

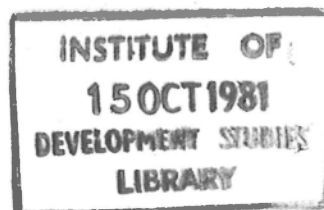
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THE DEVELOPMENT OF LARGE-SCALE INTEGRATED SUGAR SCHEMES IN  
WESTERN KENYA

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THE DEVELOPMENT OF LARGE - SCALE INTEGRATED SUGAR SCHEMES  
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ABSTRACT.

This paper examines the development of the large - scale agro-industrial sugar schemes in western Kenya. The schemes are related both to Kenya's attempts to become self-sufficient in sugar production and to promote rural development in western Kenya. In particular, the paper emphasises the need to integrate the development of agricultural output, industrial production and transport systems and examines the spatial patterns consequent upon these developments.

### Introduction

Large-scale sugar schemes have become one of the most significant features of the development policies for western Kenya. Four schemes are already in operation, two of which are undergoing expansion and two further schemes are scheduled to begin production in the near future. The six schemes have common characteristics in that all require the integration of widespread agricultural development, large-scale industrial production and an efficient transport system. In addition, all the schemes attempt to meet rural development needs by emphasising the provision of incomes and employment in areas of high population growth and density and low incomes (I.L.O. 1973). In detail however, there are marked contrasts between the schemes. Development of the early schemes dates back to the mid-1960's and succeeding schemes have been modified on the basis of experience gained. Schemes have also been located in areas with varying ecological characteristics and with differing land systems. Perhaps the most marked contrast between the four existing schemes is the apparent success of the Mumias scheme and the continued difficulties experienced by Miwani, Muhoroni and Chemelil schemes which together constitute the Nyanza sugar belt. The Mumias scheme, which did not become operational until 1973, is already undergoing an expansion to triple its output by the early 1980's and the organisation of this scheme has been used as a model for two further developments. In contrast, the longer-established schemes of the Nyanza sugar belt have been less successful, especially in their ability to meet production targets and the general level of satisfaction with these schemes is much lower than with Mumias.

This paper examines the major spatial changes which have resulted from the development of sugar schemes in western Kenya. Particular attention is paid to the locational factors influencing the choice of mill site, to the importance of different size units in the growing of cane and to the evolution of the transport system. The schemes are evaluated at a macro level in the context of Kenya's attempts to become self-sufficient in sugar production and to create greater income and employment opportunities in the rural areas of western Kenya. This requires both an analysis of the extent to which the schemes have, or have not, been successful in integrating widespread agricultural development with large-scale industrial processing and an examination of the contrasts in the organisation of the schemes. Data for this study were supplied by the sugar companies and a variety of organisations concerned with the sugar industry. At this stage, no attempt

has been made to conduct a survey at individual farm level although it is recognised that this may be the most logical development to the present survey.

The context of large - scale sugar schemes

In 1964 there was a substantial demand for industrially produced sugar in Kenya of which 67% was met by imports (Frank, 1966). As anticipated, the high rates of population growth and the increases in per capital income in the post - independence period have further increased the demand for sugar (O'Connor, 1975) and resulted in a 117% increase in consumption between 1964 and 1977. For the most part, government policy aims to meet demand rather than restrict consumption through price and market controls and successive development plans have recognised that unless home production was expanded, Kenya would face a growing volume of imports (Republic of Kenya, 1966, 1969 1973). In addition, several areas of the country, especially in western Kenya, were dependent on subsistence agriculture although they were suited to cane growing and consequently, the existing scheme at Miwani has been expanded and five new schemes have been established in western Kenya since 1964.

Examination of consumption figures (table 1) indicates that the demand for sugar increased continually between 1964 and 1974. This expansion was checked in 1975 and 1976 mainly because of substantial rises in the retail price of sugar<sup>2</sup> and partly because of distribution problems, but the upward trend was resumed in 1977. Providing that there are no further major increases in the retail price of sugar, the Kenya Sugar Authority estimates that sugar consumption will continue to rise by at least 7% per annum during the 1980s. Expansion of the sugar industry since 1964 has had to consider not only the existence of an initial deficit between production and consumption but also almost constant increase in demand which is likely to continue in the future. Although output has been expanded by a notable 425% between 1964 and 1977, the ultimate aim of self-sufficiency is not likely to be met until 1981. The deficit between production and consumption has been higher than predicted firstly because consumption levels have been underestimated (the period of the 1970-74 development plan had an estimated consumption rising to 180,000 tns whereas actual consumption rose to 223,661 tns) and secondly because some schemes have been unable to meet their full production potential. Had the latter problem been overcome, Kenya may well have become self-sufficient in sugar production by the late 1970's.

Table 1. Consumption, production and imports of sugar since 1964

Year	Consumption tons	% change	Production tons	% change	Deficit tons	IMPORTS from E. Africa	outside E. Africa
1964	103,500		34,500		69,000	43,600(U)	29,000
1965	110,493	+ 6.8	28,511	-17.4	81,982	18,000(U)	66,188
1966	119,469	+ 8.2	34,993	+22.7	84,476	5,000(U)	90,982
1967	119,463	-	59,463	+69.9	60,003	30,097(U)	8,768
1968	130,437	+ 9.2	80,130	+34.8	50,307	34,384(U)	18,417
1969	142,002	+ 8.9	115,498	+44.1	26,504	20,708(U)	5,411
1970	157,628	+ 11.0	125,156	+ 8.4	32,472	18,293(U)	19,406
1971	183,062	+ 12.7	124,073	- 0.9	58,989	-	59,087
1972	194,612	+ 6.3	92,284	-25.6	102,328	-	113,617
1973	217,462	+ 11.7	137,932	+49.5	79,530	-	76,006
1974	223,661	+ 2.8	164,308	+19.1	59,353	-	79,605
1975	198,360	- 11.3	159,641	- 2.8	38,719	4,648(T)	15,370
1976	197,013	- 0.7	167,081	+ 4.7	10,386		31,815
1977	224,198	+ 13.8	180,991	+ 8.3	43,207		33,680*

Source: East African Community, Ministry of Commerce and Industry

(U) - imports from Uganda

(T) - imports from Tanzania

\* - all imports.

As a consequence of this deficit, imports have remained at a high level (table 1). The situation was further aggravated once supplies of sugar from Uganda were no longer available and in period such as 1974-5 when sugar prices on the world market reached £650 per ton. Imports fell quite sharply in 1975 in response to the reduction in the levels of consumption but recovered in 1976 and 1977. The present shortfall is expected to continue until the early 1980's and expansion of sugar output is planned until 1985. By that date, Kenya expects to be in a position to become a net exporter of sugar and if this situation materialises, hopes to obtain a quota to export to the European Economic Community. With the exception of the Ramisi Mill in Coast province and a limited numbers of small-scale sugar mills, all expansion will be based on the 6 large-scale sugar schemes of western Kenya.

In 1964, industrial-sugar production in Kenya came from two schemes where cane was grown on an estate (plantation) and supplied to a large-scale mill. The Miwani scheme typified the situation since it consisted of a mill supplied by a nucleus estate and large private farms, all controlled by Asians. While this type of scheme was economically viable it could not be used as a basis for the expansion of the sugar industry because of unacceptably social and political consequences. The present agro-industrial schemes of western Kenya have adopted a system whereby sugar milling and small proportion of cane production are on a large scale, while the majority of cane is grown on smallholder farms. The choice of this type of scheme represents a compromise between differing constraints: the required rate of expansion of sugar output almost inevitably necessitated large-scale schemes, while large-scale industrial plants offered considerable economies of scale in sugar milling. On the other hand, the expansion of cane growing on smallholder farms meets the need to create incomes and employment in the rural areas.

#### The sugar mills

In 1964 sugar was produced in two privately-owned mills at Miwani and Ramisi (Fig. 1). Post-independence expansion has established two new mills in Nyanza at Muhoroni (1966) and Chemelil (1968) and enlarged Miwani to form the Nyanza sugar belt. The most recent scheme to become operational is at Mumias (1972) in Western province which, in addition to Chemelil, is already scheduled for expansion. Two further mills will shortly be coming into operation - the Nzoia scheme (1978) in western province and the Sony scheme (1980) in South Nyanza (Fig. 1) Assuming that all schemes operate

at full capacity, there is a potential production by 1980 of 385,000 tns of sugar in the provinces of western kenya (Table 2).

Table 2. Mill output and capacity (tns sugar)

Mill	output 1976	capacity 1976	Planned capacity 1980
Ramisi	6,100	15,000	?
Miwani	25,200	60,000	60,000
Muhoroni	26,200	40,000	40,000
Chemelil	46,100	45,000	60,000
Mumias	63,700	60,000	130,000
Nzoia	-	-	60,000
Sony	-	-	35,000

Source: the sugar companies.

The choice of mill sites was determined by the availability of adequate cane supplies and the existing transport network. All mills have been located in areas of medium or high agricultural potential and have involved the development of extensive areas of cane production which vary in size from 9,500 to 12,500 hectares (Table 3). The scheme areas have been located in areas where sufficient cane could be grown within a limited radius around the mill to avoid excessive costs for the transport of harvested cane. Mill sites were also chosen to take advantage of the existing road network, but even so substantial investment in infrastructure has been necessary for the transfer of harvested cane. Mills are well located for the distribution of processed sugar as all have access to the national road network and Miwani, Muhoroni and Chemelil have direct access to the rail network (Fig. 1). The feasibility of linking Mumias, Nzoia and Sony mills to the rail network is also being studied.



Table 3. Agricultural schemes by mill zones, 1975\*

(hectares)

Mill Zone	Nucleus Estate	Asian Farms	Large Farms	Small-holder Schemes			Total
				Resettle ment	Co-operatives	Out-growers	
Miwani	3,642	6,070	-	-	608	-	10,320
Muhoroni	1,821	-	1,214	5,261	1,214	-	9,510
Chemelil	3,238	1,012	4,654	-	3,642	-	12,546
Mumias	3,238	-	-	-	-	6,597	9,835
** Sony	2,833	-	-	-	-	8,256	11,089
** Nzoia	3,238	-	-	-	-	7,376	10,614

Source: Field survey, 1975

\*Agricultural zones in the Nyanza sugar belt were defined in 1972

(Republic of Kenya, 1972).

\*\* Proposed

A major feature of the four sugar mills at present in operation has been the variation in their ability to meet production targets. Since opening in 1973, Mumias has exceeded planned production while the three mills of the Nyanza sugar belt have consistently operated at less than full capacity. This problem has been most marked at Miwani and Muhoroni mills (Table 2) but has also been a feature of Chemelil mill until 1976. Had this situation been overcome, Kenya would have been self-sufficient in sugar production at an earlier date. The mills themselves have not been responsible for this under-utilization of capacity although occasional problems, such as machinery breakdowns and labour disputes, have caused small losses of output. The major problem has been lack of cane since the Nyanza sugar belt has not produced sufficient cane to keep three mills operating at full capacity. Inevitably, cane supplies vary from year to year due to fluctuations in the intensity and duration of the rains and occasionally marked differences in yield occur, as in 1971 and 1972. Climatic variations alone do not, however, explain the consistent lack of cane. This is due to a variety of causes including insufficient hectares under cane and poor yields, especially in the smallholder areas. In addition, some harvested cane has either not reached the mill or has arrived in poor condition due to transport difficulties. Overall, insufficient cane supplies may be regarded as a major reason for the inability to become self-sufficient in sugar production. In addition, the capital intensive sections of these sugar schemes, namely the mills and the transport networks, have received substantial investment which has not been fully utilized.

Agricultural Schemes:

The most apparent and far reaching effects of expanding the sugar industry have been in the agricultural rather than the industrial sector. By 1975, 42,000 hectares of western Kenya were under commercial cane production, as opposed to 10,000 hectares in 1964, and a further 30,000 hectares will be established by 1985. In 1964, most commercial cane production came from estates and large farms owned by Asians and Europeans and although such farms have continued to play an important role, smallholdings have become increasingly significant in the production of cane. The result of this policy has been two-fold: cane is now grown both on a variety of scales from estates to small plots and as part of different agricultural schemes, especially in the Nyanza sugar belt where land-tenure has a complex history. The following section examines the rationale behind the development of each size unit and comments on the contrasts between different agricultural schemes.

(i) Nucleus estates:

The plans to expand cane output have recognised the advantages of estate production and a nucleus estate has been developed in each of the 6 sugar schemes (Table 3, Fig. 2). The estate is located adjacent to the mill and is the responsibility of the sugar company who integrates production, transport and processing of cane. In the initial stages of scheme development, it is the role of the nucleus estate to produce seed cane for planting on the smallholder plots. Once a scheme is in full production however, the nucleus estate is used to regulate the flow of cane to the mill since supplies from smallholders have frequently been erratic. In general, nucleus estates have lower average costs of production per ton of cane than smallholder plots and, with the exception of Mumias, higher average yields. The major disadvantage of nucleus estates is that they necessitate the alienation of land from subsistence farmers and have, therefore, been limited in extent. Where families have been made homeless (the Mumias nucleus estate resulted in 1000 landless families), the sugar company has offered wage employment in the mills or resettlement elsewhere.

(ii) Asian Farms:

The medium-sized farms in Miwani and Chemelil zones (Fig. 2) date back to the 1920's and represent the original development of commercial cane farms in western Kenya when land was alienated for Asian farmers in association with the Asian-owned mill and estate at Miwani. Since 1964, approximately 80 farms have remained in production, of which 870 supplied the Miwani mill. The average size of farm is 100 hectares and 90% of the farms are in the 20 to 150 hectares range. They have the common characteristic of growing sugar as a monoculture and give rise to a landscape similar to that of the nucleus estates.

A policy of Kenyanisation of ownership of these farms is being encouraged and although the exact numbers of transfers to Africans is unknown, the majority of non-citizen Asians and a few citizen Asians had sold their farms by 1976. The remaining Asians saw their future as uncertain and both the transfers and the insecurity have affected farming practices. Most Asian farmers have increasingly opted for quick returns and have been reluctant to make investments on the scale of the colonial period. The Asians had developed a closely-linked farming community, often through family ties, and it was common to share labour and machinery during harvesting, to make joint investments in equipment and to rely on the mechanically-skilled members of the community for vehicle repairs. African purchasers have frequently had to buy farms requiring substantial investment in land improvement and machinery if the high levels of production were to be maintained. Many had already invested all available capital in the land itself and there has been a marked shortage of working capital amongst the new owners. There has been a dearth of both farming and mechanical skills amongst the Africans and they have been unable to participate in the co-operative activities of the Asians or develop their own farming community. The overall results have been a fall in yields in one of the most productive parts of the sugar belt and under-utilized capacity at Miwani mill.

(iii) Large-scale farms

The large-scale farms in Muhoroni and Chemelil zones (Table 3, Fig. 2) are a remnant of a formerly more extensive farming type since they originated in the period when land alienation by Europeans created the White Highlands (Odingo, 1971). With the Asian farms they have been exempt from the subsequent programme to subdivide large units into African smallholdings, mainly because 50% or over of their land was under a plantation crop. Unlike the Asian farms, however, they have not always produced sugar and in the 1960's the majority produced other plantation crops such as sisal. They have expanded sugar cane production since the late 1960's partly because it has become more profitable than other crops and also because Chemelil and Muhoroni mills have provided a marketing outlet. In 1975 there were 20 farms in this group, all of which were over 100 hectares in size and 10 of which were over 500 hectares and their yields were generally equal to, or higher than, those from nucleus estates. In contrast to the Asian farms, sugar cane was not a monoculture but was combined with other crops and livestock. Several of these farms have been purchased by Kenyans but seemingly without the problems associated with the transfer of Asian farms. The remainder are still owned by Britons or limited companies but are likely to pass into Kenyan ownership in the near future.

(iv) Smallholder schemes

Smallholder schemes for the growing of sugar cane have been introduced in western Kenya partly to avoid large-scale land alienation but also to provide income opportunities in areas of high population growth. The decision to develop such schemes was also influenced by Kenya's experience in successfully producing other cash crops, notably tea, coffee and pyrethrum, on large numbers of smallholder plots. In Uganda, moreover, smallholders were already supplying cane to two large-scale mills (Smith, 1970). In view of the success of other schemes and the poverty of western Kenya, smallholders are playing an increasingly important role in the programme to expand sugar production.

Approximately 12,000 smallholdings had been established in the four mill zones of western Kenya by 1977 and there is a potential expansion to 33,000 smallholdings in the six mill zones by 1985. The smallholdings may be subdivided into three groups comprising resettlement, co-operative and outgrowers schemes (table 3). All have the major problem of co-ordinating large-scale milling of sugar with a cane growing system based on hundreds of small units. Unfortunately, the resettlement and co-operative schemes have not always been successful in overcoming their problems and consequently have never met their full potential. This has resulted in lower incomes for the farmers, lost production at the mills and under-utilized investment in industrial plant and transport networks.

Resettlement schemes (Table 3, Figure 2) have been established in Muhoroni mill zone where large farms became available for subdivision as part of government policy to transfer them to African smallholdings (Odingo, 1971). A group of European-owned farms have been divided into 3,000 smallholder plots combining subsistence crops, cane growing and livestock. Income considerations were the main factor in determining the size of smallholding. In line with all of Kenya's resettlement schemes started in 1960's each farm was to generate a cash income of between £25 and £100 per annum. The majority of resettlement farms are less than 8 hectares and the standard unit consists of 1.0 hectare for subsistence crops and 3.0 hectares for sugar-cane. The sugar plots were demarcated before resettlement occurred and, whenever possible, they were grouped to give continuous blocks of cane land.

Sugar was first planted on resettlement smallholdings in 1964 for the harvest to coincide with the opening of Muhoroni mill in 1965 and all plots had been allocated by the Resettlement Board by 1969. The full cane potential from these schemes has been difficult to realise and although considerable expansion has taken place, only the 1970 figures were near the target output. The shortfall arose partly from the underdevelopment of designated cane land. Some of the first crops to be harvested were never processed due to a delay in the opening of Muhoroni mill and difficulties in transporting cane to the mill once it was open. As a result of these initial

problems, farmers experienced financial difficulties which prevented them from developing further cane areas. Low yields have also been characteristic of the resettlement schemes. With limited financial and managerial resources at its disposal, the Resettlement Board has concentrated on expanding cane hectares and has been unable to pay sufficient attention to increase production by improving yields. The situation is further aggravated by the number of absentee farmers within the seven Muhoroni resettlement schemes. Consequently, it is unlikely that production targets will be met for some time and under-utilized capacity at Muhoroni mill will continue.

Smallholder co-operatives (Table 3, Fig. 2), which as a group from the Sugar Belt Co-operative Union, supply cane to all three mills in the Nyanza sugar belt. The majority of societies are found outside the main extent of the belt and especially in the Luo Units to the south of the railway (Fig. 2). They initially developed in the mid-1960's when many African farmers in the former reserve area saw the opportunity of earning a cash income from selling cane to Miwani mill. This inevitably resulted in a very haphazard pattern of cane growing based on small scattered plots. The government supported the development of co-operatives in these areas initially to co-ordinate the flow of smallholder cane to the mill and later actively to expand the area under cane.

In 1975 there were 11 producer and 21 marketing cooperatives in the Nyanza sugar belt. The former were the result of government attempts to ensure a sufficient cane supply to the mill at Chemelil and were developed in such locations as Kibigori and Chamase (Fig. 2) where land for smallholdings was organised into subsistence blocks and cane blocks. The Chemelil Sugar Company financed road building, land preparation and transport and contracted with the cooperatives to pay for these services out of the returns from the harvested cane. The marketing societies, on the other hand, were established to help those farmers who had developed cane land of their own accord. SBCU data on selected co-operatives illustrates that the average size of plot may be as low as 0.1 hectare. Many plots are located at some distance from three mills in areas where road transport is difficult and the initial role of the SBCU was to ensure that harvested cane reached the mill. Since 1972, the Union has been more active in

promoting the expansion of cane areas. It has also encouraged farmers to group together to form larger cane blocks, with the aim of making mechanisation and transport less costly. The SBCU has been unable to direct adequate resources towards improving the low yields which characterise the co-operative smallholdings and consequently, the full potential of these areas has rarely been realised, either for cane output or for the income levels of the smallholders. In view of the problems in the marketing co-operatives, it is not surprising that the original estimates for cane hectares in these areas (Gibb, 1965) have never been reached.

Outgrowers supply the majority of cane requirements at Mumias and will do so in the two other schemes being developed at present (Table 3). To date, the Mumias scheme has been the most successful of Kenya's new projects: in contrast to the Nyanza mills it has exceeded production targets, yields from the outgrowers' plots have at least equalled those of the nucleus estate and smallholder satisfaction with the scheme is high. It is also worthy of note that this has occurred in an area where smallholders formerly relied on subsistence farming and had little, if any, experience of cash crop production. Outgrowers' schemes have much in common with other smallholder schemes, especially the Chemelil producer co-operative, but they differ in the degree and type of organization and their success must be partly attributed to this.

Each smallholder signs a contract with the Mumias Sugar Company to release part of his land for cane cultivation and becomes a registered outgrower. His land is allocated to a planting programme devised to ensure a flow of mature cane to the mill throughout the year. MSC ploughs the land prior to planting, provides seed cane and fertilizer and this ensures the quality of the cane produced. The company also harvests and transports the mature cane to the mill. All these services are provided on credit until the cane is sold to the company. Overall, this has promoted high yields from the outgrowers' plots and credit facilities have enabled farmers to avoid incurring substantial debts before the first harvest.

By 1975, over 4000 smallholders, located within a 13km. radius of the mill, had become registered outgrowers and by 1978 this had further increased to over 6,000. The majority of farmers have between 1.2 and 2.0 hectares of cane but plots have been grouped to form blocks of at least 6.0 hectares (the minimum block size developed by MSC). The road network has been planned in association with the cane blocks, thus allowing efficiency in mechanisation of agriculture and cane transport.

to organise effectively and generally has been more costly. Individual holdings are often small and although farmers have been encouraged to co-ordinate cane plots, fields of cane tend to remain small and scattered in location. The problem is further aggravated by the low yields which typify these smallholder areas so that some areas, especially in the Luo Land Units, have not reached the production targets on which road provision was based.

As indicated, the Nyanza sugar belt road network outside the nucleus estate was provided through government investment, but initially it was assumed that private enterprise would be responsible for the vehicle fleet. Unfortunately, this policy resulted in such serious problems with the vehicle fleet that in 1975 the Kenya Sugar Authority undertook a survey of transport. The survey indicated that while the total number of vehicles in the sugar belt was only slightly inadequate for harvesting cane, there were particular times and areas where the problems became acute. There was a serious shortage of vehicles during the main harvesting months from November to January, particularly in the smallholder areas. In order to protect smallholders the government had laid down transport rates per ton for four distance zones around each mill, but smallholders were frequently charged in excess of these rates at times of vehicle shortage. In addition, smallholders in remote locations were constantly paying excessive rates. As a result of this situation, there were not infrequent cases of cane not reaching the mill, of over-ripe cane because harvesting had been postponed until transport was available and of cane with low sugar content due to delays in its transfer once harvested. One proposed solution to this problem is the centralisation of transport organisation for each mill zone or for the whole of the Nyanza sugar belt (Nyongesa D.P., 1975). Following the 1975 survey, the government accepted the need to invest in the vehicle fleet and additional vehicles have now been purchased while greater centralisation of control of vehicles is beginning to improve the situation in the smallholder areas.

The Mumias sugar scheme has avoided many of the transport problems encountered in the Nyanza sugar belt. It illustrates the benefit of a centrally planned road network, much of which has been constructed and maintained by a works unit based at the factory. In 1975, its vehicle fleet was the smallest of the four mill zones but central organisation of transport combined with a well-planned harvesting programme had allowed efficient use of the fleet. Moreover, the vehicles, which are of one make, are maintained by the Mumias sugar Company, thus avoiding the servicing difficulties encountered due to the wide variety of makes used in the Nyanza sugar belt.



### The transport system

Experience has shown that the successful operation of a large-scale sugar scheme is highly dependent upon an efficient transport system. The nucleus estates have few transport problems since they are provided with vehicle fleets and with internal networks which have been planned and constructed by the sugar companies. Outside the nucleus estates, there has been large-scale government involvement in the provision of a transport network and the major consideration has been the linking of thousands of small-scale cane producing units with a central processing plant. Since all the schemes developed since 1964 have been in areas with relatively poor infrastructure, substantial investment in the road network has occurred in every scheme. It is estimated that £3.6m has been spent on the construction of 'sugar' roads in the Nyanza sugar belt and £1.2m in the Mumias scheme. In the former area it was assumed that cane transporting vehicles would be provided by private investment but this policy led to an inadequate vehicle supply and severe bottlenecks in the flow of cane to the mills. Consequently, the Mumias scheme was provided with a centralised vehicle fleet sufficient to transfer all the outgrowers' cane and this practice will be adopted in future schemes.

The same principles underlie the development of the road network in all the schemes. One company has been responsible for planning the network and construction has been undertaken by one company so that comprehensive development has been possible. There have been two basic requirements in developing the network: firstly, to up-grade the existing classified road network to withstand heavier volumes of sugar traffic and traffic generated by general economic development; secondly to construct agricultural feeder roads to provide links between the sugar plots and the main road network. The up-grading of the classified network has had relatively little impact on accessibility. In contrast, the agricultural feeder roads have had a considerable impact since they have been concentrated into smallholder areas (table 4) which previously had no access to the main road network (Gibb, 1965, 1966, 1971, 1972). On the whole, the provision of feeder roads has been adequate but has varied in effectiveness and efficiency between the various smallholder schemes. In the Mumias outgrower areas and the Muhoroni re-settlement schemes the locations on cane blocks (groups of individual smallholder plots) were established and the road network was planned in association with the land use. The Mumias scheme had the added advantage of a sugar-company operated works unit for road construction which has allowed flexibility in net feeder road construction and facilitated adequate road maintenance. The construction of feeder roads in the co-operative areas of the Nyanza sugar belt has been much more difficult

Table 4. Agricultural feeder roads constructed in each mill zone (kms)

Type of farm	MILL			ZONES			CHELIL			MUMIAS		
	Distribu- tion	Access	Total	Distribu- tion	Access	Total	Distribu- tion	Access	Total	Distribu- tion	Access	Total
Large-scale farms	-	-	-	-	-	-	20.8	-	20.8	-	-	-
Smallholders:- resettlement	-	-	-	119.2	132.8	252.0	-	-	-	-	-	-
co-operatives	31.2	48.0	79.2	12.0	58.4	70.4	64.0	123.2	187.2	-	-	-
outgrowers	-	-	-	-	-	-	-	-	-	88.0	240.0	328.0
Total	31.2	48.0	79.2	131.2	191.2	322.4	84.8	123.2	208.0	88.0	240.0	328.0

\* distribution roads have a gravel surface, carry two way traffic and are open at least 10 months in the year: they link access tracks with the main road network.

\*\* access tracks are of much lower standard since they are often only operational during ploughing and harvesting: they link the sugar fields with the distribution roads.

Conclusion:

The rapid expansion of six large-scale sugar schemes emphasising smallholder production of cane has inevitably necessitated government participation. The Kenya government has been responsible for the financing of the schemes either through the sugar companies, in which the government has at least a 70% share, or through such aspects as road building. Various government departments, including the Ministries of Agriculture, Works, Lands and Settlement, have been involved in the expansion of the Nyanza sugar belt but the Mumias scheme has adopted a more centralised organisation in which the sugar company has overall responsibility. This has come to be regarded as more appropriate for a large-scale agro-industrial project especially because it has proved successful in integrating the cane production of thousands of smallholders with a large central processing plant. Close integration of cane growing, transport and industrial processing by one company will also be a feature of the Nzoia and Sony schemes and is being introduced in all three schemes in the Nyanza sugar belt.

While increased sugar output is the overall aim of these schemes, this is not the only measure by which they may be evaluated. When fully operational, the six schemes will make a significant contribution to income and employment opportunities in western Kenya since there is a potential of 10,000 employed directly by the sugar companies, 33,000 smallholders producing cane and additional employment from the multiplier effects. It is also worthy of note that three of the schemes, Mumias, Nzoia and Sony, have been located in areas which were highly dependent on subsistence agriculture. Although the emphasis on smallholder production in these schemes has allowed the retention of subsistence agriculture, substantial changes in land holding and land use have also been inevitable. In the Nyanza sugar belt, with its longer history of cash crop production, this impact has been less marked but certain areas, such as the settlement schemes, have seen substantial reorganisation, while many farmers in the Luo Land Units have been given the opportunity to develop commercial production of cane. All the schemes have been characterised by large-scale investment in the transport network which, although specifically related to the requirements of cane transport, has considerably improved accessibility within the scheme areas.

The agro-industrial schemes have met the aims of increasing sugar production and providing rural employment but in other respects the nature of their development may be questioned. The trend has been towards a system whereby cane growing on smallholder plots and the transport network are organised by the sugar company. This system is best developed at Mumias although it is now being adopted in the Nyanza sugar belt. It may be argued that in the long

term this does not give the smallholder sufficient responsibility or develop his agricultural knowledge. Moreover, it is also questionable as to whether such large areas should become dependent on one crop, even to the extent of cane transport requirements determining the evolution of the transport network. While areas in the smallholder schemes are set aside for subsistence crops, with the exception of the Nzoia scheme, very little attempt has been made to actively encourage the development of crops other than sugar. There is indication that the success of the Mumias scheme will create a situation whereby the demand to grow sugar will exceed the capacity of the mill. Undoubtedly, the role of the sugar company is to balance cane production with industrial capacity but greater consideration in the design of schemes could be given to alternative crops.

The sugar schemes have reduced Kenya's dependence on imported sugar and may make the country self-sufficient by 1981. Thereafter, it is likely that sugar consumption will continue to rise and further developments will be necessary. Initially increased demand will be met by new output from the Nzoia and Sony schemes and both projects have the potential for further expansion if required. A more immediate priority is, however, to use more fully the investment already made in the sugar schemes, especially in the Nyanza sugar belt.

NOTES

1. Sugar manufactured in Kenya is of mill-white as opposed to refined quality. Jaggery sugar is also produced, usually on a small-scale and for local consumption and such production is outside the scope of this study.
2. The retail price of sugar, which is controlled by the Government, had shown only small increases between 1964 and 1974. In 1975 the price was increased from 2/40 shillings per kilo to 3/50 shillings and to 4/50 shillings in 1976, an increase over the two years of 87.5%.

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