McKay, J., R. W. Kates, and D. Conyers, "Benefits from Rural Water Supply: The Impact of the Bulenya Hills Pipeline in North-East Nzega", University College, Bureau of Resource Assessment and Land Use Planning Research Report No. 5.

BUREAU OF RESOURCE ASSESSMENT
AND LAND USE PLANNING

UNIVERSITY COLLEGE, DAR ES SALAAM

Research Report No. 5

Benefits from rural water supply: the impact of the Bulenya Hills pipeline in north-east Nzega.

by

R.W. Kates
J. McKay
D. Conyers

assisted by

B.G. Choka
P. Mussa
H. Omari
W.D. Sabaya

The Mwambiti plains lie in the Northeast corner of Nzega district approximately 500 square miles, mainly of good ibushi soils, with adequate seasonal rainfall but extremely dry for long periods during the year. The only permanent source of water in the area is from the Bulenya Hills pipeline.

Bulenya Hills dam has a catchment area of about 57 square miles, provides storage for 2,600 acre feet, and is capable of providing about 570,000 gallons per day. From the dam the pipeline goes east to Igunga paralleling the East-West road and then northward through Mbutu to Ibuta a distance of 16 miles with distribution tanks located approximately every three miles. The dam was completed in 1961 and the pipeline constructed in stages from 1963 through 1967.

This area, approximated by the boundaries of Igunga division, has been one of rapid growth, extensive crop production of cotton and maize rapidly spreading in an area previously used mainly as seasonal grazing lands. Much of the growth is generally attributed to the construction of the pipeline enabling the development of the area by permanent year-round settlement. Estimates of this growth (frequently cited in official correspondence) for the entire area are 260% in population over five years (1961-66) and a seven-fold increase in cotton production for the same period (3,000 bales increased to 20,000 bales).

Adjacent to the Bulenya Hills pipeline area, further east on the plains is an area capable of being served by a pipeline from Mwamapuli dam, presently under construction. This dam along with extensions of the Bulenya scheme will provide domestic and cattle watering facilities for almost the entire area of the Mwambiti Plains.

...2/

The Bulenya pipeline experience, provides a model for anticipated developments on the entire plains and for similar opportunities elsewhere. There was, therefore a desire on the part of the Water Development and Irrigation Division (W.D.&.I.D.) of the then Ministry of Lands, Settlement and Water Development, for a careful evaluation of the impact of the Bulenya Hills Pipeline on the Economy and lives of the people in the area it serves. This desire coincided with the interest of the Bureau of Resource Assessment and Land Use Planning of University College, Dar es Salaam in evaluating the role that services or facilities play in encouraging new settlement and rural development and the Bureau undertook to make the evaluation for W.D.&.I.D.

As this is the first of several rural water supply evaluations, a considerable portion of the report is devoted to a general discussion of the nature of anticipated benefits from the provision or improvement of rural water supplies and the methods of evaluation. Some recent findings regarding rural water use are summarized in this context. The final and major section of the report then sets out our findings and their significance.

Previous Work and Related Investigations

We do not know of any previous evaluations of rural water supply impacts, although several feasibility studies including one from Nigeria have attempted to estimate such benefits. In all cases they involve untested assumptions as to the relationship between improved water supply and agricultural productivity.

Prospects for improved understanding of the impacts in the future are more encouraging. A recent research workshop held at University College featured discussion of several promising studies currently underway. These are summarized in Table 1.

Table 1

Current research in Tanzania on aspects of rural water supplies

INVESTIGATOR	INSTITUTION	SUBJECT
Heijnen, J.D.	BRALUP, U.C.D. DAR ES SALAAM	Baseline study for evaluation of Ismani Plains Pipeline recently constructed
Kates, R.W. McKay, J. and Conyers, D.	BRALUP, U.C.D. DAR ES SALAAM	Impact study of Bulenya Hills Pipeline
Kreysler, J.	Max Planck Nutrition Research Unit Bumbuli	Assessment of intestinal parasite infection rates following treatment and installation of tap water in Mayo Village.
McCullough, F.S.	Tanzania/WHO project East African Institute for Medical Research Mwanza	Bilharziasis Pilot control and training project
Salter, A.J.	Nordic Tanganyika Center, Kibaha	Self-help well improvement scheme.
Warner, D.	ERB, U.C.D. Dar es Salaam	Evaluation of Rural Water Supply programs
White, G.F. Bradley, D White, A.	University of Chicago and Makerere College Kampala	Study of Domestic Water use in East Africa.

The work by Heijnen and Warner is just beginning and that of Kreysler, McCullough and Salter is only partly completed. The White, Bradley and White study is nearing publication but it will be at least a year before it is in print. Because its findings are so valuable as background to any discussion of rural water use, we have abstracted portions of the findings from various reports and papers given at conferences.

...4/

The East African Domestic Water Use Study - Findings on Rural Water Use

Based on field observations made in 1966 at 38 sites in all three East African countries, the survey provides the first comparative data on variation in use and direct cost between piped and unpiped supplies in different areas of water availability. Per capita daily use of water is summarized in Table 1. Of particular interest for this study, are the observations of water use found at 12 farming sites where the 307 households studied were obliged to carry water into the house from rain barrel, spring, well, stream or standpipe. Per capita water use varied by site averages of 4.4 to 17.6 liters per day.

Table 2

Type of site	Number of Sites	Per Capita Daily Use in Liters: Mean for All Sites	Range of Uses in	Mean Sites	Range of Individual Us
Unpiped					
Farming	12	9.5	4.4 - 17.6		1.4 - 48.5
Towns	7	14.0	9.3 - 20.8		4.2 - 36.5
Piped*					
High Density	2	92.0	30.1 -153.9		16.1 -198.7
Medium Density	10	168.1	31.6 -167.2		18.6 -450.6
Low Density	3	222.7	161.4 -254.3		49.6 -506.3

Source: A.V. White, 1968

Seeking to explain this variation in use Anne White notes:

> In unpiped households the amount withdrawn is closely associated with size of family: the larger the number of children the smaller the per capita use; the largest uses are by single working men or couples without childre; the smallest uses are by elderly people living alone. Greater material wealth is associated with

*The piped sites are classified here according to housing density. The medium class includes smaller towns of mixed density as well as a few low income communities with medium density pattern of dwellings.

> greater use. An apparently significant factor is the size of the common carrying container: linked with the customary behavior of the different ethnic groups, the carrying vessel, ranging ordinarily from 15 to 40 liters, is associated with differences in use. Where clothes washing is done near the water source the withdrawal is less. (A V White 1968).

Somewhat surprisingly she finds that:

> No strong association has been observed between water use and the distance it is carried, the nature of the source, or the education of the user.

In assessing the direct cost of water the investigation employed a simple but clear method to enable comparison between piped and unpiped supplies.

> The direct costs for piped water supplies (see Table 3) were calculated from meter records and information from household interviews. For unpiped supplies, the elements entering into the direct costs are the cash price paid at a source such as a standpipe, or paid to a water-carrier; the energy expended in carrying water from a source; and energy spent waiting in a queue. By estimating caloric expenditure for a trip to fetch water, taking into account body size, load, and slope, an estimate was made of the amount of maize flour required to furnish this energy, and the cost of this amount of flour in the local market. In this way a rough estimate was obtained of the cash cost of this kind of energy expenditure. Using such estimates, direct costs for piped water range from a mean of 0.00 East African cents per liter in Moshi, Tanzania, ($0.30 per 1,000 U.S. gallons) to a mean of 0.22 E.A. cents ($1.18 per 1,000 U.S. gallons) in the small town of Maruri in Kenya. For unpiped supplies, the means run from 0.02 E.A. cents per liter in the rural

> greater use. An apparently significant factor is the size of the common carrying container: linked with the customary behavior of the different ethnic groups, the carrying vessel, ranging ordinarily from 1 to 40 liters, is associated with differences in use. Where clothes washing is done near the water source the withdrawal is less. (A V White 1968).

Somewhat surprisingly she finds that:

> No strong association has been observed between water use and the distance it is carried, the nature of the source, or the education of the user.

In assessing the direct cost of water the investigation employed a simple but clear method to enable comparison between piped and unpiped supplies.

> The direct costs for piped water supplies (see Table 3) were calculated from meter records and information from household interviews. For unpiped supplies, the elements entering into the direct costs are the cash price paid at a source such as a standpipe, or paid to a water-carrier; the energy expended in carrying water from a source; and energy spent waiting in a queue. By estimating caloric expenditure for a trip to fetch water, taking into account body size, load, and slope, an estimate was made of the amount of maize flour required to furnish this energy, and the cost of this amount of flour in the local market. In this way a rough estimate was obtained of the cash cost of this kind of energy expenditure. Using such estimates, direct costs for piped water range from a mean of 0.06 East African cents per liter in Moshi, Tanzania, ($0.30 per 1,000 U.S. gallons) to a mean of 0.22 E.A. cents ($1.18 per 1,000 U.S. gallons) in the small town of Nanuri in Kenya. For unpiped supplies, the means run from 0.02 E.A. cents per liter in the rural

.../6

White concludes on this point of cost that

> In all the areas studied women are an important part of the labour force in the production of food. In many places they do all the planting and cultivating, helped to some extent by the men in the heavy work of clearing and preparing the fields. Water carrying would seem to cut pretty heavily into a woman's available time and energy, although it is a matter of speculation as to just how she would use these if freed from this task.

The East African study will not only increase our understanding of the use and associated costs of water but the process of user choice as well. For example, one simple hypothesis is minimal distance, that is people use the nearest source. A second hypothesis frequently stated is social interchange, that is people, especially women, favour sources where meeting their neighbours for gossip and talk is possible.

The field observations do not seem to bear this out. Rather Gilbert White observes that:

> There is a widespread and persistent concern by water users to obtain clean supplies from individual sources. This is marked in considerable part by individual perception of water sources and alternatives.
>
> When an attempt is made to described how users chose among alternative water sources and there usually are two to six sources that are theoretically available - it is found that people do not simply go to the nearest source or the traditional one or one where they are likely to meet neighbours.

> The decision is a complex process bound up in the ecology of the area. Perception of a clean source is not necessarily linked with education or the existence of such a source according to prevailing scientific standards. Perception of economic costs is not strong linked with level of material wealth.
>
> Users seem to prefer their own private sources and to be willing to pay heavily for what they perceive to be healthy supplies. It may be misleading to charge their failure to use a new borehole or a clean standpipe source simply to ignorance or stupidity or custom. Perception of choice is shaped by other aspects as well as formal information.
> (G.F. White, 1968)

Thus when water carriers choose their sources, health factors as they perceive them are influential in their choice. But the actual health impact of an improvement is more difficult topredict. David Bradley, the microbiologist author of the study, has summarized the prevailing medical and scientific opinion.

> The effects of changing the water source environment are therefore predictable in terms of quantitative indices of pollution but prediction of the resulting epidemiological changes is not yet possible with any precision, since the simple relations which ahve usually been assumed to operate between pollution and disease in municipal water supplies in temperate countries by no means necessarily follow in the rural tropics.
>
> (Bradley, 1968).

Impact Study Methods and Problems

The methods of analysis for impact studies and related feasibility studies vary greatly, but the basic principle is often summarized as the "with and without" principle. Simply stated, we ask the following question: What is (will be) the state of affairs with the presence of the project, what was (would it have been) without the project? Ideally in a carefully planned impact study we can carry on a base-line survey of present conditions, then assess the future state of affairs some time in the future. But seldom are ideal research conditions available; in many cases the information is needed immediately. So in general one of the states is unknown and must be projected. In the case of assessing the impact of an already existing improvement we must project the "without" situation. In the case of a feasibility study for a planned improvement we must project the "with" situation.

In the Bulenya Hills case, no baseline study was made of conditions in 1961 at the beginning of the project and these must be reconstructed. Then this "without" situation must be projected forward in time. For to measure the impact of the project we need to assess not merely the change of condition say between 1961 (without) and 1968 (with), but what changes might have occurred on the Mwambiti Plain even in the absence of the pipeline.

The central point here is that seldom does a single service or facility account complete for developments. In the Bulenya Hills case many factors are operative: the opening of the East-West road, the building of the ginnery at Manonga, the introduction of the U.K. 55 cotton variety, the presence of village development at

.../

Igunga, the drift of Wasukuma, Wanyamwezi and Wairamba into the area, and the natural reproductive growth of population. All these factors would have led to substantial changes over the analysis period regardless of whether the water supply was improved, although we suspect at a reduced rate.

Related to these multiple factors is the problem of distinguishing causal factors. In most development situations the single service or facility provided may be a necessary but seldom sufficient requirement for development. For example improved cotton roads may be just as important a requirement for increasing cotton production as a permanent water supply for settlement. Attributing all beneficial impacts to either the roads or the water supply easily leads to double-counting of benefits and mistaken policies.

Anticipated Benefits from Improvement of Water Supplies

The First Five Year Plan offered two major justifications for the expansion and development of rural water supplies. In Volume I is found, "Provision of Water supplies for human and livestock users is one of the vital preconditions for economic and social development." In Volume II, "Clean Water supplies are essential to the health of the people." To these justifications might be added the comfort of the people, namely that the provision of permanent water supplies may enhance the living conditions of rural people, by the provision of a more convenient social service.

In general therefore we might think of the beneficial impacts of rural water supplies as health, wealth, and convenience, but in practice these can be interrelated in complex ways. For example both health and convenience have important economic dimensions. In a land where agricultural productivity is directly related to labour availability both improved health and the convenience of near-by water supplies can increase the supply of labour for productive purposes.

Despite these complexities we might distinguish under major headings of health, wealth, convenience and well-bring the general benefits of improved rural water supplies and the specific benefits of the Bulanya Hills pipeline.

Health. - Improved rural water supplies serve (1) to satisfy the minimum daily human requirement for water, (2) to reduce or eliminate contaminated sources for water borne and related disease, and (3) to improve standards of cleanliness and personal hygiene by increased water availability.

Recently Bradley (oral communication) has proposed a classification useful for health impact assessment. Water related disease are of four types: the traditional water borne diseases such as typhoid, cholera and various diarrhoeas, the water-washed diseases such as trachoma, yaws, scabies, the water multiplied diseases of schistosoma and guinea worm and the water vectored diseases of malaria and onchoceriases.

...12/

Traditional temperate area engineering practice has focused on water-borne disease and the problem of adequate treatment. These would not seem to be significant in the arid Bulenya Hills context except for the diarrhoeas, nor would the water-multiplied and water-vectored diseases be significant. More important would be the water-washed diseases and the limited evidence available suggests that these diseases can be substantially reduced by increased water availability for washing in dry areas. Balancing such health improvements is the potential increase, although extremely difficult to measure is the infection hazard brough about by concentrating people and cattle at a few watering places. The effect of the pipeline on the incidence of bilharzia is also a difficult question. The Bulenya Hills dam is infected with bilharzia snails and it has been suggested that the pipeline carries this disease throughout the pipeline service area. However, there is no evidence on the relative rates of incidence in the pipeline area and in the wider area of Nzega District.

Wealth. - An increase in wealth and economic yield can take place through an improved water supply in several ways: (1) by increased productivity through reducing disabling or debilitating water-related disease, (2) by increased productivity through the release of effort previously expended on the non - productive transport of water, (3) by the stabilization of settlement in fertile productive areas hampered by seasonal water shortage and (4) by the increase in livestock productivity through the use of new sources of grazing, operation of dips and markets, and improved watering of stock.

In the Bulenya Hills context it would appear difficult to evaluate the increase in labour productivity from health improvement when we know so little of the health impacts themselves. The benefits of released labour, particularly of women, in the arduous porterage of water is significant but valuing this is more difficult. We know from detailed surveys of Sukuma agricultural practices (Collinson, 1961-4) that differences in working days between men and women vary by about 15-25% or about one hour of agricultural work per day. Water porterage is only one of the many chores that contributed to this difference and it is not clear whether the released time would be used productively. The opportunity for such productive use would be mainly during the period of cultivation, when with heightened rains, alternative sources of water close at hand are usually found.

The major productive impact of the Bulenya Hills system would be the encouragement to permanent settlement making possible increased utilization of the land, improved agricultural practices, shifts from subsistence to cash crops, and the release of additional resources not fully utilized in areas of higher population density. Such increases appear substantial but need to be estimated carefully with full allowance for required ancillary investment and for projections of alternative growth without the water improvements. The potential for equally significant improvements in animal husbandry exists but is probably unrealized because of the well-known inhibitions towards a more commercially based livestock enterprise. Nevertheless the opportunities for improved grazing and cattle care have to be studied.

...14/

Convenience and well-being. - By providing water for drinking, bathing and laundry, rural water supplies can provide (1) greater leisure and convenience, (2) an incentive for the provisions of other services that may require water such as schools, shops, and particularly dispensaries and (3) a sense of communal satisfaction and evidence of governmental concern with popular well-being.

In the Bulenya Hills context the released labour will provide significant amounts of extra leisure and convenience. In terms of allocational inducements for other services it is difficult directly to ascribe such benefits to the project, but as secondary benefits they are clearly relevant. Finally, a significant but difficult to evaluate factor would be the sense of communal satisfaction. In the regional context, great emphasis is placed on the development of this area which is seen as a major opportunity in a less-favoured region of Tanzania. Similar feelings of satisfaction seem to exist on a district and local level.

It is important to note that not all water supply improvement may prove beneficial. For example, Bradley has observed that the provision of a permanent improved supply may lead to the concentration of users and thus actually increase the danger of contamination and the spread of disease. Or in another context P. Baker writing about Uganda notes:

> "The provision of large numbers of dams and tanks in Karamoja concided with massive programs of disease control (for cattle). The activities removed the principal

> constraints on cattle numbers. As consequence the number of stock grew rapidly in Karamoja. The Government however, was unable to provide grass, and with the balance of the traditional ecology upset serious overgrazing resulted. The outcome was a situation of considerably more hardship than had previously been the case."

(letter to Transition No. 36, 1968, pp. 11 - 12)

To summarize then, the major benefits from improved rural water supplies fall into three related classes of health, wealth and convenience. Very little attention has been given to assessment of these benefits or the occasional unbeneficial impacts as well. The available evidence for East African experience suggests that assessment of these benefits should prove difficult given the complex ecological and cultural environments. The generally accepted approach is the "with or without" analysis, but such analysis even with the use of base-line surveys always involves some speculative projection.

Finally a word of caution is in order. It has been suggested that engineers are often preoccupied with the technical problems of water supply development and fail to be sufficiently critical of the actual impacts of their construction and development activities. In seeking to remedy this there is an equal danger. Economists and economic geographers seeking to assess these impacts and aware of the many problems of measurement may err in the opposite direction. Beneficial impacts that are difficult to assess especially in quantitative terms are recognized in theory but tend to be ignored in practice. To ignore elements which cannot be measured precisely may be to ignore the very essence of development.

...16/

Sources of Data

The foregoing discussion on anticipated benefits suggest that the most readily assessible benefits are those dealing with population and crop production changes, and other benefits are more speculative. These are also the major benefits frequently cited in official documents and we have concentrated our research on these with more limited study of other benefits.

The study area in Northeast Nzega is poorly favoured in the availability of basic survey materials, maps and aerial photographs. No satisfactory map of the area exists, the only available map is the Nzega district map at 1:125,000 scale. Even the W.D. & I.D. maps of the pipeline area have prove unreliable and are now being revised by the Division. Aerial photographs are old (1951) and are now being analysed, but will probably not prove very helpful in measuring changes over the last six years. A new aerial survey of the area to be served by the pipelines from the Mwamapuli Dam is planned for June 1969.

The 1958 census used a very different territorial division and the data for smaller areas are not available. The occurrence of the 1967 census is quite fortunate but the descriptions of enumeration areas are ambiguous and some of the populations reported are anomalously high for these small areas. Compilations of cotton production by buying point have been made available through the countesy of the Ministry of Agriculture and have proven quite helpful. Advice and suggestions received from Assistant Director

...17/

J. Holloway, Regional Engineer Stanislawski, A. Hurle and Technical Assistant J. Punch have proven most useful.

The major source of data, however, has been our own field surveys. Twice in the last year in May and September teams of students and staff have visited the area and conducted an intensive survey in the farthest extension of the pipeline, the seven miles from Mbutu to Ibuta. In a four mile wide service area centered on the pipeline 178 households were interviewed (53% of the estimated households) and of these a detailed survey was made for 60 households. This survey included information on the farm (fields, crops, inputs, production and marketing) and the background and motivation of the settlers. In addition some households beyond the service area were interviewed to examine the range of pipeline influence.

The value of these surveys was somewhat reduced by the arduous field conditions in the area. During the wet season roads are totally impassable, all visits had to be made on foot, and to a certain extent both farmers and interviewers were reluctant to visit some of the more distant fields. When the team returned to measure these in the dry season, many of the farmers were absent and their wives were reluctant to undertake visits to their harvested fields in the absence of their husbands. The disastrous rains of the 1967-8 season also complicated the analysis by destroying much of the cotton crop.

Despite these difficulties it is possible from these data to sketch a broad picture of the present state of development in the service area and the historical process of settlement.

.../8

The present development of the Bulenya Hills service area

In February 1961, with the completion of the Bulenya Hills Dam, the first step was taken towards the opening up of the Mwambiti Plains. The pipeline distributing water from the dam was built in three stage. The first 5½ miles from the dam to Igunga was built in 1964, the next stage to Mbutu in late 1965, and the final 7 miles from Mbutu to Ibuta was completed in February-March 1967 (Fig. 1).

We have only a limited picture of conditions in the area before this time. The plain was probably only sparsely and seasonally populated. Cattle herders grazed their animals there during the rainy season when numerous pools and small streams provided a water supply. During the dry season, however, even large streams such as the Mbutu river become dry and water could be only obtained by digging into the dry river bed. Over most of the area the soil was so baked and dry, and watering places so rare that the herds were forced to move away to the east, to the permanent waterholes towards L. Kitangiri and the Wembere Plains.

For some time agricultural officers and other administrators had noted the potential of the soils of the area, and pointed to the need for an all year domestic and cattle water supply to open up the area for large-scale development. Of equal importance in the opening up of the area was the construction in 1962-3 of the new East-West Road from Singida to Nzega which passes through Igunga.

These two services have attracted large numbers of Wasukuma from the north, anxious to find land on which to grow cotton. We have no detailed

...19/

Fig. 1

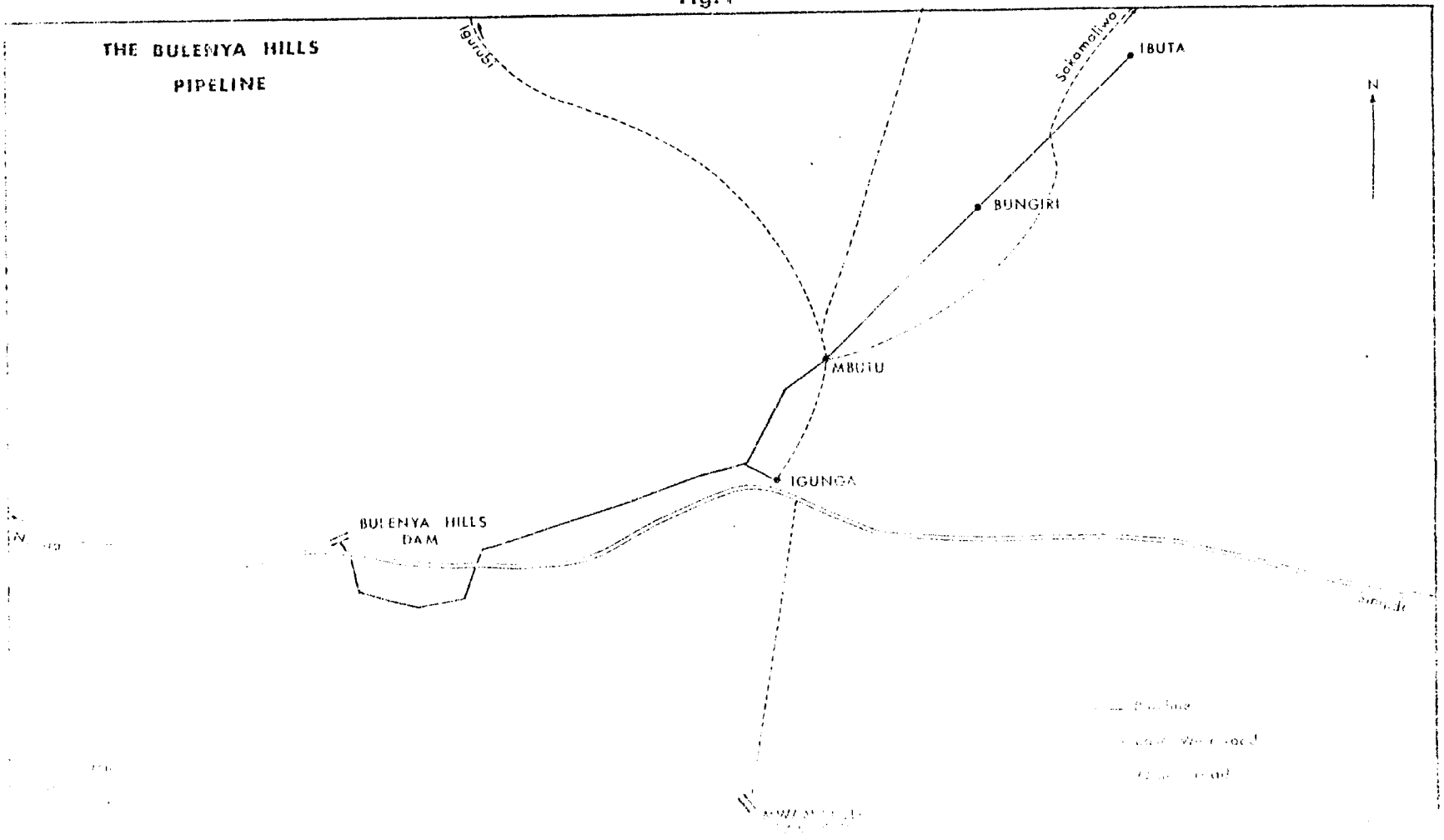
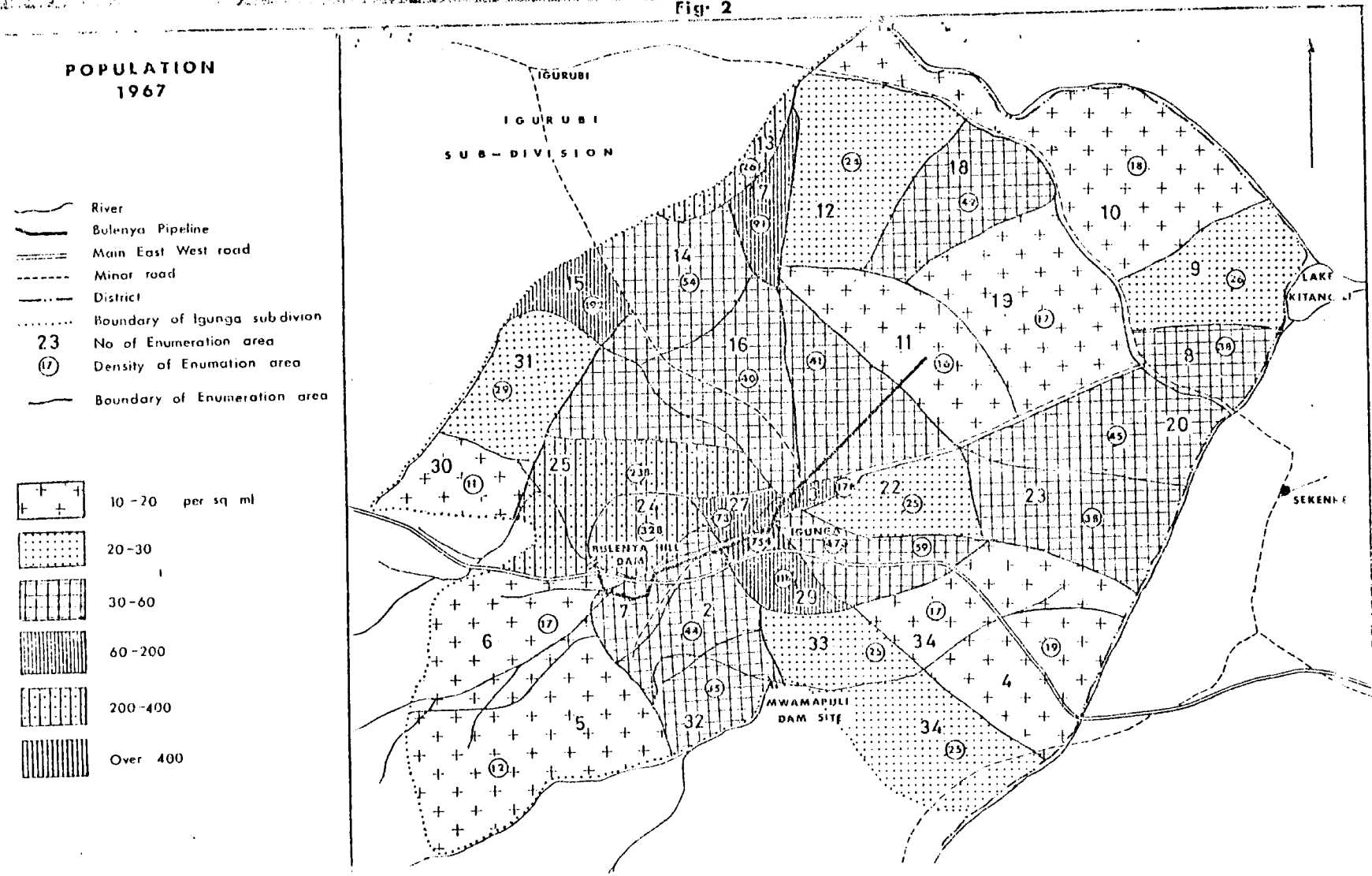

THE BULENYA HILLS
PIPELINE
Igurusi
Sokomoliwa
IBUTA
N
BUNGIRI
MBUTU
IGUNGA
BULENYA HILLS
DAM

Fig. 2


POPULATION
1967
River
Bulenya Pipeline
Main East West road
Minor road
District
Boundary of Igunga sub divion
23 No of Enumeration area
(17) Density of Enumation area
Boundary of Enumeration area
10 - 20 per sq ml
20 - 30
30 - 60
60 - 200
200 - 400
Over 400
IGURUBI
IGURUBI
SUB - DIVISION
BULENYA DAM
IGUNGA HILL
MWAMAPULI
DAM SITE
LAKE
SEKENE

information on the movement of people into this part of Nzega District, but the recent census does enable us to see the stage reached by this process in 1967. The density of population in each of the enumeration areas making up the Igunga Division is shown in Fig. 2. There is some doubt about the accuracy of the enumeration area boundaries, but on the basis of this census material it seems that in August 1967 there were some 8,000 people living within a two mile zone on either side of the pipeline.

With the arrival of Wasukuma settlers, the production of cotton in the pipeline service area has shown a marked increase. The five cotton buying posts serving the area purchased a total of 6,979,902 lbs (AR and FR) during the 1966-67 season, compared with a mere 50,717 lbs in 1960-61. The more detailed analysis of increases in cotton production presented later suggests that the pipeline is only one factor involved, however this increase is an impressive one.

Far less is known about fluctuations in the numbers of cattle kept in the area. A survey at present being undertaken by the Ministry of Agriculture should soon give us a picture of the distribution of cattle in Nzega District.

This, very briefly, is the present development of the pipeline service area. Most of our survey was concerned with only a part of this area and with the important variations found there.

The Process of Settlement and Growth

The different dates of construction of the water points along the pipeline allow us to observe various stages in the growth of the pipeline settlements.

Mbutu has had the benefit of a piped water supply since 1965 and has therefore had more time to develop than have Bungiri or Ibuta, whose present development gives us some clue as to the original form of Mbutu. Thus by comparing the three settlements it is possible to say something about the process of settlement. However, it is clear that part of the variation involved cannot be explained only in terms of the stage of development reached. As the original purpose of the survey was to isolate the impact of the water supply, Igunga was excluded, since there the impact of the main East-West Road has been considerable. It soon became clear that the effects of varying access to transport services were an important variable in all parts of the area, hence our discussion of the process of settlement includes this element. We begin this discussion of the processes involved by looking at the kinds of variation found in the Mbutu, Bungiri and Ibuta parts of the service area.

1. Settlement pattern.

By far the largest settlement cluster in this part of the service area is at Mbuta, which at the time of the survey had a total population of 86 families (383 people). This cluster is situated at the junction of the Igunga-Ibole and Igunga-Sakamaliwa roads, and at one of the water distribution points. So far, no such cluster has developed very close to the Bungiri or Ibuta distribution points. There is a ring of small settlement cluster about ¼ mile from the Bungiri tank, while population is more widely scattered in the Ibuta area. It is significant that neither of these distribution points is served

...21/

by a road. A cluster is developing along the Mbutu-Sakamaliwa road at the point where it passes closest to the Bungiri tank. This settlement at present contains 78 people. At the point where the Mbutu-Sakamaliwa road crosses the pipeline a T.Y.L. settlement of 31 people has been established at Ibutamisuzi. At this point there is one tap from the pipeline, but no cattle watering point. These differences in the settlement pattern of the area are clearly shown in Fig. 3.

The differences in the intensity of settlement between the Mbuta, Bungiri and Ibuta areas can be summarized by looking at the percentage of the total cultivable land which is actually utilized. Within a two mile radius of the distribution points, approximately 14 per cent is cultivated at Mbutu, compared with 7 per cent in Bungiri and 3 per cent in Ibuta.

2. Origins of settlers

Probably no more than 2 per cent of the present population were actually born in the pipeline service area. Most settlers have migrated from parts of Shinyanga, Mwanza, Singida and Tabora Regions (Table 4). Very few families are from Nzega District itself.

Table 4

Origin of settlers by tribe and region

Tribe	Sukuma	Nyamwezi	Iramba	Other
% of total households	59	12	13	16
Region of origin	Shinyanga	Mwanza	Tabora	Singida	Other
% of total households	35	19	18	15	13

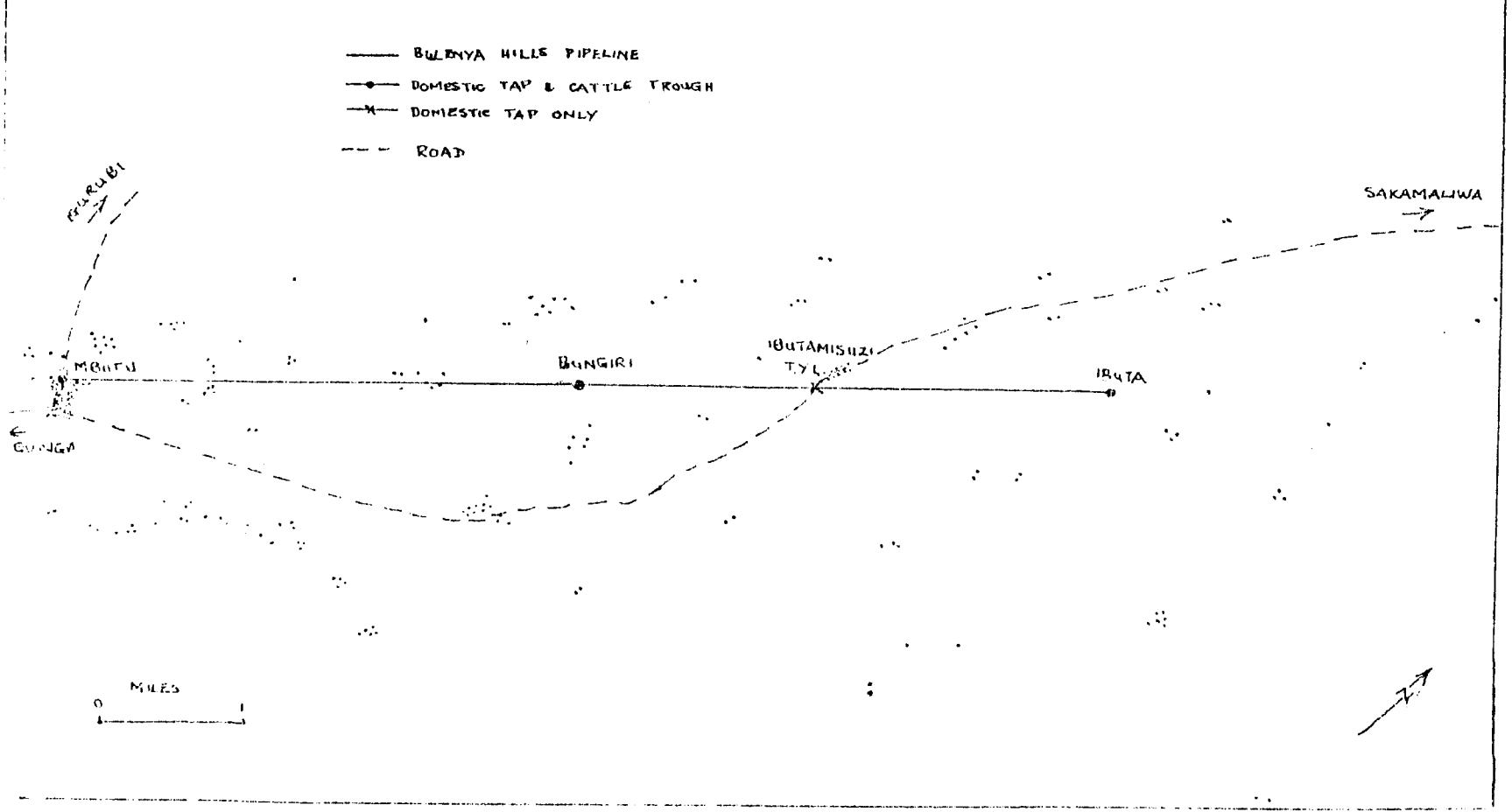
Within the area, people of the same tribe and from the same region tend to congregate in particular settlements. Most of the Iramba and Nyamwezi are found in the Mbutu area. In contrast, Sukumas constitute almost the entire population of the smaller settlements, with the exception of the T.Y.L. scheme, which includes representatives of a wide variety of tribes and regions. The ethnic composition of the settlers seems to have varied very little over time, with only a slight increase in tribal diversity among the more recent arrivals.

3. Settler motivation

All of the heads of households were asked how they heard about the Bulenya Hills area and why they had decided to come there. The majority had moved in the hope of getting better crops in the new area. About 40 per cent had been told of the fertility of the area by relatives or friends, while a similar number had seen the area for themselves while travelling along the East-West Road. About 17 per cent stated that they had moved to join relatives already living in the area. Several of the newer settlers came specifically to grow cotton, but in almost no case did a farmer single out the pipeline as the main attraction. Some people expressed the hope that they would now benefit from the improved water supply. Only two heads of households said that their main hope in coming was to obtain non-agricultural employment.

...23/

FIG. 3 : DISTRIBUTION OF HOUSEHOLDS WITHIN THE SURVEY AREA



4. Time of settlement

Almost all the settlers have moved into the area in the last 10 years, and 79 per cent since 1962 when the East-West Road was built. The rates of growth in the different areas over the last ten years can be seen in Fig. 4a, which shows the percentage of the present population reached in each year since 1958. It must be noted that these figures were derived from information on the dates of arrival of the current population and takes no account of settlers or original inhabitants that have now left the area, but we feel that the general picture is an accurate one. For this purpose the two settlements along the Igunga-Sakamaliwa road have been grouped together, as they show similar growth patterns. All areas show a marked growth over the last six years, but this is greatest in the case of Mbutu and the settlements along the road, which have experienced fairly constant growth since 1962. Bungiri and Ibuta have a much higher proportion of settlers who have been in the area for more than 7 years (Fig. 4b). The growth of these two settlements has been somewhat slower and more irregular, with no noticeable changes in growth rates since the construction of the pipeline.

5. Household composition

The average household size in the area is 6.1 persons, but there is much variation, ranging from 3.1 in the T.Y.L. scheme and 4.3 in Mbutu to 8.6 in Bungiri and 8.7 in Ibuta (Table 5).

...24/

Table 5

Household composition

	Persons per household	Man equivalents* per household	Persons per man equivalent
Mbutu	4.3	2.2	2.0
Bungiri	8.6	3.8	2.3
T.Y.L.	3.1	2.0	1.6
Ibuta	8.7	4.4	2.2
Total	6.1	2.9	2.1

This can largely be explained in terms of the differences in length of residence of the settlers for, as Table 6 shows, the settlers coming to the area more recently have consistently smaller families. Because of the large numbers of relatively new settlers, the average family size of 6.1 is somewhat lower than that of 7.2 recorded by Collinson (1961-65) in Sukumaland.

Table 6

Family size in relation to length of stay

No. of years in settlement	Persons per household	Man equivalents per household	Persons per man equivalent
1 - 2	4.4	2.1	2.14
3 - 4	5.6	2.6	2.13
5 - 6	7.4	3.4	2.16
Over 6	9.5	4.4	2.22

A more useful measure of household size is the size of the labour force, measured in man equivalents. The average number of M.E.s per household is 2.9. The variation with place and length of stay is similar to that of persons per household, the newer settlers having a smaller workforce as well as total family size. The average is also less than the 3.2 quoted by Collinson for Sukumaland.

---

*The man-equivalents used here are those developed by Collinson (1961-5) to standardise the measurement of work potential of a family group. The values are derived as follows:

Age	Over 50	19-50	15-18	10-14	Under 10
Male	0.67	1.00	0.67	0.25	0
Female	0.50	0.67	0.50	0.25	0

.../25/

GROWTH OF SETTLEMENTS 1958-68

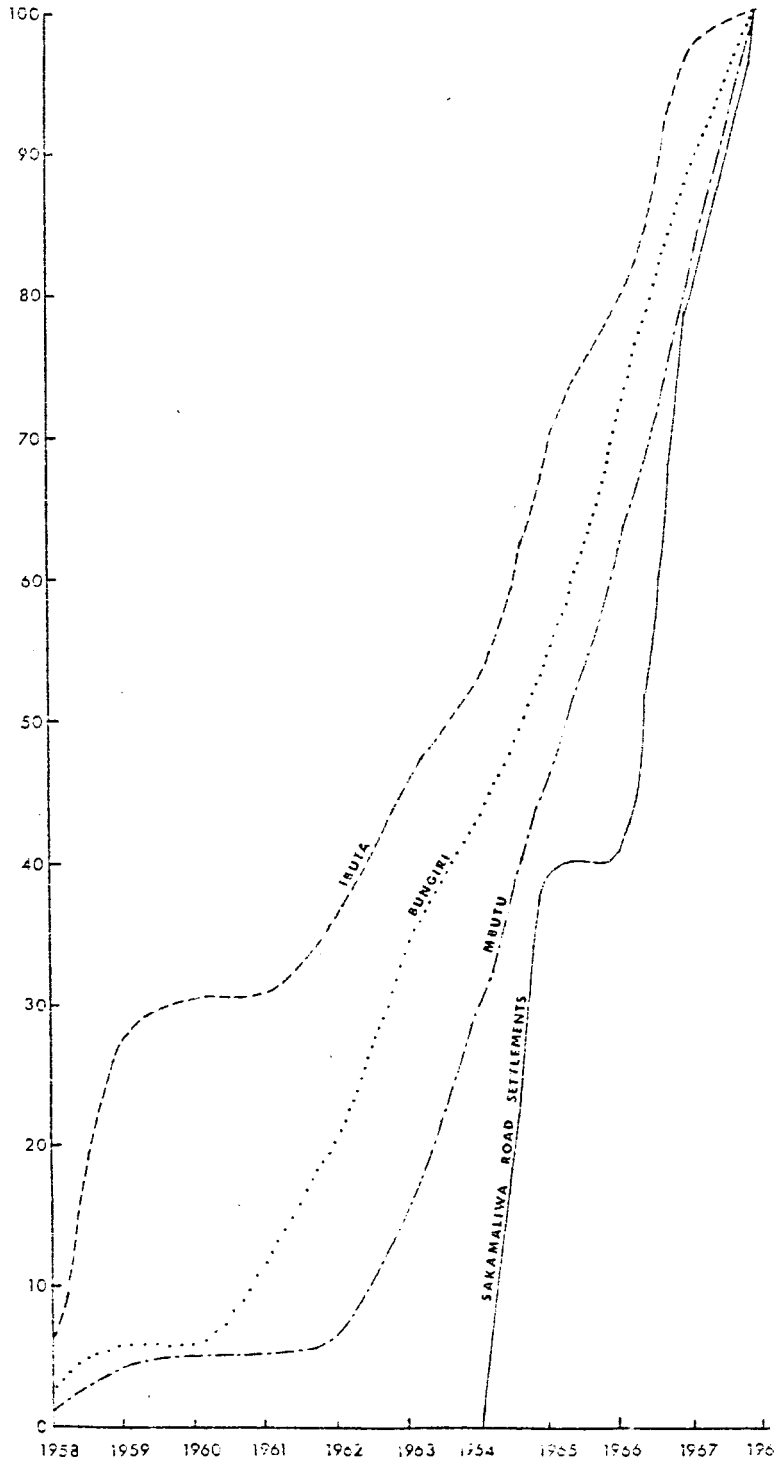
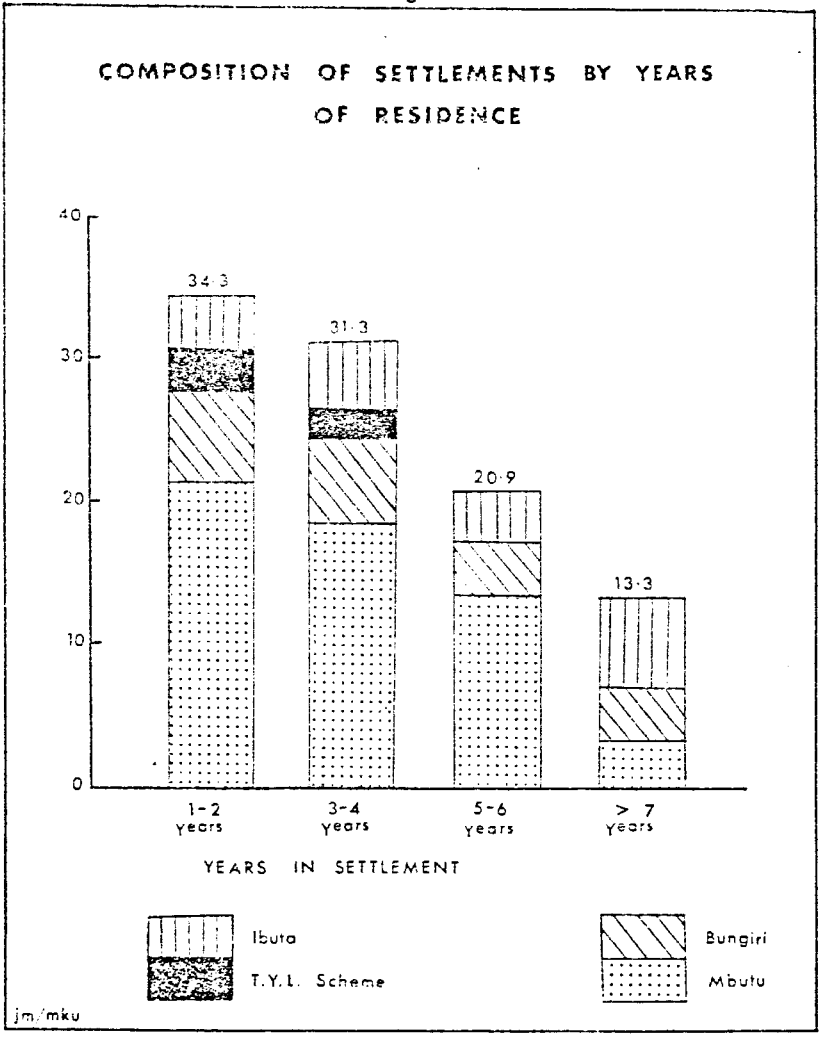


Fig 4b


COMPOSITION OF SETTLEMENTS BY YEARS OF RESIDENCE
40
30
20
10
0
34·3
31·3
20·9
13·3
1-2 years
3-4 years
5-6 years > 7 years
YEARS IN SETTLEMENT
Ibuta
T.Y.L. Scheme
Bungiri
Mbutu
jm/mku

Another measure of household composition is the number of persons per man equivalent, which reflects the number of dependents in the family. Again there is considerable variation within the area, the workers of Mbutu and the T.Y.L. schemes having to support fewer people than those of Bungiri and Ibuta. In this case there is very little variation with the length of stay, and the average figure of 2.09 is only slightly lower than the 2.25 recorded by Collinson.

6. Wage work experience

Some 29 per cent of the settlers interviewed had previous wage work experience. The large majority of the population had always been farmers, cultivating their own land.

7. Land cultivated

The average amount of land cultivated in the area is 7.4 acres per household, the figure varying from 5.9 acres in Mbutu to 7.2 in Ibuta, 9.7 in Bungiri and 11.1 in the T.Y.L. (Table 7). The low figure for Mbutu is largely explained in terms of the numbers of recent settlers, for there is a marked tendency for the acreage to increase with the length of time the household has been established in the settlement (Table 8). This relationship is obviously related to the differences in the size of labour force available per household, the large households in Bungiri and Ibuta being able to cultivate larger acreages. In terms of acres per person, the farmers at Mbutu are able to cultivate more than those at either Bungiri or Ibuta. The very high acreage figure for the T.Y.L. scheme needs further explanation. The settlers are able to borrow a tractor to cultivate their communal cotton field and are thus using a very different technology.

.../26/

Also it seems likely that the T.Y.L. settlement land recorded by the enumerators is not all cultivated in any one year.

Table 7

Acreages cultivated by area

	Acres per household	Acres per person
Mbutu	5.9	1.4
Bungiri	9.7	1.1
T.Y.L.	11.1	4.2
Ibuta	7.2	0.8
Total	7.4	1.3

Table 8

Acreages cultivated in relation to length of residence

No. of years in settlement	Acres per household	Acres per person
1 - 2	4.5	1.0
3 - 4	7.5	1.3
5 - 6	8.6	1.2
Over 6	11.7	1.2

It is interesting to note that the average figure recorded by Collinson was 5.9 acres per household, exactly the same as Mbutu.

The T.Y.L. scheme was, at the time of the survey, the only settlement having any communally farmed land. There, about 90% of the scheme's land was communal.

Crop Mix

Cotton accounted for 42 per cent and maize 32 per cent of total crop acreage on the sample farms during the 1967 - 68 season. Millet, sorghum, groundnuts and sweet potatoes accounted for most of the remaining land.

...27/

The areal variations are very marked, and here the effects of communications seem to be important. Mbutu and the two settlements along the Igunga - Sakamaliwa road have a considerably higher percentage of land under cotton than do the other settlements (Table 9).

Table 9

Areal variations in crop mix

	Cotton (%)	Maize (%)	Other (%)
Mbutu	55.3	36.3	8.4
Road	69.3	28.0	2.7
Bungiri	24.8	22.5	52.7
Ibuta	36.5	39.7	23.8
Total	42.4	32.2	25.4

The relationship between cropping patterns and the length of residence is shown in Table 10. Cotton is of greatest importance among those households which have been in the area for 3 - 4 years. It seems likely that the more recent settlers intend to cultivate more cotton, but have not yet built up to their full acreage.

Table 10

Relationship between crop mix and length of residence

No. of years in settlement	Cotton (%)	Maize (%)	Other (%)
1 - 2	35.2	34.8	30.0
3 - 4	64.3	28.4	7.3
5 - 6	34.7	35.2	30.1
Over 6	36.0	26.7	37.3

9. Cattle

It is notoriously difficult to obtain accurate data on cattle numbers, and our information is no more than a rough approximation. However it is likely that we can make some comparisons between

.. 28/

the various settlements in the area. Excluding the T.Y.L. scheme, where no cattle are kept, the average number of cattle owned are about 14 per household or just over 2 per person. There is great areal variation, the number of cattle increasing markedly in Bungiri and Ibuta (Table 11). This can be largely related to the length of residence of the households in the settlements (Table 12).

Table 11

Areal variations in cattle numbers

	Cattle per household	Cattle per person
Mbutu	6.1	1.1
Bungiri	17.1	1.9
Ibuta	33.9	3.7
Total	13.8	2.0

Table 12

Cattle owned in relation to length of residence

No. of years in settlement	Cattle per household	Cattle per person
1 - 2	3.6	0.8
3 - 4	8.2	1.5
5 - 6	16.1	2.2
Over 6	41.0	4.3

10. Material wealth

Cattle are one of the main indicators of material wealth in the area. An attempt has been made to produce a general wealth index based on the quality of housing, furniture, clothing and the ownership of a bicycle and radio, as well as livestock numbers. On this index, Bungiri and Ibuta rank highest, followed by Mbutu. The T.Y.L. scheme falls considerably lower than the other settlements.

...29/

Table 13

Material wealth index by area

	With Livestock	Without livestock
Mbutu	3.22	2.35
Bungiri	4.39	2.31
T.Y.L.	1.60	1.60
Ibuta	4.42	1.84

As has been shown in a wider survey of 12 new settlements in Tanzania (Kates, McKay and Berry, 1969), material wealth is usually accumulated with age, and with length of stay in a settlement. This general pattern is clearly found in the Bulenya Hills area (Table 14). The material wealth index results

Table 14

Material wealth by length of residence

No. of years in settlement	Material wealth index with livestock	Material wealth index without livestock
1 - 2	2.92	2.24
3 - 4	3.48	2.20
5 - 6	3.94	2.16
Over 6	4.71	2.22

are very largely determined by the importance given to livestock, however this is the stress also given by the Sukuma farmers. When cattle are excluded from the index Mbutu and Bungiri rank highest, with Ibuta considerable lower, and the T.Y.L. scheme again the worst off. There appears to be no significant variation with length of residence in the settlement.

Using these variations in the socio-economic structure of the survey area we are able to draw a number of conclusions about the process of settlement taking place around the Bulenya Hills pipeline.

.../30

Mbutu and Bungiri, which have only just received the improved water supply, represent conditions as they must have been over much of the pipeline service area until very recently. Mbutu, favoured by better communication and earlier construction of the water point, points more the kind of development that is possible in such an area of high cotton - growing potential. Mbutu and Bungiri have larger households of the extended family type, sons setting up their houses around the homes of their fathers. Farmers in these areas have small crop acreages, and a smaller percentage of their land devoted to cotton, and have considerably larger herds of cattle. Families in Mbutu are smaller, of the nuclear family type, have higher percentages of their land under cash crops, and as yet have small numbers of cattle. These differences are summarized in Figs 5a and 5b. Clearly for most newcomers to the area the most attractive site for settlement within the survey area is at Mbutu, mainly because of better communications and easier access to medical and other services. It seems likely that unless something is done to improve communications from Mbutu and Bungiri, these sites will only be developed when growing pressure on available land forces newcomers to look outside Mbutu. In the next section we seek to predict rates of growth over the next few years to judge when this widening of the settlement area is likely to take place.

Projections of Future Development in the Service Area

The differential process of growth and development in the Mbutu - Ibuta sector of the pipeline

...31/

FIG 5a : CATTLE & ACRES PER PERSON BY AREA

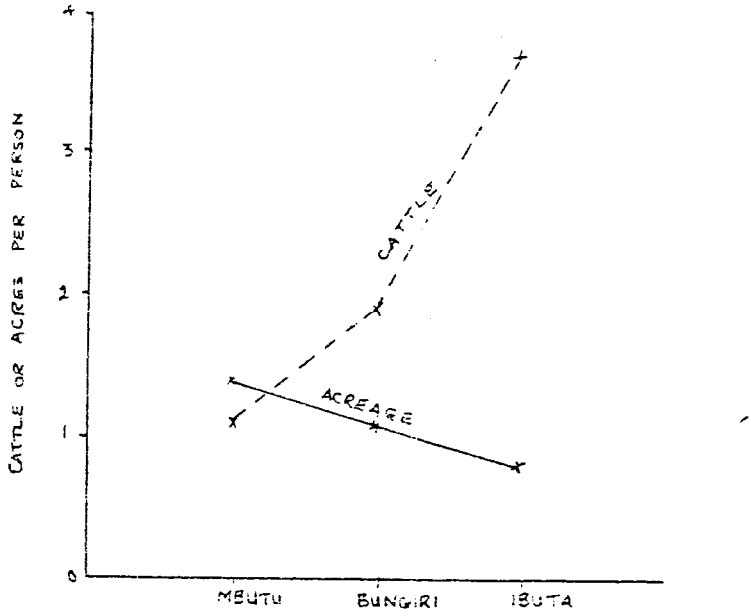
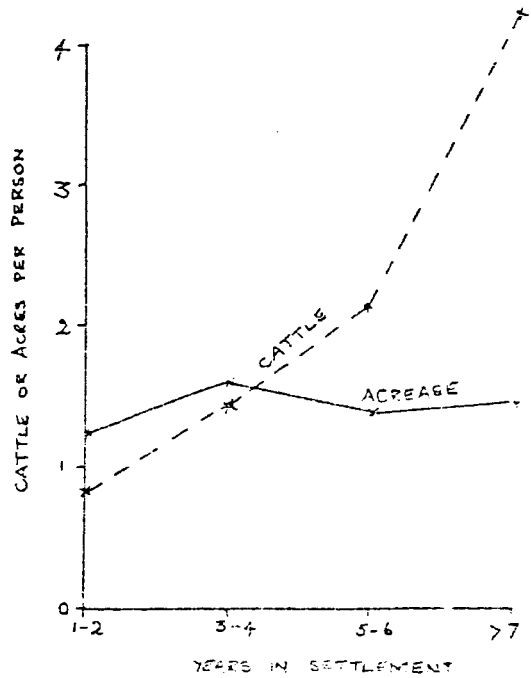


FIG. 5b : CATTLE & ACRES PER PERSON BY YEARS IN SETTLEMENT



over the past six years provide a basis for limited projection into the future of the service area development. We have chosen 1975 as our forward planning date as it coincides with the end of the Second Five Year Plan and provides an average of a ten year development period for the pipeline giving an adequate period to consider future benefits.

We have noted previously the consistently differentiated pattern of growth between - Mbutu, Bungiri and Ibuta with markedly lower growth rates the further out along the pipeline one ventures. This phenomenon, already shown in Figure 4a, is shown in an alternative way in Figure 6, which seeks to present differences in growth of amounts of cultivable land actually used over the last ten years.

Table 15

Estimates of Population, Cattle and Cultivated Area for Survey Section, Pipeline Service Area[1]

Number of Households	334
Number of Persons	1,964
Persons per household	589
Cultivable land (95% of total acres)	26,752
Cultivated land (acres)	2,274
Per cent of cultivable land-cultivated	8.5
Cotton acreage	955
Per cent cultivated land in cotton	42
Cultivated land per capita	1.16
Number of cattle	3,955
Cattle per capita	2.01

[1]The Survey Section of the Pipeline Service Areas extends from two miles before Mbuta to two miles beyond Ibuta and two miles on each side of the pipeline giving a rectangular area of 44 square miles (4 x 11). Estimates are based on total household count for half of the area and includes interviews with 176 households.

.../32/

These different growth rates are apparently related to distance from the main East-West Road rather than to different inauguration dates of the pipeline segments. The increments of growth for each area have stayed pretty constant over time although the rate of increase has been decreasing.

A linear plot of agricultural development for each sub-area of the survey area until 1975 is also shown in Figure 6. The assumption of employing a straight-line projection seems viable through 1975 although in Mbutu at least one would suspect increased friction for land especially close in to the settlement center and even now there are already reports of such friction. Taking the Mbutu sub-area by itself, by 1975 about 32 per cent of the cultivable area will be under cultivation, and this does not seem a significant limit before which a marked downturn in the rate of growth takes place. Combining the sub-area projections, Table 16.

Table 16

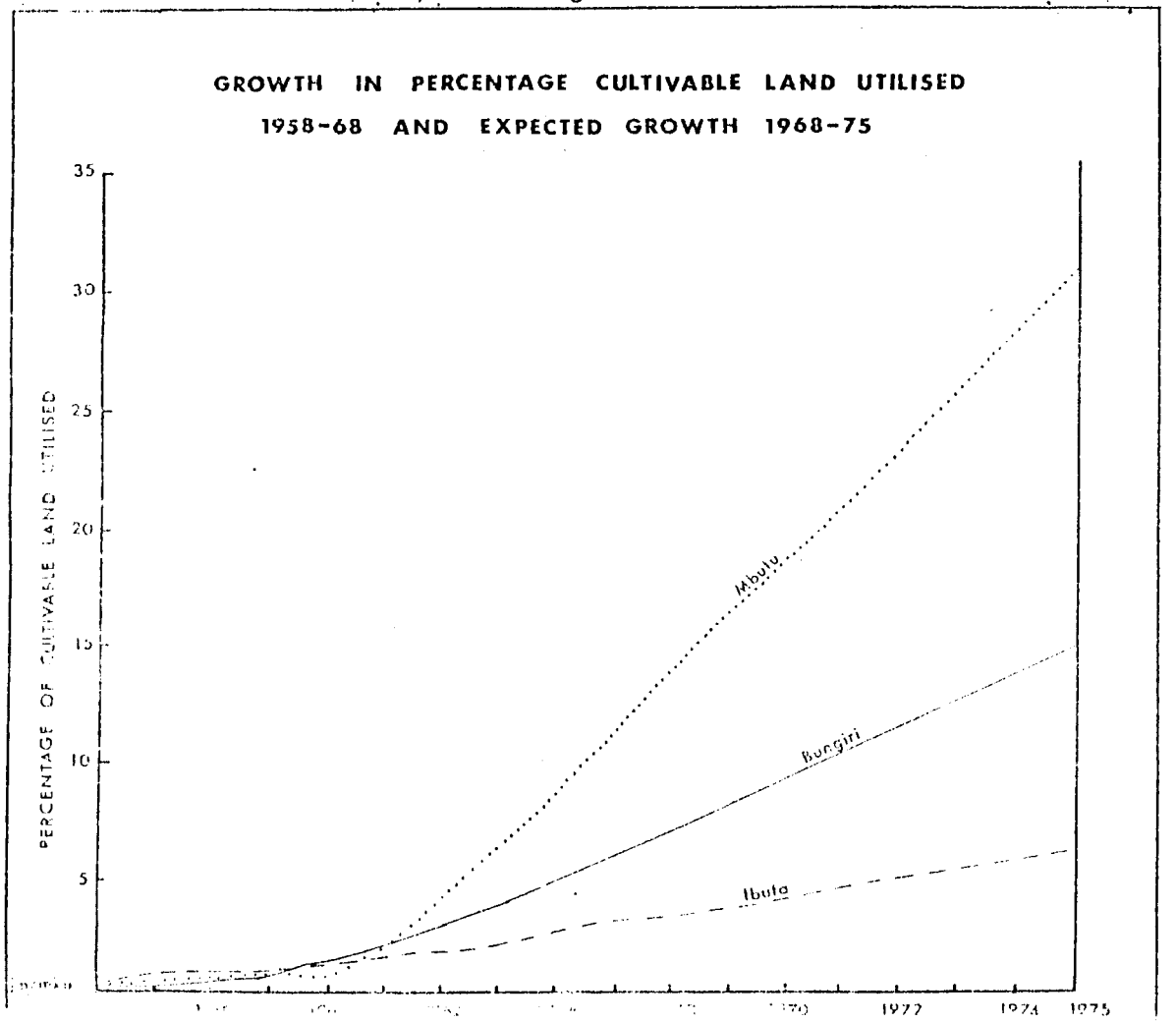
Projections of Population, Cattle and Cultivated area for Survey Section, Pipeline Secure area, 1962, 1968, 1975[1]

	1962	1968	1975
Households	50	334	700
Population	295	1,964	4,130
Cultivated Area	320	2,274	4,800
Cotton Area	130	955	2,010
Cattle	610	3,955	8,310
% Cultivable Area Cultivated	1.2	8.5	17.9

[1]Projections based on population/household, population/cultivated area, population/cattle, and cotton/cultivated area ratios of 1968.

...33/

Fig. 6


GROWTH IN PERCENTAGE CULTIVABLE LAND UTILISED
1958-68 AND EXPECTED GROWTH 1968-75
PERCENTAGE OF CULTIVABLE LAND UTILISED
35
30
25
20
15
10
5
Mbulu
Bungiri
Ibuta
1972
1974
1975

sets out the projection for the Survey Area, the Mbutu-Ibuta sector of the pipeline. Over the past six years the number of families has increased approximately seven-fold from the very low base of approximately fifty households. Starting from the higher base of our present estimate of 334 households, we would expect that to double again by about 1975. Keeping constant average cattle and land holdings and using a proportion of 42 for cotton cultivation (42-45 is a figure found for cotton cultivation in wide areas of Sukumaland) we have calculated the increase in cattle and cotton land under cultivation as well.

Turning now to the entire service area, we think that conditions in Mbutu are probably more typical of relationships in the Igunga sector than the more remote areas and we have relied more heavily on the data from there. We have made a somewhat conservative estimate of overall population growth forecasting slightly less than a doubling by 1975, with population going from 8,000 to 15,000 in the coming seven years (Table 17).

Table 17

Projections of Population Cattle and Cotton Acreage for Pipeline Service Area, 1968-1975

	1968	1975
Population	8,000	15,000
Cotton Acreage	5,600	12,000
Cattle	10,000	24,000

Cattle holdings will increased faster as cotton earnings are put into cattle but cotton land will increase only at a slightly faster rate than the

...34/

population. Thus in 1975 we expect by 1975 15,000 people, 24,000 cattle and 12,000 acres of cotton under cultivation.

Infrastructure and development of Cotton Production

We have already seen that there has been a sizeable increase in cotton production in the area served by the Bulenya Hills Pipeline. We now address ourselves to the question of how much of this expanded production can be directly attributed to the provision of the domestic water supply alone.

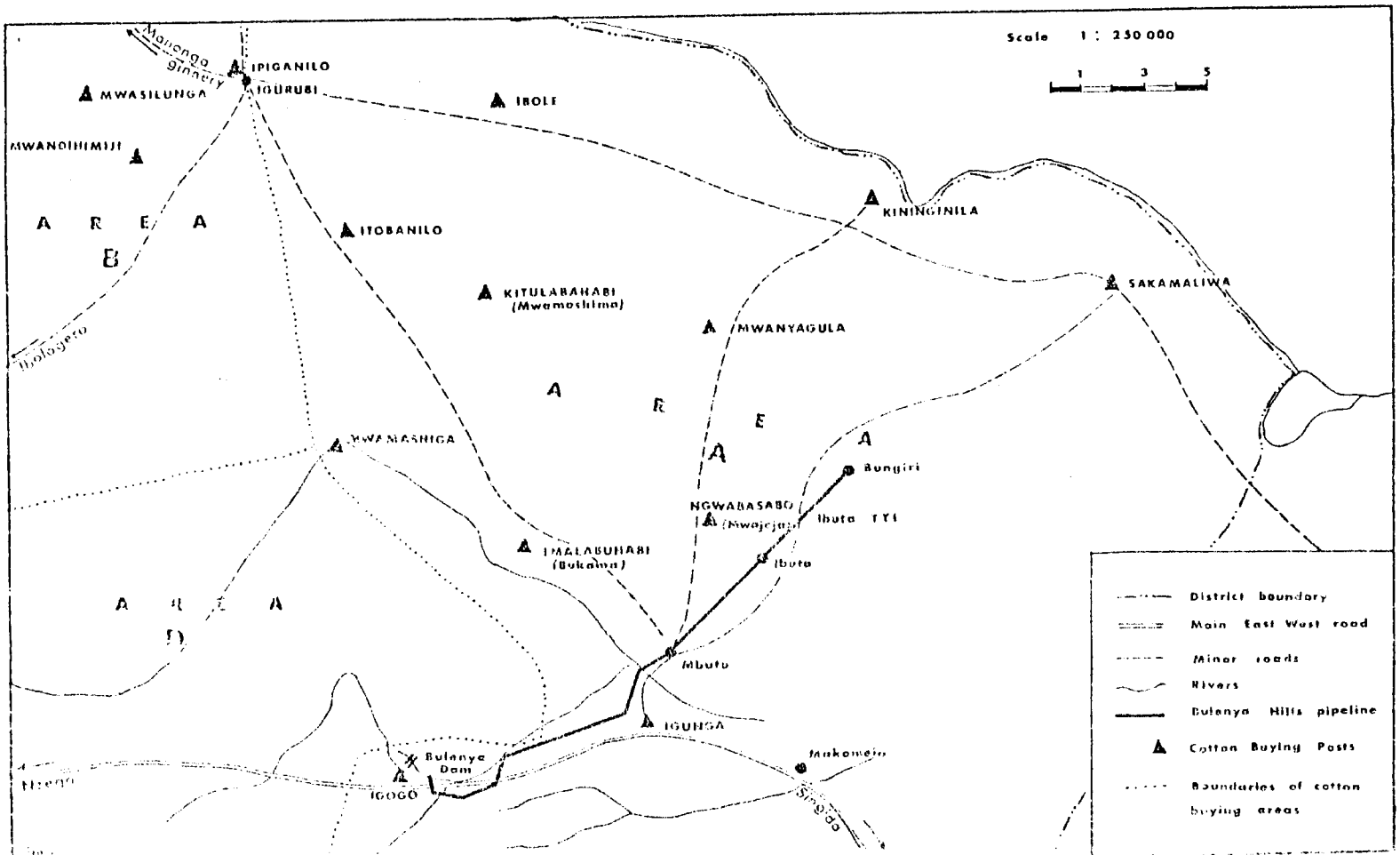
A detailed examination of the purchases made by buying posts serving the Bulenya Hills service area (Fig. 7) seems to indicate a relationship between the dates of pipeline construction and the increase in cotton production (Table 18). Overall cotton production has shown a general increase, and the buying posts serving the Bungiri and Ibuta areas have become important only in the last two to three years. However, to exaplain this pattern only in terms of the construction of the pipeline would be a gross oversimplification. In Nzega District as a whole, five main factors - would seem to control the level of cotton production:

(1) The weather, and in particular the timing and amount of rainfall.

(2) The number of Sukuma migrants moving into a particular area to grow cotton. The availability of domestic water supply for these settlers is of extreme importance.

...35/

COTTON BUYING POSTS



(3) The level of the cultivation techniques employed by the farmers, and the availability of inputs, such as fertilizers, insecticides and improved strains of seeds.

(4) The proximity of cotton buying posts to areas of potential production, and the availability of means of transporting the cotton from the farms to the co-operatives.

(5) The price the farmer expects from the sale of his cotton.

The use of an improved variety of seed seems to have been of great importance in increasing the output of cotton in the Bulenya Hills area. During the 1962-63 season the variety of cotton formerly grown in the area (U.K. 51) was replaced by the higher yielding U.K. 55. This largely accounts for the 204 per cent increase in production in this eastern part of the Manonga Ginnery Zone between 1961-2 and 1962-3. By the next season (1963-4) even more farmers had recognized the profitability of growing much high - yielding cotton, and production increased by a further 51 per cent. Thus production had almost reached 7.5 million pounds even before the pipeline had reached Igunga. This latter increase was also encouraged by the

Table 18

Purchases by cotton buying posts serving the Bulenya Hills Pipeline area

	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67
Igunga	50,717	419,288	1,874,081	1,592,104	1,285,222	2,274,506	1,527,829
Mwanyagula	-	15,590	-	1,230,928	1,402,190	1,765,122	2,085,064
Ng'Mwabosabo	-	-	-	-	-	1,596,845	1,467,602
Sahamaliwa	-	330,902	914,059	1,004,870	618,379	1,805,333	835,536
Igogo	-	-	-	-	229,365	1,383,385	1,063,871
Total	50,717	765,780	2,368,852	3,827,902	3,535,156	8,825,191	6,979,902

Source: Records of purchases by primary societies

.../36

construction of the new main East - West road from Singida to Nzega, passing through Igunga, which was completed in 1962-63. This allowed the easier movement of cotton to the buying posts at Igunga and Isoso, but more particularly encouraged more Sukuma to settle in the area.

The importance of these other factors is seen when one compares production increases in the Bulenya Hills service area with the rest of Nzega District and with Tanzania as a whole (Table 19)

Table 19

Comparison of cotton production in the Bulenya Hills area, Nzega District and Tanzania (1963-67)

(1963 = 100)

	1963-4	1964-5	1965-6	1966-7
Bulenya Hills service area	100	92	231	182
Rest of Area A	100	133	222	253
Area A Total	100	112	227	193
Area B	100	107	184	194
Manonga Ginnery Zone	100	111	210	214
Tanzania total	100	126	148	133

The impressive expansion of cotton growing in the pipeline area has been matched by a very similar increase in the whole of Areas A and B (Fig. 7), and in the Manonga Ginnery Zone as a whole. Indeed the performance of the rest of buying Area A has been marginally better, although examination of the service Area's production as a percentage of total Area A output shows that the difference is small (Table 20).

Table 20

Cotton output of Bulenya Hills service area as a percentage of total production of Area A

1961-2	1962-3	1963-4	1964-5	1965-6	1966-7
47	43	52	43	53	44

.../37

Variations in production within the service area have been rather greater than within the rest of the Manonga Zone. In a generally good year the pipeline area has performed relatively well, but drops in production in less good years have been relatively greater than in the rest of the Zone.

If we assume that the effects of weather and of the year to differences in the price paid to farmers for their cotton are the some over the restricted area of the Manonga Zone. The pattern of production within the area can be explained in terms of the three factors mentioned earlier. The importance of the introduction of a new variety of cotton has already been noted. The movement of Sukuma cotton farmers into various parts of the District is of vital importance, and explains why production in the Manonga Zone has grown at a rather faster rate than in Tanzania as a whole.

The foregoing may seem to discount the importance of the pipeline construction and suggest that the increase in the Bulenya Hills area is only part of a wider development that would have taken place in any case. This is far from the case. In an area of such severe seasonal water shortage, incoming farmers have only been able to settle in areas where an all-season water supply is sufficiently close. The vast majority of the increased cotton output has taken place in two areas: firstly, fairly close to the Manonga River close to the ginnery at Chemachankola; and secondly in the Bulenya Hills pipeline area. The Manonga

...38/

River provides an all year water supply and was thus a favoured area for settlement. Similarly the Mbutu River provided water for the Igunga area and allowed earlier settlement to take place close to the East - West Road. The pipeline has opened a much greater area to settlement, and thus cotton production has increased. It is also important to remember that the last stage of the pipeline has only just been completed and we have only witnessed the early stages of development. As with all impact studies it is almost impossible to predict what cotton production would have taken place without the construction of the pipeline. Some cotton farmers lived in the area before the pipeline was built, and important increases in cotton production have taken place in other parts of Nzega District. However, the improved water supply has opened up a larger area of fertile soil and as such has played a vital role in the recent development of the area - a growth which is only the first step in realising the full potential of the area.

Benefits due to the Pipeline

To sum up our findings on the impact of the Bulenya Hills pipeline we can return to our original classification of anticipated benefits into those related to health, wealth and convenience.

Health

The lack of medical staff in our research group means that we can add nothing to the short discussion on health and water supply presented at the beginning of this paper.

...39/

Wealth

We have seen that over the last few years there have been impressive developments in the Bulenya Hills pipeline area. There have been considerable increases in population and in cotton output. The cotton crop of 6,979 lbs. bought in 1966/7 by the primary societies serving the pipeline area provided a significant contribution to the wealth of the region. Were one to attempt a proper benefit/cost appraisal of the pipeline one would have to ask two important questions:

(i) To what extent this cotton production represents output that would have been produced by the present Bulenya Hills settlers even if the new land in Nzega District had not been available, or to what extent the new settlers represent a formerly landless group that would have been able to produce no cotton in the former areas.

(ii) To what extent have factors other than the pipeline contributed to the growth of output, and to what extent would this growth have taken place had no pipeline been constructed.

As regards the question of whether this production in Nzega District is merely the transfer of output from one area to another, we would feel that in the main the growth is a real gain to the Tanzanian economy. Pressure on the land in Sukumaland, the home area of many of the settlers, is such that many people are being squeezed out

...40/

because of the lack of sufficient land. Most farmers said that they came to the area so that they would have room to grow larger acreages of crops, and they felt that the yields on the new soil of the Mwambiti Plains would be higher than in their old home areas.

The question of the role of other inputs and investments is much more difficult to answer. Indeed, the data collected from our short survey do not allow us to even attempt to isolate out the effects of the investment in the water pipeline. It may be that one should not even attempt to do so even with more detailed information. Those concerned with both the theory and practice of rural development are generally becoming convinced of the inter-related nature of the vast majority of stimuli and agents for developments. All we can say in this case is that in the recent impressive growth of population and production in north-east Nzega District the Bulenya Hills pipeline has played an important role by providing a permanent water supply to an area of such seasonal aridity, but other factors, notably the construction of the East-West Road, have been equally important.

Convenience

There is no doubt that the convenience effect of the pipeline has been very great. Even if we were to take the extreme view that even without the building of the pipeline large numbers of cotton farmers would still have come into the area, one would still have to admit that the new

...41/

water supply has made a tremendous difference to the lives of the people in the area. One has only to observe the water supply problems when, as happens all too frequently, the pipeline is broken to realise this fact. There is no river in the area, other than the Manonga far to the north, that maintains a flow throughout the dry season. The people of Mbutu have to dig in the dried up bed of the Mbutu River for water for themselves and their cattle. The farmers around Ibuta have to drive their herds as far as the Manonga River. We are not able to say to what extent the time saved by the pipeline, when it is operational, is put into productive activities, but this permanent water supply certainly reduces the drudgery of the daily task of the area's households.

The Need for Integrated Planning and Development

The major lesson from this survey that should be carried forward to the planning of the new pipelines from the Mwamapuli Dam, is that the investment in improved water supplies should not be viewed in isolation from the other development inputs that are needed in the area. We have seen how development has first taken place at the points where the pipeline and the roads came together. This is only one example of how the combination of several inputs can produce results greater than the sum of the individual components. By themselves the new pipelines would have beneficial effects on the areas, but their value can be many times enhanced if the pipelines, roads, marketing structure, agricultural extension programme, and a variety of other services can be all co-ordinated in one development plan for north-east Nzega District. It was for this

....42/

reason that the Bureau put forward the idea of working on such a plan. The idea was accepted by the Government departments involved, and the fieldwork for the wider survey is now underway. It is hoped that this new survey will provide much more detailed information for a far wider area and be the first stage in the co-ordination of a variety of development agencies. If this can be achieved, the very modest study reported in this paper, by being a first pointer in the right direction, will have more than achieved its original aims.

References:

Bradley, D.J. and Murwa, P.E. (1968) "Predicting the Epidemiological Effects of Changing Water Sources", a paper presented at the conference on - Change and Disease in Africa, Makerere University College.

Collinson, M.P. (1961-65) Farm Management Survey 1 - 4, Western Research Centre, Ukiriguru, mimeo.

Kates, R.W, McKay J. and Berry L. (1969) "Twelve New Settlements in Tanzania: A Comparative Study of Success", paper prepared for the University of East Africa Social Science Conference, Makerere University College.

White, A.V. (1968) "Social Cost and Individual Disease in Domestic Water Use in East Africa", a paper presented at the Annual Meeting of the Association of American Geographers, Washington.

White, G.F. (1968) "Domestic water Use and Cost", a paper presented at the conference on Change and Disease in Africa, Makerere University College.