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Desalegn Mamo and Zebene Asfaw (PhD)

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Assessment of farmers' management activities on scattered trees on crop fields at Gemechis district, West Hararge Zone, Oromia, Ethiopia

Desalegn Mamo[1], Zebene Asfaw (PhD) [2]

[1] Mechara Agricultural Research Center, Mechara, Ethiopia

[2] Hawassa University, Wondo Genet College of Forestry and Natural Resorce, Wondo Genet, Ethiopia

Corresponding author E-mail: *desu.mamo@gmail.com*

Abstract

Purpose: This study was designed to assess farmers' management activities on scattered trees/shrubs on crop fields at Welargi and Hidha Dima kebeles in Gemechis district, West Hararghe Zone. Key informants and household interviews were used.

Methodology: Data collected from key informants and household interviews was analyzed using software SPSS version 20 (statistical package for social science). The analyzed data was summarized in narrative form and presented in descriptive manner

Result finding: The result showed that, farmers deliberately retained/planted and managed different tree/shrub species. Trees/shrubs scattered on crop fields were identified along their uses. The identified trees/shrubs were seventeen in number and their uses were for soil fertility improvement, animal feed, food, fuelwood, timber, construction and cash income. Management activities they used for managements of different trees/shrubs species were pruning, pollarding and coppicing. Tree-crop based farming system is the most widely distributed agroforestry practice in the study area. Under this practice, the most abundant retained tree species on crop fields by farmers is Croton macrostachyus, under which sorgum and maize were the most dominantly intercropped crops. This study demonstrated that pruning activities is the most dominant management activities for scattered on-farm trees/shrubs in the study area.

Recommendations: Farmers' management activities knowledge to be integrated with scientific knowledge to enrich their knowledge and techniques for practice, such as pruning and pollarding time, intensity etc., deserves attention. Study on litter quality (litter decomposition) and nutrient dynamics in the canopy tissues of this tree species should be conducted in order to determine when branches have to be pruned and pollarded for off-site uses or in situ soil conservation activities.

Keywords: *Pruning, Pollarding, Coppicing, Gemechis, Scattered trees/shrubs, Hararghe*

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1.0 Introduction

In many traditional agroforestry systems, trees have always been a key element for sustainability, and farmers often manage high percentage of trees on their lands to control soil erosion and improve the soil fertility (Lakany, 2004). On-farm trees can be found in agricultural landscapes in various forms of spatial and temporal arrangements for different purposes. One of the features of on-farm tree management is that the biological characteristics of trees are often taken into account to determine where it should be grown (Tesfaye, 2005).

Evidence throughout the tropics indicate that trees/shrubs on crop fields contribute to socio-economic (sustain food and wood security), and biophysical sustainability (productivity, environmental services mainly maintenance of soil quality and microbial diversity). Socio-economic benefits include: increase farmers' income and alleviation of poverty, creation of employment opportunity, provision of fuel wood, fodder and construction wood, provision of food, shade provision both for animals and humans medicine. With regard to the latter some of the advantages of the inclusion of compatible and desirable species of woody perennials on farmland are: increasing organic matter content of soil, enhancing efficient nutrient cycling hence maintaining soil fertility, control of soil erosion (Rocheleau *et al.*, 1988; Nair, 1993; Young 1997; Rao *et al.*, 1998).

On-farm tree throughout the tropic has been managed through indigenous knowledge (IK). IK is perceived as knowledge that is unique to a given culture or society. It is embodied in culture and described as an integrated pattern of human knowledge, beliefs and behaviors, ideas, customs, taboos, codes, institutions, tools, techniques, artifacts, rituals, ceremonies and gender. This culture is passed down from one generation to the next generation. It provides a holistic view of how to use natural resources based on traditional ethical perspectives (Atteh, 1991). As on-farm trees and trees outside the natural forests are also important for conservation and social benefit, understanding of farmers' management activities on these resources requires particular attention.

Four factors contribute to a frame of reference: knowledge, experience, values and interests (Boogaard *et al.*, 2006). Experiences is there where traditional management of resources such as on-farm trees and forest has emerged over a century's cultural and biological development and represents accumulated indigenous knowledge of farmers. Recent interest in the value of farmers' indigenous knowledge in developing countries has largely stem from a dissatisfaction with the differentiate and modernization approaches in dealing with poverty, a situation exacerbated by the seeming inability of science and technology to improve the living standards significantly for the majority of people in developing countries (Briggs *et al.*,1998).

Farmers' indigenous knowledge complements scientific knowledge by providing the long practical experience of farmers in managing, living within ecosystems, and responding to the changes of ecosystems. An understanding of the reasons underlying a farmer's management activities can help the researcher to identify the potentially beneficial tree/crop cultivation practices or to stimulate research leading to technical alternatives. So, consideration of farmers' knowledge is important because both farmers and scientific knowledge systems should incorporate each other's ideas and techniques (Den Briggelaar, 1996).

In order to manage tree cover in agricultural landscapes for conservation and production goals, it is important to understand the existing pattern of tree cover, how farmers manage the trees within their farms, and the roles that trees play within production systems. Further more understanding

of the roles of the trees on-farms and diversification of the farm in terms of species richness, as well as evenness through increase in number of trees of rare species or through replacement of more common species are the best options for preventing degradation of agroforest ecosystems on-farms (kindt *et al*., 2005).

2.0 Materials and Methods

2.1. Descriptions of the study area

2.1.1. Location

The study was conducted in Gemechis district of the West Hararghe zone of the Oromia National Regional State. Gemechis district is one of the fourteen districts in West Hararghe zone, which is located at 343 km east of Addis Ababa and about 17 km south of Chiro, capital town of the zone.The district is situated at the coordinate between $8^0$40’0” and $9^0$04’0” N and $40^0$50’0” and $41^0$12’0” E. It shares borders with Chiro district in the west and north, Oda Bultum district in the south and Mesala district in the east (DOA, 2014) (Fig. 1).

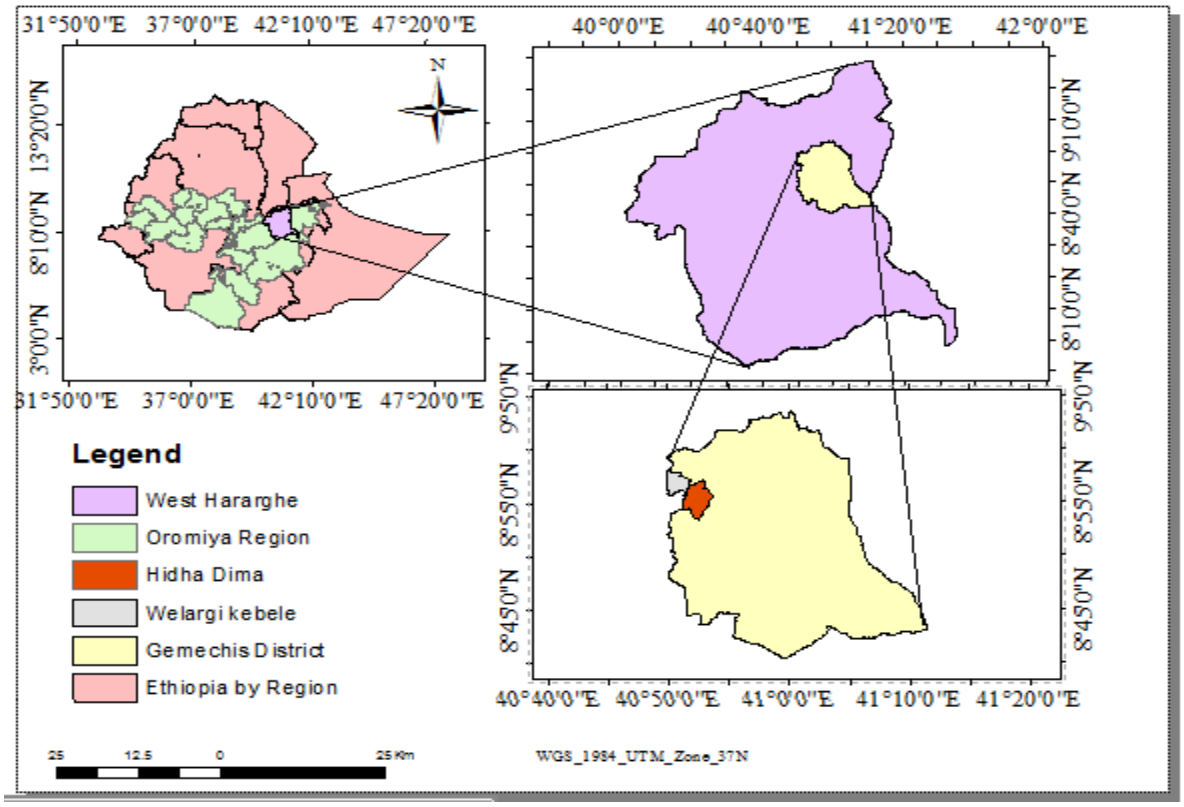

Figure 1. Map of Gemechis district (study area)

2.1.2. Soil and vegetation

The soil of the study area was dominantly loamy soils (moderately fine texture). The vegetation type of the district is characterized by forest, bushes and shrubs. The area of the district covered by forest, bushes and shrubs is 1385ha (DOA, 2014). The most dominant tree species found in

the area include; *Croton macrostachyus, Cordia africana, Olea europaea, Vernonia amygdalina, Erythrina abyssinica* and many others.

2.1.3. Climate

Agro-ecologically, the district has three climatic zones classified as temperate climatic zone (highland) constituting (15%), warm mild climate (midland) (45%) and lowland climate (40%). The district is found within 1300 to 2400 meters above sea level (m.a.s.l). It receives an average annual rainfall of 850 mm. The district has bi-modal distribution in nature with small rains starting from March/April to May and the main rainy season extending from June to September/October (DOA, 2014). The average temperature is 20 ^{0}c.

2.1.4. Population

The total population of the district is 184,032 of which 93,659 are males and 90, 373 are females (CSA, 2007). It has thirty-five rural and one urban kebeles. The number of agricultural households in the district is estimated to 38,500 with 32,308 male headed and 6,192 female headed (DOA, 2014). The average family size is estimated to be 6 and 4 per household in rural and urban areas respectively. The district is the first most densely populated district in the zone.

2.1.5. Agricultural activities

The agricultural activities in the district are mainly characterized by the presence of subsistence mixed farming, of both agricultural crop production and livestock. Gemechis district is known for its crop production in West Hararghe zone. There are also households engaged in non/off-farm activities. On-farm trees are the main source of fuelwood demand for the whole communities. The major cereal crops produced in the district are Sorgum and Maize and vegetables (onion, potato, redroot, tomato and cabbage), fruits (banana, pineapple, mango, avocado, papaya), and chat (*Catha edulis).* Minor crops are teff, wheat and barley. The land used for cultivation in the district is 32,994.5ha (DOA, 2014). Based on climatic classification, the farming systems vary in such a way that in low lands one finds livestock dominated type of production system and as one goes up to mid and highlands, crop based mixed production system prevails in the district. Generally, the main sources of income for the local communities are selling of crops and livestock.

2.2. Methods

2.2.1. Site selection

Gemechis district was selected based on extensive practice of different trees/shrubs on crop fields and the familiarity of the researcher with the biophysical and socio-economic settings of the study area. In order to have a fair representation of the site, multistage sampling procedure was followed starting from the district, kebele and household levels. Reconnaissance survey was undertaken in the district to select representative scattered tree on crop field practicing kebeles. Of the thirty-five rural Kebele administrative in Gemechis district, Welargi and Hidha Dima were purposefully selected because of extensive practice of scattered trees/shrubs on crop fields. Within the kebeles, random selection procedure was employed for selecting individual households.

2.2.2. Key informants

In order to get data on the scattered trees/shrubs on crop fields, the species type and type of management activities they used; key informants were identified. Key informants are defined as persons who are knowledgeable about soil resources and management, trees and tree cultivation and management, changes in local conditions and have lived for a long time in the respective sites.

To select individual farmers who can identify key informants (KI), snow ball method was carried out. During farm walk, individual farmers were randomly asked to give the name of ten key informants from each kebele. Finally, twenty key informants were selected.

2.2.3. Households

The total numbers of households in both kebeles administrations are 1500. The name of the households living in the village was obtained from the kebeles office and cross-checked by the KIs for its inclusiveness. There are several approaches to determine the sample size. According to Storck *et al*. (1991), the size of the sample depends on the available fund, time and other reasons and not necessarily on the total population. Therefore, this study sampling was representing five percent of the total households for the study site. Finally, eighty households (42 HHs out of 786 in Hidha Dima kebele and 38 HHs out of 714 in Welargi kebele) were randomly selected for interview.

At kebele level, data were collected through both informal interviews with key informants and household questionnaire. Semi-structured questionnaires was prepared to obtain the necessary data about the type of management activities farmers practiced on scattered trees on crop fields, the number and type of trees/shrubs retained/planted on crop lands, crops intercropped with trees/shrubs and other related topics. Beside the interviews, the farms were visited to make observation on the overall condition of the practices.

2.3. Data analysis

Data collected from key informants and household interviews was analyzed using software SPSS version 20 (statistical package for social science). The analyzed data was summarized in narrative form and presented in descriptive manner.

3.0 Results and Discussion

3.1. Demographic and socioeconomic characteristics of the respondents

Farmers' settings in different socio-economic situations affect the management of tree/shrub species diversity in their landholdings. In this study, the demographic and socio-economic features of the sampled households were assessed and presented (Table 1).

From the total respondents 93% were male, the remaining were female respondents, and majority of the respondents (84%) were married. However, 9% and 8% of the respondents were divorced and widowed, respectively. This in line with the work of Soyebo *et al.* (2005) that agriculture is very much practiced by married people to make ends meet and cater for their children.

Age is an indicator of experience and accumulation of knowledge in farming activities practically obtained through experience. At the study site, the mean age of the respondents was forty years (Table 1).

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Household size represents the total number of individuals living in the same house. Accordingly, the result of the study revealed that 39%, 51% and 10% of respondents constituted a total family size of less than or equal to 5, 6-9 and above 10 members, respectively (Table 1). On the other hand, the mean of family size was six in the study area.

Table 1. Demographic and socio-economic characteristics of the respondents at Welargi and Hidha Dima kebeles in Gemechis district, West Hararghe.

Variables	Frequency and mean of the respondents(n=80)		
	Categories	Frequency	Mean
Sex	Male	74	
	Female	6	
Age(years)	≤30	27	40
	31-64	50	
	≥65	3	
Marital status	Married	67	
	Divorced	7	
	Widowed	6	
House hold size	≤5	31	6
	6-9	41	
	≥10	8	
Educational level	Illiterate	34	
	Primary (1-8)	35	
	Secondary (9-12)	11	
Total Livestock owned in TLU	≤5	51	3.74
	≥6	23	
Farm size(ha)	≤0.5	69	0.4
	≥0.51	11	
Non and off-farm income activity involvement	yes	21	
	no	59	

Educated farmers have more knowledge and capable of recording, documenting and transferring the locally known management activities to the follow farmers and next generation. It also enhances the skill and ability to better use activities practiced in the study area on management of scattered trees/shrubs on crop fields. This survey result indicated that 44% respondents completed primary education followed by illiteracy with 43%and the remaining 14% was achieved secondary education (Table 1).

Land is the component of nature, which has various elements on it, and each element has various uses for humans. In Ethiopia, farmers' livelihood is mainly dominated by agriculture and it forms the backbone of the country's economy. Farm size in this case refers to area under scattered trees/shrubs on crop fields with crop. The result of this study shows that average land holding of household was 0.4 ha. However, majority of them had land holding less than or equal to 0.5 hectare (Table 1).

Farmers in the study area pursued mixed farming in which livestock production was a component. Cattle, Goat, Donkey and poultry were important species of livestock kept by the farmers in the study area. Farmers rear these different types of animals for various purposes such as, source of food (milk and meat), cash income, draft power, means of transport and source of dung for fuel and manure and most importantly as capital asset in time of shocks resulting from crop-failure and other natural hazards. High proportion of the respondents (71%) owned less or equal to five and the rest 29% owned greater or equal to six(Table 2). The mean total livestock owned of the respondents were 3.74 TLU.

Rural household normally diversify their income into a range of farm, non-farm and off-farm activities (Ellis, 2000). According to this study result, from total numbers of respondents 74% farmers involved in on-farm activity, where as the remaining proportion (26%) were based on both non/off-farm activities (Table 1). According to respondents, the main non/off-farm activities that they involved were serving as daily laborer (14%), petty trading (11%) and weaver (1%).

3.2. Trees/shrubs scattered on crop fields and their uses

All interviewed farmers had trees/shrubs scattered on their farm lands, but there was variation in the number of trees/shrubs species. Tree/shrub species richness in the studied farmlands was not high. A total of17 trees/shrubs species were recorded over all farms (Figure 2).

Most of the respondents (91%) in the study area used seedlings from natural regeneration to replace old trees in their crop fields, including trees such as *Croton macrostachyus*, *Cordia africana*, *Olea europaea*, *Vernonia amygdalina* and *Erythrina abyssinica*. For scattered trees/shrubs on crop fields, (Rocheleau *et al*, 1988) agree that it is better to protect young natural stands than to plant nursery stock. The practice of protecting the existing natural regeneration, rather than raising seedlings in nurseries and then replanting them, has many advantages, such as labor and cost reduction and they reported that trees in crop fields originate mainly from natural regeneration. However, few of the respondents (9%) used both natural regeneration and seedlings from other sources like from government nursery to replace old trees scattered on their crop fields.

Among scattered trees/shrubs species on crop fields in the study area,C*roton macrostachyus*(90%) was the most frequently encountered species which was retained or planted

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as on-farm tree and it occurred almost in all visited fields; *Cordia africana* (79%) was the second abundant species; followed by *Olea europaea*(36%), *Vernonia amygdalina* (29%), *Erythrina abyssinica* (16%),*Ehretia cymosa*(15%) and *Casuarina equisetifolia* (15%) with a decreasing order of frequency(Figure 2). These commonly existing species are indigenous. According to the respondents, these indigenous are preferred for two main reasons: first, farmers already have experience as how to manage them and secondly, indigenous trees are better adapted to the local environment.

Farmers and KIs in the study area indicated that, they do not plant species which is not previously known in that area on crop fields. Based on their experience they are well knew which species are suitable for crop production through facilitation. So, farmers give primarily attention for soil fertility improvement rather than other purposes for those trees/shrubs scattered on crop fields and they remove species which is competing with crops.

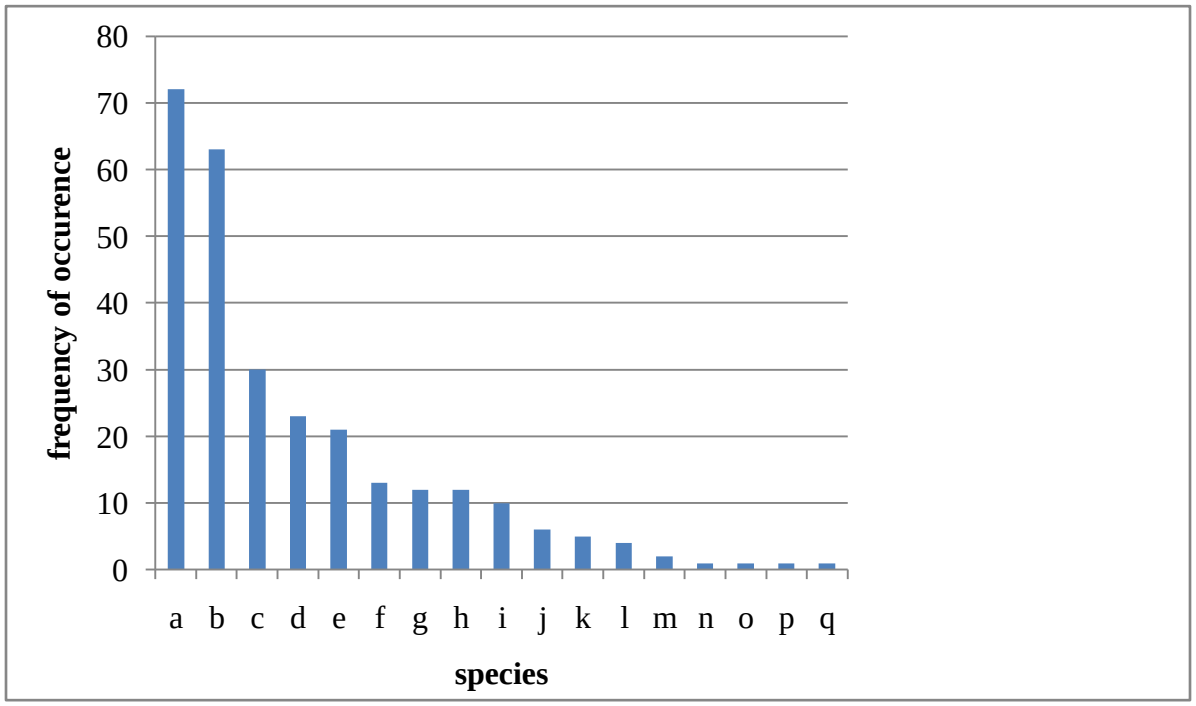

Figure 2. Frequency occurrence of scattered trees/shrubs on crop fields at Welargi and Hidha Dima kebeles in Gemechis district, West Hararghe.

Where: a=*Croton macrostachyus* b=*Cordia africana* c=*Olea europaea* d=*Vernonia amygdalina* e=*Erythrina abyssinica* f=*Casuarina equisetifolia* g=*Ehretia cymosa* h=*Acacia abyssinica* i=*Psidium guajava* j=*Casimora edulis* k=*Anona reticulate* l=*Ricinus communis* m=*Mangifera indica* n= *Persea Americana o=Prunus persica* p= *Podocarpus falcatus* q= *Sesbania sesban*

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There exists accumulated knowledge that helps farmers to manage trees for various uses. Trees/shrubs that are best for soil fertility improvement, fuelwood, animal feed, food, cash income and other purposes are well known by farmers in the study area and they indicated multipurpose nature of trees. Although a number of trees can be used for the same purpose, preferences of farmers for selecting them depend upon several factors, such as fast growth, ease of management, ease of decomposition and good market demand.

The interviewed respondents indicated that from scattered tree species on their crop fields, *Cordia africana* was mainly maintained for its wood products (timber and fuel wood) and soil fertility. However, *Croton macrostachyus* was mainly for soil fertility improvement. Similarly, from fruit trees Mango (*Mangifera indica* L.*)*, Avocado (*Persea americana*), Bullok's heart*(Anona reticulate L)*, Guava (*Psidium guajava)*, White sapota (*Casimora edulis* La Llave & Lex.) andPeach (*Prunus persica* (L.) Batsch) were maintained for food and cash income (Table 2).

Table 2. Percentage of respondents identifying uses of trees/shrubs scattered on their crop fields at Welargi and Hidha Dima kebeles in Gemechis district, West Hararghe.

Trees/shrubs	**Percent of respondents (n=80)**							
	SF	AF	FW	FT	F	SD	TCW	CI
Crotonmacrostachyus	90	12.5	87.5	-	-	75	37.5	-
Cordia africana	78.8	62.5	75	50	-	68.7	78.8	67.5
Erythrina abyssinica	16.3	16.3	-	-	-	12.5	-	-
Olea europaea	25	37.5	12.5	-	-	5	3.8	-
Casuarina equisetifolia	12.5	8.8	10	-	-	15	7.5	-
Acacia abyssinica	12.5	12.5	6.3	-	-	12.5	-	-
Ehretia cymosa	7.5	15	10	15	-	15	11.3	-
Vernonia amygdalina	7.5	28.7	5	-	-	-	-	-
Persea americana	1.3	-	-	-	1.3	1.3	-	1.3
Podocarpus falcatus	-	-	-	1.3	-	1.3	1.3	1.3
Sesbania sesban	1.3	1.3	-	-	-	-	-	-
Mangifera indica	-	-	-	-	2.5	-	-	2.5
Psidium guajava	-	-	-	-	1.3	-	-	1.3
Prunus persica	-	-	-	-	1.3	-	-	1.3
Casimora edulis	-	-	-	-	6.3	-	-	3.9
Anona reticulata	-	-	-	-	2.5	-	-	1.3
Ricinus communis	2.5	-	-	-	-	-	-	2.5

Key: SF=soil fertility, AF=animal feed, FW=fuelwood, FT=farm tools, F=food, SD=shade, TCW=timber and construction wood, CI=cash income.

Tree-crop based farming was the most widely distributed agroforestry practice in the studied area. Under this practice the most commonly retained and planted tree species by farmers was *Croton macrostachyus* under which Maize (*Zea mays*),Sorgum(*Sorghum bicolor* (L.) Moench*)* were the most dominantly intercropped crops, whereas Barley(*Hordium vulgare),*Wheat(*Triticum aestivum),* Chat (*Chata edulis)* and Haricot bean (*Phaseolus vulgaris)*

were also the intercropped crops. All of the interviewed farmers incorporated annual crops with trees into their farmlands.

3.3. Farmers' management activities on scattered trees/shrubs on crop fields

The result of this study indicated that farmers managed different trees/shrubs species on their crop fields. All the interviewed farmers and key informants (KI) indicated that, managing scattered trees/shrubs on crop fields is important for many purposes, such as for soil fertility improvement, animal feed and for other tree products. Farmers used different management activities for managing different scattered trees/shrubs species on their croplands in the study area. These management activities include pruning, pollarding and coppicing.

Farmers in the study area also indicated that managing trees/shrubs on their crop fields by using different management activities were used not only to extract output but also to shape the growth of the tree (through pruning/pollarding). They also indicate that pollarding is used to initiate the preferred stem growth. Management of scattered trees/shrubs on crop field by pruning was used for better crop-tree interaction, which is commonly practiced by farmers in the study area. Similarly, pollarding practice was also an established management activity for management of scattered trees/shrubs on crop fields in the study area. However, coppicing practiced mainly for harvesting of trees for various purpose (Table 3).

Farmers in the study area not only have profound management activities of which tree species are capable of pruning, pollarding and coppicing, but also the time these activities accomplished. They also indicated that time of pruning; pollarding and coppicing are determined by the need of the trees/shrubs products they wanted. All of the respondents and KIs in the study area indicated that the suitable time for pruning and pollarding was during entry of wet season. In addition, they indicated that those trees that are pruned and pollarded during wet season were used mainly for soil fertility improvement (for example, *Croton macrostachyus* and *Cordia africana)*. Respondents mentioned that the trees pruned and pollarded in dry season cannot properly sprout and not easily decomposed. However, pruned branches with leaves practiced during dry season, is used for animal feed (e.g. *Erythrina abyssinica*, *Olea europaea* and *Acacia abyssinica*).

In the study area, farmers have practiced branch and shoot pruning activities largely for *Croton macrostachyus* and *Cordia africana* for the purpose of soil fertility improvement through transfering the biomass to the crop fields by applying their leaves as a mulch and makes nutrient available to the crops, besides reducing the competition of the trees for water and light and for other purposes, such as for fuelwood. Similarly, they also prune branch and shoot of *Olea europaea*,*Vernonia amygdalina*, *Erythrina abyssinica*, *Ehretia cymosa* and *Acacia abyssinica* and *Sesbania sesban* and use their leaves, pods, twigs and bark as a source of animal feed, fuel wood, construction and also apply it as a mulch to improve soil fetility. In addition, they also prune *Podocarpus falcatus* for the purose of fuel wood,construction as well as for soil fertility improvement(Table 3).

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Table 3. Percentage of respondents practicing management activities on scattered trees/shrubs species on crop fields at Welargi and Hidha Dima kebeles in Gemechis district, West Hararghe.

Species	Percent of respondents(n=80)		
	Pruning	Pollarding	Coppicing
Croton macrostachyus	90	37.5	25
Cordia africana	83.3	50	62.5
Olea europaea	37.5	31.3	12.5
Vernonia amygdalina	28.7	-	10
Erythrina abyssinica	16.3	16.3	7.5
Casuarina equisetifolia	-	10	6.3
Ehretia cymosa	12.5	6.3	7.5
Acacia abyssinica	12.5	7.5	5
Sesbania sesban	1.3	-	-
Podocarpus falcatus	1.3	-	-

The farmers practicing pruning activities for scattered trees/shrubs on crop fields in the study area is in consistent with study made in Awi zone by Workineh (2002), where he reported that pruning by farmers of trees on croplands was common, and was intended to reduce competition with crops for nutrients and water and to obtain fuel wood and construction wood. Similarly in Hararghe, Eastern Ethiopia, Poschen (1988) record that 83% of the respondents pruned *Faidherbia albida* and use for animal feed. As Poschen mentioned, the extent of tree pruning and removal of trees is mainly determined by the need for the tree products.

Based on their experience of cultivating various crops under trees retained on crop lands farmers in the study area practice pollarding for *Croton macrostachyus,Cordia africana, Olea europaea, Erythrina abyssinica,Casuarina equisetifolia,Acacia abyssinica* and *Ehretia cymosa* for the purpose of reducing shade effect,soil fertility improvement, fuel wood, animal feed and construction.In line with this study, FAO(1985) reported that in the highlands of Kenya, the pollarding of Grevillia robusta growing on agricultural lands is common. Similarly in Lay-Gayint district, south Gonder zone, Abebaw (2006) reported pollarding of *Acacia abyssinica,Olea africana,Croton macrostachyus* and *Cordia africana* growing on agricultural lands.

The other management activities mentioned at study area was coppicing. Similar to other activities farmers in the study area also practiced coppice activities for *Cordia africana, Croton macrostachyus,Olea europaea, Vernonia amygdalina, Casuarina equisetifolia, Acacia*

abyssinica,Erythrina abyssinica and *Ehretia cymosa* mainly for the purpose of harvesting tree for various use(Table 3). Farmers used the harvest part for timber, firewood, charcoal and other tree products. Respondents and KI noticed that coppicing avoids the need to replant trees after harvesting if appropriate time for cutting and method of cutting applied correctly. All respondents and KIs indicated that, the appropriate time for coppicing was after the rainy season. They indicate that cutting of trees during rainy season cause stump of tree. This agrees with study made in Lay-Gayint district by Abebaw (2006), who reported that cutting of trees in the rainy season cause stump decay. They also preffered to cut trees at near the ground at a height of one shoe mainly to protect the sprouts from splitting by wind.

In general, the farmers' view on management of scattered on-farm trees by different management activities is in line with farmers' view of Dhillion and Gustad (2004) who reported different activities are known and locally applied in order to protect and maintain trees successfully in the farm fields for future human benefit. Tree management practices can be applied to meet a variety of specific outcomes; pruning for example can be applied for sanitation, production of specific shapes and rejuvenation.

3.3.1. Scattered trees/shrubs on crop land and soil fertility management

This study indicated that the tree-crop based farming system have both production and protection roles. The production role includes food, feed, timber and fuelwood, which are directly obtained from scattered on-farm trees, whereas the protection role is mainly related to soil fertility improvement and conservation. According to the KI, soil fertility management is predominantly accomplished through using animal manure. They know that soil fertility management using trees depends on the type of tree species, their arrangement and management practices.

Farmers in the study area identify fertile soil by colour; they said that fertile soil is black in colour, while infertile soil is red. All respondents and KI agreed that a decrease in crop yield is the indicator of decrease of soil fertility status. This is consistent with a study made in Zimbabwe by Chuma *et al*. (2002), stated that farmers have expressed that soil fertility has declined to such an extent that no yield can be obtained without applying fertilizers.

Farmers have developed various techniques to improve or maintain soil fertility (Reijntjes *et al*., 1992). The interviewed farmers have a considerable knowledge on soil fertility management. They select trees/shrubs that maintain soil fertility and recognize which parts of their decompose faster and change to soil. Respondents mentioned leaves as fast decomposing tree parts. Similarly, study in Kindo Koisha district of Wollaita by Eyasu (2000), showed that there were a wide use of leaf litter by resource poor groups of farmers to manipulate soil fertility. In the study area,*Croton macrostachyus* was highly preferred by farmers as soil fertility improvement, due to the reason that; faster decomposition of its leaf. The farmers' response on faster decomposition of *Croton macrostachyus* leaf was in line with Gindaba *et al*. (2004) who reported that trees such as *Croton macrostachyus* whose leaves decompose rapidly could supply nutrients in the short term for uptake by crops.

All respondents replied that soil fertility is better under tree canopy than outside areas because of litter addition under tree canopies.With regard to soil fertility and the role of tree species, interviewed households had similar view with KI. The farmers' view on the role of tree species in improving soil fertility is in line with the farmers' view reported by (Kamara and Haque (1992),Abebe *et al*. (2001); Tadesse *et al*. (2001) for *Militia ferruginea* and by Zebene and

Agren (2007) for *Millettia* and *Cordia* grown on enset fields and by Zebene and Agren (2007) for Millettia-enset-coffee and Cordia-enset-coffee agroforestry practices managed by Sidama traditions.

4.0 Conclusion and Recommendations

In Gemechis district at Welargi and Hidha kebeles, trees/shrubs are retained/planted on crop lands in an intimate association mostly with annual and rarely with perennial crops. The total number of trees/shrubs scattered on crop fields were seventeen and their uses were for soil fertility improvement, animal feed, fuelwood, food, shade, cash income, construction and timber. The most dominant crop intercropped with trees/shrubs was maize and sorgum. The activities farmers used on managements of different trees/shrubs species scattered on their crop fields were pruning, pollarding and coppicing. The management of scattered trees/shrubs by different management activities, which is currently being practiced in the area, could significantly improve livelihood of the people. Hence, their integration in the farming system is worthy and should be encouraged.

Based on these findings the following points are recommended:

- Integration of farmers' management activities knowledge with scientific knowledge to enrich their knowledge and techniques for practice, such as pruning and pollarding time, intensity etc., deserves attention.
- Study on litter quality (litter decomposition) and nutrient dynamics in the canopy tissues of this tree species should be conducted in order to determine when branches have to be pruned and pollarded for off-site uses or *in situ* soil conservation activities.

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