Neth. J. agric. Sci. 19 (1971) 76—84

The Tana Irrigation Scheme: an integrated development project

J. A. Baarspul

International Land Development Consultants (Ilaco), Arnhem, the Netherlands

Received: 8 December 1970

Summary

From the agricultural point of view the results obtained at Galole are not too striking but the set-up of the project has definitely been a success. The Tana Irrigation Scheme is now a well-functioning settlement scheme where tests on the introduction of new crops can be continued. The results of the last few years have shown that if proper agricultural techniques are applied under good management conditions, the opportunities for the Gaolle farmer are much better than was supposed at first sight. With careful planning, constant guidance and full support it will even be possible for him to achieve a good deal more.

The prejudice against the Galole farmers who were considered to be not too industrious and rather unmanageable can be refuted irrevocably.

At the Galole Pilot Demonstration and Training Centre technical assistance has proved to be a most valuable tool in development work.

Introduction

The village of Galole is located on the West Bank of the Tana River, two hundred miles East of Nairobi. Galole is the administrative centre of the Tana River District, an area of about 12,800 miles, with a population of some 60,000, living in hamlets along the river. Their means of subsistence are agriculture and livestock husbandry. For the rest, the semi desert area is not inhabited.

Galole acquired a dubious renown during the Mau-mau insurrection that preceded Kenya's independence. At the time the village was a place of exile for members of the rebelling Kikuyu tribe. The Tana Irrigation Scheme was established to have the mostly landless Kikuyus settle themselves as farmers far away from their native soil. After the emergency period the greater part of the unvoluntarily settled farmers returned to their tribal lands and gradually the local population was integrated into the Scheme.

Until recently the Scheme had been in distress and it was falling more or less in decay. Beside it being too small to justify the overhead costs related to the establishment of such a settlement scheme, the yields and consequently the farmer's income had been too low.

In 1966 the Scheme again aroused interest when it was decided to establish an experimental and demonstration farm in the Lower Tana area on the Tana Irrigation Scheme. The area had meanwhile been surveyed in the framework of an FAO/UNDP project between 1963 and 1966 and it had been found suitable for agricultural development. Well over 200,000 acres might be used for irrigated agriculture in the future.

The plans for his 'multi-purpose' had been drawn up by the (Dutch) International Land Development Consultants N.V. (Ilaco) in co-operation with the Canadian consulting firm Acres International Ltd.

The Tana Irrigation Scheme

The Tana Irrigation Scheme is one of the five irrigation 'settlement' schemes that are managed by the National Irrigation Board on behalf of the Ministry of Agriculture. The projects, which are considered to be of national importance, are subsidized if they are not self-supporting.

The rainfall pattern in the area is not very reliable and varies from year to year between 350 and 650 mm.

Usually the period of long rains (March–May) accounts for 40% of the total precipitation while the period of short rains accounts for another 40%. The remaining 20% can be expected any time during the months June–October.

Although in some years hardly any irrigation water is required during the cotton-growing season (February–June) irrigation facilities are a must to ensure the successful cultivation of the crop in the 'average' season.

The main part of the soils of the Scheme can be characterised as a reddish brown rather heavy clay (50% < 2 μm in the top layer, increasing to 90% < 2 μm in the layer 75–100 cm). In wet as well as in very dry condition the soil is almost unworkable.

The salinity of the topsoil amounts to 0.56 mmho/cm increasing to 3.70 mmho/cm in the layer 75–100 cm.

The total irrigated area of the Scheme is well over 1,500 acres, divided into three main blocks of 850, 400 and 250 acres, respectively.

The irrigation water is pumped by a number of pumps mounted to floating pontoons into a 12 km long main supply canal. It is conveyed via a system of structures, primary and secondary canals to irrigation units of 20 acres each. The units are split up into plots of 4 acres. The best farmers are allowed more than one plot provided an insufficient number of intending farmers have applied.

The scheme is supervised by a manager who is assisted by a staff comprising field assistants, water masters, work shop personnel and clerical staff.

Each year the farmers conclude an agreement with the manager in which the rights and obligations of both partners are clearly defined. The farmers undertake to follow closely the instructions of the management with regard to crop maintenance. If they fail to do so, they can be prosecuted and their contract may be cancelled. The scheme management takes care of soil preparation; is responsible for the purchase and distribution of seeds and fertilizers; determines where and when planting and irrigation are to be effected; arranges for aerial spraying whilst it also sets the binding regulations as to care of the crop by the farmers. The cost involved in the goods and services supplied by the scheme are settled with the farmers after the harvest. During the cropping season each farmer receives a number of advances to allow him to run his farm.

Strong management and tight discipline are prerequisites to operate an irrigation project on which the local population is engaged in the cultivation of a cash crop like cotton, successfully. Except for circumstances beyond any one's control, it depends on the farmers' inclination for work and the capibility, insight and enthusiasm of the Scheme's management, whether a crop will be grown successfully or fail. Undoubtedly, the activities of both parties engaged in this type of agricultural production process have an impact on each other.

The rather deplorable condition of the Scheme in 1966 and the promising results since the project was implemented are a distinct proof of the foregoing statement.

When Ilaco started its activities on the Scheme, cotton had been grown as a monoculture for a number of years, however, with little success.

Originally no nitrogen at all and later too small quantities had been applied as a result of which the soil had become almost exhausted. In addition, weed and pest control had been deficient and average yields over years had never exceeded 1000 lb seed cotton per acre. The irrigation system had been neglected, the fields had an irregular surface due to improper levelling, drainage of excess water was almost impossible. The machinery was obsolete and should have been renewed years ago. The local farmers were considered by some observers to be not very industrious and rather unmanageable. They lived in delapidated villages and seemed to have no confidence in the Scheme.

The pilot farm

The establishment of the experimental and demonstration farm was financed out of funds made available by the Dutch Government under the bilateral aid programme by providing for expert services and the necessary equipment. Implementation of this project was entrusted to Ilaco which could proceed from its earlier exxperience in the area concerned, in close co-operation with experienced counterpart staff made available by the National Irrigation Board.

The objectives of the project can be briefly described as follows:

- Continuation of the agricultural investigations initiated during the earlier study of the basin
- Introduction of other crops in addition to the traditional cotton crop and integration of these crops into an intensive crop rotation
- Field-scale introduction of the most suited cultivation practices based on the results obtained on the experimental fields
- Assistance in the introduction of proper farm management and, after a few years of operation, advice on the desired level of mechanization and the inherent labour requirement
- Training of field staff.

Once the work had been started, it proved to be essential for Ilaco to deal with a much wider range of activities, since beside agricultural research and technical advice, the management aspects called for immediate attention.

Problems related to farm management, social conditions and in the field of general agriculture had to be solved.

A new manager, the first African manager of an irrigation project in Kenya, was appointed. The contact with the farmers was restored and agricultural extension was given full attention. Gradually, the houses in the villages were restored, whilst, moreover, a completely new village was constructed which has shortened the distance between the farmers' fields and their homes considerably.

Agricultural aspects

It was fully realized that both the management and the farmers on the Scheme would not be able to adjust out of hand their cultivation practices which had been established more or less traditionally in the course of years.

The decision was, therefore, made to start to improve the current cultivation methods and to introduce intensified cropping and crop rotation gradually.

Thorough mechanized soil preparation

A thorough and especially timely soil preparation is a prerequisite to successful crop growing. The weeds abunding after the short rains period in November/December must be ploughed under, if possible before new seeds have formed. Harrowing and ridging are the next activities to be undertaken before the field irrigation ditches are constructed. These operations are partly done mechanically and partly by the farmer himself. A fleet of 12-MF 165 tractors with the necessary implements are available on the Scheme.

In ploughing, one-way disc ploughs (3 discs) are used, whilst for harrowing three heavy, mounted offset disc-harrows are available.

Finally, the land is ridged with a set of three ridger bodies behind a tractor. The distance between the ridges is 90 cm.

The machine inputs per acre for the various activities as recorded in the season 27 December 1968–14 March 1969 are summarized in Table 1.

Advancing of sowing date

In former years planting was started when the rains set in by the end of March.

June, July and August are relatively cool and cloudy. This cool period with little sunshine coincides with the time when the cotton crop forms most of its bolls which, owing to the prevailing weather conditions, fail to reach optimum development. Another disadvantage of planting when the first rains set in is that weeding is almost impossible on the wet fields so that the cotton crop meets heavy competition in its important first stage of growth.

By advancing the planting time by some six weeks, flowering and boll formation would take place in a climatically favourable period.

Moreover, the first two weeding rounds have then been completed and the crop almost fully covers the soil before the fields are too wet to be worked.

Better weed control

Even if weeding can take place under favourable conditions, handling a 4-acre cotton plot in the period when also thinning and fertilizer application must be done has proven to be too heavy a job for the African farmer who is supposed to be able to cope with his farming activities with the help of his family. Therefore, half of each farm is now treated with herbicides, i.e. 450 g Diuron (Karmex) per acre, applied as a pre-emergence weedkiller. Per acre 80 l spraying liquid are applied with knapsack sprayers. Moreover, each farmer has been supplied with a Dutch hoe in addition to the local hoe that has been used for all activities so far. The introduction of this long-handled implement, manufactured locally, has resulted in a much higher output per manday, as it is a much more suitable tool under the local circumstances.

Increased fertilizer application

Fertilizer application is closely supervised at the moment in order to ensure that each farmer applies at least 200 lb ammonium sulphate per acre. Owing to the intensive extension efforts the farmers now even ask for higher levels of nitrogen themselves and, on an average, 60 lb N (300 lb ammonium sulphate 20%) are being applied per acre. The results obtained on the experimental fields have shown that the crop does not respond to P and K applications.

Table 1. Machine inputs per acre.

Type of activity	Tractor days	Working hours	Actual working hours	Traveling time (hours)	Delays in working shop and field (hours)	Acres worked	Engine hours	Engine hours per acre	Acres/ tractor day	Diesel (gal)	Oil (pints)
Ploughing	236	2183	1652	127	404	1421	1725	1.12	6	1910	178
Harrowing	96	861	663	48	150	1313	743	0.56	13.7	689	87
Ridging	84	772	527	35	210	1322	601	0.45	15.7	643	75
Total	416	3816	2842	210	764	1322.5	3069	2.32	3.18	3242	340
% of total working hours		100	74.5	5.5	20.0						

Average working time per day: 9 hours and 10 minutes.

Pest control

Cotton growing on the Scheme is constantly threatened by all sorts of pests.

Investments creating optimum growing conditions are not justified, unless insect pests are under full control. Especially American bollworm (*Heliothis* spp.) and Spiny bollworm (*Earias* spp.) cause much damage to the crop. Cotton stainers (*Dysdercus* spp.) can heavily affect the crop during boll formation and cause the quality of the cotton to deteriorate strongly. Furthermore aphids and Red spider mites (*Tetranychus* spp.) occur; in 1966 the crop was completely gluttonized by a leafeating caterpilar (*Cosmophila flava*) which had not been observed on the Scheme up to that moment. During the growing season the crop is inspected for pests twice a week, starting the 6th week after sowing.

Project personnel has been trained for this job. A large number of sample areas is selected, scattered over the Scheme in which the number of larvae of American bollworm and Spiny bollworm as well as the number of plants infested with aphids, spider mide and stainers in a certain number of plants of each sample area are recorded accurately. In this way a quantitative picture of the degree of infestation can be obtained. Based on the data recorded it can be decided when spraying is required and which type of insecticide should be used. The results of the insect countings have been accurately recorded and graphically presented for a number of years.

The data show that American and Spiny bollworm appear each year according to a fixed pattern, starting 6–8 weeks after planting. During one season three generations are to be expected, emerging one month after each other. A more effective insect control can be realized by concentrating planting as much as possible and by such a distribution of irrigation water that the Scheme, if so required, can be split up into blocks of an adequate size in which the cotton has been planted simultaneously during a

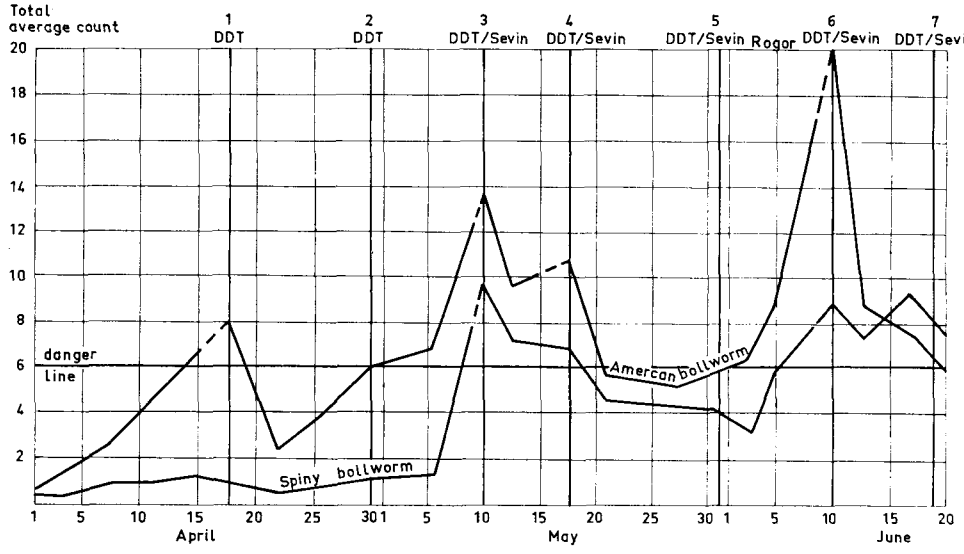

Fig. 1. Pattern of infestation by American bollworm and Spiny bollworm. Spraying programme of the 1968 crop.

period of, say, ten days. Serious attacks can then be tackled by aerial spraying at the right moment. In this way earlier planted cotton will not be subjected to insect attacks for too long a period, and unnecessary and thus expensive spraying of later planted cotton can be prevented. It is possible to predict fairly accurately for the different blocks with subsequent plantings when the upward line of the first generation in the graph is reached, how the insect populations will develop and which measures at what time will have to be taken.

On an average, aerial spraying is practised seven times during each season. For additional hand spraying of the 1500-acre project, 10 knapsack sprayers have been found to be sufficient.

The infestation by American and Spiny bollworm during the 1968 season is presented in Fig. 1. The dates on which insect countings and subsequent spraying took place have been plotted on the absciss. The ordinate reflects the degree of infestation; the figures indicate the average numbers of larvae registred per sample area (20 plants) averaged for the whole Scheme. The average planting time was on or about the beginning of March. In the fifth spraying, DDT was used against American bollworm, Sevin against Spiny bollworm and Stainers, whilst Rogor 40 was added to deal with aphids and Red Spider mite. DDT and Sevin were sprayed in a concentration of 450 g a.i. (wettable powder) per acre; the effective quantity of Rogor per acre proved to be 250 cm^3.

Irrigation and drainage

As far as irrigation and drainage are concerned, the following measures have been taken:

- Levelling of the irrigation service units which allows equal wetting of the plant ridges and prevents the occurence of excess surface water. In these activities use was made of a number of Eversman landplanes, an Eversman scraper and an Atlas road grader mounted to an MF 165 tractor.
- Widening and clearing of irrigation canals and the installation of a system of drainage ditches, as well as construction of culverts and repairs of structure. Furthermore, a 60-m long aquaduct in the main irrigation canal conveying the water across a ravine has been constructed.

A wide range of agricultural measures were required which would strongly affect the traditional agricultural pattern.

Quantification of the results obtained

Yields

Owing to the effective way in which the various problems have been handled, average yields could be increased by 90%. In 1968, the average yield was over 1500 lb seed cotton per acre, in 1969 it was over 1880 lb per acre whilst it exceeded 2000 lb in 1970 as compared to the average yield of 1000 lb per acre recorded in previous years. The most important aspect is that the difference in yield per individual farmer is less than it used to be and almost everybody shares the newly acquired prosperity.

The actual result to the farmers is that without any material increase in inputs except for their own labour, their net income is now nine times as high as it used to be. The average yields are summarised in Fig. 2.

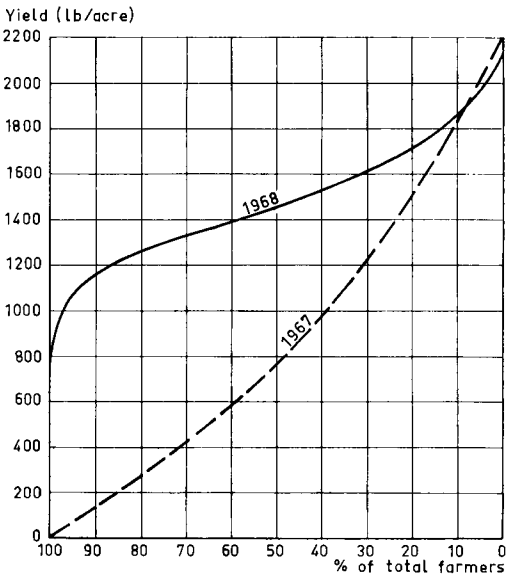

Fig. 2. Distribution of farmers according to the average yield per acre.

Cost and benefit comparisons

The cost/benefit comparison for a 4-acre farm under conditions before and after 1968 is as given in Table 2.

Table 2. Cost and benefit comparison of a 4-acre farm; in shillings.

Factor	Before 1968		After 1968	
	per acre	total (4 acres)	per acre	total (4 acres)
Costs				
Soil preparation	60	240	60	240
Irrigation	100	400	100	400
Fertilizing [1]	35	140	50	200
Insect control	140	560	140	560
Chemical weed control [2]	—	—	25	50
Hired labour: weeding	60	240	25	100
„ „ : picking [3]	50	200	140	560
Total costs	445	1780	527.5	2110
Benefits [4]	500	2000	950	3800
Net results	55	220	422.5	1690

[1] Before 1968 40 lb N/acre, after 1968 60 lb N/acre.
[2] On 2 acres only.
[3] Before 1968 500 lb/acre, after 1968 1400 lb/acre; Sh. 0.10/lb.
[4] Before 1968 1000 lb/acre, after 1968 1900 lb/acre; Sh. 0.50/lb.

The comparison is based on the assumption that the farmer, with the help of his family, is able to pick 2000 lb of seed cotton during the picking season and to handle all activities during the growing season except in the first weeding period.

Actually the net farm results are even more favourable since each farmer is growing second crops, viz. one acre maize and half an acre groundnuts whereby apart from the cost of fertilizer for maize almost no costs are involved.

A comparison between the period before 1968 and the period afterwards can easily be made, since the cost of hired labour and the spraying cost have not changed since 1963. Soil preparation and irrigation services are provided by the scheme management for a fixed nominal fee, far below the actual costs.

The price for seed cotton paid by the Cotton Board has not changed since the start of the Scheme.