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AGRICULTURAL CHANGE IN MAZABUKA DISTRICT, ZAMBIA†

INTRODUCTION

A study of Mazabuka district of Zambia formed part of a broader investigation of factors affecting agricultural change in tropical Africa by an interdisciplinary team from the Food Research Institute of Stanford University. Detailed studies were made of agricultural development in a number of areas in East, Central, and West Africa which provided a wide range of contrasts in agricultural potential and development. Mazabuka district is an example of a savanna area with a high potential for crop production and a situation of active agricultural change. There is a well-documented history of the acceptance of new farming methods by the Plateau Tonga, and a short field survey, carried out by the authors in June 1967, provided an assessment of the response by farmers to the new planting material and techniques that have become available to them in the present decade. An interdisciplinary approach was necessary as agricultural change is influenced by a whole complex of interrelated factors. Relevant factors include social traditions and attitudes to change, land tenure, the extent to which knowledge is available on methods of increasing farm productivity, the cost to the farmer of adopting new methods and the benefits that accrue to him, the means of disseminating information, facilities for marketing produce and purchasing farm requirements, the availability of credit, and government agricultural policy.

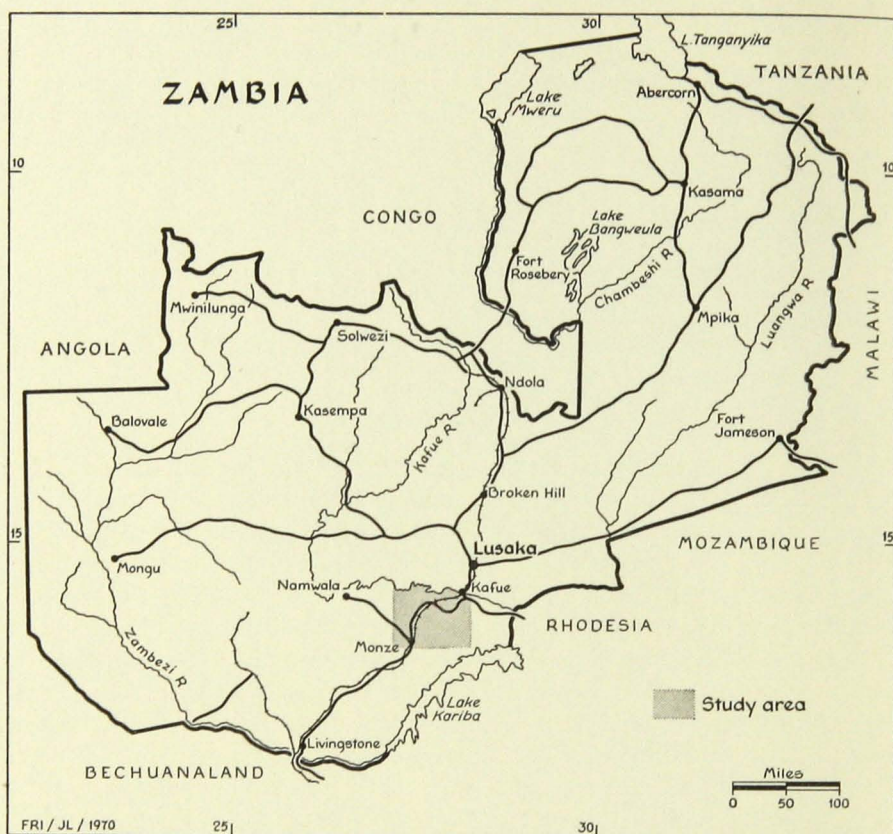
The Tonga have been subjected to various stimuli to change since the turn of

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† This is a report on one of seven field studies that were a part of a Food Research Institute study of economic, cultural, and technical determinants of agricultural change in tropical Africa. The studies in Teso district (Uganda), Kisii district (Kenya), Geita district (Tanzania), Bawku district (Ghana), and this study of Mazabuka district (Zambia) were carried out jointly by Anthony and Uchendu. A study of the cocoa farmers of Akim Abuakwa in the Eastern Region of Ghana was carried out by Uchendu alone, and Anthony and B. F. Johnston carried out a field study in Katsina district, Nigeria. The Institute's study of agricultural change in tropical Africa was supported by a research grant from the Rockefeller Foundation.

The Mazabuka survey was facilitated by two circumstances. The first was the availability of excellent ethnographic data. In this respect, the work of Colson should be mentioned particularly (7; 8; 9; 10; 11; 12; 13). The second was the help given us by officers of the Ministry of Agriculture who readily supplied information and advice and did everything to facilitate the arrangements for our field-work. We gratefully acknowledge our indebtedness to the research and extension divisions of the Ministry of Agriculture.

MAP 1.—ZAMBIA, SHOWING STUDY AREA



the century, and a special advantage of the district as a study area was that a series of highly professional studies provided bench marks, which enabled an assessment to be made of change over time. The earliest of these was an ecological survey of the area by Trapnell and Clothier in the period 1932–34 (23).

Although Wilson made a study of migrant labor in Northern Rhodesia in the late 1930s, there was little sociological study of the Tonga until the Allan, Gluckman, Peters, and Trapnell reconnaissance survey in 1945 (24; 3). This study was one of the earliest attempts made to involve an anthropologist in a course of social action, especially in planned agricultural change. From the viewpoint of this study, their report was particularly important because it was followed by government action. This took the form of the creation of the African Improved Farming Scheme in 1947 which, whatever its deficiencies, was to provide the basis for future development. After a decade of operation, the performance of the scheme was evaluated by Johnson and Rees, and Department of Agriculture reports provided information on the later period of the scheme (17; 22; 25; 29).

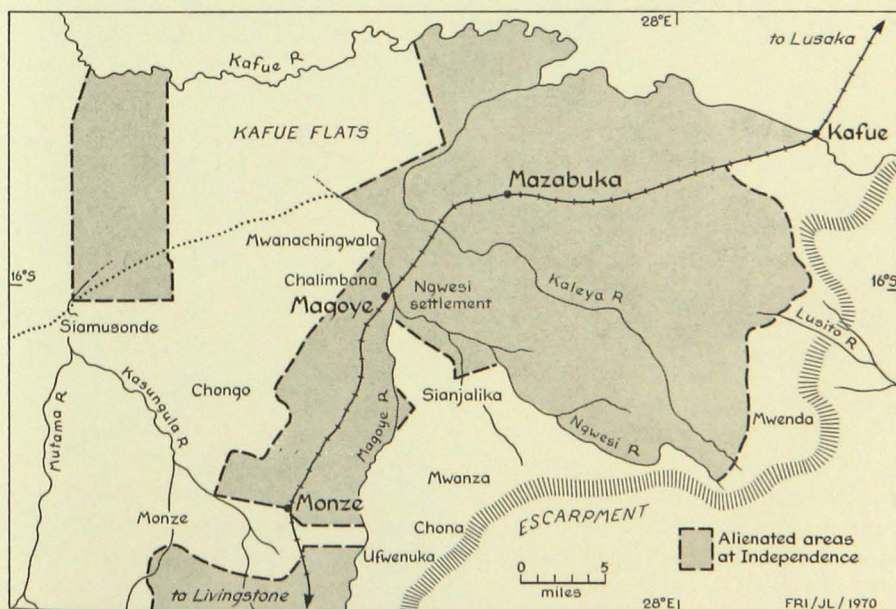
In the 1967 field survey a three-tier approach was adopted for data collection. Visits were first made to the Mount Makulu and Southern Region Research Stations, in order to obtain the technical background to measures for increasing productivity. In the second stage of the survey information was sought on the means

adopted for securing the diffusion of ideas and the role played by supporting institutions. This included training facilities for agricultural extension staff, the coverage of extension workers in the district, the extension approach, marketing facilities for crops, and the availability of agricultural inputs and credit. In the third stage a total of 60 farmers were interviewed, 20 in each of three localities within the district. The emphasis in these interviews was on obtaining a good background knowledge of farmers' problems and attitudes to change, and no pretense was made of obtaining a sample that conformed to the strict requirements for statistical validity.

Important features of agricultural change in Mazabuka have been: the early acceptance of the ox plow and the continued interest of farmers in the acquisition and use of other ox-drawn implements; the comparatively recent adoption of rewarding techniques such as the use of hybrid maize seed, fertilizers, and insecticides; and the new interest in commercial cotton production. Although the ox plow is commonly used in other African savanna areas, the Plateau Tonga are exceptional in the extent to which they have adopted a wide range of other ox-drawn implements. There has been cumulative acceptance of innovations deemed to be worthwhile by the farmer. Government programs in the area have been realistic and have been influenced by the work of the agricultural scientists. The research scientist has shown how productivity per acre can be substantially increased, and as a result the extension service had something worthwhile to offer and has made an impact on farmers. The concentration of junior extension workers, particularly in cotton extension, was high compared with our other study areas, and, to a large extent, their numbers compensated for whatever deficiencies may have existed in their technical training.

It should not be supposed, however, that the agricultural change that has taken

MAP 2.—STUDY AREA



place in Mazabuka district is typical of Zambia. Agricultural development in Zambia has been largely confined to the fertile areas along the line of rail in Southern and Central Provinces and in Eastern Province. Makings estimated that in the period 1962-64, only about 30 per cent of the country's African farmers marketed cash crops and that the average value of cash crop sales per family was only £13 per annum (18, p. 238). The Grain Marketing Board of Zambia recorded the purchase of 4.16 million bags of maize in 1966/67. Of this, 2.58 million bags, 62 per cent of the total, were purchased from European farms (28). Purchases from African farmers in the Southern Province amounted to 767,000 bags, nearly half of the Board's purchases from African producers, and the Plateau Tonga of Mazabuka and Choma districts accounted for most of this marketed surplus in the Southern Province.

THE ENVIRONMENT

The Plateau Tonga, a division of the Bantu-speaking Tonga peoples, occupy the Mazabuka and Choma districts of Zambia between latitudes 16° and 17°S. Before 1950, the area was one political unit covering about 7,450 square miles. Following administrative changes in 1950, the area now known as Mazabuka district is smaller in area, 4,278 square miles, and in population. The district lies in high savanna country, 3,000 to 4,000 feet above sea level. In the north and northwest it extends to the Kafue river and flood plain, which provides valuable dry season grazing for cattle. To the east, the country breaks into a zone of rugged hills known as the Gwembe escarpment. Except for the Kafue river, none of the rivers or streams of the district has a perennial flow.

The location of the study area within Zambia, and details of the area, are shown in Maps 1 and 2.

Climate

The mean annual rainfall of Mazabuka district is 30 to 35 inches, extending from mid-November to the end of March. There is a single rainfall peak in December. While mean rainfall is not limiting, variation in the amount between seasons and the pattern of rainfall within a season can be critical to farming in certain years, and crop failures are not uncommon. The time of arrival of the first rain is especially critical for the early sowing operation. Maximum temperatures range from about 76°F in June-July to about 93°F in October, prior to the commencement of the rains. Minimum temperatures range from about 36° to 40°F in June-July to 60° to 64°F in the rainy season. Harvesting is carried out at the end of the rains in a period of low humidity which promotes cob drying and reduces storage loss.

Soils and Vegetation

In an early ecological survey of the area, Trapnell and Clothier found a close correlation between soil and vegetation types. Their classification of soils and vegetation is the most widely used in literature on the area (23). Agricultural soils of Mazabuka district fall into two main divisions, the plateau group of light textured soils and the upper valley group of medium to heavy textured soils. The older and more highly leached plateau group is mainly derived from acid igneous

and metamorphic rocks. The soil depth varies appreciably but is generally shallow, and the soils have low inherent fertility. They carry *Isoberlinia-Brachystegia* woodland (*miombo*), interspersed with grassy, wet depressions (*dambos*).

The upper valley group occurs in somewhat lower areas with less mature relief and is associated with calcareous sedentary and basic igneous rocks. Soils vary from sandy loams overlying sandy clay to clay loams and have a better fertility status than those of the plateau group. The lighter transitional soils of this group carry scrub woodland of *Combretum*, *Terminalia*, and allied species, interspersed with tall grass. The thorn soils of the group carry *Acacia* tree-grassland and have for long been considered the best maize soils in Zambia, although it should be recorded that some of the best maize crops in Zambia are now grown on the sandveld soils of the Central Province. A favorable environment and the high potential of Mazabuka soils for maize production have been important factors in agricultural change, and, in this respect, the Plateau Tonga are particularly well favored, compared with people in many other African savanna areas.

Population Density

Early population statistics for Mazabuka district are unreliable and Colson has suggested that the variations in the yearly estimates largely reflected the thoroughness with which they were collected (11, p. 5). Numbers seem to have been grossly underestimated in the 1940s and 1950s and no factual information is available on the rate of population increase in the postwar period. In the 1963 population census the total population was estimated to be 157,000, of whom 127,000 were living in the chiefs' areas (21).

Factors that have affected the population densities of Mazabuka district since the 1940s are natural increase, a limited amount of emigration, and, until the late 1940s, a flow of population from other areas, particularly the Gwembe valley. What does emerge is that there has been a substantial net increase in population, associated with a high birthrate, but its extent is a matter of conjecture. The loss of a substantial proportion of Tonga land to settlers contributed to produce the fairly high population densities found in some localities.

As presently constituted, Mazabuka district occupies an area of 4,278 square miles. Of this, 1,532 square miles, or 36 per cent of the total area, are alienated for large-scale farms, and the chiefs' areas cover 2,726 square miles, or 64 per cent of the total (29). The population density of the areas available to small- and medium-scale farmers is currently about 50 persons per square mile. However, not all of this area is cultivable with present techniques. An investigation by Allan of sample areas of Plateau Tonga country, totaling 356,000 acres of thorn, transitional, and southern plateau soils, indicated that only 22 per cent was cultivable (1, p. 12). Subsequently, Muchangwe estimated that approximately 25 per cent of the chiefs' areas in Mazabuka district was cultivable (20). Thus, the mean population density for cultivable land is about 200 persons per square mile. Within the district population density has been determined by alienation of land for large-scale farming, and local soil, water, and topographical conditions. Population densities are highest on the more fertile soils.

The Tonga are traditionally cattle owners and in 1963 the cattle population was estimated to be about 187,000 head, approaching 150 animals per 100 head of farming population. Access to the grazing areas of the Kafue flats makes it pos-

sible to maintain this relatively large cattle population. Sheep and goats are not of great importance and were estimated to total about 12,800 (21).

CULTURAL BACKGROUND

Early History

The history of contact between the Tonga peoples and Europeans has been summarized by Colson and Mousley (11, pp. 7-14; 19). Their recorded history goes back no further than the 1850s, and their oral traditions have limited time depth, but much more is known, or can be inferred from, their cultural traditions.

Livingstone came into Tonga history in 1853. According to Clark, the Tonga might then have been in their present area some three to four centuries (6). Whatever was the status of their social-political system, they were too badly fragmented to withstand the attack of better organized neighbors before the European penetration. From about 1850 to the advent of the rule of the British South Africa Company in the 1890s, Tonga country formed a buffer between the Makololo, and later Lozi, peoples and the Ndebele, who constantly raided and preyed on Tonga property and lives. Their common reaction to these raids was to take refuge in flight, a characteristic also manifested until recently in the relative instability of their villages. Thus Colson observed that the Tonga tended to find a solution to their personal difficulties by moving away from them and taking up residence elsewhere (11, p. 26).

Raids on the Tonga came to an end when the Ndebele were defeated by Southern Rhodesian settlers in 1893. Five years later the British South Africa Company established a police port at Monze, and civil administration commenced in 1903. Other early effects of British rule were the creation of a hierarchy of chiefs, through which the administration could function, and the later alienation of substantial areas of Tonga lands for settlers who arrived after the building of the Rhodesian railway. The loss of a large area of land influenced future Tonga attitudes to the administration, and, as late as 1948, their sense of grievance was aggravated by the eviction of about 7,600 squatters, who had occupied vacant Crown Land and previously untenanted European farms (11). However, at no time prior to or after alienation was there more than slight resistance to government. Colson recorded two minor incidents, which occurred in 1902 and 1915/16, while Johnson noted that the campaign against the former Federation of the Rhodesias and Nyasaland in the 1950s resulted in some decline in the numbers of farmers who participated in the African Improved Farming Scheme (11, p. 9; 17, p. 16).

With the growing need for a cash income there was increasing dependence on migrant work for a livelihood. Tonga migrants found work in Southern Rhodesia, other parts of Northern Rhodesia, and some as far afield as the Union of South Africa. With the imposition of a hut tax the demand for cash increased and wage work earned it.

Other outside influences asserted themselves. Christian missionaries arrived in the early part of the century and established schools. The Zambian copper mines were developed in the 1920s and provided a growing market for maize. This led to a tendency for Tonga to move to the line of rail, where it was easier to sell crops, and to growing population pressure in these areas. In the late 1930s

the government began a program to provide dams and wells in the western areas, and some further migration took place to the areas opened for settlement.

The Social Organization

The clan is the most enduring unit of Tonga society. Clan membership guarantees hospitality to individuals when they come into contact with others who bear the same clan name. Marriage within the clan is forbidden. However, for the Tonga the clan simply represents an extended family relationship and provides no binding ties with a particular neighborhood. Clans are widely dispersed, own no property in common, and do not have any political or legal functions. Clan-owned land does not exist.

Matrilineal groups, the subdivisions of clans, have a degree of corporateness lacking in the clan. This is expressed in the inheritance rules, succession to status or office, a share of bridewealth payment, and some ritual responsibility. Tonga matrilineal groups are dispersed and are generally unnamed. They tend to be undifferentiated and short-lived. The ancestral shrine is not as important as in West Africa, and ancestral spirits are not associated with any fixed place. Thus, there are no traditional beliefs to inhibit residential mobility.

Political Innovations

Before the arrival of the Europeans, the Tonga lived in small, widespread neighborhoods. Although people moved in and out at will, the neighborhood remained an enduring social unit, and residents were united under the ritual authority of the Rain Shrine as long as they chose to remain there. Under British rule, the area was first organized into districts, each under a headman, and these were later grouped into areas under chiefs. Indirect rule was formalized in 1929 and hereditary chieftainships established. Administrative areas were defined, but the Tonga, by tradition a mobile population, were no respecters of village boundaries. In the event, the stabilization of villages has come about not through administrative regulations, but rather through land scarcity, which has led to the improvement of land through capital investment, and effectively restrained the desire to move.

Attitudes Toward Change

Certain attributes that are relevant to the acceptance of change can be identified in the Tonga culture. Perhaps the most important is toleration of the individual's right to be different. This is expressed in acceptance of a man's right to live where he pleases. The Tonga is essentially an individualist and his attitude toward authority is one of ambivalence. Thus, Colson explains Tonga attitude toward authority as "Any man may call himself a chief, but that does not mean that I will obey him" (11, p. 31). This emphasis on individual independence creates a climate in which it is possible for a man to adopt new practices without incurring the disapproval of his neighbors.

Also important is the Tonga preference for a minimum of organization demonstrated in their somewhat nebulous political structure prior to the coming of the British. This character has relevance to the structure of the organization that can effectively be used to promote change. In their 1945 reconnaissance survey

of Mazabuka district, Allan *et al.* found the Tonga system of borrowing and lending plows inefficient and recommended that it be replaced by communal use of the plow (3, p. 9). The subsequent experiment in cooperative or group farming, on the Chalimbana Pan near Magoye, had to be abandoned as settlers preferred to farm their holdings individually. The failure of group farming schemes in many parts of Africa shows how easy it is to overemphasize the African's communal orientation or to underplay his individualism. Like other societies, Africans do cooperate, but the conditions under which they do so differ and change rapidly.

The extent to which the returned immigrant is more receptive to change can only be a matter for conjecture. Colson suggests that he learned little from his work elsewhere, and this is probably true as many found work in the towns. On the other hand, it is likely that exposure to new experiences stimulated a greater receptivity to change. Perhaps more to the point has been the influence of the large-scale farms as a concrete demonstration of the profitability of the new methods of farming.

LAND USE

Land Tenure

Traditionally, the Tonga had not much fixed or immovable property that could keep them indefinitely in one locality. Their houses had a short life of about ten years. Their cattle were movable assets. Though improvement in land conferred rights of continued use, land was not regarded as property, and land rights were ill-defined.

The 1945 reconnaissance survey team reported that cultivated land was acquired from a common pool of virgin or regenerating, but unclaimed, land. The rights to the land could then be transferred to another person, temporarily or permanently. Inheritance of land had been unusual in the past, but with increasing shortage, land was beginning to be inherited in the same way as cattle, goods, and names, but with greater latitude. In a sample survey of 1,308 acres, said to represent a typical village, they found that 69 per cent of the land had been acquired by clearing virgin or regenerated bush; and that 29 per cent of the area had been acquired by inheritance and transfer of rights (3, pp. 92-93).

In a small sample investigated near Monze in 1953 by Johnson, about 40 per cent of the land was said to have been acquired in these last two ways (17, p. 34). Johnson observed that, although the Tonga are matrilineal, land commonly passed from father to son. The matrilineal system of inheritance, which led to the dispersal of property among the matrilineal heirs, did not provide sufficient security for a man's children. With the increasing father-centered orientation of the Tonga family, the traditional customs are beginning to be modified so as to reflect the new values. Social custom has thus changed according to the felt needs of the people in response to the changing economic environment.

The Farming System 1893-1945

As an immediate result of the establishment of law and order at the turn of the century the Tonga were able to start rebuilding their herds which had been

decimated by cattle raids and rinderpest. However, it was the construction of the Rhodesian Railway through Tonga country, within 15 years of the establishment of the police post at Monze, that, more than any other factor, was to provide the necessary economic environment for change. Attracted by good soils and the agreeable climate, settlers followed the line of rail, and blocks of land were allocated to them. These were formally established in 1928 by the Crown Land and Reserve Order in Council. The Tonga were moved from these areas to reserves, but none were more than 40 miles from the line of rail.

The early settlers began to supply the Congo mining industry with maize and beef and the Tonga were able to benefit from this new market opportunity as traders commenced to buy these commodities from them and provide a source of trade goods including implements. Subsequently, the development of the Zambia Copper Mines, in the late 1920s and early 1930s, created a further local demand for grain. It was reported that the first plow was sold to an African farmer in Mazabuka in 1914, and the demand for ox-drawn implements grew, as the Tonga learned the techniques of plowing from the missionaries and settlers, who also provided a source of equipment.

Trapnell and Clothier have described the agricultural practices of the Tonga as they found them in 1933 (23). In the southern *miombo* woodland areas, there had been very little change in the traditional farming practices. These were based on hand cultivation and the progressive extension of cultivations into new land, with regular periods of cropping and resting. The main cultivations of the village were laid out in one large block. On the plateau soils, land was cultivated for about three years, rested for one to three years, cultivated for a further two years, and then allowed to regenerate for 20 years or more. In addition to the main bush garden, there were village gardens where cropping was more or less continuous. Sorghum continued to be the staple food crop, but maize was grown on an increasing scale for sale along the line of rail. Finger millet and bulrush millet had come to be largely used for beer making. Other crops included groundnuts, cow-peas, ground beans (*Voandzeia subterranea*), sweet potatoes, cassava, and pumpkin. A few plows were observed, but plowing for commercial maize production was found to be common only in the transitional and thorn-type country of what is now Mazabuka and North Choma districts.

On the more densely settled and fertile *Acacia* soils about the Kafue flats, there was a change in the traditional agricultural system due to greater soil fertility, and a general adoption of large-scale maize cultivation by European methods, wherever the land allowed of it and a market was available. This was most marked on the whitethorn (*Acacia Woodii*) and winterthorn (*A. albida*) soils where there were large areas of easily stumped land suitable for maize. In these areas traditional farming methods were increasingly being supplanted. Mixed cropping and the customary rotations were being gradually abandoned. Although the mixed sorghum gardens were still retained to some extent, maize was replacing sorghum as the staple food crop. Because of their size the maize gardens were poorly cultivated. Manure had been adopted only locally; the practice was thought to have been introduced about 1930 through the influence of the missions. In some of the reserves a land shortage was arising and was aggravated by the numbers of cattle owned by the Tonga. In some places, too, there were signs of soil

deterioration and sheet erosion. On two of the reserves it was observed that the extension of the acreage under maize was leading to a breakup of the village into small scattered family units, already equipped with plows, cultivators, and occasional planters.

This account of the farming situation as it was in 1933 shows that the first adoption of new farming methods was in areas nearest to markets, on soils which gave the highest maize yields, and on land that could most easily be brought under the plow. With the adoption of maize as a commercial crop, the early maturing flint varieties, which had been first introduced into Tonga country, were replaced by later maturing white dent types obtained from the European settlers.

The acceptance by the Tonga of the new opportunities available to them was all the more impressive for being largely unaided. It is perhaps understandable that, through lack of knowledge of the problems created by the opening of large areas for maize and more particularly by overstocking, their enthusiastic response was leading to soil deterioration problems in some areas. A number of possible remedial measures were recommended by Trapnell and Clothier and included improved cultivation methods, the introduction of new rotations, and measures to prevent erosion. The Department of Agriculture began extension work in the Plateau Tonga country in 1936 with the establishment of Kanchomba Station and the subsequent extensive demonstration of a simple crop rotation and the use of kraal manure or compost on farmers' holdings. Contour ridging was commenced in 1940, following an aerial survey, but at first was carried out on a very limited scale.

A major innovation in this period was the stabilization of the maize price. A recession in the mining areas in the 1930s affected the demand for maize and, by 1935, the price of a 200-pound bag of maize was only five shillings. Under the Maize Control Ordinance of 1935, the market for maize was divided between European and African producers; the latter received a lower price for their maize, but the difference was paid into a special development fund for Africans. The price paid to producers was determined by the relative proportion of maize sold at the controlled local price and that exported at the lower world price. Large crops of African maize were brought to the market in 1936 and 1937, but thereafter quantities fluctuated at a much lower level during the period 1938 to 1944. Allan has argued that the fluctuations in quantities sold to the Maize Control Board in this period could be accounted for by variations in weather conditions (2, pp. 37-43). However, it can be surmised that a reduced economic incentive, resulting from wartime economic conditions and lower prices, was an equally important factor.

The Reconnaissance Survey of 1945

The 1945 reconnaissance survey team found that, with the use of the plow and the growing pressure on land, the traditional system of regular cropping and fallowing had largely disappeared in their survey areas. Plateau soils were commonly being cultivated for five years without manure and sometimes longer with manuring. Yields dropped from about three bags of maize per acre in the second year of cultivation to one bag in the fifth year. The better transitional and thorn

soils had often been in cultivation for ten to twenty years or longer, generally without manure, and yields had dropped to about two bags per acre. Overstocking was locally severe and in places had led to extensive sheet erosion (3, pp. 130-32).

The changed pattern of land use can be seen from the data collected by the reconnaissance team for a sample of farmers in the 1944/45 season. This is given in Table 1 as the mean crop acreage per farm household. As in many other parts of Africa, where maize can be grown successfully, it had become a preferred food and had largely replaced sorghum. The crop also had the important advantage that surpluses to family requirements could be readily marketed. Maize in pure stand occupied 64 to 86 per cent of the acreage of the crops. Sorghum had become a secondary crop and was not grown by the larger farmers. It was found that an understanding of crop rotation and the value of leguminous crops had gained some ground and some of the farmers were using sunnhemp as a green manure crop. However, the team felt that the progress made toward better general agriculture, while by no means negligible, had been altogether inadequate to meet the needs of the situation. They estimated that about 85 per cent of the farm owners in Mazabuka district fell into the category of subsistence cultivators; only 14 per cent could be described as smallholders, defined as cultivating about twice the acreage cultivated under subsistence agriculture; and less than 1 per cent were farmers, cultivating three times or more the acreage cultivated under subsistence agriculture (3, p. 85).

They concluded that the main problem of the area was one of land deterioration under prolonged cultivation and overstocking. The team further concluded that progress toward better farming methods was inhibited by such factors as the suspicion created among the Tonga by the alienation of a substantial proportion

TABLE 1.—RECONNAISSANCE SURVEY, 1945: CROPS CULTIVATED IN 1944/45*
(Average acres per family, except as otherwise indicated)

	Subsistence cultivators		Smallholders		Farmers	
	Acres	Per cent	Acres	Per cent	Acres	Per cent
Sample size (<i>number of families</i>)	44		45		11	
Land use						
Maize	6.51	64	16.65	82	73.80	86
Maize and sorghum	0.59	6	1.50	7	0	0
Sorghum	0.39	4	0.18	1	0	0
Cowpeas	0.29	3	0.54	3	4.84	6
Groundnuts and groundbeans	0.38	4	0.23	1	1.09	1
Sweet potatoes	0.05	<1	0.03	<1	0.11	<1
Sunnhemp	0	0	0	0	3.25	4
Resting land	1.74	17	0.95	5	1.93	2
Newly broken land (unplanted)	0.16	2	0.14	<1	0.83	1
Total	10.11	100	20.22	100	85.85	100

* Data from W. Allan, M. Gluckman, D. V. Peters, and C. G. Trapnell, "Land Holding and Land Usage Among the Plateau Tonga of Mazabuka District: A Reconnaissance Survey, 1945," Rhodes-Livingstone Paper No. 14 (London, 1948), pp. 82, 141.

The sample was classified according to the number of 200-pound bags of maize sold in the preceding year: subsistence cultivators 10 or less, smallholders 11 to 99, and farmers 100 and over.

of their land; the general apathy and acceptance of low standards of yields and living; the limited material resources of the majority of the people; the poor maintenance of what implements they had; and general ignorance of the nature of soil deterioration and the value of manure.

The survey team made eight major recommendations. Two of these dealt with research: the need for pasture investigations, especially to discover the carrying capacity of the land, as a basis for effective culling recommendations; and the need for an assessment of population trends to aid long-term planning. A third recommendation stressed the need for an attempt to explain to the Tonga that all their problems did not arise from land alienation.

Recommendations were also made for more agricultural instruction in schools, in order to introduce new generations to higher standards of farming; the use of communities rather than families as units for agricultural development; the creation of agricultural settlements with communal fields and communal use of implements; common grazing areas which would enable restrictions to be imposed on stocking; and differential maize prices to provide an incentive to good farmers. The creation of settlements was not intended to involve any physical movement of people and was expected to provide agricultural units that would serve the needs of improved farming. It was thought that the kinship system, the uneven distribution of resources, and the shortage of supervisory staff made this approach an attractive and practical proposition. The subsequent abortive experiment carried out by the Department of Agriculture has already been commented upon. However, it was the principle of differential maize prices that was to provide a means of financing the African Improved Farming Scheme, which subsequently played an important part in establishing the basis for development in the 1960s.

It would now appear that much of the apparent lack of response of the Tonga at this time was associated with the period of wartime shortages and poor crops, commented on by Johnson and Colson (17, p. 7; 10). Events over the next twenty years have demonstrated the response of the Tonga farmer to economic opportunity.

THE AFRICAN IMPROVED FARMING SCHEME

The period 1945-60 was one of slow but continued improvement in Tonga agriculture and was associated with a major government program, the African Improved Farming Scheme, under which farmers were provided with an economic incentive to adopt change. This was initiated in the 1946/47 season. The technical requirement for the participating farmer was the adoption of the so-called Kanchomba system, knowledge of which had already been disseminated to farmers through the extension services. An improved farmer was expected to adopt fallows, contour-work his land, maintain any soil conservation works that had been constructed on it by the Agricultural Department, and adopt reasonable standards of cultivation and weed control. Kraal manure had to be applied to one-quarter of the land, and the farmer had to follow a rotation of maize (manured), maize, legumes, maize.

Improved farmers were paid 22 shillings a bag for their maize compared with 18 shillings per bag paid to unimproved farmers. The money withheld from un-

improved farmers went into a fund used for price stabilization and the financing of erosion control measures in the producing areas. In the three seasons during which this method of payment operated, 95, 303, and 362 farmers qualified, in succession. All of these were in the areas served by Kanchomba (Choma), Monze, and Magoye stations (17, p. 8).

Administration of the price differential proved too complicated and in 1948 an acreage bonus was substituted. It was also felt that the time had come for the introduction of fertilizers and green manure into the Tonga farming system. Two grades of improved farmer were established. To meet the requirements of the first grade, the farmer had to follow a rotation of maize (fertilized with super-phosphate), legumes, maize (manured), and green manure. A good standard of cultivation, weed control, and freedom from stumps in cultivated land were also expected of the farmer. The second grade differed from the first only in that, in place of green manure, a legume for harvest could be taken and fertilizer was not insisted upon. A special grade, known as the smallholder grade, was added in 1950 to meet the circumstances of the small farmer. Farmers in this category were expected to follow the old rotation of three maize crops and one legume, but two of the maize plots were to be manured and fertilizer applied to the third. This class was limited to farms up to ten acres. The smallholder grade was paid at the same rate as the first-grade farmers but the second-grade farmer received a smaller acreage payment.

The African Farming Improvement Fund was created in 1949 to provide the finance for these measures, and a portion of the maize realization price was paid into the fund annually. This was used to finance bonuses and subsidies to improved farmers, soil conservation works, water conservation and supply, improvement of storage and marketing facilities, equipment for conservation work, and subsidies on scotch carts. In addition, the government provided substantial subsidies for soil conservation work. A particularly important measure, taken at the same time, was the establishment of a rural buying organization of the Maize Control Board and the decision to pay a flat price for maize throughout the area in order to relieve pressure on land close to the railway line.

In 1948/49, the bonus of first-grade farmers was 15 shillings per acre and for second grade, eight shillings. These bonuses increased by small annual installments to 27 shillings and 17 shillings an acre, respectively, in the 1954/55 season. Johnson reported that, with the adoption of more exacting qualifications, the number of improved farmers in Southern Province fell to 262 in 1949/50 (17, p. 9). Thereafter, they rose to 450 in 1950/51 and 706 in 1951/52. The interruption of the progress of the scheme in 1952 was associated with the political campaign against federation, but there was a subsequent recovery. Numbers of participating farmers in Mazabuka district in the period 1952-60 are given in Table 2.

Agricultural staff regularly visited registered farmers during the course of the season to determine whether they should qualify for a bonus. The numbers of participating farmers varied from season to season and it did not necessarily follow that a farmer would be so classified two seasons running. However, the general trend in the 1950s was upward, and a peak was reached in the 1959 season when there were 1,538 improved farmers in Mazabuka district, who had a total improved acreage of 29,296 acres and received a bonus of £28,978 (29).

TABLE 2.—NUMBERS OF IMPROVED FARMERS, MAZABUKA DISTRICT, 1952-60*

Year	Number	Acreage	£ bonus
1952	355		
1953	392		
1954	366		
1955	507		
1956	714		
1957	755		
1958	907	16,185	19,987
1959	1,538	29,296	28,978
1960	1,410	24,454	23,153

* Data from Zambia, Southern Province, *Stocktaking*, November 1960.

Thus, of the approximately 14,000 to 15,000 farmers in the chiefs' areas in 1960, about 10 per cent were receiving an improved farmer bonus, a not inconsiderable proportion.

Yields

There was no evidence of substantial improvement in maize yields during the period of the African Improved Farming Scheme. Thus, a sample of 23 gardens in the Kanchomba area in 1937 gave an average yield of 3.5 bags per acre (22, p. 24). Similar results were obtained by the 1945 reconnaissance survey, which estimated the average yields in five chiefs' areas to be between 3.0 and 3.5 bags per acre (3, p. 138). Johnson carried out a survey of maize yields in the 1953 and 1954 seasons and obtained average yields of 3.3 and 3.0 bags per acre, respectively, for unimproved holdings and 6.4 and 5.0 bags per acre for the improved (17, p. 24). However, he observed that while improved farmers' yields appeared disappointing in comparison with the yields obtained on agricultural stations, they compared satisfactorily with the average yields of the European farms, which were calculated by the Maize Control Board to have been 5.9 in 1952/53 and 6.6 in 1953/54.

In the 1954/55 season, Rees estimated the average maize yield of improved farmers to be 3.1 bags per acre and of second grade, 1.9 bags. The yields for their unimproved land were 1.1 and 0.7 bags per acre, respectively (22, p. 25). These yields compared with an average of 7.0 bags for a sample of 31 European farmers in Northern Rhodesia for the same season. Rees attributed the discrepancy between the yield levels obtained in his economic survey and those of the earlier surveys to the respective sampling methods used.

These data indicate a slight but significant improvement in the yields of improved farmers, and it appears that soil deterioration had been arrested in the period. Although the yields of improved farmers were not high, they did not compare very unfavorably with those of European farmers.

The data collected by Rees also indicated that although improved farmers were fairly well equipped there was still a definite limit to the area they could handle efficiently when this was measured in terms of yield per acre. There was

a relationship between yield per acre and the number of acres sown to maize, with a tendency for maize yields to decline with an increase in the area sown to the crop. The average yield of improved farms with 15 acres or more of maize was 1.7 bags per acre compared with nearly three bags per acre for those with less than 15 acres (22, p. 28). However, yield per acre is only one of the factors influencing farm income. Rees showed that advantages of scale of production outweighed the disadvantages of a decrease in maize yields, and the larger farmers were able to make larger incomes than smaller farmers with higher yields. But on the majority of farms there was still scope for a big improvement in management and the general standards of farming (22, pp. 58-64).

Implements

A striking feature of the period of the African Improved Farming Scheme was the increase both in the numbers and range of farm implements owned. The 1945 reconnaissance team estimated that very nearly 40 per cent of their subsistence class owned no implements, about 50 per cent owned one plow, and 10 per cent owned more than one. In contrast, their farmer class, which made up less than 1 per cent of all families, were well equipped. Every family interviewed had two or more plows and many had three-disc and double-furrow moldboard plows. Practically every family had two or three cultivators and one or two harrows. Most had a wagon or a scotch cart, and about one-half had planters and shellers. Some had hand mills. These estimates apply to a larger sample than the area figures shown in Table 1 above (3, pp. 155-57).

In the 1953/54 sample survey, 48 per cent of improved farmers were found to have one plow and 52 per cent two or more. Among the sample of unimproved farmers there were still 30 per cent with no plow, but 45 per cent had one plow and 24 had two or more (17, p. 22). The data presented by Rees for 1955 show the wide range of implements that had already been acquired by improved farmers. There had been substantial investment in machinery and implements, and Rees estimated that the average secondhand value of this investment on the farms of first-grade improved farmers amounted to £91 and on second-grade farms £34 (22, p. 31).

Investment in implements during this period was made possible by the income derived from maize farming, the provision of the improved farmer bonus, and short-term loans provided to improved farmers. The average cash receipts per farm earned by the sample of 112 improved farmers included in the economic survey amounted to £72, of which £23 were improved farmer bonus. Mean cash expenses per farm were £30, and £19 of this were allocated to mechanization expenses. There were already 27 African-owned tractors in the Southern Province in 1955, though only one of these fell in the Rees sample (22, pp. 31, 45, 53).

Loans given to improved farmers in Mazabuka district in 1958-60 are summarized in Table 3 and show the wide range of equipment for which they were made available. Total amounts involved were comparatively small, but in terms of what this money would then buy, they nevertheless provided a valuable injection of capital into the area. More farmers were beginning to adopt tractor mechanization.

TABLE 3.—LOANS TO IMPROVED FARMERS FOR SPECIFIED PURCHASES,
MAZABUKA DISTRICT, 1958-60*
(£)

Loans spent for	1958	1959	1960
Scotch carts	3,464	4,990	4,925
Cultivators and harrows	1,685	1,230	1,180
Plows	997	832	534
Wire, fencing materials	1,358	1,716	1,390
Planters, shellers	300	374	528
Wells, windmills	139	133	360
Work oxen	476	50	0
Tractors and implements	1,815	2,050	2,810
Seeds, fertilizer	79	17	0
Miscellaneous	0	197	0
Total	10,313	11,589	11,727

* Data from Zambia, Southern Province, *Stocktaking*, November 1960.

Land Improvement

Cultivable land, which traditionally had been free, acquired value as it became scarce. Adoption of the plow required land stumping, and this contributed to the acceptance of permanency of residence and a preparedness to invest further in land improvement. The incomes received by farmers who participated in the scheme made further capital investment in land possible. This took the form of better houses, the provision of farm water supplies, contour ridging of land, some fencing, and the planting of fruit trees.

Availability of water for domestic use and livestock presents a problem for Tonga villages during the dry season. Often the Tonga have to dig shallow wells in stream beds or take water from the pools left standing there after the flow ceases. Consequently, water conservation works have been an important form of government aid from the inception of the agricultural extension program in Mazabuka district. Under the African Improved Farming Scheme the development of earth dams and weirs was further increased, and funds were provided from the African Farming Improvement Fund and in the form of government subsidies. In 1960, 70 of the 146 dams and 187 of the 634 wells in the Southern Province were in Mazabuka district (29). The increased number of water points led to a more even distribution of cattle and reduced the possibility of soil erosion from local overstocking.

As a result of extension work, which had begun in the early 1940s, and the requirements of the African Improved Farming Scheme, the growing of green manure crops and the use of manure had become more general, and these innovations were not confined to improved farmers. In the 1953/54 survey, one-half of the sample of unimproved farmers were using manure and it was observed that contour plowing had become established in large areas. At the same time, use of fertilizer was obligatory to first-grade improved farmers who were becoming accustomed to its normal use. Thus, the first-grade improved farmers interviewed in the 1954/55 economic survey purchased an average of 5.05 bags of superphos-

phate and 0.1 bag of sulphate of ammonia per farmer, at a cost of £5 5s. 9d. per farmer (22, pp. 53-54).

Livestock

Under the Improved Farming Scheme emphasis was put on the improvement of arable farming methods and much less attention was given to livestock improvement. However, a livestock improvement scheme started by the Veterinary Department in 1956 was taken over by the Agricultural Department in 1959 and shortly afterwards combined with the African Improved Farming Scheme. Under the original scheme it was stipulated that a cattle owner must own an approved bull and must sell 4 per cent of his cattle annually, must build a suitable kraal and calf pen, and must have his animal inoculated against anthrax and quarter evil. In return, he received a £4 entry bonus, a bonus of £2 per year for four years for keeping an approved bull, and a subsidy on all cattle sold higher than grade four. This was subsequently changed and the farmer was paid £15 on entry if he possessed an approved bull and a subsidy on all animals sold if they were at least 4th grade in a six-class grading system. A member of the scheme might be provided with a bull by the Department if one was available (29). Grazing facilities were extended by the provision of stock watering points and communal paddocks. However, pasture work in the period remained largely experimental.

Achievements

The African Improved Farming Scheme made an undoubted impact on Tonga farming methods. In his 1954/55 appraisal Rees concluded that farmers had already moved a considerable way along the road from shifting subsistence cultivation to stabilized commercial farming, although the achievements at that date had fallen short of the original hopes. Crop yields were still low and the scheme was expensive in terms of the manpower required for supervision and the numbers of participating farmers. Little had been done to foster improvement in the livestock sector and the scheme had not led to a closer integration of livestock and crops (22, pp. 70-71).

This was undoubtedly true but, on the other hand, the scheme provided a valuable injection of capital which enabled farmers to increase their investment in implements and the improvement of their homesteads and land. Soil erosion was arrested by measures taken at both the district and farm levels and there was an increasing use of manure by unimproved as well as improved farmers. In the 1954/55 survey a number of improved farmers were found to have purchased kraal manure from their neighbors. Under the terms of participation in the scheme, fertilizers also began to be used in the district. If there was no serious attempt made to integrate livestock and crops into a mixed farming enterprise, neither does there seem to have been any information how this could best be achieved, or indeed if there was any positive advantage in doing so, in an area where the stock-carrying capacity of veld paddocks is one beast to about seven acres.

Whatever its drawbacks, the scheme made a major contribution to agricultural change in Mazabuka district by creating a readiness to accept new farming

methods. The spread of ox-drawn implements made possible an increase in acreage cultivated; and the adverse effects on yields resulting from poor husbandry practices because of the tendency of farmers to overextend themselves were increasingly overcome as the range of implements available increased and as farmers acquired greater skill in ox cultivation. Although the improvement in crop yields was very limited, it was some achievement that soil fertility was maintained sufficiently to prevent a decline in yields. Moreover, the spread of knowledge concerning improved farm practices and soil management almost certainly contributed to the subsequent success that was achieved when high-yielding varieties became available. Mazabuka was one of the few survey areas where farmers were generally familiar with a concept of unit land area, and the acreage bonuses under the African Improved Farmer Scheme undoubtedly contributed to this. It seems likely that familiarity with that concept and the use of the scotch cart for hauling grain from the field made it easy for farmers to estimate per acre yields and presumably made it somewhat easier to gain acceptance of yield-increasing innovations.

In the early 1960s it was decided to bring the scheme to a close. The Ministry of Agriculture quotes from the Southern Province Report as follows (25, 1962, p. 11):

The scheme has played an important part in agricultural development of the Province, but it has severe limitations in its regimentation and it is essential that we use its dying years to re-orientate our approach to produce a fully effective extension machine working on a much broader base.

In 1962 there was a significant fall in the numbers of qualifying farmers in Mazabuka district due to a local breakdown in the organization of fertilizer distribution. However, as the bonus scheme was due to terminate in 1964, no vigorous attempts were made to increase the number of participants. The fund's income from crop levies ended during 1962.

THE RESEARCH BASE

Continued agricultural change depends on a flow of information from the research scientist on new and rewarding techniques of farming. This has been available in Mazabuka where recent agricultural development has been based on a solid foundation of technical knowledge laid down by the research section of the Ministry of Agriculture. An agricultural and veterinary experimental station was opened at Mazabuka in 1926 and was the headquarters for the agricultural research services in Zambia until the Mount Makulu central research station was established in 1950, 16 miles from Lusaka, and became the center for specialist research and advisory services. In the district, agricultural research is now carried out at the Southern Region Research Station at Magoye and the Mazabuka Animal Husbandry Research Station. Specialized investigations on the development problems of the Kafue flats are carried out at the Kafue Irrigation Station.

Maize

The very widespread adoption of new farming innovations in Mazabuka district is largely associated with the high maize yields shown to be obtainable if

hybrid varieties and fertilizers are used. The hybrid varieties, first developed in Southern Rhodesia and now produced in Zambia, consistently outyield open-pollinated types even at a low fertility level. Yield results from two maize variety trials carried out at Magoye Station are summarized in Table 4. At the time of the Food Research Institute survey, the three recommended varieties for Mazabuka district were SR52, SR11, and SR13. SR52 is an outstanding performer and in field trials yields 50 to over 100 per cent more grain per acre than the open-pollinated Hickory King, which was one of the earliest introduced commercial varieties. Because SR52 is a single hybrid, the seed is comparatively expensive and cost approximately 36 shillings per acre in 1967. It has often been in short supply; at such times the recommendation was to use one of the double hybrids, SR11 or SR13, seed of which cost about 14s. 6d. per acre. This compared with a market value of about 6 shillings for home-produced local seed. Very substantial yield increases over the open-pollinated varieties are also obtained with existing double hybrid material, on average about half of that observed with SR52. The Grain Marketing Board producer price of class A maize in the 1966/67 intake year was 33s. 3d. per 200-pound bag of grain, so that for both single and double hybrid varieties the returns realized from the use of purchased seed were extremely attractive.

Commercial maize yields in Zambia are high by world standards. Yields of over 40 bags per acre (four tons) maize seed are becoming commonplace on large acreages, and in the 1965/66 season a yield of over 60 bags per acre (six tons) was recorded at the Broken Hill Research Station in Central Region. Three-way cross hybrids are now being produced at Mount Makulu, using SR52 as the female parent. Some of these have the yield potential of SR52 and the cost of their seed would be no more than that for double hybrid varieties. The plant breeding section maintains close liaison with maize breeders in Kenya and elsewhere in Africa.

Ultimately, the impact made by the breeder on the farm economy depends on the efficiency of seed propagation and distribution. This is looked after by the seed services section of the research branch. The plant breeding section maintains foundation seed and carries out the first multiplication of inbred material. The seed is then taken over by the seed services section and bulked by the Zambia Hybrid Maize Seed Growers Association. The first hybrid SR52 seed was pro-

TABLE 4.—MAIZE VARIETY TRIALS, MAGOYE: YIELDS PER ACRE*
(Bags of 200 pounds)

Variety	1962/63	1964/65
Hybrid		
SR52	40.8	33.3
SR13	29.7	22.7
SR11	26.0	26.7
Open-pollinated		
Hickory King	18.3	15.6
Southern Cross	17.8	...
S.E.	±1.1	±1.33

* Data from *Annual Reports* (27).

duced in Zambia in 1965/66 and it was expected that sufficient hybrid seed would be produced in 1968/69 to meet the country's needs.

Throughout the Southern Region early sowing is a prerequisite for high maize yields. A delay in sowing of only a few weeks after the first sowing rains results in a very substantial drop in yield and it is estimated that, at Magoye, every week's delay after this date results in an average loss of three bags of grain. There are obvious difficulties in achieving timely sowing where the farmer has only a pair of poor oxen with which to carry out his land preparation and has to wait until there is sufficient moisture in the soil before he can start land preparation. Check-row planting is one possible solution and is currently being investigated at Magoye Station. Holes are prepared by hand at 36-inch centers in the dry season and phosphate fertilizer applied. With the first sowing rains, four seeds are thrown into each hole, dusted with aldrin, and covered. In a first field scale trial at Magoye Station a yield of 37.5 bags per acre was obtained using this method. Ways of reducing labor requirements are being further investigated. Currently, farmers are recommended to sow maize in rows three feet apart and to leave one foot between each plant in the row, giving a population of about 14,500 plants per acre. Where heavy fertilizer dressing and hybrid seed are used, the within row planting can be reduced to nine inches, giving about 19,300 plants per acre.

Table 5 gives a summary of the results of two factorial trials designed to determine the yield responses of open-pollinated Hickory King and the single hybrid SR52 to different levels of sulphate of ammonia and single superphosphate. They demonstrate the substantial response that can be obtained with the addition of fertilizer, and the phosphate-deficient nature of Magoye soils. The

TABLE 5.—MAIZE FERTILIZER TRIALS MAGOYE: YIELDS PER ACRE,
AVERAGE 1963-66*
(Bags of 200 pounds)

Variety	Pounds N per acre, as sulphate of ammonia				Mean
	0	60	120	180	
Maize following sunnhemp					
Hickory King	18.4	19.5	20.1	21.0	19.8
SR52	30.4	30.4	32.8	32.2	31.5
Maize following maize					
Hickory King	12.0	15.5	17.2	17.9	15.7
SR52	18.6	26.9	29.2	33.1	27.0

Variety	Pounds P ₂ O ₅ per acre, as single superphosphate				Mean
	0	30	60	90	
Maize following sunnhemp					
Hickory King	13.5	19.5	22.2	23.6	19.7
SR52	22.7	32.9	34.7	35.6	31.5
Maize following maize					
Hickory King	11.4	16.9	16.0	18.4	15.7
SR52	22.1	26.9	27.8	31.1	27.0

* Data from *Annual Report* (27). Mean of trials 1963/64-1965/66.

application of sulphate of ammonia to maize following sunnhemp resulted in only small yield increments. However, small farmers usually sow maize on land which has been cropped with maize for several seasons, and under these circumstances the application of a nitrogenous fertilizer is necessary for the achievement of the high yields that are possible in this area. In general, the application of fertilizer to SR52 is more rewarding than to the open-pollinated Hickory King variety.

The standard maize fertilizer recommendation, on which loans issued by the Land Bank were based in 1967, was 250 pounds per acre each of an NP mixture (10-20-0) and either calcium ammonium nitrate or sulphate of ammonia. Fertilizer costs varied from depot to depot but, on average, this recommendation cost between £8 and £8 8s. per acre. Fertilizer was subsidized in some parts of Zambia but not in the Southern Region. The research services advised that where cash was a limiting factor and management was of a high order, the farmer should be encouraged to first purchase SR52 seed and then, if he had further cash, to purchase fertilizer. However, it was emphasized that neither hybrid seed nor fertilizer could overcome poor management. It is, however, arguable whether good management standards are to be found on maize farms where no fertilizer is being used.

The use of aldrin or dieldrin was recommended for the control of soil pests and DDT for maize stalk borer control. The aldrin application costs 15 shillings per acre. A striking feature of Mazabuka district was the extent to which there were both awareness and an increasing acceptance of these pesticide recommendations, demonstrating an increasing readiness to invest in new practices shown to be worthwhile in terms of their final return to farmers.

Cotton

Various attempts have been made to promote cotton production in Zambia since the early part of the century, but intense pest damage led to successive failures until the work of the Cotton Pest Research Team at the Gatooma Research Station, Rhodesia, showed the way to realizing the potential of the Central African countries for cotton production through the use of recently developed insecticides and spraying techniques. Three insecticides are recommended for the control of the insect pest complex in Zambia: carbaryl, DDT, and dimethoate. The choice of insecticide is determined by pest observations made in the field.

Scouting to determine the incidence of cotton pests is carried out by specialized demonstrators, who are in a position to advise farmers on what insecticide to use and when. Appropriate amounts of the three insecticides in small packets, each providing the correct dosage for mixing with three gallons of water, were available to farmers in 1967 in a sealed box and at a cost of 41s. 6d. Each box contained enough insecticide for treatment of half an acre of cotton. The standard spraying equipment cost £25 and consisted of a three-gallon knapsack sprayer with tail boom and nozzles. The model used at the time of our survey had proved not to be sufficiently robust and was being replaced. There was a 50 per cent subsidy on this equipment, which was sold to farmers for £12 10s.

The variety grown is Albar 637. Following recommended practices, 1,200 to 1,500 pounds of seed cotton per acre represent good average yields of this variety under local conditions, and yields of over 2,000 pounds seed cotton per acre are

obtainable. In the early years, the seed for the commercial crop was obtained from the Sabi Valley, Rhodesia, and from 1965 was drawn from the commercial crop ginned at the Lusaka ginnery. A cotton seed maintenance and breeding program was finally initiated in Zambia in 1966/67. Farmers are charged 6d. per pound for acid delinted cotton seed. As with maize, early sowing is extremely important and a delay of four weeks can result in a 50 per cent reduction in yield.

Fertilizer trials on cotton in the district have often yielded contradictory results but, in general, where the land is not in good condition it pays to apply fertilizer, and the general recommendation is one bag of P mixture per acre.

A cotton disorder, termed "crumple top," appeared in Zambia during the 1963/64 season and caused localized but very serious loss of crop in places. The cause was identified as boron deficiency which can be corrected by the addition of soluble boron (Solubor) to normal insecticide sprays. In the 1966/67 season, for the first time, Solubor was made available to farmers in 1.5-pound packs, enough for half an acre, at a cost of 3s. 9d. each. The degree of awareness of this new recommendation by farmers, found during the Stanford survey, showed the transfer of information from research station to farmer to be good.

Groundnuts

Groundnuts are an important secondary crop in the area. Until recently the crop received much less attention from research workers than maize or cotton. Breeding work has been carried out at Mount Makulu and an agronomy program at the Magoye Station. More recently, this program has been stepped up with investigations on the prevention of pops, a condition in which empty pods occur. Early maturing varieties are recommended for the area, and the variety Natal Common, which is less susceptible to pops, is grown. Results in the 1967/68 season indicated that the application of lime and boron substantially reduced the incidence of pops in susceptible varieties (27).

Early sowing and a plant population of about 52,000 plants per acre are recommended, plus the application of 100 to 150 pounds of single superphosphate per acre. Under favorable conditions groundnuts should yield six to seven bags (180 pounds) of shelled nuts per acre.

ECONOMIC AND INSTITUTIONAL ENVIRONMENT

Mazabuka has been a favored district for agricultural development, in terms of sustained extension effort, concentration of extension and marketing services, and the government funds devoted to the area.

Agricultural Extension

Tonga receptivity to agricultural innovations cannot be divorced from the favorable economic and institutional environment which seems to prevail in Mazabuka district. Extension work began with the establishment of Kanchomba station in 1936. This was followed by the opening of the Monze and Magoye stations in 1940. Three major periods, each distinguished by a different extension emphasis and program, can be distinguished. In the late 1930s and the 1940s the major emphasis was on the construction of large-scale soil conservation works.

In addition, demonstrations of the Kanchomba rotation, with the use of manure and compost, were carried out on farmers' holdings. These farmers were paid for their cooperation over a four-year period and the reconnaissance survey report recorded that, as a result, their neighbors looked upon them as paid employees of the government. Indeed, many demonstrators regarded themselves in the same light, and as a result, although some impact was made, it was not great (3, p. 3).

With the introduction of the African Improved Farming Scheme greater emphasis was laid on the improvement of general standards of farming and the halting of soil deterioration on individual holdings. Improved farmers had to meet stipulated standards if they were to qualify for an improved farmer bonus. There was a heavy concentration of both senior and junior extension staff but these devoted their attention largely to those farmers who participated in the scheme. However, other farmers benefited from the improvements that were effected for the community as a whole. Major soil conservation work was partly financed by the African Farming Improvement Funds and, in the period 1951-53, 25 per cent of the deductions in the African maize price were allocated to this program, plus a further 14 per cent to the related improvement of water supplies. In addition, the government granted 100 per cent of the cost of major waterworks which were of more than local benefit and one-third of the cost of works that were to the advantage of a particular group of people. Substantial progress was made and by 1960 about one-quarter to one-third of the land around Magoye was said to be adequately protected.

The flooding of the lower reaches of the Ngwesi and Magoye Rivers in the 1958 season emphasized the great need for conservation work to be carried out in the upper catchment area of the Ngwesi River. In 1959 the government started catchment area planning in the upper Ngwesi and this marked the beginning of extensive catchment and regional planning in the traditional areas. This planning involved the surveying and classification of the land into arable and nonarable areas. The nonarable areas were then fenced and storm drains and contours constructed on the arable land. In addition, access roads were constructed and dams and bore holes put in to provide water for the people and for cattle. Because of the expense, this was eventually cut down to skeletal work, the government putting in one contour in three while the landholders concerned were expected to construct the intermediate contour banks.

As elsewhere, conservation work, which is troublesome and confers what are essentially long-term benefits, was never popular with the Tonga. As late as 1965/66, the annual report of the planning section of the Department of Agriculture, Mazabuka, stated:

In the traditional sector although downright opposition to catchment planning is no longer experienced, there is a general feeling of apathy amongst the people. No effort has been made to maintain contour ridges, fences, or even water supplies put in under the various plans and one wonders what has been achieved by the plans. Without an intensified extension drive within each area before and after each plan is implemented the effects on individuals are small and the expenditure cannot be fully justified.

Since the termination of the African Improved Farming Scheme, an effort has been made to reach a larger percentage of farmers. The agricultural extension headquarters for the area is in Mazabuka town and there are three agricultural divisions in the chiefs' areas with their local headquarters at Monze, Magoye, and Mapangazia. Each of these divisions, under the supervision of a technical officer, is subdivided into a number of chieftaincy areas to which agricultural camps are assigned. Depending on the size of a camp it is staffed with one or more demonstrators and either an agricultural assistant or a technical assistant.

The concentration of extension staff in Mazabuka district is large compared with the other areas studied by the authors. In October 1966 the extension staff was composed of 3 professional officers, 3 technical officers, 19 technical assistants, 25 agricultural assistants, and 53 demonstrators. The last category included 32 cotton demonstrators and 18 maize and cattle demonstrators. The ratio of extension workers of all grades to farmers was about 1:150-200. An unusual feature was the large number of specialist demonstrators, who have duties similar to the tea demonstrators of Kenya. The high concentration of cotton demonstrators reflected the importance attached by government to this new crop.

Demonstrators usually have had eight years of schooling. They undergo a specialized course before the season starts. This is a refresher course for existing demonstrators and an introduction for the new intake of staff. Additional courses are provided during the season to highlight various topics such as spraying and harvesting. However, the extension service is, in effect, as good as its demonstrators, and one reason that the continuous training of cotton demonstrators had not resulted in a greater achievement was the large turnover in the establishment. In 1967, demonstrators were paid £11 to £12 per month and there was a need to make their conditions of service more attractive.

After two years of service in the department, demonstrators are eligible to take the annual examination for entry into the Monze School of Agriculture. This provides a one-year course designed to produce agricultural assistants. On satisfactory completion of an in-service course, agricultural assistants may become technical assistants. Men who have reached GCE standards are eligible to go to the National Resources Development College at Lusaka which provides a two-year course for the training of technical officers. Unfortunately, because of the shortcomings of rural amenities, these officers often do not take kindly to being posted to the smaller stations. Technical officers may also be promoted from the lower scales of the cadre. The recently formed Faculty of Agriculture of the University of Zambia now provides a source of local graduates in agriculture to fill agricultural officer and other senior grades in the Ministry.

It was obvious from the Food Research Institute survey that extension had made a very considerable impact on the farming community. In part this was due to the high concentration of extension workers; but even more important, the extension service had something worthwhile to offer farmers in terms of innovations that were very rewarding. Moreover, by their very nature, these innovations were self-spreading and a farmer who had taken note of the results obtained on the farm of a neighbor or a European could himself follow suit, depending on what funds he had available or could obtain on credit.

Marketing Institutions

Until the expansion of maize production the Tonga had very few commodities to sell. At first traders and settlers bought maize from the Tonga and sold to them machine-made goods, including ox-drawn implements. Except on the line of rail, this system remained essentially the trading pattern in most areas of the Southern Province until the 1950s.

With the enactment of the Maize Control Ordinance, the Maize Control Board was set up in 1936 to provide a market and a guaranteed price for maize along the line of rail. The Board's buying and selling prices were fixed by the government, and the Board was the sole exporter and importer for maize into Zambia. Other produce was largely handled by small traders, while, because of the African Improved Farming Scheme, the Agricultural Department found itself involved in buying and reselling green manure seed. The Maize Control Board became the Grain Marketing Board in 1958. This was a change in name only and there was no change in policies or facilities, other than the extension of control to other grains. In Mazabuka district the Grain Marketing Board has line of rail depots at Mazabuka and Monze.

In 1959 the African Rural Marketing Board (ARMB) was set up to take over the buying of maize on behalf of the Grain Marketing Board in the African rural areas of the Central Province and in Mazabuka district. The service operates nine depots throughout the district and pays producers the statutory price for maize, less charges for transport and handling. Producers can register with the Grain Marketing Board as commercial producers for direct delivery to their depots, thus getting a slightly higher price for the maize. The gazetted prices for maize delivered to the Grain Marketing Board between the first of May 1966 and the thirtieth of April 1967 were 33s. 3d. per bag of Class A maize, 32s. 9d. for Class B, and 31s. 9d. for Class C. Direct delivery has become increasingly popular and in the period 1966/67, 250,000 bags of maize were delivered direct to the Grain Marketing Board in the Southern Province by Africans, out of a total African delivery of 767,000 bags. The number of African farmers registered as producers for direct delivery in the Southern Province rose from 845 in April 1965 to 1,494 in April 1967.

In order to stabilize Zambian maize production the government has decided to announce annually a preplanting price for the crop based on the country's requirements. It was stated, in October 1966, that (28, p. 5):

In accordance with the approved long term price and production policy for maize, the Minister of Agriculture announces not later than September each year a pre-planting producer price in respect of the following intake year commencing 1st May.

The policy provides that if production is 10% or more in excess of national requirement (which includes building up of reserves and exports made at no loss) then there may be a reduction in the new pre-planting price not exceeding 2s. 6d. per bag compared with the previous pre-planting price; if production is 10% or more below the national requirement an increase in the same amount is permitted.

In order to streamline the marketing organization it was decided in March 1967 that the Grain Marketing Board would take over all functions of the Agricultural Rural Marketing Board in the Southern, Central, and Western Provinces. This would include all functions of the ARMB in respect to supply, distribution, and the sale of fertilizer as an agent for the government. The two Boards were finally combined as the Agricultural Marketing Board of Zambia in August 1969.

Supply Arrangements

Neither the Maize Control Board nor the Grain Marketing Board, which superseded it, had any interest in supplying farm inputs to farmers. From time to time, under ad hoc arrangements, the Grain Marketing Board had assisted distribution of fertilizers and ox carts sponsored by the Agricultural Department. The trading posts and a few Tonga and European farmers handled the retail trade as far as their capital and interests permitted.

There are no cooperative societies in Mazabuka district but two major institutional innovations provided for the supply of inputs. The African Rural Marketing Board traditionally supplied fertilizers and in 1966/67 supplied maize seed. A major innovation was the creation of the African Farming Equipment Company, Ltd., in the late 1950s in order to provide the African farmers' requirements of improved seed, fertilizers, insecticides, implements, and other requisites. The company began operations in Central Province but its activities were extended in 1961 to include part of Southern Province. It is jointly owned by the African Farming Improvement Funds of the Central and Southern Provinces and by the Northern Rhodesia Industrial Development Corporation Limited. This company has played an important part in the development of Mazabuka district in the 1960s.

Credit

Organized institutions for the provision of agricultural credit in the Tonga area are a recent development. In general, most Tonga farmers built up their own farming capital gradually through sale of their cattle, wage work, trading, farming, and sometimes by borrowing from their neighbors. A few farmers, however, benefited from the subsidy schemes of the 1950s.

The report of the 1946 reconnaissance survey drew attention to the shortage of rural capital in Tonga country and recommended yield-increasing innovations as the means for building up rural capital. Loans were made to a limited number of improved farmers from the African Farming Improvement Fund. In 1956, Johnson estimated that the total loanable funds available in this Fund were only £4,000 for the whole Tonga area. By 1960 annual loans to farmers amounted to about £11,000 in Mazabuka district. However, this was still small compared with the subsidy payments under the acreage bonus scheme. There were also indirect benefits in the form of subsidized ox-drawn equipment, including a 50 per cent subsidy on ox carts.

More recently, government increased the loanable funds available to farmers. These were made available through two organizations, the Credit Organization of Zambia and the Land and Agricultural Bank. In September 1967 these were

merged as the Credit Organization of Zambia. At the time of the Institute's survey there was a branch of the Land and Agricultural Bank in Mazabuka and the authors were able to interview members of the Advisory Committee on Credit.

The Land Bank in Mazabuka district was largely concerned with the issue of credit for the purchase of seed, fertilizers, and implements. Farmers had to file applications for credit on standard forms; these were often filled out by the agricultural extension staff, who were expected to certify the farmers' credit worthiness. Agricultural staff regarded this latter role as incompatible with their duty of gaining the confidence of the farmers. As a result, comments were usually confined to farming facts. The forms were then passed on to the local District Credit Advisory Committee which, at the time of our visit, consisted of five members nominated by the Minister of Agriculture on the advice of the Minister of State for the province. Successful applicants were notified at meetings held in their own neighborhood areas. They were then issued local purchase orders from the bank which they could take to their source of supply, thus obtaining their loan in kind.

The Advisory Committee could approve loans up to £300 per farmer. Larger loans required approval at a higher level. Seed and fertilizer loans were on the basis of the acreage to be improved and the standard recommendations. Thus, one 100-pound bag of maize seed was adequate for five acres, and a loan for one bag of seed could be accompanied by credit for twenty bags of fertilizer.

The weakness of the system was the lack of contact between bank staff and farmers, so that the staff had inadequate knowledge of the individuals to whom they granted credit. Shortage of staff made visits to individual holdings impossible. Among the general problems of the area were the distances between farms and markets and the shortage of fertilizer distributing centers.

Loans carried an interest rate of 8 per cent. If a farmer defaulted in payment, he had to produce a good reason for having done so before he was given a second loan. The default rate was high but not discouraging. Of the 1965/66 loan repayments due, the sum of £43,000 was repaid out of the £66,000 expected. Substantial sums have been made available as credit. In the first year of its operation, 1965/66, the Credit Advisory Committee at Mazabuka gave approval for the issue of £129,162 credit although not all of the sum approved was taken out by applicants, because approval came too late for some farmers to make good use of fertilizers. In 1966/67, 5,033 applications were made for a total of £378,363 credit. Of these, only 401 were rejected, their applications totaling £8,020.

Cotton has been developed by a block credit system. The Agricultural Department informed the supplier of inputs, the African Farm Equipment Company, Ltd., what the cotton acreage was likely to be, and the likely fertilizer and insecticide requirements. Registered growers were then issued cards which gave the name of the grower and the acreage he had planted. Farmers could obtain their required inputs at stores on presentation of the card. Credit was recovered when farmers were paid for their crops.

Tractor Mechanization Scheme

Tractor mechanization is not new to Mazabuka. European farmers have completely adopted tractor-drawn equipment. A few African farmers have also

purchased tractors; it was estimated that there were 88 African-owned tractors in the district in 1963 (21). In 1965/66 a pilot mechanization scheme was started in Zambia and it was decided in the first instance to concentrate on the provision of facilities for winter and early summer plowing, as the most practical way to encourage early sowing on which the good husbandry of most crops in Zambia depends. Four units were established in Mazabuka district: a seven-tractor unit at Ngwesi, and units of four tractors each at Mapangazia, Mujika, and Katimba. The hire charge to farmers was £2 an hour and credit was provided by the Credit Organization of Zambia. At the time of the Institute's study the Mazabuka units still had to justify themselves. Operating costs were high and demands for tractor hire were disappointing. Probable contributing causes for the poor demand were that farmers were used to doing their own work with ox plows and that the hire service had to compete with privately owned tractors, the owners of which also provided a contract service. It appeared that the operation of this service was following the same pattern to be found in Uganda, Tanzania, and Ghana—undue haste in its implementation, heavy capital outlay, and inadequate number of technical staff at the early stages of development.

There is undoubtedly a place for tractor mechanization of African farms in Mazabuka district. A minority of farms are large enough to justify tractor use and their owners are already purchasing equipment. There is also room for tractor hire facilities, so that farmers with crop acreages too small to justify the purchase of a tractor can have work carried out on their behalf. Limited facilities are already provided by private tractor owners. The Tonga respond readily to economic opportunity and it is likely that private contract services will develop faster with growing demand. It would be logical to allow the development of tractor mechanization to proceed on these lines, farmers being charged an economic rate for tractor hire by the private contractors. Government services are costly to establish and operate and it is difficult to see what merit they have over private hire services. If the object is to provide cheap, and therefore highly subsidized, tractor hire in order to facilitate early sowing and improve yields, they can defeat their aim by encouraging the sowing of larger areas than farmers can efficiently cultivate.

The Ngwesi Scheme

A settlement scheme was started at Ngwesi in 1964 when 32 farmers were settled on land bought from European farmers. The scheme is of particular interest as its progress is studied by staff at the nearby Magoye Research Station and it thus provides a measure of the achievement of a class of medium-scale farmers. In 1967 there were 75 farmers, each having 40 acres of arable land and more than 100 acres of grazing (if individual rights to communal grazing areas are included). The communal grazing area was divided into four paddocks, one out of the four being burnt every year. Farmers were allowed to keep eight oxen for farming purposes.

The performance of the scheme up to October 1966 has been evaluated by Hailey and Petch (15). Crop yields have been good. The main crops were maize and groundnuts, with maize dominating. In 1965, 471 acres of maize were grown and gave a yield of 12 bags per acre; there was an average maize sale of 168 bags

TABLE 6.—SUMMARIZED COTTON ACREAGE DATA, MAZABUKA*
(Acres)

Season	Small-scale farms	Large-scale farms	Season	Small-scale farms	Large-scale farms
1961/62	152	60	1964/65	561	1,180
1962/63	409	320 ^a	1965/66	824	375
1963/64	503	840	1966/67	723	75 ^b

* Data from *Annual Reports* (26).^a One farmer grew 200 acres.^b One African farmer.

per farm and an average of 14.8 bags per farm were retained for domestic consumption. In the 1965/66 season the average maize yield rose to 14.4 bags per acre; the average sales per farm increased to 186 bags and the amount of maize retained for domestic use to 27 bags per farm. Six of the farmers had yields of 21 to 25 bags per acre and one farmer obtained an average yield of 28.5 bags per acre. An average of 1.9 acres of groundnuts was grown by 30 farmers in 1966 and gave an average yield of six bags of unshelled nuts per acre.¹ These figures reflect the present order of yields now being obtained by medium-scale Tonga farmers.

Cotton

The extension of cotton production in Mazabuka district has been bedeviled by special problems, largely institutional. Areas planted to cotton by small- and large-scale commercial farms, mainly owned by Europeans, since the introduction of cotton into the district in 1961/62 are summarized in Table 6. The development of cotton production has been slow despite the high potential for the crop in this area. This has resulted from a combination of factors, including the discouraging effect that late payment for the crop has had on the small producers. In the 1961/62 season, cotton production was organized entirely by the Agricultural Department. The cotton officer at Mazabuka issued the seed, arranged for the crop to be sprayed, collected the seed cotton, arranged for its transport to Gatooma in Rhodesia, collected the proceeds, and paid farmers. All farmers were paid by mid-September 1962.

The following season the purchase and marketing of the crop were taken over by the African Rural Marketing Board. Because of delays in finalizing individual accounts farmers were not paid until November in the following two seasons. In 1965 it was decided that, in order to expedite payments, the Marketing Board should pay for the crop in two installments, an initial payment and a second payment from which credit would be recovered. In practice, the first payment was made in August 1965, but the second payment was not made until February 1966 and, owing to accounting problems, the final payment for the 1965/66 crop was not made until January 1967.

At the same time, yield levels were far from satisfactory. This was due to a combination of late planting, insufficient spraying, and soil boron deficiency in

¹ A standard bag of unshelled groundnuts in Mazabuka is 65 pounds compared with 180 pounds for shelled groundnuts and the 200-pound bag that is standard for maize.

some areas. Timeliness of sowing depends upon the earliness with which the land can be prepared and, in turn, upon the resources at a farmer's disposal. The difficulties encountered have been commented on in an earlier section, with relation to timely maize sowing. Some farmers have been able to make use of the services of the tractor hire scheme or private contractors for land preparation. However, even then, they only benefit if their plowing is done early, and this presupposes that credit is available on time. Other crops also benefit from early sowing, and at sowing time the decision has to be made on the relative sowing priorities. Maize as the major cash crop usually gets priority.

A survey of the small-scale cotton crop in Zambia was carried out by Bosse in the 1963/64 season (5). Detailed information was obtained on the cultivation practices of 753 Zambia cotton farmers. It was found that 17 per cent of the farmers in the sample had sown their cotton before the eighteenth of November and had obtained a mean yield of 1,015 pounds of seed cotton per acre; 52 per cent had planted between the eighteenth and thirtieth of November and obtained a mean yield of 827 pounds per acre; and 11 per cent had sown after the eighth of December and had obtained an average yield of only 568 pounds per acre.

Although there was an obvious tendency for farmers to economize on spray applications this was not very marked in the sample of farmers for which Bosse collected data in the Magoye and Monze areas. In 1963/64 the sample of farmers at Magoye sprayed an average of 8.4 times each and at Monze, 12.0 times. Insufficient spraying was not always the fault of the farmer. It was said that the number of breakdowns of sprayers and tail boom equipment in the field has been appalling and there has been some difficulty in finding adequately robust equipment. At the time of the Institute's field study, the cotton officer, Zambia, thought he had found a suitable robust sprayer, and the Ministry of Agriculture was trying to find a local manufacturer who would be prepared to make tail booms to local specifications.

The potential of the area for cotton production is demonstrated by the yields obtained by the large-scale farmers. Between 1962/63 and 1965/66 the average cotton yield obtained by these farmers in Mazabuka district ranged from 1,200 to 1,474 pounds of seed cotton per acre. In the early years of cotton growing a comparatively small number of large-scale farmers made a significant contribution to total Zambian cotton production, and in 1964/65 approximately equal areas of cotton were grown in Zambia by large-scale and small-scale farmers. However, owing to difficulties encountered in securing enough labor to pick their crop, large-scale farmers abandoned cotton growing and in 1966/67 only one large-scale African farmer in Mazabuka district was growing cotton. It was hoped that the introduction of mechanical harvesting would encourage these farmers to return to cotton growing and thus boost national production.

Beginning with the purchase of the 1966/67 cotton crop, marketing was improved. It was based on the overriding condition that farmers would be paid within a fortnight from the time of delivery of their crop to the depot. In order to achieve this, two basic changes were made. It was decided to carry out classification of all seed cotton at the rural depots and to replace the large wool packs formerly issued to farmers by smaller containers. Previously, classification had been carried out at Lusaka, and the usual time elapsing between delivery at the

rural buying centers and arrival at the cotton ginnery had been one month. The wool packs, formerly used, had weighed between 350 and 400 pounds when full of cotton and their transport from farm to buying depot presented difficulties. With the streamlining of marketing facilities, a technical solution to boron deficiency, and the availability of better spraying equipment, the future progress of cotton development will depend on individual farmers' assessments of the economic advantages of cotton growing and of the relative advantages of investing capital and labor in maize or the more troublesome cotton crop.

Off-Farm Occupations

Opportunities for gainful employment elsewhere often play an important role at an early stage of agricultural development. New experiences serve to widen the horizon of the farming community, condition farmers to the acceptance of change, and provide a means of accumulating capital. At a later stage of development the investment of farm income in businesses is associated with the emergence of a class of small entrepreneurs.

The Tonga have been accustomed to finding alternative sources of employment since the turn of the century. It was customary for men and boys to seek employment in Southern Rhodesia and as far afield as the Republic of South Africa. Later, work became available on local European farms and in other parts of Zambia, including the copper belt.

Colson, writing of the period 1946-50, noted that about 50 per cent of the income of the poorer Tonga was made up of sources other than the sale of maize and included a wide range of craft products (11). In the 1950s there was a growth of specialized enterprises. Off-farm occupations included carpentry, felling of trees and plank cutting, tailoring, shoe repairing, and minor blacksmith work. Some Tonga were buying poultry and eggs to sell in the urban markets and others became cattle buyers for European butchers.

By the late 1940s a few Tonga already obtained very substantial incomes from farming. It was known that some farmers had gross cash incomes of £600 to £1,000 in the period 1946-50 and not all of these were registered as improved farmers. Some farmers invested their savings in businesses. A few had stores and tea shops and others were able to purchase lorries and establish themselves as transport contractors. Thus, within 30 years of the construction of the Rhodesian Railway and the growth of a market for maize, a class of progressive farmers and traders had emerged from the ranks of the former subsistence cultivators. What is remarkable is not that this occurred, but the comparatively short period in which it happened.

FARM INTERVIEWS

The sample of farmers interviewed was made up of progressive farmers and their near neighbors. The progressive farmers were chosen by the Agricultural Department as representative of the progressive farmers of the district. Three neighbors were selected by the authors for every progressive farmer, and a sample of 20 farmers—5 progressive and 15 neighbors—was interviewed in each of the three extension areas: Magoye West, Monze East, and Monze West. The choice of

these areas was dictated by their accessibility to an extension station and their degree of involvement in past or continuing agricultural programs. The areas represented three distinct ecological types. The Magoye sample was on relatively fertile upper valley soils with the associated vegetation. Farms visited in Monze West were predominantly on plateau soils carrying *Isoberlinia-Brachystegia* woodland. The sample farmers in Monze East were on predominantly sandy soils, largely denuded of the original tree cover and with all indications of past overstocking and the subsequent onset of erosion.

In Magoye West the sample of farmers was drawn from two sections of Chief Mwanachingwala's area, Mbeya and Chalimbana, close to the regional research station at Magoye. The chief's area is estimated to contain 31,000 acres of cultivable land, about 10 per cent of the total area of the chiefdom (20). There are approximately 1,400 farm families in the area. Mbeya was the site of a settlement scheme in 1950 that ended in failure insofar as the initial aim of communal or group farming was not realized. Like other areas in Mazabuka district, which were involved in a land planning program, the pattern of land use in Magoye West consists of individual arable holdings and communal grazing fields established by government. The communal paddocks are in a state of disrepair because farmers are not cooperating to mend fences. Between August and November, the cattle in the area are driven to the Kafue flats for grazing.

Monze West comprises the largest chief's area in Mazabuka district, that of Chief Monze. The chieftaincy contains 128,000 acres of cultivable land, 60 per cent of the total area, and about 2,700 farm families.

Monze East comprises three chiefs' areas; the sample was taken from those of Chiefs Mwanza and Ufwenuka. A total of about 2,400 farm families live in the two chiefs' areas, which are estimated to have about 60,000 cultivable acres, 33 per cent of the whole area of the two chiefdoms. One of the four tractor hire units in the area was at Mujika in Chief Mwanza's area.

Neighbors' farms in the Magoye sample had an average of eight acres, with a range of from three to ten acres. In Monze the range was from two acres to 160 acres under crops per farm. Consequently, the data for neighbors in Monze has been summarized for three acreage groups: farms with up to ten acres of crops; those with 11 to 20 acres; and those with more than 20 acres. One farm in Monze West with 160 acres under cultivation, all under maize, was excluded from calculations of mean data for the group of farmers with more than 20 acres in order not to unduly bias the averages.

The sample of farmers interviewed was small and it is not suggested that the mean data presented gave close estimates of the mean values for the district. However, it is thought that the sample included a good cross section of the African farming community, ranging from subsistence farmers to medium-scale commercial growers. Taken in conjunction with other survey data, it provided an assessment of current progress in agricultural development.

Social Background of the Farmers

The mean age of the sample of progressive farmers was 51, and for the entire sample 45 years (Table 7). There was marked variation in age distribution within each of the groups, and one-third of all farmers were 40 years old and under. The

TABLE 7.—THE FARM FAMILY

	Food Research Institute, 1967 ^a						Rees 1955, improved farmers ^c	Ngwesi 1966 ^d
	Progressive farmers	Magoye	Neighbors			All neighbors		
			Monze: cropped acres					
			1-10	11-20	20+ ^b			
Number in sample	15	15	12	11	6	45	112	73
Age of farmer								
Average age	51	40	40	48	50	43	46	40
Number 40 and under	1	7	7	3	2	19	50	35
Farmers' education (<i>percentage of farmers</i>)								
No school education	0	13	17	18	17	16	42	12
Less than standard V	87	74	83	64	50	68	53	69
Standard V and above	13	13	0	18	33	16	5	19
Other work experience (<i>number of farmers</i>)								
No other work experience	5	6	7	4	1	18	8	...
Farm employment	4	5	0	1	1	7	28	...
Non-farm employment	6	4	5	6	4	20	76	...
Average years worked	7	5	4	4	7	5		
Persons per farm								
Adults	4.9	2.4	2.3	3.6	4.0	3.0	4.0	3.4
Children	11.4	4.2	3.2	6.0	7.1	5.0	5.3	5.5
Total	16.3	6.6	5.5	9.6	11.1	8.0	9.3	8.9
Children at school	5.4	2.1	1.3	2.2	3.0	2.0	...	1.6
Wives per farmer	2.9	1.2	1.2	1.2	1.5	1.4	1.4	...
Family labor force (<i>number per farm</i>) ^e								
Adults	4.9	2.9	2.6	3.7	4.7	3.2	3.9 ^f	...
Children	1.7	0.3	0.3	1.1	1.0	0.7	2.2 ^f	...
Total ^g	5.8	3.1	2.8	4.3	5.2	3.6	5.0	...

^a Data from the Food Research Institute Field Survey, 1967, described in text, pp. 245-46.

^b Excluding one grower with 160 acres of maize; this grower is included in the "All neighbors" column.

^c Sample of improved farmers in 1954/55 from A. M. M. Rees, "An Economic Survey of Plateau Tonga Improved Farmers," Northern Rhodesia, Department of Agriculture, *Agricultural Bulletin*, No. 14, 1958, pp. 8-12.

^d Farmers on the Ngwesi Settlement Scheme, near Magoye; from S. Hailey and H. Petch, *Investigations into Small-Scale Farming Systems*, No. 1, *Ngwesi Settlement Scheme* (processed, Lusaka, 1966).

^e In the Food Research Institute Survey unmarried children big enough to do adult work were classified as adults in the labor force figures, but as children in the persons-per-farm figures.

^f Family labor only. Rees shows an additional 0.4 adult and 1.1 children as non-family labor said to be mainly casual labor employed for short periods only.

^g Adult units considering two children equivalent to one adult.

youngest group of farmers was in Magoye area and, usually, the largest acreages were farmed by the oldest farmers. This was because they had usually opened their land themselves, and their holdings were still undivided.

All of the progressive farmers had received a formal education of some sort and 73 per cent of the sample farmers had between one and five years of schooling. A further 15 per cent had been to school for five years or more and only seven farmers had received no school education. The proportion of farmers who had received schooling was relatively high for a developing country and particularly so for these age groups. The progressive farmers had gone to school in the late 1920s and their neighbors in the late 1930s, and these figures reflect the early and important contribution made by the mission schools. A Jesuit mission was established in the area in 1904 and a Seventh-Day Adventist mission the following year. The first schools were established in 1905 and, according to Colson, seven different denominations had mission stations in the area by the 1920s and schools were then beginning to proliferate (12). By 1950 there were two secondary schools at missions in the district and the first Tonga had already been sent to the United Kingdom for advanced training.

A high percentage of farmers had other work experience. Only 23 farmers stated that they had never had any paid employment and over one-third of the sample had experience of nonagricultural work. Job experiences ranged from work as laborers with the Grain Marketing Board and the railways to mining, bricklaying, truck driving, police work, and trading. Two farmers had worked in Southern Rhodesia and three as far afield as Johannesburg. However, the proportion of farmers who had no other work experience was substantially higher than that found by Rees 12 years earlier.

The 1945 survey team observed that although the Tonga once had a tradition of labor migration the habit was declining among the younger men (3, pp. 161-63). As it becomes increasingly unnecessary for farmers to find work elsewhere, the percentage of men who have engaged in alternative employment is decreasing.

Household Composition

An average of ten persons were supported per farm. These included the farmer, his wives and children, and various dependents. Progressive farmers had a greater number of wives than the other classes and their families were on average twice as large as those of their neighbors. Among the neighbors, there were substantially larger farm families in the larger acreage groups. Consequently, household labor was also greater on the larger farms. In estimating adult labor per household, unmarried children who were big enough to do adult work were classified as adult, whereas in the summarized data for household composition, they were classified as children. Although the number of children supported by the farm families was high, 6.6 for the whole sample, the use of small children as farm labor is declining. On the average, only one child per farm family was available for farm work, reflecting the increasing tendency to give children some formal education.

Farm Size

Data for cropped acreages per farm and the numbers of farmers growing specific crops are given in Tables 8 and 9. The present system of land use involves individual arable holdings which are sown to annual crops, usually on separate fields. Farm size has been influenced by individual drive and initiative, the laws of succession and inheritance, and participation in the government settlement scheme at Mbeya. In Monze West it was still possible to acquire some new marginal land if a farmer took up residence in a village. One farmer had acquired two pieces of land in this way in the previous ten years. However, in Magoye West no available land was left and holdings were not only small but increasingly divided among heirs.

The data given for total farm size are estimates of all the land claimed by farmers and may be exaggerated. Progressive farmers claimed an average of 56 acres per farm and their neighbors 21 acres. About 70 per cent of the total acreage claimed was under crops in 1966. The average cropped acreage per person ranged from 1.0 for neighbors in Magoye West to 2.0 for all progressive farmers and 3.2 for those neighbors in Monze who had 20 acres or more under crops.

Maize was grown by every farmer and occupied about 63 per cent of the cropped acreage of progressive farmers and 77 per cent of that of their neighbors. Some neighbors had all of their field crop acreage under maize. Groundnuts was second in importance. It was grown by 48 farmers and about 10 per cent of the crop area was devoted to the crop. The maximum area of groundnuts cultivated by any one farmer was ten acres.

Cotton was grown only by a minority of farmers in Mazabuka district; the sample clearly drew a disproportionately high percentage of cotton growers. The majority of these grew one to two acres of the crop, but one farmer had grown four acres in 1965/66 and had 14 acres of cotton under cultivation in 1966/67.

A significant number of farmers still grew green manure crops (sunn hemp and velvet beans), a practice which was adopted during the period of the African Improved Farming Scheme. A farmer's ability to sow a green manure crop depends upon the acreage available to him. Farmers with less than ten acres of crops sowed very small acreages of sunn hemp and velvet beans or none at all, but progressive farmers and neighbors, with 20 acres or more of crops, devoted 14 to 17 per cent of their total cropped area to these crops. Some of this area was reaped and provided income from the sale of seed. Rees found that 54 per cent of the area of the two crops, sown by his sample of farmers, was plowed in and the remainder harvested (22, p. 21). Comparable figures are not available from the Food Research Institute survey.

The data in Table 5 above indicate gains in yields of maize following a green manure crop, related to the nitrogen applied. However, with more intensive land use, and an increase in fertilizer use, the sowing of green manure crops is likely to become less common.

Progressive farmers had made sizable investments in their holdings and many of them had substantially built brick houses. Among this class, 11 had wells to provide a domestic water supply; only four of the neighbors possessed wells but

TABLE 8.—THE FARM HOLDING

	Food Research Institute, 1967 ^a						Rees 1955, improved farmers ^c	Ngwesi 1966 ^d
	Progressive farmers	Magoye	Neighbors			All neighbors		
			Monze: cropped acres					
			1-10	11-20	20+ ^b			
Number of farms in sample	15	15	12	11	6	45	112	53 ^d
Having fences	10	6	2	1	1	10	...	
Having kraals	14	8	7	11	5	32	...	7
Owning cattle	15	15	11	11	6	44	109	
Acres per farm, 1965/66								
Acres claimed	56	8	10	20	41	21	...	
Acres cropped								
Maize	21.0	4.4	5.2	11.7	23.7	12.4	15.5	14.8
Groundnuts	3.0	1.1	0.7	1.5	3.5	1.4	1.8	1.0
Cotton	1.7	1.1	0	0.2	0.1	0.4	0	0.1
Velvet beans	2.3	0	0.2	0.5	5.0	0.9	3.0	0.1
Cowpeas/beans	2.0	0	0.2	1.1	3.5	0.8	...	...
Sunn hemp	3.3	0	0	0.4	0.1	0.1	4.2	0.4
Other crops	... ^e	... ^e	... ^e	... ^e	... ^e	... ^e	0.7	... ^e
Total	33.3	6.6	6.3	15.4	35.9	16.0	25.2	16.4
Number of land parcels per farm	2.2	1.9	1.5	1.7	1.2	1.6	2.5	1.0
Cropped acres								
Per person	2.0	1.0	1.1	1.6	3.2	2.0	2.7	...
Per labor unit ^f	5.8	2.1	2.3	3.6	6.9	4.4	5.0	...

^a Data from the Food Research Institute Field Survey, 1967; see text for description.

^b Excluding one farmer with 160 acres of maize and no other crops. This grower is included in the "All neighbors" column.

^c Sample of improved farmers in 1954/55. See Table 7, or citation 22, for source.

^d Farmers in Ngwesi Settlement Scheme, near Magoye; 20 of the 73 farmers had not yet planted crops. See Table 7, or citation 15, for source.

^e Negligible.

^f Two children considered equivalent to one adult.

TABLE 9.—CROPS GROWN, 1966*

Crop	Progressive farmers		Neighbors	
	Number growing	Acres per grower	Number growing	Acres per grower
Maize	15	21.0	45	9.1 ^a
Groundnuts	14	3.2	34	1.8
Cotton	10	2.6	14	1.4
Velvet beans	6	5.8	8	5.0
Cowpeas	3	9.8	11	4.0
Sunnhemp	9	5.5	3	1.2

* Data from the Food Research Institute Field Survey, 1967. There were 15 progressive farmers and 45 neighbors in the sample. See text for further description.

^a Excluding one neighbor with 160 acres of maize, and no other crops.

13 shared wells with neighbors or obtained water from nearby boreholes. The mean distance to cattle watering points was about one mile.

One-third of all farms had some fencing and three-quarters possessed kraals. The larger farms had large strongly constructed cribs for storing their produce.

Land Inheritance

The inheritance of land is a comparatively recent innovation among the Tonga. As recently as 1955 Rees found that only 35 per cent of the land owned by a sample of improved farmers had been acquired by inheritance or transfer, whereas 65 per cent had been obtained by bush clearance (22, p. 16). In the Food Research Institute survey, only eight of the 60 farmers claimed to have acquired their holdings by bush clearance. One farmer had bought his holding while 33 had inherited their farms. One woman had inherited her holding from a deceased husband, nine farmers claimed their fathers as the source of inheritance, four claimed their mother's brother, and three claimed a grandfather. Others did not specify the source of inheritance. There was thus no single source of land inheritance. A person may inherit from his father, mother's brother, or grandfather. This multiple system of inheritance contributes to fragmented holdings which are more characteristic of those inheriting land than those acquiring their land through residence (Table 10).

Colson found that significant changes have also taken place in the land ten-

TABLE 10.—LAND TENURE: MEANS OF ACQUIRING LAND*
(Number of farmers)

	Progressive farmers	Neighbors	Total
Inherited	8	25	33
Bought	0	1	1
Given (settlement)	3	16	19
Cleared	6	2	8
Others	0	2	2

* Data from the Food Research Institute Field Survey, 1967; see text for description.

ure system of a section of the Valley Tonga within the last few decades (13). These reflect response to different stimuli than those that have influenced the changing pattern of land holding among the Plateau Tonga, but further demonstrate that traditional rules governing land tenure can and do respond to changing economic and institutional environments.

Farm Equipment

A characteristic feature of farms in Mazabuka district is the high capital investment in equipment. This includes a wide range of ox-drawn implements, tractors, and tractor-drawn equipment, groundnut and maize shellers, grinders, wells, and occasional windmills.

The plow was first adopted by a Tonga farmer in Mazabuka at about the same time as in Teso district, Uganda. However, whereas in Teso district few farmers have any other implements, Mazabuka farmers possess an impressive range of equipment (Table 11). The Rees survey data show that this was already the case in the 1950s. The Food Research Institute data suggest that the trend to acquire new equipment continues. In the last 12 years progressive farmers have acquired increased numbers of ox-drawn implements, particularly cultivators, and the possession of maize shellers is rapidly spreading. Only one of the sampled farmers had no ox plow. He was a young man who cultivated 2.5 acres belonging to his mother and relied on borrowed oxen and equipment.

Plows and cultivators were standard equipment and some farmers possessed as many as four of each. Harrows were commonly used, and a high percentage of farmers owned carts despite their cost. Those who did not possess carts frequently hired them for the transport of their maize crop to the buying depots.

Seven of the farmers, six of them progressive farmers, owned Massey-Ferguson tractors, mainly MF 35. These appeared to be seriously underemployed. On the basis of the fuel costs that the authors were able to collect, it was estimated that, on average, they worked for between 150 and 200 hours per year. One of the tractor owners had cultivated only 17 acres of crops. He was a man of substance who possessed 180 head of cattle and had been able to purchase a new MF 135 tractor in October 1966. At the time of the survey he expressed concern about how the tractor would be employed but hoped to obtain contract work. The sample of farmers at Magoye had small crop acreages and none had hired tractors. However, there was evidence of demand for tractor hire among farmers with larger crop acreages and three of the progressive farmers and five of the neighbors in Monze made use of tractor hire facilities.

Tractor cultivation leads to substantially higher production costs and must therefore be accompanied by higher production levels to be worthwhile. This necessitates high levels of management and inputs. Costs of operations of European farms and in the Chombwa settlement indicate that, with tractor mechanization and the use of recommended inputs, a yield of about 17 bags of maize per acre must be obtained in order to break even.

Livestock

The Tonga, who are traditionally cattle owners, rapidly built up large herds under the secure conditions of the twentieth century. All but one of the sample of

TABLE 11.—FARM IMPLEMENTS

Food Research Institute, 1967 ^a								
	Progressive farmers	Magoye	Neighbors			All neighbors	Rees 1955, improved farmers ^c	Ngwesi 1966 ^d
			Monze: cropped acres					
			1-10	11-20	20+ ^b			
Number in sample	15	15	12	11	6	45	112	73
IMPLEMENTS PER FARM								
Tractor	.40	0	0	0	0	.02	.01	0
Tractor trailer	.33	0	0	0	0	.02	...	0
Tractor disc plow	.44	0	0	0	0	.02	...	0
Tractor harrow	.27	0	0	0	0	.02	...	0
Tractor planter	.07	0	0	0	0	0	...	0
Ox-drawn implements								
Plow	2.73	1.27	1.17	1.55	3.17	1.56	2.02	2.05
Cart	.93	.20	.33	.73	.83	.44	.65	.50
Ridger	.13	0	0	0	0	0	0	.14
Planter	.66	.13	.08	.27	.50	.18	.13	.31
Cultivator	2.53	1.00	1.00	1.45	2.50	1.29	1.16	1.42
Harrow	1.00	.53	.25	.45	1.00	.49	.70	1.22
Spray pump	.60	.13	0	0	0	.07	...	...
Groundnut sheller	0	.07	.08	0	.17	.07	...	.03
Maize sheller	.47	.07	.17	0	.33	.13	.03	.12
Grinder	.40	.07	.08	.18	.50	.18	...	...

^a Data from the Food Research Institute Field Survey, 1967; see text for description.

^b Excluding one farmer with 160 acres of maize; this grower is included in the "All neighbors" column.

^c Sample of improved farmers in 1954/55; see Table 7, or citation 22, for source.

^d Farmers in Ngwesi Settlement Scheme, near Magoye; see Table 7, or citation 15, for source.

farmers had cattle. Substantial numbers of cattle were owned and while one-third of the farmers had ten animals or less, nearly one-half had 11 to 30 head of stock (Table 12). About one-quarter of the average cattle holding per farm were trained oxen. The progressive farmers were wealthy in terms of their cattle holdings as well as their crop enterprises. Five progressive farmers owned more than 70 beasts each and the average herd for the progressive farmer represented a capital investment of about £1,000 per homestead. This investment was made possible by proximity to the dry season grazing areas on the Kafue flats.

Sheep and goats are not very important in the district, but pig-keeping is not uncommon and was already practiced in the 1940s. Seven of the farmers who were interviewed kept pigs, and one of the progressive farmers had a substantial concrete piggery with eight pens, which he said he had built in 1956 at a cost of £400. He fed fishmeal and concentrate to his stock and, at the time of our visit, owned 22 pigs. His animals were sold direct to the cold store at Lusaka.

TABLE 12.—CATTLE PER FARM

Food Research Institute, 1967 ^a						Rees 1955, improved farmers ^c
Progressive farmers	Neighbors					
	Magoye	Monze: cropped acres				
		1-10	11-20	20+ ^b		
SIZE OF SAMPLE						
Number of farms	15	15	12	11	6	112
CATTLE PER FARM (<i>number</i>)						
Trained oxen	12.3	5.1	3.8	5.9	7.7	5.9
Untrained oxen	5.5	1.8	0.8	0.6	3.0	1.2
Others	44.2	8.1	5.6	6.8	22.3	14.1
Total	62.0	15.0	10.2	13.3	33.0	21.2

FREQUENCY DISTRIBUTION OF HERD SIZE (*number of farms*)

Cattle per farm	Food Research Institute, 1967 ^a			Rees 1955, improved farmers ^c
	Progressive farmers	All neighbors	All farms	
None	0	1	1	3
1-10	0	19	19	33
11-20	1	15	16	35
21-30	4	6	10	16
31-40	1	1	2	8
41-50	2	1	3	6
51-60	2	2	4	5
61-70	0	0	0	5
Over 70	5	0	5	1

^a Data from the Food Research Institute Field Survey, 1967; see text for description.

^b Excluding one farmer with 160 acres of maize.

^c Sample of improved farmers in 1954/55; see Table 7, or citation 22, for source.

Crop Yields

Although not all farmers had a concept of pound weight, it was possible to obtain an estimate of production in terms of units of produce sold and scotch cart loads retained. The latter were converted into sacks, taking into account the various cart sizes. It was thus possible to estimate yields per acre.

Maize yields have substantially increased over the last ten years (Table 13). This appears to be principally associated with the recent introduction of hybrid varieties. The variety most commonly grown was the double hybrid SR13, although a few farmers grew SR11. Only three farmers said they had purchased the single hybrid SR52. This may have reflected partly the higher cost of seed and partly shortage of seed of SR52. Maize yields are determined by the inherent fertility of the soil, amount and distribution of rainfall, the variety used, the amount of fertilizer applied, and the general standards of husbandry. The problem of achieving timely sowing is still an important factor limiting the yield per acre of many farmers.

Rees found a trend for yield per acre to decline with an increase in the area planted to maize. This may, in part, have resulted from farmers sowing bigger acreages than they could efficiently cultivate. Any such relationship is obscured in the data given in Table 13 owing to differences in the amount of hybrid seed and local variety sown. Some farmers planted all, or the greater part, of their acreage with a hybrid variety, others only part of their maize area, and others used only a local variety. Among the neighbors of progressive farmers, the highest mean yield was obtained in Magoye West. This appeared to be due to a combination of

TABLE 13.—ESTIMATED CROP YIELDS PER ACRE

	Food Research Institute, 1967 ^a					Rees 1955, improved farmers ^c	Ngwesi 1966 ^d
	Progressive farmers	Magoye	Neighbors				
			Monze: cropped acres				
			1-10	11-20	20+ ^b		
Maize (<i>200-lb. bags</i>)	10.3	11.4	5.1	5.1	6.1	2.2	14.4
Shelled groundnuts (<i>180-lb. bags</i>)	2.4	2.4	1.6	2.2	1.8	1.1	1.6
Seed cotton (<i>lb.</i>)	850	870		1000	600	...	...
MAIZE YIELD FREQUENCY (<i>number of farmers</i>)							
Total in sample	15	15	12	11	6	112	53 ^d
Bags per acre							
0- 4.9	4	2	9	7	2	104	5
5.0- 9.9	2	4	2	2	3	7	16
10.0-14.9	5	4	1	1	1	1	17
15.0-19.9	4	3	0	1	0	0	8
20.0-24.9	0	2	0	0	0	0	7

^a Data from the Food Research Institute Field Survey, 1967; see text for description.

^b Excluding one farmer with 160 acres of maize.

^c Sample of improved farmers, 1954/55; see Table 7, or citation 22, for source.

^d Farmers in Ngwesi Settlement Scheme, near Magoye, 1965/66; see Table 7, or citation 15, for source. Twenty of the 73 farmers in the sample had not yet planted crops.

fertile land, the greater use of hybrid seed and of fertilizer, and the more efficient use of the limited land available. One Magoye farmer obtained an average yield of 22.5 bags per acre from four acres.

In order to assess the effect on maize yield of the use of the new varieties now available to farmers, mean maize yields were determined for those Magoye farmers using both hybrid seed and fertilizer, those using fertilizer but applying it to the local variety, and those using neither fertilizer nor a hybrid. The results are summarized in Table 14. All farmers who had purchased hybrid seed used SR13 and had enough seed for their entire maize acreage. Their mean fertilizer purchases were adequate for application to about 62 per cent of their maize acreage, if used at the recommended rate of application. It is not known whether farmers did this, but it appears likely that the fertilizer was applied at a reduced rate to the whole of their acreage. Those applying fertilizer to the local Hickory King type had bought enough for just one-half of their total maize acreage.

Farmers who had used SR13 and fertilizer obtained an average yield of 16 bags per acre, slightly better than that obtained in the nearby Ngwesi settlement, and were rewarded by a very good net return from their investment. Those who had purchased fertilizer alone obtained a yield of nine bags per acre but the data

TABLE 14.—MAIZE YIELDS AND RETURNS OF NEIGHBORS*

	Magoye			Monze	
	Hybrid seed and fertilizer	Local seed and fertilizer	Local seed; no fertilizer	Hybrid seed and fertilizer	Local seed; no fertilizer
Number of farmers	6	6	3	8	15
Cropped acres					
Per farm	7.5	5.3	8.0	27.4	10.8
Per family labor unit ^a	2.4	1.8	2.7	7.2	2.7
Average per farm					
Maize (<i>acres</i>)	4.5	3.5	6.0	17.1	8.9
Purchases (<i>bags</i>)					
Seed	1.0	0	0	3.4	0
Fertilizer	11.3	7.3	0	36.9	0
Yield (<i>bags per acre</i>)					
Maize	16.3	9.0	6.9	9.0	3.1
Maize value per farm (£)					
Sold	79.35	22.35	20.50	202.35	7.50
Retained for home use	34.25	29.10	43.40	47.40	34.85
Total	113.60	51.45	63.90	249.75	42.35
Costs per farm (£)					
Hybrid seed	3.30	0	0	13.75	0
Fertilizer	23.70	15.90	0	69.70	0
Total	27.00	15.90	0	83.45	0
Net return (£)					
Per farmer	86.60	35.55	63.90	166.30	42.35
Per acre	19.24	10.16	10.65	9.73	4.76

* Data from the Food Research Institute Field Survey, 1967; see text for description.

^a Children regarded as one-half labor unit.

obtained suggests that the increased yields obtained on these soils, with low rates of application to a local variety, failed to pay for the total cost of the fertilizer.

A similar analysis was carried out for Monze area, and a comparison was made of the yields and returns of eight farmers who had each purchased enough seed to sow at least 70 per cent of their acreage with a hybrid variety and 15 farmers who had purchased neither seed nor fertilizer. Again, SR13 was used by all those who had purchased seed and, in addition, one man had sown half his area with SR52. Enough fertilizer was purchased by the first group of farmers for 54 per cent of their acreage at the recommended four bags per acre. Farmers who purchased neither seed nor fertilizer obtained an average yield of only three bags per acre, the yield level of the 1940s and 1950s. Farmers who had purchased both inputs obtained a worthwhile return for their investment, but even so their level of yields was low and the return per acre was less than that of the sample farmers of Magoye who had not grown a hybrid variety.

The poor yields for the Monze farms are thought to reflect both the poorer intrinsic fertility of the plateau soils and a lower standard of cultivation on the comparatively large crop acreages farmed by the Monze sample. The larger the crop acreage, the greater is the likelihood of delayed sowing. Moreover, farmers in Monze area had been particularly badly hit by a dry spell early in the crop season.

Progressive farmers had purchased enough hybrid seed to sow about 65 per cent of their maize acreage and enough fertilizer for about 33 per cent. They obtained a mean yield of ten bags per acre but there was substantial variation and yields ranged from 1.3 to 19.0 bags per acre. Four of the progressive farmers, all in Monze East, had yields of less than five bags per acre and this appeared to be associated with drought conditions and poor sandy soils. The data show that individual farmers had benefited from the use of improved maize varieties and fertilizers and it is not surprising that the use of both is rapidly increasing with the ready availability of credit for their purchase. However, for optimum returns, early sowing and a good standard of cultivation are essential and there is substantial room for improvement.

There appeared to have been little general improvement in groundnut yields, reflecting farmers' assessments of relative returns and costs compared with the maize crop, and research and extension emphasis upon maize and cotton. On the other hand, the cotton yields of our sample farmers were not unsatisfactory. One of the progressive farmers had 14 acres under the crop in 1966/67. The crop looked good and would probably average 1,100 pounds of seed cotton per acre. One acre had been used as an Agricultural Department fertilizer demonstration and, whether due to the fertilizer or to the choice of the site, would probably yield about 1,500 pounds of seed cotton. The farmer expressed satisfaction with his crop and stated that he planned to sow 22 acres of cotton in the following season.

Farm Inputs and Gross Farm Returns

Tonga farmers have taken a major step towards commercial farming. This is reflected in the amount of purchased inputs used. Mean expenses and cash receipts of the progressive farmers and their neighbors are summarized in Table 15, although no attempt has been made to set the cost of family labor and the amount

TABLE 15.—AVERAGE FARM RECEIPTS AND EXPENDITURE
(£ per farm)

Food Research Institute, 1967 ^a						
	Progressive farmers	Magoye	Neighbors			Rees 1955, improved farmers ^c
			Monze: cropped acres			
			1-10	11-20	20+ ^b	
Cash receipts						
Maize	268.40	44.75	17.75	45.75	188.90	21.40
Cotton	43.80	32.05	0	12.20	3.35	0
Cattle	101.55	12.35	10.90	22.85	34.50	17.95
Groundnuts	7.60	3.65	0	2.00	4.00	.85
Beans, cowpeas	3.30	0	0	1.00	4.15	.75
Pigs	41.35	0	0	.90	29.10	0
Tractor hire	3.35	0	0	0	0	0
Others	3.30	4.50	1.25	1.30	0	8.70
Total	472.65	97.30	29.90	86.00	264.00	49.65
						22.85 ^d
						72.50 ^e
Expenses						
Maize seed	10.35	1.25	1.80	3.95	12.60	.65
Cotton seed	.85	.55	0	.10	.10	0
Fertilizer	57.75	14.30	9.50	22.05	66.00	4.20
Insecticide	8.50	4.20	.05	1.25	.75	... ^f
Concentrate	7.25	0	0	0	7.30	... ^f
Tractor fuel, oil	10.00	0	0	0	0	.95
Tractor repairs	8.00	0	0	0	0	... ^f
Depreciation						
Tractor, implements	67.00 ^g	0	0	0	0	... ^f
Ox implements	19.15	6.20	6.40	10.30	17.55	12.50
Repairs and spare parts	...	...	...	...	...	6.05
Tractor hire	4.75	0	.35	2.35	10.05	... ^f
Transport hire	2.75	.80	.50	3.80	10.25	.40
Labor	22.75	.65	0	1.25	18.30	1.05
Others	0	0	0	0	0	4.55 ^h
Total	219.10	27.95	18.60	45.05	142.90	30.35
Approximate net cash income						
Including cattle						
Per farm	253.55	69.35	11.30	40.95	121.10	42.15
Per acre cropped	7.61	10.51	1.79	2.66	3.37	1.67
Excluding cattle						
Per farm	152.00	57.00	.40	18.10	86.60	24.20
Per acre cropped	4.56	8.64	.06	1.17	2.41	.96

^a Data from the Food Research Institute Field Survey, 1967; see text for description.^b Excluding one farmer with 160 acres of maize.^c Sample of improved farmers in 1954/55; see Table 7, or citation 22, for source.^d Improved farmer bonus.^e Total receipts.^f Expenditures, if any, included in "Others." See note *h*.^g Based on total value of £750; see text.^h Includes livestock purchases 3.40, hire of implements, .15, contract work .12, and miscellaneous .88.

of food reserved for domestic use is not included in gross farm receipts. These data are not fully comprehensive because of the time constraint of the survey. However, they show the extent to which the farmer was increasingly prepared to invest in farming and give a rough indication of his returns. There was increasing acceptance of new varieties, fertilizers, and insecticides. The last included insecticides recommended for the control of cotton pests, maize stalk borer, soil and storage pests. As from the 1966/67 season farmers were beginning to invest in Solubor to correct boron deficiency symptoms in cotton. The major recurrent expenditures were on seed, fertilizer, insecticide, and labor. Expenditure on labor depended very much on the acreage of the crops; for farmers with less than ten acres it was nil or negligible. In contrast, the larger farmers spent substantial sums on hired labor.

Estimates were made of machinery and implement depreciation. For ox-drawn implements, the depreciation figures calculated for the Magoye unit farm were used. In the case of tractor equipment, estimates were based on costs given by Hammon-Tooke (16). It was assumed that although underemployment of tractor equipment could be expected to increase the life of equipment this would be largely counterbalanced by inferior maintenance.

Transport is especially important in Mazabuka district because of the large quantities of farm produce that have to be hauled to market. Farmers who did not possess either a cart or a tractor trailer had to pay for the transport of their produce by neighbors. The normal charge was 1s. 6d. to 2s. a bag.

Maize formed the major source of farm income. One farmer (not included in Table 15) had grown a total of 160 acres of maize from which he had obtained a gross income of £1,600. Large quantities of maize were also retained for home use. Progressive farmers kept an average of 60 bags per farm and their neighbors 24 bags. Cotton was an important secondary crop for some farmers, and comparatively small quantities of groundnuts, beans, and cowpeas were also sold.

There has been a market for cattle since the arrival of the first European settlers, and farmers are now able to sell their stock to itinerant dealers for resale in the Copper Belt and Lusaka. The sale of cattle still forms the second most important source of a farmer's income. The average price obtained per beast by the neighbors was £19 and the progressive farmers averaged £27.

Gross cash receipts ranged from £30 for the sample of Monze farmers who had less than ten acres of crops to £472 for the progressive farmer group, with calculated net cash incomes of £11 and £253, respectively. The most efficient farm enterprises were those of the Magoye neighbors, both in terms of the return from cash invested in farming and the net income per acre, irrespective of whether or not cattle were included in the estimate. Both the gross and net incomes of this group were higher than those of Monze farmers in the 11 to 20 acre group. A comparison of our survey data with that for improved farmers in the 1955/56 season demonstrates the increasing readiness of farmers to purchase inputs and the increasing cash returns being obtained per acre with a more general use of improved varieties, fertilizers, and insecticides.

The potential returns from farming in this area are high and the incentive to adopt innovations correspondingly so. Thus, in the proposals for the Magoye unit

farm, it was estimated that the gross margin per acre for a cotton crop yielding 1,000 pounds of seed cotton per acre was about £15 to £16. The net return from a maize crop of ten bags per acre was estimated to be about £5, from a 15 bag crop £13, and from a 20 bag crop £21 per acre. Yields of 30 to 40 bags of maize per acre are being obtained by large-scale farmers, and their example continues to provide an added and important stimulus.

Extension Work

There was a relatively large number of extension staff in the district. Since the 1940s the extension services have devoted special effort to work in the area. Recently, the introduction of cotton as a new cash crop has led to an increase in extension staff through the formation of a cadre of cotton demonstrators. With the expansion of cotton acreage the original ratio of one extension worker to about 10 to 15 farms cannot be maintained but a good foundation has been established and this should facilitate future extension. Within the three agricultural areas covered by our case studies there was one extension worker, stationed at an agricultural camp, to about every 120 farm families. In Magoye West there was one extension worker for about 90 families. Contact between farmer and extension worker was therefore good and all the progressive farmers, and all but three of the 45 neighbors, had been visited by extension workers in the year preceding the study. Farmers in Magoye West and the progressive farmer class had received the most visits. The data collected shows that extension work in Mazabuka district has yielded substantial results.

Awareness of Recommendations

The important technical recommendations at farmer level were those that dealt with the three major crops—cotton, maize, and groundnuts. The progressive farmers were the best informed group; seven of them had been registered as improved farmers in the 1950s. The strength of the extension staff accounted for the high degree of awareness of both cotton and maize recommendations in the Magoye West area (Table 16). In Magoye West all of the neighbors showed awareness of the maize recommendation, as did 10 of the 11 growing cotton.

In the 1966/67 season, 14 progressive farmers and 21 of their neighbors had purchased hybrid maize and 47 out of the 60 farmers had purchased fertilizer. Farmers were aware of and practiced the numerous pest control recommendations, including the use of insecticides for the control of storage pests.

Farmers who grew cotton were aware of the right time to sow, of the spraying and fertilizer recommendations, and of the names of the three insecticides used. At the time of our survey, farmers had heard of and were beginning to use Solubor. One farmer displayed an awareness of the residual effect of phosphate by saying that he had not applied P mixture to his cotton, as he had already done so to the maize crop that had occupied the land in the previous year. When one of the members of the team made an earlier visit to Mazabuka district, another farmer was able to show him American bollworm eggs.

There was also a general awareness of the names of alternative groundnut varieties and spacing recommendations. However, the yields of this crop were

TABLE 16.—AWARENESS AND PRACTICE OF RECOMMENDATIONS, 1967*

	Progressive farmers	Neighbors
Number of farmers	15	45
Maize		
Number growing maize	15	45
Number using hybrid seed 1965/66	14	17
Number using hybrid seed 1966/67	14	21
Average number bags of seed per user	2.9	2.4
Number knowing variety names	14	43
Number using aldrin	7	8
Number using fertilizer 1965/66	14	27
Number using fertilizer 1966/67	15	32
Number aware of fertilizer recommendation	15	38
Number of bags fertilizer per user 1965/66		
P mixture	14.6	8.8
CAN	7.5	4.0
Sulphate of ammonia	7.4	4.6
Cotton		
Number growing cotton	10	14
Number aware of fertilizer recommendation	10	13
Number using fertilizers	5	3
Number aware of insecticides	10	14
Average number of sprays applied	7.9	8.7
Bags of P mixture per user	3.2	2.6
Groundnuts		
Number aware of variety names	15	41
Number using kraal manure	15	38
Number using storage insecticide	14	31

* Data from the Food Research Institute Field Survey, 1967; see text for description.

low and the acreage grown by farmers was small, reflecting the greater economic returns that can be obtained from maize and cotton. The knowledge of current agricultural recommendations displayed by farmers was a testimony to the quality and coverage of extension staff and the economic incentive which encourage farmers to take heed of the advice offered to them.

Farmer's Problems

Farmers were asked what they considered to be their main problems. Their answers, given as the number of replies, are summarized in Table 17. The most frequent complaint was lack of capital. It is not clear what this really meant. One explanation is that many Tonga farmers are now thinking about the acquisition of tractors and tractor equipment. The same farmers, who certainly suffered from no shortage of ox-drawn equipment, stated that another problem was inadequate farm implements.

Only a fifth of the farmers complained of having inadequate land, and, surprisingly, only two farmers in Magoye West thought of this as a felt need. Land shortage appeared to be accepted as an inevitable fact of life. Much more interesting as a reflection of change orientation was the growing awareness among

TABLE 17.—MAZABUKA FARMERS: THEIR PROBLEMS, 1967*
(Number of times mentioned)

Nature	Progressive farmers	Neighbors
Lack of credit and/or capital	7	16
Lack of and/or inadequacy of implements	7	14
Water supply	5	11
Inadequate land	3	9
Poor prices and/or profit margin	3	7
Insufficient labor	1	5
Lack of knowledge	2	4
Marginal soil	2	3
Cotton problems	2	3
Poor grazing	2	2
Crop damage by cattle	1	2
Others	0	2
None	0	1

* Data from the Food Research Institute Field Survey, 1967. There were 15 progressive farmers and 45 neighbors in the sample. See text for further description.

farmers that lack of technical knowledge could be limiting agricultural output. Six farmers expressed the opinion that this was a limiting factor.

SUMMARY AND CONCLUSIONS

In 1967 the Mazabuka district presented a picture of active and comparatively rapid agricultural change. This had its roots in the early part of the century with the building of the Rhodesian Railway and at first was largely unaided. The construction of the railway was followed by the arrival of large-scale European farmers who provided an example to be emulated, while their presence resulted in the establishment of supporting marketing and input supply facilities. Growth of the Congo and Northern Rhodesian mining industries provided a local market for cattle and maize. Christian missions provided the first schools early in the century and these rapidly increased in number as more missions were established. In their search for work to pay taxes imposed by government and to meet their other needs, many Tonga found temporary employment in the Copper Belt in Rhodesia and in South Africa and were thus subjected to the further stimulus of new experiences.

In the early decades of the century progress was slow, but there was no lack of response by the small Tonga farmer to new economic opportunities. The demand for maize, which coincided with the availability of ox-drawn implements, made for an increased acreage of the maize crop. Tonga farmers learned the new techniques of training oxen and ox plowing from the settlers and missionaries. During this early period a familiar pattern of agricultural development emerged. Increased agricultural output, mainly of maize, was achieved by the expansion of acreage and yields remained low.

Alienation of land, natural population increases, and a tendency to move to fertile soils along the line of rail and near to markets, led to localized high popu-

lation densities. At the same time there was a rapid buildup of Tonga cattle herds which led to overstocking in some areas. By the 1930s there were visible signs of soil deterioration. This led to a government soil conservation program. The soil conservation measures taken in the 1940s were not received with great enthusiasm by farmers but an impact was made by direct works put in by government and through those measures that were obligatory at the farm level to participants in the African Improved Farming Scheme. The major works put in, and particularly the provision of cattle watering points, benefited both improved and unimproved farmers. There was only a slight improvement in maize yields during the period of the African Improved Farming Scheme but the yields of European farmers were also not high. In spite of its limitations, the scheme made a major contribution to change in introducing farmers to new techniques and concepts and in creating a readiness to accept new farming methods.

The Tonga are a strongly individualistic people and there are no strong social barriers to inhibit personal initiative. Taking the opportunity presented by the availability of a market for maize, a small class of comparatively large farmers had emerged by the late 1940s and some were already selling several hundred bags of maize. By 1950 a few had gross incomes of over £1,000 per annum (12, p. 610). Most of this came from the sale of maize but poultry, cattle, and pigs formed important secondary sources of income. A few were able to invest in trucks and one or two in tractors; others set up businesses. With the incomes obtained from farming, particularly under the African Improved Farming Scheme, capital investment in farms continued. This took the form of better housing, wells, the occasional windmill, fencing, implements, and machinery.

Farmers were introduced to two major technical innovations in the 1960s, hybrid maize seed and a new cash crop, cotton. With the use of hybrid varieties and fertilizer, yields of 30 to 40 bags maize per acre became obtainable. The two inputs, hybrid seed and fertilizer, cost about £9 per acre at the recommended rate. However, the survey showed that substantial and increasing numbers of Tonga are purchasing both inputs, and that individual farmers are getting yields of over 20 bags per acre. Within our sample, there was a greater number of farmers using both hybrid seed and fertilizer in 1966/67 than there were in 1965/66, and, with the high returns to be obtained, there is every reason to suppose that this trend will continue. The wider use of these innovations has been stimulated by the provision of substantial credit and facilities for marketing and the purchase of inputs. In 1966, five Tonga farmers each sold over 1,000 bags of maize (26).

The increase in cotton acreage has been slow, but, with the improvement of marketing arrangements and the provision of Solubor for the correction of boron deficiency, future prospects for the crop have been improved. Progress will depend on the individual farmer's assessment of whether or not the crop provides as good or better a return to investment than maize. Tonga farmers are increasingly adopting new practices; they are outstanding in tropical Africa in the extent to which they use a wide range of insecticides for the control of soil, field, and storage pests.

Acceptance of change in Mazabuka district has been stimulated by a combination of factors, planned and unplanned. Compared with other African savanna

areas, the Tonga have the advantage of living in an area with comparatively fertile soils. The area is highly suitable for the growing of maize, for which there was an early and continued demand. The arrival of European settlers led to the alienation of a high proportion of Tonga land, but made a major contribution toward the development of the area. The settlers showed that farming could be highly profitable and provided an example that was far better than any government demonstration could be. Many Tonga obtained seed and ox-drawn implements directly from the large-scale farmers. The existence of a commercial farming community also provided a stimulus for research. Continued requests by farmers for assistance in solving their problems ensured that research maintained a practical bias. Thus, a significant development was the creation of specialist advisory services as part of the research branch. In recent years, shortage of labor at weeding time has prompted requests for information on herbicides. While herbicide investigations would doubtless have been carried out even if there had been no commercial farmers, their readiness to use suitable materials gave the work a new urgency.

The spread of commercial maize growing was associated with the provision of marketing facilities and the use of labor-saving, ox-drawn implements. More recently, however, the major development has been the spread of the type of innovation, such as improved varieties and fertilizers, that can be expected to make the greatest impact in a developing agricultural economy. These are innovations that provide a high return to investment and can be used without any major adjustments in the farming system. Innovations of this type are self-spreading because a farmer who has observed their successful use by a neighbor can adopt the innovation on whatever scale he wishes or is able. When they are easy to understand, farmers can learn the required techniques from their neighbors and a high concentration of extension workers is not necessary.

This is not the case with the recently introduced cotton crop, because of the relatively complicated pest control measures required. Consequently, fairly intensive extension support has had to be provided through the formation of a cadre of specialist cotton demonstrators. Marketing facilities and the ready availability of inputs, indispensable but often neglected aspects of development, have made an essential contribution to change.

Agricultural change among the Plateau Tonga over the last 60 years has been impressive whether measured against the situation existing at the beginning of the century or against the experiences of other African savanna areas, and in recent years the contribution made by the agricultural scientists has been of major importance. The Tonga farmer has responded readily to economic incentive. Future development in the area will depend on the availability of markets for Tonga produce. At present, the district is essentially a one-crop area. The economy is dependent on external demands for maize but with the disadvantage of the high transport costs of the long haul to the coast. Fortunately, cotton is a suitable cash crop for the area, and the construction of a textile factory at Kafue, with a production capacity of 14 million yards of cloth per year, now provides a local market for the crop.

A controversial aspect of development in the area is the extent to which assistance should be provided for tractor mechanization on small- and medium-scale

farms. Large-scale tractor mechanization is capital intensive and, if successful, results in the displacement of labor. In countries where mechanization has been introduced too rapidly, it has often resulted in a burden of high recurrent costs to government without a compensating increase in crop production. This does not imply that there is no room for mechanization in the developing African countries at present, but that the possibilities for successful tractor mechanization are limited at an early stage of agricultural development. A minority of Tonga farms in Mazabuka district are large enough for the economic use of tractors and there are others that would benefit from the use of seasonal tractor hire for land preparation. This is a situation that is best left to the enterprise of the Tonga themselves. Past development suggests that, as the need arises, so the wealthier farmers will purchase tractors for private and contract work. Government assistance can most effectively be provided by ensuring that the tractor owners can obtain adequate training for themselves or for their employees in the maintenance and use of their equipment. Any action that accelerates the process of tractor mechanization, such as the provision of easy credit facilities for the purchase of tractors, or a subsidized rate of tractor hire, is likely to result in the inefficient use of expensive equipment and the wasteful application of farmers' resources. Aid to farmers is best channeled where it is already proving most effective—in encouraging investment in seed, fertilizers, insecticides, and cotton cultivation.

CITATIONS

1 William Allan, "Studies in African Land Usage in Northern Rhodesia," *Rhodes-Livingstone Paper 15* (London, 1949).

2 ———, *The African Husbandman* (London, 1965).

3 William Allan, Max Gluckman, D. U. Peters, and C. G. Trapnell, "Land Holding and Land Usage Among the Plateau Tonga of Mazabuka District: A Reconnaissance Survey, 1945," *Rhodes-Livingstone Paper 14* (London, 1948).

4 K. R. M. Anthony, *Report on a Visit to the Cotton Growing Areas of Zambia* (Lusaka, 1965, mimeo.).

5 T. Bosse, *An Analysis of the Small-Scale Cotton Crop: 1963-64* (Lusaka, 1965, mimeo.).

6 J. D. Clark, "A Note on the Pre-Bantu Inhabitants of Northern Rhodesia and Nyasaland," *N. Rhodesia J.* (Livingstone), 2, 1950.

7 Elizabeth Colson, "The Plateau Tonga of Northern Rhodesia," in *Seven Tribes of British Central Africa*, ed. by Elizabeth Colson and Max Gluckman (London, 1951).

8 ———, "The Role of Cattle Among the Plateau Tonga of Mazabuka District," *Rhodes-Livingstone J.* (Lusaka), 11, 1951.

9 ———, "Residence and Village Stability Among the Plateau Tonga," *ibid.*, 12, 1951.

10 ———, "The Tonga and the Shortage of Implements," *ibid.*, 14, 1954.

11 ———, *Marriage and the Family Among the Plateau Tonga of Northern Rhodesia* (Manchester, 1958).

12 ———, "Trade and Wealth Among the Tonga," in *Markets in Africa*, ed. by Paul Bohannan and George Dalton (Evanston, 1962).

13 ———, "Land Law and Land Holdings Among the Valley Tonga of Zambia," *Southwestern J. Anthropol.*, 22, 1966.

14 Food Research Institute, *Field Studies of Agricultural Change: Background and Procedure* (Stanford, Calif., Nov. 1968, mimeo.).

15 S. Hailey and H. Petch, *Investigations into Small-Scale Farming Systems, No. 1, Ngwesi Settlement Scheme* (Lusaka, 1966, processed).

- 16 A. Hammond-Tooke, "Estimated Costs of Operating Agricultural Machinery, Zambia," *Mo'ly Econ. Bull.* (Lusaka), Sept. 1966.
- 17 C. E. Johnson, "African Farming Improvement in the Plateau Tonga Maize Areas of Northern Rhodesia," *Bull. Dept. Agr., N. Rhodesia* 11 (Lusaka), 1956.
- 18 S. M. Makings, "Agricultural Change in Northern Rhodesia/Zambia: 1945-1965," *Food Res. Inst. Studies*, VI, 2, 1966.
- 19 J. C. A. Mousley, *Historical Background: Village Stability and Composition* (Lusaka, 1960, mimeo.).
- 20 I. H. Muchangwe, *Tonga Land Utilization Survey* [Mazabuka district] (Lusaka, 1962, mimeo.).
- 21 Northern Rhodesia, African Affairs, *Annual Report, 1963* (mimeo.).
- 22 A. M. M. Rees, "An Economic Survey of Plateau Tonga Improved Farmers," *Bull. Dept. Agr., N. Rhodesia* 14 (Lusaka), 1958.
- 23 C. G. Trapnell and J. M. Clothier, *The Soils, Vegetation and Agriculture of North-Western Rhodesia* (Lusaka, 1937).
- 24 G. Wilson, "Economics of Detribalization in Northern Rhodesia," *Rhodes-Livingstone Papers* 5 and 6 (London, 1941, 1942).
- 25 Zambia/Northern Rhodesia, Min. of Agr., *Annual Report*, various years (mimeo.).
- 26 ———, Min. of Agr., Mazabuka District, *Annual Report*, various years (mimeo.).
- 27 Zambia, Min. of Agr., Res. and Spec. Serv., *Annual Report*, various years (mimeo.).
- 28 ———, *Mo'ly Econ. Bull.*, various years.
- 29 Zambia/Northern Rhodesia, S. Province, *Stocktaking*, Nov. 1960.