

A DESCRIPTION OF FARM ENTERPRISE COMBINATIONS AND PRODUCTION PRACTICES IN THE SOUTHERN HIGHLANDS OF TANZANIA, 1989 - 1991

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ABSTRACT

The Southern Highlands are the most important grain-producing area of Tanzania. This paper outlines the forces that have determined farming patterns in the area, which is farmed predominantly by smallholders. A major determinant has been state policies, which are described from a historical perspective. With the help of data from the 1989 to 1991 monitoring exercises of the Agricultural Support Programme, the paper describes smallholder farm enterprise combinations and production practices. It is noted that through gradual improvement rather than transformation of farm families, considerable advances have been made in the utilization of technologies developed by research, and in particular by Uyole Agricultural Centre (UAC). It is also noted, however, that there are still constraints to more efficient production which need to be addressed. The paper underlines the need for research to put more emphasis on the identification and development of means of removing these production constraints, and the need for training and extension to step up the dissemination of research findings.

INTRODUCTION

Background

The Southern Highlands of Tanzania comprise of four regions: Mbeya, Iringa, Rukwa and Ruvuma. The zone is the granary of Tanzania, and its major surplus food producing area, accounting for 60-90% of the maize that is bought by marketing institutions (FINNIDA, 1989). Most of the zone is over 1000 m above sea level, and it covers a land area of about 250,000 km² (28% of the mainland area of Tanzania). The Southern Highlands receive good and reliable rainfall, which ranges between 1000 mm and over 2600 mm annually. The soils are well drained and generally fairly heavy but tend to be acid with low to medium levels of nutrients and low organic content. Temperatures are generally low, with low evapotranspiration, resulting in reduced likelihood of moisture stress. Good and reliable responses to fertilizer, improved seed and good husbandry are generally obtained (IFAD, 1986).

In the 1988 population census, a population of 4.2 million people was recorded in the Southern Highlands, representing 18% of the country's total population. Ninety percent of the population is engaged in agriculture, and these people are responsible for 80% of Tanzania's total maize production (Croon *et al.*, 1984). The average household size is 5.1, with Ruvuma and Rukwa having larger household sizes than the other two regions (Table 1). The population density has increased from nine people per km² in 1967 to 17 per km² in 1988. This figure is somewhat below the national average of 26 people per km², but there are some areas of the Southern Highlands in which the population density is high and problems of mounting land pressure are experienced. These areas include the Rungwe and Kyela District in Mbeya Region. The farm size per household varies between 1.6 and 2.8 ha, with an average of 2.0 ha. On this land area, farmers grow maize, beans, paddy, potatoes and vegetables. They also grow traditional cash crops like coffee (Mbeya and Ruvuma), tobacco (all four regions), cotton (Mbeya), tea and pyrethrum (Mbeya and Iringa). Livestock are kept in all four regions, with small scale dairy production gaining in importance.

A railway line, two tarmac highways and a paved road have helped open up the Southern Highlands to Dar es Salaam, the main source of inputs and the main market. The railway line (Tanzania Zambia Railways, TAZARA) and a tarmac road cross Iringa and Mbeya regions in an east to southwest direction from Dar es Salaam to the Zambian border at Tunduma. A tarmac road running from Makambako to Songea connects Ruvuma to the Dar es Salaam-Tunduma highway. A paved road from Rukwa joins the highway from Dar es Salaam to the Zambian border at Tunduma. However, there are long stretches of poor roads within much of the Southern Highlands, which pose haulage problems for inputs and produce, despite the considerable efforts of the Rural Road Maintenance Project (RRM) and other agencies to rehabilitate and maintain rural roads in the zone.

The main source of income of the farm families is agriculture. The majority of the population live a subsistence life, dependent for food on their own production. Cash crops and sales from surplus food production are their main sources of income. An annual income of TSh 1700-2000 (20 TSh = US\$1, approximately, 1985/86) per person has been estimated (IFAD, 1986). Most of this cash income is spent on essential household items, such as kerosene, and on more durable items such as housing construction materials (roofing material and nails) and clothes.

The dependence on agriculture of the majority of Tanzanians for their income and food, and the contribution made by agriculture to foreign exchange earnings (75%) and to the gross national product (GNP, 50%), has made governments both before and after independence put much emphasis on the agricultural sector. The resulting policies and strategies are briefly outlined here.

Table 1. Land area (km²), population density and number of people per household in the Southern Highlands

	Area	People km ⁻²			People household ¹
		1967	1978	1988	1988
Mbeya	60 350	12	18	25	4.9
Iringa	56 864	12	16	21	4.8
Ruvuma	63 498	6	9	12	5.3
Rukwa	68 635	4	7	10	5.3
Average	-	9	13	17	5.1
Tanzania	883 749	14	20	26	-

Past state policies on agricultural production

State policies on agricultural production in Tanzania can be delineated into three distinctive, though sometimes overlapping, phases. The first phase, 1919-1950, was characterized by a policy of food self-sufficiency. The second, 1950-1970, was a period which emphasized cash cropping and cooperatives, with dramatic attempts to 'modernize the peasantry'. The third, 1970-1983, was the period of socialist agriculture, characterized by pronouncements and directives from the Party and Government.

Food self-sufficiency, 1919-1950. State campaigns obliging farmers to grow more crops were operational between 1919 and 1950, with the objective of achieving household and national food sufficiency. The campaigns were implemented through by-laws (which continued to operate into the 1970s), which obliged smallholders to plant their food crops first, stipulated the minimum food area to be planted and, in drought-prone areas, enforced the planting of cassava as a famine reserve crop (Brycesson, 1988). A complementary strategy was the encouragement and institution of the capitalized farming of cash crops. Large scale farms were encouraged to grow food as well as cash crops, in an effort to make up food deficits, as smallholder food production continued to decline. In the same period, smallholder farmers with entrepreneurial skills adopted cash crops, especially coffee, responding to the example of European farmers and the encouragement of missionaries rather than to

government insistence or extension advice. Whereas previously smallholders in the Southern Highlands had grown only food crops, this period saw the adoption of coffee as a cash crop by smallholders in Rungwe and Mbozi Districts in Mbeya Region around 1930, and later in Mbinga District in Ruvuma Region (Sterkenburg, 1970).

The main forces driving these strategies included:

1. Frequent droughts, especially in 1917, 1943, 1946 and 1949;
2. Improvement in the transport infrastructure, to the extent that human portage was replaced by motorized transport;
3. Relatively high commodity prices as a result of favourable world market prices. Marketing of smallholder produce was undertaken solely by Asians who were later 'caught between smallholder resentment and state suspicion of their trading practices', during the depression of the 1930 which forced international commodity prices down (Brycesson, 1988). This and other factors led to the closing of this period and the opening up of the period of the cooperative movement.

Cash crops and co-operatives, 1950-1970. The most revolutionary period was that of cash cropping and cooperatives from 1950 to 1970. The salient features of this period included:

1. A continuing call for food self-sufficiency, but with the emphasis on the production of foodstuffs in those areas where soil and climate conditions were most favourable. The law of comparative advantage was applied for the first time. Emphasis was placed on livestock breeding and cash crop cultivation in areas where staple foodstuffs were difficult to grow. Soil conservation measures were enforced. The major force behind the emphasis on food self-sufficiency at this time was a sharp rise in world raw material commodity prices during the Korean War.
2. State fostering of co-operative movements and marketing boards, as the final purchasers of produce before export, and the provision of extension advice for farmers. In the Southern Highlands more cash crops were introduced, including pyrethrum, tea and tobacco. Cash crop based co-operative societies (especially for coffee) were established, starting with the Rungwe African Cooperative Union in Mbeya Region and the Matengo Cooperative Union in Ruvuma Region. The co-operatives were also responsible for input supplies and extension services. In this period an experimental station and demonstration unit was established at Mitalula in Rungwe, Mbeya Region, much earlier than the Uyole Agricultural Centre. The co-operatives were a channel for government taxation, as well as a tool for implementing government planning targets to stimulate and/or regulate crop production. The co-operatives were successful in drawing smallholder farmers into cash cropping, despite the smallholder's disenchantment with the co-operative's profit margin, which reduced producer prices to the extent that farmers again turned to Asian traders who were offering higher prices. No revolution in agricultural practices occurred over this period, and smallholder productivity did not advance materially (Brycesson, 1988).

During this period, dogma on the irrationality of smallholder farm families as economic agents was superseded by the Schultzean hypothesis, which expounded smallholder economic efficiency. The hypothesis described farm families as 'efficient but poor', and considered that there were comparatively few inefficiencies in the allocation of production factors in traditional agriculture (Ellis, 1988). This hypothesis led to the adoption of the 'transformation approach' by the State in its Rural Development Programmes, which emphasized dramatic shifts in farm technology, with the establishment of the overcapitalized village settlement schemes (VSS). The VSS were characterized by the imposition of fully mechanized agriculture and complete technical packages (including seeds, fertilizers, insecticides, and credit), with close Government supervision. They proved a failure and

were abolished by 1966. One of the major reasons for the failure was their over-capitalization in relation to their capacity to generate an economic return (MOA, 1982). In general, the level of agricultural technology remained low, and hopes that 'traditional' farmers outside the schemes would benefit as a result of the expansion in the extension services were frustrated. The transformation approach did not affect much of the Southern Highlands, except for some parts of Ruvuma Region, where the Ruvuma Development Association was established. In most of the Southern Highlands the 'improvement approach' was adopted, in which emphasis was placed on extension and farmer education. This included the establishment of the Uyole Agricultural Centre (UAC) and its seven sub-stations in the late 1960s, with a mandate to carry out research on food crops and provide long and short courses for extension workers and farmers. The National Maize Research Programme (NMRP) was set up at UAC in 1974, and the National Maize Project (NMP) in 1976 (IFAD, 1986). The extension services continued to work with the co-operatives (Sterkenburg, 1970), and introduced hybrid maize and associated yield-increasing components (such as fertilizer and insecticides) in 1968. Towards the end of this period, the political goal was to achieve a fully developed agricultural sector. The transformation approach, disguised in political rhetoric, eventually gave way to a period of socialist agriculture, between 1970 and 1983.

Socialist agriculture, 1970-1983. Socialist agriculture, as defined in the 1967 Arusha Declaration, put an emphasis on self-reliance, the importance of the peasant farmer, and the importance of agriculture (MOA, 1982). It stated that agriculture was the basis of development and that the country should produce food for national consumption, as well as the industrial crops for national industries and for export. This was little different from previous policies. The strategies adopted, however, made this period unique. Pronouncements and directives of the party and Government were aimed at re-organization at village level, to collectivize agricultural production and so facilitate the delivery of modern techniques. It was envisaged that the movement of scattered smallholders into villages (*ujamaa*) would occur voluntarily and by means of the smallholders' own efforts. This movement did not happen, and in 1973 the State embarked on a territorial-wide enforced movement of rich and poor peasants into planned villages. The exercise was badly done; the quality of soils and access to water were overlooked, and the whole exercise was disruptive to food and export crop production (Brycesson, 1988). Co-operatives were disbanded and parastatals were set up to redress the inefficiencies of the co-operatives. The parastatals proved efficient in procuring inputs for farmers, but performed poorly in marketing the produce, because of operational and pricing inefficiencies. Brycesson (1988) noted that the resulting erosion of the State and market led to the undermining of the peasant production infrastructure, resulting in ever-declining production levels and further weakening of the State and market. This is made clear in the agricultural policy document of 1982 (MOA, 1982), which outlines a number of weaknesses inherent in the Party and the Government for this whole period. Briefly, the major weaknesses included policies based on political campaigns and slogans, a lack of co-ordination between the policy makers and Government functionaries, and a lack of accountability among the top leadership in the Party, Government and the Parastatals. The performance of the agricultural sector remained inadequate. Food self-sufficiency was not achieved and export earnings from agriculture lagged behind those needed to maintain the planned pace of development. This led to the appointment of a task force in 1982 which was charged with reviewing the poor performance of the agricultural sector and drafting a national agricultural policy document. Meanwhile several agricultural development projects were initiated in the Southern Highlands, including food crops projects (IFAD, 1986) and cash crop programmes for tea, coffee and pyrethrum.

UAC in particular has played an important role in introducing varieties of such crops as maize, tomatoes, wheat, and potatoes with a high yield potential. The purchase of certified seed and chemical fertilizers has increased (FINNIDA, 1989) but few smallholder farmers have fully adopted 'improved practices', the majority applying only a minimum level of chemical inputs and using mainly simple farm implements, particularly the hoe.

In the light of the history of smallholder development in agricultural production, this paper has the following objectives: to summarize information from the 1989-1991 monitoring exercises of the

Agricultural Sector Support Programme (ASSP) on farm enterprises and production practices in the Southern Highlands, and to highlight the major constraints to the adoption of improved practices common to most small-holder farmers in the Southern Highlands. A description of production practices for three districts, which represent a cross-section of the Southern Highlands farming systems, is presented here: Njombe High Plateau, which is characterized by wheat and Irish potato production; Songea District characterized by maize; and Mbozi District, characterized by coffee cash cropping.

METHODOLOGY USED FOR MONITORING FARM PRACTICES

This paper draws heavily from the 1989 to 1991 monitoring exercises of the ASSP on farm enterprises and production practices in the Southern Highlands. The methods used in generating the information are briefly outlined here.

A pilot survey was used to assess how best to organize the full-scale base-line survey and to finalize the design of the survey questionnaire. Results from the pilot programme enabled the team to define their sampling frame as shown in Table 2.

Divisions were initially selected on the criterion that they were intensive maize growing areas. Later, selection was based on important food and cash crops. From each selected village eight households were randomly selected, giving a total of 1248 households which were interviewed in phases.

Structured questionnaires were administered by trained enumerators. A farm management approach was adopted in carrying out the surveys, with detailed area measurements and crop-cuttings, farmers' estimates of crop areas and production, and enumerators' estimates made by observation, rectangulation and pacing. The survey therefore combined in-depth farm management and socio-economic interviews with measurements of area and yield for all the main food crops.

The data generated from the survey were compiled, analyzed and reported for each district in a set of three report volumes: Volume 1 describing household composition, farm size, crop areas and yields, livestock and farm equipment, Volume 2 farm management, and Volume 3 farm inputs, credit and marketing. The findings for the Njombe High Plateau, the Mbozi/Ileje Plateau and Songea District are summarized in the following three sections, which cover labour resources, land rights, farm enterprises, cropping operations, household income and expenditure, and production constraints.

Table 2. Sampling frame used for the base-line survey

Region	District	No. of villages selected (8%)	No. of wards
Ruvuma	All	26	84
Iringa	All	50	113
Mbeya	All	51	135
Rukwa	All	29	68

THE NJOMBE HIGH PLATEAU

The Njombe High Plateau lies between 8°40'-9°50'S and 34°15'-35°5'E at an altitude of 1500-2000 m above sea level. The area has well drained loam to clay soils.

labour

About one-half of the family members in the household are available for farm work (Table 3). Those not available include those at school and those who are too old, young or infirm to work. Slightly more than half those unavailable are female members (55%) and, since women do much of

the farm work, this implies that crop production is lower than it might otherwise be. A small proportion (3% of males and 1% females) work in part-time jobs, mostly on neighbouring estates.

Table 3. Household composition in Njombe High Plateau, 1989/90 (n=80)

	Male	Female
Gender of household head (%)	67	33
Number of people per household	2.3	2.7
Occupation full-time on farm (%)	50	44
Occupation full-time job (%)	0	0
Occupation part-time job (%)	3	1
School/old/young/infirm (%)	47	55

Land

As in many parts of the Southern highlands, traditional land rights apply. The average household has a total cultivated area of two hectares. Double cropping accounts for a total sown area over the year of 4.4 ha of the major crops.

Farm enterprises

The main crops grown are maize, beans, green vegetable, wheat and Irish potatoes (Table 4). All farmers grow maize followed by beans and vegetables. The net sown area indicates that most land is allocated to maize, followed by green vegetables and wheat. Maize yields (1500 kg ha^{-1}) are somewhat below the expected yield of 2250 kg ha^{-1} under good management (Temu, 1989). Wheat yields, at 0.15 t ha^{-1} , are extremely poor compared with the average yield in the Southern Highlands of 0.84 t ha^{-1} .

Crops are produced both for subsistence and sale. Up to two-fifths of the maize, wheat and Irish potato crop are sold (Table 4). Beans, which might be expected to be mainly for home consumption, are sold in even greater proportions (about three-fifths), perhaps simply to obtain more cash, or because there are many other vegetables than can be substituted for home use (about 90% of green vegetables are retained).

The main animal enterprises, in order of importance, are cattle, pigs, goats or sheep and fowl. Of the 80 sample households, 24 owned cattle, and an average of two households with sheep or goats and ten with fowl could be found in every village (Table 5). An average of three oxen were owned by 18 households, indicating ownership of a pair of oxen three out of every 10 households.

Cropping Operations

Farm operations continue throughout the year, implying that farmers do not have a clearly marked rest season. Land preparation for all crops except wheat is carried out between September and December, with planting following immediately or being carried out simultaneously (Table 6). Much land preparation (61%) is done by hand using a hoe, 36% is done with oxen, and only 2% by tractor. Most of the planting (19%) is done by hand, and 46% of households plant maize in rows. Over 50% plant hybrid maize, while the rest plant composites and other types of maize seeds.

Fertilizer application is reserved mainly for the maize crop (Table 4), with 64% of the households applying basal fertilizers at the rate of 300 kg ha^{-1} (six bags). Nitrogen fertilizers are used at far below the recommended rate: 250 kg ha^{-1} of calcium ammonium nitrate (CAN) are applied, compared with the recommended rate of 400 kg ha^{-1} . In the case of urea, 40% of households apply 200 kg ha^{-1} , compared with the recommended rate of 350 kg ha^{-1} . One third of the sample farmers applied manure (the rate was not recorded).

Weeding is done mainly by hand, using the hoe, with only 3% using oxen and 2% using chemicals. Weeding commences in December and ends in May.

Table 4. Main crop enterprises and expenditure (TSh) in the Njombe High Plateau, 1989/90 (n=80 households)

	Maize	Beans	Green vegetables	Wheat	Irish potato
No. of households producing	80	18	10	11	8
Area per household (ha)	1.6 ¹	0.3	1.1	1.1	0.3
Yield (kg ha ⁻¹)	1 500	480	3 200	150	3 400
Production per household (kg)	2 416	145	3 509	164	1 016
Quantity sold per household (kg)	1 055	92	195	55	2 460
Proportion of crop sold (%)	44	63	6	34	45
Farms applying TSP	64	14	0	4	4
Amount (50 kg bags ha ⁻¹)	6	5	-	-	-
Farms applying urea	48	0	0	1	0
Amount (50 kg bags ha ⁻¹)	4	-	-	-	-
Farms applying CAN	26	0	0	4	1
Amount (50 kg bags ha ⁻¹)	5	0	-	-	-
Farms applying composite fertilizer	4	0	0	0	0
Farms applying manure	36	10	3	0	1
<i>Mean Farm expenditure (TSh)</i>					
Land preparation	1 619	467	370	236	NA
Seed	699	156	0	0	NA
Fertilization	4 262	648	0	0	NA
Weeding	1 055	389	100	136	NA
Harvesting	381	790	90	NA	NA
Total expenditure	8 016	2 450	560	372	NA
Overall total (%)	70	21	5	3	

¹Mono-crop maize 0.9 ha, mixed crop maize 0.6 ha; TSP, triple superphosphate; CAN, calcium ammonium nitrate; NA, data not available.

Table 5. Main livestock enterprises in the Njombe High Plateau, 1989/90, (n=80 households, cattle includes oxen)

	Oxen	Cattle	Pigs	Sheep/goats	Fowl
Total animals	45	146	61	193	785
No. of farms owning	18	24	-	-	-
No. per owner	2.5	6.1	-	-	-
No. per household	0.6	1.8	0.8	2	10

February/March and July/August are the busy months for harvesting, with the processing of produce following within the same period. Storage of produce is mainly (over 90%) in granaries, with the rest being stored in pots or bags. Storage losses are highest for beans (38%), followed by maize (22%) and wheat (16%).

Expenditure on cropping operations is shown in Table 4. The majority (70%) of total farm expenditure is spent on maize (mostly for fertilizer), while most of the rest is spent on beans.

Table 6. Cropping operations in the Njombe High Plateau, 1989/90

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Land Preparation		Wheat							Ir.Pot	Maize		
										Beans		
										Green veg.		
Planting		Beans									Maize	
			Wheat								Beans	
										Potato		
Fertilization												
TSP												
Manure												
Compost												
First top-dressing												
CAN												
Urca												
Weeding	Maize		Maize									Maize
			Beans									
			Wheat									Ir.Pot
Harvesting			Beans				Maize					
		Green veg.				Beans						
		Ir.Potato				Wheat						
Processing									Maize			
			Beans			Beans						
							Wheat					

Household income and expenditure

Most income is derived from crop and livestock sales. In terms of gross margins, green vegetables, livestock and maize (in descending order) contribute most to income (Table 7). Average net income, after cash and non-cash overheads have been deducted, is estimated very approximately at TSh 48,000 (200 TSh = US\$1, approximately, 1989/90). Household expenditure is shown in Table 8, and appears to exceed net income from farming enterprises.

Production constraints

Reasons for not using fertilizer include lack of cash resources, unavailability and late delivery (Table 9). Some farmers use manure, but more than one-quarter do not own livestock, and most find it difficult to prepare and haul manure to the fields. Chemicals are considered too expensive and farmers do not have enough money to purchase them. One-eighth of farmers indicated that improved seeds are too expensive.

Table 7. Enterprise gross margins and farm income (TSh) in the Njombe High Plateau, 1989/90

	Maize (1.6 ha)	Beans (0.3 ha)	Green Veg (1.1 ha)	Wheat (1.1 ha)	Potato (0.3 ha)	Cattle 4 head	Other stock
Total revenue	26 576	7 262	29 441	8 808	8 230	1 350	31 058
Variable costs							
Cultivation	1 619	647	370	236	-		
Seed sowing	699	156	-	-	-		
Weeding	1 055	389	100	136	-		
Chemicals	750						
Harvesting	381	790	90	-	-		
Processing							
Fertilization	4 262	648					
Veterinary cost							
Feeds							
Livestock taxes							
Total variable costs	8 766	2 450	560	372	-	-	1 780
Gross margin	17 810	4 812	28 881	8 436	8 230	1 350	29 278
Total gross margin	100 577						
Fixed (overhead) costs							
	Cost				Cost		
Pair of oxen	20 000		Ox-plough+accessories		8 500		
Ox-cart	3 000		Knapsack sprayer		4 400		
Hand pulper	5 000		Hoe		700		
Axe	250		Granary		5 000		
Bicycle	3 000		General taxes		927		
General deductions	546		Machine taxes		1 130		
Total fixed costs	52 453						
Net farm income (gross margin - fixed costs)	48 124						

Table 8. Household expenditure (TSh) in the Njombe High Plateau, 1989/90

	Cost		Cost
Clothes	5 645	Batteries	1 840
Soap	3 576	Kerosene	1 927
Lotions	1 320	General purchases	10 000
Festivals	2 069	Holidays	926
School fees	459	Medical expenses	2 161
General contributions	895	Miscellaneous expenses	30 030
Other expenses	15 688	Total	76 536

Table 9. Number of farmers reporting specified constraints in the Njombe High Plateau, 1989/90

Constraint	No. of farmers	Too expensive	No money	Not available
Fertilizer	19	-	6	5
Chemicals	5	1	1	-
Improved seed	8	1	-	-
Sprayers	1	-	-	1
Farm implements	1	-	-	-
Knowledge	21	-	-	2
Timely input supply	17	3	6	1

THE MBOZI/ILEJE PLATEAU - MBOZI DISTRICT

Mbozi district lies between 8°5'-9°25'S and 33°15'E, at an altitude of more than 1500 m above sea level. In general, the district has well-drained clay soils.

Labour

The average number of people per household is 5, half female and half male (Table 10). More than half the household members are available to work full time on the farm, while about 41% of females and 38% of males are not available for farm work. Off-farm activities are important in Mbozi, with 1% working in full-time jobs and 4% in part-time jobs. For both full and part-time work off-farm, the number of males exceeds the number of females.

Land

The average cultivated area per household is 2.36 ha, but with double cropping a gross sown area of 2.79 ha over the year is recorded. This figure is less than that in the Njombe High Plateau (4.4 ha). Land committed to coffee is not available for double cropping.

Farm enterprises

The main crops grown are maize, beans, groundnut, finger millet and coffee (Table 11). Almost all farmers grow maize and beans. Maize is allocated the most land, followed by coffee and beans. Maize yields (1630 kg ha⁻¹), though higher than those of Njombe, still fall below the minimum yield of 2250 kg ha⁻¹ expected under good management. Coffee yields, however, are higher than the average for the zone, which is 300 kg ha⁻¹. About three-quarters of the beans and half of the maize produced is sold for cash (Table 11).

The livestock kept include cattle, pigs, goats, sheep and fowl. The number of oxen is more than in Njombe (Table 12) and the average number of cattle per household is 1.9.

Cropping operations

Land preparation for all crops is carried out between July and April (Table 13). Most land preparation (79%) is done by hand hoe while 19% is done by ox, mostly on maize fields. Land preparation using tractors is minimal. Sowing follows immediately after land preparation, with little use of planters (1%). Fewer than half the farmers (43%) plant their maize in rows; 45% plant hybrid maize and 9% plant composites.

Fertilizer use is restricted to maize and coffee (Table 11). Some farmers (18%) apply basal fertilizer to maize at a rate of 150 kg ha⁻¹. This is less than the ideal recommended rate but more than the minimum recommended rate. Overall, 68% of the sample farmers reported using inorganic fertilizers. This is far fewer than in Njombe where the corresponding figure is 96%. Manure is more popular than compost as fertilizer.

Table 10. Household composition in the Mbozi Ileje Plateau, 1989/90 (n=99)

	Male	Female
Gender of household head (%)	88	12
Number of people per household	2.5	2.5
Occupation full-time on farm (%)	56.9	56.8
Occupation full-time job (%)	0.9	0.4
Occupation part-time job (%)	4.1	2.1
School/old/young/infirmary (%)	38.1	40.7

Table 11. Main crop enterprises and expenditure (TSh) in the Mbozi/Ileje Plateau, Mbozi District, 1989/90 (n=99 households)

	Maize	Beans	G'nuts	F/millet	Coffee
Number of households producing	96	76	36	27	24
Area per household (ha)	1.15	0.47	0.23	0.3	0.64
Yield (kg ha ⁻¹)	1 630	398	683	853	553
Production per household (kg)	1 877	187	157	256	354
Quantity sold per household (kg)	969	138	23	44	354
Proportion of crop sold (%)	52	74	15	17	100
Farms applying triple superphosphate	18	1	-	-	4
Amount (50 kg bags ha ⁻¹)	4	2	-	-	4
Farms applying urea	10	-	-	-	8
Amount (50 kg bags ha ⁻¹)	4	-	-	-	4
Farms applying CAN	5	4	-	-	-
Farms applying SA	1	-	-	-	-
Amount (50 kg bags ha ⁻¹)	0.9	-	-	-	-
Farms applying composite fertilizer	22	-	-	-	17
<i>Mean farm expenditure (TSh)</i>					
Land preparation	2 145	518	317	763	1 521
Seed	1 433	-	-	-	-
Fertilization	7 056	2 140	-	-	4 295
Weeding	873	24	14	148	421
Harvesting	617	150	153	185	3 142
Total expenditure	12 124	2 832	484	1096	9 379
Overall total (%)	47	11	2	4	36

TSP, triple superphosphate; CAN, calcium ammonium nitrate; SA, sulphate of ammonia.

Weeding of coffee starts in August while other crops are weeded between November and June (Table 13). Many farmers (43%) weed using the hand hoe, but an appreciable number (21%) use herbicide. There is very little use of oxen for weeding (1%).

Harvesting of all crops is carried out between February and August, with crop processing being done at almost the same time but extending into December (Table 13). Farm produce is stored in bags and granaries. The majority of farmers (90%) use insecticides against storage pests. Storage losses are greater for beans (38%) than for maize (90%).

About half of the total expenditure on cropping operations goes on the maize crop while about one-third is spent on coffee (Table 11), mainly on fertilizers.

Table 12. Main animal enterprises in the Mbozi/Ileje Plateau, Mbozi District, 1989/90 (n=99 households, cattle includes oxen)

	Oxen	Cattle	Pigs	Sheep/goats	Fowl
Total animals	54	192	125	115	638
No. of farms owning	20	39	-	-	-
No. per owner	2.7	4.9	-	-	-
No. per household	0.5	1.9	1.3	1.2	6.4

Table 13. Cropping operations in the Mbozi/Ileje Plateau, Mbozi District, 1989/90

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Land Preparation	Maize											
	Beans								Beans			
	G'Nuts								Groundnut			
	F/Mil									Finger millet		
	Coffee								Coffee			
Planting	Maize								Maize			
	Beans				Beans		Beans				Beans	
	G'nut										G'nut	
Fertilization												
TSP												
Manure												
Compost												
First top-dressing												
CAN												
Urea												
Manure												
Second top-dressing												
CAN												
Urea												
Weeding	Maize								Maize			
	Beans								Beans			
	Groundnut											
	Finger millet											
	Coffee											
Harvesting							Coffee				Coffee	
	Maize											
	Beans											
					G'nut							
	Finger millet											
	Coffee											
Processing	Maize											
	Beans				Beans							
					G'nut				Groundnut			
	Finger millet											
	Coffee											

Household income and expenditure

Crop and livestock sales make a major contribution to farm income in Mbozi. The gross margins in Table 14 show that after livestock, coffee is the most important contributor to farm income, followed by groundnuts. The gross margin for maize could be improved by improved production practices. Net farm income after cash and non-cash costs are deducted, is estimated at approximately TSh 38,000. Household expenditure is shown in Table 15; as for Njombe, expenditure appears to exceed income earned from farming.

Over half of the farmers interviewed indicated that they considered fertilizers and chemicals to be too expensive (Table 16), and frequently unavailable and/or supplied late.

Table 14. Enterprise gross margins and farm income (TSh) in the Mbozi/Ileje Plateau, Mbozi District, 1989/90

	Coffee (0.64 ha)	Maize (1.15 ha)	Beans (0.47 ha)	G'nuts (0.23 ha)	F/millet (0.3 ha)	Cattle 13 head	Other stock
Total revenue	47 684	21 848	6 551	16 397	4 547	28 922	7 405
Variable costs							
Cultivation	1 521	2 145	518	317	763		
Seed		370					
Sowing							
Weeding	421	873	24	14	148		
Chemicals	11 836	4 623	800				
Harvesting	3 142	617	150	153	185		
Processing							
Fertilization	3 950	7 013	2 140	-	-		
Livestock tax						92	
Veterinary costs							
Feeds							
Total variable costs	20 870	15 641	3 632	484	1 096	92	-
Gross margin	26 814	6 207	2 919	15 913	3 451	28 830	7 405
Total gross margin	91 539						
Fixed (overhead) costs (TSh)							
		Cost				Cost	
Pair of oxen		20 000		Ox-plough+accessories		8 500	
Ox-cart		3 000		Knapsack sprayer		4 400	
Hand pulper		5 000		Hoe		700	
Axe		250		Granary		5 000	
Bicycle		3 000		General taxes		1 064	
General deductions		2 347		Machine taxes			
Total fixed costs	53261						
Net farm income (Gross margin - fixed costs)	38 278						

Table 15. Household expenditure (TSh) in Mbozi/Ileje Plateau, Mbozi District, 1989/90

	Cost		Cost
Milling expenses	1 200	Clothes	10 919
Matches	210	Batteries	4 150
Soap	4 476	Kerosene	2 001
Lotions	1 118	Cooking pots	700
Household furniture	105	Travelling expenses	2 167
Festivals	5 457	Holidays	1 815
School fees	1 842	Medical expenses	867
Church contributions	302	General contributions	1 355
Miscellaneous expenses	9 273	Total	47 957

Table 16. Number of farmers reporting specified constraints, Mbozi/Ileje Plateau, Mbozi District, 1989/90

Constraint	No. of farmers	Lack of knowledge	Too expensive	Late input supply	No money/credit	Pest/disease	Not available	No transport
Fertilizer	53	-	28	8	24	7	23	31
Chemicals	32	2	24	-	17	2	14	17
Improved seed	23	-	13	2	12	2	6	11
Manure	3	-	-	-	-	-	-	3
Ploughs	21	-	8	1	9	7	6	2
Farm implements	5	-	5	-	2	-	1	1
Oxen	5	1	-	-	5	-	-	-
Ox-sledges	2	-	-	-	3	-	-	-
Trailers	1	-	1	-	-	-	-	-
Transport	1	-	-	-	1	-	-	-

SONGEA DISTRICT

Songea District is located between 9°40'-11°45'S and 35°-37°10'E, at an altitude of 1000-1500 m above sea level. It has well drained sandy loams to clay soils.

Labour

The average number of people per household is 5. Over 50% work full-time on the farm; off-farm employment is almost non-existent (Table 17). Those unavailable to work full-time on the farm are equally divided between males and females.

Table 17. Household composition in Songea District, 1989/90 (n=83)

	Male	Female
Gender of household head (%)	88	12
Number of people per household	2.2	2.3
Occupation full-time on farm (%)	50.3	55.8
Occupation full-time job (%)	0.1	0
Occupation part-time job (%)	2	0
School/old/young/infirm (%)	46.9	44.2

Land

The average total cultivated area per household is 2 ha. It has been estimated that one-half of all respondents have some fallow land, suggesting that there is little or no land pressure and that the farmers practice crop rotation. The gross sown area is 3.55 ha, less than in Njombe but much more than in Mbozi.

Farm enterprises

The main crops grown are maize, beans, sunflower, rice, sweet potatoes, and tomatoes (Table 18). All farmers grow maize followed by rice. Most land is allocated to maize, followed by sunflower, rice and beans in that order. The average maize yield is much less than the minimum expected yield of 2256 kg ha⁻¹ under good management, and is also less than the yield achieved in Njombe and Mbozi. Rice yields are higher than the overall average yield of 1800 kg ha⁻¹ for the Southern Highlands.

The amount of maize reported as sold is more than that reported as produced (Table 18). This could be a result of double counting, caused by the cropping seasons not being clearly defined. About one-third of the produce from the other crops is sold.

Livestock kept include cattle, pigs, goats, sheep and fowl (Table 19). Ownership of cattle is insignificant. Most households own at least one pig and up to four goats or sheep. There are only five pairs of oxen, all owned by one household.

Table 18. Main crop enterprises and expenditure (TSh) in Songea district, 1989/90 (n=83)

	Maize	Beans	Sunflower	Paddy	Sweet potato	Tomato
No. of households producing	82	9	5	14	5	3
Area per household (ha)	1.22	0.49	0.83	0.56	0.24	0.21
Yield (kg ha ⁻¹)	1 185	465	1 700	1 990	2 060	800
Production per household (kg)	1 446	228	1 418	1 115	495	175
Quantity sold per household (kg)	1 630	80	527	244	840	-
Proportion of crop sold (%)	-	35	37	22	-	0
Farms applying Triple superphosphate	0	0	0	0	0	0
Farms applying sulphate of ammonium	31	0	0	0	0	0
Amount (50 kg bags ha ⁻¹)	2	0	0	0	0	0
Farms applying urea	0	0	0	0	0	0
Amount (50 kg bags ha ⁻¹)	4	0	0	0	0	0
Farms applying manure	6	0	0	0	0	0
<i>Mean farm expenditure (TSh)</i>						
Land preparation	1 217	1 444	2 880	1 457	1 080	-
Seed	547	-	-	-	-	-
Fertilization	3 109	-	-	-	-	-
Weeding	427	100	60	64	160	-
Harvesting	370	533	420	186	360	-
Total	5 670	2 077	3 360	1 707	1 600	-
Overall total (%)	40	14	23	12	11	-

Table 19. Main animal enterprises in Songea District, 1989/90 (n=83 households, cattle includes oxen)

	Oxen	Cattle	Pigs	Sheep/goats	Fowl
Total animals	10	18	62	313	5
No. of farms owning	1	3	-	-	-
No. per owner	10	6	-	-	-
No. per household	0.1	0.2	0.7	3.8	0.1

Cropping operations

Land preparation for rice starts in June, while land preparation for other crops is done from August to March (Table 20). Land preparation is done by hand using the hoe. The maize is sown in ridges; row and flat-planting are not practised. Fertilizers are applied only to maize and they are rarely, if ever, applied at sowing. One third of the farmers interviewed apply sulphate of ammonia at a rate far below the minimum recommended rate of 250 kg ha⁻¹ (5 bags). Hand weeding is carried out between December and April. Harvesting is carried out between February and September, with produce being processed during the same period. Most produce is stored in granaries, but some is stored in bags. Three-quarters of the farmers interviewed use insecticides as a storage treatment. Maize storage losses were reported to be as high as 24%.

The largest proportion of expenditure on agricultural activities is spent on maize (20%), and the smallest on sweet potatoes. Fertilizer costs for maize account for more than half the total expenditure on the crop.

Table 20. Cropping operations in Songea District, 1989/90

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Land preparation	Maize							Maize				
	Beans									Beans		
	Sunflower									Sunflower		
							Rice					
	Sweet Potato										Sweet Potato	
Planting	Maize											
	Beans		Beans									Beans
												S.Fl
	S.Pot.							S.Pot.				
	Rice											Rice
Fertilization												
TSP												
Manure												
Compost												
First Top-dressing:												
CAN/SA												
Urea												
Weeding	Maize											Maize
	Beans											Beans
	Sunflower											
	Rice											
	S.Pot.											
Harvesting						Maize						
	Beans											
	Sunflower											
	Rice											
	Sweet Potato											
Processing	Maize				Maize							
	Beans							Beans				
	Sunflower											
	Rice											

Household income and expenditure

Household income is derived mainly from crop sales. Rice contributes most to the total gross margin, followed by beans and maize (Table 21). Net income, after cash and non-cash costs are deducted, is estimated to be approximately TSh 65,000. Fixed costs are the lowest of the three districts, mainly because the farmers of Songea appear to invest less on farm capital items than those in the other districts. With this income, the households appear to be able to cover their reported expenditure (Table 22), which is smaller than that of the other two districts reported here.

Production constraints

Most of the farmers interviewed were of the opinion that inputs are too expensive, and said they had no money to buy the inputs (Table 23). Unavailability of inputs was another important limitation, reported by more than one-third of the interviewed farmers.

Table 21. Enterprise gross margins and farm income (TSh) in Songea District, 1989/90

	Maize (1.22 ha)	Beans (0.49 ha)	S.flower (0.56 ha)	Paddy (0.56 ha)	S/potato (0.24 ha)	Tomato (0.21 ha)	Other stock
Total revenue	16 828	14 535	11 500	23 214	2 005	7 000	7 968
Variable costs							
Cultivation	1 217	811	2 400	1 207	560	-	-
Seed	800	-	-	-	-	-	-
Weeding	427	100	60	64	160	-	-
Chemicals							
Harvesting	370	533	420	186	360	-	-
Fertilization	2 948	-	-	-	-	-	-
Total variable costs	5 762	1 444	2 880	1 457	1 080	-	-
Gross margin	11 066	13 091	8 620	21 757	925	7 000	7 968
Total gross margin 70 427							
<i>Fixed (overhead) Costs</i>							
	Cost				Cost		
Hoe	700	Matchetes			300		
Axe	250	General taxes			834		
Bicycle	3 000	General deductions			204		
Total fixed costs 5286							
Net farm income (gross margin - fixed costs) 65 141							

Table 22. Household expenditure (TSh) in Songea District

	Cost		Cost
Clothes	6 051	Batteries	2 591
Soap	3 254	Kerosene	1 945
Festivals	2 239	Holidays	2 513
Medical expenses	2 196	Contributions	1 396
Miscellaneous expenses	9 155	Total	31 340

Table 23. Number of farmers reporting specified constraints in Songea District, 1989/90

Constraint	No. of farmers	Lack of knowledge	Too expensive	No money	Not available	No transport
Fertilizer	62	1	40	14	32	18
Chemicals	20	-	13	5	7	5
Improved seed	13	-	9	2	5	4
Hoes	7	-	5	2	4	-
Oxen	1	-	1	-	1	-
Timely input supply	4	-	2	2	1	1

DISCUSSION

The Southern Highlands of Tanzania are predominantly a food producing zone, with maize as the dominant crop. Both before and after independence, the state embarked on programmes to transform the farm families, which generally resulted in disruption to the agricultural systems which prevailed. However, the later 'improvement approach', widely adopted in the Southern Highlands, has had commendable success, with the Southern Highlands now consuming more than 65% of Tanzania's total fertilizer consumption. The majority of this fertilizer is used on maize. There is a general awareness among the zone's farmers of the benefits of improved seeds and their accompanying package of other inputs (Table 24), for which the research and extension services should take credit. However, there are areas which remain to be addressed, and which have far-reaching implications for research, extension and policy making. This discussion is based on the notion of constrained profit maximization by farm families, and emphasis is put on the identification and removal of the current major constraints.

Seed technology

Improved maize seed is popular in the Southern Highlands, but there are still areas in which the use of modern varieties lags behind (Table 24). The use of improved seed needs to be complemented with other inputs (fertilizers, insecticides), and considerable success has been achieved with this as well. The major limitation today is the overall low level of input application, as a result of inadequate supplies, high retail costs and late delivery. The de-regulation of input supply should result in some improvement in timeliness and in the quantities supplied.

Level of mechanization

The hand hoe is still the most commonly used farm implement in the Southern Highlands, with a maximum of 36% of all cultivations done using oxen in some areas. The era of the 'transformation approach', which put the emphasis on dramatic shifts in technology, left mechanization languishing in the 'tractorization' bandwagon. There is an urgent need for both the research and extension services to promote the use of animal traction, to alleviate labour bottlenecks and reduce the work-load on women.

Pricing policies

The complaint of farmers world-wide, of the high price of inputs, has to be examined in relation to the price of outputs, as shown in Table 25 for nitrogen fertilizer: maize price ratios. In 1989/90, fertilizer prices were about 1.1 to 1.3 units of maize, sufficient to make the use of fertilizer reasonably profitable. The de-regulation of producer prices should allow prices to maintain their value relative to the prices of inputs. The Ministry of Agriculture, and the research services within the Ministry, could help to maintain price ratios by monitoring price changes. The provision of credit is a fairly risky exercise with de-regulated producer prices, in that in years when yields are high, producer prices are likely to fall, resulting in widespread defaults in repayment. The setting of a minimum price would assist farmers when negotiating with private traders.

Table 24. Proportion of farmers (%) using improved maize seed and inorganic fertilizers, 1989/90

District	Improved maize seed	Inorganic fertilizers
Njombe	68	96
Mbozi	72	68
Songea	24	96

Table 25. N-fertilizer and maize price ratios (TSh)

District	Price per kg CAN/UREA	Price per kg maize	Ratio
Njombe	15.56	12.00	1.30
Mbozi	13.58	12.23	1.11
Songea	14.74	10.72	1.38

Cash:food crops ratio

Most of the smallholder farmers' resources are allocated to the production of food crops, even in coffee-based farming systems. Although farmers complain of high input prices, the main investment of their limited cash resources is on food crops, which have less stable prices than cash crops. The food crops are needed in order to provide minimum subsistence for the household. Research on lower-cost measures to maintain productivity is vital, not only to develop systems sustainable in the long-term, but to free resources for cash cropping.

Future research, extension and training

Smallholder farmers are not necessarily profit maximizers, and profit maximization for smallholder farmers is generally partial or constrained. Hence there is a need to re-direct the emphasis towards problem-oriented research, specifically addressing the constraints facing farmers, with the involvement of farmers who best know the problems confronting them.

The extension services urgently need to adopt cost-effective ways of reaching many farmers at one time. The 'teach-to-teach' approach needs to be emphasized.

The training of extension workers at certificate and diploma level should emphasize a problem identification and solving approach, to enable them to investigate farmers' production constraints, and to initiate testing of constraint causes, in collaboration with research personnel. This would go some way towards reducing the barriers between extension and research personnel, and towards the introduction of a 'bottom-up' approach in extension and research. Researchers should no longer pose like a kettle full of tea pouring into empty cups, presently seen as the extension personnel.

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