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Characterization of Agro forestry Practices and their Socioeconomic Role in Selected Districts of Gurage Zone, Ethiopia

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ABSTRACT

This paper characterizes the agroforestry practice in Cheha woreda, Gurage Zone, Ethiopia on the basis of the existing system components and evaluates socio economic role using data collected through structured questionnaire, focus group discussion and field observation. Households to be interviewed were selected through proportional sampling procedures from six peasant associations (PAs) out of 39 that were identified to be intensive practitioners of homesteads. Enset, Coffee and Chat based homestead agroforestry and crop raising were found out to be the dominant land uses in the study area and the major sources of livelihood and income. Land holding size did not reveal marked differences across PAs ranging from 0.6 Ha to 0.8 Ha with an average of 0.5Ha. Significantly larger areas are allocated for Enset, coffee and chat based homestead agroforestry practices as compared to the rest of the identified land uses across all PAs. 12 different tree/shrub species are mainly planted in homesteads of the study area. Eucalyptus viminalis woodloots are integeral parts of homesteads mainly contributing to hoshold energy demand and income generation. Incomes were found to be prominently generated from sell of Chat and Eucalyptus. Practitioners of agroforestry were found to gain optimum incomes either annually or in the duration of 4-6 years in the studied PAs. Water shortage, coffee leaf/stem drying, Enset stem/root decay and wild animals' raid are among most serious problems that are currently constraining the practice of homestead agroforestry in the surveyed PAs.

Keywords: *Agroforestry, homesteads, species, woodlot*

INTRODUCTION

The land use system in Ethiopia is associated with the decrease in the size of holding both for arable and grazing lands. Thus, there is continued trend toward the conversion of forested and marginal lands to agricultural lands, resulting in massive environmental degradation and a serious threat to sustainable agriculture and forestry. The decreasing in the size of land holding is related to population explosion.

Agroforestry offers a potential solution to the problem of declining rural agricultural production in the tropics .Cultivating trees, agricultural crops and pastures and/or animals in intimate combination with one another spatially or temporally is an ancient practice that farmers have used throughout the world (Nair, 1989; 1993). Agroforestry (AF) is a relatively new name for a set of old practices. There are several types of traditional systems exist in different parts of Ethiopia, and there are new technologies started by several institutions at a national level across different land use systems (Abebe Yadesa et al 2001). The aim and rationale of agro forestry lies in optimizing production based on the interactions between the components and their physical environment. This will lead to higher sum total and a more diversified and /or sustainable production than from a monoculture of agriculture or forestry alone.

Agroforestry provides a wider range of products, more secure subsistence or more cash income from wood products to enable the farmer to buy food. Nair (1993) indicated that the combination of several types of products which are both subsistence and income generating, helps farmers to meet their basic needs and minimizes the risk of the production system's total failure. In tree home gardens, the production is for home

consumption, but any marketable surplus can provide a safe guard against future crop failures and security for interval between the harvests (e.g. rice in Java and Sri Lanka, coffee and maize in Tanzania, coconut and rice in South Western India).

It is a prerequisite to have knowledge about the potentials of existing agroforestry practices prior to attempting to introduce modifications that are alleged to facilitate complementarities in the existing agroforestry practices. This would call for the need for characterizing existing agroforestry practices, evaluating their role to generate livelihood alternatives in rural communities and assess people's attitude towards management of agroforestry practices. Thus this study intends to characterize the existing agro forestry practice in the study area while evaluating the contribution of these practices to rural livelihood and assessing perception of farmers towards management and problems of agro forestry practices.

MATERIALS AND METHODS

Description of the Study Area

Guraghe Zone is one of the zones found in the Ethiopian Southern Nations, Nationalities and Peoples Region (SNNPR). It is located in the western part of central Ethiopia; it is bordered on the south by Hadiya on the West, North and East by Oromia Region, Yem on Southwest and on the Southeast by Silte Zone.

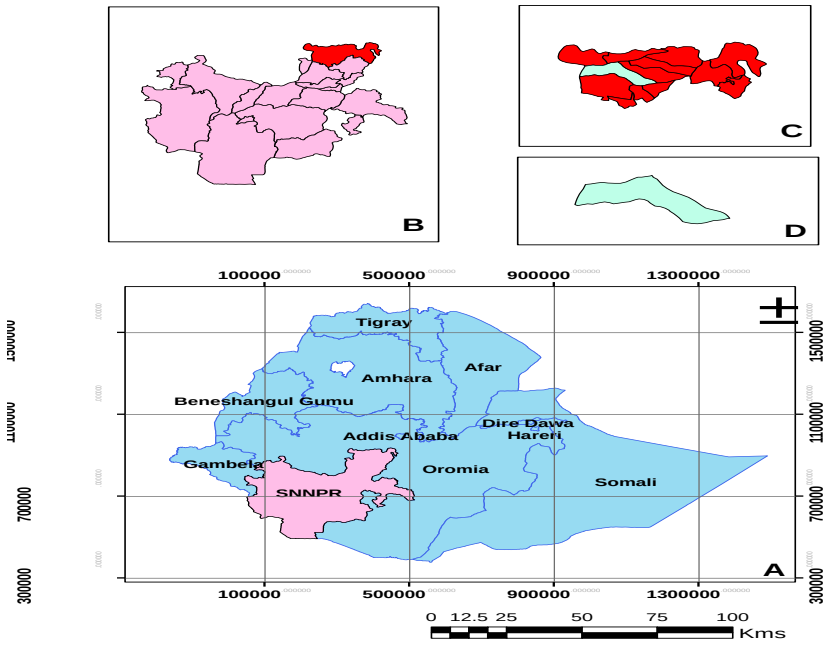

Fig1. *Map of SNNPR in Ethiopia (A), Gurage zone in SNNPR (B), Cheha woreda in Gurage zone (C), Map of Cheha woreda- the study area (D)*

Its land area is estimated as 593,200 hectares. The zone is divided in to 13 woredas and two town administrations. These are Abeshgie, Cheha, Enemor-Ener, Endegagn, Kebena, Ezha, Geta, Gummer, Mareko, Kokir, Mehurena Aklil, Meskan, Sodo Woredas and Butajira and Wolkite town administrations.The total population of the zone is estimated to be 1,398,945 (Guraghe Zone Finance and Economic Development Department, 2010 population projection) having distribution of 680,047male and 718,898 female with percentages of 48.6 and 51.4, respectively (Table 1). The majority of the population (90%) lives in rural areas leading an agricultural life.The nature of topography in the zone

exhibits three categories. These are the mountainous high land (represented by the Guraghe Mountain chain, dividing the zone east to west, having an elevation of 3600 m), the plateau flat lands and the low stretching area (the western fringe of the rift valley and the Wabe-Gibe valley having an elevation of 1000 m).

The zone is divided in to three agro ecological zones namely 'Dega' or highland climate (31.6%), mid highland climate or 'Woina-dega'

(65.3%) and lowland or 'kolla' climate (3.1%). Most of the areas lie in the mid highland division. The distribution of rainfall and temperature mainly follows this pattern. The annual average rainfall ranges from 200 MM/annum - 1,400 MM/annum. The highest and lowest temperature record is 32^0c and 7 ^{0}c respectively.

Table1. *Population and land coverage of Gurage Zone.*

S.N.	Name of woreda	Population (urban and rural)			Peasant Associations			Area (Hectare)
		Male	Female	Total	Rural	Urban	Total	
1.	Abeshgie	34,718	30,923	65,641	26	-	26	61,016
2.	Cheha	62,034	64,477	126,511	39	3	42	57,400
3.	Enemor-Ener	86,292	96,368	182,660	64	2	66	81,820
4.	Endegagn	24,844	28,603	53,447	17	-	17	12,720
5.	Ezha	43,841	48,612	92,453	27	1	28	43,130
6.	Geta	35,853	39,579	75,431	16	-	16	17600
7.	Gummer	40,813	46,463	87,276	18	1	19	18,400
8.	Mehur -Aklil	44,062	50,263	94,325	29	1	30	42,120
9.	Kebena	27,808	28,048	55,856	23	-	23	27,772
10.	Wolkite Town	17,344	15,870	33,214	-	5	5	1,132
11.	Kokir	48,786	53,851	102,637	33	1	34	60,010
12.	Sodo	73,352	73,797	147,150	55	3	58	82130
13.	Meskan	85,622	88,927	174,549	41	1	42	54,100
14.	Mareko	35,212	34,146	69,359	25	1	26	32,750
15.	Butajera Town	19,466	18,970	38,436	-	5	5	1,100
	Total	680,047	718,897	1,398,945	413	24	437	593,200

Source:http://www.gpsdo.org.et/index.php?option=com_content&view=article&id=8&Itemid=10
http://www.ikimap.com/map/administrative-area-cheha-ethiopia

Location and Climate

The study was conducted in Cheha Woreda, located in Gurage Zone of Southern Nations, Nationalities and Peoples Regional State (SNNPRS), Ethiopia (Figure 1). The capital of the Woreda, Imdbir, is located at 188 km distance south of Addis Ababa on the way to Welkite town, the capital of the Zone. Imdibir means "mother forest" and is the combination of two words in the Gurage language, "Im" means mother and "dibir" means forest. This name clearly indicates that the area was once covered by forests (Mojoa et.al,2015). The geographical location of the study area extends from 8° 00' 18.9" to 8° 15' 28.53" N and 37° 35' 46.48" to 38° 03' 59.59" E .Cheha woreda covers an area of 44,072 ha and its altitude ranges from 1200 m a. s. l. in the lowlands to 2600m a. s. l. in the highlands. The annual rainfall of the area ranges from 800 to 1200 mm .Enemor Ener Woreda borders the in the south, Oromia region in the west, Ezha Woreda in the East, Gumer and Geta in the Southeast, and Wabe River, which separates it from Abeshege, and Kebena in the North. The woreda constitutes 40 rural kebeles (the lowest administrative unit) of which 39 are rural and 1 is rural town.

Table2. *Population of Cheha woreda*

Sex	Population			
	Urban	Rural	Total	% of Total
Male	4655	82387	87042	49
Female	4845	86363	91208	51
Total	9500	168750	178250	100

Rainfall and temperature conditions for Cheha woreda depend on elevation as it is the case for other parts of the country too. According to the Ministry of Agriculture (MoA) (1998), the agro-ecology of the area is classified into three agro-ecological zones. These agro-ecological zones include Dega (Highlands, 2,300 - 3,200 m a.s.l), Weina Dega (Midlands, 1,500 - 2,300 m a.s.l) and Kolla(Lowlands, 500 - 1,500 masl) (EIAR, 2011). The Weina Dega covers the largest part, which accounts for about 94 % of the total while both Dega and Kolla cover 6%.

The information obtained from the Cheha Woreda Agriculture and Rural Development Office indicates that the area receives unimodal

rainfall. 'Kiremt', the main rainy season is from June to September with the peak in July and August.

The short rainy season with erratic nature i.e. 'Belg' extends from March to May.

Sampling Procedure and Sample Size Determination

The questionnaire survey was conducted in Cheha woreda of Gurage zone located in SNNPR. This study adopted purposive sampling procedure where samples of n private households are selected by using the formula developed by (Kothari, 2004). The woreda has 39 rural Peasant associations (PAs) which were used as our base for assigning households to be interviewed. Out of the 39 PAS we identified (purposively selected) with the support of woreda experts six PAs that are representatives of highlands and lowlands; these PAs also represented model sites for intensive practicing of agro forestry activities in the woreda. Households in each six PAs were listed out and summed up to come up with a total number of households equal to 2882.

Table3. *Number of household and population size by PA*

No	Name of PA	Households (HHs)	Male headed	Female headed
1	Emdebera	412	315	97
2	Wedro	353	258	95
3	Ewan	660	564	96
4	Gasore	708	585	123
5	Buchach	432	336	96
6	worden	317	261	56
	Total	2882	2317	563

The number of sample size per PA (households to be interviewed = n) was calculated proportionally based on household for each PA using (Kothari, 2004) .

$$n = \frac{z^2 \times p \times q \times N}{d^2(N-1) + z^2 \times p \times q}$$

(Kothari,2004)

n= 112, where Z=1.96,p&q= 0.5 each,

N=2882,d=0.09

Where:

- n=Sample size
- N=Size of population
- Z=Coefficient of normalization
- q=Probability of failure
- d=Margin error
- p=Probability of success

For allocating sample size at PA level the proportional allocation formula is used:

$$ni = \frac{Ni \times n}{N}$$

Where:

- ni=The sample size proportion to be determined
- Ni=The population proportion in the stratum
- n=The sample size
- N=The total population

Using proportionate sampling the number of households to be interviewed in each PA is depicted in Table 4.

Table4. *Number of households and sample size in each PA*

No	Name of PA	No. of households(HHs)	No households interviewed(ni)
1	Emdebera	412	16
2	Wedro	353	14
3	Ewan	660	26
4	Gasore	708	28
5	Buchach	432	17
6	Worden	317	13
Total			114

Each PA was GPS coded and information based on the contents of structured questionnaire was collected (Fig.2). Focus group discussion (FGD) was also conducted to characterize the existing

agroforestry systems and their products from farmers' perspectives. The village heads and local farmer representative group consisting of 10 farmers were present in the FGD. Secondary data sources on the contribution and role of agroforestry practices were also being accessed. Data collected using questionnaires surveys were subjected to SPSS statistical software for analysis.

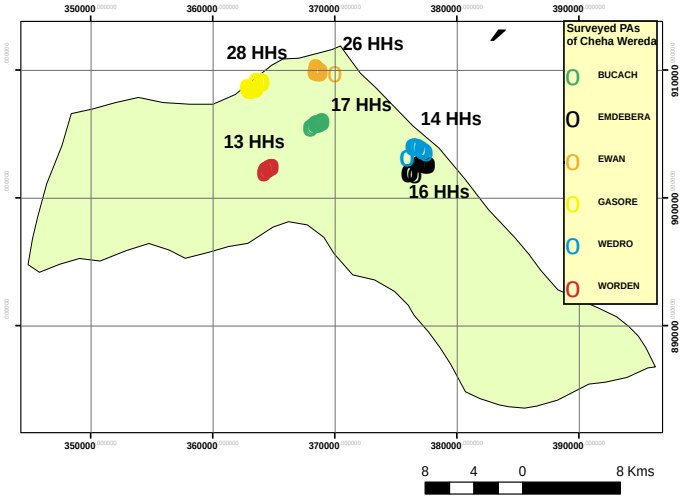

Fig2. *GPS locations of Households (HHs) in the survey*

RESULTS AND DISCUSSION

Agro Climatic Setting of the Study Area

From the analysis of the altitudinal distribution of sampled household locations the studied PAs in the woreda (Fig 3) can be broadly classified as highlands (Buchach, Emdebera and Wedro) and lowlands (Worden, Ewan and Gasore).

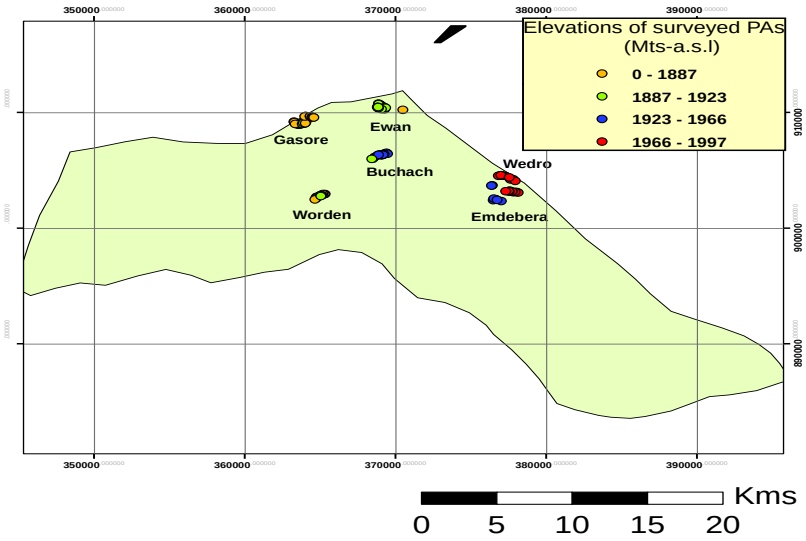

Fig.3. *Altitudinal distribution of households in the study area.*

Trends of Vegetation Cover

The majority of respondents from the interviewed PAs replied that vegetation cover is improving from time to time. This is mainly attributed to their planting of *Eucalyptus viminalis* on woodlot plots that are mainly located at a separate yard at the back of their fruit and Enset based homegarden . The other reason stated for increasing trend of vegetation cover was their recent integration of fruit trees like *Mangifera indica* -Mango and *Persea americana* -Avocado in their land use system. Accordingly out of 28 farmers interviewed for their opinion on trends of vegetation cover at Gasore about 25 respondents (89%) responded that it is increasing. Emdebera, Wedero, Ewan, Buchach and Worden had 50%, 85%, 88%, 82% and 76% respondents respectively that replied as

increasing on trends of vegetation cover in the area (Fig.4).

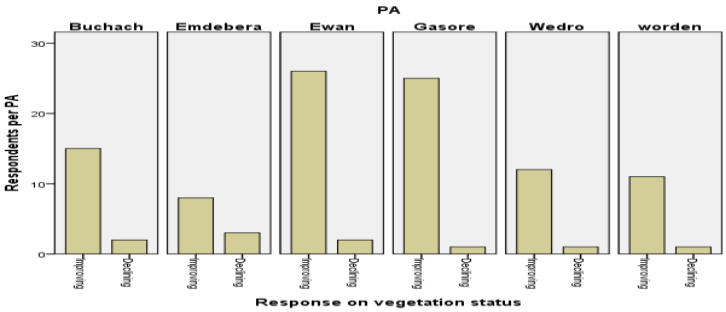

Fig4. *Comparison of responses on trends of vegetation cover across PAs*

Land Holding and Characterization of Land Uses

The survey results of this study indicated that Enset, Coffee and Chat based home garden agroforestry in and crop raising as indicated in Fig.5 are the dominant land uses in the area and the major sources of livelihood and income .

Fig5. *Enset, Chat, fruit tree based homesteads at different maturities in the study area*

Land holding size did not reveal marked differences across PAs. Buchach, Emdebera, Gasore and Wedero had land holdings that ranged from 0.6 ha to 0.8 ha. Comparatively larger land holdings that ranged from 1- 1.2 ha were found at Worden while Ewan had comparatively the least land holding size that averaged about 0.5 ha (Fig. 6). Excluding the area left for settlement the most dominant land uses identified in the study area include homestead agroforestry, agriculture and grazing lands. Significantly larger areas are allocated for Enset, coffee and chat based home garden agroforestry practices as compared to the rest of the identified land uses across all PAs (Fig.7). Area coverage for homegarden agroforestry practices was significantly higher (0.5ha on average) at Buchach while the least coverage for the same practice was at Gasore and Ewan (0.2 ha on average).

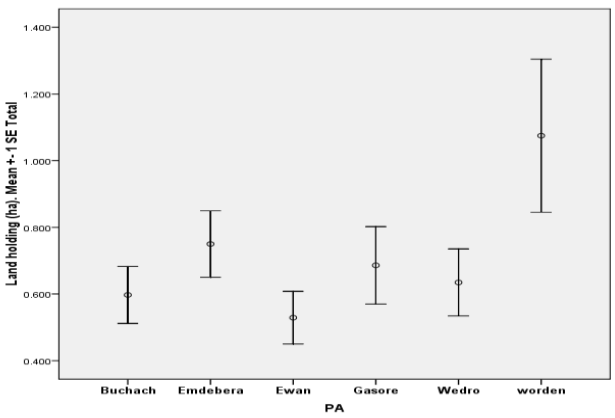

Fig.6. *Average land holdings of the studied Pas*

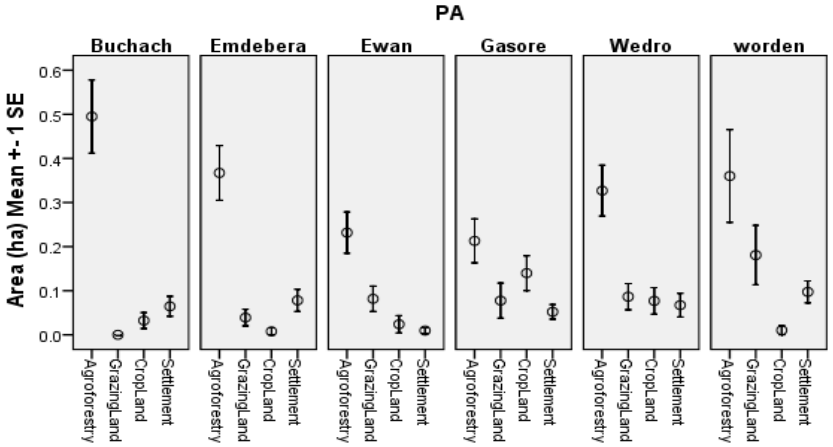

Fig7. *Characterization of land uses at different PAs of Cheha woreda*

Area for grazing land was comparatively larger at Worden while Buchach had the least allotment for grazing land from among the compared PAs. Agricultural land area was found to be the least of all the compared land uses at all the studied PAs with the exception of Gasore where it has closely comparable grazing land coverage with agroforestry.

Tree Planting Purposes

In the study area trees are planted for various purposes. The survey results indicated that farmers plant trees and shrubs mainly for household consumption of products, source of construction material, cash income, shade and for soil and water conservation. Of all the various uses mentioned household consumption, ash income and construction in their decreasing order were found out to be the most predominant purposes mentioned for planting of trees by respondents (Fig.8).

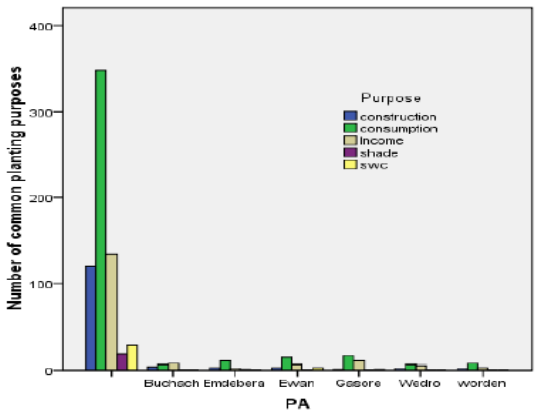

Fig8. *Characterization of tree planting purposes*

It was found out from respondants reply that about 12 different tree/shrub species are mainly planted in homegarden systems in the study area. Different tree species were found out to be planted to address the identified purposes of planting. *Eucalyptus viminalis*, *Podocarpus falcatus* and *Cordia africana* are tree species prefered for planting as sources of construction material in all the serveyed PAs. *Eucalyptus viminalis* woodloots are integeral parts of agroforestry practices situated at the rear end of homesteads (Fig.9). Woodlots mainly contribute to hoshold energy demand and income generation. It must be recognized that timber, fuel wood and fodder, all of which are products that may often be of particularly high importance for local livelihoods (Thompson et al. 2010).

Fig9. *Woodlots are given a separate parcel at the rear of homesteads*

Chata edulis, Enset ventricosum, Coffee arabica,Persea americana and Citrus reticulata are predomenantly planted for household consuption purposes. Homestead systems play a significant role in improving food security for the resource poor rural households as discussed by (Asaduzzaman et al. 2011). In terms of dietary diversification agroforestry has given more varieties of food than other forms of agriculture (Alemu 2016). Tree species planted for income generation include Persea americana,

Chata edulis, Enset ventricosum and Coffee arabica. It is found out that Enset which is an integeral component of homegardens in the study area is planted more for consumption than market in all the PAs studied (Fig.10).Responses with respect to SWC and shade as tree planting purposes are very insignificant in most of the PAs with the exception of Ewan and Gasore where respondents mentioned that they keep tree/shrub species like Enset,Chat and persea as meanses for soil and water conservation apart from their primary uses. Parkland agroforestry is totally non existing in the studied PAs (Fig.7). Homestead components that are used for consumption were found more diversified at Gasore followed by Ewan than the remaing PAs.

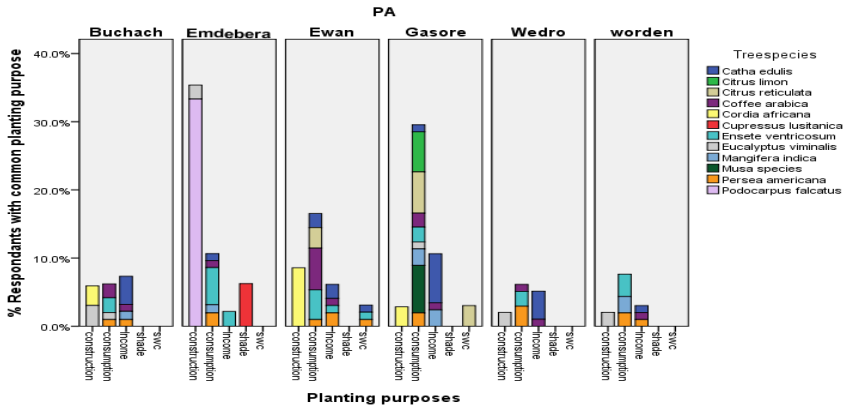

Fig10. *Tree species preferences and the associated planting purposes.*

Perception about Agroforestry

The majority of the respondents recognized the environmental role of agroforestry to increase soil fertility and its contribution to farm income and household food security. Serious trhreats that are constraining agrofoestry are also stated by the respondents.

Contribution of Agroforestry to Household Income

The survey results revealed that homestead agroforestry positively contributes to household income. Incomes were found to be prominently generated from sell of Chat and Eucalyptus. Practitioners of agroforestry were found to gain optimum incomes either annually or in the duration of 4-6 years in the studied PAs. Chat contributed more to the income generated annually while Eucalyptus had the highest share for the income generated during 4-6 years and this is because 4-6 years is the rotation age of Eucalyptus for production of mature bole for construction material. Since it is fast growing and coppiced more Eucalyptus is used frequently for firewood selling and construction purpose, when planted as woodlots (Madalcho and Tefera 2016). Agroforestry as a viable diversified land use and to develop the rural livelihood and conservation of natural resources has ranked high (Franzen and Mulder, 2007).From the comparison of incomes across PAs Emdebera was found to gain the highest incomes both on annual basis(> 6,000 Birr) and in 4-6 years(>7,000 Birr) time durations. By location also this PA is proximal to the main road which gives ease of access to market for homestead products. As incomes are clustering more around 4-6 years this could indicate that in most of the studied PAs comparatively higher incomes are generated from agroforestry practices in longer durations than annually (Fig.11).

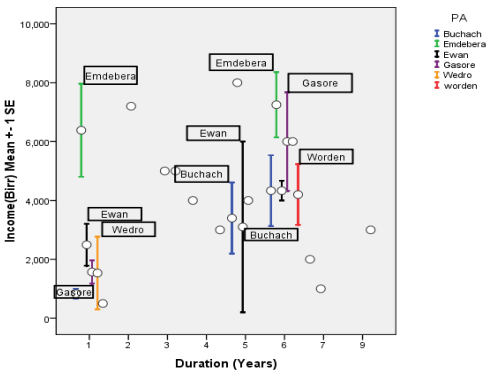

Fig11. *Household income generated from homestead agroforestry*

It was found out from the survey results that agroforestry highly contributes to compensation of food security problems in times of crop

failure. Interviewed farmers related from their history about the role that the discardable part of Enset root that is locally known as "Amecho" played as a life saver during the extended drought the people faced in 1983. Enset is regarded as a food security crop in this densely populated area because of its high productivity per unit area compared to cereals and because it serves as livestock feed during the dry season (Mojoa et.al,2015; Elias, 2003). They also emphasized that their Eucalyptus based woodlot homestead practices play aignificant role in saving the considerable time spent on fuel wood collection and hence reduces the burden imposed up on rural women to satisfy household energy demand.

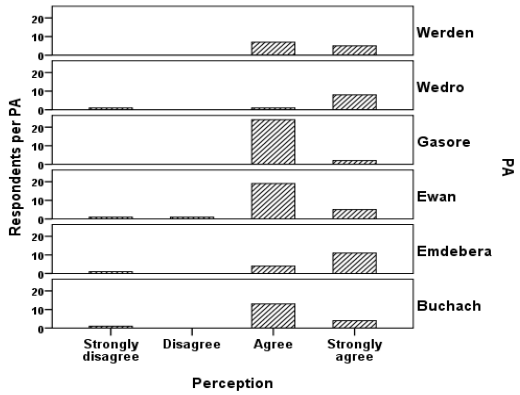

Fig12. *Responses on conservation role of homestead practices*

Perception about Environmental Role of Agroforestry

The level of perception on the role of homestead practices to conserve soil and water was assessed during the survey. It is drawn from respondents' responses that they have positive perception about the environmental role of homestead practices. In this regard respondents either agreed or strongly agreed that homestead practices positively contribute to soil and water conservation. Comparison of responses across PAs indicated that the respondents at Gasore while agreeing on the conservation role of homesteads were found relatively more perceiving (Fig.12). The structural components of homesteads at Gasore were also the most diversified. Respondents also perceived positive structural component interactions at homesteads.

Challenges against Practicing Homesteads

In spite of the valuable contributions that homestead agroforestry renders to the community the practice was found out to be highly constrained by different challenges. The survey results indicated that water shortage, coffee leaf/stem drying, Enset stem/root decay (Fig.14) and encroachment by wild animals were the most tempting problems that are hampering the practice of homestead agroforestry in the surveyed PAs.

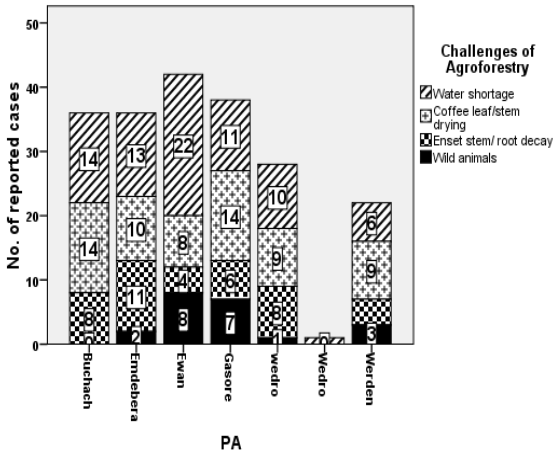

Fig13. *Categorization of factors constraining homestead practices*

Fig14. *Decaying of Enset stem and root*

The observed Coffee and Enset diseases require further detailed studies to be clearly isolated. From the comparison of responses on the collective effect of reported challenges against homestead practices the severity was found out to be more intense at Ewan as compared to the rest of the PAs (Fig.13). In contrary the challenges were found out to be significantly lower at Wedro which indicates that homestead practices are undertaken in relatively conducive environment. The most frequently reported wild animals that attack fruit trees in the homesteads include monkeys, porcupines, warthogs and apes. The numbers of major crop raiders,

particularly monkeys, porcupines, and apes are reported to be increasing. Porcupines, mole rats and wild pigs are the major pests of Enset in the study area (Mojoa et.al, 2015). As homestead components that mainly comprise fruit trees were found more diversified at Gasore followed by Ewan than the remaing PAs the threas by wild animals were also prevalent in these PAs (Fig.13).

CONCLUSION AND RECOMMENDATION

The study has indicated that the potential of homestead agroforestry is tremendous in the surveyed PAs. Diversified products of both consumption and economic value are generated from homestead agroforestry in the study area. The existence of diversified structural components in homestead practices that include woody perennials like Eucalyptus, tree crops like Coffee and fruit trees and non woody perennials like Enset have a significant contribution to household consumption and income generation. Enset and Chat based homesteads were found indigenous age old practices while fruit trees are introduced agroforestry technologies to the study area that contributed more to the current increased production and structural diversification of homesteads.

Homestead components of Chat, Coffee and Enset are organized in nicely structured assemblage of their own parcel and receive careful management. *E. viminalis* based woodlot practices are given their own separate parcel at the rear of homesteads and mainly address household energy demand and generate income through sell of construction materials. Based on the findings of the study farmers preferably engage on homesteads than agriculture since homesteads have the potential to address household consumption demands adding to the dietary advantage of getting fresh produce and provide cash income when the need arises. Therefore it is highly recommended to encourage farmers to engage in integration of cash crops of improved varieties at homesteads. Respondents were also found out to be cognizant of the conservation role of agroforestry.

The population of fruit trees mainly of Mango and Avocado at homesteads is showing a gradual increase and these fruits are getting wider acceptance by the community. Thus the old Enset and Chat based practices are getting diversified leading to modification of plant structure at some of the homesteads. Incidences like insect /disease attacks on Enset and Coffee trees are currently becoming serious threats to old homestead practices and these need immediate identification of problems and provision of preventive solutions to sustain the practice.

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