

Food and Nutrition Studies Programme

Large-Scale Irrigation Development in Kenya

Past Performance and Future Prospects

George M. Ruigu

Report No. 23/1988

**Food and Nutrition Planning Unit,
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FOOD AND NUTRITION STUDIES PROGRAMME

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Contents

List of Tables	04
Summary	05
1. Introduction	07
2. Irrigation Land Area	10
3. The NIB Schemes	10
4. Land Tenure	11
5. Irrigation Areas Rules	11
6. Cultivation on the Schemes	13
7. Tenant Holdings and Responsibilities	14
8. Livestock	14
9. Crop Production	15
10. Scheme Costs and Cost Recovery	16
11. Agricultural Marketing and Pricing of Products	20
12. Irrigation Research	21
13. Nutrition and Quality of Life on the Schemes	24
14. Other Issues	25
References	27
Notes	29

List of Tables

Table 1. Kenya: Land Potential and Use, Mid-1970s	07
Table 2. Kenya: Estimated Per Capita Availability of Arable Land By Province 1969, 1979, 1989	08
Table 3. Irrigated Area by Type of Scheme and Crops, 1985	09
Table 4. NIB Irrigation Schemes by Cropped Area and Crops, 1985	10
Table 5. Breakdown of Costs for Bura West Irrigation Scheme	17
Table 6. Operational Costs of Public Irrigation Schemes, 1984	18
Table 7. Income, Expenditure and Costs Recovery, Public Irrigation Schemes 1982/83	19

Summary

This paper examines some policy issues relating to large-scale public irrigation schemes ¹. It starts with considering the need for intensified agricultural production given a declining land base and a rapidly growing population. Irrigation development can assist in land use intensification.

The management system of the irrigation schemes is effected by the National Irrigation Board and the Bura Scheme management under the Trust Land Act (Irrigation Areas Rules, Cap 288 of the Laws of Kenya). The tenants operate on the basis of one year occupational license which is renewed subject to satisfactory performance. Security of tenure is a major concern of tenants who feel deprived relative to farmers in rainfed Settlement Schemes. The latter get freehold titles for their land as a matter of policy.

The costs of operation and recovery of investment and operational costs were discussed. Except for Mwea the costs were shown to be high. Recovery of operational costs ranged from zero in Bura to 100% for Mwea and Bunyala Schemes. In the case of Mwea some rents are charged and used to cover unmet deficits in other Schemes and the headquarters costs of the NIB. The NIB is a very centralized board and the issue of decentralization to individual scheme management was raised. The financing system of irrigation development was also considered.

Irrigation research was the primary responsibility of the National Irrigation Board but some work is also done by the irrigation and drainage research section at the National Agricultural Laboratories at Kabete. The current research was examined and the possibilities of the new KARI taking greater role in irrigation research was raised.

Other relevant matters concern nutrition levels and the need to improve the quality of life on the schemes. The issues of water rights and an irrigation development co-ordinating body were mentioned. It was argued that successful co-ordination is unlikely to occur in a policy vacuum, and Kenya does not currently have a national irrigation policy.

1. Introduction

Agriculture plays a dominant role in the Kenyan economy. Kenya is however short of agricultural land. Based on rainfall patterns 9.3% of Kenya's land is classified as high potential (zone 2) and a further 9.3% as medium potential (zone 3). Out of total land area of 5.7 million hectares, however, only about 7% can be described as good agricultural land in the sense of having adequate and reliable rainfall, good soils and not being steeply sloping. Another 4 to 5% of the land is otherwise suitable for crops but is subject to periodic drought. About 3.3% of the land is currently forested; mostly in the high and medium potential zones. The productive activity on much of the remaining land is restricted to livestock grazing with varying degrees of intensity, tourism and wildlife preservation.

Table 1. Kenya: Land Potential and Use, Mid-1970s

		A. LAND POTENTIAL ¹		B. LAND USE ²		
	Zone	Area (m.ha)	Share %	Share %	Area (m.ha)	Description
I	Afro-alpine	0.1	0.1	6.2	3.5	Recorded Small Farms
				4.7	2.7	Recorded Large Farms
II	High-Potential	5.3	9.3	1.8	1.0	"Gap" Farms
III	Med. Potential	5.3	9.3	3.3	1.9	Forest Land
IV	Semi-Arid	5.3	9.3	80.8	46.0	Rangeland and Other
V	Arid	30.0	52.7			Unsuited to Agr.
VI	Very Arid	11.2	19.7	3.3	1.9	Other Use
Total		56.9	100.0	100.0	56.9	Total

1. Source: Tidrick, 1983

2. Source: Hazlewood, 1979

The availability of high and medium potential land is presented in Table 2 which is based on historic trends in population and internal migration patterns. In the three most densely populated provinces (Central, Western and Nyanza) high and medium potential land per capita will fall by approximately one-half between 1969 and 1989 to approximately *one-quarter hectare per capita*. By the end of this decade, Kenya's less densely populated provinces (Eastern, Rift and Coast) will have little more such land per capita than Kenya's most populated areas had at the beginning of the 1970's i.e., just over half a hectare per person. On a national basis, availability of high and medium potential land will have fallen by more than half between 1969 and 1989 to approximately 0.3 to 0.4 hectares per person (Henin, 1981)

Table 2 Kenya: Estimated Per Capita Availability of Arable Land by Province, 1969, 1979, 1989.

	ARABLE LAND (1000ha)	POPULATION (1000's)			ARABLE LAND HA PER CAPITA		
		1969	1979	1989	1969	1979	1989
Central	924	1,676	2,476	3,882	.55	.37	.24
Western	741	1,328	1,896	3,015	.56	.39	.25
Nyanza	1,252	2,122	2,863	4,335	.59	.44	.29
Eastern	2,692	1,907	2,756	4,261	1.41	.98	.63
Rift Valley	3,148	2,210	3,415	5,289	1.42	.92	.60
Coast	1,148	944	1,342	1,936	1.22	.86	.59
North Eastern	--	246	323	502	--	--	--
Nairobi	--	509	863	1,286	--	--	--
Kenya	9,905	10,942	15,942	24,506	.91	.62	.40

Source: Henin, 1981.

Kenya's population of 19.6 million is expanding at the rate of 4.0% per annum. Gross National Product per capita which was US\$ 310 in mid-1984 was estimated to have been increasing at 2.1% over the 1965-84 period (IBRD, 1986). Agriculture generates nearly one third of the GDP, provides employment for 75% of the labour force and accounts for over 60% of the export earnings. Agriculture grew at 3.5% per annum over the 1973-84 period.

To accelerate agricultural development major efforts have been made since independence in 1963. These have involved the introduction of cash crops, new technologies, the supply of agricultural inputs and the provision of incentives for farmers. Some success has been achieved. For instance, a major gain has been made in the staple food crop (i.e. hybrid maize), and coffee and tea.

The Government is committed to the goal of achieving broad self-sufficiency in food (Kenya, 1981). To realize this goal given a declining land per capita will necessitate the continued emphasis on land use intensification, agricultural research and the provision of incentives for farmers to encourage the use of modern farming practises, and an adequate input supply system for improved seeds, fertilizers and pesticides. Concomitantly more agricultural credit should be provided for the purchase of inputs.

Various sources have estimated that Kenya's crop land could be expanded by as much as 400,000ha through forest clearance, 540,000ha through irrigation and by 1 million ha by valley bottom drainage (Ruthenberg,1978; Tidrick,1983; IBRD,1984). Each of these methods have their own drawbacks. This paper however deals mainly with irrigation

related issues. Irrigation could play an important role in increasing Kenya's agricultural production, and in the intensification of land use (which will be the key to Kenya's agricultural development). In addition, irrigation could play an important role in increasing the supply of agricultural land, and in absorbing some of the burgeoning population.

The combined effect of the recent drought and Kenya's high population growth rate should rekindle interest in irrigation as a means of increasing the supply of agricultural land, achieving greater productivity per unit land and stabilizing agricultural production in situations of adverse climatic conditions. Irrigation agriculture is the most productive form of agriculture despite its high costs. The Sessional Paper No.1 of 1986 however gives limited role to irrigation. The Government of Kenya appears not to be putting a major emphasis on irrigation. It is however committed to the rehabilitation of existing projects and on completion of on-going ones like the Bura Irrigation Settlement Project.

Table 3: Irrigated Area by Type of Scheme and Crops, 1985

TYPE IRRIGATION DEVELOPMENT	PRINCIPAL CROPS	AREA (ha)
Large commercial	Coffee, pineapple & miscellaneous horticulture	23,400 ¹
National Irr. Board	Rice, cotton & horticulture	8,950
Bura	Cotton, maize	2,500 ²
Modern small-holder (IDB or NGO Promoted)	Rice, maize & horticulture	2,500
Regional Authorities and other Public Agencies	Maize, rice & horticulture	1,200
Modern small-holder (Private)	Horticulture	500
Traditional smallholder	Maize, sorghum, millet, legumes	800
TOTAL		39,850

1) Source: Roe & Whitaker (1985) for coffee figures; for other crops (Kenya, 1985b)

2) About 3,900 ha. are ready but water is a constraint to allow farming operations on all available hectareage.

2. Irrigated Land Area

The total area under irrigation in Kenya was estimated to be 39,850ha in 1985 (Table 3). This includes large-scale commercial farms, the NIB schemes and various small-scale schemes. A comprehensive treatment of the schemes is given by Migot-Adholla and Ruigu (1986) and by Arao (1986).

Clearly, only a small proportion of the arable land is irrigated. The remaining areas rely on unpredictable rainfall, except for the 7% of total land which has reliable rainfall. The level of investment in irrigation over the last 20 years has been relatively small. The only exception is the Bura Irrigation Settlement Project. Less than 7% of the estimated irrigation potential of 540,000ha is currently under irrigation. We now turn to look at the large-scale (NIB) schemes.

3. The NIB Schemes

Several of the NIB Schemes were developed using Mau Mau detainee labour i .e. Mwea, Perkerra and Hola. Subsequently Mwea has been expanded substantially: The major objectives of setting them up originally was to settle the landless and the unemployed. During the early period the schemes were directly managed by the MOA through the provincial Agricultural Boards.²

The National Irrigation Board was established by an Act of Parliament in 1966 to supersede management of the schemes by the Ministry of Agriculture (Kenya,1966). It is responsible for the planning, implementation and management of all public large-scale schemes except Bura, which in 1985 reverted to the Ministry of Agriculture. Table 4 shows the NIB operated schemes.

Table 4 NIB Irrigation Schemes by Cropped Area and Crops, 1985

SCHEME	AREA (ha)	MAIN CROPS
Mwea	6,299	Rice
Ahero	840	Rice
Bunyala	212	Rice
West Kano	895	Rice
Hola	870	Cotton
Perkerra	200	Chillies/Onions
Total	9,316	

Only one of the large-scale irrigation projects i.e. Mwea, pays its way or makes a profit³. The others survive on subventions from the Treasury. An important issue is how long will the subventions persist? Could the schemes be expected to break even or even make profits? These are important questions given the recent creation of 3 regional development authorities (with some interest in irrigation). The limited resources may be spread too thin.

4. Land Tenure

As stated earlier, one of the major reasons for creating the large-scale irrigation schemes was to provide settlement opportunities for the unemployed and the landless. Unlike settlement under rainfed land, tenants on public irrigated schemes do not have titles to the land. Rather, they operate on the basis of an annual temporary occupational licence.

It has been argued that some degree of control and discipline is required in an organized community such as Mwea, Ahero and Bura where the well-being of the tenants and of the schemes are dependent on the performance of a technically determined cycle of activities. In all the NIB Schemes the production efficiency and, concomitantly, the returns which the tenants receive largely depend upon the timely performance of operations according to the schedules determined by the scheme management (Veen, 1973). Others have argued that the higher irrigation costs dictate project rather than a people's orientation. The issue of tenant participation is a controversial one and is discussed by Alila, 1986.

5. Irrigation Areas Rules

The legal basis for the management of the large-scale irrigation schemes in Kenya is provided by the Trust Lands Irrigation Areas Rules (Kenya, 1962). The rules are very comprehensive and clearly stipulate the rights and obligations of both the management and the tenants. The rules have been viewed by some as providing for an extremely authoritarian system which gives the managers nearly total control over the labour power of the tenants and their families and the right to enforce discipline, impose fines, confiscate property and cause their imprisonment. The rules however, also provided safeguards against arbitrary action by the management. The system of rules is also adopted to give the management better control of cropping which may not be obtained easily were the tenure on irrigation schemes freehold.

The tenants in Bura and NIB schemes are strictly speaking 'licensees', who do not own the land which they cultivate but who operate it under a license which is automatically renewable from year to year subject to satisfactory performance. They are also transferable to nominated heirs. On arrival at the scheme each tenant is made familiar with the irrigation rules and signs an acknowledgement to certify his understanding and as an undertaking to abide with them. "The rules provide for specific legislation for crop and water discipline, absenteeism and disposal for crop, and empower the settlement management to take disciplinary action against those tenants who fail to adhere to instructions" (Veen, 1973: 125). Various disciplinary options are available depending on the severity of the problem. They range from verbal warnings, to written warnings, to prosecutions in courts of law, and to termination of tenancy and eviction. Three written warnings are given with eviction taking place on the third warning. The written warnings are usually initiated by irrigation officers. Discipline has not been a major problem in the schemes. In Bura for instance, only 18 tenants have been issued with the first warning letters by 1984. There has however, been a high defection rate for various reasons.

The insecurity of tenure is a major cause of concern among all tenants, most of whom were landless before being settled and who would prefer a freehold tenure backed by a title deed. A freehold tenure is claimed to be likely to make it difficult to operate the schemes on the current basis and would also entail the freedom to transfer through sale or otherwise, subdivision among heirs, etc. The settlers however see it as a desirable goal. The security of tenure is regarded as important, irrespective of levels of incomes obtained in the scheme. Tenants prefer to invest elsewhere where security of tenure is available (Migot-Adholla, 1982). It therefore seems desirable that irrigation policy be reviewed for all the public schemes to meet this need of the tenants. The tenants feel relatively deprived when compared to settlers on rainfed schemes where titles are given as a specific policy objective⁴.

Examples from India and Sri Lanka suggest that it is possible to have successful irrigation farming under free-hold tenure systems (WAMANA, 1985). Farmers are given land titles, a pre-determined amount of water and left free to grow their crops. Paddy is usually the main crop but it is not the only crop.⁵ It is possible to conceive a Mwea Irrigation Scheme with tenants owning land titles and continuing to grow paddy, provided that the necessary incentives are maintained. Ogendo (1986) argues that we should explore alternatives of tenure with tenancy being at the bottom of ladder and free-hold titles at the top. Tenants could then climb the ladder through a system of tenure building with security of tenure as a

goal. Longer leases could be considered. Alternatively the tenants could eventually purchase the security of tenure by buying up the state rights. This has been reported to have occurred in Zimbabwe (Sibanda, 1986).

Another reason for re-examining the issue of titles stems from decreasing availability of trust lands. Consequently future development of irrigation will entail irrigation development on privately owned (freehold) plots. This is of special concern at Mwea Scheme, where further expansion is actively being evaluated.

6. Cultivation on the Schemes

As stated earlier the NIB Scheme Management has its duties and obligations. It provides various services to the farmers at a cost. These include land preparation, water supply, fertilizers, pesticides and marketing services.

Land preparation on the schemes is done mechanically with the exception of levelling, weeding and harvesting. Ideally land preparation for the cotton in Bura, for instance, starts in December and continues up to the planting season which begins in February but should not be beyond April 15, the latest planting date. The land preparation operations include ploughing, harrowing and ridging. Land preparation by the scheme management ensures a good seed bed and also strives to ensure that the cropping schedule is accurately timed and maintained. A strict schedule is also followed in all other schemes. Unfortunately, the Bura management has inadequate machinery and equipment and it has had to tender the job to a private firm.⁶ In the long run, however, the scheme management will provide all the services just like in the NIB schemes. The other schemes also operate on the basis of a fixed seasonal schedule which is determined by the management. Farmers adhere to rigid time-table of water use, field preparation and other production arrangements.

The NIB tractor fleet has also been faced with a few problems such as breakdowns and timeliness of fuel supply. Given financial problems the NIB has not been able to replace its tractor fleet as regularly as in the past. This implies higher maintenance costs while breakdowns prolong cultivation time. The centralization of NIB activities with in-adequate provision of operating funds for the local scheme management militates against fast solutions to minor problems and causes unnecessary inefficiencies. There is a strong case for decentralization to give scheme managers more flexibility.⁷

7. Tenant Holdings and Responsibilities

Each tenant in NIB schemes is given 1.6ha (4 acres) in 4 plots of 0.4ha (1 acre each). In Bura the size of the holding is smaller i.e. the tenant is given 1.25ha (about 3 acres) in two plots of 0.625ha each. These holdings have important implications for the potential income for the tenants. They could be bigger in size but this would, in turn, imply fewer tenants.

The tenants in all the schemes agree to farm the plots subject to the Irrigation Areas Rules. For example, they agree to devote full time to the cultivation of, and improvement of, the holding without being absent for more than one month without prior approval in writing by the manager.

The tenant farmers are obliged to plant, irrigate, weed and harvest the crop. Each tenant is expected to clear and maintain, to the satisfaction of the scheme manager, all irrigation channels and works on/or serving his holding. He is also to observe all instructions concerning crop rotations and husbandry as stipulated by the manager (Rule 8). It is the responsibility of the Board to pump the water and to maintain the main canals.

The farmers are prohibited from hiring any stock or machinery other than the scheme's without written approval. In any case since the NIB provides the machinery and arranges land preparation the farmers have only a modest need for capital equipment. These include jembes, pangas, spades, axes, spray pumps, wheelbarrows, and ox-carts which are needed for operations on the holding. The NIB provides some of the farm tools on credit but the farmers are also free to bring their own. The standard issue of tools in Bura comprises four dutch hoes, three pangas, two jembes and one shovel.

8. Livestock

The keeping of livestock or grazing of stock without a license in a gazetted irrigation area is prohibited under Irrigation Rules. The tenant should not keep any livestock other than those specified in his license. This has implications for nutrition and since zero grazing has proved successful elsewhere, it should be reviewed.

In Bura however, this rule has not been strictly adhered to partly because settlement is still continuing and a time of 'settling down' is required and also perhaps because the problems of the pastoralists in the surrounding areas are not yet adequately addressed. A number of

tenants reported ownership of cattle (13.6%), sheep (33.6%) and goats (45.0%) some of which were to be seen in the tenant villages. Not all the livestock of the tenants were to be found on the schemes. Rather, many tenants left their animals to be cared for by the Ormas in the neighbouring manyatta encampments. (The Ormas in turn drive their animals to graze on maize stover after harvest). In addition, poultry was kept by 42.9% of the Bura tenants. There was a mean of three chickens per household. The contribution of poultry to improved nutrition by supplying eggs and poultry meat could be greatly expanded (Ruigu et al.,1984).

9. Crop Production

The public schemes grow different crops which are determined by the management under flood irrigation. Mwea, Ahero, Bunyala and West Kano produce paddy. The latter three produce rice based on organization control and methods which have been developed at Mwea. Ahero, Bunyala, West Kano are pumping schemes while Mwea and Perkerra are gravity fed schemes.

Despite a single main crop per year which is grown in Mwea yields are high and equal to those obtained in large-scale farms of Japan and the U.S.A. The scheme also produces the high quality Basmati variety which trades at nearly twice the price of good quality Thai long-grain grades. Basmati rice has a characteristic aroma and is preferred by Kenyan consumers. Paddy yields in Ahero, and west Kano are much lower than in Mwea but in the Bunyala Scheme they match those of Mwea.

Cotton is the major crop in Bura, just as it is in the Hola Scheme. The main season of the crop is February to September. As we saw earlier each tenant is given two plots of a combined area of 1.25ha. The first plot of 0.625ha is put under early cotton while the second plot is put under late cotton. The interval between the establishment of the two crops ideally should be three weeks to one month. There are problems of low yields in the late planted cotton. The early cotton plot is required for the growing of maize in the off-season period of September-January while the second plot is fallowed and constitutes the early cotton plot the following year. The cropping pattern has the primary objectives of maximizing cotton production and producing basic food requirements of the tenant population.

All the inputs which go into crop production except weeding, irrigating and picking labour are provided at a cost by the scheme management. In Bura for instance, the charges for land, water and mechanical cultivation for the two plots are consolidated and set at KSh 3,000 per annum. Land, water and mechanical charges are postponed for any tenant not farming 1.25ha of cotton and 0.625ha of maize, otherwise tenants would not realize any income. The charges for pest control were KSh 2,372/50 in 1984 for the two cotton plots. The crop protection practises evolved successfully from the Hola experience and involves aerial application of insecticides. The fertilizers are supplied at cost plus handling charges. All the costs of the farm inputs which are provided by the project management are to be recouped from the crop sales of the tenants.

10. Scheme Costs and Cost Recovery

The costs of an irrigation scheme are a function of the size of the project, the technology applied, ecological setting, the crops produced and marketing and pricing policy. A gravity scheme is likely to be cheaper than a pumping scheme. Except for Mwea and Perkerra all the other large-scale schemes are pumping schemes. Drainage is by gravity except for West Kano where pumping is necessary to get rid of excess water. In Mwea water is conveyed by gravitation and distributed through canals to flood the farms. The black cotton soils have high retention rates and little infiltration. High efficiency rates are achieved (i.e. 85%). The water flow is reliable since the rivers feed the head works with sufficient quantities all the year round. (Manig, 1973). This contrasts sharply with Bura where water has to be pumped and conveyed over 40km canal to reach the scheme. Just like in the other NIB projects poor distribution sometimes occurs due to several factors including pump breakdown (as occurred in Bura in 1986), shortage of diesel, insufficient water from source and excessive loss during conveyance. The Perkerra Scheme, for instance, experiences an irregular flow and shortage during the peak season.⁸

The planning, design and construction also has important implications for the final scheme costs. Mwea was constructed in four phases, with each phase being funded separately. As Gitonga (1985) argues this approach is to be preferred since it provides ample time for investigative planning, design, construction and training of personnel. Appropriate cost savings could be achieved through construction in successive stages. The experience gained can be replicated in later phases and machinery and equipment which are acquired in the earlier phases could be utilized more effectively.⁹

There is a great contrast between costs of developing Mwea and Bura. The cost of developing one hectare in Mwea is KSh 70,000 (US\$ 4,375) including - 40% of the cost of construction and 60% for the cost of basic infrastructure (Ireru, 1986). This compares with over US\$ 25,400 per hectare for irrigation works alone in Bura and about US\$ 33,000 per family settled. (Table 5)

The Bura Irrigation Settlement Project which is located on the West Bank of Tana River Project has been plagued by many problems. It is located in an arid area where mean annual rainfall averages 400mm. In the initial planning the scheme was estimated to cost KSh 766 million (US\$ 98.4 million) equivalent to KSh 148,700 (US\$ 18,000) per family settled (IBRD,1977). There were many delays from the onset of implementation in practically all administrative areas. There were major revisions on scheme design too. Thus the costs of the project, which were calculated in 1977 bear no relationship with current costs (and the scheme is still incomplete). The cost over runs were to be met by the Kenya Government which revised downwards the original 6,750ha to 3,900ha. Unfortunately, the areas which are excluded are the ones with the better soils (Gitonga, 1985).

Table 5: Breakdown of Costs for Bura West Irrigation Scheme

	ESTIMATED COST (Million US\$)	PERCENT
Irrigation Works	42.5	25.0
Roads/Airfields	7.4	4.3
Infrastructure	59.7	35.1
Public Health	1.4	0.8
Afforestation	1.7	1.0
Vehicle/Equipment	6.9	4.1
Cotton Ginnery	10.0	5.9
Consultants	14.2	8.3
Agricultural Management	4.0	2.4
NIB Operation	12.9	7.6
Farm Inputs	8.4	4.9
Training	1.1	0.6
Total Investment per Hectare		US \$ 25,400
Total Investment per Settler Family		US \$ 33,000

Source: Toksoz, 1981: 15

The costs of operating schemes in Kenya have also been shown to be relatively high when compared to experiences in other countries (Table 5). World Bank pumping schemes and gravitational projects cost US\$ 145 and US\$ 31 respectively, compared to over US\$ 1,500 in Bura and Perkerra schemes (IBRD,1981). Mwea is the cheapest scheme and all the other schemes are not financially viable. Bura is perhaps one of the most capital intensive

schemes in the world. Some of the smaller schemes are so expensive that the value of inputs provided by the Board exceed the value of the crops produced (i.e. Perkerra, Hola, Ahero and West Kano). The value added is negative and the contribution to the GDP is dubious. The NIB does not fully recover the costs of operating these schemes (Table 6). Rather, the 2140 tenants on the schemes are subsidized by over K£ 900,000 annually. Some of these schemes have remained in the 'pilot' phase almost perpetually. There is an important issue concerning possible ways of reducing costs if the schemes are to be maintained.

As stated above the operations of the schemes are financed through charges to farmers for water, land preparation, seeds, fertilizers and other inputs; and from government subsidies. For Mwea, the service charges which are recovered per hectare cover more than

Table 6: Operational Costs of Public Irrigation Schemes, 1984

SCHEME	TOTAL EXPENDITURE ¹ (US\$)	TOTAL AREA (ha.)	COST /HA (US\$)
Mwea (gravitation)	1,140,875	5,784	197
Perkerra (gravitation)	287,823	183	1,573
Tana (Hola) (water pumping)	491,031	782	628
Ahero (id)	465,988	1,103	422
West Kano (id)	535,481	1,095	489
Bunyala (id)	83,652	213	393
Bura (id)	1,226,952	782	1,569

1) US \$ = KSh 16.00

Source: Ireri, 1986: Table 2

the direct costs. They include an element of rent. The recovery of investment costs in the schemes has been a complicated issue for the NIB. Ideally, user charges should be established to recoup all the costs of investment, maintenance and operation of the schemes with the proviso that investment costs would be spread over the life of the project. The tenant farmers however, are likely to be disadvantaged if full recovery of costs would be applied for several reasons. First, on the rainfed areas farmers are not charged for services like extension, roads, health, water etc. Second, incomes in the schemes are modest and farmers have accumulated substantial debts. In Bura, a relatively new scheme 26.3% of the tenants in 1984 owed the NIB some money (about KSh 1,000 each), in Mwea some farmers owed as much as KSh 5,000 each while in Hola some farmers had debts exceeding KSh 10,000 (Ruigu et al., 1984). In addition, the farmers have resisted some charges, particularly water charges. Farmers find it difficult to accept that water is conveyed at a cost. For this reason the NIB has lumped all the costs under one category - service charge.

For Mwea as stated earlier some rents are recouped with service charge involving some cess.

In the Mwea scheme the NIB makes substantial surpluses and uses these to subsidize other schemes. This sometimes involves insufficient funds allocation for the Mwea Scheme operations and could lead to reduced surpluses in future. In 1982/83 for instance, there were inadequate finances for the maintenance of the plant, tractors and vehicles. Although farmers in all the NIB Schemes on average enjoy higher incomes than those in neighbouring rainfed areas, there are important issues pertaining to the charges and whether the schemes should or should not run independently.

Table 7: Income, Expenditure and Cost Recovery, Public Irrigation Schemes, 1982/83

SCHEME	INCOME (US\$)	EXPEN- DITURE (US\$)	SURPLUS ¹ /DEFICIT (US\$)	GOVER. GRANT (US\$)	% OF O&M ² RECOVERED (%)
Mwea	1,885,161	1,140,875	744,286	Nil	100+
Perkerra	91,295	287,823	(196,528)	54,360	32
Tana (Hola)	93,078	491,031	(397,953)	128,199	19
Ahero	316,343	465,988	(149,645)	173,650	68
West Kano	286,681	535,481	(248,800)	178,784	54
Bunyala	115,970	83,652	32,318	42,582	100
Bura	(104,465)	1,226,952	1,331,417	1,331,417	0
Average (Excl. Bura)					62%

1) Figures in brackets indicate deficits

2) Recovery rates for IBRD(1981) financed schemes ranged from 20 - 62%

Source: Ileri, 1986 + NIB Annual Reports

In addition to individual scheme costs there are the NIB head office costs, which are partly financed by subsidies from the Treasury and partly through surpluses generated from Mwea. In 1984/85 this amounted to K£ 1.3 million. There has been little involvement of the Agricultural Finance Corporation, the specialized agricultural credit agency, in financing irrigation farming. Ideally some irrigation development funds should be voted each year in the normal government budget.

11. Agricultural Marketing and Pricing of Products

As we have alluded above, the legal basis for the management of large-scale schemes is provided by the Trust Land Irrigation Areas Rules. In addition to specifying the rights and obligations of the tenants and management, the rules also provides for the disposal of the crops which are grown in the scheme i.e. paddy in Mwea, Ahero, Bunyala and West Kano; cotton in Bura and Hola, onions and chillies in Perkerra. The type of crops which are grown in each scheme have important implications for the level of incomes for the tenants and for the scheme operations.

The marketing system, just like in the case of rainfed products, is largely controlled and takes place through a single channel. Thus rice is sold to the National Cereals and Produce Board (NCPB) and cotton to the Cotton Lint and Seed Marketing Board (CLSMB). All payments are made through the NIB in order to enable the NIB to recoup the costs for water, land preparation and other inputs as described above. The marketing of chillies is done by the NIB through private agents and sometimes this poses some difficulties and low prices. Onions are marketed through the Horticultural Crops Development Authority (HCDA) and this tends to be a costly undertaking.

The milling of rice in Mwea is done by the Mwea Rice Mills Ltd (which is owned 60% by the NIB and 40% by the tenants through the Mwea Amalgamated Cooperative Society). In western Kenya milling is done by the United Millers. The NCPB purchases milled rice and distributes it through agents appointed by district distribution committees.

The producer prices for rice and cotton are determined during the Annual Review of agricultural prices while the consumer prices are gazetted under the Price Control Act. Ostensibly, the price determinations are supposed to protect producers as well as consumers. The producers are supposed to receive incentives to spur increased production. An active black market for rice, particularly basmati, exists. For instance, the controlled price of a bale (containing twelve bags of 2 kg rice) which retails at slightly above KSh 200 at the NCPB depot fetches between KSh 400 and 480 in the black market and it is usually impossible to obtain in shops. This high price is due to excess demand. Neither the producer nor the consumer benefits. The middlemen/black marketeers make much more than the producer while the treasury has to continue subventions to the NIB. The price control should take a more flexible approach based on import parity and costs of production. It would be preferable to subsidize either consumers or producers not middlemen.

Just like in the case of rice, the level of cotton prices which the farmer receives for his production from the Cotton Lint and Seed Marketing Board is a major determinant of tenant income. It is therefore important that the farmer receives the highest price possible for his product i.e. CLSMB prices for raw cotton should be set at such levels which are adequate to maintain incentives for farmers to continue growing cotton. The farmers could be paid a net realization price (assuming CLSMB costs are reasonable) based on the prices realized at the auctions. Long delays between actual delivery of cotton and pay out should be avoided.

The CLSMB should introduce a system of premiums taking into account the higher grades of cotton produced under irrigation in Bura and Hola.¹⁰ The price of irrigated cotton was reported to be 20% more than the market price (Kenya,1985a).

Currently the pricing system recognizes only two grades of cotton (i.e. AR and BR). Either the CLSMB can introduce a premium payment for irrigated cotton which would be in conformity with the current payment procedures or the Board can introduce a finer classification system with several more grades for the cotton crop. New grades would be established which could permit irrigated cotton farmers to be paid the full amount which their cotton is worth. This last alternative may be more time consuming than introducing premium payment as it may require the amendment of the Agriculture Act (Cap 318 of the Laws of Kenya). The pricing system for cotton also does not take into account the possibility of higher ginning out-turn for some cotton varieties. This can be considered to be a constraint for the adoption of other promising cotton varieties.

The necessary consultation between NIB, CLSMB and Development Planning Division should be accelerated in order to resolve the pricing issues and to reward the irrigated rice cotton growers.

12. Irrigation Research

Research pertaining to irrigation farming is mainly carried out by the National Irrigation Board. The Research Unit of the NIB does research on various crops grown under irrigation i.e. paddy, cotton, and horticultural products.

Irrigated cotton research has been carried out at Hola since 1963. The work has involved variety trials, fertilizer response and other agronomic work such as evaluation of plant

population and date of planting effects; pest control, weed control and the use of herbicides. Similar trials have been established at Bura.

From experiments which were executed between 1966 and 1970 it has been established that the best time for cotton planting is between February 15 and March 15 (NIB,1983), hence the importance of timely land preparation. The recommended intra-row spacing for cotton has been shown to be 40cm between the plants with two plants per hole. The distance between rows is usually fixed during the ridging operation and is 90cm. This gives a plant density of about 55,000 per ha. The average yield is sensitive to the plant population and the closer it is to the optimum, the higher the output.

With respect to fertilizers, cotton has been shown to respond positively to nitrogen but not phosphorus or potassium. The recommended application rate is 80kg of nitrogen per ha in form of sulphate of ammonia, 30-45 days after sowing. Thus farmers in Bura are provided with eight 50kg bags of sulphate ammonia for the two cotton plots.

The monitoring of pests in both Bura and Hola is a routine process in order to assess the incidence of various pests and to evaluate the performance of the spraying company in achieving effective pest control. There are 20 species of pests which attack cotton in Kenya and it is virtually impossible to grow the crop successfully without the application of pesticides. The insect pests which cause most damage are the American boll-worm, the spiny bollworm, cotton stainers, cotton lygus and cotton spider mites. The ultra low volume (ULV) technique is in operation in both Bura and Hola where aircrafts are used.

The East African Upland varieties which have been developed for the East African rainfed conditions have been grown since 1958 when the Hola Scheme became operational. Specifically BPA 75 is grown in Bura. Variety trials started in 1963 but it was not until 1971 that a representative range of American varieties was included. The varieties are assessed for yields, resistance to pests and diseases, ginning out-turns and fibre quality. At present the BPA 75 variety is considered to be the most suitable in terms of disease resistance, quality and yield. The American varieties have higher ginning out-turns however, but some of them may be more susceptible to diseases, particularly bacterial blight, and also to pests. The higher ginning out-turns does not confer any advantages to farmers since the present pricing structure does not compensate for higher lint out-turn. Rather, it is based on the output of seed cotton. More research work on cotton varieties, is being undertaken.

The Coast composite maize variety and Pioneer hybrid variety are grown in Bura. More varieties including hybrids are being screened in order to select for higher yields.

Rice research has concentrated on adoptive trials using varieties obtained from the International Rice Research Institute (IRRI) in the Phillipines. As yet there are no rice breeding programmes under the NIB research activities which are centred at Ahero. In Mwea research has concentrated on trying to establish a possible dry footed second crop but so far this has not been successful. There has also been a strengthened research programme geared to the development of a second rice crop which has been shown to be unviable due to ecological, technical as well as economic reasons. Mwea is located at medium altitude and the major crop is grown during the short rains. A second crop in the long rains period has tended to be uneconomic and also problematic. Firstly, the temperatures drop by about 2°C during this period which makes pollination impossible with concomitant sterility and very poor yields. Research has thus been directed to try and identify cold tolerant rice varieties. Unfortunately, the cold tolerant varieties which have been introduced from IRRI have proved unsuccessful in Mwea so far.

Secondly, the second crop disrupts the main crop because tractors cannot work on the land immediately after drainage. The soils of Mwea are black cotton soils and alternation between drying and wetness appears to have some favourable effects. Thirdly, the second crop increases the incidence of pests and disease by curtailing the wet fallow period which is necessary to break the cycles of pests and diseases. This significantly increases the cost of spraying. In addition, a short fallow does not permit algae to fix nitrogen and this may imply greater fertilizer application rates in the long run. Fourthly, the fallow period permits the tenants and their families to take a break from the monotony of paddy cultivation and to get out of the scheme areas and also permits some rest for a rigorous next season. Even in western Kenya schemes where two crops per year were common, they had to be abandoned in favour of a single crop due to relatively low yields per crops and very high costs.¹¹ Nevertheless, research on second crop is on-going.

Research is also going on to identify more profitable crops. In Ahero and West Kano schemes sugar-cane has tended to perform better than paddy but marketing is said to be a major problem.

The National Agricultural Research Laboratories (NAL) of the Scientific Research Division of the Ministry of Agriculture (MOA) has an irrigation and drainage section. The section is geared to tackling water management problems of both rainfed and irrigated agriculture.

Some studies which have already been undertaken include the use of and water management on the red soils of Upper Tana; salinity development in Lower Tana, and drainage problems and reclamation problems at Yala. More research is envisaged on soils, irrigation and socio-economic conditions. Currently, research under Scientific Research Division of the MOA is being re-organized under a new parastatal, KARI, the Kenya Agricultural Research Institute (ISNAR,1981). The Dutch Government has been approached to assist in the setting up of an irrigation and drainage research section.¹²

There is a need for greater co-ordination between the NIB and the MOA research activities. The NIB may require to be assisted in the research efforts which are taking place at Mwea and elsewhere. In the end all agricultural research could become responsibility of the new KARI. This would obviate tenant farmers having to fund irrigation research thus placing them at par with farmers in rainfed farming areas. There is an urgent need for research on irrigation management which could also be closely linked with the monitoring and evaluation functions.

13. Nutrition and Quality of Life on the Schemes

Apart from the insecurity of tenure, the quality of life in nearly all the large-scale irrigation schemes have been reported to be unsatisfactory (Migot-Adholla, 1982; Ruigu et al.,1984; Ileri, 1986). The level of nutrition in each scheme is largely determined by the farm income and by the nature of the crop mix.

Although the average incomes of the tenants in most schemes is higher than in the surrounding rainfed areas there is a substantial number of tenants whose incomes fall below the poverty line ¹³, even at Mwea, the most efficient scheme. It is therefore not surprising that protein malnutrition is common in the irrigation schemes. Our survey in the newest scheme, Bura estimated an average income of KSh 5,300 after allowing for 10 bags of maize for domestic consumption (Ruigu et al.,1984). About 24.8% of the tenants did not achieve a minimum output of 1,588kg which was needed to break even. After adjusting for labour costs of about KSh 900 the net income drops to KSh 4,500, for an average family of 8, two of whom were living away from Bura. We estimated that at least 45% of the households had incomes which were inadequate to meet the requirements for basic needs.

Obviously, the Board has attempted to address these problems in recent years but when some of these schemes were initiated nutrition and health¹⁴ were not given much weight.

As long as farmers were able to retain a number of bags of rice or maize, minimum nutrition was to be expected. In Mwea for instance, farmers are permitted to retain up to 12 bags of paddy while in Bura farmers grow maize on one of the early cotton plots. The Mwea tenants supplement their incomes by selling some of the rice in the parallel market. They also produce maize and beans on the red soil plots. In Bura, some tenants are sometimes unable to obtain adequate harvests of maize. Each tenant however, has a plot of 0.05ha for the growing of vegetables.

A survey in Mwea showed that the diet of tenant households was dominated by maize and beans and a little rice (McGuire, 1981). Another survey in Bura also demonstrated a preponderance of maize and beans in Bura (Ruigu et al., 1984; Vainio-Mattila, 1987). The incidence of stunting in Mwea has however been shown to be the same as the national average and, in recent years, the nutritional status on the scheme generally is said to have improved somewhat. A recent survey revealed precarious nutritional conditions among the resident tenants in Ahero and West Kano, but not among the tenants living outside the schemes. The authors attribute this finding to the restricted resource base of the first group (Niemeyer et al., 1985).

To improve the nutritional status of tenants the range of types and varieties of crops which are grown need to be re-evaluated. Ways and means of increasing tenant incomes should be sought and marketing and pricing policies should be accompanied by prompt payments for the products delivered.

14. Other Issues

It is not possible to provide a comprehensive coverage on all aspects of irrigation farming. It is however important that we mention the issues of human settlement and water rights. Kenya has limited water resources and water is one of the major constraints facing irrigation development in the country. Water is the major determinant of the country's irrigation potential (540,000ha) together with soils and topography. Given Kenya's burgeoning population the demand for water is likely to expand. As the demand for water increases, competition for its access by the various groups in society will intensify. Therefore the optimisation of water use and the rational allocation among conflicting demands for domestic, industrial, irrigation, hydropower, rural/urban, public/private will gain special importance. Any person or private party wishing to divert water for any use including irrigation has to apply for a permit from the Water Apportionment Board. The

application is usually gazetted to allow any would be objectors to such a right being granted to do so. The application is eventually considered in light of availability of the flow in the river system and/or objections received from other affected parties. In addition, the recommendation of the District Agricultural Officer is requested if the water is to be utilized for irrigation. In this way, the Apportionment Board can adjudicate on water rights for different parties.

A national water Master Plan for Kenya which provides detailed information on the availability and reliability of the country's irrigation and hydropower potential has been completed while River Basin studies are being executed. It will also be necessary to review the existing system of water rights which determine the access to water and the implications of such rights. Currently the Water Act is being revised (Cap. 372). The rights should be structured in such a manner as to ensure efficient utilization, conservation and protection from pollution.

The issue of the framework for co-ordination of irrigation matters is addressed by Kimani (1986). The case for, or against, a single authority to co-ordinate all irrigation activities in the country will be examined. The structure and functions would also be specified. Kenya does not have an explicit national irrigation policy. Such a policy would be crucial in determining the effectiveness of the co-ordinating body. It would also stipulate the goals, priorities and implementation framework and schedules. In addition, it should permit consistent and co-ordinated action by the various agencies and serve to avoid duplication and/or competition.

Bibliography

- Alila P O (1986) **Grassroots Participation in Small and Large-scale Irrigation Schemes.** Paper presented at joint seminar on Irrigation Policies, Kenya and Zimbabwe, Nairobi, 27-28 November 1986.
- Arao L (1986) **Types of Irrigation Systems in Kenya.** Paper presented at joint seminar on Irrigation Policies, Kenya and Zimbabwe, Nairobi, 27-28 November, 1986.
- Chambers R & Moris J (eds) (1973) **Mwea: An Irrigated Rice Settlement in Kenya.** African-Studies Nr. 83. Munich: Weltforum Verlag.
- FAO (1985) **Irrigation in Africa South of the Sahara. A Study with Particular Reference to Food Production.** Rome: Food and Agriculture Organization.
- Gitonga S M (1985) **Bura Irrigation and Settlement Project, Kenya.** Paper presented to informal meeting on Irrigation in Anglophone Africa, Rome, FAO, June 24-28.
- Hazlewood A (1979). **The Economy of Kenya: The Kenyatta Era.** Oxford : Oxford University Press
- Henin J (1981) **The Characteristics and Development Implications of Fast Growing Populations.** In T Killick (ed). **Papers on the Kenyan Economy : Performance, Problems and Policies.** Heineman Educational Books.
- IBRD (1977) **Bura Irrigation Settlement Project.** Appraisal Report. Report No. 1446 KE, Eastern Africa Region, Agricultural Credit and Division. Washington: International Bank for Reconstruction and Development.
- IBRD (1981) **Water Management in Bank-Supported Irrigation Project System: An Analysis of Past Experience.** Report No. 3421. Washington : International Bank for Reconstruction and Development.
- IBRD (1982) **Kenya, Irrigation Subsector Review.** Washington: International Bank for Reconstruction and Development.
- IBRD (1984) **Kenya Agricultural Sector Report,** Report No. 4629-KE, Eastern Africa Projects. Washington : International Bank for Reconstruction and Development.
- IBRD (1986) **Kenya : Agricultural Sector Report. Vol.1: Overview and Summary.** Report No. 4629-KE. Washington: International Bank for Reconstruction and Development
- Irer D (1986) **Mwea Tebere Irrigation Scheme: Lessons of Experience.** Paper prepared for IDS/EDI Agricultural Sector Planning and Management course. Nairobi, July 1986.
- ISNAR (1981) **Kenya's National Agricultural Research System.** A Report Submitted to the Government of Kenya. International Service for National Agricultural Research. The Hague - Netherlands.
- Kenya (1962) **The Trust Lands (Irrigation Areas) Rules.** Chapter 288, Laws of Kenya. Nairobi: Government Printer.
- Kenya (1966) **Irrigation Act.** Chapter 347, Laws of Kenya. Nairobi: Government Printer.
- Kenya (1981) **Sessional Paper No.4 on National Food Policy.** Nairobi: Kenya Government
- Kenya (1985a) **Bura Irrigation Settlement Project.** Mid-term Evaluation Report 1984.
- Kenya (1985b). **Economic Survey.** Nairobi

- Kenya (1986) **Economic Management for Renewed Growth**. Sessional Paper No. 1, 1986. Nairobi: Government Printer.
- Kimani J (1986) **Irrigation Development Institutional Aspects**. Paper prepared for joint seminar on Irrigation Policies, Kenya and Zimbabwe, Nairobi, 27-28 November 1986.
- Manig G G (1973). **Engineering Aspects and Water Control**. In Chambers R & Moris J (eds). **Mwea: An Irrigated Rice Settlement in Kenya**. Munich: Welt forum Verlag. African-Studies No. 83. Pp.80-98
- McGuire J (1981) **Incorporating Nutrition Objectives in Development Projects**. In S E Migot-Adholla and J A Nkinyangi (eds). **Proceedings of a Workshop on Food and Nutrition Planning in Kenya**. Nairobi: Ministry of Planning and National Development.
- Migot-Adholla S E (1982). **Some Sociological Aspects of Management Constraints at the Bura Irrigation Settlement Project** (mimeo).
- Migot-Adholla S E & Ruigu G M (1986) **Issues on Irrigated Farming in Kenya**. Paper prepared for Discussion on Irrigation Farming in Kenya, IDS Nairobi, April 16, 1986.
- NIB. **Annual Reports**. Various Issues. Nairobi: National Irrigation Board
- NIB (1983) **Research Reports**. Nairobi : National Irrigation Board.
- Niemeyer R, Geuns M, Kliet T, Ogonda V & Hoorweg J (1985) **Nutritional Aspects of Rice Cultivation in Nyanza Province, Kenya**. Food and Nutrition Studies Programme Report No. 14. Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre.
- Ogendo O (1986) **In Proceedings of Discussion on Irrigation Farming in Kenya**, IDS, Nairobi, April 16, 1986.
- Roe J D M & Whitaker M J (1985) **Economics of Estate Coffee Production**. In **Kenya Coffee** (Monthly Bulletin), Vol.50, no.588. Nairobi: Coffee Board of Kenya.
- Ruigu G M, Alila P O & Chitere P A (1984) **Bura Irrigation Settlement Project. A Social Economic Survey**. Study carried on behalf of the National Irrigation Board.
- Ruthenberg H (1978) **Outline of a Strategy for Agricultural Development in Kenya** (mimeo).
- Sibanda B (1986) **Smallholder Irrigation in Communal Areas : Farmer Involvement/Participation**. Paper presented at joint seminar on Irrigation Policies, Kenya and Zimbabwe, Nairobi, 27-28 November,1986
- Tidrick G (1983). **Kenya : Issues in Agricultural Development**. In **Kenya : Growth and Structural Change**. World Bank Country Study. Washington DC: World Bank.
- Tiffen M (1984). **Human Resources in African Irrigation**. In **Africa Regional Symposium on Small Holder Irrigation**. Harare : University of Zimbabwe/Hydraulic Research Ltd.
- Toksoz S (1981). **An Accelerated Irrigation and Land Reclamation Program for Kenya : Dimension and Issues**. Development discussion paper no.114. Cambridge : Harvard Institute for International Development
- Vainio-Mattila A (1987) **Bura Fuelwood Project Domestic Fuel Economy**, Report 13/1987B. University of Helsinki, Institute for Development Studies.
- Veen J J (1973) **The Production System**. In Chambers R & Moris J (eds) **Mwea and Irrigated Rice Settlement in Kenya**. African-Studies Nr. 83. Munich: Weltforum Verlag.
- WAMANA (1985) **A quarterly Newsletter on Water Management** Vol. 5, No. 3.

Notes

- 1 The author is senior research fellow at the Institute of Development Studies, Nairobi. An earlier version of this paper was presented at the joint seminar on Irrigation Policies in Kenya and Zimbabwe, at the Silver Springs Hotel, Nairobi, November 1986
- 2 There was a joint irrigation committee which was chaired by the Director of Agriculture and consisting of the Departments of Agriculture, Public Works and the Provincial Administration. The Department of Agriculture was responsible for finance and agricultural activities of the schemes; Public Works Department for design engineers, contractors and consultants and the Provincial Administration for labour and settlement.
- 3 In 1981/82 the Mwea surplus was K£ 328,000 while the loss of the other schemes. Bunyala, Hola, Perkerra, Ahero and West Kano was K£ 961,000 excluding NIB head office costs.
- 4 Tiffen (1984) argues that this mode of management is alien to Asia, where irrigation is more developed.
- 5 Personal communication, Deputy Director General, International Irrigation Management Institute.
- 6 The charges were KSh 560 for ploughing, KSh 240 for harrowing (one pass) or KSh 440 for complete harrowing and KSh 360 for ridging (1984).
- 7 On the takeover of the Bura Scheme by the MOA, the need to manage Bura from site was emphasized.
- 8 Unreliable water supply is also said to be experienced in schemes in other countries (IBRD, 1981)
- 9 A long implementation schedule however, lowers the internal rate of return.
- 10 Irrigated cotton is of higher quality (has longer staple) and is sold at premium prices by the Board. There is a perceivable difference between AR or BR cotton depending on whether it is grown under rainfed or irrigated conditions. But the tenants are paid at the same rate per kg as those applying for cotton grown under rainfed condition. This depresses potential output. (Personal communication, Development Planning Division, Ministry of Agriculture and Livestock Development.)
- 11 Due to bogging down of tractors and low rates of land preparation.
- 12 Personal communication
- 13 In 1978 the Central Bureau of Statistics estimated the rural poverty line to be KSh 2,200 while KSh 1,700 was said to be the minimum desirable food consumption level. Some tenants are unable to make this figure in 1986.
- 14 The health issues are addressed by Mwabu, 1987