-farm occupation	(c)	10
Full-time farmers	(a-b-c)	5

Quite a number of workers had full-time year-round jobs.[16] This meant that the farm work had to be done by the other members of the household (women, children) and in peak periods by paid labour and by the workers themselves when off duty. Nearly all full-time farmers happened to be old people.

2.3.1 Resource use and production in Javanese rice-farming

In this section the emphasis is on technical conditions. For convenience this is discussed under the headings land, labour, capital services and rice production.

Land The natural swamps, where rice is grown in Sidodadi, contains little water during the dry season (February–April). Thereafter they become filled gradually from direct rainfall and through feeding from creeks, which transect the swamps. Rice farming is risky under these conditions and its success depends entirely on the evenness of the distribution of rainfall within the season. There may be dry spells in the early part and flooding later in the rainy season. During dry weather, weeds get an opportunity to compete with rice and seedlings may also die because of lack of moisture. On the other hand, rice may become submerged during flooding and this also limits yields. The swamp bottom is uneven so that dryness and flooding may therefore occur in the same area at the same time. At the lower end of the farm plots the swamp vegetation starts and it is a continuous struggle to keep this part clear of obnoxious

Table 7. Distribution of the net size of the actual and 'expected' rice area (in ha) by number of farms

	Number of farms	
	actual area	'expected' area
0.00–0.50	6	5
0.51–1.00	21	10
1.01–1.50	5	11
1.51–2.00	3	9
Average area per farm	0.83 ha	1.11 ha

[16] All 11 workers in this category held positions in the lower ranks of Government Service (road labourers, agricultural labourers).

weeds. In sampling these farms as far as possible only those were included which usually cropped an area of between 1 and 2 hectares. This estimate was made shortly before the rains and was based on the farmer's expectations and checked against information on his previous results.

In practice, the area cropped in 1966 was quite different, as can be seen from tabel 7, in which its distribution is presented. The principle set-back experienced, which limited the cultivated area was the virtual absence of a Hindustani contract-worker, living nearby, who usually tilled with his tractor for these farmers. A minor reason was lack of seedlings, at the time of transplanting, due to drought.

Labour Work in the field is carried out by both men and women, but heavy manual clearing of the paddy field is done predominantly by men. As in Java, people practise the system of mutual assistence (gotong rojong) to ease labour requirements in busy periods. An equal labour effort is worked in return.

The employment of paid labour is well known and this is especially so during the busy periods before planting, and during planting and harvesting operations. The hiring of labour for rice occurred on 24 farms (out of 35); on 15 of these farms more than 10% of the total man-days was worked by paid labour. These farms belonged either to old people (7) or to people with full-time (6) and part-time (2) non-farm occupations. On average of all farms, the percentage of paid labour amounted to 13.6% of the total labour time, expressed in man-days (table 8). Both exchange and paid labourers are drawn exclusively from within the Javanese community.

Table 8. Average number of man-days worked on various operations in rice cropping (SIDODADI, 1966)

	R1	R2	R3	R4	R5	R total	Family labour[1]	Paid labour
Number per farm	31.0	34.5	9.0	50.5	12.5	137.5	119.0	18.5
Number per ha	38.0	42.0	10.5	61.0	15.0	166.5	144.0	22.5

[1] Including gotong rojong.

For Groups I and II the labour input has generally been noted under the following headings:

R1: labour used in land preparation, such as weeding and minor clearing.[17] The preparation of the small seedbed is also included. In areas with drainage and irrigation facilities the maintenance of tertiary canals is also included.

R2: labour used in planting out (or broadcasting), pulling out and including the transport of seedlings.

R3: labour used after planting and before harvesting (weeding, manuring, pest control).

[17] The use of resources for new clearings has been considered of course under capital formation.

R4: labour used in harvesting and sheaving.
R5: labour used in threshing, including bagging and storage.

This schedule gave the picture of table 8 for the average use of labour on the rice farms in Sidodadi. As shown in table 8, land preparation and planting took much of the total labour. The reasons for the large input on land preparation are the incidence of weeds and tall grasses and the need to carry out some water control by building temporary small dikes and watercourses each year. There were no farmers who practised broadcasting, all rice being sown on small seedbeds, whereafter the seedlings are transplanted on the fields, approximately six weeks after germination.

Harvesting also required much labour. This is closely related to the use of the ani-ani harvesting knife. With this instrument a far greater amount of labour is required than with the sickle. Its use seems to be connected with the respect paid to the goddess of rice.[18] The threshing of rice is done on 'threshing-tables' or by trampling the paddy under foot.

Capital and variable inputs The value of the stock of capital for rice farming was quite small. This stock consisted of simple implements, worth *f* 10 on average and an unexpensive paddy barn (by no means all farmers had one), not worth more than *f* 15 on average.[19]

However, a considerable stock of capital is represented by the clearing of new farmland. Our data are rather fragmentary on this point but some information has been produced by this survey. For instance, in March 1966, 8 informants (23 %) spent an average of 41 man-days per farm clearing land. On six of these farms an average of 32.5 man-days were spent on clearing during April. For these 8 farms, an average of 66 man-days in all was devoted to clearing on each during these two months. This high figure indicates that several other household members took part in it too. These days of clearing are not counted in table 8 and represent an addition to the net value of the land. Ignoring other than labour costs and rating the opportunity return on labour at *f* 2 per man-day, this capital formation amounted to *f* 132 per enterprise on these 8 farms,[20] assuming the opportunity return on labour has been correctly assessed.

The following variable inputs were used:

Seed The paddy seed is usually kept from the previous year's best-looking rice plants. The Javanese hold mainly to their own varieties and the best known variety in Surinam, Skrivimankoti, was hardly observed in the survey. About 90 % was planted with the variety Holland, which has been selected by the Government Experimental Station around 1950 and which seems very suitable to either dry or extremely wet

[18] In a recent study on the rural Javanese in Surinam, VAN WENGEN (1966) observed that, while elderly Javanese stick to the harvesting knife, the younger generation was gradually turning to the sickle.

[19] f = Surinam guilder, worth about US $ 0.53.

[20] It is a pity that the national accounts of low-income countries hardly ever consider this type of investment.

conditions.

Fertilizers and insecticides Though these items are available in the area, no fertilizers were used during the year of survey. Two farmers applied weedkillers but the effect was not large and yields proved to be low.

Implements Few implements are used; these are the hoe, a cutlass, a harvesting knife and a pitchfork.

Tillage charges Mechanical tillage is a capital service, not usually connected with traditional agriculture, but this does not greatly affect our scheme of stages, as will be shown later. The significant point is the labour/capital relation, which is high amongst the farmers under discussion here. In this Javanese community there were, for instance, no farmers with plough and bullocks or with a tractor or a threshing machine and, as shown earlier, they were completely dependent for them on outside assistance. Of the 35 farmers, 7 could not obtain (or did not want) this tillage service in 1966 and many others had their fields tilled either partly or less intensively than is usual in transitional rice cultivation.

Threshing costs Apart from human labour, there were no extra costs, threshing machines being unknown.

Transport costs Only three farmers incurred these costs. This is connected with the exclusive subsistence (i.e. self-sufficiency in food) character of rice cultivation amongst these farmers; very little is sold (see Section 3.4).

Production Paddy yields varied greatly. The average yield was 25.9 bags per hectare or around 1850 kg per hectare. But this average contains large variations as shown in table 9. The distribution seems rather uneven and there are conspicuous extremes. Though this unevenness may be due to the small sample, the more plausible answer seems to lie in losses from the following types of damage. Low and very low yields (below 1400 kg per hectare) on 9 farms was caused by flooding, the incidence of rats or jassids.[21] Interviews with local farmers showed that these were recurrent set-backs.

To obtain a closer view of paddy production, the relationship between production in bags of paddy and either area cultivated or man-days worked is shown in figures 3 and 4. Though there seems to be a relationship between cultivated area and production, fluctuations in yield per hectare can be quite large as the scatter diagram indicates. This is even truer of labour. An output of 20 bags of paddy may require from

Table 9. Frequency distribution of paddy yield per hectare (in kg) by number of farms

	350–700	700–1050	1050–1400	1400–1750	1750–2100	2100–2450	2450–2800	2800–3150	3150–3500
Number of farms	1	7	1	2	9	6	4	3	2

[21] The damage on 4 of these 9 farms was caused by water, on another 4 by water and rats together, on 1 by water and jassids. Another 5 farmers whose yields varied between 1400 and 2100 kg per ha merely complained about losses due to rats.

about 90 to 200 man-days.

The finding of such a large range does not seem to be attributable to the method of measuring labour or to the actual measurement itself. The weak relation between labour input and paddy output certainly tallies with the natural conditions under which rice is cultivated in Sidodadi. As presented in figure 4, farmers who employed paid labour (i.e. those with more than 10% of the total labour input from hired workers) were no more efficient than those who used family labour. Reasonably high returns were obtained by a few informants, whose farms happened to have level plots.

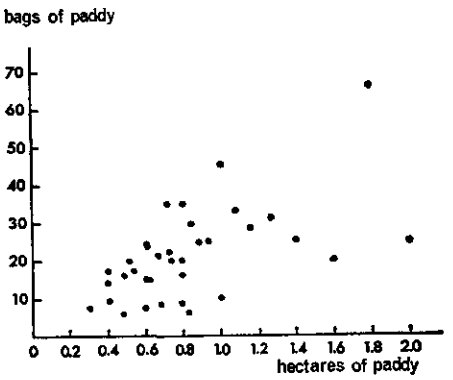


Fig. 3. Relationship between farm size and crop returns (Sidodadi, 1966)

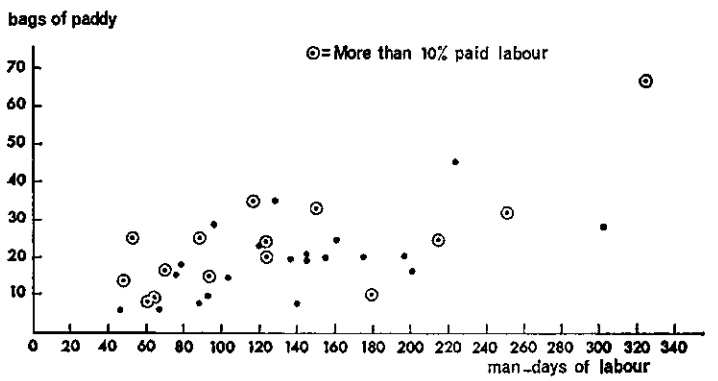


Fig. 4. Relationship between labour input and crop returns (Sidodadi, 1966)

2.3.2 A cost-accounting analysis of the Javanese rice-farms

To achieve some consistency and to allow comparison with other countries (if required), I used the cost concepts, developed in Indian Farm Management Studies, which seem to have found also a wider application outside India.[22] These concepts can be summarized as follows:

Cost A: This item covers expenditure incurred in cash and kind: seed, ploughing charges, threshing and transport costs, fertilizers, pesticides, implement charges, miscellaneous charges, land rent, water taxes and paid labour costs.

Cost B: Cost A + interest on owned fixed capital (imputed).

Cost C: Cost B + the imputed cost of family labour.[23]

Since these farmers do not own the land they cultivate, output (O) minus cost A clearly gives the 'farm business income' or the income accruing to the farmer's own capital, labour and management. Family labour income is equal to O–B and farm profit is defined as O–C.

The pricing of relevant inputs and outputs is a knotty problem in traditional agriculture, as came out, for instance, in a seminar of the Indian Society of Agricultural Economics (1961).

Though the concept of opportunity cost is generally acceptable, it may be difficult to estimate in the evaluation of family labour. Table 10 presents a general picture of the average cost (per farm, per hectare) on the sampled farms. Most items are self-evident and a few remarks should suffice.

Table 10. Cost-accounting analysis according to Concepts A, B and C on Javanese rice farms (1966)

	Cost per farm in *f*	Cost per ha in *f*	Cost A %	Cost B %	Cost C %
Hired labour	39.97	48.44	51.0	50.2	12.6
Seed	6.73	8.16	8.6	8.5	2.1
Fertilizer, pesticides	0.32	0.39	0.4	0.4	0.1
Implement charges	0.68	0.83	0.8	0.9	0.2
Tillage charges	28.17	34.14	36.0	35.4	8.9
Transport charges	0.49	0.59	0.6	0.6	0.1
Miscellaneous charges	0.36	0.43	0.5	0.4	0.1
Land rents	1.66	2.00	2.1	2.1	0.5
Total cost A	78.38	94.98	100.0		
Interest on owned capital	1.20	1.45		1.5	0.4
Total cost B	79.58	96.43		100.0	
Cost of family labour	238.00	288.00			75.0
Total cost C	317.58	384.43			100.0

[22] See, for instance: Econ. Bull. Asia and the Far East, United Nations, 15 (1964).

[23] In this particular case we did not use the gross-margin method, because we are less interested in the planning of a farm than in comparing several systems of rice farming with varying cost structures.

Tillage charges Charges were *f* 2.50 per square chain for complete land preparation (harrowing twice). Of the 28 farmers who had their land tilled, costs amounted to *f* 42.50 per hectare. At *f* 2.50 per square chain this would have cost *f* 62.50, so that these fields could only have been partly tilled.

Land rents In village settlements such as Sidodadi, farmers pay *f* 2 per hectare per year.

Interest on fixed capital The only item was the paddy barn, whose average value was *f* 15. Average rates of interest amount to 8% per year in Surinam.

Cost of family labour Daily wages to agricultural labourers within this Javanese community varied between *f* 1.75 and *f* 3, average *f* 2.13, for the 1966 rice season. This is low compared with Government daily wages in comparable unskilled jobs (about *f* 2.50) and with similar daily wages amongst Hindustani rice-farmers (about *f* 3). On Javanese farms I have arbitrarily fixed family labour at *f* 2 per day.

It should be noted that there is little difference between Costs A and B; hired labour forms much of these costs (nearly half) and ploughing (a third). On the basis of Concept C a major portion falls to family labour. This raises the question whether the evaluation of family labour, as attempted above, is realistic. This point will be discussed further in the following section. The average output was 25.9 bags of paddy per hectare, valued at *f* 270.95 per ha or at *f* 224.89 per farm. Table 11 brings together output and cost.

Table 11. Average farm-business income, family labour income and farm profits on Javanese rice holdings

		Income per farm in *f*	Income per ha in *f*	Number of farms with losses
Farm business income	(0–A)	146.51	175.97	1
Family labour income	(0–B)	145.31	174.52	28
Farm profit	(0–C)	-92.69	-113.48	

Using Concept A, only 1 farm incurred a loss but using Concept C this number was large. Only 7 farms showed a profit, assuming that the evaluation of the various cost items is realistic. On gross output, the farm business income represented 63% of total output. Actual remuneration of family labour, shown in table 11, amounted to *f* 1.22 per man-day on average.

2.3.3 Production function analysis of the Javanese farm data

An attempt has been made to analyse whether the allocation of resources in Javanese rice farming can be considered efficient. This has been done by means of the production function concept. Though it has limitations, we have selected the Cobb Douglas production function as this type has the advantages of computational feasibility and its efficient use of degrees of freedom in statistical testing. Moreover, it permits individual factors of production to have diminishing marginal (and average) products and indicates returns to scale. In order to test the notion that there is a relation between inputs and outputs in rice farming, this function was applied to the farm data for the whole of Group I.

Table 12. Regression coefficients for 35 Javanese rice-farms (1966)

	Land	Labour	Operating expenses
	X_1	X_2	X_3
Partial regression coefficient	$b_1 = 0.2674$	$b_2 = 0.5880$	$b_3 = 0.2024$
Standard error	0.1931	0.1470	0.0851
t at 34 degrees of freedom	1.3847	4.00	2.378

Table 12 shows the results of multiple regression analysis. The coefficient of multiple determination (R^2) was 0.5801 and proved to be highly significant. Student's t distribution was used to test the partial sample regression coefficients b_1, b_2 and b_3; b_2 and b_3 were significant at the 0.025 level (two-tailed test) and b_1 only at the 0.10 level. All b values were below 1.0, indicating diminishing returns for the corresponding inputs.

The sum of the regression coefficients, indicating returns to scale, was 1.0578. With a two-tailed t test it was found that at the 1% level the null hypothesis (i.e. constant returns to scale) could not be rejected. There was no indication of multicollinearity.[24]

To compare the marginal value productivity of inputs with factor costs, the marginal productivity of land and labour were calculated from the formula:

$$\frac{dY}{dX_i} = \frac{b_i}{\overline{X}_i} \overline{Y}$$

With $\overline{Y}$ and $\overline{X}_i$ (at geometric mean levels) known, it was found that the marginal value product of labour amounted to f1.08 per man-day. The marginal value produc-

[24] The correlation between log X_1 and log X_3, which is easily the most susceptible to these interrelations, was only 0.3577. It amounted to 0.4771 in the case of log X_1 and log X_2 and this is well below the level of 0.8, which is normally considered a level of high intercorrelation (HEADY & DILLON, 1961, p. 136).

tivity of land was found to be 6.67 bags of paddy per hectare or *f*69 per ha.

Labour's marginal value product, *f* 1.08, was smaller than its average value product, *f* 1.22 (see previous section). This suggests that production is carried out in the rational stage. But it will be apparent from calculating the ratio

$$\frac{\text{Marginal value productivity of labour}}{\text{Marginal factor cost (wage rate)}} = \frac{1.08}{2.13} = 0.5$$

that there is no perfect efficiency (i.e. the relation = 1) in the use of labour. This result suggests that farmers are irrational in rice cultivation in working on their farm far beyond the point where the remuneration is equal to the wage rate in off-farm occupations.

But there are several objections to this reasoning here.

Firstly, as has been shown, there have been severe setbacks on some holdings (flooding, drought, rats). It often occurred after much of the labour input already had been expended. Apparently, losses are large and cannot be predicted beforehand. Considering these uncertainties, one should not be too rash in judging the peasant's efficiency after a one-year crop-survey. In fact, in this particular year, weather conditions for swamp rice were rather adverse. According to the farmers the yields in 1966 were only two thirds to three quarter's of those in normal years and such bad years occur once every 4 years.

Secondly, the marginal product of labour calculated above is an *average*. It could be argued that calculation of the partial marginal labour product during a peak period (when in fact labour is hired) may show a large value for this product.[25] Such an assumption is not unrealistic in time-bound agriculture; at these peak periods the alternative of family labour only spread over a much larger period (and without paid labour) may lead to a considerable reduction in output.

Thirdly, farmers may well be aware of the losses or low remuneration in rice farming. I commented on Table 5 that the population pyramid of the Sidodadi farmers was remarkable. Further interviews showed that in the economically active age-group (21–40 years) there were 16 males in the sampled families present, while another 12 had left the district during the last decade. Besides the 20 females in the age-group present in Sidodadi during 1966, another 14 had left the area. Another 11 boys and 9 girls in the age-group 11–20 years worked elsewhere or were at school outside Saramacca District (Paramaribo or even in the Netherlands). This indicates that many young people in Sidodadi have turned their backs on farming.

Fourthly, it may have been incorrect to combine paid labour and family labour in

[25] For a theoretical discussion on this point see LUNING (1967, Section 3.6). Although I do not go into this subject further, techniques such as linear programming could produce the marginal products for these peak operations. Programming, however, assumes restrictions and a choice of farming activities. With only one activity, say rice, there is no choice, hence no programming problem.

the analysis. In the number of man-days by family workers many may have been included, which have little or no opportunity return in other occupations, because the people are too old. As said earlier, nearly all full-time farmers were old and therefore could hardly compete for other jobs.

Thus results of a production-function analysis should be scrutinised with extreme care; little value can be attributed to the above example of labour productivity and factor costs. Scrutiny of figures 3 and 4 makes clear that the part explained by the inputs land, labour and operating expenses is very small, compared with the unexplained variable(s), affecting the production process.

The item operating expenses is a mixture of various inputs and it is purposeless to discuss its marginal productivity aspects in relation to factor costs. Of the item land, its average productivity per ha (calculated as a residual by subtracting all other costs from total gross return with the exception of land rent) was negative. As indicated, this is connected with the huge share going to labour. But land certainly has some value. We already noticed the process of capital formation (clearing, dikes, watercourses). Though no hiring of land was recorded between members of this Javanese community in 1966, this occurrence on land rented from the Government is well known in other rice areas, as will be discussed later. In Nickerie, for instance, the actual charge was 15–25 bags of paddy per hectare, for irrigated and well drained land.

2.4 Economic analysis of rice farms in transitional agriculture: the Hindustani farmer[28]

Like the Javanese, rural Hindustanis are a distinct group and they form the backbone of Surinam's rural communities. As noted before, their staple is rice and they cultivate it wherever possible. The Hindustanis in this sample have large families with many small children and there are few old people. Table 13 contains this data for the Hindustani farms in Surinam District (39), Saramacca (10) and Nickerie (54 farms). Evidently the population pyramid has a very broad base and a very small top.

Though the main emphasis in this farm management study is rice, records have been kept on all income-earning activities during the first survey year (1965–6). As is shown in table 14, the farming pattern varies from place to place. The land-use pattern indicates that rice, dairying and vegetables form the major sources of agricultural income in Surinam District, while in Saramacca this income is derived mainly from rice, perennial and annual crops, and livestock. Nickerie is characterized by its heavy reliance on rice.

Farms have all been laid out in rather narrow, rectangular strips and this accounts for the large proportion of land used for dams and watercourses.

[28] From the heading of this paragraph it should not be deduced that Hindustanis are transitional ricefarmers while the Javanese are still in the traditional stage. A connection between ethnic group and stage of rice farming cannot be maintained. Also discussed in Section 4.1.

In both Surinam and Nickerie districts there are ample opportunities for off-farm occupations but this is not so for Saramacca farmers; they have to earn a living mainly

Table 13. Some data on family composition in Group II

	Surinam (IIa)		Saramacca (IIb)		Nickerie (IIc)		Total	
	m	f	m	f	m	f	m	f
Total number of persons	196	153	46	43	202	193	444	389
Age distribution								
0–14 years	112	83	27	25	123	122	262	230
15–60 years	80	68	16	18	77	70	173	156
> 60 years	4	2	3	0	2	1	9	3
Average size of family	8.9		8.9		7.3		8.1[1]	
Number of persons older than 14 years per family	3.9		3.7		2.8		3.0[1]	
Average age of head of household	42		45		40		41[1]	

[1] Weighted averages

Table 14. Land use in 1965 amongst the Hindustani peasants in hectares and in percentages of total land (averages per farm in each district)

	Surinam		Saramacca		Nickerie	
	ha	%	ha	%	ha	%
Total land	168	100	84	100	177	100
Rice	90	54	28	33.5	147	83
Permanent pasture	23	13	5	6	–	–
Vegetables	4	2.5	0.4	0.5	0.8	0.5
Perennial crops	10	6	14	17	2.2	1.5
Annual crops	0.8	0.5	1.9	2	–	–
Compound, dams, watercourses	17	10	8.6	10	15	8.5
Woodland and fallow	23.2	14	26.1	31	12	6.5

Table 15. Percentage of average family net income, earned in specific economic activities (1965–6)

	Surinam	Saramacca	Nickerie
Rice	12.9	52.7	39.8
Livestock	17.2	17.4	8.3
Vegetables	5.4	–	–
Perennial crops	–	9.3	–
Annual crops	–	7.9	–
Total agricultural income	35.5	87.3	48.1
Off-farm income	65.5	12.7	51.9

Table 16. Annual allocation of total family labour in man-days per average farm (1965–6)

	Surinam	Saramacca	Nickerie
Rice	138	215	111
Livestock	34	24	25
Vegetables	65	–	–
Perennial crops	–	85	–
Annual crops	–	56	–
Labour for capital formation (clearing)	11	31	5
Total work on farms	248	411	141
Off-farm work	233	44	188
Total family labour	481	455	329

Table 17. Average earnings per family and per man-day from different sources (1965–6, in *f*)

	Surinam	Saramacca	Nickerie
Net agricultural income	431.50	1165.25	642.25
Off-farm income	782.00	168.25	692.25
Total income	1213.50	1333.50	1334.50
Earnings per man-day in agriculture	1.74	2.84	4.56
Earnings per man-day in off-farm work	3.35	3.80	3.67
Average earnings per man-day worked	2.52	2.93	4.06

from agriculture. This income pattern, which is connected with distance to factor markets (mainly for labour) and product markets is presented in table 15. Since capital assets do not play a great role in off-farm earnings, the most important factor to be allocated in obtaining income is therefore labour. This pattern of labour allocation is given in table 16 and average labour earnings in table 17.

A comparison of table 16 with 15 reveals that the productivity of labour is low in rice and vegetable farming in Surinam District. Rice growing is reasonably productive in both Saramacca and in Nickerie districts. In the survey year in Saramacca a lot of clearing has been done and to a lesser extent in Surinam District.

Total net income varied less between the districts than number of man-days required to earn this income. Table 17 shows differences in earnings per man-day. Earnings in agriculture are particularly low in Surinam District. Daily earnings were better in off-farm occupations than in agriculture but Nickerie was an exception.

2.4.1 Resource use and production in transitional rice farming

Land The average area under rice per farm intentionally did not vary greatly between the three areas. But the quality of the land varied a lot. The sampled farms in Surinam District had only drainage facilities. This particular polder was laid out in 1906, when the technical knowledge, for instance, of lay-out and soil properties, was

limited, whereas the ones in Saramacca and Nickerie were established much later. The ricefields in Surinam District are further divided by small dikes to exert some degree of water control in these rain-fed basins. This subdivision is not required on the oblong strips in the other two districts, where irrigation water enters at one end by gravity and leaves at the other end of the farm. In Saramacca a number of farms border the natural swamp, so that weeding and clearing required quite a labour effort.

Farms had on average 2–3 hectares of rice under cultivation[27], but in practice there was variation, since farmers leased or hired out parcels of land without giving prior notice. The actual distribution according to area under rice is given in Appendix A.

Labour Amongst the Hindustanis a similar system of mutual assistance exists in meeting the peak demand for labour in rice growing (especially planting). This system has nothing to do with traditionalism in rice farming; even in the semicommercial rice-farming of Nickerie it is practised. There it eases the shortage of labour and is favoured to draw the people into community. This is possible because water is allotted to particular polders on different days. This enables relatives and friends from other polders to help in planting fields which have just received water. Paid labour is employed during periods of heavy demand. Only on 7% of all the farms was paid labour not hired.

As on Javanese farms (Section 2.3.1), operations in rice growing were arranged under the headings R1 to R5. Average numbers of man-days per farm and per hectare are shown in table 18 for the three areas. The distribution is given of man-days worked by family and paid labour.

Table 18. Average number of man-days worked on various operations in rice cultivation (per ha)

	R1	R2	R3	R4	R5	R total	Family labour	Hired labour
Surinam 1965	9	20	4	28	9	70	60	10
Surinam 1966	4	20	4	30	6	64	50	14
Saramacca 1965	17	18	7	21	16	79	77	2
Nickerie 1965	8	18	4	19	3	52	41	11
Nickerie 1966	5	15	3	21	3	47	36	11

The differences in input per operation between the areas can be attributed partly to the techniques used in rice growing. In fact, these three groups represent different steps in the transformation continuum. As can be deduced from the column R total (total labour per hectare), Saramacca and Surinam farms are within one group and Nickerie, which uses less labour, is in another. In Saramacca more labour was used in land preparation (R1) and weeding (R3) because of the luxuriant natural vegetation. Moreover, not all plots were ploughed but some were cleared of weeds in-

[27] For the country as a whole the average area under rice is about 2 hectares per typical rice farm.

stead. The short rainy season early in the year failed to bring much rain in 1966 and subsequently less weed clearing was involved in land preparation that year. There was not much variation in R2 labour, transplanting being the rule in all areas, but in Nickerie there was a fair amount of broadcasting in 1966. While R1 to R3 are linearly related to area sown, R4 and R5 are determined by yield per hectare, ignoring differences in techniques. All farmers used the sickle for harvesting but Surinam farmers required more labour despite lower yields. This seemed connected with severe lodging and the uneven ripening without irrigation. This forced the farmers to return several times to the same field, especially as the local variety is prone to shedding.

Owing to the different methods for threshing, the quantity of R5 labour varied distinctly. While threshing was entirely mechanical in Nickerie, it was partly by machine and partly by oxen in Surinam, and in Saramacca it was still by hand. In Saramacca nearly all labour was provided by the family, the possibilities for off-

Table 19. Estimated values of capital assets per average farm and per hectare for the three areas (in f)

	Surinam		Saramacca		Nickerie	
	farm	ha	farm	ha	farm	ha
Paddy barn	37	14	124	44	111	38
Oxen	145	55	72.50	26	–	–
Ox-plough, miscellaneous tools	26	10	31	11	12	4
Tractors, disc-plough	349	133	–	–	494	169.50
Tractor shed	1	0.50	–	–	4.50	1.50
Total	558	212.50	227.50	81	621.50	213

Table 20. Frequency distribution of farms with different paddy yields per hectare

Yield	Surinam		Saramacca	Nickerie		Total
in bags	1965	1966	1965	1965	1966	
10–15	3	1	–	–	–	4
15–20	6	6	–	–	–	12
20–25	8	8	–	–	–	16
25–30	15	8	–	2	1	26
30–35	5	9	–	1	1	16
35–40	2	4	4	9	7	26
40–45	–	2	1	10	11	24
45–50	–	1	2	8	16	27
50–55	–	–	2	8	4	14
55–60	–	–	–	7	8	15
60–65	–	–	1	6	4	11
65–70	–	–	–	–	1	1
70–75	–	–	–	1	–	1
75–80	–	–	–	1	–	1
Total	39	39	10	53	53	194

season employment being few; in Nickerie and Surinam districts paid labour made a substantial contribution.

Capital The value of the stock of capital for rice farming has been summarized in table 19. The estimated value of the stock of capital is surprisingly similar for both Surinam and Nickerie, but this stock is much less in Saramacca. The capital structure varies a lot with Nickerie and Saramacca at the extremes. Surinam farms are intermediate, with substitution of tractors for oxen in full swing. In Saramacca the substitution of labour for capital is not yet far advanced (cf. table 18). Further attention to these differences in capital structure will be given in Chapter 3.

Production Paddy yields per hectare varied within each area and between areas (table 20).

It is evident that variations between years in each area are not as important as differences between areas. Surinam District lacks irrigation and this seems to limit the output per hectare.

2.4.2 A cost-accounting analysis of the Hindustani rice farms

Only a brief word is needed after what has been said in Section 2.3.2 on the various cost concepts. In tables 21–25 a summary is given of the average cost (per farm, per hectare) on the sampled farms in Surinam, Saramacca and Nickerie districts, respectively.

A few remarks need to be made about some of the cost items in these tables.

Seed Paddy seed is mostly bought from special stores, run by members of the Agricultural Extension Service. In the survey years most of the areas were sown with the local variety Skrivimankoti, but in Nickerie an increasing number of farmers bought seed, selected for the Wageningen Scheme (stiff-stemmed, especially developed for combine-harvesting) and which response favourably to fertilizers.

Tillage charges Some farmers in the sample had oxen and a plough (Surinam district), others owned tractors, disc harrows and other equipment (Nickerie, Surinam), but it was not possible to give a precise account of their costings and revenues, since all tractor-owners in the sample worked for other farmers as well. These people did not keep books and with limited staff it was not possible to keep detailed accounts on the economics of farm machinery.

For better comparison I have assumed that all farmers made use of ploughing services, provided by outsiders at the rates operative in each area.[28] I have of course

[28] Detailed accounts were, however, kept on a few tractor holders but we are not sure whether they are representative. Anyhow, in these cases studied it appeared that hiring charges were about equal to factor costs.

excluded capital assets such as farm machinery and working bullocks in the item interest on fixed capital.

The method of tillage is different in Nickerie from in Surinam District. In Surinam District it consists of harrowing twice, with a fortnight between. It could better be called puddling. In Nickerie District the land is dry-ploughed with disc ploughs during the dry season (with one rice crop a year), ploughed again later, harrowed twice and often harrowed yet again just before sowing or transplanting. Dry ploughing in Surinam District clashes with the interests of the dairy enterprises, which is an important source of income (tables 15 and 16), whereas in Nickerie most of the cattle are kept in a communal grazing area.

Interest and depreciation of fixed capital The only remaining item was the paddy barn.

Threshing and transport costs Labour used in threshing and transport is not included in these costs. These charges are connected with output so that costs were about twice as high in Saramacca and Nickerie as in Surinam District.

Land rents The land-tenure system in Surinam is complicated[29] and various types of tenure exist. Though some of the land in our sample was owned (allodial), most of it was on long-term lease from the Government. To allow comparison, I have considered all land to be leased from the Government, to whom farmers pay *f* 10 annually

Table 21. Cost-accounting analysis of Hindustani rice-farms: cost per farm in *f*

	Surinam		Saramacca	Nickerie	
	1965	1966	1965	1965	1966
Hired labour	69.43	84.26	19.55	108.18	112.81
Seed	16.02	18.75	13.92	21.15	26.15
Fertilizers, pesticides	2.74	3.55	3.00	5.78	6.34
Implements	0.64	0.30	6.35	2.77	0.26
Tillage charges	93.77	119.15	117.55	108.09	110.71
Transp., threshing charges	27.47	35.49	54.21	72.10	84.08
Miscellaneous charges	3.94	2.75	–	0.17	2.09
Land rents	22.50	25.70	27.00	24.00	25.10
Hiring extra land	0.77	–	10.00	39.97	37.23
Total cost A	237.28	289.95	251.58	382.21	404.77
Interest on fixed capital	6.47	6.47	22.56	18.84	18.84
Total cost B	243.75	296.42	274.14	401.05	423.61
Cost of family labour	412.50	384.87	644.34	333.93	296.71
Total cost C	656.25	681.29	918.48	734.98	720.32

[29] For a detailed account, see QUINTUS BOSZ (1954).

per hectare. Owned land could not be accurately valued since so little land changed of owners. From the few transactions in Nickerie District which I heard about, it seemed that recent prices varied from place to place between *f* 1500 and *f* 2500 per hectare.

Hiring extra land Some land, especially in Nickerie, was hired between farmers. This land was hired for one year at high rates, ranging from *f* 75–*f* 200 per hectare per year.

Cost of family labour Daily wages for agricultural labour varied between *f* 2.50

Table 22. Cost-accounting analysis of Hindustani rice-farms: cost per hectare in *f*

	Surinam		Saramacca	Nickerie	
	1965	1966	1965	1965	1966
Hired labour	30.19	32.79	6.98	39.92	40.59
Seed	6.97	7.30	4.97	7.80	9.41
Fertilizers, pesticides	1.19	1.38	1.07	2.13	2.28
Implements	0.28	0.12	2.27	1.02	0.09
Tillage charges	40.77	46.37	43.52	39.89	39.83
Transp., threshing charges	11.94	13.81	19.36	26.61	30.25
Miscellaneous charges	1.71	1.07	–	0.06	0.75
Land rents	10.00	10.00	10.00	10.00	10.00
Hiring extra land	0.33	–	3.57	14.75	13.39
Total cost A	103.38	112.84	91.74	142.18	146.59
Interest on fixed capital	2.82	2.52	8.05	6.95	6.95
Total cost B	106.20	115.36	99.79	149.13	153.54
Cost of family labour	179.35	149.82	230.12	123.21	106.59
Total cost C	285.55	265.18	329.91	272.34	260.13

Table 23. Cost-accounting analysis of Hindustani rice-farms: percentages of cost A

	Surinam		Saramacca	Nickerie	
	1965	1966	1965	1965	1966
Hired labour	29.3	29.1	7.6	28.1	27.7
Seed	6.7	6.5	5.4	5.5	6.4
Fertilizers, pesticides	1.1	1.2	1.2	1.5	1.6
Implements	0.3	0.1	2.5	0.7	0.1
Tillage	39.5	41.1	47.4	28.1	27.2
Transport, threshing	11.6	12.2	21.1	18.7	20.6
Miscellaneous	1.7	0.9	–	–	0.5
Land rents	9.5	8.9	10.9	7.0	6.8
Hiring extra land	0.3	–	3.9	10.4	9.1
Total cost A	100.0	100.0	100.0	100.0	100.0

and *f* 3.50 for both rice seasons. The remuneration of family labour is therefore fixed at *f* 3 per day.

In Cost C, the concept comprising all imputed costs, family labour takes the largest share, with Saramacca the largest proportion, nearly 70%, in Nickerie it is 40%, while Surinam takes an intermediate position with about 60%. In all areas family labour had been converted to man-days, using weighing factors where necessary for women and children. Again, there is little difference between Costs A and B. In Surinam District the main shares of Cost A go to ploughing, hired labour, and threshing and transport charges. On the Saramacca farms there are two main items, ploughing, and threshing and transport charges, while in Nickerie the sequence is hired labour,

Table 24. Cost-accounting analysis of Hindustani rice-farms: percentages of cost B

	Surinam		Saramacca	Nickerie	
	1965	1966	1965	1965	1966
Hired labour	28.4	28.4	7.0	26.8	26.5
Seed	6.6	6.3	5.0	5.2	6.1
Fertilizers, pesticides	1.1	1.2	1.1	1.4	1.5
Implements	0.3	0.1	2.3	0.7	0.1
Tillage	38.4	40.2	43.6	26.8	25.9
Transport, threshing	11.2	12.0	19.4	17.8	19.7
Miscellaneous	1.6	0.9	–	–	0.5
Land rents	9.4	8.7	10.0	6.7	6.5
Hiring extra land	0.3	0.0	3.6	9.9	8.7
Interest on fixed capital	2.7	2.2	8.0	4.7	4.5
Total cost B	100.0	100.0	100.0	100.0	100.0

Table 25. Cost-accounting analysis of Hindustani rice-farms: percentages of cost C

	Surinam		Saramacca	Nickerie	
	1965	1966	1965	1965	1966
Hired labour	10.6	12.4	2.1	14.7	15.6
Seed	2.4	2.8	1.5	2.9	3.6
Fertilizers, pesticides	0.4	0.5	0.3	0.8	0.9
Implements	0.1	–	0.7	0.4	–
Tillage	14.3	17.5	13.2	14.6	15.3
Transport, threshing	4.2	5.2	5.9	9.8	11.6
Miscellaneous	0.6	0.4	–	–	0.3
Land rents	3.5	3.8	3.0	3.7	3.8
Hiring extra land	0.1	0.0	1.1	5.4	5.2
Interest on fixed capital	1.0	0.9	2.4	2.5	2.7
Cost of family labour	62.8	56.5	69.8	45.2	41.0
Total cost C	100.0	100.0	100.0	100.0	100.0

ploughing and threshing and transport charges. The cost composition is quite similar in Nickerie and Surinam between the two years. The *total* (imputed) costs per hectare are of the same order of magnitude in both Surinam and Nickerie districts, being somewhat higher for the Saramacca enterprises. Table 26 presents an overall picture of the profitability of rice farming in these districts. For farm profits, Surinam is in one group, Saramacca and Nickerie in another. Yields per acre are conspicuously lower in Surinam District then in the other areas. This is certainly connected with the absence of irrigation in Surinam District.

Taking Concept A, one farm in the Surinam District incurred losses both in 1965 and 1966. Family labour did not receive its *imputed* remuneration on between 70 and 80% of the farms in that District. This is in sharp contrast with Saramacca and especially with Nickerie, where nearly all farms made a profit on rice.

Table 26. Yields per hectare (in bags), farm business income (0–A), family labour income (0–B) and farm profits (0–C) on Hindustani rice farms (1965–6)

	O–A	O–B	O–C
Surinam (1965)			
Yield	25.0		
Income per farm in *f*	212.72	206.25	−206.25
Income per ha in *f*	96.62	93.80	− 85.55
Number of farms with losses (−) or profits (+)	1 (−)	32 (−)	7 (+)
Percentage of farms with losses (−) or profits (+)	2.6	82.1	17.9
Surinam (1966)			
Yield	27.7		
Income per farm in *f*	279.56	273.09	−111.78
Income per ha in *f*	108.76	106.24	− 43.58
Number of farms with losses (−) or profits (+)	1 (−)	27 (−)	12 (+)
Percentage of farms with losses (−) or profits (+)	2.6	69.2	30.8
Saramacca (1965)			
Yield	50.5		
Income per farm in *f*	839.22	816.66	171.32
Income per ha in *f*	312.26	304.21	74.09
Number of farms with losses (−) or profits (+)	0	1 (−)	9 (+)
Percentage of farms with losses (−) or profits (+)	0	10	90
Nickerie (1965)			
Yield	48.7		
Income per farm in *f*	669.71	650.87	316.94
Income per ha in *f*	247.42	240.47	117.26
Number of farms with losses (−) or profits (+)	0	2 (−)	52 (+)
Percentage of farms with losses (−) or profits (+)	0	3.7	96.3
Nickerie (1966)			
Yield	51.9		
Income per farm in *f*	637.38	618.54	321.83
Income per ha in *f*	268.61	261.66	155.07
Number of farms with losses (−) or profits (+)	0	1 (−)	52 (+)
Percentage of farms with losses (−) or profits (+)	0	1.9	98.1

Finally, a calculation has been made of the farm business income in total output on the basis of the gross output. This farm business income represented 76% of tota output in Saramacca, and for 1965 and 1966, respectively, 62% and 63% in Nickerie and 46% and 47% in Surinam District.

2.4.3 Production function analysis of Hindustani farm data

As with Javanese farms (Section 2.3.3) a Cobb Douglas production function analysis was carried out for the farms in Nickerie and in Surinam District. The Saramacca enterprises were excluded as the sample was too small. For the model and symbols used, reference is made to the section on Javanese farms.

The aggregation of inputs gave difficulties for X_3, the operating expenses. Certain costs such as those for threshing and transport were excluded from the analysis, as they did not determine rice production but were themselves determined by the level of output.

However, a study of the correlation matrix showed a high intercorrelation between log X_1 (land) and log X_3 for both areas (about 0.9). Closer scrutiny showed that this was caused by ploughing costs, which are paid on a hectare basis. There was little evidence of varying thoroughness of ploughing and thus this item was dropped from the X_3 category. Ultimately, X_3 consisted of the (partly) imputed costs of seed rice, fertilizers and pesticides. Final calculations showed that the problem of multicollinearity had been solved, whereupon a multiple regression was carried out. Before looking at table 27, it should be pointed out that simple correlations between inputs and output were tried on graph paper first.

For the 1965 farm data from Surinam District, there was no relation between inputs and output, though the input range was quite considerable (correlation coefficient 0.02). This seems to be connected with the great range of soil-water conditions, which had a profound influence on the output level, regardless of costs. Analysis into subsamples was not possible. We have therefore excluded the 1965 data for Surinam from table 27.

In all cases, the coefficient of multiple determination (R^2) was significantly different from zero. Student's t distribution was used to test whether the regression coefficients, b_1, b_2 and b_3 differed from zero. The regression coefficients of the Nickerie farm data were, with one exception, significant at either the 1% or the 2% level. For the Surinam sample, only the coefficient for land differed from zero. All b values were below 1.0, indicating diminishing returns on the corresponding inputs. The sum of the regression coefficients did not statistically differ from 1.00 in all areas and the null hypothesis (i.e. constant returns to scale) could not be rejected.

The constant term was very large for the Surinam sample. Moreover, as two of the three production elasticity coefficients were insignificant, there is little sense in further discussing these farm data. As was feared for the 1965 data, one is faced here with the phenomenon of hybrid functions. This has been corroborated by field observations.

Turning now to the Nickerie data, the marginal value productivity of the inputs has

been compared with the relevant factor costs, using the equation of Section 2.3.3. *Labour*'s marginal value product amounted to *f* 3.14 per man-day in 1965 and *f* 3.01 in 1966. The actual (agricultural) wage levels varied somewhat within the year and a weighted average of *f* 3.30 per man-day has been kept. There were no differences in wage levels between the two years. The relation marginal value productivity to marginal factor cost (MVP)/(MFC) for labour in 1965 and in 1966 was 0.952 and 0.912, respectively.

Using the equation:

$$\text{var.}\left(b_2 \frac{\overline{Y}}{X_2}\right) = \left(\frac{\overline{Y}}{X_2}\right)^2 \text{var.}\,(b_2)$$

to calculate the variance of labour's marginal product, and using Student's *t* distribution with 50 and 46 degrees of freedom, respectively, it was found that the null hypothesis, i.e. that labour is applied efficiently, could not be rejected. A close agreement is indicated between the theoretical and the real values for this input. There is conspicuously little variation between the two years.

Land's marginal value product amounted to 35 and 34 bags per hectare in 1965 and 1966. This is a bit higher than the rate farmers charge each other in hiring land (25 bags/hectare). But it is of the right order of magnitude compared with the official land rent, fixed by the Government in 1852, and equivalent to 1½ bag of paddy per

Table 27. Regression results for rice farms in the districts of Surinam (1966) and Nickerie (1965 and 1966)

	Land	Labour	Operating expenses
Surinam (1966)			
partial regression coefficient	$b_1 = 0.7287$	$b_2 = 0.2532$	$b_3 = 0.0466$
standard error	0.2417	0.1784	0.1283
t value	3.02***	1.4	0.4
Nickerie (1965)			
partial regression coefficient	$b_1 = 0.7470$	$b_2 = 0.4372$	$b_3 = -0.0847$
standard error	0.1259	0.1331	0.0444
t value	5.93***	3.28***	1.90
Nickerie (1966)			
partial regression coefficient	$b_1 = 0.5470$	$b_2 = 0.3417$	$b_3 = 0.0972$
standard error	0.0866	0.0972	0.0401
t value	6.32***	3.69***	2.42**

	Σb	b_0	R^2
Surinam (1966)	1.0285	211.3461	0.600
Nickerie (1965)	1.0995	2.2203	0.755
Nickerie (1966)	0.9859	2.4174	0.915

hectare. The relation (MVP)/(MFC) was 1.40 (1965) and 1.36 (1966). Following the same procedure as outlined for labour above, it was found that the null hypothesis could not be rejected, i.e. the unofficial mutually agreed land rent was fixed in an efficient way.

The productivity of *capital services* involves a mixture of various inputs and therefore it is not possible to analyse its marginal productivity aspects in relation to factor costs.

2.5 Economic analysis of family rice-farms in the commercial stage

During the late fifties the Surinam government recognized that the emphasis on the social aspects of land-settlement policy had ignored the fact that these farms were too small to make a living. Besides, on these smallholdings the family labour could not be used fully outside the periods of labour peaks, which are very conspicuous for rice (figure 5). The establishment of medium-sized mechanized family rice-farms on a commercial basis was considered justified by:

1. the more efficient use of labour supply through adjustment of farm mechanization at periods of labour congestion
2. a minimum of wastage in the capacity of agricultural machinery, hence a cost-reducing effect

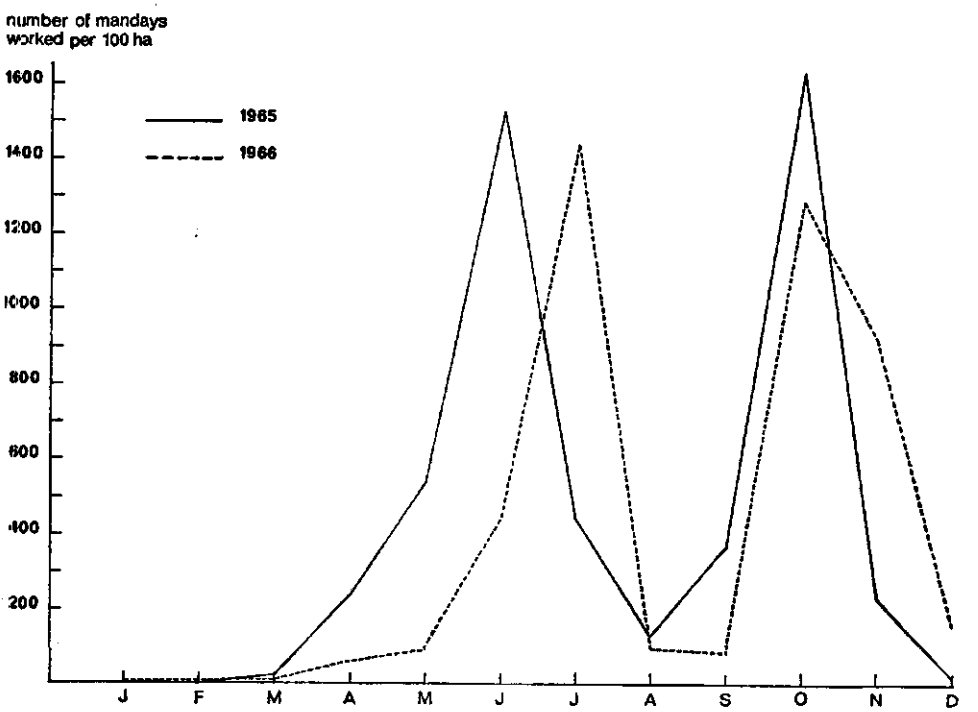


Fig. 5. Monthly labour requirements on rice smallholdings (seasons 1965 and 1966)

3. better net results and a favourable productivity level of resources (KLAASSE BOS, 1964).

The Government realized that such a type of enterprise required a high investment per worker, to be financed partly by the Government, partly by the prospective settlers themselves. But in this way it was thought possible to create an independent peasantry with incomes equal to those in corresponding employment; furthermore, this project could become a starting point for a structural transformation of peasant agriculture.

Since such a scheme would depend heavily on access to new types of input resources, a polder was planned adjacent to the Wageningen Rice Scheme by the Office of Rural Development in 1963 and implemented the same year. The polder covers about 1000 hectares in 7 sections of 144 hectares each. In each section 6 farms have been projected each of 24 ha. Each farm is subdivided into 4 fields of 6 hectares. By hiring out or leaving one or more fields fallow farms may be varied in size. Farmers are admitted only after rigorous selection and are trained for one year at a specially created centre within the Wageningen Project.

The first 4 farmers were allotted farms in October 1964, followed by 5 in October 1965 and another 9 towards the end of 1966. To be eligible, persons must have Surinamese nationality, must be married, and between 26 and 45 years of age, and must bring in at least f 100 capital per hectare. The 24-ha farms are handed over without houses and farm buildings, but farm credit has been made available to a maximum of *f* 12,000 at 7% interest, to be paid back in six years.

During planning, the Government decided to adjust farm size to the available family labour so that farmers would be independent of outside labour. In view of the technical level envisaged, the Government considered that one adult worker could cope with 24 hectares. In this scheme two rice crops can be obtained per year but the settlers were advised to sow an area of between 125 and 150%, as is customary in the Wageningen Scheme. No place was given to the production of other crops or to livestock. Soil characteristics and drainage problems would obviously be limiting factors for livestock and citrus.

Tenure was by an annual lease from the Government at *f* 10 per hectare. After 6 years, a long lease contract can be obtained, if ability has been proved.

Of the first 9 farmers, settled in 1964 and 1965, five were Hindustani, two Javanese and two Creole. Farmers in this project are provided with many services by both the Wageningen Project and by the Ministry of Agriculture. The extension officer in charge of Nickerie District provides any advice to the farmers, and credit is provided by another agent of the Ministry. Services provided by the Wageningen Rice Scheme are: hiring out of caterpillar-tractors and combine-harvesters, sale of seed, pesticides and fertilizers, and the buying up of the settlers' paddy. Moreover, in combating jassids in rice, aeroplane services, used in the large Scheme, are also provided (against payment) to these settlers.[30] It is evident that the supply of new inputs and the sale

[30] For an up-to-date review of technical levels of rice cultivation in the Wageningen Project, see TEN HAVE (1967).

of the product is much more intensively organized than it is for the traditional and transitional rice farmers.

2.5.1 Resource use and production in commercial rice-farming

Land Each group of settlers starts farming in the Scheme in October, when a new cropping cycle is initiated, rounded off by the harvest in March. The second cycle then starts in April-May and this crop is harvested in September. Long experience at the Rice Scheme indicated that yields per hectare are significantly better in the September harvest and the first settlers were therefore urged to cultivate only half their area in October, and plant rice on it all during the second cycle. This system allowed for dry ploughing.

As HASSELBACH and VAN AMSON (1965) had clearly shown for the clay soils of the young coastal plains of Surinam, dry ploughing before planting increases yield per hectare by an average of 300 kg paddy on peasant rice-farms. This practice is already well established among Nickerie rice-smallholders. Settlers accepted this advice in the first year (1965), as can be deduced from table 28, containing records of eight settlers. The first nine settlers kept their own records but those of one farmer were untrustworthy so his results were discarded in the following analysis.

Table 28. Area under rice in 1965 and 1966 and percentage occupation in each cropping season

Farm code No	1	2	3	4	5	6	7	8
Area	22.80	23.09	22.93	22.85	22.41	22.55	22.37	22.24
Spring harvest 1965	50	50	50	50				
Autumn harvest 1965	100	100	100	100				
Spring harvest 1966	100	100	100	100	100	100	100	100
Autumn harvest 1966	100	50	100	75	100	100	100	100

Source: SLANGEN (1967).

All groups started their first season a little late, owing to unavoidable delays, such as the building of houses and arrangement of farm machinery, and these arrears continued in later cropping seasons. In the autumn of 1965, farmers decided to plant the full area, as results had been very satisfactory for the first two cycles, hoping to repay their debts as quickly as possible. However, the late availability of water and the general arrears caused the spring sowing of 1966 to be late and some farmers could not plough their entire fields.

Labour Hand operations in this type of rice farming are almost confined to sowing and the application of fertilizers;[31] all other operations are mechanized. In the original plan it was assumed that farmers would co-operate in sowing and in harvesting by

[31] Seeders were used for the first time by some of these settlers in 1966.

working together. Mutual assistance is widespread in Surinam peasant farming, as has been discussed in earlier sections.

In the autumn harvest of 1966 mutual help on these eight enterprises varied between 3 and 17% of the total labour input. For the first time labourers had been employed, amounting to between 4 and 16% of total labour. The farmers said they wanted to become more independent of other farmers and work could be done more efficiently with paid labourers.[32] With the stock of agricultural machinery anticipated for these enterprises, the labour requirements were estimated by KLAASSE BOS (1964) at 70

Table 29. Man-hours of labour per hectare planted in 1965 and 1966 (averages for 2 cycles)

Farm code No	1	2	3	4	5	6	7	8	Average
1965	66.8	63.1	63.5	59.4					63.2
1966	62.4	58.6	52.4	46.1	53.5	41.9	51.8	62.4	53.6

Source: SLANGEN (1967).

Table 30. Percentage of man-hours spent on various tasks (1965 and 1966)

Farm code No	1		2		3		4		Average	
	1965	1966	1965	1966	1965	1966	1965	1966	1965	1966
Land preparation	14.4	12.7	15.2	17.0	19.2	17.1	13.0	14.0	15.5	15.2
Sowing	8.5	5.5	14.4	7.3	8.5	8.7	7.3	4.9	9.7	6.6
Tending of crops	27.4	31.1	17.8	25.6	22.6	31.8	21.1	23.2	22.2	27.9
Harvesting, transport	17.2	10.4	14.1	14.2	14.7	12.8	16.4	14.7	15.6	13.0
Miscellaneous	32.5	40.3	38.5	35.9	35.0	29.6	42.2	43.2	37.0	37.3

Source: SLANGEN (1967)

Table 31. Planned investment for a 24-ha rice-farm in 1964

Type of machine	Purchase price	Per number of farms	Investment per farm	Period of depreciation
Tractor	*f* 6,000	2	*f* 3,000	5,000 hours or 6 years
Disc plough	1,000	2	500	6 years
Harrow	600	2	300	6 years
Trailer	2,000	2	1,000	10 years
Weedcutter	3,300	6	550	10 years
Combine-harvester	to be hired from Wageningen Rice Scheme			
Motor spray	300	2	150	2 years
Saval spray	75	1	75	2 years
Covers	50	2	25	1 year
Implements	250	1	250	5 years
Shed	1,000	1	1,000	10 years
Total	*f* 14,575		*f* 6,850	

[32] This tallies with the opinion of one of our sample farmers in Surinam District. By hiring daily labour he forced his grown-up sons to start earlier and work harder in the field.

man-hours per hectare at a cropping occupation of 125%.

With the average cropping percentages for 1965 and 1966 of 150% and 180%, respectively, and allowing that family labour will be used more efficiently as cropping percentage rises, it is evident from table 29 which is converted from man-days that the earlier mentioned estimate of 70 man-hours with 125% is in close agreement with reality.

The distribution of particular activities (table 30) hardly varied between years, but did so between farms. The lower percentage on sowing in 1966 is connected with the purchase of seeders by some farmers. The percentage on harvesting was less in 1966 because of the poor crop in the autumn. The category miscellaneous is notably large. It consists of supervision, maintenance, extension talks, administration and miscellaneous transports. As farmers recorded their own labour, there may have been a bias towards the last category.

Investments The original plan was that the investment schedule per farm would depend on how much the farmers co-operated. This co-operative spirit was kindled during the one year training period, when farmers had to work together. It was assumed that such co-operation would be a great social achievement and would benefit the economics of such enterprises, since all the machines bought by *separate* enterprises, would have too high a capacity (KLAASSE BOS, 1964). Table 31 presents the intended investment schedule.

In practice, this plan has not completely succeeded. Sharing of a tractor, the largest investment item of these farms, was soon given up. Only farms 5 and 6, which started in October 1965, worked together in 1966, but this arrangement will cease as soon as money allows. According to TEMPELMAN (1966), this attitude seems to be dictated by the following considerations.

1. The time available between cropping cycles is usually short, so farmers want to prepare the seedbed as thoroughly as possible and to use a tractor whenever it suits them.
2. Farmers accuse each other of careless and excessive use, neglect and insufficient maintenance of shared machinery.
3. The tractor is also used as a private vehicle, especially in the rainy season, when the roads are almost impassable.

The remainder of the listed farm machinery and implements have either been purchased jointly by the farmers or items were bought complementary to each other. The actual investment per rice farm valued at 1 November 1966 ranged from *f* 5,618 (with a shared tractor) to *f* 9,758 on these eight farms.

Production The yields per hectare (table 32) were very good in the first year (although the two cycles were not analysed separately). Yields were lower for the spring harvest of 1966 but this was to be expected. Lower yields in spring may be connected with the shorter daylength in the growing season.

In autumn 1966 yields were very disappointing. Due to the lateness of the previous

Table 32. Yields in kg per hectare per farm in 1965 and 1966

Farm code No	1	2	3	4	5	6	7	8	Average
Harvest 1965[1]	3297	3580	3763	3994					3658
Spring harvest 1966	3222	3665	3329	3632	3049	3386	2768	2784	3229
Autumn harvest 1966	2180	2177	2811	2327	2381	2634	2394	2708	2452

[1] Averages of 2 cycles.
Sources: VUURSTEEN (1966); SLANGEN (1967).

season, farmers were not able to dry-plough; instead they wet-harrowed. This and the disappointing performance of the particular variety were the main reasons for low yields. Neither was the performance very good on the Wageningen Rice Scheme as a whole; yields there averaged 3,480 kg per hectare against an average of 3,900 kg per hectare in 1966 on the small peasant farms of Nickerie.

2.5.2 A cost-accounting analysis of the commercial rice enterprises

A few comments need first to be made on the various items.

Fertilizers, pesticides This item includes: fertilizer, snailkillers, insecticides, rat poison, and weedkillers. It also includes the cost of spraying by aeroplane.

Implements Depreciation and maintenance costs of all machinery except the wheel-tractor.

Threshing, transport Hire of combine-harvester and transport.

Land and water charges The Government lease amounts to *f* 10 per hectare per year, but the Government also charges farmers for maintenance of the polder and its irrigation works at an annual rate of *f* 15 per hectare. Settlers pay the Rice Scheme *f* 30 per hectare actually sown for irrigation.

Interest on capital Capital is considered here to consist of the tractor and related equipment, and implements. Interest is 7%. Depreciation has been included in the running costs of the tractor and under other items.

Labour The imputed remuneration for the farmer is set at *f* 8 per working day of eight hours. This is much more than the remuneration found in transitional rice-farming (about *f* 3 per day), but this seems justified as it includes entrepreneurship, which is a very important factor in commercial farming. Besides, the settlers paid hired labourers *f* 6 per day.

Table 33 contains the cost items arranged for comparison with a similar scheme of the traditional (table 10) and the transitional rice-farm (table 21). The analysis is limited to the averages for four settlers for whom two years (four crops) of cost-accounting data are available.

Table 33. Cost-accounting analysis according to concepts A, B and C on four commercial rice-farms (1965 and 1966) in *f*. See appendix B for details of individual farms.

	per farm		per hectare		% cost A		% cost B		% cost C	
	1965	1966	1965	1966	1965	1966	1965	1966	1965	1966
Hired labour	–	42.6	–	1.0	–	0.4	–	0.4	–	0.3
Seed	911.3	1043.7	26.3	25.1	11.2	10.5	10.9	10.3	9.0	8.6
Fertilizer, pesticide	1455.4	1791.9	42.0	43.2	17.9	18.1	17.3	17.7	14.3	14.8
Implements	532.3	731.9	15.4	17.6	6.6	7.4	6.4	7.2	5.3	6.1
Tillage	1286.3	1953.0	37.1	47.0	15.8	19.7	15.3	19.2	12.7	16.1
Threshing, transport	2259.7	2472.4	65.3	59.5	27.9	25.0	27.0	24.3	22.3	20.4
Miscellaneous	31.4	16.7	0.9	0.4	0.4	0.2	0.4	0.2	0.3	0.1
Land and water	1639.0	1841.8	47.3	44.4	20.0	18.7	19.5	18.1	16.2	15.3
Total cost A	8115.4	9894.0	234.3	238.2	100.0	100.0				
Interest on capital[33]	265.6	264.3	7.7	6.4			3.2	2.6	2.6	2.2
Total cost B	8381.0	10158.3	242.0	244.6			100.0	100.0		
Family labour	1754.0	1938.4	50.6	46.7					17.3	16.1
Total cost C	10135.0	12096.7	292.6	291.3					100.0	100.0

Total costs were higher for the 1966 crop cycles, because of a higher cropping rate (on average 41.52 hectares of rice per farm in 1966 against 34.63 hectare in 1965). There is surprisingly little difference in the cost per hectare between years. Threshing costs were higher in 1965 but this is linked with the higher yields in that year. As already mentioned, some paid labour was employed for the first time during the second cycle of 1966. Appendix C presents a similar analysis for the second group of farms during their first year (1966); their figures are in line with those of the first series.

Table 34. Family labour income (O–B) and farm profit (O–C) on commercial rice-farms per farm and per hectare harvested (in *f*)

	O–B per farm		O–B per ha		O–C per farm		O–C per ha	
	1965	1966	1965	1966	1965	1966	1965	1966
1	4742	3719	138.1	81.4	2916	1281	84.9	28.0
2	6880	3929	196.6	113.4	5258	2169	150.2	48.6
3	6186	3836	176.4	83.6	4352	1647	124.1	35.9
4	6963	3610	204.1	90.3	5229	2064	153.3	51.6
5		3426		76.4		1367		30.5
6		2836		62.9		1162		25.8
7		2451		54.8		505		11.3
8		3143		70.7		1524		34.3
Average	6193	3369	178.8	79.2	4439	1465	128.1	33.3

[33] For simplicity no distinction has been made between owned and borrowed capital.

Total Cost C is here *f* 285.80 per hectare for the four farms and the distribution according to cost items gives a similar picture. Ploughing costs were on average less for the second group of farms, because 2 farms shared a tractor.

Table 34 shows what family labour income (O–B) and farm profits (O–C) have been achieved by these entrepreneurs. Financial results were exceedingly good in 1965 but considerably less so in 1966, largely because of the disappointing yields of the autumn harvest (table 32). Differing production levels in 1965 and 1966 did not affect the cost per hectare (table 33). This phenomenon occurred also in Nickerie and Suriname transitional rice-farms (tables 21 and 23). This point is discussed more fully in the next chapter.

3 Differences in the economic structure of rice farms in transformation

The separate farm-management studies in the previous chapter now allow a comparison of the economic structure of these various types of rice-farms. For convenience this discussion is arranged under the following headings:

1. Resource use, resource productivity and the factors affecting them
2. Average cost of rice production for each type of enterprise
3. Economic performance of these farms.

3.1 Resource use, resource productivity and the factors affecting them

3.1.1 Land

As pointed out earlier, the suitability of land for wet rice is dependent, apart from the soil properties, on natural microrelief and its suitability for drainage and irrigation. The microrelief allows cultivation of wet rice in all areas studied, but drainage and irrigation are absent on Javanese rice-farms while irrigation is not possible on the farms of Surinam District. Both facilities are provided in the other areas.

The productivity of the land, which is so closely tied to water control, will, of course, vary considerably (table 35). The average productivity of land has been calculated for each area by the residual method (YANG, 1965, p. 56).[34] All costs except land rents have been deducted from gross production.

As the table shows, there is a tremendous range in land productivity. Rice farming seems unprofitable in the unirrigated or undrained areas (Groups I and IIa) (with the worst conditions in Group I, even though family labour is valued at only *f* 2 per day). High productivity is found on the irrigated land. Official land and water rents are only very moderate, as can be deduced from the second line and this means that farmers make handsome profits in Nickerie (IIc) and Wageningen (III).

Table 35. Average land productivity, government land and water rents and private rents (per hectare in *f*)

	I	IIA		IIB	IIC		III	
		1965	1966		1965	1966	1965	1966
Residual value of land/ha	−111.5	−75.2	−33.6	87.2	142.0	178.4	175.4	77.3
Government land, water rents/ha	2.0	10.0	10.0	10.0	10.0	10.0	47.3	44.0
Private rents/ha	not applicable	50*	50*	50*	200	200	not applicable	

* estimate

[34] YANG pointed out that a major objection to this method is the possibility of a negative residu, largely through deduction of the imputed value of family labour with zero opportunity.

The above approach is of course arbitrary. Residual values for land depend on the estimate for the value of family labour. For instance, with labour valued at f 1.50 and f 2, respectively, for Groups I and IIa, the residual value of land would amount to $-f$ 29.50 per hectare for the Javanese in Saramacca and to $-f$ 15.40 (1965) and $+f$ 16.30 (1966) for Surinam District.

The third line of table 35 is based on fragmentary knowledge of private hiring of land. Rents are very high in Nickerie but this accords with its high marginal value product (see Section 2.4.3). Actual rents in Surinam District were quite high but transactions were only few. The Surinam figure corresponds to the marginal value of land, found by variable resource programming. HOEFMAN (1968), using van Riemsdijk's credo-complex method, found a marginal value of f 49 per hectare for rice farms of Surinam District with an area of 3.75 hectares or less.

The question arises whether more land should be brought under cultivation. Accepting that production function estimates can be used for a broad analysis of resource allocation, these functions for the farmers of Nickerie were as follows:

$Y = 2.22\ X_1^{0.7470} \cdot X_2^{0.4372} \cdot X_3^{-0.0847}$ (Nickerie, 1965) and
$Y = 2.42\ X_1^{0.5470} \cdot X_2^{0.3417} \cdot X_3^{0.0972}$ (Nickerie, 1966)

These functions indicate that a 1% increase in land (with other inputs held at their geometric mean levels) would raise production by between 0.5 and 0.75% on Nickerie farms. In this district there is much scope for an increase in land area per farm, assuming that the land be properly drained and irrigated. This is indeed keenly felt by the farmers, as can be observed from their attempts to hire land at very high prices. Such increase in land area has little purpose for the Javanese in Saramacca and the Hindustani farmers in Surinam District unless irrigation (and drainage) facilities become available.

3.1.2 Labour

While the farm labour in traditional and transitional rice-farming can be considered skilled in its own right, the quality of labour has clearly improved greatly for the medium-sized farms near Wageningen. Training has improved the labour input at Wageningen. This is reflected in the imputed price (f 8 per man-day against f 3 for transitional and f 2 for traditional farmers).

Labour productivity is a partial productivity and its size depends on all inputs for production. This point should be kept in mind while studying Table 36, in which average family labour productivity has been calculated per hectare and per man-day. Again, the residual method has been used; remuneration of labour and management has been combined.

Labour income *per farm* varies greatly, with the lowest income in the traditional and the highest in the commercial group. But a similar trend is absent for productivity of family labour *per hectare*, which is highest in Saramacca and Nickerie (Groups IIb and c). This is partly due to irrigation in these districts but not in Surinam District, but

labour productivity per hectare is also high on the unirrigated Javanese farms in Saramacca (Group I). This points to another aspect: the rarity of off-farm jobs in Saramacca. Both Hindustani and Javanese farms there made use of the abundant resource, labour. This phenomenon must also be connected with the use of paid labour. As was shown in table 18, there is least hired labour on the irrigated Saramacca farms (2 man-days per ha), but much more in Surinam and Nickerie (between 10 and 14 man-days per ha in 1965 and 1966). Family labour is the abundant resource in Saramacca and it has few opportunities off the farm. But the average number of hired man-days is large on the Javanese farms too (22 man-days/ha, table 8). Their low level of technique seems mainly responsible for a high labour requirement. Since farm work is so often tied to the season, particular operations have to be carried out in a limited period, during which outside labour is recruited.

To return now to table 36. Though rice farming is technically sophisticated on the Wageningen farms, labour productivity per hectare is not conspicuously high. This is certainly connected with the lower average yields per hectare, especially in 1966.

There is at least a factor ten in the remuneration of family labour between traditional and commercial rice-farming, as is clearly evident from the last column of table 36. This raises the question whether such a state of affairs is economically and socially desirable. This will be discussed in Chapter 4.

The actual use of labour in rice farming depends closely on both natural conditions and the use of capital services. Land preparation (R1) was time-consuming in Saramacca District (tables 8 and 18) on both Javanese and Hindustani farms, partly because of the surrounding jungle. This R1 labour is also connected with the thoroughness of tillage, as will be discussed in the next section. Number of planting days (R2) for the Javanese is also much higher (42 man-days per hectare against 20 man-days at the most on the transitional rice-farm), since transplanting coincided with weeding. One of the most important functions of water in paddy fields is the suppression of weeds but in these natural swamps the water level is insufficient until *after* transplanting, not *before* as in the other rice areas studied, hence extra work.

Broadcasting is only less expensive if land can be levelled satisfactorily and irrigation facilities are provided, otherwise the labour saved (about 15 man-days per ha)

Table 36. Family-labour productivity per farm (in *f*)

	I	IIa		IIb	IIc		III	
		1965	1966		1965	1966	1965	1966
(Residual) Labour income per farm	139.0	215.8	280.4	851.7	651.4	727.3	6,193.0	3,369.0
Labour productivity per hectare	166.9	93.8	108.7	304.2	240.5	261.7	178.8	79.2
Labour productivity per man-day	1.19	1.50	2.08	3.90	5.73	7.10	22.25	11.31

does not balance the lower yields and the larger seed requirements. So far this has been possible only in some places in Nickerie but it is on the increase since written-off grading equipment from the Wageningen Scheme is increasingly being used by the more progressive farmers there.

Because of the uneven microrelief, weeding too was more time-consuming amongst the Javanese than among the others. The difference in R4 labour is explained by the Javanese preference for the rice-knife over the sickle which is used by the Hindustani. The knife requires roughly twice as much labour as the sickle. The different methods in threshing are mainly responsible for the variation in R5 labour. A comparison of tables 8 and 18 shows that threshing tables are used in both survey areas in Saramacca.

However, the magnitude of R4 and R5 depend greatly on the output per hectare. I have therefore presented the total labour input (including paid labour) in table 37 under I, as shown earlier in tables 8 and 18, but under II this labour requirement has been based on a yield of 3500 kg paddy per hectare for all areas.

Table 37. Average number of man-days worked on various rice operations in 1966 (man-days/ha)

	Group I		IIa		IIc	
	I	II	I	II	I	II
R 1	38.0	38.0	4.0	4.0	5.0	5.0
R 2	42.0	42.0	20.0	20.0	15.0	15.0
R 3	10.5	10.5	4.0	4.0	3.0	3.0
R 4	61.0	118.0	30.0	53.5	21.0	20.5
R 5	15.0	29.5	6.0	10.5	3.0	3.0
R totaal	166.5	238.0	64.0	92.0	47.0	46.5

I actual work.
II assuming an average yield of 3500 kg paddy/ha.

Assuming no change in technique with higher yields, differences in labour input would be even larger amongst the Javanese and the farmers of Surinam District. A comparison with the pattern of labour input on the commercial rice-farms is hardly feasible; the labour input varies between 7 and 8 working days per hectare (table 29), quite a different order of magnitude.

3.1.3 Capital

Table 38 summarizes data on the stock of capital on the various types of rice farm.

The stock of capital is negligible on traditional farms and large on commercial farms. Per hectare sown use has been slightly better for commercial farms than for transitional farms in Surinam and Nickerie districts. This demonstrates the well known phenomenon of 'lumpiness of capital' on small enterprises. However, in

Groups IIa and c many tractor-owners plough and do other services for other farmers nearby. These farmers are keen on earning income from these supplementary relationships, whereas flow services, such as labour and tractors, are idle in certain periods. The stock of capital per hectare is also low on irrigated Saramacca farms (Group IIb) but the input-input combination is different there with abundant family labour.

In flow of capital services, first interest is in the *yield-increasing* inputs, such as fertilizers, insecticides and pesticides. They have been very little used by traditional farmers (*f* 0.39 per hectare on average), little by transitional rice-farmers (just over *f* 1 per ha in Surinam and Saramacca, just over *f* 2 in Nickerie). But a lot has been used by commercial farmers (table 33 and Appendices B and C) ranging from *f* 42 to *f* 50 per ha sown. Main costs are for fertilizers (about *f* 30 per hectare sown) followed by insecticides (*f* 9); control of snails, weeds and rats made up the remainder.

Commercial farmers used different methods of production from those on the *small* transitional farms, where labour is still the most important factor quantitatively.[35] The commercial rice-growers have so far strictly followed recommendations laid down by the Wageningen Scheme. Non-availability of water on time and late planting have caused them some difficulties. It is disputable whether the present heavy rates of fertilizer (which is connected with the use of a stiff-stemmed variety) is entirely warranted, with inadequate water control. Yields per hectare for the commercial growers are certainly poorer than for the small farmers of Nickerie, where irrigation and planting were on time.

The use of capital services cannot be analysed without considering the factor labour. This aspect of factor substitution can probably best be illustrated by analysis of tillage and threshing costs. Table 39 compares tillage charges per hectare for each area with the costs actually paid by farmers during the survey.

These differences between official rates and actual costs can be attributed to thoroughness of tillage. The difference is small in Surinam and Nickerie districts, but in Saramacca part of the tillage has been replaced by hand-labour, especially weeding

Table 38. Estimated value of capital assets per farm and per hectare (in *f*)

	Barn		Ox-plough Small implements		Tractor Other machinery		Total	
	per farm	per ha	per farm	per ha	per farm	per ha	per farm	per ha
Group I	15.0	18.0	10.0	12.0	–	–	25.0	30.0
Group IIa	37.0	14.0	171.0	65.0	350.0	133.5	558.0	212.5
Group IIb	124.0	44.0	103.5	37.0	–	–	227.5	81.0
Group IIc	111.0	38.0	12.0	4.0	498.5	171.0	621.5	213.0
Group III*	–	–	127.0	5.0	6,866.5	286.0	6,993.0	291.0

* actual value per hectare, not per area sown

[35] On the larger transitional farms in Nickerie (8–20 hectares rice) production methods are quite similar to those on the farms of the commercial ricegrowers. Large amounts of inputs such a fertilizers and insecticides are used (SITAL, 1968, personal communication).

Table 39. Tillage charges per hectare (in *f*)

	Group I	IIb	IIa	IIc
Tillage charges per hectare	62.50	62.50	50.00	37.50
Actual costs per hectare	34.14	43.52	46.37	39.63

before planting. This cost aspect should therefore be related with the number of man-days devoted to land preparation (R1). In 1965, after a wet 'dry season', land preparation required 9, 8 and 17 man-days per hectare in Groups IIa, c and b, respectively. The extra 8–9 days in Saramacca can be considered a substitute for ploughing. Eight days' extra work saved *f* 19 on ploughing (table 39). This works out to *f* 2.40 per day. Though it is lower than the average labour product for rice (*f* 3.90 per man-day, table 36), it is not unreasonable for family labour if alternative jobs are few in certain periods.

For the Javanese, 38 days of R1 labour per hectare were recorded in 1966 against 4–5 days for the Surinam and Nickerie transitional farmers. If this figure is deducted from 38 and an extra 7 days per hectare allowed for the jungle-swamp conditions in Saramacca (which extra work has to be done regardless of tillage), there is a total of 26 extra man-days. This labour has saved *f* 28.36 or *f* 1.09 per day on ploughing. The figure per day tallies with the average labour productivity in the area, *f* 1.19 per day (table 36).

Some farmers in Surinam District are still using bullocks for ploughing their fields. Bullocks are rarely replaced when old and are seldom hired to other farmers. Labour costs per hectare are *f* 31.50, variable costs in using oxen and plough are *f* 8 per hectare, altogether *f* 39.50. This is cheaper than tractor-ploughing in Surinam District but this reasoning will not hold for a newly bought pair of oxen, since then all other costs have to be included so that a tractor can be hired more cheaply.

A similar case of capital substitution for labour can be found in threshing and transport costs. Table 40 splits these costs into labour and monetary outlays (hire of threshing machines, transport) per hectare.

Table 40. Threshing (and transport) of paddy (1966) per hectare

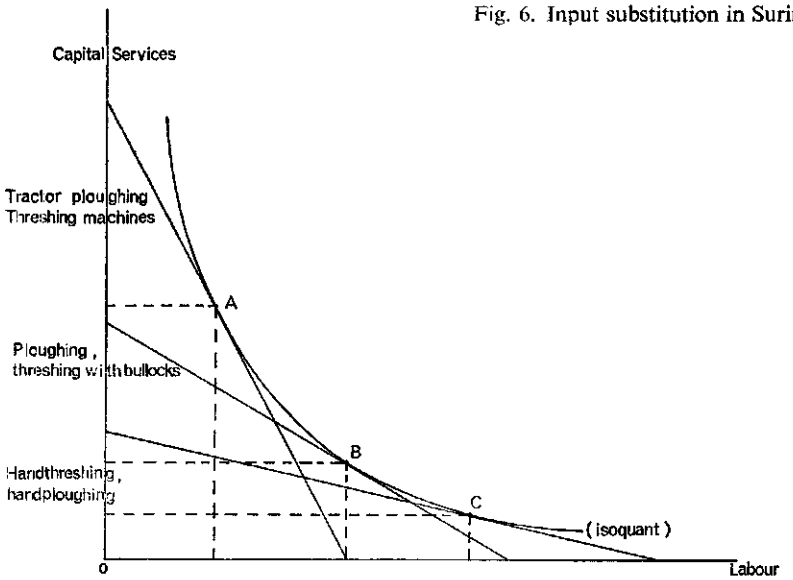
	Group I	IIa	IIc
Labour in man-days	15.2	5.9	3.0
Machinery hire in *f*	0.59	13.81	30.25

Assuming a wage (for threshing) of *f* 2, *f* 3 and *f* 4 per day in the respective areas, the cost per hectare would then average *f* 31, *f* 31.51 and *f* 42.25. But these costs should reallly be related to the varying yields per hectare. Per bag of paddy, they were *f* 1.20, *f* 1.14 and *f* 0.81, respectively. This does not mean that the use of a threshing machine should be encouraged in, for instance, Saramacca. Hiring charges would probably be raised by much higher costs such as for distances and price of petrol.

In Surinam District some farmers use bullocks for threshing their paddy. It has been calculated that costs per bag are of the same order as for tractor-threshing if maintenance of the bullocks is the only cost item included. For a new pair of oxen all costs have to be considered and then modern machinery would cost less per bag.

The general impression is that farmers combine inputs to approach least cost. Hence, varying proportions in the use of labour and capital inputs, according to their relative prices in each place.

Fig. 6. Input substitution in Surinam rice-farming.



The previous discussion is summarized in figure 6. The evidence in tables 39 and 40 suggest that points A, B and C of figure 6 correspond with the situation in Nickerie, Surinam and Saramacca (Javanese) districts. Above A a point could be placed, representing Wageningen. The selection in resource use seems to depend firstly on the price of labour (which is determined by opportunity cost) and the price of capital services for each area. The distance to main centres seems to control the price of capital.

3.1.4 Management

This factor seems hardly important in the traditional and transitional stage of rice cultivation. But it is important in *commercial* enterprises, where the penalty of bad management and risks in the use of new inputs are much greater. For instance, it is doubtful whether the farmers' decisions about ploughing for the 1966 autumn harvest were right (see the last paragraph of Section 2.5.1). This led to low yields.

Management has not been considered as a separate input, but in the remuneration of the commercial farmer, it has been considered. These farmers have received special training and they should be paid accordingly.

3.2 A cost-accounting study for the areas investigated

Cost-accounting studies for agricultural products are important for two main reasons.

1. They indicate how the farmer should allocate his resources for maximum net income or any other desirable goal.

2. They provide data for the Government on which an agricultural policy can be put into effect by manipulating prices and by other measures. This is particularly relevant in fostering economic development.

The cost-accounting analysis should embrace a number of years, so that both inputs and output can be standardized. Conclusions based on a cost-accounting analysis of one year are usually unreliable. The actual input and output data are then used but averages over a number of years might have yielded different results. This is particularly true for yield per acre, which may vary greatly between years; such variations in input are usually less pronounced.

But in most low-income countries (including Surinam) such a series of data is not available. Cost accountings over one or two years have then to be used to assess the production cost per crop and the farmer's earnings. This method can be used particularly when differences in cost prices are large between areas and small between years within an area.

Table 41. Average costs for the areas studied (1965 and 1966)

	I	IIb	IIa		IIc		III	
			1965	1966	1965	1966	1965	1966
Yield per hectare in kg	1850	3500	1750	1940	3420	3630	3660	2920
			(100)	(111)	(100)	(106)	(100)	(80)
Total costs per hectare in *f*	384.43	329.91	285.55	265.18	272.34	260.13	292.60	291.30
			(100)	(93)	(100)	(96)	(100)	(100)
Cost price per kg paddy in cents	20.8	9.5	16.3	13.7	8.0	7.2	8.0	10.0

Table 41 compares calculated cost price per kg paddy between areas and, where possible, between years. Calculations are based on an imputed family-labour cost of *f* 3 per man-day, except for the Javanese (*f* 2 per man-day) and the commercial farmers (*f* 8 per day).

On average paddy has been produced most cheaply by the transitional farmers of Nickerie, followed by the commercial farmers of Wageningen. Results have also been good on irrigated farms in Saramacca but not in Surinam District and on Javanese farms. Taking 1965 as the standard (100), yields per hectare clearly vary much more between years than do total costs.

The cost-accounting figures raise the question whether the great discrepancy in rice

profitability could be removed, but clearly such a change could not be brought about simply by price policies. A guaranteed minimum price of 10.5 cents was at the time of survey quite reasonable *for irrigated paddy*; it even left those farmers with handsome profits. This price was inadequate for farmers without irrigation. It is easy to suggest that Javanese swamp-rice farmers and the farmers in Surinam District should turn to other income-generating sources, but what else is possible?

The younger Javanese tended to leave, as also occurs in other agriculturally backward rural areas of Surinam, the districts of Commewijne and Coronie (table 42).

Table 42. Population registered in the coastal plains of each district as percentages of the total known population of Surinam

	Paramaribo + Surinam Distr.	Nickerie	Saramacca	Commewijne	Coronie	Marowijne
1950	70.88	9.12	4.97	10.66	2.12	2.25
1955	71.25	9.68	4.74	9.31	1.90	3.12
1960	72.72	10.07	4.54	8.05	1.60	3.02
1964	75.54	10.18	3.72	6.88	1.30	2.38

Source: LUNING (1966).

People have moved to Paramaribo and the surrounding District of Surinam. The decrease in rice area has not only occurred in Commewijne and Saramacca, but also in the District of Surinam (table 43).

The similarities between tables 41 and 43 are striking: there has been a decline in paddy cultivation in all areas without irrigation or drainage, where the cost price is unfavourable. People react either by moving away, when few opportunities occur or they turn to other income sources. This is quite possible in Surinam District, where infrastructure is being constructed in the neighbourhood and recently (1960–3) the Government has set up banana plantations. Also the dairy industry has expanded in the years 1962–7, owing to the establishment of a dairy factory in Paramaribo. Riceland has been put down to grass.[36] There is, however, a limit to this expansion; there is already an overproduction of both milk and butter in Paramaribo for much of the year.

Table 43. Average annual peasant rice areas, for two periods per district

	Nickerie	Surinam	Commewijne	Saramacca	Other	Total
1956–60	6,985 (100)	8,569 (100)	2,700 (100)	2,469 (100)	447	21,170 (100)
1961–65	8,333 (119)	6,126 (71)	2,217 (82)	2,357 (96)	275	19,308 (91)

[36] Though our sample was restricted to only one rice-producing area of Surinam District, conditions in other parts are notably similar. This is also true of Commewijne district, without drainage and irrigation facilities.

3.3 The economic performance of the farms

The cost-accounting analysis disclosed great variations in cost price, but these variations cannot merely be attributed to variations in economic performance. This performance cannot be directly equated, since *ceteris paribus* does not operate.

This said, I will attempt to measure economic performance by analysing cost/output relations on each type of farm, while bearing in mind *ceteris non paribus*. Firstly, Cost A has been set against gross production of paddy (per hectare) in table 44.

The following comments can be made. Where capital services are more expensive and labour more abundant, as in Saramacca, farmers see a high percentage of gross rice output going to farm business income. The traditional Javanese have done notably well, especially since their output per hectare is considerably lower than that of the Hindustanis in the same district.

A reasonable ratio has been achieved on Nickerie farms but, compared with the irrigated Saramacca farms (with similar gross output), they have used more capital services. The impression is that they have slightly overcapitalized. This is not so surprising. These farmers make profits, as the previous discussion on the cost-accounting analysis showed. Part of these profits are ploughed back into rice and other farm-enterprises. But I have noticed that the investment base in Nickerie District is narrow. There are clearly too many ricemills, sawmills, tractors, buses and taxis already and few of them can run economicly. A part of this profit is used for buying more leisure (see Chapter 4).

The relation Cost A/output is less favourable for Surinam farmers. Their stock of capital per ha has the same average value as that of the Nickerie farmers (table 38). Though the flow of capital indicates a lower value for Surinam than for Nickerie, it is especially the yield which is so much lower. But it would be futile to suggest that the amount of fixed and flow capital should be cut back, say to the level of Saramacca. This rice area is within easy reach of Paramaribo and this certainly influences the attitude to manual work in general. Moreover the Government social policy of paying handsome allowances to unemployed townspeople a short distance away cannot be ignored and part of the machinery investment should be considered for consumptive purposes.

Finally, the commercial farmers also have a high relation Cost A/output. Like the Nickerie farmers, they make profits (table 41), which are especially large since they

Table 44. Farm business income as a percentage of gross product

	I	IIb	IIa		IIc		III	
			1965	1966	1965	1966	1965	1966
Cost A per ha	94.98	91.74	103.38	112.84	142.18	146.59	234.30	238.20
Gross output per ha	270.95	353.50	175.00	194.21	340.90	363.30	420.67	326.60
Cost A/output	0.35	0.26	0.59	0.58	0.42	0.40	0.56	0.73
Farm business income as % of gross output	65	74	41	42	58	60	44	27

command such a vast area in comparison with the other farmers.

Some more light is thrown on the economic performance of the various types of farm by considering some other relations in table 45, where

L = labour, comprising both family and hired labour (expressed in guilders),
L′ = L (converted to man-days),
L″ = Family labour, converted to man-days,
C = Capital, comprising cost B minus hired labour,
O = gross output of rice in monetary terms,
O′ = farm-business income plus cost of hired labour,
O″ = farm-business income.

The first line shows once more the combinations in which labour and capital are used and the distinct division between traditional agriculture (relation 6.5), transitional agriculture (between 1.2 and 2.6) and commercial agriculture (0.2). The sharp drop in the relation L/C is caused by two movements: a mounting cost of capital services and a declining labour cost. To assess the effect of these charges the O/L′ and O′/L′ ratios have been calculated, which represent the gross and net average labour product (all labour) per man-day. For family labour separately the *net* labour product is given by the ratio O″/L″.[37]

There is a sharp increase in both gross and net labour-product in the process of economic transformation but the net product increases less quickly than gross product, as the second and third lines of table 45 indicate. A good comparison is well-nigh impossible, because in the O/L relations it is not only the method of production which varies, but also the yields per hectare. On the basis of gross product in kg paddy/man-day the labour product for groups I, IIa, IIc and III in 1966 was 11 kg, 30 kg, 77 kg and 406 kg paddy per man-day, respectively.

Attention has been focused on differences in economic performance between groups of farms; an analysis of the performances of individual farms within each group falls outside the scope of the present study.

Table 45. Input-input and output-input in the transformation process

	I	IIb	IIa		IIc		III	
			1965	1966	1965	1966	1965	1966
L/C	6.5	2.5	2.6	2.1	1.4	1.2	0.2	0.2
O/L′ in f	1.6	5.1	2.9	3.5	7.5	8.8	51.6	45.3
O′/L′ in f	1.3	4.0	1.8	2.1	5.4	6.5	22.3	11.5
O″/L″ in f	1.2	4.0	1.5	2.1	5.9	7.3	22.3	11.5

[37] The O′/L′ ratio is the same as the O″/L″ ratio in Groups III and IIb because of the negligible amount of paid labour. In Groups II a and I the O″/L″ ratio is less than the O′/L′ figure. This is related to the remuneration of paid labour, which is higher than the average family remuneration, whereas in Nickerie the reverse holds.

3.4 Production for subsistence

In staging the agricultural development process Section 2.1 pointed out that in traditional agriculture there is usually only a small marketable surplus while in commercial farming the bulk of the produce is sold. To see whether our division into three stages has been relevant, a consumption/production relation has been calculated for four distinctly different groups of farmers. The paddy production is for 1966. Consumption of rice has been estimated at 0.4 kg per adult per day for the rural inhabitants of Surinam.[38] I have added a certain percentage of production for seed, wastage and fodder, while assuming that this percentage declines in the transformation process. Whereas I deducted 10% for the Javanese (in view of the state of their barns and the length of the storage period), this figure is set at 8% for Surinam District and 5 and 3% for Nickerie and Wageningen (table 46).

Table 46. The percentage of production for subsistence in the transformation process

	I	IIa	IIc	III
Consumption in bags per household	12.6	23.7	19.6	25.0
Seed, wastage, fodder	2.2	5.7	7.2	36.3
Total consumption	14.8	29.4	26.8	61.3
Production in bags per farm	21.5	71.3	144.2	1211.0
Consumption as % of total production	69	41	19	5

Table 46 shows that our classification has been relevant as an index of how far the studied groups depend on growing their own food.

[38] KOOL (1964, p. 121) mentions an average of 0.4 kg per adult per day in 1958 for Surinam as a whole. Though this average figure may have declined somewhat (by the substitution of bread in urban centres), the above figure seems reasonable for our sample of rural households.

4 Factors affecting the transformation process

4.1 The human factor

After describing the stages of transition from traditional to commercial rice-growing (Chapter 2) and after analysing their differences in economic structure (Chapter 3), this chapter will ask *why* such differences have occurred in the development of rice farming in Surinam. The areas studied are at most 120 miles apart from the Surinam to the Nickerie farms. The irrigated rice-farms of the Hindustani and the unirrigated swamp farms of the Javanese in the District of Saramacca are no more than 15 miles apart.

From the outset it is evident that the reason for these differences in rice development cannot be found by the economist alone. The economist confines himself usually to the study of economic variables, leaving cultural and other differences to the disciplines concerned. But in many low-income countries the economist has to work unaided. This means that he has to evaluate the importance of non-economic variables himself. This was true here and the question remains whether ethnic differences could have had a large influence on the economics of rice farming.

The work of social anthropologists may indicate whether ethnic differences between Hindustanis and Javanese are expressed in economic activities. In a study entitled The Javanese of Surinam, DE WAAL MALEFIJT (1963, pp. 66–67) observes: "The Javanese value system (in Surinam, auth.) 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."

The Hindustanis seem to have retained "a separate set of criteria of status, that assisted the process of their internal rank distinction... While (the Hindustani, auth.) continued to value certain elements of his own cultural background, the growth of economic opportunity through the developing rice industry enabled him to manipulate slight differences in wealth to establish prestige differences within the Indian Community" (SMITH, 1964, p. 326).[39]

These quotations suggest that the Javanese are impeded by their particular value

[39] Though this quotation refers to the Hindustani of (formerly British) Guyana, these observations are equally applicable to the Hindustani of neighbouring Surinam.

system from exploiting new opportunities and it seems 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 districts such as Commewijne and Saramacca who would be labelled traditional and there are Javanese in the transitional and commercial stages.[40] The Javanese commercial rice-farmers in the Wageningen sample, for instance, seem to pursue economic goals similar to those of their Hindustani neighbours, while a group of transitional Javanese being studied in the Nickerie Polder (1968) hardly differ from surrounding Hindustani in resource use for rice cultivation. Of course there are certain customs such as the use of the ani-ani harvesting knife in Saramacca by the Javanese, but differences do not seem as large as some anthropologists would have us believe. Maybe the Javanese as a group are slower in transformation. But this could well be connected with the fact that some groups live in villages, where community ties are stronger. Hindustanis are more individualistic.

In conclusion, the change from traditional to commercial agriculture can hardly be ascribed to the human *ethnic* element.

But there is a human element, which may be of importance in accelerating this transformation process. This has been studied amongst transitional rice-growers. The unirrigated Surinam farms and the irrigated small farms of Saramacca and Nickerie fell into this category. With a similar area under rice the family business income (O–A) derived from rice in 1965 and 1966 was *f* 213 and *f* 280, respectively, in Surinam District, *f* 670 and *f* 637 in Nickerie, and (1965 only) *f* 839 in Saramacca (table 26). Farmers, especially in Surinam District, strove to find off-farm employment. The off-farm income for Surinam District was 65.5%, for Nickerie 52% but for Saramacca 13% (table 15). In 1965 rice represented 12.9, 52.7 and 39.8% of total net income for Surinam, Saramacca and Nickerie, respectively.

Total net income from all sources for that year, based on data from the cost-accounting analysis, amounted to *f* 1520, *f* 1530 and *f* 1590 for the average farm in Surinam, Saramacca and Nickerie, respectively. There seems to be little difference in earnings between areas, which are completely different in income-earning resources. But the great difference between these areas was the number of days worked. To acquire this annual net income, workers in Surinam and Saramacca districts worked on the average 336 and 303 days per year, respectively, whereas in Nickerie only 231 days were worked (including self-employment). And yet, only in Nickerie District was there any vacancy on the labour market.

The Hindustani smallholders of Surinam are known for their thrift and zest for work. But when they reach a certain income, as is apparent for the Nickerie farmers, they seem to value leisure more than additional money income from work. This suggests a target income which is, in the short term, connected with limited aspirations. If the abstract concept of limited aspirations could be expressed quantita-

[40] Our main criticism is directed against de Waal Malefijt's title, which gives the impression that this study embraces a fair sample of the Javanese.

tively as a target income, it may show some human factor in the transformation. An analysis of this concept may assist understanding of the peasant's behaviour on the labour market and of the transformation process itself.

Without attempting to provide a complete answer which might satisfy a sociologist, field observations in Nickerie suggest the existence of three strata:

1. The small crofters and old people, farming a small area (less than 1.5 hectares rice).
2. The big farmers (more than 8 hectares) who form the entrepreneur class in Nickerie.
3. The numerous farmers with a rice area of 1.5 to 8.0 hectares.

If such a target income really existed, it would only be found amongst the third stratum, since the first would vary in aspirations and the entrepreneur class, which earns an annual income far above the socially defined welfare level, would have almost unlimited aspirations.

With irrigation, the difference between expected and actual returns (for equal effort) is not significant for rice-farming in Nickerie. As the area under rice is kept almost uniform in the sample, the factor deciding the need for off-farm employment will be the size of the family.

If net agricultural income per person is low, in other words if many mouths have to be fed from a small area of agricultural land, the workers in the family are forced to earn a certain off-farm income. If limited aspirations really exists, the incentive to find outside employment will diminish as soon as farm income per person reaches a certain level.

This hypothesis was tested on 50 farms of Nickerie District (Group IIc) by linear correlation analysis. For each family the net farm income per consumption unit and the non-farm income per potential worker (women excluded) were calculated for the year 1965–6. To calculate consumption units, other essential needs were included besides basic food requirements; all adults were therefore taken as one consumption unit, children between 7 and 14 years as three quarters and those between 2 and 7 years as half a consumption unit. The correlation coefficient (r) between net farm income per consumption unit and off-farm income was –0.425 and the relation was highly significant ($p < 0.01$). The uniformity of this group can probably be ascribed to the lack of any great differentiation in outlook, its place in the social scale and its educational background.[41]

Quite independently, another study was carried out in the eastern polders of Nickerie District in 1966 to test whether a target income could also be established for groups of farms of different size but still within the socially defined stratum of farms between 1.5 and 8 hectares. Fifty of the farms were in the class 1–2 hectare of rice, 50 in the size between 5 and 8 hectares.[42] The survey method was used and not cost accounting. For each farm, data were collected on cost and production of paddy and other agricultural produce (but the latter did not prove important) and on net family income

[41] All the farmers had at least one or two years at primary school but none had aspired to any education beyond primary, so they could not compete for higher paid jobs.

[42] The actual average area under rice for the two groups was 1.5 and 5.7 hectares, respectively.

derived from other sources, especially paid labour. Total net annual income per consumption unit is presented for the average farm household of each size in table 47.

Table 47. Estimated net income (in *f*) per consumption unit on differently sized farms in 1966

Size	Farming income	Off-farm income	Total income
1–2 hectares	63	178	241
5–8 hectares	132	112	244

Source: TEMPELMAN (1966)

Though the average net farm income differs significantly (*f* 320 on the 1–2 ha farm against *f* 1023 on the 5–8 ha farm), there is little difference in total net income per consumption unit, as table 47 indicates. The hypothesis was again tested, that the necessity for off-farm income decreases as agricultural net income per consumption unit increases. This has been done separately for each size class. For the 1–2 ha class the algebraic function was $y = -2.22x + 472.4$ (with y the non-farm income per potential family worker and x the net farm income per consumption unit, both in guilders). The coefficient of correlation was -0.42 and the relation was significant at $p = 0.005$. For the 5–8 ha size class the function was $y = -0.90\ x + 326.2$ and the coefficient of correlation amounted to -0.38; the relation was significant at $p = 0.01$.

Thus target income has been clearly demonstrated for this stratum of transitional farmers in two independent studies. This social factor may be of importance in the development towards much larger commercial rice-farms. The question arises whether this type of farmer, from small farms, could be transferred to commercial rice-farms with his present preferences. However the commercial farmers in our sample did not come from such small farms: either they were employed by the Wageningen Scheme for some years or they originated from larger farms in Nickerie (more than 8 hectares). They probably had quite different incentives and attitudes influencing their decisions to work.

4.2 Techno-economic factors

No doubt the most important technical factor, responsible for the sharp contrast between traditional and transitional agriculture, is water control during paddy cultivation. The foregoing cost-accounting analysis (Section 3.2) shows that traditional agriculture in Suriname (which is not inefficient *per se*), cannot attain the return on labour achieved by the higher stages. That so many farmers, such as the Javanese studied here, persist in rice cultivation without even drainage facilities, can be explained by the large amount of labour (women, elderly people) with little opportunity return. The area in Saramacca also allows the Javanese to cultivate groundnuts, quite a profitable crop which is popular among them. With what off-farm work is available they seem able to obtain a satisfactory living, for their standards.

Within the range of transitional farming there are great contrasts between the

drained but unirrigated farms in Surinam District and the irrigated farms of Nickerie and Saramacca. This is expressed especially in yields per hectare; lack of irrigation or drainage seems to limit output (tables 9 and 20). Obviously, lack of irrigation or drainage is the limiting factor before any other new agricultural input can be introduced.

Liebig's Law of the Minimum comes to one's mind here. Insecticides had little effect on the paddy yields of these Javanese farms (Section 2.3.1). Similarly fertilizers in Surinam District were effective on some fields, but not on others. These are certainly not isolated examples as a recent study by HASSELBACH and UBELS (1966) shows. Their study in the rice areas of Surinam District (of which our sample is representative) showed that 200 kg natural phosphate should increase yields by an average of 450 kg paddy per hectare. But an economically profitable effect could be demonstrated in only 45.3% and 63.0% of the fields in 1960 and 1963, respectively.

A similar picture was obtained in a study of dry ploughing. In the same district HASSELBACH and VAN AMSON (1965) found that on average an increase of 300 kg of paddy per ha could be expected when land was ploughed in the dry season. However, an economically profitable effect could be demonstrated on only 47.8% and 51.4% of the fields in 1960 and 1963, respectively. But in their calculation of economic profitability they did not allow for the loss of grazing areas in Surinam District. This would no doubt reduce milk production, which is an important source of income (table 15). This would even further reduce the economic profitability of dry ploughing.

These figures indicate that the risks are so large (about fifty-fifty) that such measures will not be economically profitable. Rice farming without irrigation is hazardous since the supply of water is beyond the farmer's control.

A new yield-increasing measure such as chemical control of snails (practised in Nickerie) can be effective only on irrigated farms, where the land can be drained and reflooded to a schedule. Hand-broadcasting of seed becomes important as labour gets scarce because it saves a lot of labour. (The method can particularly be applied when the farm is large). It can hardly be profitable on unirrigated farms, because the young crop will be smothered by weeds. On the Nickerie farms seed was broadcasted wherever the land was level enough. Farmers in that area are prepared to hire grading equipment: an investment which would be of limited use on unirrigated farms, where the vagaries of the weather control production.

Combine-harvesters can be used only when the paddy ripens evenly. On the unirrigated farms this does not happen and harvesting is more laborious (table 18).
Tractor-tillage is more costly in Surinam District, partly no doubt because the fields are subdivided (for some degreee of water control) and this hinders farm machinery.[43] In these areas yield-increasing inputs and other farm investments must await effective water control.

The irrigated small holdings of Nickerie and the large farms of Wageningen have

[43] According to one of Surinam's most experienced farm extension workers, a contractor can harrow 70 square chains per day in Nickerie, while in Suriname District only 35 square chains is possible.

similar soils. In Wageningen (with two rice crops per year) the timing of water distribution seems a more decisive factor in paddy production. Lack of water was a limitation during second rice cycle of 1966 and caused a serious depression in yields. The salt content of the irrigation water is also a vital point; in certain years it reaches a critical value. Saltdamage has been apparent in at least some seasons in the Wageningen project. These two factors may completely undo the effects of a generous use of fertilizers. Thus with little fertilizer but good quality and timely supply of irrigation water, Nickerie small holders can often achieve better yields per hectare per cropping cycle.

An important techno-economic factor is the position of the rice area, which affects the use of inputs, and especially the substitution of labour for capital. Relative factor prices change from area to area and this leads to different combinations. But this does not necessarily effect the economic performance of the farms (Section 3.1.3).

Although the data concerns only a small area on the South American continent, they may have more general application, as recent literature suggests. Thus, RUTTAN *et al.* (1966) reached similar conclusions about the increase of rice production in the Philippines and Thailand. In those countries, average yields for rainfed rice rarely exceeded 1500 kg paddy per hectare but in fully irrigated areas may exceed 3000 kg on average. Surinam figures were of a similar order (tables 9 and 20). Ruttan *et al.* could hardly explain differences in yields by such factors as new varieties, better cultural practices, more generous use of fertilizers and insecticides. Also economic and social differences between regions and between Thailand and the Philippines did not prove important. As in Surinam, effective water control was essential for development. As in Surinam this factor was beyond the control of the individual farmer.

4.3 The government's role in stimulating the transformation process

Of Surinam's labour force, about a third is engaged in agriculture, forestry and fishing, and nearly a quarter in Government service. Manufacturing, construction, commerce and service industries each absorb far fewer people. The population is small and multifarious. Production for the home market is unimportant, especially as consumer markets are fragmented by different ethnic preferences. The most important industry, bauxite, is capital-intensive and the high population increase (between 3.0 and 3.5% annually) puts heavy pressure on the net income per head. Though Surinam's Government has genuinely attempted to promote development planning since about 1950, income per head has not notably improved since then (KOOL, 1964); the population explosion has been mainly responsible for this.

To accelerate economic development, all possible productive resources must be mobilized. The recent indiscriminate recruitment into Government service could well be viewed as an unemployment policy. Despite it several thousand people are openly unemployed in Paramaribo. Agriculture is an economic sector and not a social problem needing subsidy. Otherwise, economic growth, if based only on the bauxite industry may remain slow.

It is now accepted that the *Government* of a low-income country must provide much of the stimulation for economic development. In Surinam, the food crop economy (rice) has sometimes received government help. The establishment of new polders (with and without irrigation), the settlement of former contract labourers in particular places, agricultural extension and research efforts were such inducements to development. Lately the decision to provide a small number of carefully selected settlers with commercial 24-hectare farms is another example of the Government's efforts.

Despite these attempts, peasant paddy production has declined in certain areas, especially Surinam and Commewijne districts. The lower annual production was linked with a decline in paddy area (table 43). This can definitely be ascribed to the present economic profitability of traditional and transitional rice-farming. If alternatives are available, as in Surinam District, people may stay on but in Commewijne, Coronie and parts of Saramacca alternative opportunities for employment within and outside agriculture are limited. People have to migrate, usually to Paramaribo and its surroundings (table 42). But there are few alternatives for other agricultural products in some districts and for the last few years the peasant sector has no longer supplied local demand for rice[44], so a counter attack on this rural drain by improvement of existing rice cultivation may be necessary.

The last two sections demonstrate that two factors are important in the improvement of rice farming. In this transformation the *human factor* is only slightly influenced by Government measures and change should certainly not be expected immediately. The introduction of agricultural education may speed up this transformation process; again, the availability of a larger range of consumer goods may also induce greater production. Eventually this target income will lose the rigidity, which it now has.

The role of the Government seems much clearer in the *techno-economic* field. The determinant of the stage of rice cultivation seems to be the technical level of farming, which is in turn determined by water control. It is encouraging that farmers are still willing to invest, even in the swamp land where water management proved impossible. As has been shown in Section 2.3, jungle was being cleared on several Javanese farms in the survey year. Whether clearance was economic is another matter. The residual value of land in guilders per hectare (assuming a certain remuneration of family labour) was negative (table 35). But the activities of these farmers should make the Government realize its duty (where possible) of sustaining the farmer's efforts in this process of capital formation. Investigations are needed into reclamation and improvement of riceland, which is not now irrigated or drained. This is urgent because it affects many rice areas of the country, including Surinam District where the residual value of land was negative also. The economics of reclamation and improvement of

[44] It could be argued that the commercial rice schemes (Wageningen) should become the principal providers of rice for local consumption. However, it will be to the country's advantage for peasant production to satisfy at least the local demand for rice. For an extensive discussion see LUNING (1967, p. 122).

existing polders has yet to be compared with the establishment of new polders in the land of Surinam.

Lack of attention to existing riceland is not entirely Surinam's fault. Money loans and other development aid are often tied to the establishment of new projects, while it is much more difficult to obtain money for the improvement of existing areas. Aid to existing settlements may be profitable in places where irrigation has later become feasible. The attractiveness of setting up new polders at the fringe of the present farming area will depend partly on transport costs. The introduction of infrastructure and social services in these new frontier areas may be expensive.

Broadly speaking, agricultural research (with special reference to rice) has played a modest part. Most recent rice research for peasant farming has been on the unirrigated ricefields of Surinam District, as is evident from the earlier mentioned publications by HASSELBACH & UBELS (1966) and HASSELBACH & VON AMSON (1965). New inputs can only be *effectively* used on irrigated farms, as has been clearly demonstrated in the previous section. Irrigated rice has been mostly studied on the large commercial Wageningen Project and these research findings cannot always be extrapolated to the peasant on the small scale. Changes in the strategy of rice research are therefore imperative.

Government maintenance of a minimum price is not a solution, as the range in production cost is too great. This range is connected with irrigation (8–10 cents per kg paddy), with drainage but without irrigation (12–16 cents) and without water control (18–22 cents).

In rice areas where irrigation and drainage are not available to the farmers yet, the Government has two choices in transforming rice cultivation: either to improve existing conditions or provide the people with alternatives (citrus, cattle), which could give them a reasonable standard of living.

A different approach is needed for areas already provided with irrigation. Average production cost is quite reasonable, as in Wageningen and in Nickerie. The farmers there even make profits.

Literature on economic development often considers agriculture as a provider of an agricultural surplus in low-income countries. Much of the literature argues that agriculture is not taxed heavily enough in most of these countries (S. R. LEWIS, 1967). There is certainly point in making agriculture contribute to economic growth, especially in those countries, where this sector is large and provides employment opportunities for much of the working population.

Present agricultural taxation on the Nickerie and Wageningen rice-farms in the form of land and water rents are low or moderate. The land rents in Nickerie date back to 1852 and farm profits are clearly the outcome of low rents. From that point of view, a squeeze on agriculture would be quite justified, especially since it has been observed during the surveys that overinvestment is taking place. There are too many faulty investments (taxis, buses, ricemills). Probably the Government should step in,

especially in Wageningen, where these farmers earn a very favourable living. Such a squeeze is not recommended for Nickerie yet, as long as the average size of the farm is so small and so much of the family income must come from off the farm.

Nickerie first needs an increase in farm area to get away from the small-sized farm set up by the former Colonial Government. Such an increase in area can be achieved, first by growing a second rice crop each year and secondly by establishing new polders. Designs for either strategy are already at an advanced stage. Agricultural economic research is now being directed to a study of the economics of farm size in rice with advanced methods of cultivation. An economically viable farm size seems to lie in the range 10–25 hectares but obviously there is never an optimum farm size because it is constantly changing. The problem is therefore chronic. Assuming there are no more profitable alternatives, irrigated rice farmholdings have to be extended for a large number of families. Creating a few large-scale farms (30–50 hectares of rice) would certainly lead to a great social inequality, because the great majority of farmers would still be on small farms. The difficulty lies in striking the right balance between economic viability of a certain size of farmholding and social desirability, *i.e.* income parity.

This case study and further experience in other parts of the world show that, to increase the peasant farmer's welfare, more attention must be paid to the society's allocation of resources for (agricultural) development. It is often the society's failure 'to take the steps necessary to provide an environment in which the peasant can be more productive' (MELLOR, 1967, p. 50).

The present lack of inducement in using new inputs for rice farming in areas without irrigation suggest that such rural institutions as the extension service, agricultural education and credit can be less effective while this state of affairs continues.

Appendix A. Size distribution of the sampled farms (net area under rice)

		0–1 ha	1–2 ha	2–3 ha	3–4 ha	>4 ha	Total number of farms
Surinam	1965	1	8	32	8	5	54
	1966	1	9	28	8	8	54
Saramacca	1965	–	2	4	4	–	10
Nickerie	1965	4	9	18	6	2	39
	1966	1	9	21	4	4	39
Total		7	37	103	30	19	196

Appendix B. Cost-accounting analysis according to concepts A, B and C on four commercial farms (1965) – in *f* –

	No. 1	No. 2	No. 3	No. 4	Total
Hired labour	–	–	–	–	–
Seed	940.3	882.0	916.3	906.5	3,645.1
Fertilizer, pesticide	1,508.2	1,114.2	1,655.7	1,543.4	5,821.5
Implements	599.6	599.6	465.4	464.6	2,129.2
Tillage	1,211.2	797.5	1,572.5	1,564.0	5,145.2
Threshing, transport	2,134.6	2,252.2	2,403.1	2,248.8	9,038.7
Miscellaneous	32.8	23.0	33.0	37.0	125.8
Land and Water	1,630.8	1,650.0	1,651.8	1,623.3	6,555.9
Total cost A	8,057.5	7,318.5	8,697.8	8,387.6	32,461.4
Interest on capital	227.8	227.8	289.6	317.1	1,062.3
Total cost B	8,285.3	7,546.3	8,987.4	8,704.7	33,523.7
Family labour	1,826.0	1,622.0	1,834.0	1,734.0	7,016.0
Total Cost C	10,111.3	9,168.3	10,821.4	10,438.7	40,539.7

Appendix C. Cost-accounting analysis according to concepts A, B and C on four commercial farms (1966) – in *f* –

	No. 5	No. 6	No. 7	No. 8	Total	Average per farm	Average per ha	% Cost A	% Cost B	% Cost C
Hired labour	15.0	45.0	131.0	116.0	307.0	76.7	1.7	0.7	0.7	0.6
Seed	1,440.6	1,315.6	1,359.8	1,329.1	5,445.1	1,361.3	30.4	12.9	12.6	10.6
Fertil., Pesticide	2,411.4	2,143.5	2,131.1	2,319.5	9,005.5	2,251.4	50.3	21.3	20.9	17.6
Implements	484.9	832.0	649.1	723.7	2,689.7	672.4	15.0	6.4	6.2	5.3
Tillage	1,469.9	1,640.1	1,836.9	1,623.2	6,570.1	1,642.6	36.7	15.6	15.3	12.8
Transport, threshing	2,569.2	2,660.0	2,542.6	2,549.4	10,321.2	2,580.3	57.6	24.4	24.0	20.0
Miscellaneous	34.6	9.2	20.3	37.5	101.6	25.4	0.6	0.3	0.2	0.2
Land + Water	1,944.6	1,952.4	1,942.6	1,934.4	7,774.0	1,943.5	43.4	18.4	18.1	15.2
Total Cost A	10,370.2	10,597.8	10,613.4	10,632.8	42,214.2	10,553.6	235.7	100	–	–
Interest Capital	195.4	222.8	214.0	219.0	851.2	212.8	4.7	–	2.0	1.6
Total Cost B	10,565.6	10,820.6	10,827.4	10,851.8	43,065.4	10,766.4	240.4	–	100	–
Fam. Labour	2,060.5	1,693.5	1,946.0	2,433.0	8,133.0	2,033.2	45.4	–	–	15.9
Total Cost C	12,626.1	12,514.1	12,773.4	13,284.8	51,198.4	12,799.6	285.8	–	–	100%

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