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## Contribution of Agroforestry Home Gardens to Household Food Security and Income Generation among Communities in Habro District Western Harerge in Eastern Ethiopia

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### Abstract

The study was conducted in Habro woreda at Gelemso Rural District with the main objective of assessing the contribution of Agroforestry home gardens to household food security and income generation among communities. The study involved four randomly selected wards, one village per selected ward and thirty households from each village, all selected randomly. Data collection was done through field surveys using relevant social survey methods. The findings indicate that 99% of the communities in Habro Rural District practice Agroforestry Home gardens as one of their main sources of household food security and income generation. Six sources of household food security and income generation were identified in the study area with Agroforestry home gardens and agriculture being the main sources of life sustenance. Of the Agroforestry Home gardens contribution, seventeen percent (17%) is towards household food security and twenty five percent (25%) towards income generation. According to the communities studied, food security and income generation over the year form 78% of the motivating factors to adopt the Agroforestry home gardens. Crop competition, low capital and unreliable markets, were together the main factors (by 77%) which negatively affected the contribution of Agroforestry home gardens to household food security and income generation in the area. Sixty seven percent (67%) of the communities indicated that credit facilities, knowledge on components arrangements and market availability for home gardens products, were the main interventions required in improving the contribution of Agroforestry home gardens adoption. Based on these findings, Agroforestry home gardens is a major source of food and income generation in Habro Rural District. Therefore, there is a need for enhancing and reviving further the Agroforestry home gardens technologies for the benefits of the wider communities beyond the District. This should go hand in hand with the provision of sufficient credit facilities, extension services together with marketing arrangements.

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### Keywords

Homgarden, Agroforestry, Habro district, food security, income generation.

### Introduction

Home gardens are traditional Agroforestry practices with multiple functions practiced by rural farmers around homesteads as a strategy of livelihood diversification to

stabilize their sustenance (Das and Das, 2005; folliot, 2005; Kebebew *et al.*, 2011). Home gardens involve integration of various woody perennials, herbaceous crops and /or livestock on the same unit of land management (Nair, 1993) with the aim of increasing

production and income generation (Nair and Kumar, 2004). Home gardens also are among the Agroforestry technologies maintained by rural farmers, fulfilling an important role in the ecological, social and economic function of communities (Nair, 1993).

The main attributes that have been identified from home gardens which contribute to the sustainability of these technologies are biophysical advantages such as efficient nutrient cycling offered by multispecies composition, conservation of bio-cultural diversity, product diversification as well as non-market values of products and services, and social and cultural values including the opportunity for gender equality in managing the technologies (Kumar and Nair, 2004). With their multi-layered vegetation structures, home gardens serve as an important habitat for wild flora and fauna (Kehlenbeck and Maass, 2004; Tangjang and Arunachalam, 2009).

Likewise, this Study shows that home gardens are generally regarded as very complex, species-rich Agroforestry systems managed in a sustainable manner over decades or even centuries.

Because of high plant diversity in the home gardens (Kumar and Nair, 2004), a wide spectrum of multiple-use plant products can be generated with relatively low labour, cash or other inputs (Kumar, 2006). In seasons of scarcity home gardens with their diverse products available year round, contribute towards food security (Tynsong and Tiwari, 2010). Home gardens are most commonly planted in blocks, rows (Alley farming), or random arrangements around or adjacent to homesteads and communities (Ffolliott, 1998). Kumar and Nair (2008) reported that tropical home gardens is one of the oldest forms of managed land-use systems and are considered to be epitomes (hearts) of sustainability. They evolved through generations of gradual intensification of cropping in response to increasing human pressure and the corresponding shortage of arable lands.

The contribution of Agroforestry home gardens practices is well appreciated throughout the world (Kebebew *et al.*, 2011). Globally, famine and starvation are knocking with speed. As the world population expands the food problem has become increasingly severe, with the number of those malnourished reaching 3 billion (Olajide Taiwo *et al.*, 2010). During the period of 1993 to 2003 up till now, Africa's rate of population growth has been higher than the rate of food production (Bishaw and Abdelkadir, 2003). Despite the identification of food security as an important policy goal in Africa, too many

African countries continue to be food insecure especially among the urban-poor (Olajide Taiwo *et al.*, 2010). This can be reversed through conscious integration of the home gardens strategy into rural and urban development (Krishnal *et al.*, 2012). Home garden technologies provide an additional food supply and cash income for the people (Das and Das, 2005). The importance of home gardens as a technology is based on the complexity of interactions between species that occur within Home gardens, and their apparent sustainability over time in order to meet the people's needs in terms of food, fuel wood, livestock products (milk, eggs, meat) fodder, income and building materials. The primary emphasis of home gardens is food production for household consumption (Ndaeyo, 2007; Lulandala, 2010). However, recently, there has been a decline in food production trends which resulted in low yields and income earnings to households (URT, 2010). These declines required a strategic plan that will enhance the balancing of the productivity rather than its normality (URT, 1997). Development and introduction of new technologies which increase productivity of labour and land are highly needed to fulfill the people's needs. Integrative and sustainable natural resources management is required to rescue the environment from destruction as well as biodiversity loss (URT, National Environmental policy, 1997). Compared with subsistence agriculture, Home gardens Agroforestry provide added benefits by generating income from the marketing of diverse products which will sustain the household food supply throughout the year (Fenandes *et al.*, 1984).

### **Justification and Statement of the problem**

Food and household income insecurity are the major concerns today in many parts of the countries which are fueled by the increase in population density (FAO, 1999). High population density has put a lot of pressure on land as more of it is required for settlement (Musotsi *et al.*, 2008). This has led to land fragmentation, which has negatively affected food production, hence, resulting into food insecurity (Kebebew *et al.*, 2011). Complying with the objectives of the National Agricultural Policy (URT, 1997), there must be assurance of basic food security and improvement of national nutritional standards by increasing output, quality and availability of food commodities to all citizens. Land use practices thus have to be intensified to maximize food production on the small land available. Home gardening has been identified as a means of providing all year round access to food for rural households (Kebebew *et al.*, 2011; Kumar, 2006; Akinnifesi *et al.*, 2010), that helped

smallholder farmers to support their family (Kalaba *et al.*, 2009). According to Motiur *et al.*, (2005) reported that in Bangladesh and India on average, 15.9% and 11.8% of household food and income is derived from Home gardens respectively. In Africa, Musotsi *et al.*, (2008) reported that in Butere Western Kenya; home gardening plays a significant role in food security of rural households with respect to size of land and food stock. Rugalema *et al.*, (1992; 1994) in Bukoba district. Ethiopia indicated that home gardens productivity declined due to gradual decline of soil fertility which was mainly influenced by various factors in Agroforestry home garden farming systems. While Fernandes *et al.*, (1984) reported that the Chagga home gardens have an advantage claimed from the multi-species, multi-storey home gardens, which include soil conservation, nutrient cycling and efficiency, microclimate enhancement and other benefits such as labour efficiency, risk minimization, and continuous production.

From this point of view, in Gelemso Rural District the review of literature clearly shows that there is no known research done on the systematic assessment and documentation of the home gardens potentials and the information to that effect remains fragmented. Therefore, the present research is intended to fill this information gap and provide information on the contribution of Agroforestry home gardens to the livelihoods of the smallholder farmer's households. The findings obtained from this study will be useful in redirecting, improving and strengthening the existing Agroforestry home gardens programmers in Gelemso Rural District and elsewhere in the country of Ethiopia. Therefore, this study was designated with following objectives

To assess contribution of Agroforestry home gardens to household food security and income generation among communities in Eastern Ethiopia.

To identify the Agroforestry home gardens technologies practiced in the study area.

To identify and determine the various sources and quantities of household food supply and income generation among communities;

To determine the proportion of home gardens technologies contribution to households food security and income generation to smallholder farmers;

To determine the factors influencing the contribution of Agroforestry home gardens technologies to household

food production and income generation to smallholder farmers.

## **Materials and Methods**

### **Sampling procedures and sample size**

A simple random sampling technique was used to select wards, villages and the number of heads of households in the study area. Four wards with one village from each ward were selected and a minimum of 30 households were interviewed in each village whereby other members of households were encouraged to give support to the head in order to get more accurate data and information. Table 1 shows distribution of population, households and sample sizes in each study village.

### **Data collection techniques**

Both primary and secondary data were collected. Primary data was collected through various social economic survey techniques, whereby background information on Agroforestry home garden technologies practiced, sources and quantities of household food and income generation were identified, the contribution of Agroforestry home gardens to households food supply and income generation were obtained in the study area.

### **Sampling technique**

The researchers select to use simple random sampling method to select the participants from the total population of the farmers. According to the Keble administration office in 2012E.C.

### **Reconnaissance survey**

This technique was used by the researcher to familiarize with the study area and obtain critical information from the district, ward and village officials that helped in better planning the study and scheduling the data collecting process. Also was valuable mechanism of controlling the quality of data that was collected.

### **Household data collection**

Through structured and semi structured questionnaire, socio economic data were collected. Both closed and open ended questions were employed for interviewing household heads to determine their farming practices, number of dependents, various sources and quantities of income and food supply, sources of firewood, its

availability and prices, the type of integrated trees, crops, livestock products, amount of food and income obtained from Agroforestry home garden components (amount in kilogram/ year, litres/yr, bunches/yr, pieces/ year, months of availability and its prices).

### **Note**

The income determination in this study was based on product of farm yield estimates and its farm gate prices used at the time of selling and sources of household food security and income generation were identified basing on the homestead closeness (i.e. those products around homestead were termed as Agroforestry home gardens and outside homestead as other sources).

### **Observation method**

Direct researcher observations were made on the selected household farm fields concerning the general condition of their farming practices, identification of various Agroforestry home garden technologies practiced in the study area, their component arrangements such as tree crop components, tree crop animal components and type of trees/shrub species used in their farms and their amount.

### **Secondary data**

Secondary data were collected from office periodic reports and publications from local authorities, institutions, government offices, libraries, website.

### **Data Analysis**

Both qualitative and quantitative data were summarized, coded and analyzed. Statistical Package for Social Sciences (SPSS version 16) was used to obtain the central tendency (means and percentages) and dispersions (frequencies and deviations) through descriptive and multiple response analysis. Analysis of Variance (ANOVA) was used to determine the significant difference between means through Costat analytical Programme. The Least Significance Difference (LSD=0.05) was used to separate the non-significant means from significant means.

Content analysis method was used to handle the qualitative data/ information from key informants and community working group business. The component of verbal discussion were analyzed in detail with the help of content analysis method in which recorded dialogue with

respondents was broken down into smallest meaningful units of information and tendencies.

## **Results and Discussion**

### **Extent of Agroforestry Home gardens Usage in Habro Rural District**

The results on the extent of the Agroforestry home gardens adoption in Habro Rural District are presented in Table 2. They indicate that 99 % of the households in the District are practicing Agroforestry home gardens. The findings also indicate that the adoption is more or less evenly spread through the whole District.

### **Types of Agroforestry home gardens systems and technologies practiced in Habro rural district.**

The results on the types of Agroforestry home gardens technologies practiced in Habro Rural District are presented in Table 3. Two types of Agroforestry home garden technologies are found in the study area. These include Agroforestry home gardens consisting of trees/shrubs mixed with herbaceous/ annual crops (Agrosilvicultural home gardens system) and the Agroforestry home gardens of tree /shrubs mixed with herbaceous crops and animals (Agrosilvopastoral home gardens system). The results indicated that 80% of the district community preferred more to use Agroforestry home gardens of Agrosilvopastoral system.

### **Tree/shrub species planted in Agroforestry home gardens of Habro Rural District**

The results on the tree/shrub species found in the study area are presented. Banana (20%), avocado (18.9%), mango (13.1%), and peach (10.7%) were the most planted species. This was probably due to their multiple functions they have as they can provide immediately fresh and nutritious fruits that sustain their households with food and income. At the same time they provide fuel wood and building materials.

### **Common types of livestock found in Agroforestry home gardens in Habro Rural District**

The results on the common types of livestock found in Agroforestry home gardens of Habro rural are presented in Table 4. These were chicken, goats, cattle, donkey, sheep and other livestock. This implied that chicken keeping was the commonest to majority of the community in the study area. Probably due to easiest

method of keeping and involving low investment since they can be kept free ranging and housed inside peoples living houses.

### **Various Agroforestry home gardens technologies used in Habro Rural District**

The results indicated that various Agroforestry home gardens systems consisted of various technologies that include live fences intercropping, alley farming, mixed intercropping and shelterbelt/wind break intercropping as shown in the following image 1, 2, 3 and 4.

Various arrangements of Agroforestry home gardens found in the study

### **Various sources of Household Food Security and Income Generation in Habro Rural District**

The results on various sources of household food security and income generation identified in Habro Rural District are presented in Table 5. The results indicated that three sources of household food supply and income generation were identified: agriculture, Agroforestry home gardens,, livestock, Agriculture and home gardens revealed to be the major sources of household food security and income generation in Habro rural communities.

### **The contribution of various sources and quantities to household food security in Habro Rural District**

The results on contribution of various sources of household food security and income generation in Habro Rural District. Generally, Habro rural communities depend on various sources with agriculture being the highly significant ( $p < 0.05$ ). Agroforestry home gardens come as the second most important contributors to the district household food security. This implied that agriculture and Agroforestry home gardens are the main occupation to the majority of Habro rural communities.

### **Contribution of various sources and quantities to household income generation**

Agroforestry home gardens and agriculture indicated high proportions on contribution to household income generation among Habro rural communities followed by business. This was probably implied that most of the Habro rural communities depend relatively on various sources for their livelihoods.

### **Factors that motivated people to use Agroforestry homegardens to household food and income generation**

Having sufficient food throughout the year, getting income and diverse products to their families were the most influencing factors for the Habro rural communities to adopt Agroforestry home gardens technologies.

### **Measures required in improving the contribution of Agroforestry home garden technologies to household food security and income generation**

The results on the measures to be taken in improving the contribution of Agroforestry home garden technologies to household food security and income generation in Habro Rural District are Credit facilities provision was the most significant measure to improve the performance of home gardens technologies in the district

### **Extent of Agroforestry home gardens usage in**

The results show that majority of the Habro rural communities practice home gardens technologies by 99%, implying that majority are aware of the technologies as discussed by Kitanyi *et al.*, (2006), although their existence have not yet recognized nor documented. The results also indicate that adoption of the Agroforestry home gardens is more or less evenly spread throughout the district. This could possibly be due to the fact that Habro Rural District is among the most endowed districts with high rainfall and different climatic regimes ranging from tropical to temperate climates as reported by DED (2012). Also the study area shows to have various economic opportunities that influence people to migrate from different areas to come and invest. Furthermore, the report showed that Habro Rural District is among the densely populated area whereby land fragmentation was obvious. This has resulted into land scarcity as discussed by Rugalema(1992; 1994)Land use practices thus have to be intensified to maximize food production on a small land available.

Agroforestry home gardens can make a significant contribution in meeting the daily households' needs. These results agree with findings by Fernandes *et al.*, (1986) who reported that home gardens are the best solution to all areas with high population density.

Abebe (2005) also reported that Chagga home gardens cited as model example of land use management to abate

environmental deterioration as well as biodiversity conservation.

Two types of Agroforestry home garden technologies were found in the study area with various structural arrangements. These were Agroforestry home gardens of trees mixed with herbaceous crops (Agrosilvicultural home gardens) and the Agroforestry home gardens of tree /shrubs mixed with herbaceous crops and animals (Agrosilvopastoral home gardens). The results show that 80% of the District communities preferred Agroforestry home gardens of Agrosilvopastoral system. The multiple production function from these technologies assured them access to food and income throughout the year. Also the biophysical advantages offered by these multi-species composition (efficient cycling nutrients) and conservation of bio-cultural diversity.

This results are in line with report given by Nair (1986); Nair and Kumar (2004); Tolunay (2008); Bassullu and Tolunay (2010) that traditional Agroforestry home gardens involving animal component with growing various trees, small trees, shrubs and similar wood-like species and agricultural products have high output compared to those without it if are well managed. Also FAO (1996); Tewari (1994); Makino (2003); Hassanuzzaman (2008), reported that diverse production from various components (tree/shrub/annual crops/animals) provided food security to a large low-income population particularly during periods of drought and works as an insurance against famine and crop failure.

The results also indicate that various home gardens technologies were arranged as live fences mixed cropping arrangement and alley farming arrangements for land use effectiveness. The results are similar to those reported by Nair (1993) as discussed in the literature review. The occurrence of tree/shrub species in the study area differ between wards depending to ecological distribution. Through observation technique, the study showed that tree/shrub species like banana, avocado and chat were found in all ecological zones. Orange, mango, grevillia and citrus tree/shrub species suited only in low altitudes. On the other hand maize and chat are the most herbaceous crops grown by Habro rural communities; as these are the major food crops in the study area. Different households keep different species of livestock.

Most of the Habro rural communities in the study area keep local and cross breed types of livestock and only few of the households keep exotic breeds of cattle, goat

and sheep. The types of livestock kept are chicken, goat, cattle, sheep and other livestock. This means that chicken keeping is the commonest to the majority of the communities in the study area. This implies that chicken keeping is the simplest investment as reported by URT (2010). The study also shows that majority of the rural households keep more than one type of animals as a strategy to maximize profit as well as risk reduction in food supply and sufficient income to the family. Jensen (1993a, b) and Wilson (1995) reported that diverse livestock keeping contributed significantly to the household income of small-scale home gardens in many developing countries to fulfill many social and cultural needs. Also due to limited land size owned by the majority of the community as shown in appendix 14 make households to diversify their production. This justifies adoption of Agroforestry home gardens technologies in the study area. Devendra and Thomas (2002) indicated that in some of the very small gardens, where land was a constraint to production, livestock were sometimes the main income generators, serving as cash buffers and capital reserves. Apart from income generators, livestock also contributed to the nutrient cycling in the system (Jensen, 1993b; Thorne and Tanner, 2002; Hailu, 2008). On the other hand, the study shows that all households with animal component benefited from animal products like milk, meat and animal manure by adding their nutritional status to their families as well as increasing their farm crop yields by improving soil fertility of their farms using animal dung. Various Sources and Quantities of Household Food Security and Income Generation in The results on the various sources and quantities of household food security and income generation in Habro Rural District. Six sources of household food security and income generation were identified in the study area; these are Home gardens; agriculture, forestry, livestock, business and employment.

Generally Habro rural communities seem to depend on various sources of household food security and income generation with Agroforestry home gardens being the main sources of relatively livelihoods dependence at level of ( $p < 0.05$ ). The results agree with the study done by Trinh *et al.*, (2003); Gautam *et al.*, (2004); Bonifasi (2004) and Das and Das (2005) that Agroforestry home gardens are the important sources of household food and income in the world.

On the other hand, agriculture has the highest contribution to food supply and the second to income generation in the study area. The importance of

agriculture has also been explained at national level. Also agriculture is the backbone of the Ethiopia economy in terms of production, employment, income and foreign exchange generation (Nyoni, 2007).

However, contribution of agriculture to household food supply and income generation in terms of quantity was low compared to home gardens. This is because that majority of the interviewed households complained to have low capital to invest in agriculture as a single cropping system (monoculture), since it required high capital compared to home gardens.

High prices in agricultural inputs led majority of the communities to end up with low yields due to low purchasing power. As result they only applied topdressing fertilizers rather than using both basal and topdressing fertilizers. This result is contrary to that of a study done by Dorward *et al.*, (2008) in Malawi where they tried to improve the smallholder maize production by subsidizing the agricultural inputs timely through agricultural Input Subsidy Programmed (AISP). The results showed that in two years' time their production trends increased. Unreliable distribution of rainfall on the other hand, affected contribution of food supply from agriculture. Majority of the households interviewed in the study area depended on rain fed agriculture which leads to frequent crop failures, resulting to low contribution of household food supply, hence household food insecurity as reported by FAO (1996); Nyange (2000); DAPD (2006/2007); Shilabu (2008). Also pests and diseases, inadequate input use, poor use of farm tools and poor husbandry could be other factors affecting agriculture sector hence lowering contribution to household food and income supply. This result is in line with a study done by Makundi (1996); SUA (2006) that the fore mentioned reasons led majority of the household to food insecurity. However, there are coping strategies that the Habro rural communities used to overcome the household food shortages. These included buying food

from market and doing casual labour. Integration of tree species provided biophysical benefits. Not only had that but also increased the soil fertility through fallow system. This therefore, shows that Agroforestry home gardens technologies are the best options in community livelihoods sustenance.

### **Contribution of Agroforestry Home gardens to Household Food Security and Income Generation to Livelihoods of Habro Rural Communities**

The results indicate that Agroforestry home gardens ranked highest proportion in contributing to household income generation per year compared to other sources, and second to agriculture on household food supply. As Agroforestry home gardens consisted more than one components (tree/shrubs/ annual crops; tree/shrubs/annual crop/livestock components) which favoured the community's access to food and income throughout the year as reported by FAO (2004). Ndaeyo (2007) reported that food security was of paramount importance to communities' livelihoods as it was the central well-being of any creature. Therefore, Agroforestry home gardens significantly improved the household financial and food statuses of the communities as discussed by Fernandes *et al.*, (1984); Bishaw and Abelkadir, (2003).

Furthermore, Lulandala (2011) and Krishnal (2012) reported that Agroforestry home gardens reduced the cost of labour as most of activities in home gardens operated by family labour. However, the Agroforestry home gardens products sold varied highly from one household to another. These results were similar to Marsh, (1998); Trinh *et al.*, (2003); Therefore, Agroforestry home gardens remain the main occupation for income generation and food supply to rural communities as reported by Fernandes *et al.*, (1986); Mendez *et al.*, (2001); Maroyi *et al.*, (2009); Guuroh *et al.*, (2011).

**Table.1** Distribution of respondents in the surveyed area

Village	Total No. of hhs	Total sampled households
V1	350	30
V2	533	30
V3	294	30
V4	300	30
Total	1477	120

**Table.2** Usage of Agroforestry home gardens in Hbro Rural District

Ward of the Respondents	frequency	Percent
fA	30	25
Fb	30	25
fC	29	24
fD	30	25
Total	119	99

**Table.3** Types of Agroforestry home gardens technologies identified in Hbro Rural District

S /No	Type	Frequency	Percent
1	Agrosilvicultural home gardens	24	20
2	Agrosilvopastoral home gardens	96	80
	Total	120	100

**Table.4** Livestock component found in Habro Rural District

Type of livestock	fA	fB	fC	fD
Chicken	13	12	8	10
Goat	6	9	12	4
Cattle	8	6	3	7
donkey	3	2	1	2
Sheep	12	8	10	6
Total	42	35	34	29

**Table.5** Various sources and quantities of household food security and income generation in Habro Rural District

Various sources	Frequency(count)	Percent (%)
<b>Agriculture</b>	<b>120</b>	<b>100</b>
<b>Home gardens</b>	<b>118</b>	<b>98</b>
<b>Livestock</b>	<b>21</b>	<b>18</b>

**Table.6** Measures required in improving the contribution of home gardens to household food security and income generation

Type of measure	Frequency	Percent
Credit facilities provision	34	25
Knowledge provision	31	23
Earlier subsidy fertilizer provision	24	18
Reduction of fertilizers price	15	11
Provide fertilizer subsidies to all sellers	14	11
Market availability	8	6
Agricultural extension officers to have demonstration plots	3	2
Type of tree selected	3	2
Land separation to each crop	1	2
<b>Total</b>	<b>133</b>	<b>100</b>



**Image.1** Live fence home gardens arrangement



**Image.2** Alley farming home gardens arrangement



**Image.3** Mixed cropping home gardens technology arrangement



Image.4 Shelter belt/windbreak home gardens arrangement



Agroforestry home gardens also can be described as an important social and economic unit of rural households, from which a diverse and stable supply of economic products and benefits are derived. The results from respondents' point of view indicate that combination of herbaceous crops with different production cycles and rhythms resulted into an uninterrupted supply of food products as discussed by Maroyi (2009). This assures Habro rural communities to be food and income secured as reported by Fernandes and Nair (1989); Kajembe *et al.*, (2000); Beckford *et al.*, (2011); Nair (2012).

In line with this significance of home gardens, there are various factors that can either influence or limit the community's adoption of the Agroforestry home gardens technologies. However, in Habro Rural District the results showed that majority of the communities adopted the technologies.

#### **Factors Affecting Contribution of Agroforestry Homegardens to Household Food Security and Income Generation in the District**

The results on the factors influencing contribution of Agroforestry home gardens to household food security and income generation. On average, majority of the interviewed households are positively motivated to use the Agroforestry home gardens technologies because of sufficient food and income obtained throughout the year and by having diverse products. The results of this study are similar to Guuroh *et al.*, (2011) that home gardens played a vital role in supporting households in many diverse ways, including the provision of food, fuel wood,

building materials, and fodder for livestock, and income. They are regarded as a source of income diversification and also play a crucial cultural and social role in rural communities. Moreover, Tynsong and Tiwari (2010) reported that in times of food scarcity, home gardens with their diverse products available year round, contributed towards food security. On the other hand, crop competitions the main significant factor affecting the rural households to use the Agroforestry home garden technologies.

This is because majority of the communities lack skills on the tree management and arrangement, due to insufficient farmer training. Competition for shade, light, soil moisture and nutrients between components increased disappointment to farmers. Trees as the main component in the technologies may outcompete arable crops for nutrients, growing space, and light and soil moisture and may reduce the yields of the associated crops as discussed by Kumar and Nair (2004). Therefore, this effect caused negative perception to farmers on the use of technologies. Njuki(2001) reported that crop competition was the major constraint to the integration of trees into farming technologies as majority of the communities have not known the right tree species that can be used to integrate properly in their fields.

Moreover, low capital and inaccessibility to credit facilities hindered the adoption of the Agroforestry home gardens in the study area. Though there was ward bank (SACCOS) in the study area, still the registration regulations were too stringent and fees were too high that lead to many of the communities not to afford joining.

Some of the communities were not aware of the existence of the ward bank institution. Credit facilities have helped many people to come out of poverty.

The facilities lead them to increase their production by accessing the required inputs and improve the contribution of the Agroforestry home garden technologies and hence improve their household food security and income generation. The results from this study, however, are contrary to that of Smale *et al.*, (2009) that credit facilities are the corner stone's for the rural farmers' development.

Apart from this, through focused group discussion, the business group dealing with production and processing of various products from fruits to add value argued that lack of capital hindered them from reaching their goals of production.

Furthermore, unreliable markets in the study area were another factor that caused the communities to be disappointed to adopt Agroforestry home gardens technologies. As they sold their products under farm gate markets (85.8%) with a very low prices resulting into low earnings hence low contribution of the home gardens and household food insecurity. Baiphethi and Jacobs (2009) reported that reliable markets to rural farmers may improve their livelihoods.

Land shortage on the other hand constrained the communities to use home gardens technologies in the study area as discussed by Musotsi *et al.*, (2008).

The results indicated that there was land shortage in the District and the farmland was highly fragmented with land holdings ranging from 0.25 – 12 acres with an average acreage of 2.6 acres per household.

In general 75% of the selected households were under class having land size between 0.25 and 3.0 acres with Ijombe being the most leading ward by 96.7%. These results were contrary to that of Fernandes *et al.*, (1984) who reported that the average land size owned per household in Kilimanjaro was 0.68ha greater than that owned by Habro rural communities. The results show that all available land is intensively cultivated and hampered the efforts to increase production and demand of food by Agroforestry home gardens. However, renting and purchasing land occur in areas which seemed to have enough land as an opportunity of which favors few rich farmers.

### **Measures required in improving the contribution of home gardens technologies to household food security and income generation in the study area**

The results on the measures to be taken in improving the contribution of home garden technologies of household food security and income generation in Habro Rural District are presented in Table 13 (with details in appendix 22).

Credit provision is the most significant factor to improve the performance of home garden technologies in the district. It was found that majority of the interviewed respondents faced difficulties in accessing credits from the financial institutions (Ward SACCOS) though access to financial services is crucial to economic growth and poverty reduction in the society URT (2005).

This was probably because of poor knowledge on banking operations leading to majority of the rural dwellers to remain poor. However, even where people understand the banking operations, the requirement for collateral (guarantees) by most financial institutions impedes provision of credits. A high entrance fee rate to financial services (Ward SACCOS) is the stumbling block to access loans by respondents.

Lack of knowledge on how to access and use credits resulted into poor home gardens operation leading to low yields. Therefore, knowledge provision to all home gardens owners is of importance to overcome food shortages to the households. Also there should be open and easy access to credit facilities and entrance to all people so as to improve their home gardens production.

Agroforestry home garden technologies are among the best ways in areas with high population like Habro Rural District to sustain the communities' livelihoods.

Knowledge through training provision to farmers on the other hand can contribute in improvement of home gardens production. Majority of the respondents lacked knowledge on component arrangement and management which lead to low yields.

Therefore provision of training to farmers will enhance home gardens production resulting into food security and income sustainability. Chirwa *et al.*, (2006) and Nair and Kumar (2008) revealed that intensive tree pruning and planting of trees on proper arrangements led to increased productivity of the Agroforestry home gardens.

From the foregoing discussions, the following conclusions are drawn from this study:

The findings show that Habro Rural District has been practicing the Agroforestry home garden technologies by 99% though has not yet been recognized and documented. Two types of Agroforestry home gardens technologies are found in the study area.

These are Agrosilvicultural and Agrosilvopastoral home garden technologies. Eighty percent (80%) of the Mbeya rural communities preferred to use the Agrosilvopastoral home gardens technologies for production diversification and profit maximization.

Six sources of household food security and income generation were identified and indicated that Agroforestry home gardens and agriculture were the main sources of sustenance both for food and income in the study area. Agroforestry home gardens ranked the highest contributing source to the livelihoods of Habro rural communities.

Furthermore, Agroforestry homegardens also show the highest proportions in contributing to household income generation and ranked second to agriculture in household food security contributors. Therefore, Agroforestry home gardens technologies showed to be the best options to sustain the households of the Habro Rural District.

Access to sufficient food and income throughout the year with diverse products in their households are the main factors that motivate the Habro rural communities to use Agroforestry home garden technologies. However, crop competition, and inadequate knowledge/skills on tree management and arrangements with right tree species to integrate with their herbaceous crops are the major limiting factors to use Agroforestry homegardens technologies. Apart from this, low capital and unreliable markets were other limiting factors to adopt the Agroforestry home gardens in the area. All of these are due to inaccessibility to credit facilities, tough entrance regulations in the credit institutions and high entrance fee rates which hinder majority of the communities to access credits.

Therefore, credit and knowledge provision to all home gardens users, structural arrangements, type of tree species to integrate and its management could be the most significant factors in improving adoption of the Agroforestry home gardens technologies in Habro Rural District.

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