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Harnessing Opportunities for Productivity Enhancement for Sorghum & Millets (HOPE): Baseline Survey, Tanzania

Christin Shipmann, Alastair Orr, Elijah Muange, January Mafuru

ICRISAT, Nairobi, A.Orr@cgiar.org

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Executive Summary

The baseline survey was made in Singida Rural and Kondoa districts of Central Tanzania. A random sample of 360 farm households was sampled, divided into treatment, diffusion, and control groups. The survey was conducted in late 2010 and the results refer to the 2009-2010 agricultural year. A table with key quantitative findings is provided at the end of this summary.

Socio-economic profile: The majorities of household heads were male, and most had upper primary education. On average they farmed 2.9 ha, leaving 2.1 ha uncultivated. The primary occupation was agriculture but almost half the sample households had income from non-farm sources. Households owned farm assets valued at Tsh 237,000 and livestock assets valued at 592, 000. Almost half the households owned mobile phones. Less than one-fifth of households surveyed had access to formal credit. Average per capita income was $247 per year, equivalent to $0.7 per day, or well below the $1 per day poverty line.

Access to agricultural information: Only 15 % of sample households reported participation in any form of technology transfer, such as farmer field days or demonstrations. Government extension officers are the most important source of information about new technology but contact is infrequent and neighbors remain an important source of information.

Crop production: About three-quarters of the sample households planted sorghum and finger millet. Significantly fewer households planted finger millet in Kondoa, and significantly fewer households planted maize in Singida. About four in ten plots were planted using seed saved from the previous harvest. Yields of sorghum averaged 0.46 tons ha^{-1}. No significant difference was found between the yield of local and improved sorghum varieties. Yields of finger millet and pearl millet averaged 0.68 and 0.45 tons ha^{-1} respectively. Only 1 % of growers applied inorganic fertilizer to sorghum or millets, and about one-fifth broadcast seed rather than row-planting. About one-third of growers used in situ water harvesting, but none used integrated Striga management.

Profitability: Finger millet had the highest gross margin (203,193 Tsh ha^{-1}), followed by maize (145,542 Tsh ha^{-1}), and sorghum (108,330 Tsh ha^{-1}). These figures are based on cash costs and exclude the costs of family labor.

Adoption: Over half the sample households knew at least one improved variety of sorghum, but only one-third grew an improved variety. The major reasons for non-adoption were unavailability of seed and susceptibility to pests and diseases. The main traits farmers required for sorghum and finger millets were high yield, early maturity, and drought resistance. At the time of the survey, however, improved varieties of finger millet had not yet been released.

Utilization: Sorghum was primarily a food crop with only 14 % of the harvest being sold whereas millets were primarily a cash crop with 81 % being sold. Nine-tenths of finger millet sold was sold at the farmgate. Low market prices were reported as a major constraint on sales of both crops. However, only 4 % of farmers were members of a Producer Marketing Group.

Keywords: HOPE, Baseline Survey Dryland Cereals, Sorghum, Millets, Tanzania

JEL classification: Q160

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1. Introduction

This study was conducted as one of two country-specific baseline assessments to provide a broad overview of the production and marketing of sorghum and millets in Eastern and Southern Africa (ESA). In Tanzania, the focus was on sorghum and finger millet. The audience for this report is expected to include scientists, planners, development agencies and decision makers interested in the cereal subsectors in Tanzania and in Eastern and Southern Africa in general.

Poverty in Tanzania is widespread, with 33 % of the population in 2007 living below a poverty line of US$ 0.79 per day. Poverty is more prevalent in rural areas where 74% of the population lives. Agriculture accounts for 29% of Gross Domestic Product (GDP), and employs 77 % of the working population (World Bank 2011). However, productivity is low because of the limited adoption of improved technology, climatic risk, crop losses from pests and diseases, and underdeveloped seed supply systems and output markets.

Sorghum and millets account for 8 % and 2 % of total cereal consumption in Tanzania (2005-2007). Maize, the staple food crop, accounts for 56 %. Increasing the productivity of dryland cereals in Tanzania can help improve productivity, reduce poverty and food insecurity. Sorghum and finger millet are well adapted to dryland areas and give reasonable yields in drought years. This enables a more productive use of land, particularly in areas where rainfall is scarce and unreliable. This can help mitigate the potential negative impacts of climate change. Moreover, the higher nutrient content of these cereals makes them important for improving nutrition and health. For example, finger millet is recommended for breast- feeding mothers, the sick and elderly people. Finally, the growing market for these crops by different end-users can provide a source of cash income for smallholder producers.

Despite the importance of dryland cereals for poverty reduction and food security, lack of appropriate technology and market imperfections have often locked small producers into subsistence production and contributed to stagnation of the sub-sector. Improved varieties of finger millet have not yet been released in Tanzania, and although improved varieties of sorghum are available, the majority of farmers still cultivate traditional varieties. The low productivity of traditional varieties limits farmers' ability to meet their own consumption needs as well as market demand. The structure and functioning of the marketing system is constrained by the small average quantity marketed, lack of grading and quality control systems, lack of well-coordinated supply chains, lack of efficient market information delivery mechanisms, underdeveloped infrastructure and high transaction costs. As a result, smallholders are not well integrated into domestic and regional markets. Past research and development interventions have attempted to facilitate productivity growth for smallholder farmers. However, these efforts did however not stimulate large scale uptake of new technology, in part because of the limited understanding of farm-level constraints, farmer preferences and the challenges relating to the delivery of new technology and inputs. Moreover, market linkages for small producers were often not part of these programs.

ICRISAT addresses these constraints through Harnessing Opportunities for Productivity Enhancement of Sorghum and Millets (HOPE), a project funded by the Bill & Melinda Gates Foundation. The HOPE project is undertaken in six countries (Ethiopia, Tanzania, Uganda,

Southern Sudan and Kenya) where dryland cereals offer significant opportunities for income growth and poverty reduction.

Objectives

The general objective of this study is to provide a broad overview of the existing production and market conditions for dryland cereals in Tanzania. The specific objectives are to describe the:

(i) Socioeconomic profile of smallholder farmers, including distribution of land and other productive assets and the welfare status of the study area using expenditure data;
(ii) Main characteristics of the production system, with emphasis on resource use patterns, land productivity and profitability of different crops and the current situation of sorghum and finger millet grown in the study area;
(iii) Level of adoption and dis-adoption of new sorghum varieties;
(iv) Constraints and potential of sorghum and finger millet cultivation;
(v) Utilization and commercialization of sorghum and finger millet; and
(vi) Gender differences in the study area.

The report is organized into nine chapters. Following this introductory section, chapter two describes the methodology on data collection and analysis. Chapter three discusses household demographics and assets ownership. Access to agricultural and business services in terms of access to various kinds of information, extension service and credit is presented in chapter four. Chapter five deals with crop production issues and covers land tenure systems, cropping pattern, crop yields, input use, and profitability of different crops. Chapter six presents the welfare status in the study area. Chapter seven deals with sorghum and finger millet production in detail Gender issues are discussed in chapter eight. Chapter nine presents a summary of the key findings and implications for research.

2. Data and methods

2.1 Project interventions areas

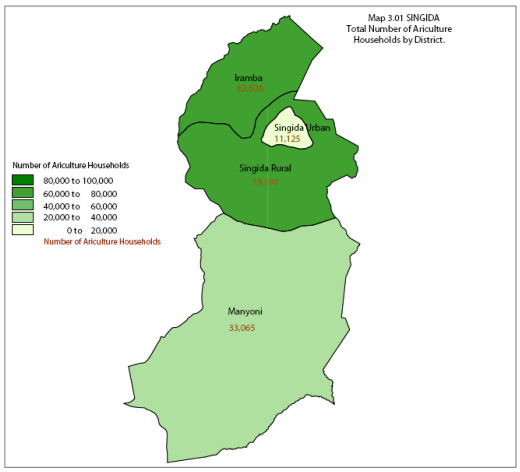
In Tanzania, the HOPE project focused in two major sorghum and finger millet producing areas, namely the Kilimanjaro region in the Northern and the Dodoma and Singida regions in Central Tanzania. Because of funding constraints only Central Tanzania was selected for the baseline survey.

2.2 Study sites

The survey was conducted in two bordering districts, namely Singida Rural district in Singida Region and Kondoa district in Dodoma Region. These districts represent one of the major centres of sorghum and millet production in Tanzania. Both regions have one main rainy season. In normal years, rainfall starts in mid-November and ends in April, with the highest rainfall between December and March. In Singida Region, the annual rainfall ranges between 500 mm and 800 mm. The average rainfall for Dodoma town is 570 mm and somewhat higher in the more agriculturally productive parts of Mpwapwa and Kondoa

districts. Crops are planted just before the main rainy season and harvested until June. The most important crops are maize (*Zea mays*), pearl millet (*Pennisetum glaucum*), sorghum (*Sorghum bicolor*), finger millet (*Eleusine coracana*) and sunflower (*Helianthus annuus*).

Figure 1: District map of Tanzania; Source: Ezilon, 2012



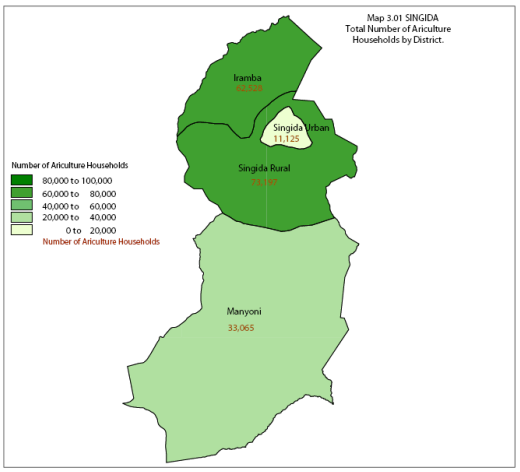


Figure 2: Map of Dodoma district; Source: United Republic of Tanzania, 2006a

Figure 3: Maps of Singida Rural and Kondoa districts; Source: United Republic of Tanzania, 2007

2.3 Survey design

A reconnaissance survey was made to have a broader understanding of the production and marketing conditions in the survey districts. Discussions were held with different stakeholders including farmers, traders and extension staff, and the findings used to refine the study objectives, sampling methods and the survey instrument. The baseline survey was conducted by DRD and ICRISAT from September to October 2010, after the harvest of sorghum and millets. Trained enumerators collected the information from the households through personal interviews. Data collected included information on household composition and characteristics, farm and non- farm assets, social assets, crop production, resource use patterns, agricultural technologies and awareness about sorghum and finger millet varieties, farming experiences, sources of information about improved varieties and markets, source of seed, major consumption expenditures, and detailed information on the marketing of sorghum and finger millet.

2.4 Sampling methods

Within Singida Rural and Kondoa districts, survey villages were selected through purposive sampling methods. In each district, a treatment, diffusion and control group was defined. The treatment group consists of villages in which HOPE project activities take place. The diffusion group consists of villages, which are close by treatment villages, so that spill over effects can be expected. Villages in the control group have the same agro-ecological conditions as villages in the other two groups, but are far enough away from the control and diffusion villages that spill over effects are unlikely to occur. In each group, households were randomly selected from a household list. We selected 90 households per treatment, and 45 households each per diffusion and control group. Consequently, a random sample of 360 households was selected for the detailed household survey from the six groups. Details of the sampling method are provided in Table 1.

Table 1: Sampled communities and households

Wards and villages – Singida	Treatment	Diffusion	Control	Total
Mungaa ward	90	45	0	135
Ntuntu ward	0	0	45	45
Names of sample villages	Mungaa Makiungu Unyaghumpi	Minyinga Kimbwi Kinku	Ntuntu Ntewa	
Wards and villages – Kondoa				
Kingale ward	90	0	0	90
Kwamtoro ward	0	45	0	45
Sanzawa ward	0	0	45	45
Villages (names)	Kingale Iyoli Chemchem Tampori	Ndoroboni Kurio Porobanguma Msera Kwamtoro	Gumbu Gungi Sanzawa Motto	

2.5 Analytical methods

The data was processed and analysed using SPSS Version 18 and STATA version 10. After checks for consistency and completeness, the data was analysed using different statistical procedures. We employed descriptive statistics such as frequencies, cross-tabulations, means and ratios to analyse, summarize and present the data. Analysis was conducted by disaggregating information by district and by group level (treatment (T), diffusion (D), control (C)) per district so that a snapshot comparison of the status quo can be made between the groups. The annex provides information disaggregated by group level (treatment (T), diffusion (D), control (C)) only. Since the primary purpose of this study is to provide an overview of production and marketing, we have not attempted econometric modelling to test correlations and cause and effect relationships between different variables.

3. Household demographics and assets

3.1 Household characteristics

Table 2 shows that the average household size was 6.5 persons, of which 3.3 constituted the productive labour force aged 15-64. The relative figures are the same in both districts. The dependency ratio[1] is about 1.2 for the whole sample, indicating that for every 100 working persons in the region, there are 102 who are not working. Households have equal numbers of male and female members, and the labour force has equal numbers of men and

[1] The dependency ratio was computed as the ratio of those not in the labour force (aged below 15 and over the age of 64) and those typically in the labour force (those between the ages of 15 and 64).

women. About 9% of the sample households are headed by women,[2] with a higher percentage of Female headed households (FHHs) in Kondoa. The average age of the household head is 45 years.

Table 2: Household characteristics (N=360)

Characteristic	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Family size									
- Total (No.)***	6.5	7.0	6.0	6.2	5.8	5.7	7.1	7.3	6.5
- Age 15 – 64 (No.)***	3.3	3.5	3.1	2.9	3.1	3.2	3.6	3.2	3.5
Dependency ratio*	1.2	1.3	1.1	1.3	1.1	0.9	1.3	1.5	1.1
- Total (No.)***	3.1	3.5	2.8	2.9	2.6	2.7	3.5	3.7	3.4
- Age 15 – 64 (No.)**	1.5	1.6	1.4	1.4	1.5	1.5	1.7	1.4	1.7
Head of household									
- Head is female (%)	9	7	11	9	13	11	8	9	4
- Age (years)***	45	43	47	49	46	44	43	43	43
Main occupation is farming (%)	99	99	99	99	100	100	100	96	100
Farming experience (years)									
- Overall**	22	21	24	25	23	21	20	23	21
- Sorghum	19	19	19	18	20	18	17	20	20
- Finger millet	13	13	13	16	12	6	13	13	14

Notes: ***, ** differences are significant at the 1% and 5% level, respectively, between the districts. . Differences are tested using t-test for numeric variables and Chi-Square for categorical variables.

Farming is the main occupation for almost all the sample households. The average household head has 22 years of experience with farming, and longer in Kondoa where household heads are older. Years of experience cultivating sorghum and finger millet cultivation are similar in both districts, but farmers have five years more experience cultivating sorghum.

3.2 Natural capital

Table 3 shows that the average landholding[3] for the sample households is 5 acres, of which around 3 ha are cultivated. Landholdings are more than 2 ha larger in Singida Rural than in Kondoa, but the difference in the average area cultivated is less than 1 ha. *Per capita* landholding and *per capita* cultivated land are also lower in Singida Rural than in Kondoa.

[2]Female-headed households (FHHs) are those in which a woman heads the household. Twenty-five percent of the sample FHHs were *de facto* FHHs, where women lived with their husbands, and 75 % were *de jure* FHHs where women heads were widows, divorced or were never married.

[3] Total landholding is the sum of own cultivated land, which includes own fallow land and own land that is rented out as well as all land that is rented in.

The lowest two quartiles own 16% of the land compared to 84% for the upper two quartiles. Thus, many farmers have small landholdings.

Table 3: Land ownership and distribution (N=360)

Land ownership/distribution	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Mean land available (ha)***	5.0	3.7	6.3	3.3	2.3	5.9	5.2	11.6	3.2
Mean share of owned land (%)	95	94	96	89	97	100	92	100	100
Mean cultivated land (ha)**	2.9	2.6	3.2	2.6	1.6	3.5	3.1	4.1	2.5
Available land per capita (ha)***	0.9	0.6	1.3	0.5	0.3	1.1	1.0	2.4	0.7
Cultivated land per capita (ha)***	0.5	0.4	0.6	0.4	0.2	0.7	0.6	0.8	0.5
Land distribution (% of own land by quartile)									
1st Quartile	6	7	7	9	20	1	9	1	23
2nd Quartile	10	13	11	17	26	3	12	6	26
3rd Quartile	25	19	19	21	21	14	27	10	28
4th Quartile	59	61	63	53	33	82	52	83	23

Notes: ***, ** differences are significant at the 1% and 5% level, respectively. Differences are tested between the districts.

3.3 Physical capital

Table 4 shows that half the sample lives in houses of unburned brick, followed by houses with burned bricks /stones and then mud houses (made without bricks). In both districts, 60% of the houses are roofed with iron sheets/tiles. One quarter of households own an ox-plough. Very few households own sprayer/water pumps, wheelbarrows or motorized vehicles, but six in 10 owns a bicycle. Whereas more than 80% own a radio only very few farmers own a TV. Significantly, almost half the households own a mobile phone. Disaggregating by quartiles shows that the lowest quartile owns only 4% of the total value of farm tools, while the top 25% owns 66%. The value of farm assets is significantly higher in Singida Rural (Tsh. 251,000) than in Kondoa (Tsh. 224,000) and more concentrated.

Table 4: Housing and farm assets (N=360)

Asset ownership	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Walling material of main house (% sample)									
Mud**	15	11	20	7	2	27	11	22	36
Unburned bricks***	50	64	37	76	58	47	38	42	28
Burned bricks/stone***	35	25	43	17	40	26	51	36	36
Roofing material of main house (% sample)									
Grass thatch	40	40	40	37	42	44	23	58	56
Iron sheets/tiles	60	60	60	63	58	56	77	42	44
Farm Assets (%. of hh owning)[a]:									
Ox-plough**	24	18	29	11	13	36	33	24	27
Sprayer/water pump	3	3	3	1	4	7	3	2	2
Ox-cart***	9	14	3	9	16	24	3	2	2
Wheelbarrow*	3	1	4	2	0	0	2	2	11
Bicycle***	62	51	73	43	67	51	80	76	56
Other motorized vehicles**	1	2	0	3	0	2	0	0	0
Radio/radio cassette	81	84	78	80	91	87	78	80	78
Television set	2	2	1	1	0	7	0	4	0
Mobile phone	49	53	46	53	53	53	53	47	29
Value of assets[a] (TSh '000')**									
Mean	237	251	224	198	262	346	246	230	173
1st Quartile (% share)	4	3	5	3	4	3	6	6	4
2nd Quartile (% share)	11	8	14	9	10	8	14	15	13
3rd Quartile (% share)	19	16	23	17	16	20	24	21	25
4th Quartile (% share)	66	73	58	71	70	69	56	58	58

Notes: ***, ** differences are significant at the 1% and 5% level, respectively. Differences are tested between the districts.

[a]Farm assets here refer to main farm tools and equipment, excluding land and farm buildings.

3.4 Human capital

Table 5 shows that most household members, including the household head, have upper primary education.[4] The prevalence of higher education is low (2 %), as is the share of household heads and members without any kind of education (4 %).

[4] Although not shown in Table 3.4, the same pattern is found for both female- and male-headed households.

Table 5: Education level of household members (N=360)

Characteristic	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Education level Ages 15-64 (% members)									
None***	4	2	8	2	2	2	6	8	10
Basic**	2	1	3	1	2	2	4	2	2
Lower primary (1-4)***	5	3	8	3	1	3	8	9	8
Upper primary (5-7)	73	72	73	69	77	74	72	68	75
Secondary (9-12)***	14	19	8	23	15	15	8	11	5
Higher (13-14)***	2	3	0	2	3	4	2	2	0
Education of household head (% heads)									
None***	4	1	8	1	0	0	9	7	9
Basic**	4	2	6	1	4	0	8	9	0
Lower primary (1-4)***	9	4	15	7	0	2	16	13	13
Upper primary (5-7)***	79	86	69	86	94	85	64	71	78
Secondary (9-12)****	3	6	1	4	2	11	1	0	0
Higher (13-14)	1	1	1	1	0	2	2	0	0

Notes: ***,**,* differences are significant at the 1%, 5% and 10% level, respectively. Differences are tested between the districts.

3.5 Social capital

Only one third of the households are involved in group or community activities (Table 3.5). Most participate in village administration (35 %), followed by formally registered SACCOs (Savings and Credit Cooperatives) (29 %) and informal farmer groups (28%). Only 4 % of sample households belong to a Producer Marketing Group (PMG). Farmer groups are more important in Singida Rural than in Kondoa. The highest share of PMG participation (11 %) was found in the treatment group in Singida Rural.

Table 6: Membership of organizations (N=360)

Organization types and membership	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Member of an organization (% sample)	34	33	34	26	49	31	30	42	33
Membership by type of organizations (% member households)									
Village administration	35	38	31	41	39	36	39	17	35
SACCO	29	27	31	22	27	36	32	44	15
Farmers group	28	22	34	19	26	21	25	30	50
Producer Marketing Group*	4	8	1	11	4	7	4	0	0
Farmer field school*	2	5	0	7	4	0	0	0	0
Other	2	0	3	0	0	0	0	9	0

Notes: * differences are significant at the 10% level. Differences are tested between the districts.

3.6 Financial capital and livestock

Table 7 shows that 47% of households reported income from a non-farm source. Households with a non-farm income source earn Tsh. 464,000 per year from these sources, of which around 75% comes from trading and business. The share was significantly higher in Singida (53%) than in Kondoa (40%). Although trading/business is equally common, it accounts for only 62% of the mean income in Singida compared to 92 % in Kondoa, suggesting that profits are higher in Kondoa. By contrast, remittances/pensions are more important in Singida Rural (Tsh. 101,000) than in Kondoa (Tsh. 6,000).

Table 7: Income sources (N=360)

Sources and amount of non-farm income	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
% households earning non-farm income **	47	53	40	61	51	40	38	42	42
Income sources (% sample)[a]									
Trading/business	82	80	83	91	57	78	77	84	95
Salary /Wages	14	17	13	24	8	0	18	16	16
Remittances/pension	4	5	3	6	0	11	3	0	5
Other	13	16	10	6	26	33	9	16	5
Average non-farm income(TSh '000')									
Trading/business	346	291	419	373	164	203	388	379	515
Salary /Wages	39	54	20	62	77	0	15	30	19
Remittances/pension	60	101	6	144	0	100	2	0	19
Other*	18	25	10	5	32	77	9	14	8
Mean non-farm income	464	471	455	583	273	381	414	422	561

Notes: **,* differences are significant at the 5% and 10% level, respectively. Differences are tested between the districts.

[a] Some households earned non-farm income from more than one source and therefore percentages under income sources may sum up to more than 100.

The conversion rate is 1000 Tsh = 0.67 US$ (October 2010).

Table 8 shows ownership of livestock and poultry among the sample. Poultry is most common (88%), followed by sheep and goats (61%) and cattle (49%). Beehives categorised as 'others'. are also relatively important The average household owns 4.2 livestock units (LSU) valued at 592,000 Tsh. Ownership of livestock is more concentrated than land. The lowest quartile accounts for only 1% of the value of livestock whereas the highest quartile accounts for 72%. The value of livestock is higher for Singida Rural (650,000) than in Kondoa (532,000).

Table 8: Livestock and poultry ownership in 2009 (N=360)

Livestock ownership	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Ownership(%)									
Cattle*	49	54	44	44	62	67	44	44	44
Sheep and goats	61	59	63	44	73	73	61	60	71
Donkeys*	6	4	8	3	9	0	10	4	9
Poultry	88	91	86	91	91	91	83	87	89
Others	22	24	20	17	22	40	10	33	27
At least one	96	97	94	94	100	98	93	96	96
Mean livestock numbers (owned)									
Cattle	3.9	4.1	3.7	3.2	5.1	5.0	3.6	3.2	4.4
Sheep and goats	7.5	6.7	8.2	5.2	7.8	8.9	7.6	8.9	8.9
Donkeys	0.2	0.2	0.2	0.1	0.5	0.0	0.3	0.2	0.0
Poultry**	10.5	11.6	9.3	11.8	9.4	14.0	7.5	8.7	13.6
Others**	1.7	0.9	2.6	0.7	0.7	1.7	1.3	5.4	2.4
Mean total livestock units (TLU[a])	4.2	4.3	4.0	3.2	5.5	5.3	4.0	3.7	4.5
Mean livestock value (Tsh '000)	592	650	532	462	881	784	584	337	615
1st Quartile (% of total)	1	1	1	0	1	1	1	2	1
2nd Quartile (% of total)	4	5	4	4	5	11	4	7	5
3rd Quartile (% of total)	23	22	23	22	26	26	25	24	28
4th Quartile (% of total)	72	72	72	74	68	62	70	68	66

Notes: **, * differences are significant at the 5%,and 10% level, respectively. Differences are tested between the districts.

[a] 1ox=1cow=1TLU, other cattle=0.75TLU, 1calf=0.45TLU, 1Donkey=0.5TLU, 1Goat=1Sheep=0.1TLU, 1chicken=0.01TLU, 1Beehive=0.001TLU, 1pig=0.2TLU[5]. Source: Survey data 2011

4. Access to agricultural and business services

4.1 Proximity and access to markets

Both districts have a rotating market system where markets take place in a different village each week. In both districts, the next closest markets are those in the district capital. Table 9 shows that in both districts the treatment villages are about one hour closer to the district headquarters than the control villages.

[5] Source of conversion rates: Otte and Chilonda (2002) and Asfaw et al (2010).

Table 9: Distance of sampled villages to the district capitals in hours and minutes

Village	Distance to the district capital	Village	Distance to the district capital
Treatment area Singida Rural		Treatment area Kondoa	
Mungaa	1.10	Kingale	0.40
Makiungu	1.00	Iyole	0.40
Unyaghumpi	1.00	Chemchem	0.40
Diffusion area Singida Rural		Tampori	0.40
Minyinga	1.15	Diffusion area Kondoa	
Kimbwi	1.25	Ndoroboni	1.00
Kinku	1.15	Kurio	2.20
Control area Singida Rural		Porabanguma	2.00
Ntuntu	2.10	Msera	1.40
Ntewa	2.10	Kwamtoro	1.30
		Control area Kondoa	
		Gumbu	2.45
		Gungi	3.00
		Sanzawa	3.15
		Motto	2.30

4.2 Access to information

Although the extension service is assumed to be an important source of information for farmers, only six in ten of the sample households had access to an extension officer (Table 4.2). As a source of information, the extension officer ranks second. For all topics, neighbours and other farmers rank first. This suggests that farmers receive little information from persons outside the village. The share of households reporting access to extension officers is higher in Singida Rural (66 %) than in Kondoa (57 %).

Farmers overcome this by using radio, TV and mobile phones. Seed traders and agro-dealers play a relatively small role in information dissemination, even for ‘learning about new varieties’ (11%). Follow-up discussions revealed that not many agro-dealers were available and they were not well informed about sorghum and finger millet. The lowest share of households with access to an extension officer (38 %) was found in the Kondoa treatment group.

Table 10 show that only 15% of households had ever participated in technology transfer. The most popular was participation in on-farm trials/demonstrations (27%), learning from lead farmers activities (24%) and farmer training centres (20%). Surprisingly, only 11% of the households (1.6 % of the total sample) have ever participated in a field day.

Table 10: Information sources for smallholder farmers in % (N=360)

Information Sources	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Access to government extension	62	66	57	69	64	62	38	76	78
No. of contacts with extension per year	1	1	1	1	1	2	1	1	1
Source of information on new crop varieties									
Extension officer	64	68	61	69	62	71	42	76	84
Neighbours/other farmers	78	78	77	82	76	73	74	80	78
Local leaders	25	22	28	21	31	16	30	29	24
Seed traders/agro-dealers	11	13	9	9	18	16	14	4	2
ICT (Radio/TV/Mobile phone)**	17	13	21	10	18	13	24	22	13
Others***	16	10	23	11	7	11	22	22	24
Source of information on crop storage									
Extension officer	66	70	63	71	62	76	46	76	84
Neighbours/other farmers	86	88	84	91	84	84	82	87	84
Local leaders	29	26	32	26	33	20	31	36	29
Seed traders/agro-dealers	13	14	12	11	18	16	20	4	2
ICT (Radio/TV/Mobile phone)	19	15	24	12	20	16	30	22	13
Others***	20	12	29	14	7	11	30	24	31
Source of information on output markets									
Extension officer	66	68	64	69	62	71	46	76	89
Neighbours/other farmers*	86	87	85	88	87	84	86	82	87
Local leaders**	29	26	33	26	33	20	32	36	31
Seed traders/agro-dealers	20	22	17	18	27	27	26	11	7
ICT (Radio/TV/Mobile phone)	23	19	26	16	22	24	30	24	20
Others***	25	18	32	19	16	18	29	29	40
Source of information on input markets									
Extension officer	68	70	67	71	64	73	48	80	91
Neighbours/other farmers	86	86	86	89	84	80	808	82	84
Local leaders*	28	25	31	23	36	18	32	31	29
Seed traders/agro-dealers	23	26	19	22	27	31	30	11	7
ICT (Radio/TV/Mobile phone)	20	16	24	16	18	16	28	28	18
Others***	26	17	35	18	11	22	32	31	44
Source of information on crop management									
Extension officer	66	69	63	71	62	73	44	78	87
Neighbours/other farmers	84	83	85	87	78	82	86	84	84
Local leaders	30	30	31	29	40	32	32	29	29
Seed traders/agro-dealers	12	14	11	10	20	16	16	9	2
ICT (Radio/TV/Mobile phone)	18	18	22	11	18	13	26	22	13
Others***	19	12	27	13	9	11	27	27	29

Notes: ***, **,* differences are significant at the1%, 5% and 10% level, respectively. Differences are tested between the districts.

Table 11: Participation in technology transfer in %)

Information Sources	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Participation in technology transfer	15	17	14	17	27	7	12	22	9
Activity participated in (% participants)									
Own plot PVS	16	10	24	7	8	33	46	10	0
On-farm trials/demonstrations*	27	37	16	20	50	67	18	10	25
Farmer field days	11	10	12	13	8	0	9	20	0
Farmer training centre**	20	30	8	40	25	0	0	10	25
Learning from lead farmers**	24	13	36	20	8	0	27	40	50
Others	2	0	4	0	0	0	0	10	0
Number of activities per hh in 2008-10**	2	3	2	2	4	1	1	2	0

Notes: **,* differences are significant at the 5% and 10% level, respectively. Differences are tested between the districts.

4.3 Collective action

Table 12 shows that only 14% of the sample households were aware of collective action. Of those aware, only one-third were ever actively involved, not because of lack of interest but because there was no collective action in the village (44 %), or they did not have enough grain (21 %), or because payment for grain sold through collective action was not immediately (15%). The share of households participating was significantly lower in Kondoa (22 %) than in Singida Rural (36 %)

Table 12: Awareness and participation in collective action in % (N=360)

Information Sources	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Awareness of collective action **	14	17	10	14	13	27	6	13	16
Ever involved in collective action (% aware)	31	36	22	54	33	17	0	50	14
Reasons for non-involvement (% respondents)									
No collective action in the village	44	40	50	17	50	50	60	33	50
Not enough grain	21	30	7	33	50	20	0	33	0
Not paying immediately	15	10	21	0	0	20	40	33	0
Prices are lower/ erratic *	6	0	14	0	0	0	0	0	33
Not interested in collective action	6	10	0	17	0	10	0	0	0
Too strict on quality	3	5	0	17	0	0	0	0	0
Others	6	5	7	17	0	0	0	0	17

Notes: *** differences are significant at the1% level, respectively. Differences are tested between the districts.

4.4 Access to credit

The ability of rural households to make investments depends largely on their access to credit. Table 13 shows that, in the 12-months preceding the survey, 16 % of the sampled households tried to obtain a loan, of which 93% were successful. Eight in ten households did not apply for credit either because they did not need it, or did not expect to be eligible for a loan, or because financial institutions were not available.

Table 13: Demand for and access to credit in % (N=360)

Access to credit	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Demand for formal credit	16	19	13	13	29	22	6	36	7
Supply of credit (% demanding households)	93	94	92	83	100	100	60	100	100
Credit sources (% borrowers)									
NGOs	4	6	0	20	0	0	0	0	0
Banks*	9	15	0	20	0	30	0	0	0
SACCOs***	60	42	86	50	54	20	100	81	100
Village money lenders	9	9	9	10	15	0	0	13	0
Family/Friends/Neighbours**	18	28	5	0	31	50	0	6	0
Total amount of credit (Tsh '000)	229	218	245	318	190	165	502	252	400
Amount of credit by source (% total credit)									
NGOs	1	2	0	5	0	0	0	0	0
Banks*	18	32	0	63	0	27	0	0	0
SACCOs**	65	43	91	30	77	15	100	89	100
Village money lenders	5	5	5	2	13	0	0	6	0
Family/Friends/Neighbours	11	18	4	0	10	58	0	5	0
Use of Credit (% total credit)									
Investment in Agriculture**	51	29	73	12	66	3	33	75	75
Investment in non-agriculture	41	56	25	76	18	81	67	23	25
Consumption	3	4	2	0	10	1	0	2	0
School fees/medical bills**	5	11	0	12	6	15	0	0	0

Notes: ***, **, * differences are significant at the 1%, 5%and 10% level, respectively. Differences are tested between the districts.

SACCOs were the most important credit supplier, accounting for 86% of the credit provided in Kondoa compared to just 42 % in Singida.. Other important sources were friends and family (18 %) as well as village money lenders (9%). The average amount borrowed was Tsh. 229,000. The average loan obtained was highest for SACCOs, followed by banks and then friends and family. Half the sample households (51 %) used credit to invest in agriculture, followed by investments outside agriculture (41%). There were significant differences at the district level. In Singida Rural 56% of the households used credit for investment outside agriculture and only one third invested in agriculture. By contrast, in

Kondoa 73 % of the sample households invested in agriculture and only 25 % in non-agriculture.

5. Crop production

5.1 Cropping pattern

Finger millet and sorghum were the most popular crops (71 %) followed by maize (69 %) and pearl millet (50 %) (Table 14). In Singida Rural, only 53 % of households grew maize, compared to 85 % in Kondoa. Besides cereals, the most popular crop is sunflower (37 %), which is primarily grown for oil as a cash crop.

Table 14 shows the mean area allocated to each crop, including zero values where households did not grow that crop. On average, most land is allocated to maize (0.82 ha), followed by finger millet (0.66) and then sorghum (0.36 ha). Whereas farmers in Singida Rural allocate more land to finger millet (0.86 ha) and sorghum (0.56 ha) than maize (0.43 ha), in Kondoa farmers allocate more than twice as much land to maize (1.22 ha) as to sorghum (0.54 ha) or finger millet (0.46 ha). Moreover, the land allocated to sorghum in Kondoa (0.54 ha) is higher than for finger millet (0.46 ha).

Table 14 shows mean crop yields for cereals in the 2009/10 cropping season. Since yields are based on farmer recall rather than on crop-cuts, the absolute values may not be entirely accurate but the relative yield between the cereal crops is expected to be accurate since the same method was used to estimate the yield for each crop. Mean yield is highest for finger millet (0.68 t/ha), followed by maize (0.63 t/ha), sorghum (0.46 t/ha) and pearl millet (0.45 t/ha). Maize yields in Kondoa are higher than in Singida Rural whereas the latter has higher yields for sorghum and millets.

Table 14: Crops grown by sample farmers (N=360)

	Farmers growing (%)			Mean area (ha)			Mean yield (t/ha)		
Crop grown	Total	Singida	Kondoa	Total	Singida	Kondoa	Total	Singida	Kondoa
Cereals									
Finger millet***	71	87	56	0.66	0.86	0.46	0.68	0.7	0.66
Sorghum	71	70	72	0.55	0.56	0.54	0.46	0.5	0.43
Maize***	69	53	85	0.82	0.43	1.22	0.63	0.58	0.67
Pearl millet***	50	58	43	0.36	0.33	0.39	0.45	0.47	0.42
Rice	2	2	2	0.01	0	0.01	0.97	0	0.97
Pulses									
Pigeonpea***	10	1	19	0.03	0	0.06	0.37	0.1	0.39
Beans*	4	6	2	0.02	0.02	0.02	0.15	0.14	0.16
Cowpea	4	3	5	0.01	0.01	0.01	0.22	0.15	0.27
Green grams	1	0	1	0	0	0.01	0.74	0	0.74
Oil crops									
Sunflower	37	33	41	0.36	0.3	0.41	0.61	0.61	0.6
Groundnuts**	2	1	4	0.01	0	0.02	0.34	0.44	0.31
Simsim**	1	0	3	0.01	0	0.01	0.3	0	0.3
Bambara Nuts	1	1	0	0.01	0.01	0	0.11	0.11	0
Roots and tubers									
Sweet potato***	5	9	1	0.02	0.04	0	3.36	3.36	0
Cassava	3	2	4	0.01	0	0.02	2.57	2.37	2.67

5.2 Use of agricultural inputs

Table 15 shows the use of key inputs in the 2009/2010 cropping season for the four cereal crops.[6] Manure is applied mostly to maize (14 % of plots) and pearl millet (15%), and less so to sorghum (8 %) and finger millet (7 %). Application of manure is similar for all cereals. Similarly, the majority of cereals plots are sown with own seeds. Finger millet has the highest shares of plots (17%), on which purchased seeds are used, followed by maize (13%). A higher share of sorghum and maize plots in Singida Rural (12% and 20% respectively) benefit from manure compared to Kondoa (5% and 10% respectively). More sorghum and finger millet plots in Singida Rural are planted with purchased seeds. Application rates of manure are highest for finger millet (4.0 mt/ha), followed by sorghum (3.5 mt/ha), pearl millet (3.0 mt/ha) and maize (2.6 mt/ha). In Kondoa, very little manure is applied to sorghum. The relatively high rate of manure applied to finger millet may reflect its status as a cash crop.

[6] Since only 1% of the farmers reported the use of inorganic fertilizer and none stated the use of chemicals for crop protection, the use of these inputs is not shown.

Table 15: Use of agricultural inputs (n=360)

	Plots (%)			Application rates		
Crop/input	Total	Singida	Kondoa	Total	Singida	Kondoa
Total Manure (t/ha)						
Sorghum**	8	12	5	3.5	5.0	0.6
Finger millet	7	5	10	4.0	4.1	3.9
Pearl millet	15	14	16	3.0	3.6	2.1
Maize**	14	20	10	2.6	2.7	2.4
Own manure (t/ha)						
Sorghum	6	7	4	1.0	1.5	0.1
Finger millet	5	5	7	2.6	4.1	1.2
Pearl millet	13	14	12	1.2	1.7	0.5
Maize**	12	20	8	1.7	2.1	1.3
Purchased manure (t/ha)						
Sorghum***	3	5	1	2.5	3.5	0.5
Finger millet	1	1	3	1.4	0.0	2.7
Pearl millet	3	2	4	1.8	1.9	1.6
Maize	2	2	2	0.8	0.6	1.1
Total seed (kg/ha)						
Sorghum	100	100	100	11.2	12.5	10.3
Finger millet	100	100	100	12.6	12.6	12.7
Pearl millet	100	100	100	11.1	12.1	9.5
Maize	100	100	100	17.4	18.1	17.0
Own seed*(kg/ha)						
Sorghum	84	80	87	10.2	12.23	8.7
Finger millet	81	83	77	9.9	10.3	9.3
Pearl millet	92	94	89	10.6	11.9	8.8
Maize	84	83	85	15.7	15.8	15.7
Purchased seed(kg/ha)						
Sorghum	4	3	5	1.0	0.3	1.6
Finger millet	17	14	21	2.6	2.3	3.2
Pearl millet	5	5	5	0.4	0.2	0.7
Maize**	13	18	10	1.7	2.3	1.3

6. Poverty analysis

Table 16 shows average household expenditure for the period Oct 2009-2010. Expenditure is generally considered a better measure of poverty than income which may fluctuate considerably between years, depending on the season. The average household spends Tsh 2,051,000 (US$ 1,395) per year, of which 60% is spent on food and 40% on other items. Less than 1% is saved. Cereals, pulses and groundnuts are the most important food items (32%) followed by processed foods and outside meals, animal products and beverages, sugar and salt. Per capita expenditure averaged TSh 368,000 per year, equivalent to US$

0.7 per day. A significant difference is found between Singida Rural (TSh 327,000) and Kondoa (TSh 409,000). In general, the sample can be classified as poor. The national poverty line for Tanzania was estimated at US$ 0.8 per day. However, Tanzania's national poverty line may be rather low by international and regional standards (Ministry of Planning, Economy and Empowerment, 2005). At the group level, in Singida the control group has the highest per capita expenditure, whereas in Kondoa the highest is found in the diffusion group. Expenditure data for the richest and poorest quartiles (not shown), shows that expenditure for the richest quartile is almost five times higher (TSh 3,883,400 or US$ 2,602) than for the poorest quartile (TSh 785,300 (US$ 526)). Per capita expenditure in the richest quartile averaged US$ 1.26 per day, compared to US$ 0.3 in the poorest quartile.

Table 16: Mean annual household expenditure (N=360)

Total household expenditure (Tsh '000')	Sample	District		Singida			Kondoa		
		Singida	Kondoa	T	D	C	T	D	C
Food items	1,197	1,136	1,259	1,272	913	1,086	1,305	1,362	1,064
Non-food items	854	849	859	877	686	954	958	846	675
Total	2,051	1,985	2,118	2,149	1,599	2,040	2,263	2,208	1,739
Spending on item (% total expenditure)									
Food	60.4	60.0	60.8	61.9	58.0	58.1	57.9	65.7	62.0
Personal care, clothing and beddings	13.8	13.9	13.7	13.3	15.7	13.4	14.7	13.2	12.3
Information, transport and communication	8.3	8.1	8.5	7.4	8.0	9.5	9.5	5.3	9.8
Housing and basic household items	6.7	6.4	7.0	6.6	6.0	6.6	7.1	6.8	6.9
Social, charity and entertainment	5.6	5.1	6.0	5.0	5.4	5.2	6.5	5.0	6.2
Education***	3.3	4.9	1.8	3.9	5.3	6.3	1.6	2.2	2.0
Health and insurance***	1.5	1.2	1.8	1.3	1.3	0.7	2.6	1.2	0.9
Savings	0.4	0.5	0.3	0.7	0.3	0.2	0.1	0.7	0.2
Spending on food items (% food expenditure)									
Cereals, pulses and groundnuts	32.2	32.1	32.3	34.2	31.6	28.6	30.2	35.1	33.5

Total household expenditure (Tsh '000')	Sample	District		Singida			Kondoa		
		Singida	Kondoa	T	D	C	T	D	C
Processed foods and outside meals	16.0	16.6	15.5	15.2	18.7	17.2	16.2	14.7	14.8
Animal products	15.1	15.8	14.5	14.3	16.4	18.0	15.8	14.0	12.3
Beverages, sugar and salt	14.5	15.1	14.0	14.8	13.9	16.7	11.8	14.1	18.4
Horticultural products***	11.6	9.6	13.6	9.6	9.2	10.2	14.2	13.2	12.7
Cooking and lighting items	4.8	4.7	4.9	5.8	3.8	3.2	6.4	3.4	3.2
Cooking fats and oils***	4.5	5.0	3.9	5.1	5.1	4.8	3.6	4.3	4.1
Root and tuber crops	1.2	1.1	1.4	1.0	1.3	1.2	1.7	1.1	0.8
Per capita expenditure (Tsh '000')									
Food***	215	185	244	203	131	202	241	271	225
Personal care, clothing and bedding***	43	37	49	38	30	41	54	50	39
Information, transport and communication	38	34	42	29	25	53	39	39	51
Housing and basic household items	29	30	29	21	12	66	29	31	26
Social, charity and entertainment**	21	17	26	17	12	22	28	24	25
Education*	13	17	10	13	18	23	6	17	8
Health and insurance***	6	4	7	4	3	4	10	6	3
Savings	3	4	2	6	1	1	1	5	1
Total**	368	327	409	332	233	412	408	442	379

Notes: **, *** differences are significant at the 5% and 1% level, respectively. Differences are tested between the districts.

The conversion rate is 1000 Tsh = 0.67 US$ (October 2010).

7. Adoption of improved varieties

Table 17 gives an overview of the number of households cultivating sorghum and millets in the 2009/10 cropping season. Since improved varieties of finger millet have not yet been released in Tanzania, this information is available only for sorghum. Only 27 % of farmers cultivate improved varieties of sorghum. The share is higher in Kondoa (55 %) than in Singida Rural (14%).

Table 17: Sorghum and finger millet cultivating farmers (N=360)

Crop	Total	Singida	Kondoa	Singida			Kondoa		
				T	D	C	T	D	C
Sorghum	256	126	130	63	24	39	48	45	37
Local varieties	218	122	96	59	24	39	31	31	34
Improved varieties	69	14	55	7	6	1	20	26	9
Finger millet	257	157	100	85	38	34	65	20	15

7.1 Knowledge of varieties

7.1.1 Sorghum

An average sorghum grower can name six different improved varieties and two local varieties. (Other un-named local varieties are summarized under the generic term 'local varieties'). Half the households were aware of at least one improved sorghum variety. The best known were Pato and Macia (Table 18). However, only 112 farmers (43%) have ever planted an improved sorghum variety. A higher share of farmers knew about improved varieties in Kondoa (68 %) and had planted them (90%). For local varieties, the most important information source was other farmers (82%), whereas extension plays only a minor role. By contrast, extension officers are the most important source of information about improved varieties (73%). Surprisingly, seed/grain stockists were not mentioned. Almost all farmers who had cultivated a local variety they knew grew it the 2009/10 cropping season. By contrast, the adoption rate for known improved varieties was only 60%. Two thirds of the farmers in Kondoa who had ever planted an improved variety did so in 2009/10 compared to less than half in Singida Rural. In total, more than half the farmers that have adopted an improved variety have stopped growing local varieties, but in Singida Rural the majority of adopters still grow local varieties.

Table 18: Sorghum and finger millet cultivating farmers (N=360)

Varieties	Knowledge of varieties						Adoption of known varieties in 2009/10 season					
	Total		Singida		Kondoa		Total		Singida		Kondoa	
	Known	Ever planted	Known	Ever planted	Known	Ever planted	No.	%	No.	%	No.	%
Local												
Langalanga	206	96	112	100	94	90	169	86	109	97	60	71
Udo	68	94	2	50	66	96	47	73	0	0	47	75
Other	62	84	38	82	24	88	37	71	23	74	14	67
At least one local***	236	99	124	99	112	98	218	94	122	99	96	87
Improved												
Pato	80	76	31	65	49	84	20	33	4	20	16	39
Macia	74	84	13	69	61	87	38	61	3	33	35	66
Tegemeo	46	67	18	56	28	75	6	19	1	10	5	24
Serena	30	3	23	57	7	86	6	32	6	46	0	0
Sila	8	100	0	-	8	100	6	75	-	-	6	75
Lulu	4	100	1	100	3	67	0	0	-	-	0	0
At least one improved***	143	79	55	62	88	90	69	61	14	41	55	70

7.1.2 Finger millet

Farmers cultivating finger millet reported a total of 340 local varieties. Of these, 94% had been planted at some time in the past. Farmers in Singida Rural reported a higher number of varieties (225) than farmers in Kondoa (115), which is consistent with the greater popularity of finger millet in Singida (Table 19). As with sorghum, other farmers and neighbours were the most important source of information.

Table 19: Knowledge and adoption of local varieties of finger millet (N=257)

Variety	Total		Singida		Kondoa		Total	Singida	Kondoa
	Known (No.)	Planted (%)	Known (No.)	Planted (%)	Known (No.)	Planted (%)	%	%	%
Local varieties	340	94	225	92	115	98	83	79	89

7.2 Reasons for adoption and non-adoption

7.2.1 Sorghum

The most important reason for adopting improved varieties was high yield (41 %), followed by best adapted (31 %) and then early maturity (14 %). Early maturity is much more

important in Singida Rural (31 %), than in Kondoa (7 %). In contrast, adaptation is more important in Kondoa (40 %) than in Singida Rural (10 %). The most important reason for non-adoption of improved sorghum varieties was non-availability of seed (39 %) followed by damage from pests and diseases (36 %). The high importance of diseases and pests suggests that the need for better adaptation.

7.2.2 Finger millet

High yields, closely followed by non-availability of other varieties were the two most important reasons for planting a specific local variety. 'Best adapted' was still mentioned by 14% of the farmers, whereas 'early maturity', 'best for brewing' and 'recommend by others' play only a minor role (Table 20).

Table 20: Reasons for adoption/non-adoption of sorghum varieties in % (N=256)

Adoption reason	Total		Singida		Kondoa	
	Local	Improved	Local	Improved	Local	Improved
Availability	33	5	38	6	29	5
Best adapted	38	31	29	10	45	40
High yields	19	41	23	42	15	40
Recommended by others	4	7	6	11	2	5
Early maturity	2	14	3	31	2	7
Best for brewing	4	2	1	-	7	3
Reasons for non-adoption						
Non- availability	16	39	37	44	-	32
Pests and diseases	32	36	25	35	36	36
Low yields	11	5	-	9	18	-
Poor taste	16	-	38	-	-	-
Late maturity	11	-	-	-	18	-
Land shortage	5	11	-	3	9	23
Lack of cash/too expensive	-	7	-	9	-	5
Other	9	2	-	-	-	4

7.3 Access to seed

Table 21 shows the relative importance of different sources of seed for sorghum and finger millet. For local varieties of sorghum, the most important source of seed is own storage (58 %), followed by farmer-to-farmer exchange (30%). Extension officers (6 %), traders and agro dealers (3 %) and local seed producers (2 %) play an insignificant role. Thus, farmers primarily use informal rather than formal seed systems. For improved varieties, by contrast, the most important source of seed is extension officers (50 %), followed by own storage (31 %) and farmer-to-farmer exchange (11 %). Again, agro dealers and local seed producers are not significant. At the district level, extension officers rank first in Kondoa (57 %) but last (10 %) in Singida Rural, where 'own storage' (50 %) is the most important source of seed.

Similarly, ‘own storage’ is the most important source of seed for finger millet (48 %), followed by other farmers (37 %).

Table 21: Access to sorghum and millet seed

	Sorghum (n=256)						Finger millet (n=257)		
	Total		Singida		Kondoa				
Sources	Local (N= 250)	Improved (N= 70)	Local (N =130)	Improved (N= 10)	Local (N= 120)	Improved (N= 60)	Total	Singida	Kondoa
Own storage	58	31	65	50	51	28	48	53	41
Other farmers	30	11	24	40	37	7	37	32	44
Extension officer	6	50	2	10	11	57	4	4	5
Agro-dealer	3	0	6	0	0	0	4	5	2
Local seed producer	2	0	2	0	1	0	5	5	5
Other	1	8	1	0	0	8	2	1	3

Note: The total number of seed sources presented for sorghum is greater than the sample size as some farmers cultivate more than one variety and information was provided per variety.

Farmers were asked about their main constraints in buying seeds. The most important constraint was missing information about recommended varieties (36 %), followed by high cost (25 %), non-availability (16 %) and low quality (15%). These results confirm that knowledge as well as availability of improved varieties are two of the most important barriers in the diffusion process.

7.4 Preferred traits for sorghum and finger millet

Farmers were asked to rank the two most important traits they considered when buying seeds. The most important aspects considered were potential yield (65 %), early maturity (18 %) and drought resistance (12 %). When traits ranked second are considered, the overall ranking remains the same, except that early maturity and drought resistance are then equally important (32 % and 38 %, respectively). When traits ranked second are considered at the district level, in Singida Rural drought resistance (44 %) becomes more important than early maturity (29 %, which is consistent with farmers’ reasons for adopting a variety (Table 22).

Table 22: Trait preferences for sorghum and finger millet in % (N=315)

Trait preference	Total		Singida		Kondoa	
	1st trait	2nd trait	1st trait	2nd trait	1st trait	2nd trait
Yielding capacity	65	16	66	18	64	15
Early maturity	18	32	21	29	16	36
Drought resistance	12	38	11	44	14	31
Pest resistance	2	9	1	7	3	11
Other	3	5	1	2	3	7

8. Profitability of cereal crops

Partial budgets for sorghum and millets were estimated for a sub-sample of the sample households. Households were asked to recall labour and input use on a specific plot for the 2009/10 season.

8.1 Labour use

Figure 4 shows the share of farmers hiring labour for each crop. Land preparation, weeding, harvesting and threshing were the most frequent operations for which farmers hired labour. However, the share of farmers hiring labour for any operation never exceeded 50 %. Hired labour was almost never used for certain operations like planting, scaring pests (birds and wild pigs), and crop storage.

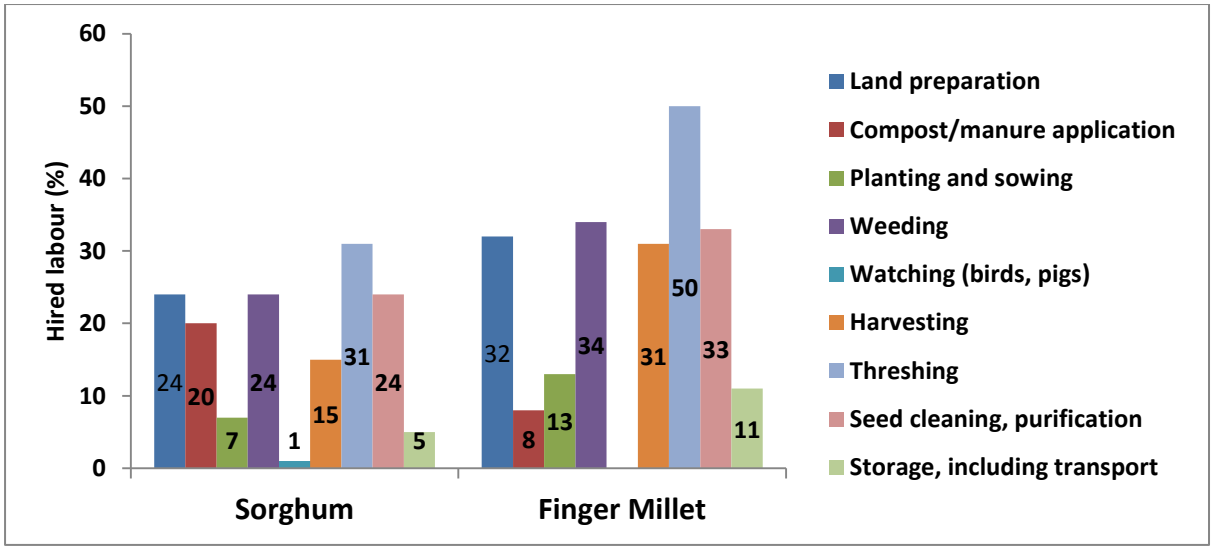


Figure 4: Use of hired labor for sorghum and millet, by operation, 2009/10

Table 23 shows the quantity of labour used for each operation for sorghum and millet. Total labour use averaged 234 man-days/ha for sorghum and 266 man-days/ha for finger millet. Family labour accounted for 87 % of total labour use for sorghum and 85 % for finger millet. The total quantity of labour recorded was similar across the two districts. For both crops, the most labour-intensive operation was protecting the crop from pests (birds and wild pigs), followed by weeding and land preparation. Interventions are needed to reduce labour requirements for these operations.

Table 23: Trait preferences for sorghum and finger millet in % (N=315)

Crop Operation	Sorghum					Finger millet				
	Total			Districts		Total			Districts	
Type of labour	Family	Hired	Total	Singida	Kondoa	Family	Hired	Total	Singida	Kondoa
Land preparation	23.3	4.3	27.7	26	29.5	24.9	9.5	34.4	45.2	21.3
Composting or manuring	19.8	2.6	22.4	23	21.7	11.8	6.7	18.6	25.9	0
Seed treatment	2.7	0	2.7	2	3.7	1.5	0	1.5	1.9	0
Planting and sowing	8.9	0.5	9.4	8.2	10.6	11.2	0.8	12	15.8	7.3
Weeding/herbicide	26.8	8	34.8	29.8	40.1	24.1	9.6	33.6	44.1	21.1
Watching birds/pigs	88.9	0.7	89.6	98.5	86.6	108.7	0	108.7	74.1	112.5
Harvesting	19.7	2.4	22.2	21.2	23	27.3	3.3	30.7	32.4	28.7
Threshing	6.1	5.1	11.2	10.6	11.7	7.3	5.6	12.9	14.0	11.5
Seed cleaning	5.5	2.2	7.7	8.3	7.1	5.7	3	8.6	8.6	8.7
Storage and transport	5.7	0.4	6.2	6.6	5.7	4.6	0.2	4.8	5.7	3.7
Total	207.4	26.2	233.9	234.2	239.7	227.1	38.7	265.8	267.7	214.8

8.2 Oxen draught power

Less than one-quarter of the sample households used oxen (Table 24). Oxen were used most frequently for land preparation and rarely for weeding or even transport. A higher share of farmers in Kondoa hires oxen for land preparation than in Singida.

Table 24: Oxen use for sorghum and millet cultivation (% of farmers)

Crop operation	Sorghum			Finger Millet		
	Total	District		Total	District	
		Singida	Kondoa		Singida	Kondoa
Own or hired oxen (% households)						
Land preparation***	24	13	35	20	13	27
Compost/manure application	5	7	3	8	17	-
Planting and sowing	2	5	1	2	3	-
Weeding/herbicide application	1	2	-	2	4	-
Storage, including transport	3	3	3	4	3	4
Hired oxen (% oxen users)						
Land preparation	47	35	51	64	25	86
Compost/manure application	25	33	-	-	-	-
Planting and sowing	25	33	-	-	-	-
Weeding/herbicide application	100	100	-	-	-	-
Storage, including transport	38	50	25	50	50	100
Own oxen (% oxen users)						
Land preparation	53	65	49	46	75	4
Compost/manure application	75	67	100	100	100	-
Planting and sowing	75	33	100	100	100	-
Weeding/herbicide application	-	-	-	100	100	-
Storage, including transport	63	50	75	50	50	-

8.3 Gross margin analysis

Table 25 shows gross margins for the four main cereal crops. Sorghum and finger millet prices were collected during the survey and present farm gate prices. Maize and pearl millet prices were obtained from official sources and represent wholesale prices, which are usually higher than farm gate prices.

Table 25: Partial budgets for sorghum and millets, TSH/ha (2009-10)

Revenues and costs (Tsh/ha)	Sorghum			Finger millet			Pearl millet		
	Total	Singida	Kondoa	Total	Singida	Kondoa	Total	Singida	Kondoa
Yield (Kg/Ha)**	458	502	423	686	704	654	444	464	413
Price (TSh/Kg)	226	243	221	299	302	292	248	258	233
Revenues**	103,508	121,986	93,483	205,114	212,608	190,968	110,252	119,817	96,262
Material Costs									
Seed	3,769	3,927	3,643	4,754	4,242	5,638	3,713	3,606	3,869
Fertilizer	0	0	0	0	0	0	0	0	0
Manure	3,773	8,261	189	3,617	4,827	1,508	8,323	11,970	2,988
Pesticides	0	0	0	12	18	0	0	0	0
Sub-total	7,541	12,188	3,831	8,387	9,087	7,169	12,036	15,576	6,857
Cost of oxen:									
Family	6,284	4,174	8,472	4,545	4,817	534	4,545	4,817	534
Hired	5,572	2,248	8,818	6,323	1,606	11,471	6,323	1,606	11,471
Sub-total	11,856	6,422	17,290	10,868	6,422	12,004	10,868	6,422	12,004
Labor:									
Family (days)	207	217	203	227	209	199	227	209	199
Hired (days)	26.2	16.7	36.9	38.7	58.4	15.5	38.7	58.4	15.5
Sub-total (days)	233.9	234.2	239.7	265.8	267.7	214.8	265.8	267.7	214.8
Labor costs									
Family	709,200	651,600	696,300	769,800	729,900	670,200	769,800	729,900	670,200
Hired	92,700	50,100	129,300	145,200	225,600	71,100	145,200	225,600	71,100
Sub-total	801,900	701,700	825,600	915,000	955,500	741,300	915,000	955,500	741,300
Total costs:									
Cash-cost basis	105,813	64,536	141,949	159,910	236,293	89,740	163,559	242,782	89,428
Full-cost basis	821,297	720,310	846,721	934,255	971,009	760,473	937,904	977,498	760,161
Gross margins:									
Cash-cost basis	-2,305	57,450	-48,466	45,204	-23,685	101,228	-53,307	-122,965	6,834
Full-cost basis	-717,789	-598,324	-753,238	-729,141	-758,401	-569,505	-827,652	-857,681	-663,899

Finger millet offers the highest gross margin (196,727 TSh/ha), followed by maize (135,193 TSh/ha) and then pearl millet (98,217 TSh/ha) and sorghum (95,967 TSh/ha). On the side of revenues, this result is driven by both, yields and prices. Finger millet has the best yields

(686 kg/ha) and also the highest prices (299 TSh/kg). Maize prices (243 TSh/kg) rank third after pearl millet (248 TSh/kg), however, high yields (639 kg/ha) substitute for relatively low prices. Having in mind that maize prices used in the gross margin analysis are higher than farm gate prices, the gross margin for maize is too high. On the other hand, maize is the least labor intense crop, which reduces the gross margin in comparison with the other three crops, which are more labor intense. In the end, these two aspects might substitute each other, so that maize still ranks second and finger millet remains the most profitable crop. The price of pearl millet is also overestimated and it is more labor intense than maize, so that the bias in the gross margin analysis overestimates the gross margin from pearl millet. As sorghum is less labor intense and gross margins are estimated with farm gate prices, sorghum most likely would rank third instead of fourth when labour costs would be included and farm gate prices would be taken for all crops.

On the cost side, seeds and manure are the two main cost drivers for all crops. Other inputs are as good as not relevant. Total costs are highest for maize (19,536 TSh/ha), which is driven by high manure costs (7,884 TSh/ha) and in particular high by high seed costs (11,570 TSh/ha). Maize needs a lot of manure when cultivated on low quality soils and under agro ecological conditions, which are not favourable for maize. Moreover, many farmers cultivated improved maize varieties, which increase seed costs. In regard to manure costs, pearl millet ranks first (8,323 TSh/ha), followed by sorghum (3,773 TSh/ha) and finger millet (3,617 TSh/ha). Sorghum does not need much manure and figures for finger millet reveal that is cultivated on good soils. Elsewise, we would expect higher costs for manure. Discussions with farmers also revealed that maize and finger millet are, as far as possible, cultivated on better soils. In regard to seed costs, all three crops have substantially lower costs than maize.

At the district level, the pattern of gross margins follows the overall pattern, except that sorghum ranks third in both districts and pearl millet last. As for the whole sample, the difference between the two is small. Having in mind that pearl millet gross margins are overestimated, we can conclude that sorghum is on average more profitable than pearl millet. Interestingly, gross margins are for all crops except maize higher in Singida. Moreover, the difference between the gross margins for sorghum and for maize is small in Singida. When gross margins for maize are estimated with sorghum prices, which are farm gate prices, sorghum becomes more profitable than maize. This stressed that Singida is not very suitable for maize cultivation. On the revenue side, the higher gross margins of Singida are driven by higher prices as well as higher yields. Even for maize, prices are higher in Singida, but yields are lower, which leads to a lower gross margin than in Kondoa. Interesting differences on the cost side are the higher costs for manure for all crops in Singida. Thus, farmers tend to have poorer soils and agro ecological conditions are in general worse than in Kondoa. Except for maize, seed costs do not differ much.

One target of the promotion of improved sorghum varieties is to increase the revenues from sorghum production. To assess in how far the cultivation of improved varieties already contributes to this target, we have estimated gross margins for local and improved sorghum varieties, respectively. Results are displayed in Table 8.4. They show that there is currently no significant difference between local and improved varieties. Improved varieties offer higher yields (486 mt/ha versus 451 mt/ha), but prices are lower (211 TSh/kg versus 239 TSh/kg). Prices, however, cannot directly be linked to the variety. Discussions with farmers

revealed that prices are mainly determined by the time of selling the crop. Thus, improved and local varieties can fetch the same prices. If we would estimate gross margins with equal prices, improved varieties would offer higher gross margins due to higher yields. On the aspect of costs, one would expect higher costs for seeds and lower costs for pesticides for improved varieties. However, there is no big difference between seed costs and costs for local varieties are even higher (3,799 TSh/ha) than those for improved varieties (3,645 TSh/ha). This can be explained by the fact that most farmers use their own seed for which costs are estimated based on grain prices which are the same for local and improved varieties. Differences in pesticide costs could not be found as pesticides are for both varieties not used. Given the low use of inputs, it is difficult to provide conclusions about the effect of improved varieties on the costs of production. Thus the most important aspects remain yields, which are, as already said, higher for improved varieties.

Table 26: Partial budget for improved and local sorghum varieties Tsh/ha (2009-10)

Revenues and costs (Tsh/ha)	Total		Singida		Kondoa	
	Local	Improved	Local	Improved	Local	Improved
Yield (Kg/Ha)	451	486	493	682	404	464
Price (TSh/Kg)	239	211	251	211	230	211
Revenues	107,789	102,546	123,743	143,902	92,920	97,904
Material costs						
Seed	3,799	3,645	3,993	2,531	3,583	3,771
Fertilizer	0	0	8,650	0	0	0
Manure	4,690	11	0	0	270	12
Pesticides	0	0	0	0	0	0
Sub-total	8,489	3,655	12,643	2,531	3,853	3,783
Labor						
Family	207.4	207.4	217.2	217.2	203.0	203.0
Hired	26.2	26.2	16.7	16.7	36.9	36.9
Total	233.9	233.9	234.2	234.2	239.7	239.7
Gross Margin	99,300	98,891	111,100	141,371	89,067	94,121

One striking result from Table 26.1b is the big difference between local and improved varieties in regard to manure costs (4,690 TSh/ha for local versus 11 TSh/ha for improved varieties). Two reasons can be found for this. First, improved varieties are cultivated on better soils so that less manure is needed. Second, farmers are reluctant to put too much effort on improved varieties as they are still testing it.

8.4 Crop management practices (CMP) and post-harvest handling

Table 27 provides an overview about the CMPs applied to sorghum and millets. Each farmer selected one plot on which he cultivated either sorghum or millets and provided information for CMPs for this plot. The majority of farmers (66%) prepare their land with a hand hoe, followed by draught power (32%). As expected, only very few farmers use a tractor. At the district level, significantly more farmers in Kondoa use draught power. However, the use of

hand hoes is still the most common practice. Tractors are only used by farmers in Kondoa, suggesting that farming is less intensive in Singida Rural. Soil fertilization is based on compost/manure application. However, only 26% of the farmers apply compost or manure. In regard to sowing practices, row planting is the most common form, practices by 80% of the farmers. However, different spacing is found in row planting. The pattern is the same on the district and group level. One difference worthwhile mentioning is that the diffusion group in both districts has the lowest share of farmers following broadcasting.

Table 27: Crop management practices

	Sorghum			Finger millet		
Technology	Total	Singida	Kondoa	Total	Singida	Kondoa
Land preparation						
Hand hoe***	66	75	59	74	81	63
Draught power***	32	21	43	29	18	47
Tractor***	6	0	11	4	0	11
Zero tillage	9	12	6	9	9	9
Soil fertilisation						
Compost/manure application	26	28	25	23	24	20
Fertiliser application	1	2	1	0	1	0
Seed treatment***	5	2	9	2	1	3
Fungicide*	1	0	2	0	0	0
Other***	5	2	9	2	1	3
Sowing						
Broadcasting	20	23	16	23	27	18
Row Planting (60x20cm)	5	6	4			
Row Planting (90x30cm)	33	29	38			
Row Planting (30x15cm)				35	33	38
Row Planting (60x30cm)				9	11	7
Row Planting (other spacing)	42	42	42	33	29	37
Weeding						
One hand weeding**	11	6	15	11	8	15
Two or more hand weeding**	83	89	78	83	85	79
Hand weeding other	5	4	6	5	6	4
No weeding	1	1	1	1	1	2
Striga control						
Weeding/hand pulling	48	45	51	49	47	55
ISM	0	1	0	1	1	1
Control of birds						
Bird Scaring***	40	24	56			
Irrigation						
In situ water harvesting	28	30	26	25	27	20
Threshing						
Manual beating	96	97	96	99	99	98
Other***	9	14	5	8	10	5

Weeding is always done by hand and most farmers weed once or twice. The pattern is the same for both districts and all groups. Striga control is also mostly done by hand weeding. Only in Singida Rural, 1% of the farmers use integrated Striga management practices. Forty per cent of farmers do some form of bird scaring. Kondoa has a higher share of farmers who scare birds. Irrigation is done through *in situ* water harvesting, which is applied by 28% of the farmers. Almost all farmers thresh their sorghum manually. Soil fertilization is based on compost/manure application. However, only 26% of the farmers apply compost or manure. Seed are not usually treated with fungicide.

Crop management practices for finger millet are similar to those for sorghum. Hand hoeing is the most common practice for land preparation (74%), followed by draught power (29%). Very few farmers use a tractor (4%) and again, none of the farmers in Singida Rural prepares land with a tractor. Only 23 % of farmers apply compost/manure for soil fertilization. Seeds are also usually not treated. Seeds are mostly sown in rows, with different row spacing. . Only 23 % of farmers broadcast their sorghum seed. Weeding is done by hand and the majority of farmers (83 %) weed twice. Striga control is also mostly done by hand and applied by 49% of farmers. Only 1% applied integrated Striga management practices. *In situ* water harvesting for irrigation is applied by one fourth of the sample. Threshing is almost always done by manual beating.

Table 28 shows results for post-harvest handling of sorghum and millets. Farmers do not usually mix sorghum varieties, either at harvest or in storage. Since many farmers cultivate only one variety, these results are not surprising. Similarly, very few farmers (6 %) mix different varieties of finger millet after harvest or at storage... The results also show that it is more common to mix varieties in Singida (9%) than in Kondoa (2%).

Table 28: Post harvest handling of sorghum and finger millet

	Sorghum (N=256)			Finger millet (N=257)		
Post-harvest practice	Total	Singida	Kondoa	Total	Singida	Kondoa
Mixing varieties after harvest	2	4	0	6	9	2
Mixing varieties in storage	3	4	4	6	9	1

9. Crop utilization

Sorghum is a food crop. Of the 312 kg harvested on average by a household, 78% is consumed at home and only 14% is sold (Table 29). The rest is saved for seeds or used for other purposes. Households consumed a greater share of local (80 %) than improved sorghum varieties (68 %). The share of harvest consumed was significantly higher in Singida Rural, suggesting that commercialisation of sorghum is less advanced than in Kondoa. The share of improved varieties sold did not differ significantly between the districts. Finger millet is a cash crop. Of the average 565 kg harvested, 81 % is sold and only 10 % is consumed. Average harvests are higher in Singida (611kg/household) than in Kondoa (489kg/household), reflecting both the higher area planted and higher yields. The share of harvest used for home consumption is significantly higher in Kondoa (19%) than in Singida (5%).

Table 29: Utilization of sorghum and millet harvests

Utilization	Sorghum (N=256)									Millets (N=257)		
	All			Singida			Kondoa			All	Singida	Kondoa
	All	Local	Improved	All	Local	Improved	All	Local	Improved	Local	Local	Local
Harvested Means (kg)	312	324	271	373**	390	207	263	252	286	565	611	489
Total (mt)	96	77	19	51	48	3	45	29	16	147	98	49
Consumed												
% share***	78	80	68	88***	89	84	69	72	64	10	5	19
Total (mt)	75	62	13	45	43	3	31	21	10	14	5	9
Sold												
% share***	14	12	20	5***	5	2	21	19	24	81	88	69
Total (mt)	13	9	4	3	2	0.06	10	6	4	119	86	33
Seed saving (%)	7	7	8	7	6	14	7	7	7	5	5	5
Other (%)*	1	1	4	0*	0	0	3	2	5	4	2	7

9.1 Food security

We asked farmers in which months in an average year the harvested quantities of a respective crop are available for home consumption. We considered only the availability of the major food crops, maize and sorghum. In total, the average household can consume sorghum and maize from its own harvest for 8.7 months and 9.2 months, respectively. Assuming that farmers will not buy a cereal that they still have in stock, and nearing in mind that the harvest of sorghum is smaller than that of maize but lasts for almost the same time, the results confirm that farmers consume more maize than sorghum. This conclusion is also confirmed by the expenditure data for the two crops. Table three presents average and total annual expenditure on maize and sorghum for farmers who also cultivate the respective crop.

Table 30: Household food security

Crop	Share of harvest used for home consumption (%)	Household food security (No. of months)
Finger millet	6.5	-
Sorghum	47.5	8.6
Maize	49.9	9.2
Sorghum local	46.9	8.5
Sorghum improved	50.5	8.7

We only consider availability of the major food crops maize and sorghum. In total a household can consume sorghum and maize from its own harvest for 8.7 months and 9.2 months, respectively. First of all, this confirms our above statement that the annual share of harvest used for home consumption is higher, than our estimates five month after harvest. Under the assumption that farmers would not buy grain of a cereal that they have still in stock, and having in mind that harvested sorghum quantities are lower than those for maize, but last for almost the same time, the results also confirm that farmers consume more maize than sorghum. This conclusion is confirmed by the expenditure data for the two crops. Table three presents average and total annual expenditure on maize and sorghum for farmers who also cultivate the respective crop.

9.2 Marketing

9.2.1 Sellers

Of the 256 farmers cultivating sorghum, only 55 (21 %) sold sorghum in the 2009/10 cropping season. Sellers had larger farms and also significantly more land under sorghum cultivation. However, the difference is only significant at a 10% level. The average household sold 273 kg of sorghum. Of this, 89% is sold as grain, followed by local brews (11 %). The pattern is the same in both districts. Most of the finger millet (94%) is sold as grain, and only 6% is sold as flour (Table 31).

Of the 259 farmers growing finger millet, 190 (73%) sold some of their crop. There were no significant differences between sellers and non-sellers in either farm size or the area planted to finger millet. In contrast to sorghum, finger millet is not sold for local brews, though local brews from finger millet are popular in other regions of Tanzania. However, these results are in line with our results on consumption patterns, which showed that only small quantities of finger millet that are consumed at home are consumed as local brews.

Table 31: Specification of sold sorghum and millet products

Sales	Sorghum (N=55)			Millets (N=190)		
	Total	Singida	Kondoa	Total	Singida	Kondoa
Sold (kg/hh)	273	364	250	432	443	400
Sold total (mt)	15	4	11	82	58	24
Grain (%)	89	96	86	94	97	88
Brews (%)	11	4	14	6	3	12

9.2.2 Buyers

Middlemen, rural assemblers and villagers each account for about one-third of sorghum purchases. Villagers buy the highest share of improved varieties (43%), closely followed by middlemen (39%). In contrast, rural assemblers have the highest share of local varieties (45%), again closely followed by middlemen (36%). One reason for this pattern might be the demand by villagers for improved varieties as seeds. Villagers are almost always the most important buyer category for farmers, except for local varieties in Kondoa where middlemen are most important. Rural assemblers are as important as villagers in Singida, but rank third in Kondoa. This confirms our assumption that in cases where middlemen are available, rural assemblers become less important.

For finger millet, rural assemblers are the most important buyers (77% and 143 farmers), followed by villagers (15% and 28 farmers), middlemen (6% and 14 farmers) and finally urban traders (2% and 5 farmers). Three interesting differences compared to sorghum are worthwhile mentioning. Higher quantities of finger millet are sold, which allows enough business for several rural assemblers, and increasing the better availability of finger millet in other markets, reducing the need for middlemen.

Table 32: Buyers of sorghum and millet products (N=55)

Buyers	Sorghum (N=55)									Millets (N=190)		
	Total			Singida			Kondoa			Total	Singida	Kondoa
	All	Local	Improved	All	Local	Improved	All	Local	Improved	Local	Local	Local
Villagers % of quantity	27	19	43	20	21	0	29	18	44	15	11	23
No. of farmers	24	13	11	5	5	0	19	8	11	28	14	14
Rural assembler % of quantity	36	45	18	80	79	100	19	20	17	77	80	71
No. of farmers	16	11	5	6	5	1	10	6	4	143	110	39
Middlemen % of quantity	37	36	39	0	0	0	52	62	39	6	7	4
Farmers	15	12	3	0	0	0	15	12	3	14	4	4

9.3 Marketing channels

The majority of farmers (62%) sell sorghum at the farm gate, followed by the village market (38%). There are few village markets available in Singida, where 90% sell sorghum at the farm gate. Villagers and rural assemblers mostly buy at the farm gate, whereas middlemen mostly buy village markets. This again reflects the limitations of farmers who do not have access to village markets. Results are similar for finger millet. The most important place of selling (88%) is the farm gate followed by village markets (7%) and then town markets (5%), which was not mentioned for sorghum. Again, the farm gate is relatively more important in Singida (Table 33).

Table 33: Marketing channels for sorghum and finger millet (% farmers)

Market channel	Sorghum (N=55)			Finger millet (N=190)		
	Total	Singida	Kondoa	Total	Singida	Kondoa
Farm gate	62	90	55	88	90	83
Village market	38	10	45	7	6	10
Town market	0	0	0	5	4	7

9.4 Institutional arrangements with buyers

Table 34 shows the average number of buyers to whom households sell sorghum (including seasons other than 2010//11). Most farmers (48%) deal with only one buyer, but 17% always deal with the same buyer. When selling to middlemen, however, the majority of farmers (97%) deal with many buyers. For finger millet, the share of farmers dealing with only one buyer is higher (74 %) and again only a minority of farmers (19%) always deal with the same buyer. However, a higher number of farmers selling to middleman (44 %) always sell to the same buyer, suggesting longer-established market relationships.

Table 34: Marketing channels for sorghum and finger millet (% farmers)

Number of Buyers	Sorghum (n=88)				Finger millet (N=208)				
	All	Villager	Rural Assembler	Grain trader	All	Villager	Rural Assembler	Grain trader	Urban grain trader
One	48	41	67	0	74	55	77	81	100
Two to Six	14	27	8	7	10	27	5	19	0
Many	37	32	25	93	16	18	18	0	0
Same buyer	17	21	18	7	19	9	18	44	20

Only one of 88 farmers selling sorghum reported a contractual arrangement with a buyer. Typically, the farmer contacts the buyer (38%) or the buyer visits the village (36%). Very few farmers (2%) stated that they meet the buyer at the market. Similarly, 42 % of finger millet sellers contacted the buyer, or the buyer just passes the village (35%), or buyers contact the farmer (20%). Meeting the buyer at the market is, as expected, relevant for only a few farmers (3%).

9.5 Grades

Table 35 shows the criteria that buyers use to grade sorghum. Since more than one grading criterion could be named, figures do not add up to 100%. Colour (44%), 'free of stones' (40%) and size of the grain (34%) are the three main grading criteria used by buyers. The same three grading criteria exist for finger millet, but their relative importance differs. Free of stones is the most important criterion for finger millet (68%), followed by colour (32%) and then size (13%). For finger millet, the most important grading criterion for all buyers is free of stones, except for urban grain traders for whom colour is more important.

Table 35: Grading criteria of buyers (%)

Grading criteria	Sorghum (N=88)			Finger millet (N=208)		
	Total	Singida	Kondoa	Total	Singida	Kondoa
Colour	44	36	48	32	30	37
Size	34	43	30	13	17	3
No stones	40	68	27	68	69	66
Other	1	0	2	0	0	0

Table 36 shows the relative importance of grading criteria for different types of buyer. For villagers and rural assemblers buying sorghum, the two most important criteria are colour (56% and 51%, respectively) and 'free of stones' (34% and 54%, respectively). By contrast, the most important criterion for middlemen is grain size (94%).

Table 36: Grading criteria of buyers, by type of buyer (%)

Grading criteria	Sorghum (N=88)			Finger millet (N=208)			
	Villager	Rural assembler	Middlemen	Villager	Rural assembler	Middlemen	Urban grain trader
Colour	56	51	0	38	32	14	60
Size	28	21	93	9	13	21	0
No stones	34	54	7	56	71	79	40
Other	3	0	0	0	0	0	0

Farmers classified sorghum according to the colour. Most farmers (74%) sell white sorghum, followed by mixed (19%) and then red (7%). Local varieties follow this pattern. For improved varieties, only white (94%) and mixed (6%) grades exist. Since all improved varieties are white, mixed refers to different shades of white. In contrast to sorghum, the majority (71%) of farmers sell red finger millet, followed by mixed (23%) and white (6%). Some finger millet sellers (31 %) referred to the grain quality, which varied between good, medium and mixed (Table 37).

Table 37: Farmers' grades for sorghum and finger millet grain (%)

Grades	Sorghum (N=46)					Finger millet (N=115)		
	Total			Singida	Kondoa	Total	Singida	Kondoa
	All	Local	Improved					
White	74	60	94	67	76	6	2	16
Red	7	12	0	22	3	71	74	66
Mixed	19	28	6	11	21	23	24	18

9.6 Prices

Table 38 shows grain prices reported by the sample households. Results should be interpreted with caution because of the small sample sizes and because discussion with farmers revealed that prices are mostly determined by the time of selling which was not captured in our data.

The average selling price for sorghum was 226 TSh/kg. Prices for local varieties are higher (239 TSh/kg) than for improved varieties (211 Tsh/kg). Moreover sorghum prices were higher in Singida (243 TSh/kg) than in Kondoa (221 TSh/kg). Mixed coloured sorghum fetched the highest price (289 TSh/kg), followed by red and then white sorghum (253 TSh/kg and 213TSh/kg, respectively). Finger millet fetches a higher price than sorghum, selling for 299 TSh/kg. White finger millet fetches the highest price (319 TSh/kg), but price differences between the colours are very small (for the total sample, 311 TSh/kg for red and 315 TSh/kg for mixed).

Table 38: Sorghum and finger millet grain prices per grade (TSh/kg)

Grain Prices	Sorghum (N=37)					Finger millet (N=177)		
	Total			Singida	Kondoa	Total	Singida	Kondoa
	All	Local	Improved					
All	226	239	211	243	221	299	302	292
White	213	219	208	222	211	319	350	307
Red	253	253	-	279	200	311	312	306
Mixed	289	285	310	300	287	315	315	316

Note: Not all finger millet sellers reported colour, so mean prices for the different colours do not add up the total mean price.

Table 39 shows that middlemen pay the highest prices. Middlemen cut out at least one trader and can therefore pay higher prices. The same holds true for villagers, who buy directly from farmers. As the first in a long line of traders, rural assemblers pay the lowest prices. All buyers pay higher prices for local than for improved varieties. Rural assemblers pay higher prices for red coloured varieties. By contrast, price differences for finger millet are small. Thus, price differences found for sorghum might rather be caused by the small sample size than by real differences.

Sorghum and finger millet grain prices per grade (TSh/kg)

Table 39: Grain prices, by type of buyer (TSh/kg)

Grain Type	Sorghum (N=37)			Finger millet (N=177)			
	Villager	Rural assembler	Middleman	Villager	Rural assembler	Middleman	Urban grain trader
All	224	202	331	307	298	305	293
Local	225	220	339				
Improved	224	166	310				
White	224	198	290	321	317	-	-
Red	204	350	-	305	313	308	305
Mixed	259	180	346	317	318	-	256

9.7 Marketing constraints

For sorghum sellers, the most important constraint is low prices (67%), followed by lack of information on markets (31%). Low prices are a bigger problem in Kondoa, where prices were lowest. Similarly, low price (68%) is the most important constraint for marketing finger millet. The results for finger millet suggest that market places are known, but far away. Finger millet is usually sold at the farm gate, whereas sorghum is usually sold at the village market. Finger millet farmers who do not wish to sell at the farm gate might need to travel to more distant markets (Table 40).

Table 40: Constraints in marketing sorghum and finger millet (%)

Marketing constraints	Sorghum (N=256)			Finger millet (N=257)		
	Total	Singida	Kondoa	Total	Singida	Kondoa
Low price	67	54	73	68	71	62
Market places not known	31	25	33	23	19	30
Buyer fixes price	19	11	22	24	21	30
Unknown buyer preferences	17	11	19	17	15	22
Long distance	9	7	10	16	14	20
Lack of price information	0	0	0	11	13	7
Other	2	4	2	4	2	7

10. Gender

10.1 Gender-related differences

Of the 360 households in the sample, 32% were headed by women[7]. Significant differences were found between male- and female-headed households (FHHs). FHHs have a smaller mean household size and consequently fewer economically active members. A significantly higher share of FHHs has economically active members with no or only basic education, and a correspondingly lower share with secondary or higher education. Interestingly, the picture is different when it comes to the education of the household head. Female household heads are more likely to be literate, and there is no significant difference in other levels of education between male and female heads of household. One explanation might be that when women are widowed, other family members only allow women to become household head if their level of education is above average.

Female-headed households have less than half of the land available and cultivate half the land of their male counterparts. The total value of assets owned by FHHs is also lower. Fewer FHHs own a bicycle, radio/cassette player, or mobile phone, three assets that are important for mobility and access to information. A higher share of FHHs earns income from non-farm sources, suggesting they may have a greater need for such income because they cultivate less land. However, there is no significant difference in the mean income from non-farm sources, suggesting that FHHs are engaged in activities with lower value that require limited skills. FHHs have a higher demand for credit, but the amount borrowed is lower than that for households headed by men, suggesting that FHHs are perceived as a higher credit risk. Male-headed households invest primarily in agriculture whereas FHHs split their investments equally between agriculture and non-agriculture, suggesting that FHHs may have different investment priorities. Fewer FHHs own livestock and the total value of livestock they own is also lower. Although total expenditure did not differ significantly, FHHs spent more on health and insurance, information and communication, but a lower share of income on education, which may reflect financial hardship and a greater need for their children to be economically active (Table 41).

[7] Female headed households (FHHs) include both de jure and de fact FHHs. In the sample, in 25% of the FHHs, women are living together with their husband. In the other 75%, women are widows, divorced or were never married.

Table 41: Gender differences for key variables, by sex of household head (N=360)

Category	Variable	Total	Head of household	
			Male	Female
Household	Household size (no.)***	6.5	6.6	5.3
	No. of economically active members**	3.3	3.3	2.7
Land assets	Mean cultivated land (ha)***	2.9	3	1.5
	Mean cultivated land per capita (ha)*	0.5	0.5	0.3
Human assets	Illiterate household head (% hh)**	4.4	12.5	3.7
	Experience in own farming activities (years) *	22.3	22.6	19.2
Income	Household earns non-farm income (%) **	47	45	66
	Mean amount of credit borrowed (000 Tsh.)***	229	263	80
	Mean amount of credit invested in non-agriculture (000 Tsh.)**	103	4	20
Livestock	Livestock Value (000 Tsh.)***	592	629	214
Adoption	Knowing at least one local variety**	92	94	81
	Ever planted a local variety*	91	92	82
	Cultivation of local sorghum varieties 2009/10**	85	87	69
	Cultivation of improved sorghum varieties 2009/10**	27	25	46
	Source for variety information is extension officer*	35	34	45
Crop production	Finger Millet yield (mt/ha)*	0.68	0.69	0.5
Marketing	Share of sorghum harvest consumed as pombe*	1	9	0
	Share of finger millet harvest consumed at home***	10	9	25
	Share of finger millet harvest sold*	81	83	66
	Finger millet price in TSh/kg**	299	303	271
	Number of finger millet buyers a farmer deals with*	2.6	2.7	1.1
	Farmer contacts buyer to sell finger millet***	42	39	80

Notes: ***, **, * differences are significant at the 1%, 5%, and 10% level, respectively.

Although there was no difference between the share of FHHs cultivating sorghum or finger millet, a lower share (81 %) of FHHs knew at least one local sorghum variety, and a lower share of FHHs had ever planted the local variety they knew. Interestingly, in the 20010/11 planting season, the share of FHHs that planted an improved variety (46%) was higher, suggesting that FHHs were more likely cultivate improved varieties. A higher share of FHHs has the extension officer as a source of variety information. Female headed households have lower yields of finger millet, but the difference for sorghum was not significant. As yields fluctuate between years and our yield data derives from only one year, results should be treated with caution.

Female headed households used less sorghum for *pombe*, and a higher share of their finger millet harvest was consumed rather than sold. Female headed households also received lower prices for finger millet, but prices are determined by many other factors. Female headed households deal with fewer buyers and a higher share of FHHs contacts the buyer themselves.

10.2 Decision-making

Results for responsibilities in the households are shown in Table 42. For issues concerning the farm like land and livestock as well as farm inputs and also storage and marketing, both men and women, are usually responsible. In some cases (farm equipment or own labour), the share of households where the man is responsible and the share of households where the woman is responsible are the same. In other cases, like land, livestock and hired labour and marketing, the share of households where men are responsible is higher, whereas for fertilizer and pesticides, the share of households where women are responsible is higher. The pattern changes for post-harvest activities like seed cleaning, milling, and other post-harvest and processing activities. In most households, women have the primary responsibility for these activities. For other decisions like the education of children, migration or children's marriage, men and women usually share the responsibility. However, the picture is different for cash income, where decision-making is controlled either by men or by women.

Table 42: Decision-making, by Gender (%)

Resource	Men	Women	Both
Land	12	7	81
Livestock	13	5	82
Farm equipment	8	6	86
Household items	8	8	84
Investment	6	8	86
Seeds	7	8	85
Fertilizer	7	14	79
Pesticides	0	14	86
Own labor	7	7	86
Hired labor	14	9	77
Crop production	4	8	87
Storage	5	8	87
Marketing	18	10	71
Threshing	20	14	66
Seed cleaning	5	62	33
Milling	6	67	27
Other processing	5	50	44
Other post-harvest	5	43	52
HH maintenance	33	20	47
Education of children	23	9	68
Migration	21	7	71
Cash income - farm	9	10	81
Cash income - non-farm	12	10	77

Children's marriage	18	7	75

10.3 Participation in crop operations

Table 43 shows the share of households that use male, female and/or child labour for different crop operations. For a number of activities, (land preparation, compost/manure application, planting) most households use both male and female household members. However, in most households, seed treatment and seed cleaning and purification were done exclusively by women. Only one activity (storage and transport) was dominated by men. Men also dominated bird-scaring for finger millet (55%).

Table 43: Participation in crop operations, by sex (%)

Participation	Sorghum				Finger millet			
	Women	Men	Both	All	Women	Men	Both	All
Land preparation	6	9	42	37	2	16	51	29
Compost/manuring	3	17	40	38	9	27	36	27
Seed treatment	77	18	-	5	-	-	-	-
Planting	8	7	49	30	5	13	48	29
Weeding/herbicide	6	9	46	32	7	7	49	28
Scaring birds, pigs	11	23	27	34	-	55	27	18
Harvesting	8	7	45	35	6	11	48	28
Threshing	11	20	41	20	5	32	34	15
Seed cleaning	54	17	13	9	51	16	14	7
Transport and storage	9	43	27	13	4	51	29	10

Table 44 presents information of the number of labor-days disaggregated by sex. In general, those crop operations for which the highest share of households have used both men and women (land preparation, weeding, and threshing) also show a relatively equal distribution of labor-days by sex. The difference is bigger in the activities dominated by women: seed treatment and seed cleaning. The same holds true for the male dominated activity storage and transport. Even though children help in all activities, they do not work many days. Results for finger millet are similar to those for sorghum.

Table 44: Labor-days for crop operations, by Gender (days/ha)

Activity	Sorghum (n=256)				Finger millet (n=257)			
Crop operation	Total	Female	Male	Child	Total	Female	Male	Child
Land preparation	22.3	9.4	10.5	2.4	24.9	10.3	13.2	1.2
Compost/manure application	19.7	7	10.1	2.6	11.8	4.2	5.3	2.2
Seed treatment	2.7	1.9	0.6	0.2				
Planting and sowing	8.4	3.4	3.9	1.1	11.2	4.5	5.3	1
Weeding/herbicide application	21.9	9.8	9.4	2.7	24.1	10.4	10.7	1.6
Watching (birds, pigs)	85.9	32.1	41.8	12	108.7	19.8	86.5	2.5
Harvesting	19.1	8.7	7.7	2.7	27.3	11.9	11.8	2.3
Threshing	5.8	2.2	2.8	0.8	7.3	2.3	3.8	0.6

Seed cleaning, purification	5.1	3.5	1	0.6	5.7	3.5	1.2	0.5
Storage, including transport	5.5	1.6	3.4	0.5	4.6	1.3	2.6	0.5
Total	196.4	79.6	91.2	25.6	225.6	68.2	140.4	12.4

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Appendices;

Appendix a: Summary of key Household characteristics

Variable	Total (n =360)	Singida (n=180)	Kondoa (n=180)
Household demographics and assets			
Female headed households (%)	9	7	11
Age of head of household (yrs)	45	43	47
Heads with upper primary education (%)	79	86	69
Mean available land (ha)	5.0	3.7	6.3
Mean cultivated land (ha)	2.9	2.6	3.2
Value of farm assets (000 Tsh)	237	251	224
Households owning mobile phone (%)	49	53	46
Households with non-farm income (%)	47	53	40
Non-farm income (000 Tsh)	464	471	455
Value of livestock (000 Tsh)	592	650	532
Per capita household expenditure (Tsh/capita/year)	368	327	409
Per capita household expenditure (Tsh/capita/year)	247	219	274
Households applying for formal credit (%)	16	19	13
Access to agricultural information			
Participation in technology transfer (%)	15	17	14
Households aware of collective action in village (%)	14	17	13
Participation in farmer field days (%)	14	17	10
Own plot PVS	16	10	24

Appendix b: Summary of key Crop production Characteristics

Variable	Total (n =360)	Singida (n=180)	Kondoa (n=180)
Crop production			
Households cultivating finger millet (%)	71	87	56
Households cultivating sorghum (%)	71	70	72
Households cultivating maize (%)	69	53	85
Sorghum plots planted with own seed (%)	84	80	87
Finger millet plots planted with own seed (%)	81	83	77
Pearl millet plots planted with own seed (%)	92	94	89
Maize plots planted with own seed (%)	84	83	85
Sorghum yield, all varieties (t/ha)	0.46	0.50	0.43
Sorghum yield, local varieties (t/ha)	0.45	0.48	0.41
Sorghum yield, improved varieties (t/ha)	0.48	0.50	0.47
Finger millet yield (t/ha)	0.68	0.70	0.66
Pearl millet yield (t/ha)	0.45	0.47	0.42
Maize yield (t/ha)	0.63	0.58	0.67
Growers applying manure to sorghum (%)	26	28	25
Growers applying manure to millets (%)	23	24	20
Growers applying fertiliser to sorghum (%)	1	2	1
Growers applying fertiliser to millets (%)	0	1	0
Sorghum Gross Margin (Tsh ha^{-1})	108,330	120,478	97,092
Finger Millet Gross Margin (Tsh ha^{-1})	203,193	209,464	192,397
Pearl Millet Gross Margin (Tsh ha^{-1})	108,566	119,632	93,197
Maize Gross Margin (Tsh ha^{-1})	145,452	143,122	146,934
Sorghum production and utilization			
Knowledge of at least one improved variety (%)	56	31	49
Adoption of improved sorghum varieties (%)	27	11	42
Qty. sorghum sold (%)	14	5	21
Qty. sorghum sold at farmgate (%)	62	90	55
Finger millet production and utilization			
Qty. finger millet sold (%)	81	88	69
Qty .finger millet sold at farmgate (%)	88	90	83
Marketing			
Farmers reporting low price as market constraint for sorghum (%)	40	100	83
Farmers reporting low price as market constraint for finger millet (%)	68	71	62
Membership of Producer Marketing Group (%)	4	8	1