Informal Survey of YEJU Farming Systems

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INSTITUTE OF AGRICULTURAL RESEARCH

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Contents

Introduction

Surveys of farming systems are inevitable, especially in developing countries like Ethiopia where so few basic data on the field are available. Information assembled during the surveys permited the calculation of efficiency of resource use and indicated resource bottlenecks inhibiting productivity or the adoption of new technology (Dixon, 1979). Effective planning depends up on the information developed during the initial diagnostic activities (Tripp and Wooley, 1989). According to Collisons study (1987), identifying farmers' management strategies and understanding how they compromise production methods is a pre requisite for evaluating new techniques proposed for the system. The description of farmers circumstances is attained through the review of secondary data and various kinds of surveys.

Yeju awraja has never been surveyed so far. No information on the farming systems of the area is available except the study made at a micro level by the Technical Committee of Agroforestry of Ethiopia which identified this area as one of the area having a potential for improvement of productivity and sustainability through agroforestry interventions. Therefore, problems should be recognized and the root causes, both physical and socio-economic, which triggered off these problems should be assessed in detail at a micro level and subsequent actions should then be prioritized accordingly. Hence, for the knowledge of an existing land use system diagnosis is essential to plan and evaluate meaningful research and development programs. The major objectives of the study were to:

- identify common land use strategies and problems limiting production
- identify causal factors and constraints by trouble shooting production systems
- investigate the interaction between and within management units and process
- identify farmers priorities for farm improvement and the potential of agroforestry for this purpose.

Materials and Methods

Farming systems survey methodology of International Maize and Wheat Improvement Center (CIMMYT) and Diagnosis and Design (D&D) users manual prepared by the International Center for Research in Agroforestry (ICRAF), which focuses on the problem and potential of land users to determine the potential of agroforestry and to establish the priorities for agroforestry research were used.

Secondary data on the physical environment (climate, soil, topography, vegetation, etc.) were collected. Yield, demographic and socio-economic data collected in earlier times by different government and non government agencies were also gathered. Prior to the extension of the survey local officials were informed organized by development agents and extension workers.

The survey was carried out only by the department of Agricultural Economics. Though it was initially intended to incorporate all relevant disciplines in the survey, it was very unfortunate that the respective researchers could not be accessible. However, for the validity of the paper close contact and discussions with an Agroforester and fodder researchers were made. The primary sources of data for this study were small peasant farms of Yeju awraja in Northern Welo. Any representative farmer was randomly taken and interviewed informally using the guidelines. Group discussions with farmers were also undertaken in many parts of study area. Women were involved in the interview particularly for sex specific subsystems. The interview was proceeding while crops were in the field so as to get the chance of observation.

The study area

The environment

Altitude and topography

The physical features of Yeju awraja are amongst the most broken and mountainous region of Welo, varying in altitude from 1300 to 3500 meters. It can be precisely defined as the are of mountain chain (i.e, an area with series of mountains). The eastern escarpment is extremely steep, and may drop from 3500 meters to 1900 meters in 5 km to 10 km (Aggrey and Mensah, 1984). Much of the area consists of steep slopes and characterized by rugged features. The major rivers rise on the mountains spine running west to east of the escarpments with high speed. In general it is hilly terrain with large flat and undulating valley bottoms. The gently sloping lands are usually located along the hill foot slopes represent a zone of transition between the bottom alluvial lands and steeper uplands.

Soils

At foot of the escarpments, there is generally a relatively fertile valley. In contrast to the alluvial lands, the uplands are characterized by wide variations in relief, from gently undulating to very steep. According to the study made by Food and Agricultural Organization (FAO) in 1984, the dominant types of soils identified are, chromic and pellic Vertisols, vertic Cambisols, eutric Cambisols and Lithosol. The soils are widely heavy textured, varying from fairly fertile black cracking clay in alley bottoms to red clay loams on the valley sides.

Rainfall and growing seasons

The area has a bimodal rainfall pattern, i.e, two seasons; short rains occurring mostly in March and April, and long rains occurring in July up to September with a short dry spell in between. Mean annual

rainfall varies considerably with altitude dropping from 1600 mm per annum at the top, to 600 mm at the lower end, with a strong variability in time of start and finish, distribution and amount. Annual mean temperature ranges from 12 0c at 21 0c at the top and lower altitude, respectively.

The main growing season in most of the study area is from July to September it is locally called *meher*. In high lands; however, the main growing season is from March to May, which is referred to as the *belg* season. In any case, specially the highlands and mid altitudes are lucky having both growing seasons although the intensity of cropping varies for that particular reason.

Vegetation

Plant communities are an expression of unique physical and biotic conditions of an area. However, the indiscriminate destruction of forests and using the land for cultivation and/or for grazing purposes has left the lands without cover. At present very few of the survey areas are covered with natural vegetation which once was characterized by *Olea africana, Juniperus procera, acacia* spp. and countless unidentified species of trees on the slopes and in the valleys, but is now almost only Eucalyptus trees are seen around homesteads.

Socio-economic characteristics

Population

Like else where in the country population is tremendously increasing resulted in increased population density. For example, the two years data on rural population shows the following.

Table 1. Population and its density

Year	Total population	Population per total area	Population per cultivable land
1966	159 000	26	40
1989	251 684	396	626

Source: Ministry of Agriculture, Weldia

In fact figures in the third column are misleading. They are density

of the population calculated for the total area, and showing that population pressure is not a problem. The fact is the largest proportion of the total area is marginal land which does not suit for crop production. Thus the density of population calculated based on the cultivable land would most likely signifies the actual situation of the population pressure of the area. So it is possible to say population density is increased by 230 persons /km2 within about 23 years interval, and it is quite high. In addition to this figure, about 1500 disarmed militaries of the Derg government and about 9000 resettlers were registered as immigrants since a year ago. The resettlers are those people who once in the past were evicted from their home area due to severe famine hit of 1972–1973 and 1984–1985.

Realizing the serious nature of the land pressure problem and soil degradation and complete destruction of high land agricultural system, the Derg government had instituted a policy of resettling farmers on low density and virgin lands in the south and south-western part of the country mainly from Welo, Tigray, regions (1977/79 E.C). Unfortunately these days, perhaps due to instability of political situation in those areas, those people are continuously flowing back to their original areas. Specially the area under study is suffering from this new pressure.

Household member mostly ranges from 2 to 8 but in rare cases it reaches up to 12 with an average family size of 5 persons per household.

Population density increases with altitude. Particularly around towns and watersheds are excessively populated. This is to fully exploit all advantages of market and opportunity of job from the towns, and to use water for different purpose (i.e, irrigation, drink, etc.). Different settlement patterns are observed of which scattered and cluster around water sources take the greatest part. Some small villages on hillsides and near foot hills are also common.

Land tenure

Land is collectively owned by the people. No body has the right to claim land as his own private property. And hence no sale and exchange. It is only temporary specific rights of use by individuals, but has full rights to the crops, trees and grazing he produces in that particular time. Land is some times unexpectedly transferred or redistributed arranged through the peasant associations, the

government for cluster villages. Average land holding of a family is about 0.1 ha. for the highlands and the mid altitudes and about 1.0 ha. for the lowlands.

Farm incomes

From the nature of the system, crops and livestock take greater part as the source of income for the peasant farms. On the whole sorghum and tef are the backbone of the community as the source of food and cash income. Sale of sorghum stover and tef straw are additional sources of cash. Sheep, goats and sometimes cattle are also sold when a family feels necessary. Sale of garden crops such as fruits and vegetables (onion, pepper, cabbage etc) have significant contribution for the family in covering their daily expenses.

However, because of the high variability of rainfall the households often fail to produce adequate amount of their staple food crops. Still some others, due to lack of crop land fail to sustain themselves even in good years of rainfall pattern. Similarly cash income is low and mainly used to meet subsistence needs. As the result the region has been wholly aided in kind and cash since long ago.

Infrastructure

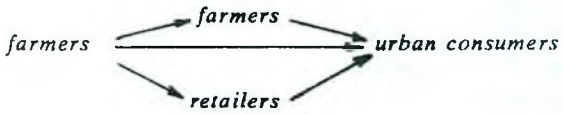
Two all weather roads, one asphalt running from Addis Abeba to Asmera and another one graveled road which extends from Weldia to Bahir Dar, pass through the study area joining only few points. The asphalt road links three towns in the awraja, Urgessa, Merssa and Weldia. Merely few feeder roads occasionally functional are joining the main roads to local market areas. Construction of road is very difficult, if not impossible, due to the notorious nature of the terrain where walking on foot is not easy. Majority of the households are out of 6 to 20 km. from the main roads.

The three towns of the awraja have postal service, telephone, and electric services. Schools, clinics, churches and mosques are available, although highly concentrated in towns.

Marketing

Variety of food crops dominate all supply. Specially sorghum and tef take the greatest proportion. The chief place of sale is in the local markets. The principal buyers to whom farmers sell their produce are retailers, urban consumers and farmers themselves.

Sales are made directly from farmers to buyers and the payment is in cash. Price is fixed by demand and supply but is mostly high since supply is always short. Donkeys and human porters are used to transport produce to local markets. The marketing channel of the area is not so complex but is simple as shown in the following relationship.



Ethnicity and religion

From the language almost all of the people of the area speak, Amarigna, it pretends that all of them are amhara people. The this language obscures the majorities ethnic group. Few old farmers interviewed, who also speak Oromiffa, explained that the new generations have been totally amarized. The young even do not know that their parents are from Oromo race. Otherwise most of the people inhabited this area are originally Oromos. However, it does not mean the number of the Amhara people are not considerable in number. And still a tremendous number of them are half casts of Oromo and Amhara.

Oromos are mostly muslims and Amharas are christian orthodox followers. Ethnic and religion have some sort of relation with altitude. High lands are inhabited mostly by christian orthodox, the mid altitudes by mixture of muslims and christians and low lands with more of muslims. New religion from the christian side, i.e., protestant is prevailing to some extent in towns.

In spite of the two opposite religions, there is no problem of cultural or political disagreements among the people. The people are sometimes not rigid to their religion. They change from one to another if the need arises. In most cases the main reason for the change of religion is marriage. Two individuals, male and female, of different religion could marry and change their religion into either.

Credit and extension

The area had been a center of war field causing security problem for the government bodies to fully execute its credit and extension

system. It is in this year for the first time since many years ago that the area is said to be peaceful. Actually there is no credit given to farmers in cash or in kind. Ministry of Agriculture freely distribute pesticides and livestock vaccines when the government determines pest and disease attack to be at economically damaging levels.

Extension system is not satisfactory. Very few extension workers penetrate the rural to the farm level. Poor extension activities are easily perceived from farmers misuse of some of their resources for which a day orientation is enough to awe them.

Findings

Farm resource assessment

Land

If not hundred percent, it is possible to say all area of land in the system is rainfed. Only a small areas of foothills endowed with streams falling from the mountains are irrigated specially for production of garden crops such as, vegetables and fruits and sugarcane. Farmers allot no special land for grazing from their own farm since land is their critical problem. They give higher priority for crop production and to feed their livestock with crop residues.

The only way to get more land is share-cropping. Oxen owners and non-oxen owners always practice this as a means with their neighbors. Non-oxen owner contributes their land only while the oxen-owner put all other necessary inputs for the production intended, that is, labor, seed, etc. Finally they share the yield in three to two ratio for oxen owner and non owner respectively. In these case non-oxen owner usually seek for off-farm works in towns or villages.

Labor

The source of labor for farm activities, like in many other regions of the country, is family members. As mentioned above in the previous section family member reaches up to 12. But It is unfortunate that great majority of the members are usually under working age. An average of only 2 to 3 members in a family are productive and are at the same time fully spend their time on their farm. All the others are offsprings to be helped. Children above seven serve their parents in herding, while those who have accesses to school are more or less out production except that they may help in some activities like weeding and harvesting during their vacation. The responsibility of farm activities lie on household heads, who are

usually the males. Women are not passive in farm practices. Though they are always bused in house holding, they weed, collect harvests and prepare threshing floors.

In spite of the fact that a greater proportion of family members are unproductive it hardly affects their produce because land size in most cases is small. The old and disabled farmers hire labor for any operation needed. There is barely any opportunity of off-farm activities particularly for distant farmers. Those who are get-at-able to towns have the chance to be hired and/or collect fuel wood for sale.

Tools and power

Traditional plowshare with its frame is drawn by oxen to cultivate farm land. This material is locally made and is available in the local markets. Normally farmers use oxen for plowing. However, in areas of very steep slopes where it is impossible to use oxen hand hoe cultivation is exercised. Households who do not have oxen obtain sometimes from their relatives, or provide feed for oxen owners and get oxen in return, and if these alternatives are not possible they go for share-cropping with oxen-owners.

Trees

Fruit trees, and eucalyptus trees are available in some farmers' compound. Eucalyptus tree is used for construction of houses of farmers themselves and/or sold for the same purpose or for fire wood to other individuals. Other trees for live fencing are also planted in homesteads and farm boundaries. Since farmers think all trees have negative impact on crops they do not want to see trees in their crop lands.

Analysis of the land use system

Land use and farm production

Mixed farming, integrated crop and livestock production, characterizes the area. Due to its rugged features of the area very small proportion of the total land is useful for production.

According to the land use study (1989) by the Ministry of Agriculture Planning and Programming section of Northern Welo, it is only

about 7% that of the study area is said to be cultivable. This tiny portion is located in valley bottoms and foot of mountains and hills. In spite of its size it suitably grows many different crops. The rest while 93% is uncultivable laid dawn to forest land, natural pasture, gorges and deep valleys etc. Out of the 93% uncultivable land, 88% is completely denuded of its natural cover, vegetation and soil, and is dry scrumland fit only for poor grazing. Many parts are over grazed and show excessive soil erosion and land degradation.

Table 2. Estimate of land use system of the study area (ha)

Total area	613 402
Cultivable land	40 184
Annual crop	39 667
Perennial crop	517
Uncultivable	573 218
Natural pasture	4397
Forest land	27 045
Construction	2641
Useless land	539 135

Crop production and management

The major annual crops grown are sorghum and tef, which together constitute more than 75% of the total area cropped, but at altitude above 2000 m., barley, wheat and beans become increasingly important. There is a reasonable double cropping in the mid and highland areas, March to May *(belg/spring)* and June to December *(mehr/ summer) season.*

Land preparation

Traditional oxen plow and rarely hand hoe on steep slopes are natural way of land preparation. It is started in February for belg crops and in June for meher crops regardless of the start of rain.

Planting: With certain period after the rain begins planting is performed in both cropping seasons. Planting of all crops is by broadcasting. There is no pronounced replanting or intercropping and usually a field is planted at one time. Farmers have their own experience of seed rate; adjusted based on soil fertility, the variety of the crops and time of planting.

Table 3. Main crops grown in both seasons and their area estimated and productivity in good years

Crop	Area (ha)	Productivity(kg ha^{-1})
Meher season		
Sorghum	16541	00
Tef	13475	00
Maize	2073	00
Chickpea	1838	40
Bean	1220	00
Pea	1113	40
Barley	1005	20
Wheat	520	00
Rough pea	533	00
Lentil	424	00
Belg season		
Tef	3120	00
Barley	700	00
Wheat	56	700
Maize	50	000

Source: Ministry of Agriculture Planning and Programming Section, 1989, Weldia.

Weeding: In general comparing the land size owned by a family and the labor it has, weed is not said to be a critical problem. But the effect of parasitic weed, *Striga hermonthica*, on sorghum crop is not simple. Normally because farmers in most cases have excess labor relative to the land they have, weeding is done several times (minimum two times) for most crops until they think no weed is left in the farm. The crop calendar for various crops grown in both seasons is shown in the following table 4.

Crop rotation and fallowing: Crop rotation is limited to few crops, and in almost all farmers of lowland and mid altitude it is sorghum ☛ tef ☛ sorghum pattern. And it is barley ☛ bean/pea ☛ wheat/oat/maize ☛ barley in highlands.

Fallowing is not all in all practiced due to land shortage problem. Hence, the absence of legum crops in the rotation of the lowland the mid altitude farmers, and the absence of fallowing in all the system put the fertility of the soil in danger.

Livestock Production

Livestock is an integral part of the system. Cattle, sheep, goats equine (donkeys, mules and camels) and chicken are managed by the house holds. Few farmers keep bees. The following is reported by the Ministry of Agriculture Planning and Programming Section in 1989.

Livestock holding is estimated at 1 head of cattle, sheep and goat for each family. All of which are local types. These people keep livestock for the following main purposes.

- Source of draft power for crop cultivation
- For milk production
- Saving or insurance

Table 4. Different classes and estimated number of livestock in Yeju awraja

Class	Number
Cattle	121 000
Equine	30 700
Sheep	140 000
Goats	120 000
Chicken	150 000

Livestock are naturally grazed during day times in the care of herdsmen or children and panelled in the family homestead at night. Cattle graze in local bushlands and farm borders while goats and sheep freely range on hillsides and valleys.

The main feeding resources are bushland/grass land and crop residues. The commonly used residues are tef, wheat, barley straw, and maize and sorghum stover or stalks. It is ridiculous that crop residues in the system are not supplementary but the principal and an inevitable without which livestock cannot survive in both wet and dry seasons. Improved pasture and forage management are not practiced in the country in general, let alone on individual farms. No significant renting in or out of grazing land but farmers exercise shared ownership of cattle. People of the higher altitude share with the lowlands who relatively have wider area of grazing.

No special shelter for livestock. Cattle and equine are stalled in the

home compound or veranda, but sheep, goats and chicken are kept in home, in which the household themselves sleep, in the night times.

Water is not as such a problem in the high and mid altitude but critical or the lowlands. The lowlands are exposed to travel at least 5 km. or more particularly in dry seasons.

Animal disease is not a pronounced problem. Veterinary services is freely regularly given for the area as a form of vaccine. Some minor diseases are locally treated by farmers themselves.

Analysis of existing knowledge in agroforestry

Traditional agroforestry

Farmers in the mid altitudes, who relatively have good access of water sources, naturally grow fruit trees intercropped with garden crops. Mostly eucalyptus tree, and other unidentified local trees are planted in households' homestead or as a live fence of their houses.

Woody perennial in the land use system

Due to old human settlement, over grazing and cereal dominated intensive agriculture, which imposes clear felling of trees and original vegetation, trees of all kinds are rare in the area. Very few Junipers procera and *Acacia abssinica* are found in less accessible areas. Sisa (*Agave sisalana*) are found in some places as boundaries and on road sides. Scattered trees and bushes on grazing lands of hillsides and marginal lands which have also repeated cutting, burning and browsing are commonly seen. But because little effort is made for research in the area they have not yet been identified.

Efforts made in the past to reforest the area

Many old men interviewed freely stated that when they were young the area they inhabited now were covered with forest or dense wood land, and springs and streams flowed where they are now none.

Taking this problem into consideration Relief and Rehabilitation Commission (RRC) had tried to reforest the area. Hillsides were closed so as to encourage natural growth supplemented by afforestation. In these lands (greater than 30% land slope) natural re-vegetation had resulted in the rapid regeneration of grasses, shrubs and tree species. In areas having 40-80% land slope afforestation

practice were undertaken together with closure. For instance, over 2 million trees were planted out of which only 9.5% survived. The reasons for the low survival could be indiscriminate species selection without considering the limiting factors and poor nursery management and insufficient management after planting.

In some parts of the area the most important tree species planted were:

Indigenous species

- *Olea africana*
- *Juniperus procera*

Exotic species

- *Eucalyptus globulus*
- *Eucalyptus camaldulensis*
- *Eucalyptus gomphocephala*
- *Acacia decurrens*
- *Leucaena leucoccephala*

Uses of tree production

Fuel

Although wood fuel is extremely scarce, most households in the system gather wood free of charge from accessible areas for domestic use as well as for sale to the town. The demand for energy or fuel wood increases with altitude as a result of a decrease in temperature. The major sources of fuel wood are crop stalk, acacia species, eucalyptus and other unidentified species.

Source of cash

One of the most sources of cash income particularly for poor farmers is the sale of wood fuel. They also make charcoal from acacia trees and regularly supply for the market. Citrus fruits and sugarcane are also marketed. The sale is to partly satisfy their need of food and clothing. The marketing channel of tree products is very simple, it directly comes from the producers and goes straight to the consumers as shown in the following relationship.

Farmers ☞ Consumers in the town /villages

However, the high marketability of trees seems the most destructive agent of trees.

Food

Citrus fruits and sugar cane are commonly produced for home consumption and for sale.

Shelter

Building poles and house construction materials are tree products. In addition it helps for fencing of compound hedges and field crops in order to protect from animal damage.

Crafts

The tradition plow parts such as handle, wings, beam and the yoke are all from of tree products. The fiber product of sisal is useful for making rope and similar materials.

Fodder

Nearly all livestock species browse tree leaves in the bushland. The researcher remarks that the above described uses of trees is not to note trees are useful in those aspects but to clearly state that the households of the system are exploiting all potential uses of trees. In spite of all these contributions and trees to the well-being of the system, farmers give no consideration to the management of even the existing trees, perhaps from lack of awareness. Hence the yield they obtain is clearly not satisfactory.

Interactions among systems

Livestock and crops

The system is mixed type. Operations in crop cultivation such as land preparation, seedbed leveling and threshing are totally performed by livestock. Plowing is by oxen while sheep, goats, donkeys, cows and calves are used for seedbed leveling. Threshing is done by cattle and donkeys. Farm transportation from fields to the store in the house and then to the local markets is by donkeys and camels. Livestock to a great extent depend on crop residues for feed. Specially cattle obtain more than 50% get their feed from crop residues. Crops which fail to give grain yield as a result of unexpected rainfall break are also grazed by livestock.

Livestock and vegetation

The impact of livestock on vegetation in the study area is negative. Cattle, sheep and goats browse tree leaves and overgraze grasses underneath. Thus, although it is hoped that these livestock partly satisfy their feed requirement, it is inevitable that the vegetation is exposed to high soil erosion (due to severe slope) and environmental degradation in general.

Crops and vegetation

The continuous increase of population pressure, particularly in mid altitude, forced the farmers to expand their farm on the marginal which in turn has led to almost complete destruction of natural vegetation. For these reason the increase in area of crop cultivation has resulted in the total reduction of forest or bush lands. However, it is undeniable that the existence of bushes on the hillsides and slopes are very helpful to the crop lands of the bottom in reducing run off and flooding during intensive rainfall.

System trends

With the change of time, the ecology of the system and farmers' circumstances are also changed. Farmers of the study area reported that there are allot of fundamental changes since 1974. The most important reasons for the changes are population pressure, which resulted in land shortage, and increase of dry season. Strictly speaking this area is producing only sorghum and tef. However, 10-15 years ago the area was known for its diversified crop production. It pretends the system is somewhat specialized in tef and sorghum. The fact farmers put forward is that since their land is very small their primary objective is firstly to maximize their staple food crop (sorghum), which at the same time is highly preferred for it has special quality of tolerating drought and is relatively highest in productivity. And secondly they want to enhance their main cash crop (tef). By the way tef by itself was originally the most preferred dish, but from the cash problem farmers face and the highest price it has these times, it is gradually changed to cash crop. Hence, in general the first chace to be planted on the available land is given to these two crops and the other crops come afterwards, if any. Because of the above reasons crop rotation has become very limited to few crops, mostly sorghum → tef → sorghum and sometimes sorghum follows sorghum and tef follows itself. Fallowing is totally abandoned. Number of livestock kept by individuals have been greatly reduced due to lack of fodder or grazing land. Many important vegetation species are no longer in existence and only scrub bushes are observed in the fields ascribed to continuous cut-off for fuel wood and construction and to increase land for crop cultivation. Because of this reason people have completely shifted to crop residues for fuel wood for home consumption or for sale. Similarly, livestock are competing for residues as natural grass lands are denuded for the same reason. As the result crop fields are always bared and have no chance to restore its organic matter which makes the soil more liable to erosion and, thereby depletion of nutrients. Marginal lands and steep slopes become under cultivation, which facilitates the development of gully erosion.

Variations within the system

So far the diagnostic survey has identified three clearly demarcate ecological zones within the study area, and hence three recommendation domains are recognized. Basically the broken and mountainous nature of the topography of the area has resulted in a high variability of altitude, and with climatic extremes. Farming system and land use strategies vary accordingly. Production limiting factors and their relative importance, and natural endowments and opportunities are also of different kinds. Thus, farmers are usually grouped into relatively homogeneous group based on their existing farming system for many reasons as mentioned above.

Table 4. Differences among recommendation domains

Criteria of main difference	Recommendation domain RD_2	RD_2	RD_3
Altitude (m)	>2000	1500-2000	<1500
Topography	Severe <50%	Sever to moderate (20-45%)	Moderate to gentile (5-15%)
Population density	high	very high	Medium
Major crops grown	barley, wheat pea, chickpea beans, oats	Sorghum, tef, maize, chickpea	Sorghum, pepper
Main growing period	belg (March-May)	meher (July-Sept)	meher (July-Sept)
Livestock population	Low	Low	Moderate
Main sources of feed	bushland and crop residue	crop residue	bushland
Dominant trees	*Juniperus procera*	Eucalyptus and Acacia spp.	Acacia spp.
Accessible to woodland		moderate	lowmoderate
Rainfall condition	very good	good	bad
Land for cultivation	very scarce	scarce	abundant
Land suitability for cultivation	bad	fair	very good

Recommendation Domain (FD) is a group of farmers with similar circumstances for whom more or less similar recommendations can be made (Byerlee and Collinson 1980).

Farmers objectives and priorities

Families have various objectives with different levels of priority, but have limited resources to realize these objectives (CIMMYT, 1985). One could observe that although there is considerable variations within the system, they have the same objectives in common to attain at with similar priorities. In general the following are farmer's most pressing objectives or needs to satisfy their families.

- Food and cash—top priority
- Shelter and fuel
- Fodder for livestock
- Saving in terms of livestock

Farmers of the different domains ranked their objectives mentioned above according to their priority needs(table 5).

Table 5. Priority objectives of different RDs

Objectives	RD1	RD2	RD3	Relative importance
Food and cash	XXX	XXX	XXX	1
Shelter and Fuel	X	XXX	X	3
Fodder	XX	XX	XX	2
Saving in terms of livestock	X	X	XX	4

XXX = Very important XX = Important X = somewhat important

Problems and their causes

Problems to production and productivity of the farming system

On the contrary to their various objectives with different levels of priority, families have limited resources to realize these objectives (CIMMYT, 1985). Hence they usually face problems that sometimes can't be solved by their own strategies. The principal problems of the study area are the following:

Erratic rainfall

It is sever particularly in low lands. It occasionally doesn't rain at all or lately start or finish early. The disturbance in duration is regular while completely dry in five to six years interval.

Lack of land for crop cultivation

Naturally the largest proportion of the area is not suitable for crop production (93% of the total). These days this part of the land is incapable to produce even forage crops and bush woods. It is becoming more critical as population is increasing beyond the capacity of the area.

Lack of feed for livestock

The main problem facing the livestock production system is the supply of feed. The shortage is highest in the dry season but compensated by crop residues, the main source of feed. However it is very critical in the cropping season when the crop lands are cultivated and occupied by crops and crop residues are also finished (June - November). Animals face seasonal weight loss, high mortality in dry season and are low in milk yield and less efficient in cultivation.

Soil erosion

The main problem resulted from the physical conformation of the region as a whole is that of soil erosion (gullies, sheet and rill) which has proceeded largely unchecked for centuries. Every valley is characterized by an enormous torrent bed of stones, flowing full at the height of rains, carrying away bridges but in dry season reduced to a trickle, if any.

Shortage of wood for fuel and construction

The supply of fuel wood and poles in the system is diminishing. The shortage has led to absolute consumption of crop residues as fuel, and thus to decline in crop yields. They use inferior items for construction purpose.

Vegetation degradation

It is largely the resultant effect of over cutting of woody vegetation to expand cropping areas.

Weed and crop pest

A parasitic weed, *Striga hermonthica* and *Stalk borer* are problems in sorghum crop. The stalk bores causes severe damage at the very young age of the crop when it rains immediately after emergence.

Water

Water shortage is critical in lowlands for both human and livestock in the dry season. During this time households are supposed to travel up to 5 Km. to fetch water and livestock not less than 10 Km.

Causes of the problems

In real sense most of, if not all, the problems are, in one way or another the result of one or the combination of the following causative factors.

Population pressure

The increase of human population resulted in increased population density and smaller and smaller holding in the limited cultivable

land, until family holdings fall below the size needed to grow the bare minimum of cultivated crop. The young people and new comers receive increasingly smaller and smaller piece of land below which they can sustain. New families are formed and periodic reallocation of holdings are made, which leads to continuous decrease in average size of holding. The problem is much worse near towns or villages and around water sources.

The increase in population density also has necessitated a greater area of land brought under cultivation. People continue to cultivate on extremely steep slopes where cultivation should ever be attempted. During the survey it was observed that many fields with a slope of more than 30% under cultivation. This has resulted in violent run-off, less water retention in relation to total rainfall and severe damage on more fertile lands below.

While increasing the cropping area, farmers are at the same time devastating the natural vegetation from the largest proportion of the areas. Much of the area has been deforested for ages for this purpose. In addition to clearing forest lands for cultivation, deforestation for construction and reconstruction of houses, especially in towns and villages, is tremendously increasing from time to time. Trees planted or naturally growing in different niches (homesteads, hillsides, valleys, etc.) become susceptible to theft. Areas near to the towns where houses are usually built on are also liable to be first cleared as well. Thus, a huge amount of trees are mercilessly cut-off without any substitution resulted in complete denudation of the system as a whole. It is this consequence which has brought the critical problem of fuel wood and construction poles at present.

The effect of population pressure did not stop with these effects. Problems caused by population pressure cause another problems. Crop residues can be very useful in protecting the soil from run-off during land preparation and crop establishment (Thomas, 1984). However, due to lack of fuel wood & feed it is regularly removed for fuel, fodder and sale. Especially the latter is dangerous from the soil conservation point of views. Similarly, crop rotation has a beneficial effect on crop growth, reduces the activity of soil born pathogens, soil erosion, weed cover and other things. The interactive effect of these parameters usually increase long-term economic crop yields (Langdale and Wilson, 1987). But its population pressure could not allow the farmers to do so, rather to select and plant their staple food only year after. Consequently, stalk borer and *Striga*

hermonthica have become permanent problem in sorghum crop. Likewise, fallowing is abandoned for the same reason in need of intensive cropping.

Land tenure

According to the land reclamation of the 1975, and from then on wards land is belongs to the people as a whole. It is not unalterable and only temporarily specific rights of use by farmers. Households repeatedly divide and redivide lands in the system for many problems they face of which the major one is political instability. In the conclusion, it is insecure form of tenure recognized as a primary cause of reduced and low productivity and consequently of shortage and famine in the country in general and in study area in particular.

For instance, one of the main elements of the proclamation which discourages planting of trees is that "no compensation shall be paid in respect of rural lands and any forest and trees on; provided that fair compensation shall be paid for moveable properties and permanent works on the land". As the result farmers become reluctant to grow trees on their farms of the time that, of course, could be belongs to someone tomorrow. Besides, farmers take no protection measures against water erosion whatever degree it may have. The maximum thing that some farmers may do is counter plowing and simple terracing in their farmers which they think merely serve to reduce sheet erosion till they harvest what they planted, but do not mind for gullies already developed. Because of the lack of proper protection from the government, all bush and forest lands have been unlawfully cleared and completely vulnerable to erosion thereby it created a problem of fuel wood and construction poled in the system.

Topography

Topography of the study area is hilly terrain with large undulating valley bottom. For this reason it is susceptible to erosion and is poor in productivity of fodder and wood products.

Cropping practice

The system of annual cropping that have developed in the areas are highly erosive for the following reasons.

- crops are often grown on slopes
- small seed crops like tef, wheat, barley, and sorghum require fine seed bed which needs criss-cross plowing. With the resultant breaking up of soil aggregates, the land becomes more erodible.
- Crops are planted in pure stand, rather than intercropped with root crops, trees and perennial crops. And if they are grown at all they are separated from the area of annual crops.

Farmers Problem Management Strategies

Farmers of the study area have their own strategies developed from long experience in order to mitigate the following problems.

Erratic rainfall

Basically sorghum comes first for this purpose, to avoid the risk of moisture stress. Farmers have a number of different varieties of sorghum most of which are local type but have a nature of responding to different climatic conditions. Although they usually have their own limitations, these varieties have some desirable characteristics, such as some are early planted-early matured, while others are late planted - early matured, still others are early planted and late matured but high yielding. Thus, farmers select their varieties depending on their rainfall expectation. Similarly, tef is liked for it does relatively better with short days of rain fall. And when it gets worse, that is, the rain scape the whole planting time of sorghum, whatever the variety may be, tef is the next crop planted on that land meant for sorghum, crop ration being ignored. However, there are still cases when farmers are forced to totally abandon planting these crops. It happens that the rain does not fall at all through the whole planting periods of sorghum and tef. In this case farmers come down to plant the minor crops like chickpea, lentil, roughpea, etc. which naturally give yield with less moisture. Never the less, this option is absent in the high lands in that they miss everything once the rain passes over the planting time of barley or wheat and bean or pea.

Land shortage

In response to increased land pressure, almost all farmers have converted their land from diversified production to few selected food crops. For instance, as mentioned above in system trend section, farmers of the middle altitudes highly decreased, if at all

they grow crops like barley, wheat maize, linseed, rape seed, finger millet, etc. and allot the land they have for sorghum and tef (their staple food and cash crop). Further more, all farmers have avoided fallowing and many of them also try to increase yields per unit area of land by intensive cropping, belg & meher, and fully exploit the potential of their land particularly where water is available for irrigation.

Water erosion

Counter plowing and simple ditches are farmers usual practice and rarely plant trees across the slope of the farm.

Stalk borer in sorghum

Actually they have no chemicals but with management practices. This pest is favored and causes severe damage when the rain falls immediately after seed emergence. To be free from, therefore, there should not be rainfall until it grows to knee height. Never the less, if it happens to rain farmers totally replow and replant again. The problem is, however, there could be a risk of moisture stress in the soil for proper germination of the replanted one.

Weed *(Striga hermonthica)*

Farmers skillfully plow the land to avoid the roots of the weed from the farm and burn it and/ or repeatedly weed at time of weeding. In spite of all these efforts farmers usually fail to achieve their subsistence objectives.

Possible solutions to the problems

Agroforestry

In previous sections many problems and constraints faced by farmers in production of crops and livestock were identified. In this section, possible solutions to some of the major problems are suggested.
As it was thoroughly discussed almost all problems are highly interrelated; a problem caused by some factors causes or at least favors another problem(s). Therefore, a remedy for a problem can be a remedy for the others too. For instance, ICRAF's Agroforestry systems Inventory project (1987) shows that prominent Agroforestry practices have solved problems like soil loss, fodder, land shortage,

shelter, etc. simultaneously in some developing countries. FAO study of 1991 also mentions that forest and trees make vital contribution to the well-being of the rural poor, providing materials, food,fuel wood, fodder and medicines. These problems are the problem of the study area indeed.

Many literatures advocate Agroforestry technologies in areas like this where fossil fuel subsidies are not possible, where trees are now absent and their products sorely missed. For example, Vergara, 1987 noted that farms curved out of upland forests and cropped monoculturally and intensively with annual plants are difficult to maintain in a productive state because of climatic, topographic and socio-economic conditions which lead to abusive use and eventual site degradation. Sustaining these farms with expensive chemical inputs seems infeasible because of the meager capital resources of upland farmers. The most viable alternative for maintaining productivity is the application of low-cost Agroforestry land use systems which promote soil conservation and minimize nutrient losses. He also added that where population pressure preclude fallowing, the better system appears to integrate agroforestry, which involves simultaneous and continuous cropping with annual and perennial. Integrating agroforestry through spatial manipulation of the crop component and selection of perennial species which maximize productivity and site protection promotes sustainability. Trees can improve productivity of crops, allow production in marginal lands and can sustain the intensification of agriculture (FAO, 1991). Experience in Egypt also shows farmers who once lost their farm lands because of the encroaching desert could produce fababean, wheat, vegetables and other crops on previously unproductive land protected by trees from decertification (Agroforestry Today V 3. No-3, 1991). It is mentioned that in the study area about 93% of the total area is marginal land, not suitable for crop production.

Therefore, the problems of the area seem to be solved through agroforestry intervention because the physical features and the overall nature of production problems and constraints indicate that the system has a high potential of Agroforestry. This implies that associating trees with crops and livestock will improve the supply of basic human needs; food, cash, fodder, shelter, energy, and raw materials.

In general, to alleviate the problems by agroforestry techniques, research is suggested in the following areas.

- Selecting fast growing multipurpose trees that are suitable for agroforestry and afforestation programs and can be used for food, fuel wood and construction materials.
- Identifying appropriate conservation-based agroforestry technologies such as, hedgerow intercropping, contour vegetation strips, agroforestry with structural conservation measures.
- Because the greatest proportion of the total area is marginal land, identifying and selecting tree species that can put this land under production would at large solve the problem of land shortage.
- Because traditional grazing resources are still relatively abundant, i.e., areas which have been over grazed and marginalized, can be put for the same purpose if research focuses on an improvement in the use of the existing grazing area with enrichment planting of fodder crops. Fodder trees can be planted else where in the system and would provide leafy fodder.

However, success in motivating farmers to practice agroforestry depends to a large extent on their perception of the economic rewards from such practice, which is greatly influenced by the nature of their tenure over land and vegetation (Vergara, 1987). If they have long term access and control over the farm, they will consider it more worth while to apply productivity maintaining techniques. On the other hand, if they have insecure tenure and face the risk of eviction, they would rationally try to maximize immediate yields & not worry about the future to produce. Hence the most secure form of tenure is private individual ownership. So modification of state tenure could over-come this disadvantage.

Conclusion

The area is generally characterized as hilly, intensive, low potential cereal zone with a climate of high rainfall diversity and occasional drought. The farmers operate production system with subsistence objectives, that is; provision of food and cash requirement to meet other similar basic needs.

Population in both distribution and size as well as its cultural orientation and practices has had a tremendous impact on the natural resource degradation. Due to long term process including population growth and relative technological stagnation in the land use, there has been extremely high degree of resource misuse. This had led the area in turn to severe ecological damage. Thus, many problems remain severe due to the prevailing socio-economic conditions. However, the argument is the poor farmers in the miserable condition can not be blamed for damaging, such as, vegetation and causing many subsequent problems in attempting to produce minimum food for their families since it prolongs their Life though it leaves the problem unsolved.

It is perfectly obvious that if this situation is allowed to continue uncontrolled, a larger and number of people will suffer annual food shortage, while the basic resources on which all depend steadily be reduced until mass starvation of the area investigated. Therefore, firstly, the need to reduce the rate of population growth in this area should not be over-emphasized because of the limited carrying capacity of the land. The present human population seem to exceed the carrying capacity of the physical resource base under the existing level of technology. The most relevant solution, however, would be the intervention of prominent agroforestry technologies. It is likely to have a potential to solve the interrelated problems of the study area at a time.

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