Enset-Based Farming Systems of Kucha Wereda Gamo Goffa Zone

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Executive Summary

Enset-based farming systems survey was undertaken in the three selected Peasant Associations namely *Daho, Bolla and Woyied*, of Kucha wereda in Gomo Gofa zone. A multidisciplinary team of researchers from Awasa Agricultural Research Center and Kucha, Integrated Rural Development Program (KIRP) was involved in the survey.

The major objectives of the study were to characterize and analyze enset based farming systems of *Kucha* wereda and identify agricultural production constraints in general and enset production constraints in particular in order to design short, medium and long term interventions that would improve agricultural productivity and consequently the livelihood of the community.

To meet the envisaged objectives, both formal and informal survey methodologies were employed to collect the necessary data for this study. Trained enumerators interviewed 92 sample households, 30 farmers per PAs. The collected survey data were analyzed with a computer software package known as SPSS 10.0 version for windows.

The enset-based farming system of the three PAs were characterized and analyzed. Opportunities and constraints of the study area were identified. All demographic, socio-economic, religion, educational status and indigenous farmers' knowledge were documented.

Agriculture is the basis for household economy. Nevertheless, farmers use traditional method of farming and agricultural production in the area is mainly for subsistence requirement. The major crop grown in the area includes maize, tef, haricot bean, enset, sweet potato, cassava, coffee, groundnut, Irish potato, wheat, barely and sorghum in their order of importance. However, the average productivity of these crops was below the national average. Livestock production is equally an important sources income for the farmers. Farmers use traditional methods of animal husbandry and they were unable to get modern veterinary services.

The result of the survey revealed that enset production systems in the area showed a declining trend as compared with the previous years. The main reasons for this were the existence of bacterial wilt disease, dead heartleaf rot, corm rot, wild animals; heavy dependence on enset, recurrent drought; use of traditional processing and storage techniques, less number of enset clones, poor soil fertility, sloppy nature of the cultivable land and soil erosion. Although livestock contributes a lot for the household economy, its production is affected by the prevalence of diseases and pests like trypanosomes, anthrax, black leg, *alkite* and seasonal feed shortage. Farmers in the study area do not have access to

agricultural credit, improved market place due to roads and transportation problems, lack of animal and human health services.

In order to alleviate the problem of inset diseases especially inset bacterial wilt, provision of training about the nature, source, cause, and transmission mechanism of the disease to inset farmers and development agents and a follow-up implementation of community based sanitary and cultural control measure considered to be a high and immediate priority interventions. Because no enset clones so far are found resistant, introduction of enset clones having better tolerant reaction to the disease envisaged to be an important task in augmenting the sanitary control measures.

Introduction and demonstration of improved crop varieties of different types, provision of credit, improving the marketing conditions in the area is essential. In addition, introduction of improved enset processing devices is important solution to reduce rural women's workload is the major short-term interventions for the area.

Introduction

Enset is cultivated as primary, secondary and tertiary important food crop in different parts of Ethiopia. It is grown as an ornamental plant in most parts of Ethiopia. The total area under inset in Ethiopia is 224, 400 hectares, whereas the total area in SNNPRS, and Oromiya are 145,860 and 78,600 hectares respectively (CSA, 1997). About 15 million (20%) of Ethiopian population depend on enset as a staple and co-staple food crop.

Enset plants are found between altitudes 1200 and 3100 m. However, it grows luxuriously in elevations between 2000 and 2500 m. Most enset growing areas receive ranging from 1100 to 1500 mm rainfall mostly between March and September. The average temperature of enset growing areas is between 10 and21 0^c. The total relative humidity was also reported to be between 63 and 80%.

Enset grows well in most types of soil if they are sufficiently fertile and drained. However, inset prefers Nitosols than Vertisols. Manure is used as organic fertilizer source in most homesteads. The soils in enset growing areas are moderately acidic to alkaline (pH 5.6- 7.3).

Enset is cultivated mainly for food. The types of food obtained from enset are *kocho, Bulla* and *Amicho. Kocho* is the bulk of the fermented starch obtained from the mixture of decorticated leaf sheath and grated corms, and true stem. Under special occasions, enset plant under vegetative stage corm is cooked and consumed and this is commonly called *amicho.*

Fiber is the by-product of enset, which left after decorticating the leaf sheaths. Enset fiber is believed to be an excellent structure and its strength is equivalent to important fiber

crop *Musa textalis*. Enset fiber has various uses to make bags, ropes, twins, cordage, mats, and as tying materials in place of nails.

Enset leaves and dried sheaths are also used for wrapping materials and for lining on the ground and pit floor and wall where *kocho* is fermented and stored. Furthermore, the leaves are also used for serving food and as a plate. Dried midrib and petiole are used for making mat and tying materials in place of nails in house construction and as fuel. Inset plants are also cut down to feed cattle especially in dry seasons when feed is scarce.

Some enset clones are used as local medication for different illness such as bone fracture, bone breakage, diarrhea, discharging of placenta, in facilitating abortion, both for human beings and animals.

In addition, enset is believed to have the following merits:

- Due to its varying growth cycle, the productions of enset obtain sustainable nature;
- Once the cycle is well established, it is possible to have sustainable yield;
- During dry season only the edge of older leaves and leaf sheathes are affected, and resume normal growth right after the on set of rainfall;
    - According to Central Planning Office (1987) about 1458 meter square land is enough to grow 63 annually harvestable plants, which will provide enough *kocho* for household having seven members, of which two third of their diet is depend on *kocho*,
- Enset plant has beneficial effects to other crops when grown as inter-crops, as coffee shade, suppress weed growth and preserve soil moisture. It is a soil enriching plant because of the foliage dropped and incorporated into the soil, it also controls soil erosion caused by rain and wind;
- In case of food shortage, enset plant can be harvested at any age of the plant and at any time of the year; and
- The storability of *kocho* for longer periods with proper management.

Kocho can be stored for longer period with out being spoiled. Under normal storage conditions, *kocho* can be stored up to 10 years.

Enset was an important food crop in *Daho, Bolla* and *Woyied* Peasant Associations (PAs) of Kucha *Wereda* (sub-district) some years ago. However, enset production in these PAs showed a declining trend. Hence, analysis of the major reasons why enset production declined in the study area is worth found to be pertinent to design appropriate intervention in the future. In addition, characterization and analysis of the farming system enables to get baseline information about crop, livestock, demographic and socio-economic characteristics of the area. Therefore, this study was conducted with the following objectives.

Objectives

The major objectives of the study were to:

- characterize and analyze enset based farming systems of *Bolla, Daho* and *Woyide* Peasant Associations (PAs) of Kucha Wereda;
- identify the major agricultural production constraints in general and enset production constraints in particular; and
- document farmers indigenous knowledge in enset production and processing.

Methodology

Data Collection

Data were collected using informal and formal survey methods in the study area. A multidisciplinary team of researchers from Awasa Agricultural Research Center conducted the informal survey using key informants in major enset growing Peasant Administrations (PAs) in the Wereda. Intensive discussion with key informants such as development agents and farmers was undertaken using interview guidelines. In order to substantiate the results of the informal survey, formal survey was conducted using structured questionnaire administered on randomly selected farmers in the study PAs.

Sampling

Based on enset production potential and accessibility of PAs, three PAs namely *Bolla, Daho* and *Woyide* were selected. Discussion was made with farmers and researchers to collect background information about the area. One-day training was given to enumerators on the contents of the questionnaire, objective of the study and general survey methodologies. All of the enumerators were 12 grades complete and fluent speakers of the local language *(Gofa).* Before conducting the actual survey, the enumerators conducted pre-testing of questionnaire and all necessary modifications were made on the questionnaire after the pre-test. A total of 92 households and 30 households from each PA were selected randomly. Among the 92 samples, only 60 of them considered for data analysis due to data collection problems. Data were analyzed using a computer software package called SPSS version 10.00 for windows.

The Study Area

Geography

Kucha is one of the wereda among the 13 weredas in Gamo Gofa zone in the Southern Nations, Nationalities and Peoples' Regional States (SNNPRS). Kucha is located between 6^0 5" N-6^0 30" latitude and 37^0 17"E-37^0 40" E longitude. It is bounded by Ofa werda of Wolayta zone to North, Loma Bossa of Dawro zone to Northwest, Boreda and Chencha wereda to the east, Daramallo wereda to south, and Zalla and Goffa zuria weredas to the west.

Agroecology

The altitude of Kucha wereda ranges between 1000 and 2250 meters above sea level (m), the total area of the wereda is estimated to be 138,422 km^2 (CSA, 1989). In the wereda there are two dominant agro-ecological zones namely *Woina dega* (mid-altitude) and Kolla (low altitude) accounting for 50.6% and 49.4% of the total area respectively. Most part of the area lies in the Omo drainage basin.

Topography and Soils

The topography of the wereda is represented by 20% and 35% flat and steep to gentle slop respectively. Mountainous part and gorges represent 35% and 10% respectively. The feature of the terrain is higher at the center and gradually decreases towards northeast and southwest. The dominant soil types of the area based on color are gray followed red and black. Fertility status of the soil is medium and low in the higher and lower altitudes of the study area, respectively. According to key informants, the soil fertility status of this PA reported to be low due to frequent cultivation of the land and

the prevailing soil erosion. Based on the color types, farmers locally classify soils of the area as *Tella* (black soil) *Gobbo* (red soil), *Anchuwa* (sandy soil), *Bokinta* (stoney soil and *Gorbuwa* (gray soils).Except *Tella* soils, other are workable. *Gobo* and *Tella* soils cover large area.

Rainfall

The study area is described by bimodal type of rainfall namely *Belg* (short rainy season) and *Meher* (main rainy season). The *Belg* rainfall starts on February and ends on March while the *Meher* starts on July and ends on October.

Land Use

Farmers allocate their land for various purposes such as for annual crops, perennials, grazing and forestland depending on the fertility status of the land. The average size of cultivated, grazing and forestland in the study area was estimated to be 1.44, 0.46 and 0.37 ha, respectively. However, the average farm size by farmer group in the study was indicated in Table 1. In the study area, the average farm size of the sample farmers was estimated to be 2 hectare.

Table 1. Average farm size by farmer group in ha

	Average size (ha)	
Farm size (ha)	N	% of sample farmers
Less than 1.0	19	31.7
1.1-1.5	4	6.7
1.51-2.5	23	38.3
Greater than 2.5	14	23.3
Total	60	100

Thirty-two % of the sample farmers have an average farm size less than 1 hectare. However, the majority of the sample farmers have an average farm size 1.51 to 2.5 hectares. From this is can be concluded that shortage of land is not a problem in the study area and farmers in the study area have a farm size above the national average, which is 0.8 hectare (CSA, 1994).

The land tenure patterns of the study area are characterized by owner operated and shared cropping systems. Under share cropping system a farmer who do not have land provide his labor to the landowner while the landowner give his land and inputs to be repaid at harvest. At the end of cropping season, the partners share the benefit equally based on their initial agreement.

Demographic and Socio-Economics Characteristics

Most of the communities were permanently settled in the area. Majority of them reside in villages constructed at the higher and mid altitudes than lower altitudes due to the prevailing human and livestock diseases. The total population of the wereda is 102,598 of which 52,534 lives in the project area (CSA, 1994).

The average family sizes of the samples farmers were found to be about eight persons. This figure is above the national average of family size 5 persons (CSA, 1994). The largest and smaller family size recorded in the study area were 18 and 1, respectively. The average number of economically active family member between 15 and 45 years old was three persons (Table 2). Moreover, the average family members for each household was below 15 and above 45 years old were shown in table 2

Table 2. Age group and average family size of sample farmers

Age group	Mean	SD
Children<5 years	2.11	1.13
Children 6-14 years	1.7	0.96
Adult between 15 and 45 years	3.02	1.45
> 45 years	1.67	0.76
Average family size	8	

The average age of the household head was found to be 45 years old. The maximum and minimum ages of sample

farmer were 75 and 24, respectively. The average farm experience in the study area was about 25 years, such long experience suggest that most farmers have a good knowledge about the farming systems of the areas.

Education, Religion and Marriage

Regarding the educational status of the sample farmers, 68 and 32 % of them were found to be illiterates and literates, respectively (Table 3). Most of the farmers that are categorized under literate were at primary school level.

Table 3. Educational status of sample farmers

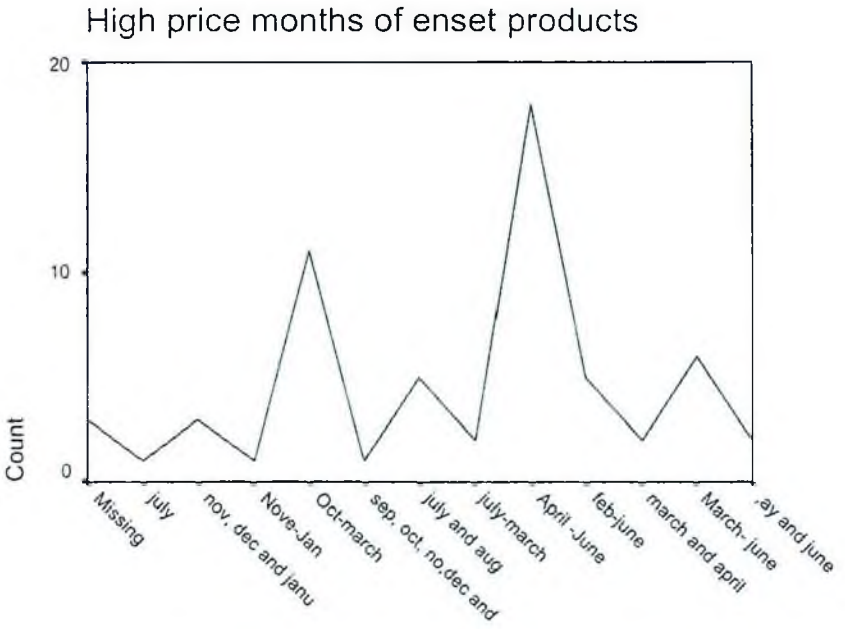
Educational status	PAs							
	Daho		*Bolla*		*Woide*		Total	
	N	%	N	%	N	%	N	%
Illiterate	14	34	14	34	13	32	41	68
Literate	6	32	6	32	7	37	19	32

There are two dominant types of religion in the study PAs. About 48 and 45 % of the sample farmers were followers of Orthodox and Protestant Church, respectively. While the remaining 6.7 % of the sample farmers were reported to have no religions. According to the survey, 88.3 % of the sample farmers were married, while 3.3%, 3.3% and 5% were found to be as single, divorced and widowed, respectively.

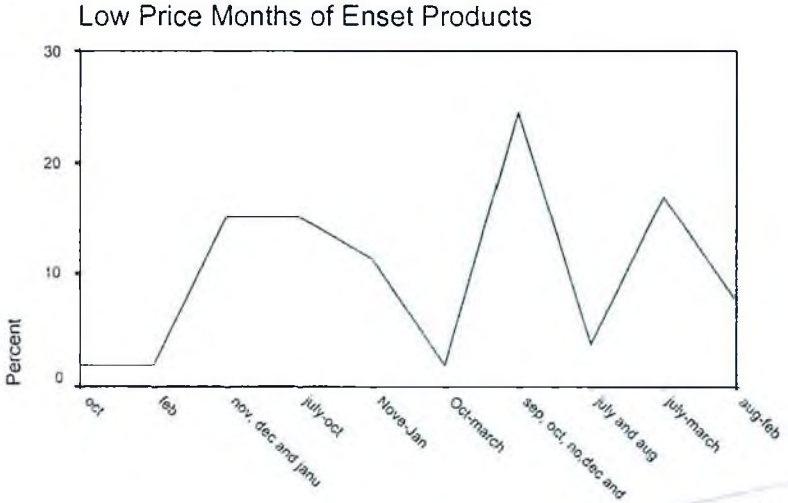
Household Income and Expenditure

Both crop and animal products are the major sources of income for farmers in the study area. Enset products such as *kocho, bulla, amicho* and fiber are commonly traded in local markets. However, the supply and demand conditions for these products vary depending on seasons and availability of other cereals in local markets. However, the results of the survey indicate that the price of enset products such *as Kocho, bulla and amicho* usually increased between April and June. This is because, in these months most of the farmers

indicated that grain reserves usually finished and people change their consumption pattern towards root crops including enset (Figure 1).



However, when the supply of other cereals increased in local markets, enset products consumption usually decreased. The results of the survey indicated between September and January, the price of enset products such as *kocho, bulla and amicho* relatively decreased. This is because the supply of annual crops increases in local market (Figure 2).



The amount of income obtained per annum from enset and livestock products is estimated to 777.1 birr (Table 4). If the income obtained from annual crops added, the figure relatively increased. Since farmers were not interested to give information about the actual yield obtained from crops per hectare, it was not included in the present calculation. Livestock products such as butter, cheese and egg are important sources of income for farmers. The average amount of milk obtained per year was estimated to be 56 liters. Few farmers reported to have more than four milking cows at a time. As a result, the amount of milk obtained per months reaches up to 500 liters. Kucha wereda is well known for its high quality butter product. As a result, farmers in the area are not interested to sale milk rather they prefer to sale butter.

Table 4. Proportion of annual income obtained from enset and livestock

Products	Average amount (birr)
Amicho	10
Kocho	16
Bulla	13
Fiber	5
Cheese	125
Egg	36
Butter	566
Total	771

Agricultural Credit

Provision of credit is an important service and believed to enhance agricultural production especially for subsistence farmers. The result of this survey indicated that about 40 % of sample farmers found to obtain credit services in different form from different sources while 60 % of them do not have access to credit. Farmers' reasons not to use credit are indicated in Table 5.

Table 5. Reasons not to use for credit

Reasons	Peasant Associations						Total	
	Daho		Woyide		Bolla			
	N	%	N	%	N	%	N	%
Absence of credit institutions	11	48	3	13	9	39	23	64
Low repayment capacity of farmers	1	20	3	60	1	20	5	14
Absence of credit institutions and low repayment capacity of the farmers	-	0	-	0	2	100	2	5.6
+0l1147ndebtedness	-	0	1	100	-	0	1	3
High interest rate	-	0	1	50	1	50	2	6
I do not need credit	-	0	-	0	3	100	3	8
Total	12		8		16		36	100

As shown in the Table 5 absence of credit institutions and low repayment capacity of the farmers were found to be important constraints that hinder credit use. However, variations among PAs were observed with regard to the reasons why they do not use agricultural credit.

Farmers use credit for different purposes like for household consumption, clothing, and school fees, medication, land rent, petty trade and for any purpose depending on the prevailing problems. Farmers have different credit sources such as relatives, neighbors social saving and they utilize the credit for different purpose.

Table 6. Sources of credit

Sources	N	%
Relatives	17	68
Neighbors	7	28
Local saving schemes	1	4
Government	-	
NGOs	-	
Total	25	100

Table 6 depicts that 68% of the farmers in the study area obtain credit from their relatives followed by neighbors. Nevertheless, none of the sample farmers reported to obtain credit neither from government nor from NGOs. Hence, it can be concluded that both governmental and non-governmental organizations should design appropriate credit scheme in the areas based on farmers' interest.

Marketing

The majority of the sample farmers in the study area use local market in order to sale their produces. There are few numbers of buyers and sellers in this market. Transactions were made most of the time among farmers themselves and it can be said that there is no market intermediaries for the majority of the products. On the average, they travel about 6 km to sale their produce to the nearby local market at lower prices. The nearest big (urban) market place was located in the capital of Kucha Wereda, *Selamber*, which is about 60 km from these PAs. If a farmer wants to sale his produce in *Selamber*, he will to travel about 6 hours on foot. Almost all respondents reported that they carry their produce to nearby market. Sometimes donkeys and horses are used for the same purpose.

Table 7. Current price of major crops

Price Trend	N	%
Increased	40	73
Decreased	14	25
No change	1	2
Total	55	100

About 73 % of the sample farmers reported that the price of major crops increased in local markets (Table 7).

As indicated in Table 8 absence of nearby market place found to be the primary constraints of marketing. About 26 % of the sample farmers reported that marketing of agricultural products is not a problem. These farmers indicated that the problem is to get marketable surplus. Due to frequent occurrence of drought farmers usually face food shortage. However, according to the information obtained from group discussion, absence of nearby market and transport were considered as the primary constraints of marketing.

Table 8. Major problems of marketing

Constraints	N	%
Absence of nearby market place	22	38.6
Transport	9	15.8
Absence of whole sellers	3	5.3
Road	2	3.5
Limited number of market days per week	5	8.8
Lack of marketable surplus	1	1.76
No problem	15	26.4
Total	57	100

Crop Production

Major Crops

According to the discussion made with farmers in *Daho* PA, the major crops grown in the study area include maize, tef, taro, beans, sweat potato, coffee, yam, banana, barley and mango, avocado and lime. Crops diversity are decreasing due to erratic and decreasing amount of rainfall received in the area. Wildlife such as, pig, monkey, and apes, damage and the prevalence of new disease in the area also contribute for the declining of crop production.

Similarly, farmers in *Bolla* PA indicated that the major crops grown in their order of importance are maize, tef, haricot bean, enset, sweet potato, cassava coffee, groundnut, Irish potato, wheat, barley and sorghum.

Table 9. Major crops grown in *Belg* and *Meher* seasons

Crops	Seasons	
	Belg	*Meher*
Maize	✓	✓
Tef	✓	✓
Haricot bean	✓	✓
Enset	✓	✓
Sweet potato		✓
Cassava	✓	✓
Coffee	✓	✓
Groundnut	✓	✓
Irish potato	✓	✓
Wheat		✓
Barley		✓
Sorghum		✓
Faba bean		✓
Field pea		✓

Crop Productivity

Majority of the farmers in this area uses local variety for each crop types mentioned in the above. Moreover, most of the farmers in the study area do not use inputs like fertilizers, pesticides, recommended cultural practices such as spacing and row planting. According to the farmers, the yield of maize, tef, haricot bean, enset, groundnut, Irish potato, wheat, barley, and sorghum yields were found to be very low as compared with the national average yields of improved crop types of the same crops. This is because they are using local varieties with traditional method with out employing recommended inputs.

Crop Production Constraints

Crop yield in the study area decreased because of the declining soil fertility, lack of improved crop varieties and types, improved practices and inputs. In addition, shortage of rainfall, pests and disease were reported as the major constraints for crop production. According to the discussion made with farmers the major crop production problems in the area were indicated in Table 10.

Table 10. Major crops and their diseases

Crop	Major disease
Sweat potato	Sweet potato butter fly
Maize	Maize stalk borer
Coffee	Coffee berry disease (CBD)
Enset	Enset bacterial wilt

Farmers use animal urine in order to minimize the damage caused by sweet potato butterfly. Farmers cut the whole plant to protect their coffee plant from CBD attack.

Enset Production and Processing

History and Trends

Enset cultivation in the study area started very long time ago. Some of the sample farmers reported that enset cultivation started during ancient times. Moreover, they informed that they got knowledge and experiences about enset production practices from their elder ancestors. About 78 % of the sample farmers reported that enset production in the study area showed a decreasing trend (Table 11).

Table 11. Trends in enset farm size since the last 30 years

Trends	N	%
Increasing	12	20
Decreasing	46	78
Constant	1	2
Total	59	100

In contrast, some farmers reported the existence of increasing trend. This is because enset tolerates drought and the crop is more productive as compared to other crops. The most important factors influencing to the decline of enset farm size in the last 30 years was indicated in Table 12.

Table 12. Reasons for the decline of enset farm size as compared to 30 years back

Reasons	N	%
Enset bacterial wilt	17	36.2
Drought	6	12.7
Heavy dependence on enset	3	6.4
Inset bacterial wilt, grotto (corm rot) and mole rat	11	23.4
Soil fertility decline	2	4.2
Shortage of labor and land	8	17.1
Total	47	100.0

About 34 % of the sample farmers reported that enset bacterial wilt disease is an important problem that contributes to the decline of enset farm size. Next to this disease, gartto (corm rot), mole rat, porcupines, drought, heavy dependence on enset and soil fertility decline also influenced enset production system in the area. The magnitude of the decline in enset farm size was indicated in Table 13.

Table 13. Farmers' response about the current farm size as compared to 30 years back across three Pas

Farmers response	Peasant Associations					
	Daho		*Bolla*		*Woyide*	
	N	%	N	%	N	%
Decreasing by half	10	23.8	20	47.6	12	28.6
Decreasing by quarter	-	-	-	-	3	100
Increasing by half	1	100	-	-	-	-
Increasing by quarter	8	72.2	-	-	3	27.0
Total	19		20		18	

The majority of the farmers in *Daho, Bolla* and *Woyide* PAs reported that enset farm size decreased by half as compared to 30 years back.

Enset Clones

Farmers in the study area differentiate enset types by giving local name. Farmers also recognize each clone from the other phenotypically with the color of petiole, mid-rib, sheath and other visible characteristics. Farmers grow mixtures of enset clones for diverse uses. The majority of the sample farmers reported that about nine *enset* clones to be popular in the area. About 42 % of the sample farmers indicated that clone *nekaka* is the most popular clone among others followed by *hala* and *gena* (Table 14).

Table 14. Vernacular names of popular enset clones in the PAs

Clones	N	%
Chichiya	3	5.1
Arkiya	1	1.7
gena	8	13.6
Nekaka	25	42.4
keteniya	4	6.8
Tuffa	1	1.7
Hala	9	15.3
Maziya	1	1.7
Kebeniya	3	5.1

Sources of Enset Clones

Even though inset plants are known to have wider adaptation, some inset clones were reported to show vigorous and luxurious growth within specific ecologies while poorly performs in the different ecologies. Farmers of the study area also described the vernacular name of nine enset clones with their specific geographic source and adaptation under the three PAs (Table 14). Enset clonal diversity also informally reported to vary agro ecologically. Higher inset clonal diversity was reported to exist in higher altitudes (*Dega*), as compared with the mid (*Woina dega*) and lower (*Kolla*) altitudes. Except *Ketenya* and *Mezya*, the remaining inset clones were reported to be original clones of *Dega* and kola areas, however, only five enset clones were originated from *woina deg* area (Table 15).

Table 15. Sources of enset clones for the three agoecologies

Clone	*Dega*		*Woina dega*		*Kolla*	
	N	%	N	%	N	%
Arkiya	1	25	1	25	2	50
Banga	1	25	-	-	3	75
Gena	3	75	-	-	1	25
Halla	4	57.1	3	75	-	-
Keteniya	-	-	-	-	1	25
Meziya	4	57.1	3	75	-	-
Nekaka	2	40	2	50	1	25
Tufa	2	50	1	25	1	25
Chichiya	1	25	-	-	3	75

Selecting Enset Clones

Farmers in the study area grow diverse inset clones in their inset field. They indicated the criteria for selecting clones. The different criteria used given by respondents in selecting inset clones are listed in the Table 16. Accordingly, majority of sample farmers indicated that drought tolerant, productivity of *kocho* and disease tolerant to be the most important criteria in selecting inset clones as compared with the remaining criteria (Table 16).

Table 16. Farmer criteria for enset clone selection

Criteria	% of sample farmers	
	N	%
Drought tolerant	12	20.0
Productivity of *kocho* and *amicho*	10	16.7
Animal feed	2	3.3
Preferred for *amicho*	7	11.7
High sucker number	2	3.3
Early maturing for *Koch* & *amicho*	4	6.7
Tolerant to diseases	10	16.7
Availability of planting material	2	3.3
Clone with vigorous growth as wind break	1	1.7
Productive as well as diseases resistant	5	8.3
Harvesting any time of the year	3	4.0
Female inset for *kocho* quality	2	3.3

Among the enset clones grown in the study area, clone *Nekaka* and *Halla* ranked first for *kocho, Bulla, Amicho* products. clones *Gena and Halla* for fiber; *Gena* for feed, and *Halla* for drought and disease tolerant; clone *Nekaka* ranked second for drought tolerant and fiber; clone *Meziya* ranked second for *kocho*, fiber and animal feed and clone *Gena* for bulla (Table 17). Though many farmers do not have clone *Lochingie,* those who have this clone indicated that *lochingie* clone to have medicinal value for both human being and animals.

Enset clones *Arkya, Chichia* and *zinkie* are preferred for *kocho*. Clones *Gena, Nekaka and Chichiy* are good for bulla. *Chichiya, Tufa* and *Keberia* are good for *amicho* and *Gena, Halla, Nekeka* and *Chichiya* are good for fiber. Clones *Chichya* and *Halla* are reported as disease tolerant, while *Gena,*

Nekaka and *Ketene* were reported as they are withstanding rainfall shortage. Enset clones such as *Nekaka, Gena* and *Chichiya* are preferred for their mid rib quality and sold for making rope (Table 17).

Table 17. Farmers' rank of enset clone based on some characteristics

Clones	Traits						
	Drought tolerance	*Kocho*	*Bulla*	*Amicho*	Fiber	Disease tolerant	Feed
Nekaka	***	***	***	***	**		
Mezya		**			**		**
Gena	***		***		***		***
Halla	***	*	*	***	***	***	
Chichya		***	***	***	***	***	
Keteaya	***	***					
Arkya		***					
zinkie		***					
Tufa				***			
Keberia				***			

Cultural Practices

Propagation

All sample farmers practice vegetative propagation method in enset cultivation. Farmers use enset corm, underground stem for sucker production. About 95 % of the sample farmers practice half corm for sucker production while only 5 % of them use whole corm.

Corm planting

Corm planting is mostly undertaken between November and March. However, majority of the farmers reported that January and February are appropriate time for corm planting. To produce enset sucker, corms from enset plant have ages of 2-3 years old are uprooted, split, exposed and aerated for one day before planting.

Stages of enset plants

The first stage *Osha,* which is a younger stage of sucker, as it grows, called *Hatta.* After one year *Hatta* will be transplanted

to the next stage called *Boshesha* stage, After one year *Bohesha* will be transplanted to *Gardwa*. After two to three years in the same place the *Gardwa* stage complete it cycle and called *Utta*. In the study area, it was identified that a total of 5 to 6 years is required from first to last enset stage (Table 18).

Table 18. Names and duration of enset stages

Stage	Local name of growth stage	Durations for each stage (year)
1st	Osha/Hata	1
2nd	Boshesha	1
3rd	Gardwa	1
4th	Utta/Latt	2-3

Generally, in the study area, sample farmers identified four different stages of enset. The duration at which each enset stage maintained in the field found to vary from 1 to 3 years. The first stage, *Osha/Hatt*a, maintained in the same field for one year, while the second and third enset stages maintained for one year before taken in to the next respective stages namely, *boshesha and Gardwa*; the third enset stage *Gardwa* stay in the same field for 1 year before it transferred in the fourth stage, *Utta /Latta* (Table 18). The *Utta* stage will be harvested after maintained 2-3 years in the same place.

According to key informants, after two months suckers are emerged called in *osha* (Healthy) it stays about a year and transplanted. During transplanting big sized suckers are planted separately while small sized suckers are planted in-group and both called *boshesha,* after about one year *boshesha* is transplanted to permanent field called *Uttta.* Normally enset produce viable seeds, but some farmers in the study area believed that the whole of the family would die if enset plant from seedling were matured and harvested.

Farmers in the study area frequently transplant enset plant from *Boshesha* to *Utta* stage about five times in one enset crop cycle. The research findings revealed that such frequent

transplanting inflict shock effect and delay maturity of the plant.

As described in the earlier section, the different enset stages allowed staying in the same filed period before transplanting into the next stage. The transplanting operations took place during the dry period of the season between December and May. There is no transplanting operation at *utta* or *latta* stage. Generally, February and March were reported to be the peak transplanting months for all enset growth stages. As described for corm planting, transplanting for different growth stages of enset was undertaken when the rainy season starts.

Planting Method

Both row and random planting methods are commonly practiced in the survey areas in enset production. However, the planting methods vary between different stages of enset. Except for *Boshosha* stage, many farmers practice random planting methods for the rest of all enset stages. Random planting is mainly practiced in *osha, hatta, gardwa and utta* stages as compared with row planting method. However, many farmers reported that they use row-planting method at *Boshesha* stage.

Table 19. Planting methods at each stage

Planting methods	Enset stages									
	Osha		*Hatta*		*Boshesha*		*Gardwa*		*Utta*	
	N	%	N	%	N	%	N	%	N	%
Row	10	18.5	19	44.2	52	96.3	9	20.5	5	23.5
Random	44	81.5	23	53.5	2	3.7	34	77.3	16	76.2
Both	-						1	2.3		

Leaf Removal and Collapsing

Leaf removal and leaf cutting are part of the activities reported by farmers in enset management. Most of the sample farmers reported as leaf cutting is undertaken at

Boshesha and *Gardwa* stages. Nevertheless, few of the sample farmers reported that leaf cutting is not usually practiced at earlier enset stages. Similar type of response was observed for leaf collapsing.

Table 20. Removal and collapse of enset leaves

Enset stages	Leaf cutting				Leaf collapsing			
	Yes		No		Yes		No	
	N	%	N	%	N	%	N	%
Osha	10	19.6	41	80.4	7	13.7	44	86.3
Hatta	21	51.2	20	48.8	11	26.8	30	73.2
Boshesha	24	46.2	28	46.7	7	13.5	45	85.5
Gardwa	33	76.7	10	23.3	13	30.2	30	69.8
Utta	22	66.7	11	33.3	11	36.7	19	63.3

Intercropping

In the study area intercropping of enset with maize, taro, yam, coffee, sweet potato is reported to be the common practice (Table 21). Few farmers reported that intercropping is rarely practiced at *utta* / final stage of enset.

Table 21. Crops intercropped with different enset stages

Crops intercropped	Enset stages									
	Osha		*Hatta*		*Boshesha*		*Gardwa*		*Utta*	
	N	%	N	%	N	%	N	%	N	%
Maize	14	48.3	13	59.1	6	40	16	76.2	2	28.6
Taro	4	13.8	1	4.5	2	13.3	1	4.8	-	-
Yam	7	24.1	3	13.6	1	6.7	2	9.5	-	-
Coffee	3	10.3	5	22.7	3	20	1	4.8	5	71.4
Sweet potato	1	3.4	-	-	3	20	1	-	-	-
Cotton and maize	--	-						4.8	-	-

Manure Application

Naturally, enset grows vigorously on fertile soils where cow dung is applied heavily. In the study area, manure was applied throughout the year at *hatta* growth stage. Majority of farmers reported that April is the most appropriate time for manure application in all growth stages of the enset. None of

the sample farmers reported to use inorganic fertilizer for their enset plant.

Methods of applications

Farmers use ring, side, broadcasting and combination of the different methods of manure application, however, methods of application vary depending on inset growth stages.

Table 22. Methods of manure application at different enset stages

Methods	Enset stages									
	Osaha		*Hatta*		*Boshesha*		*Gardwa*		*Utta*	
	N	%	N	%	N	%	N	%	N	%
Ring	22	46.8	4	10.5	5	9.8	3	7	1	3.6
Side	14	29.8	15	25	33	64.7	7	16.3	9	32.1
Broadcast	10	21.3	18	47.4	12	23.5	31	72.1	17	60.7
Ring and broadcast	-	-	-	-	-	-	-	-	-	-
Ring and side	1	2.1	1	1.7	1	2.0	1	2.3	-	-
Broadcast and ring	-		-	-	-	-	1	2.3	-	-
Broadcast and side	-								1	3.6

From the above table, it can be said that farmers apply manure to enset plants at all stages. They also reported that they practice different methods of manure application like ring, side, broadcast and combination of the methods at different stages. Among the sample farmers the majority of them reported that ring, side and broadcast application to be commonly applied on *osha, Hatta, Boshesha, Gardwa* and Utta enset stages, respectively. According to the sample farmers, combinations of the different methods of manure application are also practiced rarely (Table 22).

Rates of application

Farmers in the study area applied various amount of manure at different stages of enset (Table 23). As indicated in the Table 23, the average rate of manure applied ranges from 23 to 124 kg regardless of enset stages. Moreover, the maximum, minimum, and mean rates of manure applied for respective enset stages. However, the highest amount of manure is applied at *Utta/ Latta* stage.

Table 23. Amount of manure applied for various stages of enset

Stages	Amount(kg/plants)			
	Maximum(kg)	Minimum(kg)	Mean(kg)	SD
Osha	100	4	23.095	20.80
Hatta	1200	4	68.493	19.92
Boshesha	170	5	42.104	39.64
Gardwa	800	5	97.31	53.90
utta/batta	2000	4	124.391	37.56

Activity Calendar for Different Enset Stages

Farmers in the study area undertake different operations, at different enset stages during specific months of the year in enset production and processing (Table 24). Some of the activities were indicted to be extending continuously through out the year, while most of the activities are undertaken for about 4 to 5 months within a year time. In most cases, enset field activities are restricted during the drier season as compared with the rainy season (Table 24).

Table 24. Activity calendar of enset stages

Activities	Months											
	S	O	N	D	J	F	M	A	M	J	J	A
Corm planting		*	*	*	***	***	**					
Sucker weeding												
Sucker transplanting							***					
Osha transplanting												
Osha manuring	*	*	*	*	***	**	**	****	**	*	**	**
Boshesha transplanting							****					
Bashasha weeding			*	*		***	***	****				
Bashasha manuring				*	***		**	****	*	*	***	*
Gardwa transplanting							****					
Gardwa weeding			*	*	*	***	***	***	****			
Gardwa manuring						****	****	****	***		****	****
Hatta transplanting												
Hatta weeding			*	*	*	***	***	****				
Hatta manuring					***	***	****	****	****	***	****	****

** as the number of asterisk increases the higher the responsibility of household members*

Enset farmers allocate their time for different activities throughout the year. Sample farmers also indicated that the major activities and months of the year at which specific operations are undertaken. January and February are peak

times and different activities overlap. Some of the activities were reported to extend continuously up to 10 months, while most of the activities extend up to 5 to 6 months (Table 25). The table clearly indicates that the months of the year at which farmers are tied up with overlapping activities and the critical labor demand period for the household for enset production and processing.

Table 25. Activity calendar for enset production, processing and marketing

Activities	S	O	N	D	J	F	M	A	M	J	J	A
Land preparation for corm planting		*	*	*	***	***	**	*				
Sucker planting			*		***	***						
Sucker transplanting			*	*	**	**	*	*				
Weeding					**	**			*	*	*	
Enset hoeing		*	*		**	**	**					
Manure application	*	*	*	**	**	***	**			*	*	*
Enset processing					*	**	**	*	*			
Marketing					*	*	*	***	***	*		

**as the number of asterisk increases the higher the responsibility of household members*

Production and Processing Constraints

The main production constraints of enset in the study area as reported by the sample farmers and key informants are diseases and pests, drought, poor soil fertility, poor performance of traditional processing devices (Table 26).

Table 26. Major constraints of enset production

Problems	% of sample farmers	
	N	%
Diseases (inset bacterial wilt, *gotti, sheilo*,etc)	23	41.4
Shortage of rain fall	8	14.4
Low soil fertility	4	7.0
Lock of improved enset processing devices	4	7.0
Land shortage	3	5.3
High emphasis to other annual crops	1	1.8
Shortage of manure supply due to less number of lives tock	2	3.5
Market to sale inset and\inset products	1	1.8
Unavailability of improved enset clones	1	1.8
Topography of the land	1	1.8
Wild life (mole rat, porgies)	2	3.5
Shortage of labor	2	3.5
Heavy pressure on enset	2	3.5
Un appropriate land preparation	2	3.5
Lack of money to buy knife	1	1.8
Shading effect	1	1.8
Total	57	100

Diseases and Pests

Diseases

Several types of enset diseases were known to affect enset plants under field conditions. So far, a number of fungal, nematode, viral and bacterial diseases were reported to cause damage at different degree of intensity. The occurrence, distributions and the incidence level also indicated to vary from one enset growing locality to the other. The damage inflicted by each disease also noted to vary. Among these, enset bacterial wilt is considered as the most important one that reduce enset yield. Enset pest like enset root mealy bug is also considered as a serious problem of enset production in some areas. Wild animals, such as mole rat, porcupine, monkey and others were also reported to cause heavy damage to inset plant.

Farmers' perception, local names, symptoms of enset diseases

Among the biotic constraints, enset diseases such as enset bacterial wilt, locally called *Welo*, dead heart leaf rot (*Sheillo),* and enset corm rot (*Gottia)* were reported to be important bottleneck of enset production in the study area. Farmers have a good knowledge in describing each enset disease types based on their field symptoms.

Various disease types and mole rat were reported as the major constraints to inset production in the study area. The types of enset diseases and their local names and respective field symptoms were clearly described by the sample farmers in the area (Table 27).

Among the diseases, *welo* and *shelo* were reported to be equally important. Enset plants infected by *welo* will totally

die after a given period while those *enset* plants infected by *shelo* found to wilt and die rapidly. Moreover, due to its rapid killing nature farmers consider *Shielo* to be serious one as compared with w*elo.*

According to the information obtained during group discussion, bacterial wilt of enset occurrence in the area has been started long ago. It showed an increasing trend. They believe that this disease come along with snake. Moreover, they also explained the reasons that the incidence of enset wilt became high as the number of this particular type of snake population became high in the area.

Table 27. Local name of enset diseases and their symptoms by key informants

Local name	Scientific name	Caused by	Field symptom
Welo	Enset bacterial wilt (EBW)	*Xanthomonase species*	Wilting of central shoot leaf with yellowish color, outer leaf dry gradually kills the whole plant. When splitting the leaf petiole and sheaths, yellow oozes are visible in the air pockets.
Sheilo	Dead heart leaf rot	Unidentified bacteria	Central shoot leaf will rapidly wilt and true stem rot.
Gorttiya	enset Corm rot	Unidentified bacteria	The corm part rots and plant easily toppled.

Bacterial wilt

As farmers in the study area described about the disease conditions, relatively similar reports have documented at the national level. Dagnachew Yirgou (1968) first reported enset bacterial wilt in Ethiopia. It is caused by a bacteria called *Xanthomonas campestris pv. musacearum.* It is reported to occur only in Ethiopia. The diseases attacks also banana. It is a systemic disease and attacks the vascular system of enset plant. It blocks translocation and result initial wilt and ultimate death of the whole plant. It is widely distributed in all enset growing areas of the country with different incidence level.

The continuous and intensive cultivation of enset in the same field coupled with traditional practices, which stem from the ever increasing of human population and shrinkage of

cultivable land size exposed the crop for diverse biotic and abiotic challenges.

With out diseases, mainly bacterial wilt of inset, enset cultivation had been sustained for the last thousands years and will sustain with out the use of chemical fertilizes and any pesticides under the existing traditional way of practices. Suggesting that inset diseases to play a significant role in hampering inset production by inflicting irreversible damage to the crop. This is mainly because of that enset is a multi year crop and cultivated continuously for long period in the same field. Hence, once the disease established in inset field, it persist through out the years. Besides, the disease systemically attacks and kills all inset stages including old ones even ready for harvest.

Status of Diseases

About 83 % of the sample farmers reported that both enset bacterial wilt and dead heart leaf rot the diseases in the study area showed an increasing trend and only 17 % of them reported that currently the diseases is decreasing.

Table 28. Status of enset diseases in the study area

Disease type	Increasing		Decreasing	
	N	%	N	%
EBW	45	83.3	9	16.7
Sheilo	29	82.9	6	17.1

Tolerant and Susceptible Clones

Even though *EBW* and *sheilo* reported to affect all *enset* clones, some of them were also reported to have better tolerance reaction to the diseases (Table 29). About 46 % of the sample farmers reported that none of the enset clone showed tolerant reaction to *Sheilo*. About 49 % of the sample farmers indicated that clone *Hala* as tolerant one followed by clone *Gena* against *EBW* and *sheilo*. The rate of infection and death of enset plant found to rapid for plants infected with *shelo* (dead heart leaf rot) as compared with that of *wello*

(enset bacterial wilt). The disease *wello* reported to cause serious damage to enset plantation killing all plants in the filed. In the case of *Gottiya,* as it damages the corm of the plant, there is a chance to harvest the pseudostem part.

Table 29. Tolerant enset clones for EBW and *sheilo.*

Enset clones	EBW		Sheilo	
	N	%	N	%
Hala	21	48.8	7	26.9
Gena	11	25.6	4	15.4
Nekaka	5	11.6	1	3.8
Chichiya	3	7.0	1	3.8
Maziya	3	7.0	1	3.8
No clone	-	-	12	46.2

The results obtained from this study indicated that some of the enset clones were reported to show highly susceptible reaction to EBW and dead heartleaf rot (Table 30). About 36 % of the sample farmers reported that all of the clones to be susceptible to *sheilo* while 49 % of them reported that clone *Nekaka* is more susceptible to EBW as compared to other clones.

Table 30. Susceptible clones for *EBW* and *sheilo*

Clone name	*sheilo*		EBW	
	N	%	N	%
Nekaka	7	21	23	48.9
chichiya	6	18.2	9	19.1
ketenia	4	12.1	3	6.4
Tufa	1	3.0	1	2.1
keberiya	3	9.2	3	6.4
Gena	12	36.4		0
Hala			4	8.5
Mazia			1	2.1
Arkiya			1	2.1
No tolerant clone			2	4.4
Total	33	100	47	100

Seasons of Disease Occurrence

In the study area, the occurrence of enset bacterial wilt was reported to occur either in rainy or dry seasons. In this regard, about 76 % of the sample farmers reported that enset

bacterial wilt disease occurs in both dry and rainy seasons while 16.4 and 7.3 % of the respondents indicated that enset bacterial wilt occurs in rainy and dry seasons, respectively.

Infecting Stage

It was also indicated that both *Welo* and *sheilo* (dead heart rot) attack all stage of inset plants. However, about 43 and 42 % of the sample farmers reported that *utta* and all other enset stages are mainly infected by enset bacterial wilt (EBW and dead heartleaf rot, respectively (Table 31).

Table 31. Infecting stage

Stages	EBW		*Sheilo*	
	N	%	N	%
Utta	23	42.6	15	41.7
Gardwa	14	25.9	3	8.3
Boshesha	2	3.7	5	13.9
Hatta	10	18.5	7	19.7
All stages	5	9.3	6	10.0

Farmers' Control Measures

If the infected enset plant is big and not severely attacked, farmers process it for *kocho* to be sold in the near by market. Furthermore, the key informants also indicated that enset bacterial wilt to be the major constraints of the enset production in the three PAs. Besides, they reported that so far, they do not have any control measures practiced by them and none of the enset clones grown by them was found to be resistant to this disease.

According to the respondent, enset plant that are infected with EBW and corm rot were reported to be used for different purposes as compared with enset plant infected by dead heartleaf rot. Accordingly, 38 and 60% of respondents indicated that wilt infected enset plants were used for home consumption and market, respectively.

In the study area, 22% of the respondents' reported that they uproot, dispose and rotate with other crops infected enset plants fields. Some farmers also reported that just to pray to God as the only remedy for the disease, and all the remaining sample farmers reported, as they do not practice any of control measures against enset wilt.

Enset Yield

According to group discussion, enset plants, commonly harvested in this area before and after flowering for *kocho*, whereas *bulla* is not extracted from enset plant harvested before flowering. About 8 kg of *kocho* could be obtained from early harvests and 16 kg from late harvests. Whereas, 3 kg of b*ulla* is obtained from flowering enset plant.

However, the results of sample survey indicated farmers harvest enset plant at different ages depending on the food demand of the household. In the study area, the corresponding *kocho* yield of enset plant before and after flowering was estimated to be 17.34 and 31.19kg, respectively. However, information obtained from some farmers indicated that the yield of *bulla* reported to be almost similar before and after flowering. In addition, fiber yield before flowering was less by half as compared with the yield obtained after flowering (Table 32).

Table 32. Mean yield of enset before and after flowering

Products	Before	After
Kocho (kg)	17.34	31.19
Bulla(kg)	7.14	7.57
Fibr (kg)	1.27	3.70

Farmers prepare different kinds of traditional recipes such as *kitta* from *kocho*, *gennfo and godi* from bulla and *kikil amicho*

Enset Processing

Harvesting and processing of enset are the major and tiresome activities in enset production. Most of the sample farmers also reported that, traditional methods of processing to be the common practice of the households. About 98% of the respondents reported that they learnt enset processing practices from their ancestors, and they undertake such activities using traditional processing devices. However, farmers indicated that the traditional processing devices have a numbers of drawbacks (Table 33). The entire sample farmers reported that they are not using improved processing devices. However, in the group discussion made at *Bolla* PA, farmers indicated that enset decorticator was introduced only for demonstration purpose.

Constraints of Processing Devices

Farmers indicated that traditional processing devices have a numbers of drawbacks. Enset processing activities are usually cumbersome because it consumes time, materials easily break, requires more laborers, creates pain and less efficient (Table 33).

Table 33. Constraint of traditional enset processing devices

Problems of traditional enset Processing device	% of sample farmers	
	N	%
Time consuming	4	7.7
Requires more than on person	6	11.5
Easily broken	5	9.6
Not comfortable for working	2	3.8
Unavailability of bamboo and damage on hand	4	7.7
Creates pain on muscles	18	34.6
Less convenient as processing is done by standing	1	1.9
Loss of *kocho*, *bulla* and fiber products	4	7.7
Loss of *kocho* and *bulla* through lined leaves inside pit. (Leakage loss)	1	1.9
Lack neatness	1	1.9
No problem	6	11.5
Total	52	100

Gender Division of Labor in Enset Production and Marketing

The different operations and its responsibilities in the enset production, harvesting, processing and marketing activities in the study area were clearly outlined by the respondents. Delineation of job responsibilities of male and female and /or both for children and adult were indicted (Table 34).

Table 34. Gender division of labor in enset production and marketing

Activities	Male adult	Female adult	Male child	Female child	Male adult and male child	Female adult and female child
Land preparation	****	***	*		**	
Plowing	****	**	*			
Planting	****	**	**			
Weeding	****	***			**	*
Manuring	**	****		*	*	***
Pit preparation	*	****				**
Kocho transporting to pit	*	****		**		***
Harvesting	****	***			**	*
Enset decorticating	*	****		**		***
Bulla squeezing	*	****				**
kocho mixing, rinsing and turning	*	****				**
Enset products marketing		****		*		**

**as the number of asterisk increases the higher the responsibility of household members*

Table 34 indicates that male and female adults share all activities variably. However, the majority of the sample farmers reported that activities like land preparation, plowing, planting, weeding and harvesting to be the responsibilities of male adults. On the other hand, manuring, pit preparation, marketing and all other processing activities are reported as the responsibilities of female adults. Generally, most of the field activities are indicated to be the responsibilities of male adults while processing and enset products marketing activities are the responsibilities of

females. Activities like decorticating and grating are usually cumbersome for females.

Table 34 depicts that male and female adult farmers have different responsibilities in enset production and marketing activities. Some of the activities were undertaken by specific group and age class of the households. While some others was the responsibility of all groups irrespective of age and sex.

Livestock Production

Livestock and Production Trends

The main types of livestock owned by the farmers in the surveyed area are cattle, sheep, goat, donkey, horses and poultry. Communal grazing land is reported by the sample farmers to be the main source of animal feed.

About 71% of the respondents indicated that cattle population in the area showed a declined trend. On the other hand, about 22 and 7% of the sample farmers indicated that cattle population showed an increasing and constant trend, respectively (Table 35). Despite all the merits obtained from livestock by the household in the survey area, they reported that livestock production sector to be constrained by different factors such as disease, pests, poor management practices and shortage of animal feed.

Table 35. Herd size trends

Trends	N	%
Increasing	12	22
Decreasing	36	71
Constant	4	7

Diseases and Pests Control

Both sample farmers and key informants reported that major livestock diseases that occur in the study area to be anthrax, black leg, leeches and trypanosomes. Of which the most important is trypanosomes. Farmers practice modern and traditional methods of control against trypanosomes. However, the prevalence of the disease was not equal in all PAs. This is because some PAs such as *Bolla* already started modern trypanosomes control measures. About 34, 25 and 41 % of the respondents reported to use traditional, modern and both methods of control against trypanosomes,

respectively (Table 37). On the other hand, about 94 % of sample farmers reported that they are not using modern control methods due to lack or absence of veterinary technicians and/or Doctors that could render veterinary service for the community. About 6 % of them indicated, as they do not own livestock at all.

Table 36. Control practices of trypanosomes

Control measures	N	%
Traditional (hot iron)	25	34
Modern	11	25
Both	18	40.9

Production Constraints

About 39 % of the sample farmers reported that livestock production in the area is influenced by disease, pest, and seasonal shortage of grazing land. While 10 % of them indicated that shortage of capital to purchase medicine is another important other problem in livestock production (Table 38).According to key informants of *Daho* PA, the major animal diseases in these PAs are coccediosis, anthrax, leech, trypanosomes.

Table 37. Constraints of livestock production

Constraints	N	%
Disease and pest (trypanosomes, anthrax, cattle cough)	20	39.2
Seasonal shortage of grazing land	6	11.8
Capital problem to purchase veterinary medicine	5	9.8
Disease, pest, and shortage of grazing land	20	39.2

Livestock-Enset Interrelationships

Livestock and enset production are reported to have strong relationship. About 95% of the farmers reported that livestock are important sources of manure for enset production. The various products obtained from animals such as milk, butter, cheese, and meat are good accompany of enset products in their daily diets. Conversely, enset and enset products and by-products also reported to have different uses for livestock (Table 36). Enset leaves are used for livestock feed especially in the dry season where others feeds are scarce. Enset clone, *Lochinge* used for medicinal purpose for animals. Enset fiber used to make ropes, which used to tie animals in the garden and barn.

Table 38. Uses of enset for animal production

	% of sample farmers	
Uses	N	%
Feed	45	80
Rope	9	15
Medicine	3	5

Agricultural Production Constraints

The results of both informal and formal survey indicated that crop and livestock production systems in the area are influenced by frequent occurrence of drought, diseases and pests, use of local varieties, traditional agronomic practices, poor soil fertility, seasonal feed shortage, lack of improved veterinary services in some PAs, unavailability of improved processing devices, credit and marketing problem. Specifically, enset production system in the area is characterized narrow genetic variability of enset clones, enset bacterial wilt diseases, corm rot, dead heartleaf rot, mole rat and other vertebrate pests.

Conclusion and Recommendations

Agriculture predominantly crop farming and livestock husbandry are the backbone of the household economy in the study area. The existing two cropping seasons, *belg* and *meher*, offer possibilities of cropping divers crop types and varieties per year. Livestock production is also another potential sector in the study area. The study revealed that the present traditional agricultural practices undertaken by farmers call for the need for introduction of improved agricultural technologies for both crops and livestock in general. Due emphasis should be given to enset production, protection, processing and marketing.

Different types of crops are under cultivation in the study area, these divers crops are local types and farmers use traditional methods of cropping practices. In these PAs, very less research and extension activities are done so far. As a result, the current level of crop yield performance falls below the national average yield due to erratic rainfall, diseases and pests, decline in soil fertility, soil degradation, erosion, inadequate use of improved agricultural practices.

As a follow up action introduction and undertaking adaptation trial on released and improved crop varieties of maize, wheat, sorghum, tef, barley, groundnut, field pea, faba bean, haricot bean, Irish potato, sweet potato, taro, cassava, yam; pepper, tomato, coffee citrus, mango and avocado should be verified and demonstrated under farmers conditions.

Diversification of enset clones in the study area seems feasible. As has been reported by the sample farmers and key informants, there is limited number of enset clones under cultivation, in connection with this, introduction of enset

clones that are not under cultivation in the study area should be considered as one among the immediate tasks. This is because the existence of such limited number of enset clones might lead risks of loss biotic and abiotic factors and the yield potential from less genetic variable population will be low.

Hence, to widen genetic diversity of enset clones in surveyed area, diversifying enset clones through the introduction of different clones having better yield potential including other valuable attributes from other major enset growing areas of the country seems paramount importance. In this aspect, sucker of inquired enset clones could be propagated and multiplied on established nursery sites and distributed to enset farmers at reasonable price.

Row planting is believed to play a positive role for the implementations of sanitary control measure, cultural practices and maintaining optimum yield. Row planted enset help to facilitate activities like disposing of infected inset plant from inset fields in such a way that the path/space between rows and even plants give free movement for workers and avoid the risk of contact of infected plant to healthy ones. In addition, it also gives open space to farmers during supervision, and undertaking any other activities.

Enset farmers plant enset in a densely populated stand than the optimum population to be maintained. According to the result obtained from experimental station, a spacing lay out arranged 1x3 meters between plants and rows in a permanent stage (latter stage of enset) showed good yield. In the study area, farmers obtain lower yield of enset this is partly because of that they practice narrower spacing than the recommended. Therefore, spacing has to be demonstrated in the area as one of enset production packages.

Farmers frequently transplant enset plant from *Osha* to *Utta* stage about three times in one enset crop cycle. Therefore,

they should be advised to minimize the frequency of transplant at most two times per crop cycle.

Traditional enset processing devices are tiresome, unhygienic, time taking and not durable. According to the discussion made with farmers, it was clearly noted that farmers have strong interest to get improved enset processing devices. Therefore, testing, demonstrating and introduction of the improved version of enset processing devices including decorticator, kneader (grater) and bulla squeezer should be considered as one of the short-term priority intervention.

Sanitary control measure considered being the most reliable option to alleviate enset bacterial wilt, corm rot and dead heartleaf rot problems. This option does not need extra cost and skill; it could be handled by household members. It is safe and believed to offer reliable solution.

Before launching an implementation scheme of sanitary control measure, enset farmers have to be trained on the nature, cause, dissemination mechanism and the role of sanitary measures in reducing wilt incidence. Once farmers' awareness about all aspects of the disease gained, they have to demonstrate practically under field conditions. In addition, some selected farmers from the trainees have to share experience from other places where this practice proved to be effective. Sanitary control measure believed to be more effective when employed by collective action of the community. In this regard, farmers have to be organized themselves in-group at watershed level. The reasons for the importance of community action is that uprooting and disposing of infected enset plants from enset field into pits demand more labor and it is a difficult job for some households with few family members. The other reason to undertake community-based action of sanitary control measure is that if some of the farmers do not undertake this action such infected enset fields will be sources for the re-spread of the disease in the nearby disease free enset fields.

Most of the study area is sloppy, and highly degraded due to overgrazing, deforestation, bush fire, increased alterable land and poor cultural practices. The area needs a strategic soil and water conservation schemes. Creation of awareness about the different soil and water conservation techniques through provision of community training should be included as strategies for land rehabilitation. Moreover, community-based action through construction of different types biological and physical soil and water conservation methods believed to rehabilitate conserve, and improve soil fertility of the study area.

Farmers in the study area do not have access for agricultural credit. As a result, many farmers in do not use improved seeds, fertilizers and chemicals. Farmers indicated that credit institutions are not available in the area. Hence, the only sources of credit are relatives, neighbors and local moneylenders at higher interest rate. Hence, both governmental and non-governmental organizations should design appropriate credit scheme in the areas based on farmers' interest and priority problem.

The agricultural marketing system for both crops and livestock in the study area is underdeveloped. Farmers sale their produces in local markets at lower prices and in most cases below the cost of production. Roads and transport facilities are poorly developed. As a result, the marketing system should be improved by creating better market places, improving roads and transport facilities.

In short, following are the major recommendations of this study:

- Introduction of different improved crop varieties with recommended agronomic practices through adaptation and on-farm demonstrations;
- Introduction of enset clones for different traits with their recommended practices;

- Provision and implementation of training and community based sanitary control measure on enset bacterial wilt, corm rot, dead heart leaf rot;
- Introduction of improved version of enset processing devices;
- Provision of veterinary services and training about livestock diseases control measures;
- Introduction of improved forage legumes suitable to the area;
- Introduction of appropriate soil and water conservation measures;
- Provision of credit services;
- Development of infrastructures, like roads and improved marketing facilities; and
- Assessing and improving farmer' indigenous knowledge.

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