

4.3 SOME NUTRITIONAL ASPECTS OF IRRIGATED RICE CULTIVATION IN WESTERN KENYA

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Preface

The performance of Kenya's agricultural sector during the past two decades compares favourably with that of the majority of other African countries. Nevertheless, growth rates of annual agricultural production decreased during the late 1970s and early 1980s (World Bank, 1981; 1983). As a result of the country's high population growth, presently amounting to 4 per cent per year, food production per capita declined (FAO, 1970; 1977; 1983). Although the average food availability has generally been above the recommended standards (Republic of Kenya, 1984), this decline must ultimately have implications for the level of food energy intake per capita. Already there are indications that the energy intakes in certain parts of the country and among the poorer strata of the population fall below the required levels (Shah & Frohberg, 1980; CBS, 1983).

The unprecedented population increase has caused serious pressure on land resources in the zones of high agricultural potential (Heyer et al., 1976; World Bank, 1983; Republic of Kenya, 1984; Kliest, 1985). Future increases in agricultural production will largely depend on the possibilities of raising yields per hectare, since agro-ecological constraints limit the possibilities of opening up new land. In response to this pressing situation, and in order to secure future self-sufficiency in national food production, the Kenya Government aims to restructure the agricultural sector and to intervene in areas such as resource development in the high to medium and low potential zones; research and extension; input and pricing policies; marketing, distribution and food processing; as well as nutrition (Republic of Kenya, 1981; 1984). Moreover, the Government has given high priority to achieving a greater understanding of the factors causing nutritional problems and to realizing ways of alleviating adverse conditions.

The Food and Nutrition Planning Unit (FNPU) of the Ministry of Planning and National Development has, since 1976, been charged with the responsibility of integrating food and nutrition considerations into overall

development policy and planned or ongoing programmes, in order to alleviate hunger, malnutrition and poverty among vulnerable groups in the country. In 1983, the FNPU, together with the African Studies Centre (ASC) of Leiden, Netherlands, initiated the joint Food and Nutrition Studies Programme. In previous years, ASC staff had been responsible for the Nutrition Intervention Research Project (NIRP), an extensive evaluation of nutrition programmes in Central Province. This project was carried out in co-operation with the Ministry of Health and the Department of Social Services. The objective of the present Food and Nutrition Studies Programme (FNSP) is to assist the FNPU with the analysis of contemporary trends and future needs concerning food and nutrition in Kenya with the aim of providing data necessary for the formulation of national food and nutrition policies, as well as more localised programmes and interventions. The programme is policy-oriented and is also meant to serve as a training ground for junior members of the FNPU staff.

This form of co-operation between a government organization and an independent research centre has worked out satisfactorily for both sides. The FNPU has not been embarrassed by researchers pursuing their "private interests", and the ASC has not been restricted in the (mutual) selection of both study topics and publications. Initially, it was planned to meet the necessary personnel and operating cost of the programme from the existing manpower and budgets of the FNPU and ASC. However, the potential of this kind of reciprocal co-operation raised the interest of the Dutch Ministry of Development Co-operation which agreed to cover the operating costs of the programme.

The programme addresses food and nutrition issues at macro, as well as meso and micro levels, and currently, studies are being undertaken in the following areas of general interest:

1. Nutritional Aspects of Agricultural and Rural Development Projects;
2. Regional and Seasonal Fluctuations in Food Availability and Nutrition;
3. Agricultural Policies and Agricultural Production.

Appendix 1 gives a list of reports of the present programme, as well as the previous Nutrition Intervention Research Project.

The research under 2, above, aims to describe and analyze the incidence, origin and effects of seasonal variations in food supply leading to relative and absolute food shortages in the rural areas. A first report based on published materials and existing statistical data draws an outline of these shortages with respect to various regions of the country (Kliest, 1985). Currently, a study of seasonality in food production and nutrition in Coast Province is being undertaken (FNSP, 1985b).

The research on agricultural policies (3 above) attempts to analyze the conditions under which the agricultural sector can meet the demands that will be placed on this sector in the future. A first report focused on producer prices for agricultural products, and reviews agricultural pricing policies in the recent past (Meilink, 1985). This study will be followed by a review of developments in consumer food prices over the past years.

The major emphasis in the programme until now has been on the nutritional aspects of agricultural development projects, the topic of this workshop. Various development strategies, focusing on modernization and growth, aim to increase food production through a transition from subsistence farming to production for the market. This transition is often envisaged in terms of large-scale agricultural development projects. A common characteristic of such strategies is their primary orientation towards the national food situation, while the farmers directly involved in agricultural development projects often receive little attention. It is usually assumed that improved levels of production result in increased farm incomes and higher standards of living. However, such positive effects cannot be taken for granted. In fact, concern exists about the nutritional situation of the farm households involved in agricultural projects and there is a need for more detailed knowledge on the nutritional effects of agricultural change (McGuine, 1981; Pinstrup-Andersen, 1981; Martin, 1984). Recently, a FNSP study on the nutritional conditions in settlement schemes in Coast Province was started (FNSP, 1985a).

A previous study was concerned with the nutritional conditions prevailing among farming households engaged in irrigated rice cultivation in the Kano Plain, Kisumu District (FNSP, 1983). Detailed results of this study are presented in a forthcoming report by Niemeyer, Geuns, Kliet, Ogonda & Hoorweg: "Nutritional Aspects of Rice Cultivation in Nyanza Province, Kenya". This paper presents a brief description of the study and discusses some of the main findings. The study concentrated on food production, food consumption and nutritional status, with special attention to young children because the youngest age groups are often the first to be affected by adverse nutritional conditions. The Kano Plain was selected because it has a fairly homogeneous ecology and is inhabited by a single ethnic group, the Jalu. In this area, two large rice irrigation schemes, the Ahero and West Kano (Pilot) Schemes, are situated. In addition, individual smallholders cultivate rice in a number of small irrigation schemes.

Background

One of the means to increase agricultural production is through improved water management, notably irrigation. Kenya's potential for irrigated agriculture is quite substantial (World Bank, 1983). The Kenya Government attaches increasing importance to irrigated agriculture, which has resulted in the initiation of several large-scale schemes and support for small-sized schemes in different parts of the country (Republic of Kenya, 1984). During the past two decades, several large irrigation schemes for the cultivation of rice have been established: Mwea Irrigation Scheme in Central Province; Ahero and West Kano (Pilot) Schemes in Nyanza Province, and Bunyala Irrigation Scheme in Western Province (NIB, 1982). The large schemes are centrally managed and organized along similar lines. The tenants were initially expected to reside on the scheme, and to grow rice on the plots allocated to them. The produce is centrally purchased, and farmers are paid in cash. Each tenant can retain a certain quantity of rice for home consumption, but other foods needed for family subsistence are to be purchased from the cash returns. In addition to the large-scale schemes, a fairly large number of small irrigation schemes presently exist. Most of them were started by the farmers themselves. In contrast to the large schemes, they are managed by the participating farmers who have more freedom to select the types of crops to be cultivated, and to farm according to their own insights.

The nutritional conditions at some of the large schemes, notably Mwea and Ahero, have on several occasions given rise to concern. Studies on the nutritional state of the population at Mwea (Korte, 1969, Wanjohi et al., 1978) indicated a high prevalence of malnutrition, with at least twice as many severely malnourished children compared to the national average. Suggested explanations for these findings are low income levels, poor health conditions as a result of diseases associated with stagnant water (bilharzia and malaria), unbalanced diets resulting from the dependence on mono-cropping and insufficient food expenditures.

In recent years, efforts have been made to counter these negative effects. In some of the schemes, such as West Kano larger homestead plots were planned to allow cultivation of additional subsistence crops. In Mwea, tenants were allocated additional land for rainfed cultivation.

Other steps to improve nutritional conditions include the promotion of vegetable gardens, the planting of certain food crops on the bunds between the plots, and the appointment of nutritionists. Whether the various measures have indeed resulted in improved and more balanced diets has not yet been established.

Irrigated Rice Cultivation in the Lower Kano Plain

The Kano Plain is located in Kisumu District, one of the four districts of Nyanza Province (Map 1). In 1979 the population amounted to about 95,000 people with a population density of 175 per Km². The settlement pattern in the Kano Plain is characterized by scattered compounds comprised of kin-related families. A recent survey found an average number of families per compound of 1.8, mean family size of 5.4 persons, and an average number of 9.7 people per compound (Republic of Kenya/National Irrigation Board, 1981). The climate is relatively dry with high average temperatures during the day. The long rains usually cover the period March to May, the short rains are less important for the cultivation of rainfed crops. A considerable part of the plain consists of seasonal and permanent swamps and the lower areas are suitable for irrigated agriculture (Jaetzold & Schmidt, 1982). This area, the lower Kano Plain, was selected as the study area.

Smallholder farmers in the lowlands along the shores of Lake Victoria spontaneously started irrigated rice cultivation in the 1930's and 1940's. Severe floods and the rise of Lake Victoria in the early 1960's destroyed a substantial amount of paddy land. In the mid-1960's and 1970's, however, irrigated rice cultivation picked up again. The National Irrigation Board initiated two large irrigation schemes, that is, the Ahero Pilot Scheme and West Kano Pilot Scheme. In addition, the demonstration effects of the schemes and stimulation on the part of the Government have encouraged smallholder farmers outside the schemes to engage in irrigated rice production.

The Ahero and West Kano irrigation schemes were started in 1969 and 1976, respectively. The two schemes cover a total area of 4,800 ha of which 840 ha are presently under cultivation in Ahero, and 880 ha in West Kano. Each scheme counts 500-550 tenants with farms of 1.6 ha

each. In Ahero, all farm land is used for paddy cultivation; in West Kano it is equally divided between paddy and sugar cane production. Farmers have to adhere to strict farm management regulations. The scheme management takes care of land preparation, and supplies fixed quantities of inputs (seed, fertilizer and insecticides). After the harvesting, the management handles the marketing of the crop. The costs of inputs, land preparation and marketing are subtracted from the farmer's income. Each tenant can retain 10 per cent of his total paddy production for home consumption.

Except for the first years, cropping intensity as well as yield levels stayed below expected levels. Recently, yield levels have improved and are estimated at 4,300 kg per ha ⁽¹⁾ (Houtman, 1981). Nevertheless, the incomes of the tenants have generally stayed below those initially envisaged. Besides cultivating the paddy plots, some 90 per cent of the tenants grow crops on non-scheme land, usually a very small area around the house or larger plots outside the scheme's boundary. In both schemes, many tenants have access to non-irrigated land elsewhere in the Kano plain. Substantial differences exist among tenants in this respect; some dispose of relatively large plots, others have to rely on their irrigated land within the scheme only. Initially, the tenants were obliged to live in the villages situated within the schemes. At a later stage, farmers were allowed to take up residence outside the scheme and retain their scheme plot. Consequently, there exists a group of resident tenants living and working in the schemes, and a group of non-resident tenants who live outside the schemes.

Individual farmers encouraged by the relatively high and stable producer prices for paddy, have recently re-established rice plots in the low lying areas of the Kano Plain. The area under cultivation in these small-scale schemes has substantially increased during recent years (Table 1). At present, approximately half of the potential area suitable for paddy cultivation is developed. The schemes usually have farmers' committees that control the water distribution over the various plots; other management decisions are left to the individual farmers. Although external farm inputs are sparsely used, yield levels obtained by the individual rice cultivators are estimated to average approximately 3,500 kg per ha which compares rather favourably with yields realized on the large irrigation schemes where farmers enjoy high input levels.

Several constraints hamper the full utilization of the potential rice area. The incidental flooding of the swamp areas causes delay in cropping activities, often destroys the rice crops and, occasionally, the plots as well. Also, seasonal lack of water in some of the rice areas equally lowers the potential for rice growing. In view of the importance of rice production both for the individual growers in the Kano Plain and for the national food supply, the Ministry of Agriculture and Livestock Development supports the individual rice growers through the Provincial Irrigation Unit and the Smallholder Rice Rehabilitation Programme. Assistance includes the improvement of water supply and water management, the construction of rural access roads, and the provision of inputs and marketing facilities.

Method

The study was designed to represent the three types of existing participation in irrigated rice cultivation. The first two consist of tenants at large irrigation schemes: (a) tenants living in the scheme villages (resident tenants), and (b) tenants living outside the scheme (non-resident tenants). The category (c) includes individual rice growers involved in small irrigation schemes. For purposes of comparison, a fourth group (d) of farmers not connected with rice production in any of the above ways was included (non-rice growers). Households were sampled from five geographical locations, Ahero and West Kano Schemes, and three sub-locations. (Kochieng, Kamagaga and Kobura). Kochieng and Kobura are located in the centre of the Kano Plain, near Nyakakana, and border on each other. Kamagaga is situated on the higher ridge immediately north of Ahero Scheme (Map 2)

Because of the pronounced tendency for kin-related families to share economic resources and to have mutual cooking arrangements, the compound was defined as the main sampling unit. A total of 335 compounds were included in the survey. The number of farmers with access to rice plots in the two large irrigation schemes amounted to 147. Of this number, 83 were resident tenants, and 64 belonged to the category of non-resident tenants. The number of individual rice farmers with one or more plots in small schemes was 54. Finally, 134 households had no access to rice plots and were not directly involved in rice cultivation. The compounds numbered a total of 425 mothers of young children and 954 children between the ages of 6 months and 11 years.

Agricultural production was assessed by means of interviews on the acreage planted and quantities harvested of various cash crops (rice, sugar cane, cotton) and food crops (cereals, pulses, roots and tubers) during the long and short rain seasons of 1983/1984. In practice, very few farmers planted annual crops during the short rains, and the quantities harvested were negligible.

Food consumption was assessed by two recall methods: (a) a recall of all food prepared in the compound during the day prior to the interview, and (b) a 24-hour recall of the quantities of food consumed by individual children, aged 6-47 months, also for the previous day. Estimates of energy and protein intake per compound are expressed as intakes per consumption unit ⁽²⁾.

Anthropometry included the measures commonly used in nutrition studies: weight, height and mid-upper arm circumference which were expressed in terms of the standard values of a reference population: height-for-age, weight-for-height, weight-for-age and mac-for-age. For the calculation of the respective indices the WHO reference population was used (WHO, 1983); for mac-for-age, the tables by Jelliffe (1966).

The actual survey covered the period March and April 1984, that is, the season of the long rains. This, usually, is the time when food stocks are at their lowest level, and when nutrition problems become most manifest. It should be noted that food intakes at this time of the year most likely represent an underestimate of usual intake levels. Between the survey period and the previous harvest a period of 8-9 months had elapsed. With respect to rainfed crops, the last (long rain) harvest reportedly had been a near failure. As a result, food stocks were probably abnormally depressed. Since irrigated agriculture is less dependent on rainfall, the farming households with access to irrigated plots were in a different situation. Moreover, in many cases they had harvested their rice crop only three to four months before the date of the survey.

Resource Base

The main resources of smallholders in the Kano Plain are: crop cultivation, livestock rearing and income from migrant labour. Table 2 lists indicators for these different aspects. The area planted with cash crops, rice in particular, is highest among the tenants at the N.I.B. schemes. The area planted with cotton is generally small, this crop is mainly cultivated in the higher parts of the Kano Plain. Sugar cane is much more prominent, especially among the farming households that do not grow rice, although the N.I.B. tenants in West Kano also grow this crop. The paddy area among the individual rice growers amounts to less than one acre.

The area planted with maize and sorghum varies between 1.0 and 2.5 acres per compound, and is particularly low among the resident tenants at the large schemes. This is related to the limited availability of farm land outside the schemes for these farmers. For the three remaining study groups, the average area per compound under cereals is roughly the same, although the individual rice growers tend to have slightly more land under rainfed crops. Livestock and livestock produce still play an important role in the economy of farming families in the Kano Plain. Table 2 indicates that livestock activities are most important among the individual rice growers. The resident tenants appear hardly to be involved in livestock keeping, since they are not allowed to keep cattle within the scheme.

Finally, many compounds draw an income from migrant labour. The average number of migrant workers per compound amounted to 0.6. This figure, however, conceals an important difference between the category of resident tenants on the one hand, and the other groups. The number of migrant workers among the former group is very low, and this will have important consequences for the inflow of remittances.

In sum, there are major differences with respect to the resource base of the four groups. Particularly, the resident tenants appear to have access to few economic resources other than the production of rice (and sugar cane in the case of West Kano). The three other groups, in particular the individual rice growers and the non-resident tenants, have access to more diversified resources.

Agricultural Production & Food Availability

Table 3 lists the number of bags of maize and sorghum harvested in 1983. It is evident that both the resident and the non-resident tenants harvested smaller quantities of these food crops compared to the other two groups. Because of the disappointing harvest of 1983, very little maize and sorghum was sold. The number of bags of paddy harvested by the N.I.B. tenants averaged 64 bags, whereas the individual rice growers harvested an average of 12 bags per compound⁽³⁾. Table 3 also presents estimates of the amounts of rice that were used for home consumption, that is, the quantity retained after delivery to the scheme, payment in kind to agricultural labourers and sales in the local markets⁽⁴⁾.

In table 4 the quantities of rice, maize and sorghum retained for consumption are expressed as estimates of the number of days that these cereals sufficed to feed the compound residents⁽⁵⁾. The figures point at a relatively low "food availability", 57 days on average for maize and sorghum, the main staple foods. This is especially the case among the resident tenants. Farmers who do not grow rice succeeded in securing the largest amount of maize and sorghum. However, their total maize and sorghum output in 1983 covered only 80 days of consumption. The quantity of rice available for home consumption is highest among the non-resident tenants covering about 70 days. Corresponding figures for the individual rice growers and resident tenants were 40 and 45 days, respectively. The average period of consumption covered by all home-produced cereals (maize, sorghum and rice) appeared to be less than 3 months. However, the group of non-resident tenants were able to produce their consumption needs for a period of almost 4 months. Both the resident tenants and non-rice growers, on the other hand, could only cover 80 days, a period of 2.5 months. Disregarding these important differences in food availability, it is clear that all groups have to depend on purchased foods to cover their consumption needs for the larger part of the year. In other words, cash income either from farm or off-farm activities is of paramount importance for the provision of food.

Food Consumption

The first part of this section presents an overall estimate of energy and protein intake levels per compound for the various study groups. The average amount of energy per consumption unit does not compare unfavourably with the figure of 2600 KCal per day recommended by WHO (table 5). The lowest energy and protein intake levels are realized by the category of resident tenants. The highest figures, in contrast, are reached by the individual rice growers and the non-resident tenants. The contribution of rice to the energy intake happens to be very low; only among the resident tenants it is higher than 10%.

These averages, however, conceal large differences among individual compounds. The proportion of compounds that realized less than 80 per cent of the WHO norm is 26 per cent among the non-resident tenants and 36 per cent among the individual rice growers (table 5). The farmers that do not grow rice, as well as the resident tenants, appear to be in an even less favourable position. Not only did a much lower proportion of compounds in these groups reach the recommended energy level, but also the percentage of compounds falling below 80 per cent of the norm, especially among the resident tenants, appeared to be high. It should be stressed that the estimates presented in table 5 pertain to compounds and disregard possible intra-compound variation in energy intake, that is between the different members of the compound.

Table 6 presents the results of the 24-hour recall for the children aged 6-47 months. The children of the resident tenants have a lower energy and protein intake than those of any of the other groups. This group also has the highest proportion of children who receive less than 60 per cent of the recommended energy intake per kg body weight⁽⁶⁾. This finding corresponds with the previously noted low compound consumption among the resident tenants. Among the three remaining groups, the children of the non-rice growers have the lowest energy and protein intake and the largest proportion of children falling below 60 per cent of the recommended energy intake. With respect to the individual rice growers and the non-resident tenants, the

children belonging to the latter group show the most favourable energy and protein intakes.

Nutritional Status.

With respect to height-for-age, the children residing within the large irrigation schemes show distinctly the least favourable growth pattern (Table 7). The difference is evinced by a greater incidence of stunting. The height-for-age results of the children in the three remaining study conditions are more favourable, and differ little among each other.

Weight-for-height indicates degree of wasting and momentary nutritional condition. One difference stands out: weight-for-height is more favourable among children of non-resident tenants. No wasted children (below W-H(80)) were found in this group. The children belonging to the other three groups show equally low weight-for-height levels.

Weight-for-age, as a general indicator of malnutrition, shows that the highest incidence of malnutrition occurs among the children of the resident tenants at the large schemes. This is, of course, as could be expected: these children scored low on height-for-age as well as weight-for-height. On the other hand the lowest prevalence of malnutrition occurs among the children of non-resident tenants of the N.I.B. schemes.

Conclusion

Agricultural Development in Sub-Sahara Africa covers numerous aspects. New agricultural techniques and cropping patterns are introduced, alternative forms of farm management are developed and there is a general reorientation towards production for the market. Such changes are not introduced independently of each other and most agricultural development projects imply changes in more than one respect. Irrigation schemes are among the important types of agricultural development in Kenya. The four groups that were included in the study reflect different

degrees of participation and dependence on irrigated cultivation. At the one end, the non-rice growers take no part in irrigated agriculture and still depend largely on traditional agricultural techniques and management practices. On the other hand, the resident tenants of the N.I.B. schemes have undergone the most drastic changes. These farmers almost entirely depend on irrigated cultivation, no longer run their farms according to their own insights, but have to adhere to decisions of the scheme management. Moreover, they have to rely to a very large extent on the proceeds of their cash crops for their daily living. The two remaining groups, the individual rice growers and the non-resident tenants at the schemes take an intermediate position. The first are involved to a lesser extent in rice cultivation than to the second. In general, they cultivate a smaller rice area, manage their farms relatively independently and depend less on the sale of crops to secure a living. There are important variations in the resource base of the different study groups. The resident tenants appear to have access to few economic resources other than the production of rice. The other three groups, in contrast, have access to more diversified resources, including rainfed food and cash crop cultivation, livestock keeping, income from migrant labour and, with the exception of the non-rice growers, irrigated rice cultivation.

The observed differences in nutrition between the four groups appear first and foremost to be related to these variations in resources. The group with the smallest resource base, that is, the resident tenants, have the lowest food production for home consumption and the lowest average energy intake per consumption unit. This group appeared to have the lowest food intake levels among the young children and also showed a higher incidence of stunting compared to children belonging to the other study groups.

The differences among these groups are much smaller, although the nutritional status of the children of individual rice growers and the non-resident tenants proved to be generally more favourable. In sum, it may be concluded that the nutritional status of the groups with the smallest resource base, the non-rice growers and, in particular, the resident tenants, is the least favourable. The category of farmers with access to more resources in general score better in terms of nutrition. This applies particularly to the non-resident tenants.

Evidently it is not possible to draw an unequivocal conclusion about the nutritional consequences of participation in irrigated rice cultivation. Both the group with the most favourable nutrition conditions and the category which appeared poorest in this respect are tenants at the large rice irrigation schemes. This leads to the observation that participation in large-scale rice cultivation may have a positive impact under certain conditions, but not when the sole existence of the farming family depends on this type of agriculture. The assumption made at the time of the start of the schemes, that the livelihood of rural families can be fully covered by means of cash cropping appears not to be valid. The poor nutritional conditions among the resident tenants show this convincingly. However, it cannot be said that participation in rice cultivation, in itself, has detrimental effects. Only the group which is solely dependent on their rice plots show symptoms of severe stress.

It is clear that a diversified resource base is of great importance, and in future, as well as in existing, schemes every effort should be made to bring about such a diversification. A number of measures could be taken. For instance, in both existing and future schemes plots could be prepared for the cultivation of other crops. The cultivation of rain-fed (food) crops will become a distinct possibility when a planned shift towards single cropping in the large schemes becomes reality. Another alternative is to allocate sufficient land for rainfed cropping, provided agro-ecological circumstances allow this. Finally, it is advisable to create more possibilities for livestock keeping at the schemes, for example in the form of zero grazing. Dairy farming among tenants at the schemes (but also among the other farmers in the Kano Plain) needs to be explored and encouraged, so as to increase the availability of milk for home consumption. Rice cultivation on an individual basis in the small schemes does not appear to invoke negative nutritional effects. This type of participation in rice cultivation, therefore merits serious attention and support because it is a means to enlarge the resource base of the participating farmers, albeit to a modest extent.

Notes

(1) This estimate includes paddy delivered to the scheme, as well as the private, regular and irregular, retentions of paddy.

(2) The number of consumption units in a compound equals the number of adults increased with the number of children converted into adult equivalents. The conversion factors are based on the WHO (1974) recommended energy intakes for different age groups. For instance, the number of consumption units for a group comprising one adult and two children under five years, is $2.0(1.0+0.5+0.5)$.

(3) These figures reflect average yield levels of 4,250kg/ha for the N.I.B. tenants and 3,375 kg/ha for the individual rice growers.

(4) The estimates of the bags of paddy retained for home consumption were calculated as follows. Individual rice growers reported that they had sold three quarters of their paddy harvest, and it was assumed that the remaining quarter was consumed. N.I.B. tenants (non-resident and resident) reported that they handed over 70 per cent and 85 per cent respectively of their produce to the scheme management. On the basis of Houtman's (1981) findings, it was assumed that one-third of the quantity of paddy attained was ultimately used for home consumption.

(5) It was assumed that 2600 KCal. are required per consumption unit daily, and that 80% of daily energy intake are by provided cereals, as shown by analysis of the food consumption data of the present survey.

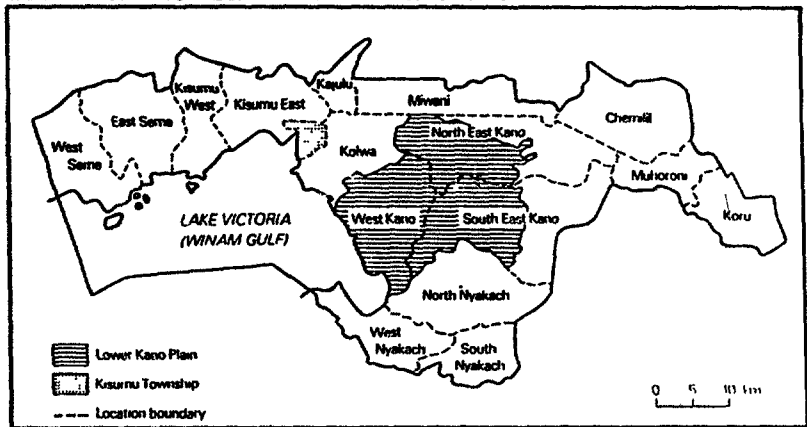
(6) For children still on the breast the number of times that the child had been given the breast was also recorded. The actual amounts of breastmilk consumed, however, were not measured. Instead these quantities were estimated using figures for children reported by Van Steenberg et al.(1984). These estimates were, however, only included in the calculations of the energy intake per kg body weight.

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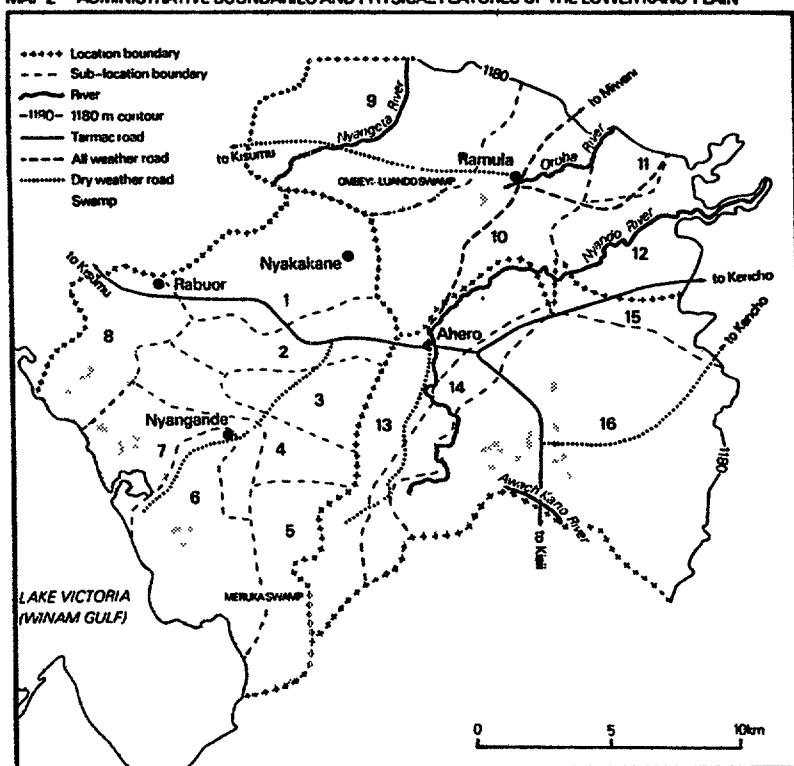
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- World Bank(1983) Kenya, Growth and Structural Change. Washington: World Bank.

MAP 1 THE LOCATION OF THE LOWER KANO PLAIN IN KISUMU DISTRICT



MAP 2 ADMINISTRATIVE BOUNDARIES AND PHYSICAL FEATURES OF 11 IE LOWER KANO PLAIN



- | WEST KANO LOCATION | NORTH EAST KANO LOCATION | SOUTH EAST KANO LOCATION |
|--------------------|--------------------------|--------------------------|
| 1 Kocheng | 9 Sidho West | 13 Kakole |
| 2 Kombura | 10 Karmagaga | 14 Kochogo |
| 3 Kaito | 11 Kabar | 15 Wawdhi A |
| 4 Upper-Bwande | 12 Wagaya I | 16 Wawdhi B |
| 5 Lower-Bwande | | |
| 6 Kadhambo | | |
| 7 Kawano | | |
| 8 Nyamwere | | |

Table 1
Smallholder Rice Schemes in the Lower Kano Plain

LOCATION	POTENTIAL AREA (ha)	ACTUAL AREA PLANTED (ha)			
		1980	1981	1982	1983
N. E. Kano	220	60	106	134	128
S. E. Kano	160	30	36	68	90
W. Kano	310	45	42	106	116
Total	690	135	184	308	334

Source: Ministry of Agriculture, 1981; 1982; 1983

Table 2
Resource Base

	NON- RICE GROWERS (N=134)	INDIVIDUAL RICE GROWERS (N=54)	NON- RESIDENT TENANTS (N=64)	RESIDENT TENANTS (N=83)	TOTAL (N=335)
Acreage under Cash Crops*	0.7	1.0	4.1	4.1	2.3
Cotton	0.2	< 0.1	0.1	<0.1	0.1
Sugar Cane	0.5	0.2	0.6	0.8	0.6
Rice	- -	0.8	3.4	3.3	1.6
Acreage under Maize and Sorghum**	2.2	2.5	2.0	1.1	1.9
Presence of cattle(%)***	38%	41%	31%	9%	30%
Migrant Workers	0.8	0.8	0.7	0.1	0.6

* Cotton: Area planted during long and short rains of 1983 (acres combined)
Sugar Cane: Area under crop at the time of the survey
Rice: Area harvested during past 12 months

** Area planted during long and short rains of 1983 combined.
*** As indicated by presence of a cattle pen in the compound.

Table 3
Cereal Production*
(Number of bags)

	NON- RICE GROWERS (N=134)	INDIVIDUAL RICE GROWERS (N=54)	NON- RESIDENT TENANTS (N=64)	RESIDENT TENANTS (N=83)	TOTAL (N=335)
Maize & Sorghum	4.2	3.5	2.9	1.5	3.2
Paddy	- -	12	63	64	- -
Paddy retained for home consumption	- -	3	6.3	3	- -

* Over period of past 12 months (1983/1984)

Table 4
Quantities of Cereals Available for Home Consumption
(Expressed in number of consumption days/consumption unit)

	NON- RICE GROWERS (N=134)	INDIVIDUAL RICE GROWERS (N=54)	NON- RESIDENT TENANTS (N=64)	RESIDENT TENANTS (N=83)	TOTAL (N=335)
Maize & Sorghum	80	58	42	32	57
Rice	--	41	69	46	31
Total	80	99	111	78	88

Table 5

Assessment of Compound Food Consumption
(Average Intake of Protein (grs.) and Energy (KCal) per Consumption Unit (CU))

	NON- RICE GROWERS (N=134)	INDIVIDUAL RICE GROWERS (N=54)	NON- RESIDENT TENANTS (N=64)	PRESIDENT TENANTS (N=83)	TOTAL (N=335)
AVERAGE NUMBER OF CU 's PER COMPOUND	7.3	7.7	9.0	6.3	7.3
Grs. Protein/CU	84	95	94	84	88
KCal/CU	2592	2767	2681	2494	2613
Compounds(%) with less than 80% of Recommended* Energy Intake per CU	41%	36%	26%	46%	39%
Contribution(%) of Rice to Energy Intake	5%	5%	6%	13%	7%

* WHO recommendations (2600 KCal/Consumption Unit)

Table 6

Intake of Energy and Protein by Study Condition
(Children 6-47 months)

	NON- RICE GROWERS (N=118)	INDIVIDUAL RICE GROWERS (N=59)	NON- RESIDENT TENANTS (N=82)	RESIDENT TENANTS (N=64)	TOTAL (N=323)
Energy (KCal)	659	679	694	552	650
Protein(grs)	18.1	20.4	20.3	15.4	18.5
Children(%) with less than 60% of recommended energy intake*	41%	35%	38%	49%	41%

* per kg-body weight

Table 7
Anthropometry by Study Conditions
 (Percentage of Children falling below H-A(90); W-H(90); W-H(80)
 and W-A (80) respectively)

	NON- RICE GROWERS	INDIVIDUAL RICE GROWERS	NON- RESIDENT TENANTS	RESIDENT TENANTS	TOTAL
AGE GROUP 6-47 months	(N=124)	(N=64)	(N=90)	(N=76)	N=(354)
AGE GROUP 4-10 years	(N=226)	(N=102)	(N=132)	(N=124)	N=(584)
<hr/>					
<u>HEIGHT-FOR-AGE (< 90) (Long-term nutrition condition).</u>					
AGE GROUP 6-47 months	17%	14%	19%	41%	22%
AGE GROUP 4-10 years	22%	18%	14%	30%	21%
<hr/>					
<u>WEIGHT-FOR-HEIGHT (<80) (Wasting)</u>					
AGE GROUP 6-47 months	6%	14%	0	6%	6%
AGE GROUP 4-10 years	4%	3%	4%	4%	4%
<hr/>					
<u>WEIGHT FOR-AGE (<80) (Malnutrition)</u>					
AGE GROUP 6-47 months	37%	38%	31%	55%	39%
AGE GROUP 4-10 years	48%	37%	36%	49%	44%

Appendix I

LIST OF REPORTS

FOOD AND Nutrition Studies Programme

1. FNSP (1983a) Nutritional Aspects of Rice Irrigation in Nyanza Province (Research Outline)
2. FNSP (1983b) Seasonal and Regional Food Shortages in Kenya (Research Outline)
3. FNSP(1983c) Agricultural Pricing Policy in Kenya: Implications for Agricultural Production and Rural Incomes (Research Outline)
4. Kliest, T.(1984) The Agricultural Structure of the Lower Kano Plain
5. Veenstra V(1984) List of Names of Foods, Drinks and Meals in Luo (draft)
6. FNSP(1984a) Progress Report: January 1984
7. FNSP(1984b) Seasonal and Regional Food Problems in Kenya Progress Report: March 1984
8. FNSP(1984c) Agricultural Pricing Policy in Kenya. Progress Report: May 1984
9. FNSP(1984d) Nutritional Aspects of Rice Irrigation in Nyanza Province Progress Report: May 1984
10. Kliest,T.(1985) Regional and Seasonal Food Problems in Kenya
11. Meilink, H.A. (1985) Agricultural Pricing Policy in Kenya: Scope and Impact
12. FNSP(1985a) Nutritional Conditions at Settlement Schemes in Coast Province-Kwale and Kilifi Districts (Research Outline)
13. FNSP(1985b) Seasonality in Food Production and Nutrition in the Coastal Lowlands of Kenya - Kwale and Kilifi Districts (Research Outline)
14. Niemeyer,R, Geuns,M., Kliest,T.,Ogonda,V.& Hoorweg,J.(1985) Nutritional Aspects of Rice Cultivation in Nyanza Province, Kenya (Draft)
15. FNSP (1985c) Women's Associations and Their Importance for Rural Development: A Study at Two Settlement Schemes in Coast Province - Kwale and Kilifi Districts (Research Outline)

Appendix 1, continued

Nutrition Intervention Research Project

- Hoorweg, J. & Niemeijer, R. (1980) The Impact of Nutrition Education at Three Health Centres in Central Province, Kenya.
ASC Research Report No. 10. Leiden: African Studies Centre
- Hoorweg, J. & Niemeijer, R. (1980) The Nutritional Impact of the Pre-School Health Programme at Three Clinics in Central Province, Kenya.
ASC Research Report No. 11. Leiden: African Studies Centre.
- Hoorweg, J., Niemeijer, R. & Van Steenberg, W. (1981) Finding of the Nutrition Intervention Research Project: Brief account of a seminar convened at the Medical Research Centre, Nairobi.
NIRP Report No. 15. Leiden: African Studies Centre.
- Hoorweg, J. & Niemeijer, R. (1982) The Effects of Nutrition Rehabilitation at Three Family Life Training Centre in Central Province, Kenya.
ASC Research Report No. 14. Leiden: African Studies Centre.
- Hoorweg, J., Niemeijer, R & Van Steenberg, W. (1983) Nutrition Survey in Murang'a District, Kenya Part 1: Relations between Ecology, Economic and Social Conditions, and Nutritional State of Pre-School Children.
ASC Report No. 19. Leiden: African Studies Centre.
- Hoorweg, J., Niemeijer, R. & Van Steenberg, W. (1984) Nutrition Survey in Murang'a District, Kenya, Part 2: Nutritional Cognition and the Food Consumption of Pre-School Children.
ASC Research Report No. 21. Leiden: African Studies Centre.