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RESEARCH REPORT

Adami Tulu Mixed Farming Zone Diagnostic Survey

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Zone
Diagnostic Survey**

Ethiopian Institute of Agricultural
Research General
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Summary

The need for participation of farmers in the research process was felt when recommendation from research centers were not transferred to farmers. The purposes of this report are to understand and describe crop and animal production practices, prioritized major constraints and suggest possible technological intervention in Adami Tulu area.

Secondary data and exploratory survey were conducted between August-October, 1988. About 50 farmers from 10 peasant Associations were interviewed and their fields were visited. The verification (formal) survey was conducted in March, 1990.

A multistage sampling procedure was used to select sample farmers. All non-accessible service cooperatives were omitted purposely. A questionnaire was designed and administered to 50 randomly selected farmers.

The survey area is 130-150 km, south of Addis Abeba. The altitude ranges between 1600m to 1860m. The average annual maximum temperature is 25°C-27°C and the minimum is 12°C-16°C. The average annual rainfall is 736-782mm; July receiving the highest. The soil is sandy to clay loam and the pH is 6.5-9.1.

The study area covers about 18200 households and the people are mostly muslim. There is one asphalt road that passes through Meki-Ziway and the feeder road network is fair. About 40% of the farmers do not receive intensive extension services. The average extension agent farmer ratio is 1:1658.

Farmers grow many maize varieties to avoid risk and to meet different objectives. These include Limat, Katumani, A-511 and Sheye. When ever there is delay of rainfall in March-April. Haricot bean and tef areas increase at the expense of maize.

Early maturity is the major criteria used by 80% of maize growers. High yield and quality for making injera are also considered as important criteria. Farmers require early-maturing varieties for two reasons (1) unreliability of rainfall during early and late in the season and (2) to shorten food shortage period by using green cobs. Higher yield was considered the most important criteria in selecting sorghum varieties. Katumani among maize varieties and Gebabe among sorghum varieties are most preferred.

On average, a family has 3.4 ha of which 3.0 ha is cultivated, a family size of 8 persons with 1.6 persons working full time on farm, and 2.2 oxen. July-August is the most busy period.

The most important crops grown in the area include maize, haricot bean and tef. Haricot bean is the major cash crop. Tef and maize are the second and the third. Other less important crops include Sorghum, Wheat, and Barley. Farmers allocate the most fertile land to maize. Tef, barley and wheat are grown on soils of medium fertility level due to lodging and weed problem. Haricot bean is grown on least fertile soils so that weed infestation will be low. Only 20% of the farmers followed a portion of their farm in 1989 cropping season.

Land preparation for maize is started in March. On average, maize fields are plowed 4 times. The average seed rate is about 89 kg ha⁻¹ which is much higher than the recommended seed rate (25-30 kg ha⁻¹) in order to reduce risk of poor seedling emergence that may arise due to moisture stress. Soil fertility, weed intensity and seed quality also affect seed rate. The main reason for not planting in rows is shortage of labor. Oxen cultivation — "Shilshallo" — is done 4-5 weeks after planting in July. About half of the farmers thin maize to get livestock feed and to reduce plant population. About 35% of the farmers weed maize once and 63% twice. Only 12% of the sample farmers used chemical fertilizer on maize in 1989 cropping season. Stalk borer is the major pest

on maize. Maize is harvested in October-November and the average maize yield in normal years is about 1400 kg ha⁻¹.

The most common haricot bean variety is mexican-142. Haricot bean fields are plowed 2-3 times. Haricot bean is planted from end of June to mid-July. The average seeding rate is about 102 kg ha⁻¹. This rate is higher than the recommended seeding rate (70 kg ha⁻¹) as a substitute for weeding. Haricot bean is not weeded due to labor shortage. It is harvested in October and the average yield in normal years is 900 kg ha⁻¹.

Red Tef variety is the most common and it is grown by 64% of the sample farmers and covers about 13% of the total cultivated land. Tef fields are plowed 3-4 times. The average seeding rate is 35 kg ha⁻¹ and planting is done in July. Thirty percent of the sample farmers used fertilizer in 1989 cropping season. About 57% of the sample farmers weeded their tef once and 30% did not. Few farmers used herbicides on Tef. Tef is harvested in October-November and the average yield in good year is about 1100 kg ha⁻¹.

The most common sorghum variety grown in the survey area is Gababe. The average number of plowing sorghum field is 3 times. On average farmers use a seed rate of 17 kg ha⁻¹. Oxen cultivation is done 5-6 weeks after planting and it is supplemented with hand weeding, 10-15 days later. Almost all of the farmers do not use fertilizer on sorghum fields. Quelea bird is reported as a pressing problem in sorghum production.

Wheat is usually planted in early July with an average seed rate of 126 kg ha⁻¹. Wheat is weeded once and about half of the sample farmers used fertilizer in 1989 cropping season. Barley is planted in late June with an average seeding rate of 188 kg ha⁻¹. Only one-fifth of the sample farmers used fertilizer on barley.

About 68% of the sample farmers have at least a pair of oxen and 84% at least own a cow. The survey area seems better support goats than sheep. Cows give birth in February-March when management of the dam is not convenient. Cows are milked twice a day for 6-8 months. Feed is commonly scarce from March to end of June. Some farmers are transhumans; "godantu". Diseases and drought are serious problems of livestock production.

Due to erratic nature of rain fall, long cycled crops and varieties are substituted by short cycled crops and varieties. Hararge and sheye varieties are being replaced by Katumani and Militia varieties. Relish crops such as field pea, lentil, and faba bean are decreasing in importance due to severe disease and pest attack. Livestock number is declining primarily due to drought and limited field availability. Goats are increasing since they can feed on shrubs.

Environmental constraints (early and late season stresses), dry season livestock feed shortage, stalk borer on maize and sorghum, rust on haricot bean and wheat, birds on sorghum, weeds on Tef, low soil fertility and animal disease are the major constraints of crop and livestock production in the study area. The following measures are suggested to overcome the above mentioned constraints. These include:

- Screening short-cycled and/or drought tolerant crops or varieties.
- Moisture conservation strategies (tied ridging).
- Introduction of forage shrubs as a hedge and alley cropping.
- Screening pest and disease tolerant varieties
- Screening herbicides at least for one of the major crops.
- Agroforestry and fertilizer response trials.

Introduction

The need for participation of farmers in the research process was felt when recommendation from research centers were not transferred to farmers. Technologies (Yilma, 1987) generated from research has not for the most part been appropriate due to lack of knowledge of the production environment. Collaborative input for assessing result using criteria that are important to farmers is important since statistically significant differences whether on-station or on-farm do not necessarily assure adoption. Results ought to be judged superior by some criteria acceptable to farmers.

Several years have passed since the Institute of Agricultural Research (IAR) has started to use survey information in the designing of new technologies and setting up priorities. Some instances include the development of early maturing maize varieties for Bako area, bird tolerant sorghum varieties and ridge-tier for Nazret area, and reconsideration of weeding recommendations on maize and haricot bean in Bako and Nazret areas, respectively, to mention a few.

This survey is also an extension off such diagnosis for research direction and formulation in the Adami Tulu area. It is hoped that this report will give an insight for researchers and policy makers in understanding the resource endowment, environmental and biological circumstances and constraints that the farmers in Adami Tulu area are living with.

The objectives of this report were to:

- Understand and describe small farmers' crop and animal production practices.
- Identify and prioritized the major constraints that limit crop and animal productivity and suggest possible technological interventions.
- Provide information for center based disciplines so that they can incorporate in designing of technologies.

Methodology

Secondary data were collected from relevant sources such as Ministry of Agriculture (MOA), Ministry of Domestic Trade and Agricultural Marketing Corporation (AMC). The survey was conducted in Adami Tulu area, south shewa administrative region. The exploratory (informal) survey¹ was conducted between August-October, 1988 when the crops were on the field. About 50 farmers from 1 peasant Associations (PAs) were interviewed and their fields were visited.

The informal survey was less comprehensive than most of the informal surveys done by the Department of Agricultural Economics. One of the objectives of the verification (formal) survey² was to fill in the gaps in the informal survey. Moreover, it was designed to verify and quantify some of the information obtained from the informal survey. The formal survey was conducted in March, 1990. The informal survey indicated that the survey area is fairly homogeneous and the Ministry of Agriculture staff also supported the idea of homogeneity. Thus it was considered as one recommendation domain³. However, cross tabulations in the verification survey indicated that the Meki zone and the Ziway zone are distinct in terms of major parameters. Thus information from grain marketing survey (60 farmers) was also used to delineate recommendation domains. The two recommendation domains identified are the Meki zone (RD I) and the Ziway zone (RD II). The farmers in RD I have less maize and haricot bean fields than those farmers in RD II. These are significant at 0.01 and at 0.05 probability levels, respectively (Table 1). Besides, farmers in RD I grow more sorghum, wheat and barley than those farmers in RD II. Farmers in RD II have more family members and own more livestock than those farmers in RD I.

A multi stage sampling procedure was used to select sample farmers. All none accessible service cooperatives (SCs) were omitted purposely. Service Cooperatives were not selected on purely random basis. It was purposely done to cover different directions of the survey area. Three accessible SCs in the Meki area (2 SCs in the north and 1 SCs in the south) and 2 SCs in the Ziway area (1 SC in the south and the other in the north) were randomly selected. Two PAs were randomly selected from each sample SC and 15 farmers from each peasant association (PA). This will make the total number of sample farmers 50. The sampling scheme was: Adami Tulu area; 21 SCs — 16 accessible SCs (purposive) and 5 SCs (purposive + random) — 10 PAs (2 PAs per SC at random), and Sample farmers (5 farmers per PA at random)

A questionnaire was designed based on the exploratory survey. Criteria for omitting or shifting a variable and make group interviews in each sample PAs were also developed. Some questions were omitted based on the following criteria:

- Questions for which secondary data were already available: This involved questions about the price of crops. AMC, Ministry of Domestic trade, and Relief and Rehabilitation

¹ An exploratory (informal) survey is a field study conducted by researchers in which informal farmer interviews, direct observations, and secondary information are used to develop an understanding of a farming system for planning experimentation and other interventions

² Verification (formal) survey is a survey of randomly chosen farmers who are interviewed using a written questionnaire in order to provide a uniform set of data.

³ A recommendation domain is a roughly homogenous group of farmers with similar constraints for whom we can make more or less similar recommendations (Byerlee, 1980).

- Questions which farmers were unable to answer: An example was a question asking farmers the proportion of each crop they kept for food and the proportion they sold.
- Questions for which we expected fairly constant responses, e.g, a question asking which grain the farmer prefer for making injera.

Some questions were shifted to an informal survey based on the following criteria: (1) very general questions such as factors affecting seed rates of major crops; (2) questions for which an association with another questions was not needed, for example, crop calendar; (3) questions which were very sensitive and/or were too difficult to answer, for example, income related questions.

Through the process of omitting some questions and shifting others to informal survey, interview time declined to about 1 hour per interview. A senior farming systems research adviser and one research officer participated in sampling, questionnaire pretesting, omitting and shifting some of the variables at least on the first day of the field work. We used one junior research officer and three technical assistants with many years of experience in farm surveys as enumerators. One researcher was doing the group interview, supervising the enumerators and checking questionnaires and some times completing questionnaires on full time basis. With this arrangement the group was visiting 2 PAs per day completing 10 questionnaires and 2 group interviews per day.

Table 1. Comparison of major parameters for Meki and Ziway areas

Parameters	Meki N=60	Ziway N=50	P
Total farm size (ha)	3.1	3.3	0.717
Total cultivated land (ha)	2.9	2.9	0.873
Maize area (ha)	1.1 (100%)	1.4 (100%)	0.009
Katumani area (ha)	0.2 (12%)	0.4 (38%)	0.038
Limat area (ha)	0.5 (42%)	0.9 (38)	0.025
Sheye area (ha)	0.2 (17%)	0.3 (18%)	0.313
Haricot bean area (ha)	0.63 (65%)	0.86 (98%)	0.043
Tef area (ha)	0.56 (85%)	0.46 (58%)	0.251
Sorghum area (ha)	0.21 (38%)	0.06 (12%)	0.003
Wheat area (ha)	0.22 (38%)	0.08 (12%)	0.016
Barley area (ha)	0.08 (25%)	0.02 (8%)	0.006
family size	7.3	9.0	0.039
Permanent labor	1.6	1.7	0.570
Oxen	1.6 (68%)	2.2 (90%)	0.053
Cows	2.9 (78%)	5.0 (86%)	0.079
Calves	2.0 (68%)	2.9 (74%)	0.165
Heifers	1.2 (43%)	2.3 (70%)	0.011
Bulls	0.5 (25%)	1.3 (54%)	0.009
Goats	1.2 (32%)	3.1 (62%)	0.008
Sheep	0.9 (32%)	0.3 (12%)	0.015
Donkey	0.6 (42%)	0.7 (42%)	0.400

Farmer Circumstances

Natural factors

Location and topography

The survey area is about 130 to 150 km south of Addis Abeba. It is located between 8° to 10° N latitude and 30° 48'E to 30° 55'E longitude. The altitude ranges between 1600 m to 1860 m above sea level. The land scape is flat with some hills. Figure 1 shows the map of the study area.

Climate

The average annual maximum temperature for Ziway is 25-27°C and 26.6°C for Adamitulu. The mean annual minimum temperature is 12°-16°C for Adamitulu and 13.4°C for Ziway. The maximum temperature is recorded during March-May and the minimum is during November-December.

The nature of the rainfall is erratic and unreliable. The mean annual rainfall in the study area is 735-782 mm; July receiving the highest . Analysis of the three lowest rainfall years out of ten indicated that July-August is the only reliable period for crop production in the three locations (Meki, Ziway and Adamitulu). The average wind speed is 4.09-7.69 kg hr⁻¹. This has no significant impact on crop production (planning Office or Central Zone, 1987). However, wind break is necessary. The report also indicated that the radiation is suitable for crop production (495 calorie/cm²) and the annual mean evaporation on Lake Ziway is 200 mm which is higher than the annual rainfall indicating the need for irrigation.

Soils

According to the studies made by Water Resources Development Authority (WRDA), the pH value of the soil in the study area is 6.5-9.1, that is medium alkaline (Table 2). The soil is sandy to clay loam. The soil has low phosphorus, potash, magnesium and sodium content. On the other hand, it has high calcium content. The electric conductivity (salinity) of the soil medium and its cation exchange capacity is high.

Water resources

Ground water has high salt and fluoride content. Thus it is not suitable for irrigation. The electrical conductivity (salinity) of Lake Ziway is low and the pH is 7.2. Thus, the lake is suitable for irrigation (WRDA, 1987). The report also indicated that although the water from Meki river is suitable for irrigation, it is unreliable in the dry season and requires high cost to collect the amount of water required for irrigation.



Scale 1:500 000

Source: Ethioplan Mapping Agency

Figure 1: Map of Adomitulu Awraja

Key



Administrative

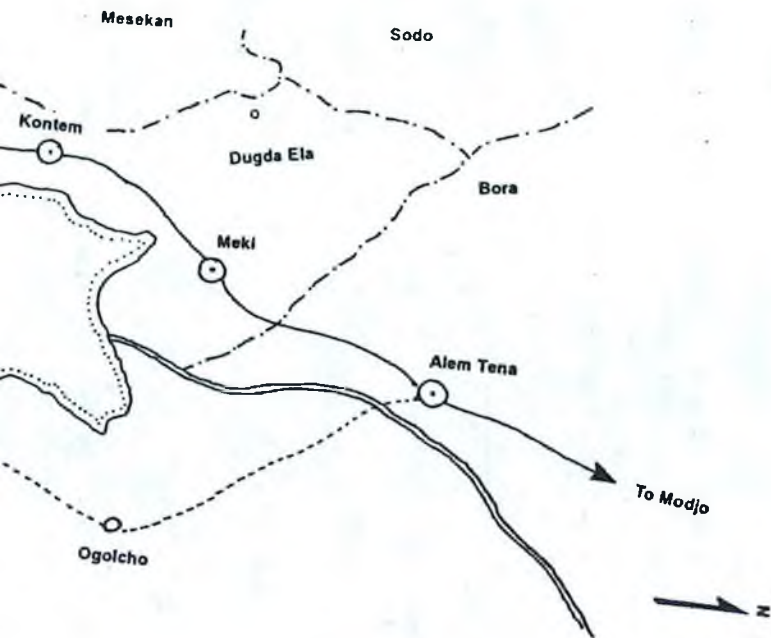
Region Boundary

Awraja Boundary

All Weather Road

Dry Weather Road

Towns



Vegetation

There are some ruminant vegetation. These include: *Ficus* spp., *Accacia* spp., and *Croton macrostachys hochst. ex*, ("*Bissana*").

Table 2. Meki Ziway irrigation project soil study summary.

Parameter	Unit	Ranges	Comment
Acidity	pH	6.50-9.10	medium alkaline
Phosphorus	p.p.m	5.60-71.20	very low
Potassium	Me/100 g dry soil	0.04-1.64	low
Sodium	Me 100 g dry soil	0.03-0.52	low
Magnesium	Me/100 g dry soil	0.48-0.840	low
Calcium	Me/100 g dry soil	4.80-41.52	high
Carbon	%	0.11-6.34	medium
Cation-exchange Capacity (CEC)	CEC	12.00-53.50	high
Nitrogen	%	0.10-4.34	medium
Electric conductivity	EC	124-4826	medium

Source: WRDA, Lake Ziway irrigation project soil survey report, March 1985, In Meki-Ziway irrigation development project document, February 1987.

Socio-Economic Factors

Population

The study area covers about 18241 households (MOA, Adamitulu office). The total population is about 153,325 and the average population density is about 70.2 persons/km² (CSA, 1990). The people are mostly muslims with few christians. The dominant language is Oromigna.

Settlement and infrastructure

The farmers are collectivized in to villages. These scheme band the following consequences:

- Coffee production has declined since it was grown as a garden crop in the previous village.
- Maize yield has declined due to shortage of manure or transporting it.
- Livestock production has declined because the new settlement areas do not allow keeping livestock
- Beekeeping has been reduced as garden crops were left.

The study area has an asphalt road passing through Ziway, The feeder road network is fair. There are 18 modern stores owned by SCs, 14 schools, one clinic and two health centers in the study area.

Institutional factors

Farmer organizations

There are 21 Service Cooperatives in Adami Tulu area with a total number of 16,435 farmers of which 5% are women. The main function of the service cooperative is to deliver consumer goods and agricultural inputs to the farmers from 1984-1990 they distributed consumer goods which worth 3.2 million Birr and fertilizer which worth about 1.75 million Birr. SCs also used to act as grain assembling agent for AMC. From 1982-1990, the SCs assembled about 15,900 t grain and made a profit of 512,404 Birr. Beside, SCs give tractor and threshing service to the farmers on rent basis. There were 19 producer cooperatives until March, 1990. This number has declined to one in 1991.

Extension

There are 11 Development Agents of the Ministry of Agriculture in Adamitulu. These agents have organized 80 farmer groups with 480 contact farmers and 10,371 followers. About 7390 farmers (about 40% of the farmers in the region) do not receive intensive extension services. Most of these farmers live in surplus producing areas. The average extension agent to farmer ratio is 1:1658.

Table 3 shows the total quantity of fertilizer distributed since 1987. The quantity of fertilizer distributed has declined since 1988 because the service cooperative composed of peasant associations which did not repay their debt could not receive fertilizer in the coming season. However, in 1990 the peasant association which repaid their debt were allowed to buy fertilizer on cash. Because of the problem mentioned there was no fertilizer shortage. Thus surplus and non surplus producing regions were equally treated.

The Ministry of Agriculture also distributes improved variety through service cooperatives. The common improved variety distributed is A-511. Katumani is preferred by few farmers because it has been introduced in to the area very recently and most do not now the advantage of katumani compared to others. Even the MOA was pushing A-511 since there was enough rain in march-April. As early maturity is the main criterion for choosing a variety, Katumani has a great probability for adoption.

Table 3. Quantity of fertilizer distributed from 1987-1990

Year	DAP (tones)	DAP price Birr t ⁻¹	Urea tons	Urea price
1987	725.3	796.5	-	-
1988	255.3	814.0	-	-
1989	369.6	983.8	-	-
1990	275.5	882.0	20.0	715.0

Source: MOA, Adami Tulu area office

The major problem in the distribution of improved seeds is the long chain from Institute of Agricultural Research to farmers. Institute of Agricultural Research (IAR) ⇒ Ethiopian Seed

Corporation (ESC) ⇒ Agricultural Inputs Supply Corporation (AISCO) ⇒ Service cooperatives (SC) ⇒ farmers. This long chain has many disadvantages:

- since ESC and AISCO add their own margins the price will be almost two folds.
- the quality will deteriorate when it passes through the long chain
- besides the above problems, availability on time is questionable. Usually, improved seeds reach after the roads are blocked by the rain. This is because AISCO gives priority to transporting fertilizer which could be stored for long even if it is not sold.

Besides the agricultural education, the Ministry of Agriculture also provides training on management and accounting for executive committee members, development committee and accountants of service cooperatives.

Credit

Individual farmers do not have access to institutional credit. Thus farmers are forced to borrow from neighbors or relatives with an interest rate of 100% per annum which is higher than the institutional rate (5%). In late 1992 the institutional rate has increased to 11%-12%. Institutional credit is given only to service cooperatives due to lack of collateral. The main source of credit is the Agricultural and Industrial Development Bank (AID Bank) which gives credit for purchasing fertilizer. It used to give credit for purchasing grain prior to the abolition of grain quota system. Since 1976, the SCs in Adami Tulu area received a total of 1,015,671.60 Birr credit of which about 87% is repaid (Table 4).

Table 4. Total amount of credit given to service cooperatives

	Service Cooperatives	Producer Cooperatives*
Credit total (1976-1990)	1015671.60	66886.25
Paid	879749.98	24886.25
Unpaid	135921.58	42000.00
Theft (total)†	293652.78	-
Paid	57589.05	-
Unpaid	236063.73	-

Source: South Shewa administrative region MOA office.
 * credit obtained from service cooperatives in kind., † only 12 out of 21 service cooperatives are audited., - information not available.

The main cause of indebtedness to SCs is theft. According to the MOA auditors, a total of Birr 293,652.78 was stolen from 12 service cooperatives of which about 80% is not paid back. Producer cooperatives are also unable to pay their debt.

Marketing

Haricot bean is primarily grown for market. The majority of haricot bean produced will be marketed immediately after harvest. The primary objective of growing other crops is to secure food for the family. But this does not mean that all of the grain marketed (except haricot bean) is surplus because one can observe repurchasing latter in the season. Tef is the second most important cash crop and maize is the third. Since March 1990 all crop quotas and regional trade barriers have been abolished. This policy change helped retailers and whole sellers to move maize from the region to Nazret, Dire Dawa and Jijiga. It is known that Adami Tulu area contribute the larger share of haricot bean export. Immediately after harvest the Ethiopian Oil and Pulses Export Corporation (ETOPEC) did not announce the price at which it is going to purchase from wholesalers. Therefore, traders were buying at lower prices (20-35 Birr 100 kg⁻¹) and after the announcement the price raised to 35-45 Birr 100 kg⁻¹. Table 5 compares the prices of crops at Meki and Ziway after the liberalization of the market. It indicates that for all crops the price at Ziway is higher than the price at Meki perhaps because Ziway town has more civil servants than Meki.

Table 5. Comparison of retail prices at Mekele and Zway April-November, 1990 (Birr 100 kg¹)

Crops	Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
Maize	43.00	-	43.00	41.50	50.25	51.80	54.75	54.80	63.00	68.75	67.75	67.75	58.00	60.00	63.00	55.00
Tef																
White	105.00	113.75	112.00	123.75	132.50	133.00	133.75	136.50	135.00	142.00	140.00	155.00	131.00	157.50	125.00	151.67
Mixed	87.50	92.50	94.00	111.25	118.75	114.00	123.75	114.00	116.00	126.25	130.00	147.75	122.00	147.75	120.00	140.00
Red	70.00	73.75	77.00	87.50	103.75	105.00	106.24	97.00	102.00	110.50	113.75	130.00	109.00	137.50	105.00	125.00
Sorghum	42.00	-	32.80	-	41.00	-	50.25	-	57.40	0	67.75	-	59.60	-	60.00	-
Durum																
Wheat	51.25	66.00	58.00	62.25	67.50	70.60	71.25	74.00	80.00	78.25	97.50	80.00	85.00	90.00	80.00	63.33
Bread																
Wheat	-	42.75	-	78.00	-	87.00	-	79.00	-	94.00	-	107.50	-	110.00	-	78.33

Source: AMC respective offices

¹ The retail price indicated is the average of four weekly price data in each month and the price at which farmers sell to wholesalers is less by about 5.00 Birr/100 kg¹ than the indicated price

- means information not available

M = Mekele

Z = Zway

Farmer Objectives and Preferences

Farmer Objectives

The main objective of farmers in Meki-Ziway is to assure food supply to sustain the family through out the year. The achievement of this objective depends entirely on rainfall situation. Farmers benefit from complimentary of the crop and livestock enterprises. The crop enterprise is dependent on livestock enterprise for draft supply, manure and transportation. In turn, the crop residues are the major source of livestock feed. The livestock enterprise also help as security in the case of drought years.

Farmer Preferences

Early maturity is the major criteria used by 80% of maize growers (Table 6). Next to early maturity, high yield and quality for injera are considered as important criteria in selecting maize varieties. Other less important criteria are drought tolerance and heavy seed weight. Since the major problem is either late on setting or early finish, farmers give emphasis to early maturing maize varieties as drought escape mechanism instead of looking for drought tolerant maize varieties. Farmers require early maturing varieties for two reasons (1) unreliability of rainfall during early and late in the season (2) to shorten food shortage period by using green cobs.

Table 6. Criteria used by farmers in selecting maize and sorghum varieties

Criteria	Percent of grower	
	Maize (n=50)	Sorghum (n=22)
Early maturity	80	23
High yield	52	50
Quality for injera	52	36
Drought tolerance	30	27
Heavy seed weight	20	18
Higher price	12	45
Quality for 'tella'	2	9
Bird tolerance	0	32

Preferred maize varieties

Among the maize varieties grown in the survey area A-511 is the most preferred variety by about 46% of the sample farmers. One of the main reasons for preferring A-511 is its early maturity compared to the local varieties such as Hararge. About 26% of the farmers reported that A-511 is high yielder. Table 7 also shows that the other reasons for preferring this variety are its drought tolerant nature and good injera making quality.

Table 7. Preferred maize varieties and reasons

	Percent of sample Farmers		
	A-511	Militia	Katumani
Preference of farmers	48	18	12
Reasons			
Earl maturity	36	14	12
High yield	26	4	0
Drought tolerance	22	6	6
Good for injera	22	8	4
Heavy seed weight	6	2	2
High price	2	2	2

About 20% of the sample farmers reported that Limat is the most preferred variety. The reasons for preferring Limat are high yield (18% of the farmers), early maturity (16%) and Injera Quality (14%). The above table indicated that early maturity, high yield and quality for injera are the main criteria for choosing maize varieties.

Although the degree of importance varies, all maize varieties can serve all purposes (food, local, drinks and for all). Among maize varieties, Limat is highly preferred for injera (55% of the sample farmers) and Sheye variety for tella (50% of the farmers) (Table 8). The main reasons for preferring Limat for injera are softness, white color and good taste (Table 9). Those farmers who preferred A-511 for injera claimed that it is soft (18% of the farmers) and white (10% of the farmers).

The main reasons for preferring Sheye variety for tella is tella made of sheye is strong (30% of the sample farmers) and has good taste 16% of the farmers.

Table 8. Preference of farmers among maize varieties for preparing injera and tella

Varieties	Percent of sample farmers	
	Injera	Tella
Limat	55	24
A-511	18	8
Katumani	10	5
Sheye	6	50
Militia	6	3
Hararge	4	5

Table 9. Reasons for preferring Limat variety for 'injera'

Reasons	Percent of sample farmers
	Limat
Softness	48
Whiteness	26
Good taste	26
Has more flour	10
Easily digestible	4

Preferred haricot bean varieties

Mexican-142 is the most preferred haricot bean variety. It is preferred for its high market value (91% of haricot bean growers), and early maturity (40% of growers) (Table 10). However, due to their good test, flavor and cookability colored bean (Woka) are preferred to Mexican-142 and are mainly used in the form of boiled grain.

Table 10. Reasons for preferring Mexican-142

Reasons	Percent of haricot bean growers
	High price
Early maturity	40
High yield	26
Heavy seed weight	11
Color	6

Preferred tef varieties

About 57% of tef growers preferred red tef variety because of its earliness, high yield and injera quality (Table 11). About 30% of tef growers preferred white tef because it has high market price and good injera quality.

Of all sorghum varieties grown in the area Gababe is highly preferred for making injera (Table 13). The main reason is that it does not dry soon compared to other varieties (58% of sorghum growers). About 19% of sorghum growers also preferred white-seeded sorghum varieties although it is facing serious bird damage. Gebabe and Desse are highly preferred for 'tella' in order of importance.

Table 11. Preferred tef varieties and reasons

	Percent of sorghum growers			
	Gebabe	Zengada	Desse	Deftere
Preference of farmers	50	27	14	9
Reasons				
High yield	24	24	-	10
Bird tolerance	29	10	-	5
Good for injera	24	14	19	-
Early maturity	10	5	5	-
Drought tolerance	10	10	-	-
Heavy seed weight	10	10	-	-
High price	-	5	14	5
Good for tella	5	10	5	-

Table 13. Preference of farmers among sorghum varieties for making injera and tella

Sorghum varieties	Percent of sorghum growers	
	Injera	Tella
Gebabe	43	54
Zengada	14	8
Desse	14	38
Deftere	5	0
White seeded	19	0
Others	5	0

Preferred wheat varieties

About 43% of wheat growers preferred Lakech for its high yield and quality for injera (Table 14). Where as 29% preferred Israel variety and 14% prefer Enkoy variety.

Food, Water and Fuel

Food

The main dishes are; injera, bread, Porridge ("genfo"), boiled grain ("nifro") and roasted grain (Kollo). The crops used in preparing different dishes are:

- injera: maize, tef or sorghum and their combination.
- Fermented bread: wheat, maize or their combination.

Table 14. Preferred wheat varieties and reasons

Reasons	Percent of wheat growers			
	Lakech	Israel	Enkoy	Abesha
Preference of farmers	43	29	14	14
Reasons				
High yield	35	14	14	14
Quality for injera	21	7	7	14
Early maturity	14	0	0	0
Higher price	0	14	0	0
Heavy seed weight	0	7	0	0
Quality for tella	0	7	0	0

- None fermented bread: wheat, maize, tef or their combination.
- Porridge: barley, tef, wheat and maize
- Boiled grain: maize and haricot bean.
- Roasted grain: Barley, wheat and maize.

Tef injera is preferred but maize is common. Wheat, barley and sorghum are substitutes. The common relishes are field pea, faba bean and lentil which are purchased from market. In the wet season cabbage and other vegetables are also used which are usually grown in the garden. Milk and milk products such as yoghurt, skimmed milk ('*arera*'); cheese ('*ayib*'), and '*agwat*' are used as relish. Haricot beans are also used for preparing relish. Meat is some times eaten particularly during holidays, other ceremonies and when cash is available. Farmers near lake Ziway also depend on fishing for protein source.

Local beer ('*tella*') and alcohol ('*areki*') are the major beverages. They are prepared mainly from maize and hop. Barley and sorghum are also used for preparing tella.

Food is plenty immediately after harvest and they run out of food in July-August. During poor rain season the food shortage period starts from April/May. During food deficit periods farmers buy small ruminants, calves, heifers, and oxen by selling chicken and cows. They also sell firewood and some look for off-farm work in the nearby state farms and towns. In July-August poor farmers eat '*chemerda*' — cabbage like weed in maize fields.

Water

Farmers close to lake Ziway and Meki River use these water sources both for human and animals. Some peasant associations use ponds and wells. In the dry season, animals are usually taken to these water bodies once in two days.

Fuel

Fuel wood is collected from nearby bushes. Maize and sorghum stover and cow dung are also used for fuel.

Resource Availability and Uses

Land

Land is relatively abundant in both Meki and Ziway. The average farm size is about 3.1 ha in Meki target group and 3.3 ha in Ziway zone. The average annually cultivated area in each target group is 2.9 ha. The major limitation to expansion of farm size is oxen shortage. The trend will not continue as the population pressure increases.

Renting land is not practiced since there is no population pressure. The area does not have water logging problem. But soil erosion due to runoff and wind are serious. The most fertile land is allocated to maize and the least to sorghum.

Labor

In the Meki target group, the average family size is 7.3 persons with a standard deviation of 4.6 persons. The coefficient of variation (c.v.) is high (44.9%) because some farmers have more than two wives who are totally dependent on them. About 62% of the farmers have one person working full time on the farm, 27% have two and 12% have three or more. The average number of farmers working full time on farm is 1.6. Wives are considered as part time workers on farm. About 54% of the farmers have one part time worker, 26% have two and 20 have three or more. The average number of part time workers per family is 1.8.

In the Ziway target group, the average family size is 9 persons with a standard deviation of 4.9 persons. The coefficient of variation (c.v.) is high (54.4%) because some farmers have more than two wives who are totally dependent on them. About 57% of the farmers have one person working full time on the farm, 20% have two and 22% have three or more. The average number of farmers working full time on farm is 1.7. About 60% of the farmers have one part time worker and 19% have two. The average number of part time workers per family is 2.1.

There is division of labor based on age and sex. The primary task performed by men includes land preparation, cultivation, harvesting of tef and wheat and threshing. Women are involved in weeding of all crops and harvesting of haricot bean and maize. Women are also in charge of water fetching, fuel wood collection, kitchen work and child care.

Children help in some field operations during peak periods such as in tef weeding and harvesting of all crops. But most of the time they are engaged in looking after livestock.

The main labor peak period is July-August. The main activities in this period include planting and weeding of tef, planting of haricot bean, planting and weeding of wheat, weeding and oxen cultivation of maize and sorghum. The second labor peak period occurs in October-December at the time of harvesting. To manage labor peak period farmers extend their working hours, hire labor and traditional labor pooling system. The slack period is early February to mid March. Farmers pay 40-60 Birr ha⁻¹ for contractual labor for weeding of crops. In addition they provide food, drinks and shelter. The source of hired labor is immigrant from distant and near by high land areas whose crops mature latter. Labor is some times hired on annual basis. In such cases, farmers hire men to work on their farms through out the cropping season. The payment ranges between 150-300 Birr based on age and other related factors. The payment may also be done in kind (300-400 kg yr⁻¹ depending on the crop type). The employee lives with the employer.

Cash

Crop sales are the most important source of cash to 57% and livestock sales to 43% of the farmers. The main cash crops are haricot bean, tef and maize. A limited number of farmers have access to off-farm work in state farmers. Cash is usually available during crop sales immediately after harvesting (December-February) and cash is scarce during the wet season (June-September). In the wet season farmers need cash to buy fertilizer, seed and labor.

Draft Power

The main sources of draft power are oxen and donkeys. Oxen are used for plowing and donkeys for transportation. About 32% of the farmers in the Meki zone and 10% in the Ziway zone do not own an ox. None-oxen owners either hire in oxen or borrow from their relatives and neighbors (Table 15). When oxen are hired, the average rent is 60 Birr/ox/year or 200-300 kg grain/year/pair of oxen.

Table 15. Land preparation strategies by none oxen owners and single oxen owners.

Parameters	Percent of none oxen owner	Percent of one oxen owner
Hire in oxen	50.0	25.0
Borrow oxen or partnership	25.0	12.5
Provide labor to oxen owners	12.5	37.5
Share cropping	12.5	25.0

When laborservice system is used, none oxen owners work for two days on the oxen owners' field and work one day on their farm. In share cropping, the oxen owner provides seed, participate equally in weeding whereas the non-oxen owner provides land and perform all activities.

Oxen work for 6 hours in dry season and for 8 hours in wet season. In the dry season, 16 hours are required to plow 1 ha of sandy soil compared to 32 hrs ha⁻¹ on the clay soil. In the wet season, 56 hrs are required to cover 1 ha of sandy soil compared to 112 hrs ha⁻¹ on the clay soil. About 49% of the farmers reported their oxen are strong enough and 47% sometimes strong enough to plow at the beginning of the rain every year.

Transportation

Donkey cart is widely used as a means of transportation in the Meki-Ziway areas. They are used to fetch water to transport goods to and from the market and transport harvested materials to threshing fields and to their house. Donkey carts are sometimes hired on 1-5 Birr day⁻¹.

Crop Enterprises

Like most of the Ethiopian subsistent farmers, farmers in Meki-Ziway area produce a wide range of crops. The major crops grown in the survey area include maize, haricot bean and tef whereas the minor crops include sorghum, barley and chick peas (Table 16). The area under each major crop varies according to the rainfall pattern, seed and draft power availability.

Table 16. Proportion of farmers growing crops and area coverage

	Meki zone			Ziway zone			% total
	% of farmers growing	Mean area (ha)	Sample area	% of farmers growing	Mean area (ha)	Sample area	
Maize	60	0.90	0.86	40	1.40	1.40	42
Haricot bean	65	0.97	0.83	20	0.88	0.86	26
Tef	85	0.66	0.56	18	0.79	0.46	14
Sorghum	38	0.55	0.21	7	0.50	0.06	2
Wheat	55	0.55	0.22	2	0.67	0.06	2
Barley	25	0.32	0.08	3	0.25	0.02	1
Others	-	-	0.06	-	-	-	-
Fallow	20	0.70	0.14	4	0.93	0.13	4
Grazing area	12	0.57	0.09	3	2.20	1.60	9
Total		0.58	0.09		2.32	1.00	100

Figures do not add up to 100% due to rounding errors. Others include: Chick peas and oats. Does not include communal grazing area.

Among the type of crops produced maize is most important both in terms of proportion of farmers growing and in area coverage. In the Meki zone maize covers about 36% of the total area and 38% of the cultivated land, whereas in Ziway it accounts for about 42% of the total area and 48% of the total cultivated land. It is primarily produced for consumption (Table 17).

Farmers allocate fertile land to maize. Whenever manuring is possible they give priority for maize fields. Tef, barley and wheat are grown on soil of medium fertility. Haricot bean is grown on least fertile soil.

Donkeys are widely used as a means of transport in the Meki-Ziway areas. They are used to fetch water to transport goods to and from the market and transport harvested materials to the fields and to their houses. Donkeys are sometimes hired on 1-2 Birr/day.

Table 17. Main use of crops.

Crops	Percent of growers reporting	
	Family use	Sale
Maize (n = 50)	100	0
Haricot bean (n=33)	9	91
Tef (=36)	42	58
Sorghum (n=18)	67	33
Wheat (n=13)	54	46
Barley (n=8)	75	25

Crop Rotation

Despite the larger farm size fallowing is not common. Only 20% of the farmers in Meki zone and 14% of the farmers in Ziway fallowed about 5% their farm in 1989. Although there is no fixed pattern, all farmers practice crop rotation on some of their crops. Since maize is manured, planting maize on the same field for three or four continuous years is not uncommon. For instance, about 74% of the sample farmers planted maize on the same field in 1988 and 1989 and they were expected to plant maize in 1990. Similarly growing haricot bean on the same field for three continuous years was reported by 17% of haricot bean growers. The most common rotations include:

Tef - Haricot bean - Tef
 Maize - Haricot bean - Maize
 Sorghum/Maize - Sorghum - Wheat

Table 18 depicts that about 77% of maize fields in 1989 were planted maize in 1988 and 90% of the maize fields were expected to be planted maize in 1990. About 38% and 18% of the haricot bean in 1988, respectively. Followed fields were usually planted with haricot bean. Tef and wheat are the most common precursor crops to sorghum. On the other hand, sorghum and tef are the most common precursor crops to wheat.

Table 18. Rotational patterns in 1989 and 1988 (percent of fields)

1988	1989				
	Maize	Haricot bean	Tef	Sorghum	Wheat
Maize	77(90)	12(28)	17(17)	17(17)	7(9)
Haricot bean	9(6)	18(25)	43(28)	17(17)	0(6)
Tef	6(2)	38(28)	15(28)	39(28)	36(31)
Sorghum	2(2)	3(3)	15(16)	0(0)	50(22)
Wheat	2(0)	6(11)	9(17)	22(33)	0(19)
Barley	4(0)	6(5)	0(3)	5(5)	7(13)
Fallow	0(0)	17(0)	6(0)	0(0)	0(0)
Total	100(100)	100(100)	100(100)	100(100)	100(100)

Figures in parenthesis indicate expected crop in 1990

Maize Husbandry

Characteristics of maize varieties

Farmers grow many maize varieties to avoid risk and to meet different objectives. The most common maize varieties include Limat, Katumani, and A-511. Other less important varieties include Militia and Hararge. The characteristics of maize varieties are illustrated in Table 19.

Limat

Limat is white-seeded maize variety with medium plant height and big cob size. It matures early and has medium to high market price. Limat is highly susceptible to weeds but relatively resistant to drought. This variety is high yielding but it cannot be stored for long time since it can be easily damaged by weevils. It is good for making 'tella' and 'injera'. It has medium seed weight.

A-511

A-511 is white-seeded late maturing (over 120 days) and tall variety. If the rain situation is conducive it is high yielding. It is resistant to mid-season stress. Its market price is medium to low. It has heavy seed weight and it is good for making 'tella' and 'injera'.

Table 19. Characteristics of maize varieties

Characteristics		Katumani (n=10)	Shaye (n=11)	Limat (n=23)	A-511 (n=11)	Militia (n=8)
Yield	Good	60	45	63	64	75
	Medium	40	65	17	38	25
	Low					
Color	White					
	Yellow					
Height	Tall					
	Medium	60	35	57	38	66
	Short	40	75	4		12
Cob size	Big					
	Medium	20	75	65	55	12
	Small	80	25	35	45	40
Maturity period	Late					
	Medium			17	27	12
	Early	100	65	4	27	
Market price	High	10	27	43	18	66
	Medium	60	65	43	38	12
	Low	10	8	13	45	38
Weevil resistance	Resist.	30	27	22	65	63
	Suscept.	70	75	78	45	37
Drought resistance	Resist.	60	45	58	62	60
	Suscept.	20	65	48	18	60
Weed resistance	Resist.			30	45	37
	Suscept.	100	100	70	55	63
Injera quality	Fair	30	65	4	9	38
	Poor		15			25
	Good	40	65	60	100	66
Tella quality	Fair	40	75	30		12
	Poor	20	75	10		
	Heavy	30	65	38	64	100
Seed weight	Medium	60	45	43	27	
	Light	10	15	17	9	

Note: n=the number of farmers interviewed about a given variety.

Sheye

Sheye is yellow seed and tall plant. Its cob is big. Sheye has heavy seed weight and receives fair market price. Although this variety is high yielder it can hardly resist weevils. It is highly susceptible to weeds and drought. Its maturity period is medium to late. This variety is known for its good 'tella' making quality. It can also be used to prepare 'injera' but it dries soon.

Katumani

Katumani is white seeded variety with short plant height and small cob size. It is early maturing (90 days) and has medium price. This variety is high yielder but subjected to storage loss. Katumani has advantage over other varieties in that it can escape drought. But it can not compete with weeds. It is good for 'injera' and 'tella' making. It is medium in seed weight.

Militia

Militia is white-seeded, medium height and early maturing variety. It is good yielder and fetches higher price due to its heavy seed weight. It is resistant to weevil. It is good for making 'tella'

Hararge

Hararge is late maturing (150 days) but it is high yielder during good rainy seasons. It is the most common variety grown by 48% of the farmers covering about 39% of the total maize area and 17% of the total cultivated land (Table 20). A-511 is also an important maize variety grown by 22% of the farmers and account for 18% of the total maize area. About 67% of the sample farmers tried new maize varieties. About 50% of the farmers have tried Limat variety, 31% of the farmers A-511 variety and only 19% of the farmers have tried katumani. The main source of these varieties are; MOA (as reported by 59% of the sample farmers), other sources include neighbors (13% of the farmers) and local market 6% of the farmers. The main advantage of the new varieties as felt by farmers are presented in table 21. The reason for discontinuing of growing new maize varieties by some farmers is seed shortage.

Table 20. Proportion of farmers growing maize varieties

Maize varieties	Farmers growing (%)	Sample mean (ha)	Maize Total cultivated area (%) land (%)
Limat	48	0.50	3917
A-511	22	0.23	188
Katumani	22	0.13	104
Sheye	20	0.15	125
Militia	16	0.17	136
Hararge	8	0.10	83

Table 21. Advantages of the new maize varieties

Advantages	Percent of sample farmers
Early maturing	52
Quality for injera	42
High yield	28
Good fodder quality	22
Drought resistance	14
Sweet green cot	6

Land preparation is started in March and the frequency of plowing maize field ranges from 3 to 5 with an average of about 4 (Table 22). Frequency of plowing depends on soil type, rain fall condition, availability and strength of oxen. Maize is planted in April (for late-maturing varieties) and in June (for short-cycled varieties). Planting time is affected by a number of factors such as availability of seed, oxen and rain.

When rain starts late farmers plant early-maturing varieties of maize and sorghum although and long-cycled varieties have yield advantage over the short-seasoned varieties. They also vary the planting date of crop varieties to avoid risk. In general, whenever there is delay of rainfall in March-April, haricot bean and tef areas increase at the expense of maize. The rainfall distribution in 1989 shows that there was enough amount of rainfall in March-April and as a result much land was planted with maize.

Table 22. Frequency of plowing by crops (percent of farmers growing the crop)

Crops	Frequency of plowing				
	One	Two	Three	Four	Five
Maize			47	45	8
Tef		6	46	33	15
Haricot bean	11	42	47		
Sorghum		30	60	10	
Wheat		14	36	14	36
Barley			33	45	22

The average seed rate used is about 89 kg ha⁻¹ (Table 23). This is much higher than the recommended seed rate (25-30 kg ha⁻¹) in order to reduce risk of poor seedling emergence that may arise due to moisture stress. The other factors that affect seed rate are soil fertility, weed intensity and seed quality. In addition farmers increase seed rate when they fear that the crop will be attacked by wild animals.

Crop	J	F	M	A	M	J	J	A	S	O	N	D
	LE	LE LE	LE LE	LE LE	LE LE	LE LE	LE LE	LE LE	LE LE	LE LE	LE LE	L
Maize	HH	LLLLLLLPPPPP			OOOOOOO	WWWWWWW		HHHHHHH				
Haricot bean		LLLLLLLPPPPPP				HHHHHHH						
Tef			LLLLLLLPPPPPP			WWWWWWW		HHHHHHH				
Sorghum	HH	LLLL	PPPP		OOOOOOO	WWWWWWW		HHHHHHH				
Wheat				LLLLLLLLLPPPPP		WWWWWWW		HHHHHHHHH				
Barley				LLLLLLLLLPPPPPPPP		WWWWWWW		HHHHHHH				

Note
 P = planting
 O = Oxen cultivation
 W = Weeding
 H = Harvesting
 L = Land preparation

Fig. 2 Crop calendar

Table 23. Maize seed rate

Rate (Kg ha ⁻¹)	% of farmers
20 - 40	6
41 - 60	10
61 - 80	54
81 - 100	12
101 - 120	14
> 120	4

The usual method of planting is broadcasting. The main reason for not planting in rows is shortage of labor power (57% of the farmers). About 29% reported that they have not heard about row planting and 8% of the farmers believe that row planting has no advantage over broadcasting.

Table 24. Reasons for not planting in rows

Reasons	Percent of farmers
Shortage of labor	57
Not hard about row planting	29
New planting has no advantage	8

All of the farmers in the survey area practice oxen cultivation 'shilshallo'. The farmers believe that oxen cultivation has the following advantages: weed control (82% of the farmers), moisture conservation (57%), aeration (37%), and adjustment of plant planting in July. The survey result also showed that about 49% thin maize mainly to get livestock feed (46%) and to reduce plant population (35%). Other reasons for thinning are high yield and aeration.

Common weeds prevailing on maize fields are *Snowdenia polystachia* (Muja) 44%, *Datura Stramonium* (Atefaris) 36%, *Galinsga parviflora* (Balewuleta) 44%, *Guizotia scabra* (Serdo) (18%) (Table 26). About 63% of the farmers weed maize only twice and 35% once.

In the survey area manuring was the only means of maintaining fertility level of maize field. About 60% of the farmers applied manure on maize in 1989 cropping season. Currently manuring has become impossible owing to the long distance between villages and maize field (Table 27). Only 12% of the farmers used chemical fertilizer on maize filed in the 1989 cropping season mainly because fertilizer was not available at planting (Table 28).

Table 25. Advantages of oxen cultivation on maize and sorghum

Advantage	Farmers reporting (%)	Percent of responses
Weed control	82	36
Moisture conservation	57	25
Aeration	37	16
Adjustment of plant population	29	13
high yield	20	9

Table 26. Common weeds in major crops (% of growers reporting)

Weeds	Maize n=50	Tef n=37	Sorghum n=19	Wheat n=14	Barley n=13	Haricot bean*
<i>Snowdenia polystachia</i>	44	5	32	21	14	
<i>Datura stramonium</i>	36	19	32	36	23	26
<i>Galinsoga parviflora</i>	44	54	32	71	38	
<i>Guizotia scabra</i>	30	51	68	71	38	
<i>Bidens piosa</i>	24	11	21	7	15	61
<i>Cynodom dactylon</i>	18	3	11	21	-	
<i>Brasica nigra</i>		19	5	14	-	
<i>Allophylus abyssinicus</i>	16	* 11	-	-	-	

*taken from Haricot bean production survey around Ziway, 1987.

Some also reported that the land is fertile enough to give reasonable yield. Other reasons include fertilizer favors weed growth and priority for other crops. Those farmers who used fertilizer applied about 50 kg DAP ha⁻¹.

Maize is harvested starting from October and the average yield in years is 1400 kg ha⁻¹ (Table 29). Moisture stress and stalk borer are the major limitations to increase maize productivity.

Table 27. Reasons for not manuring maize and sorghum fields.

Reasons	Percent of responses	
	Maize	Sorghum
Difficult to transport	65	50
Soil is fertile enough	25	8
Priority for other crop	0	17
Manure burns the crop	10	8
Manure favors weed growth	0	8

Reasons	Maize	Tef	Sorghum	Wheat
Soil is fertile enough	24	12	53	0
Fertilizer was not available on timely basis	40	41	8	17
Fertilizer favor weed growth	20	23	23	50
Priority for other crop	8	24	8	17
Others ¹	8	24	8	16
Total	100	100	100	100

¹Others include unavailability of fertilizer at all and inability to repay previous debts.

Table 29. Average yield of major crop

Crop	Good year	Yield (kg ha ⁻¹)	
		Normal year	Bad year
Maize	2400	1400	600
Haricot bean	1500	900	300
Tef	1100	500	200
Sorghum	2000	1100	500
Wheat	1600	900	400

Haricot bean Husbandry

A criterion that farmers consider to choose an area of land for growing haricot bean is level of weed infestation. This is because farmers have labor shortage to weed haricot bean fields. Land preparation starts in May. The number of plowing for haricot bean field is 2-3 (Table 22). This frequency of plowing is lower than other crops because farmers believe that haricot bean can give reasonable yield under poor seed bed preparation. Planting is done from end of June to mid July. The method of planting is broadcasting and covering the seed with Maresha. The major haricot bean variety grown in the area is white pea bean, Mexican-142. In the Ziway zone, it is grown by 98% of the farmers accounting for 26% of the total area. In the Meki zone, it is grown by 65% of the farmers and covers about 20% of the total area. Colored beans 'Woka' are not commonly grown on wider field since they are grown for home consumption. On average farmers uses a seed rate of about 102 kg ha⁻¹ (Table 30). This rate is very high as compared to the recommended seeding rate for haricot bean (70 kg ha⁻¹). Farmers intentionally increase seed rate so as to suppress weed growth.

Table 30. Haricot bean seed rate

Rate (kg ha ⁻¹)	% of growers
60-80	38.2
81-100	29.4
101-120	23.6
120	9.8

Haricot bean is harvested in October. The method of harvesting is by up rooting the plant. Mostly farmers harvest haricot bean early in the morning to reduce shattering but in some places they harvest haricot bean before it is too dry. This helps them to harvest through out the day with out shattering problem. In the survey area threshing is done using oxen.

Farmers obtain an average yield of 1500 kg ha⁻¹ during good rainy seasons and 900 kg ha⁻¹ in normal years. In drought years they are not getting more than 300 kg ha⁻¹. In the survey area haricot bean is stored in "Tegogo"

Tef Husbandry

Farmers grow 3 tef varieties namely, white, red and mixed. Red tef variety is grown by 64% of sample farmers and covers about 13% of the total cultivated land (Table 31).

Table 31. Proportion of farmers growing tef varieties.

Tef varieties	Farmers growing(%)	Sample mean(%)	Tef area(%)	Total cultivated land(%)
Tef	74	0.49	100	16.0
Red	64	0.39	80	13.0
White	6	0.02	4	0.7
Mixed	8	0.08	16	2.7

Land preparation for tef is done by oxen plow in may. Including the final plowing at planting tef field is plowed 3-4 times (Table 22). Planting is done in July. Farmers use average seed rate of about 35 kg ha⁻¹ (Table 32). Tef planting is done by broadcasting seeds after the final plowing and left uncovered. Farmers prefer rainy day to plant tef for the sake of sticking tef seeds with soils. During sunny days farmers drag acacia branches in the tef field to pack the field. Only 30% of the sample farmers used fertilizer on tef in the 1989 cropping season. This is due to in availability of fertilizer on timely basis and/or because the farmer believe that fertilizer favors weed growth. The average rate of fertilizer applied by those who used fertilizer was about 62 kg DAP ha⁻¹.

Table 32. Tef seed rate

Rate (kg ha ⁻¹)(% of growers)	
20-30	28.0
31-40	60.0
41-48	5.7
49-60	5.7
>60	2.0

Common weeds that prevail in tef field are *Galinsoga parviflora* (54% of the sample farmers), *Guizotia scabra* (51%), *Datura stramonium* (19%) and *Brassica nigra* (19%) (Table 26). About 30% of tef growers do not weed tef, 57% weed once and 3% weed their tef field twice. The frequency of weed pressure and labor availability. First weeding of tef is done 4-5 weeks after planting (August) and the 2nd weeding is 2-3 weeks later (early september). About 26% of the farmers use herbicide to control weed in tef. They use half the recommended rate of herbicide mainly 2,4-D (400 to 500 cc ha⁻¹) and this cost them, on average, 25-30 Birr ha⁻¹. Though farmers have found the use of herbicides very effective and time saving herbicides are not available in the market. So they have to buy at inflated prices. Use of hired labor for tef weeding is very common. Farmers pay 60-70 Birr ha⁻¹ when they hire labor in contractual basis plus they provide food and shelter to their employees until the terms of contract ends. When labor is hired on daily payment basis farmers pay up to 3 Birr day⁻¹ and they provide lunch to the employees. No major pests and diseases are reported on tef. Tef is harvested from October to November. The method of harvesting is manual using sickle. After harvesting the crop is piled either in the field or near a threshing floor. Transportation of the harvested crop is done using donkeys. The tef bundles are tied together with hides for ease of transportation. Threshing is done in January up to February using oxen, bulls, heifers and donkeys. Winnowing and cleaning of the crop during threshing are done using Mesh, Layda and Seives.

The average tef yield in good years is about 1100 kg ha⁻¹ and 200 kg ha⁻¹ in bad years (Table 29). Tef is stored in local granary such as "gottara" "dibignit" and sacks. Moisture stress, weeds, soil fertility and low yielding varieties are the major constraints on tef production.

Sorghum Husbandry

The most common sorghum varieties grown in the survey area include Gebabe, Zengada, Demu, and Destere. The characteristics of each of these varieties are shown in (Table 33). All of these varieties are reddish brown to tolerate bird damage.

Gebabe

Gebabe is red seeded. As the name Gebabe implies it is medium to short. Gebabe is early maturing. It is a good yielder and has medium head size. It has loose panicle. It can tolerate drought. It can not be stored for long due to weevil. Gebabe has medium to high market price and medium seed weight. It is also good for making injera and tella.

Zengada

Zengada has red seeds. It is tall and late maturing. During good rainy seasons it is good yielder and it has medium to big head size. It has loose panicle and tolerates drought. It has heavy seed weight and it is fair for making injera and tella.

Table 33. Characteristics of sorghum varieties

Characteristics		Gebabe n=13	Zengada n=11	Desse n=4	Deftere n=5
Yield	Good	62	73	50	60
	Fair	38	27	50	40
	Poor	0	0	0	0
Height	Tall	0	82	0	0
	Medium	54	9	75	0
	Short	46	9	25	100
Maturity period	Late	8	82	0	0
	Medium	8	0	50	0
	Early	84	18	50	100
Market price	High	38	0	25	0
	Fair	38	50	75	50
	Low	23	50	0	50
Weevil resistance	Resistant	22	50	0	0
	Susceptible	78	50	100	100
Drought Resistance	Resistant	77	67	100	80
	Susceptible	23	33	0	20
Weed Resistance	Resistance	50	50	25	40
	Susceptible	50	50	75	60
Injera quality	Good	62	27	75	40
	Fair	23	55	25	40
	Poor	15	18	0	20
Tella quality	Good	50	18	100	0
	Fair	40	64	0	75
	Poor	10	18	0	25
Seed	Heavy	18	50	75	33
	Medium	64	25	25	67
	Light	18	25	0	0

Note: n= the number of farmers interviewed about a given variety

Desse

Desse has red/brown seed color and medium plant height. It is medium in maturity, yield and head size. It can tolerate drought. It is good for making injera and tella.

Deftere

Deftere is red seeded, short and early maturing. It is a good yielder, has loose panicle and has medium head size. Deftere can tolerate drought but it can not compete with weeds and it is susceptible to weevils. It is fair for 'injera' and 'tella'.

Among sorghum varieties Gebabe is the most common. It is grown by 20% of the sample farmers and covers about 4% of the total cultivated land (Table 34). Sorghum is one of the minor crops grown around the survey area. Land preparation for sorghum is started in February. The average frequency of plowing sorghum field is about 3 (Table 22). For the long season varieties planting is done earlier (April-May). All of the sorghum growers reported that they don't plant sorghum in rows. The major constraint that inhibits row planting is labor shortage (57% of the farmers) and about 29% have never been exposed to the idea of row planting (Table 24).

About 40% of sorghum growers use a seed rate of 4-12 kg ha⁻¹ and 60% use a seed rate of 16-24 kg ha⁻¹. On average, farmers use seed rate of about 17 kg ha⁻¹. This rate is higher than the recommended rate (5-10 kg ha⁻¹) mainly because of expectation of poor seedling emergence. Shilshallo (oxen cultivation is done 5-6 week after planting for the purpose of conserving moisture, controlling weeds and adjusting plant population (Table 25). About 94% of the growers supplement shilshallo by one hand weeding (10-15) days after shilshallo and others weed twice.

Table 34. Proportion of farmers growing sorghum varieties

Sorghum varieties	Farmers Growing (%)	Sample mean (ha)	Sorghum area (%)	Total cultivated area (%)
Gebabe	20	0.11	55	3.7
Zengada	8	0.02	10	0.7
Desse	8	0.04	20	1.3
Deftere	6	0.03	15	1.0

The farmers' common weeds of sorghum are *Guizotia scabra* (68%) of *Galinsgo parvifloa* (32) *Datura stramonium* (32) *Snowdinia polystachia* (32) and *Bidens pilosa* (21%) (Table 26). About 30% of sorghum growers reported that they practice thinning to get additional livestock feed and reduce plant population. Almost all of the sorghum growers do not use fertilizer on sorghum field because they believe that the soil is fertile enough to grow sorghum (53%) and they believe that fertilizer favors weed growth (23%) (Table 28).

About 68% of the farmers did not use manure on sorghum field in 1989 cropping season. This is mainly because of the difficulty in transporting manure (Table 27).

Quelea bird is mentioned by the farmers as one of the pressing problem in sorghum

production. This is reported by about 89% of the sorghum growers. Bird scaring is started in October and continues till harvesting. On average farmers spend about 8 hrs day⁻¹ for bird scaring.

Harvesting is done in November. The method of harvesting is cutting the head of the crop either by hand or using sickle. Threshing is similar to that of the other crop. Sorghum grain is stored in "Gottera", "Dibignit" or sacks. Farmers obtain up to 2000 kg ha⁻¹ during good rainy seasons and 500 kg ha⁻¹ in bad years (Table 29). The major constraints of sorghum production are late season stress and birds.

Wheat Husbandry

Land preparation is started in Many. Field already sowed with maize or sorghum may be replanted with wheat in cases of very later on-Setting of rainfall. The usual time of planting for wheat is early July. Frequency of land preparation ranges from 3 to 5 but the average is 4 (Table 22). Farmers in Meki-Ziway area use a seed rate of 126 kg ha⁻¹ (Table 35). There are many wheat varieties grown in the study area including Israel, Lakech, Enkoy and Boydo (Table 36).

Table 35. Wheat seed rate

Rate (kg ha ⁻¹)	(%) of growers
40-80	31.2
81-120	25.0
121-160	19.7
> 160	25.0

Common weeds prevailing in wheat field are *Galinsoga parviflora*, *Guizotia scabra* (71%), *Datura stramonium* (36%), *Snowdenia polystachia* and *Cynodon dactylon* (21%) (Table 26). On average farmer weeds wheat once but about 22% of wheat growers reported that they weed twice. About 36% wheat growers use herbicide to control weed. They use 200-400 cc ha⁻¹.

About 57% of growers used fertilizer on wheat in 989 cropping season. Farmers who used fertilizer on wheat applied at a rate of about 61 kg DAP ha⁻¹. Harvesting of wheat is done manually using sickle in early November. Threshing is done in January using draft animals. The average wheat yield in good rainy season is about 1600 kg ha⁻¹ and about 400 kg ha⁻¹ in poor rain season (Table 29). The major constraints in wheat production are moisture stress particularly early season stress and shortage of high yielding varieties.

Table 36. Proportion of farmers growing wheat varieties

Wheat varieties	Farmers growing (%)	Sample mean (ha)	Sorghum area (%)	Total cultivated area (%)
Wheat	28	0.18	100	6.0
Israel	12	0.06	33	2.0
Lakech	16	0.09	50	3.0
Enkoy	4	0.02	11	0.7
Boydo	2	0.01	6	0.3

Barley Husbandry

About 22% reported that barley receives the most fertile land next to maize. Frequency of plowing ranges from 3 to 5 with an average of 4 (Table 22). Farmers use a seed rate of about 188 kg ha⁻¹. Only 20% of barley growers used fertilizer because of its unavailability. Common weeds in barley field are *Galinsoga parviflora* (38%), *Goizotia scabra* (38%) and *Datura stramonium* (23%) (Table 26). Weeding is done in August and it is harvested in November.

Livestock Enterprise

Livestock complements crop production by supplying draft power and manure. They also serve as security during drought years. The main livestock species kept by the farmers include cattle, goats, sheep and donkeys. They also own chicken. Oxen provide draft power. Cows furnish farm family with milk and they are kept for productive purposes. Goats and sheep are important sources of cash. Donkeys are the main means of transportation to and from the farm. Chicken are also supplementary sources of cash.

Table 37 indicates that about 68% of the farmers have at least a pair of oxen. The average number of oxen per household is 2.2 (Table 38). Most of the farmers do not keep bulls due to shortage of livestock feed. About 84% own at least one cow and half have at least one heifer. The survey area seems better to support goats than sheep. Most do not keep sheep. Despite the importance of donkeys for transportation purposes, only half of the farmers reported owning donkey. The average number of donkeys per family is 1.5.

Table 37. Proportion of farmers owning livestock

Type of animals	Zero	Percent of sample farmers		
		One	Two	Three or more
Oxen	16	16	36	32
Bulls	64	20	4	12
Cows	16	20	18	46
Heifers	50	16	16	18
Calves	26	18	18	38
Sheep	80	4	10	6
Goats	48	6	10	36
Donkeys	50	36	8	6

Table 38. Average number of livestock per house hold as of March 1990

Type of animals	Sample mean	Owners' mean
Oxen	2.20	2.60
Bulls	0.86	2.40
Cows	3.60	4.20
Heifers	1.20	2.50
Calves	2.30	3.10
Goats	2.60	4.90
Sheep	0.42	2.10
Donkeys	0.74	1.50

Livestock Management

The age of heifers at first mating is 3-4 years depending on feed availability. Cows are usually served in June-July when grazing is abundant and give birth in February-March. This period is not convenient for management of the dam. Unless there is short rainy season March-May is the most feed scarce period. This problem arises from (open) uncontrolled mating system. Whenever there is short rainy season (March-May) cows may give birth in November-December. The average calving interval is 2 years. Cows give 6-7 calves over its reproductive period.

After birth, calves are kept at home separately in warm places and they are allowed to suckle their dams with out competing with human beings for 1-2 month period. Calves are weaned at one year age and are given soft and green grasses and other weaning feeds. The average age of the calves at marketing is 1.5-2 years. Calves are milked twice a day for 6 to 9 months. Milk yield ranges between 1 to 2 liter per day. During dry season milk yield can reach up to half a liter per day. Women are responsible for milking cows. On average, cows under favorable environment are culled when they are 12-15 years old. In drought years they are sold earlier. Farmers sell neither male nor female calve. Housing varies by the type of livestock. Oxen, cows and donkeys stay in the kraal; goats and sheep in the 'guro' and calves in the house.

Goats are the main components of livestock in the area. The average age of goats at first mating is 12 months and the average kidding interval is 6 months. The average weaning interval is 5 months and the average age of goats at marketing is 6 months.

Livestock Feed

The conventional feeding system in the area is grazing supplemented with crop by products such as tef straw, stover of wheat, barley and haricot bean and stalks of maize and sorghum.

Feed is commonly scarce from March- end of June, i.e, until new grasses emerge well. During feed scarce period, supplementary feed is given selectively to plowing oxen, pregnant and milking cows. Some farmers are transhumance. "Godnatu," that is a seasonal migration of livestock to distant places in search of feed during the wet season when their area is occupied by crops. They come back at the end of the cropping season in October and November to feed on crop stubble and grasses. In the dry season, water for animals is from Meki River which is 6-8 km far. They water their animals every two days.

Livestock Disease

Diseases and drought are serious problems to livestock production in the area. The major diseases on livestock are anthrax (*Aba senga*), black leg (*Aba gorba*), and rinder pest (*desta*). According to farmers parasites are not a serious problems.

System Trends, Constraints and Opportunities

System Trends

Due to erratic nature of the rainfall there have been changes on the type of crop and varieties grown in the area. Some long maturing maize varieties such as Hararghe and Sheye and local sorghum variety (Zengada) are being expelled from the system. Instead, short cycle maize varieties such as Katumani and militia are increasing. Short cycle crops such as tef, haricot bean and wheat (Israel and Lakech varieties) are becoming popular in the area because of good grain yield, quality for food, good market price and earliness. On the other hand traditional wheat varieties are decreasing in importance mainly due to poor yields. Relish crops such as field pea, lentil and faba bean are decreasing in importance due to severe disease and pest attack. Livestock number is declining in the area primarily due to drought and limited feed availability. Goats are increasing since they can feed on shrubs, branches and seeds of trees.

System Constraints and Opportunities

The survey identified the following areas as the major bottlenecks for increased crop and animal productivity: (1) Environmental constraints (2) Dry season livestock feed shortage (3) Pests and diseases (4) Birds on sorghum (5) Weeds (6) Low soil fertility and (7) Livestock disease. In addition seasonal labor and cash shortage in July-August, shortage of oxen and seed are among the secondary constraints that limit productivity.

Environmental Constraints

The most important environmental constraints limiting crop productivity in the area are late seasons stress and early season stress. Maize and tef are affected by both early and late season stress. Sorghum and haricot bean are suffering from late season stress and wheat from early season stress (Table 39). Due to rainfall problem, farmers are often experiencing crop failures or poor crop harvests. Farmers reported that they have encountered crop failures continuously for years (1983-1987). Farmers response to poor rainfall condition is using short cycle variety (Katumani). Livestock keeping is another strategy used by the farmers in order to counter balance crop failure.

Table 39. Rainfall problems by crop

Type of stress	Percent of growers				
	Maize n=48	Haricot bean n=35	Tef n=34	Sorghum n=19	Wheat n=14
Early season stress	33	31	47	32	71
Late season stress	38	46	47	63	29
Mid-season stress	29	23	6	5	0

Besides screening short cycle and/or drought tolerant crop or varieties, moisture conservation strategies like ridge ridging could be recommended to overcome late season and mid season stress. Near Lake Ziway and Meki River the irrigation scheme should be extended.

Dry Season Livestock Feed Shortage

Whenever there is no short rainy season there is feed scarcity in March to end of June. This period is also time for calving. Therefore, it limits productivity of cows. Oxen are not always strong to plow in May due to feed shortage. Introduction of forage shrubs such as pigeon pea, *Susbania sesban* and *Luceanea* as a hedge and alley cropping could supplement the crop residues. Moreover, the farmers need to be advised to limit the number of animals to manageable size and intensify livestock production.

Pests and Diseases

The major pests are stalk borer on maize and sorghum grass hoppers on maize, tef and sorghum. Rust is the most common diseases in haricot bean and wheat. Screening tolerant/resistant maize and sorghum varieties for stalk borer is essential. Chemical control is another alternative. Development of rust resistant wheat and haricot bean varieties would help much.

Birds on Sorghum

Since the Rift Valley is the breeding center for the Qulea birds, they cause a heavy damage on crops particularly on sorghum. Farmers grow brown sorghum varieties to reduce the bird damage. Introduction of relatively bird tolerant sorghum varieties such as seredo could reduce the loss. Moreover, the effort made by the Ministry of Agriculture to control bird by chemical spraying should be strengthened.

Weeds

The most common weeds on tef are *Galinsoga parviflora* and *Guizotia scabra*. Although one or two weeding are done depending on the weed infestation level the weeding may be done late due to overlapping of activities. Herbicide verification trials could be done to verify the results obtained in Nazret area so that the released labor could be used to weed other crops. Weeds are also problems on haricot bean and wheat. Haricot bean is not weeded due to overlapping of activities. Instead they use high seed rate and semierect varieties to suppress weeds. However, these strategies are not sufficient and there is a need to screen herbicide for haricot bean or use the labor released from tef by using herbicide on tef.

Poor Soil Fertility

The soil in Meki-Ziway area is deficient in nitrogen and phosphorus. The use of chemical fertilizer is minimal. Manuring of fields is limited by bulkiness and long distance of these field from the homestead. The optimum fertilizer rate is not known, therefore, a fertilizer response trial is necessary to determine the most economical rate of fertilizer application. More over

Agroforestry research should be intensified to select best adopting species for the area. Plantation of wind breaks is necessary to reduce the wind erosion.

Animal Disease

The major livestock diseases are Black Leg, anthrax and Rinder pest. The Ministry of Agriculture is rendering a Veterinary service to the farmers.

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