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Financial Analysis of Moringa Tree Based Agroforestry Practice against Mono-Cropping System in Konso District (woreda), Southern Ethiopia

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Abstract
Agroforestry is praised for its benefit in balancing economic and environmental goals although its economic advantages over monocropping were not well documented for most agro-ecology and practices. This study was carried out to evaluate the profitability of Moringa tree based agroforestry practice against monocropping by employing combinations of methods focus group discussion, key informants interview, and household survey for data collection. The data obtained via these techniques were analyzed by using descriptive statistics, cost benefit analysis and sensitivity analysis. The result shows that moringa based agroforestry is practiced by the majority of the respondents. The comparison between the moringa based agroforestry and monocropppoing revealed that Moringa tree based agroforestry practice is more profitable than monocropping system. It is not only the profitability but also the moringa based agroforestry overrides the monocropping by being less sensitive for changes in price and other variables. The result shows that Moringa tree based agroforestry system is superior for its social, economic and environmental benefits than monocropping system. Above all, it is the land use system recommendable in the area, where the problem of inhospitable, harsh and vulnerable environments, challenging landscape, fragile soil susceptible to erosion and highly variable rainfall is very pressing. Therefore, the government and other responsible bodies should give due attention to help smallholder farmers in the area in order to use Moringa tree based agroforestry land use in addition to monocropping.
Keywords: Smallholders, livelihood, benefits, sensitivity analysis, and cost benefit analysis

1. INTRODUCTION

Agriculture contributes to economic growth of most nations (Ernest, 2013 & FAO, 1994). Nevertheless, in most developing countries, it depends on erratic rainfall, challenging landscape, and limited land use system (UNDP, 2007 & FAO, 1994). This made it poorly performing, and in turn this caused food insecurity. One of the best solutions to solve this problem in the areas, where the problem of inhospitable, harsh and vulnerable environments, challenging landscape, fragile soil susceptible to erosion and highly variable rainfall is very pressing is adopting agroforestry. Agroforestry practice yield social, economic, environmental and scenic beauty benefits (Valdivia et al., 1996). It is attention getting activity in SNNPR (Yeshambel, 2013). The use of it for soil conservation and livelihood supporting strategy is the most widely attention getting activity in southern part of Ethiopia (Yeshambel, 2013).

In Konso district, including the study site Goch'a, moringa tree based agroforestry practice (MTBAFP) is the known for its livelihood supporting strategy (Forch, 2003). Moringa is a multipurpose tree which: is used to fill gaps associated to drought impacts; has a very high nutritional advantage; is economically valuable in generating income for RHHs; and is used for shade.

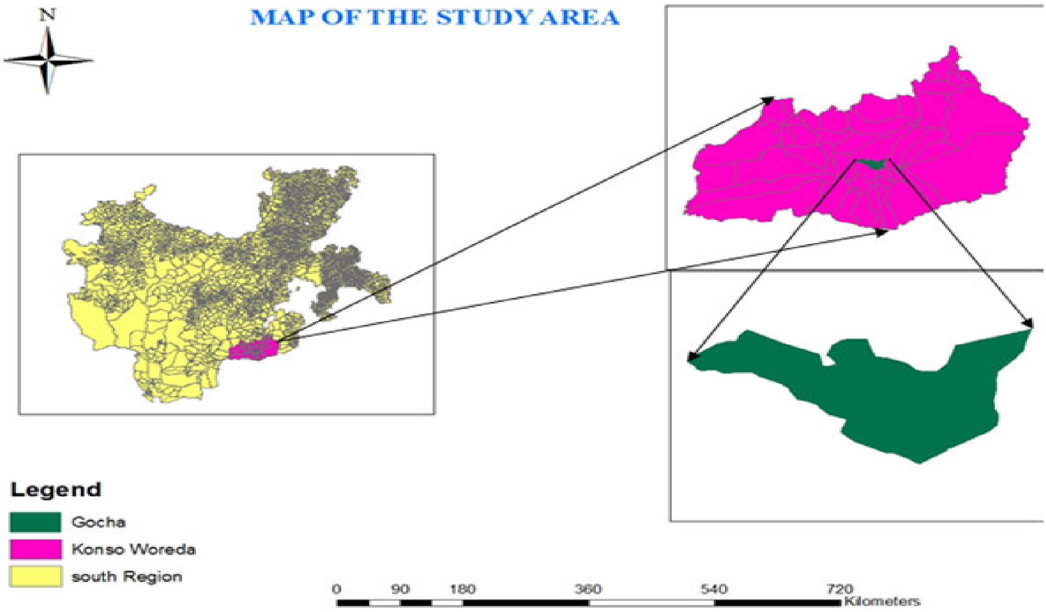
In Goc'ha Kebele the rural communities are heavily dependent on MTBAFP. For example, it is very common to see different types of small and big trees inside and around the farm land. The best example in the area is the cabbage tree Moringa Stenopetala (locally also called to be Moringa). They also harvest variety of crops throughout the year.

These unique mixed agriculture practices enabled them to cope up the climate change impacts during unpredictable environmental conditions and be profitable from the system. However, in the study area, the detailed study, hard facts and figures on profitability of the practice were not available to substantiate the claims and to scale up the practice. Thus, without a formal study, hard facts and figures, the economic benefits generated by the practice (profitability of the practice) may remain unknown. Therefore, this study, which focuses on evaluating the profitability of Moringa tree based agroforestry practice against monocropping system, was required.

2. RESEARCH METHODOLOGY

Konso woreda is one of the woredas in Segen Hizbcoh zone in the Southern Nations, Nationalities, and Peoples Region (SNNPR) of Ethiopia and covering the area of 202,286 hectare. The distance from Addis Ababa to Konso woreda is 595 km to South and the study area Goc'ha kebele exists 12km far away from the main town Karat of Konso woreda to west. The absolute location of the area lies in between 50 16′ 16″ and 50 21′ 20″ North and 370

20′ 5″ and 370 26′ 49″ East (CSA, 2007, Konso woreda adiministration, 2014).



The population of Goc'ha kebele is 3,116. Out of which 1,637 are female and 1,479 are male. **636** households exist in the area and out of which **545** households are males and 91 are females.

Two economic zones that are distinguished by differences of altitude and economic exploitation dominate the physical landscape of the area. These are semi-arid lowland areas supporting the majority of the population (between 60-70 percent); and agricultural uplands in the middle altitude supporting the rest of the primarily cultivating population.

The type of rain fall is bimodal type. The long rainy season occurs between March and May and the short during September and November (Watson, 2009). The rain fall ranges from 300-900mm per annum and the temperatures vary from 15 - 33 O^c (Jahn, 1991). Main agricultural area ranges from 1400m- 2000m a.s.l (Forch, 2003).

The native Konso indigenous land use practice is a distinct and sustainable form of agriculture that involves the building and maintaining of stone terraces, and fertilizing the fields with manure. A central feature of their fields is the endemic tree crop, Moringa Stenopetala.

They also use their land for the main crop sorghum, along with some tuber and root crops (yam, cassava, sweet potato and taro) and cotton (Yeshambel, 2013). Agricultural land still accounts for the largest share of the land use in the area.

2.1. Research methods

In this study both primary and secondary data were used. Primary data were collected through a household survey, focus group discussions, key informant interview, field observation, and biophysical resource and market assessment methods. Secondary data like the number of households in each kebele and socio-economic information were taken from the agricultural office of Konso woreda. Different offices and personal contacts were also made to obtain additional information.

A three staged sampling technique was used to draw sample households. In the first stage Konso district was selected purposely as it is one of the districts in southern nations, nationalities and people's region for moringa based agroforestry system. Konso woreda was selected purposively based on the presence of Moringa-tree based agroforestry practice. In the second stage, Goc'ha kebele was selected also purposively based on the presence of Moringa-tree based agroforestry practice after discussion with the woreda agricultural office experts. In the third stage sample households were selected by using stratified random sampling techniques. In this process the list of households who practice MBAFP were producer farmers from sampled kebeles, the intended sample size was determined proportionally to population size of farmers who practice moringa. For the household survey, structured questionnaires were prepared based on the information elicited through key informant interviews and focused group discussions.

The sample size was determined based on the formula:

$$\text{The sample size } (\mathrm{n}) = \frac{P(1-P)}{I^2}$$

Where, 95% degree of confidence is selected in the study. The confidence level is converted to a Z score which is 1.96 and confidence interval 5%. It was expected that 50 percent of respondents to respond affirmatively since such kind of research is never conducted previously in the area, 0.5 would be the proportion.

The needed sample size was computed by plugging the values into the above formula, where Z is the Z-score, P is the proportion and I is the confidence interval.

Based on this formula the sample size was = (1.96)2 * 0.5 (1-0.5) / (0.05)2 = 384; but due to time and resources constraints I have determined the sample size to be 155 (one hundred fifty five). Out of the total 155 sample households, 78 were MTBAFP users and 77 were monocroping system users.

Production and investment data of two systems were basically used for analyzing the cost and benefit of both systems. The key variables considered for the estimation were inputs (e.g. labour, seed, planting materials, fertilizers and pesticide used) and outputs produced from both systems (e.g. vegetables, fruits, cereals, fuel wood, grasses and fodders produced, root and others). The information about inputs used and output produced was obtained from households through household survey and FGD. The labour cost[1] was computed based on conversion factor. Before computing labour cost the family size was converted in man equivalent based on conversion factors, which was listed on the appendix 3. Household labor was valued at its opportunity cost as estimated by hired labor prices.

The opportunity cost[2] of labour force was 45birr, which was estimated during FGD time used for family labour. The value of Moringa leaf, chat, fodder and grasses were determined on the basis of *aqara, esir* and *Shakim*[3] (local marketing unit in the area) and their respective prices in the village.

2.2. Data Analysis

To assess economic and financial viability of the MBAFPs, a range of tools and methods were used. Some of these were cost benefit analysis including sensitivity analysis and cost effectiveness analysis (Alemu, 2013). In this paper cost benefit analysis and sensitivity analysis were used to compare the financial viability, efficiency and profitability of the Moringa tree based agroforestry practice against monocropping system.

Cost benefit analysis was used to access the present and future costs and benefits of MTBAFP. This involves the use of discounted cash flow (Khadka, 2010). Three basic indicators NPV, BCR & AEV were used in the cost benefit analysis. The NPV, BCR & AEV are common indicators used to analysis and measure the financial performance and feasibility of agroforestry system (Wahl et al., 2009; Godsey, 2010).

For this purpose, the production cost data and total revenue data were collected and entered into a Microsoft office Excel-sheet 2008 to sum up the discounted costs and benefits for thirty years. This data then built the foundation for the calculation of three economic indicators: NPV, BCR and AEV.

The mathematical formula which was employed for calculation of NPV is:-

$$NPV = \sum_{i=1}^{t} \frac{Rt}{(1+r)^t} - \sum_{i=0}^{t} \frac{Ct}{(1+r)^t} \quad , NPV>0$$

Where t=1, 2 … 30

r=discounting rate

R_t= total revenue earned from sale of the outputs in year t

C_t=total cost incurred from the different activities at the time of production in year t.

The mathematical formal employed for calculation of BCR was:-

$$BCR = \sum_{i=1}^{t} \frac{Bt}{(1+r)^t} \Big/ \sum_{i=0}^{t} \frac{Ct}{(1+r)^t} \quad , \quad BCR>1$$

Where t=1, 2 … 30

r=discounting rate

B_t= total revenue earned from sale of the outputs in year "t "

C_t=total cost incurred for different activities at the time of production in year "t".

The AEV calculates an annuity (or an annual net payment) that would give the equivalent net present value at the same discount rate. The equation used in the NPV calculation assumes varying cash flows for each year. The AEV equation assumes that the cash flow is the same in each year; that is,

$$\text{NPV} = cashflow \left\{ \sum_{t=1}^{n} \left(\frac{1}{(1+i)^t} \right) \right\}$$ (Godsey, 2008).

[1] labour cost includes both family labour cost and market labour cost
[2] Opportunity cost refers to the productivity of foregone by not investing in the next optimal project.
[3] Shakim refers the amount of chat, fodder, wood, moringa leaves, etc. in local measurement unit

$$\text{Cash flow} = \frac{\text{NPV}}{\sum_{t=1}^{n}\frac{1}{(1+r)^t}}$$

Therefore, the equation can be modified as follows

Cash flow is the annual equivalent value that is being calculated. The annuity discount factor of the equation simplified as follows:

$$\sum_{t=1}^{n}\frac{1}{(1+r)^t} = \frac{1}{r} - \frac{1}{r(1+r)^t}$$

Where t=1, 2 … 30
r=discounting rate
NPV= net present value

Assumptions which have been undertaken during financial analysis:

I. The value of land is the same and does not change over time for both practices
II. The tax amount is constant over time.
III. The opportunity cost of labour used in the case of family labour cost, will be 45 ETB/Labour
IV. The interest rate is 6%, based on current minimum saving interest rate of NBE (IMF, 2012).
V. The time horizon will be 30 years.

For the case of this study, sensitivity analysis was used for the change in the selling prices of output, opportunity cost of labour (wage) and discount rate. Multi-way sensitivity analysis was used to examine worth and best case in this study.

3. RESULTS AND DISCUSSION

This chapter is about the finding of financial profitability of Moringa tree based agroforestry practices in comparison with the monocropping system.

3.1. Socio Economic Characteristics of the Respondents

In this section the socio-economic characteristics of respondents including sex, religion, ethnicity, marital status, age, household size, farm size, and education level are presented and discussed to get general overview of the respondent's position and how these characteristics influence income earned from Moringa tree based agroforestry practice in the study area.

The socio-economic and demographic characteristics of sample households are summarized and presented in the following tables.

Table: 1. Descriptive statistics of categorical variables

Variables	**Category**	**Participation in MTBAFP and Monocrop.**		
		MTBAFP (N=155) (N& %)	Monocroping (N=77) (N& %)	Total (N=232) (N& %)
Sex	Female	33 (20.0)	13(17.0)	46(20.0)
	Male	122 (80.0)	64(83.0)	186(71.3)
Education status	Illiterate	84(54.2)	42(55.3)	126(54.2)
	Literate	71(45.8)	35(44.7)	106(45.8)
Marital status	Unmarried	17(10.9)	8(10.4)	25(10.9)
	Married	138(89.1)	69(89.6)	207(89.1)
Being Native		155(100.0)	77(100.0)	232 (100.0)

Source: own survey (2014)

Table: 2 Descriptive statistics of continuous variables

Variables	Participation in MTBAFP	Mean	Standard Deviation
Age of respondent	MTBAFP (155)	39.30	6.115
	Monocropping (77)	38.85	7.130
	Total (232)	39.34	7.343
Household size	MTBAFP (155)	7. 3	3.215
	Monocropping (77)	7.4	6.120
	Total (232)	7.3	8.953
Distance from market	MTBAFP (155)	7.4	2.170
	Monocropping (77)	7.4	2.170
	Total (232)	7.4	2.170
Land Holding	MTBAFP (155)	0.125	14.728
	Monocropping (77)	0.120	14.330
	Total (232)	0.125	14.728
Livestock Holding	MTBAFP (155)	11.156	1.5920
	Monocropping (77)	8.632	2.42821
	Total (232)	11.102	2.9157
Tree species	MTBAFP (155)	8.535	1.7281
	Total (232)	8.535	1.7281

Source: own survey (2014)

Regarding to gender, the result shows that about four-fifth of respondents were male and the remaining one-fifth of the respondents were female. This means that the highest proportion of respondents were men (80%) while only 20% were women (Table 3). This may be due to the land holding arrangement that is usually by men and also farming in general is usually labour-intensive activity that requires a lot of energy and hence widely regarded as a male's job. In contrast, women in Konso in general and in the study area Goc'ha in particular are participating both in household activities that are less difficult and on farm activities such as land preparation, sowing and harvesting where as men are expected to work on the farm only. According to FGD and the repeated made observation during the data collection, activities out by women in the area include cooking for the family including preparation of the local and cultural drink "C'eka", collecting fuel wood from their own farm, collecting fodder for livestock, carrying grain from own farm to home during harvesting and from home to market after harvesting, gathering and collecting food crops and vegetables for family use. These are culturally regarded as the duties of women in the study area. This is consistent with the study carried out by Alemu on financial analysis and determinants of income from fruit tree based agroforestry practice in Hadero Tunto Zuria woreda, Kembata Tembaro zone, South Ethiopia that indicates farming is male's job and hence there are more men (adults) than women in farming in general and in fruit tree based agroforestry practices in particular (Alemu, 2013). The result regarding females' share of job in this study is also consistent with the study carried out by Adekunle (2009) on contributions of agroforestry practice to environmental sustainability and sustainable agricultural production in Ondo State, Nigeria that shows farming is man's job and consequently more men (adults) than women are engaged in farming and agro-forestry practices. Similarly, the study conducted by Goitom (2009) revealed that the proportion of male headed households (78.4%) is quite higher than that of female-headed households (21.6%).

The result also shows that with respect to marital status the respondents belong to diverse categories. Out of the total sampled household heads, the majority (89.1%) were married, 7% were widowed, 2.6% were single and the remaining 1.3 %, were divorced

Regarding to the religion of the respondents the result (table 5) shows that almost three - fourth (74.8%) of respondents were followers of Protestant Christianity, which is the dominant religion in the study area, and more than one - fifth (22.6%) of the sampled household heads were followers of cultural religion. The proportion of the respondents that belongs to Orthodox amounts to 2.6% of the respondents (Table 5).

Regarding to the education level of the household heads in the study area, the household falls in to various categories ranging from those who did not attend any formal education to those who completed grade 12 (table 6). The categories include those who did not attend formal education; those who attended primary education (grade 1-4); those who attended secondary education (grade 5-8); those who attended high school education (9-10) and above high school level (11-12). The result shows that almost more than half of respondents (54.2%) did not attend any formal education. The household heads who attended junior secondary level (5-8) education were more than one-fifth (22.6) of the total respondents. The households who completed primary level (1-4), high school (9-10) and (11-12) were respectively 16.1%, 5.2 and 1.9 (Table 6).

The study result shows that the majority of the respondents did not attend formal education, which is a typical characteristic of country side farmers. This might be due to the absence of the education facilities in the past decades. Different studies indicate that majority of African; farmers are those who did not attend formal education. This finding is consistent with study carried out on contributions of agro-forestry practice in Ondo State, Nigeria which shows that the highest proportions (77%) of farmers in rural communities lack formal education (Adekunle, 2009). This result is also similar to that of the study carried out in Hadero Tunto, Kembata Tembaro Zone of South Ethiopia that indicate the highest proportion (44.5%) of farmers in rural communities lack formal education (Alemu, 2014).

Also the age of the sample households varies from 27 year to 57 year, with the average age being 42 years. All sampled household heads (100%) were found in the age group of 18-64 years (Table8). This age composition show that all respondents are in the productive age category. At this age level men are most active and are duty-bound to provide for their household. Therefore, people in this age group are responsive and engaged in different employment opportunities. This result is similar with the finding of Adekunle (2009) and Alemu (2013) which state that the highest proportion (79%) and (100) respectively of respondents' age was found in economically active age group.

Regarding to family size, the average family size of respondents was 7 persons although it ranges between 2 to 17 persons with standard deviation of 2.70. The result in table 8 shows that family size of respondents is characterized categorizing them in to three groups. More than half (54.84%) of respondents have family size of greater than 7 person's (large family size) category and 38.71% of respondents have a family size of 4 to 6 persons (medium family size). The remaining respondents (6.45%) have a family size of the category 1 to 3 persons (low family size). This shows that the household heads in the study area are mostly incorporated in large family size (54.84%) category followed by medium family size which is 38.71%. The result show that majority of respondents have family size of more than seven family members, which is large family size. The reason is that in the communities' culture large family size has a cultural value and this is also a typical characteristics of rural households in Ethiopia and elsewhere in developing countries.

This result is consistent with the finding of Adekunle (2009), which shows that 47% respondents have family size of 5 to 7 persons and found that farming is very labour-intensive and tedious because it is done manually in developing countries and families needs large to provide sufficient labour to work on their farm land. Similarly, study by Khanal (2011) on contribution of agroforestry on biodiversity conservation and rural need fulfillment divide the respondents family size in to four categories such as small (1-3), medium (4-6), large (7-10) and extra large (>10) family members and revealed large proportion (66.5%) of respondents have medium family members. The study carried out by Alemu (2014) in Southern Ethiopia is also another similar work to which the result of this study is consistent.

Even though land is an important economic resource for the development of rural livelihoods, there is low supply relative to the large family size of households in the study area. The size of the land owned by the respondents varies from a minimum of 0.125 hectare to a maximum of 3 hectares with the average land holding of 0.1 hectares. It is also important to note that 47.70% of the respondents owned less than 1 hectare of land and those households who own 1ha, 1.5ha, and 2-3 hectares of land are 24.53, 12.82, and 14.95% respectively. This shows around half of the respondents own less than one hectare of land (Table1&2). According to FGD the principal reason for the low average land holding was the increase in population in the area and topographic problem of the unique land creature of Konso. The shortage of land is basic problem in the study area to maximize agricultural production. This is in line with the study by Getahun (2012) in Wondo Genet, South Ethiopia that revealed that the average land holding in the area was 0.43 hectare. This study also indicated that land shortage is a basic problem that resulted in small scale production on fragmented and degraded land.

When this low average land holding of study area is compared with that of national, regional and zonal level landholding per household it is almost all similar. The current average land holding per household in the Segen Hizboch zone was 0.5 hectare and the SNNPRG's average current land holding per household is 0.89 hectare. Whereas the average the average current land holding of the nation (Ethiopia) is 1.02 hectare (Nega *et al*., 2003). This study concluded that the income of farming population closely follows the patterns observed for size of holdings and suggesting that net farm income is higher in regions with higher average holding and concluded that the low level of income of farm households is a result of both the small size of land holding and low level of productivity of Ethiopian agriculture. Similar study conducted in Ethiopia, Tigray region by Goitom (2009) also indicate that the majority of the households (86.2%) own between half and two hectares and the average landholding was 1.14 hectare.

From the total land size owned by respondents, agroforestry practices covers about 50.39 % of the total land, monocropping system covers 49.61% of total land size (Table11). The minimum and a maximum farm land sizes covered by agroforestry practice was 0.125 hectare and 3 hectare respectively. The minimum and maximum land covered by monocropping system was 0.0625 hectare and 2 hectare respectively.

The result shows that the land which is covered by agroforestry was slightly greater than land covered by monocropping. Currently the farmers prefer more land for agroforestry practice rather than monocropping, because of the agroforestry practice is traditional, cultural, climate change resisting, sustainable and more profitable than monocropping in the study area. According to FGD, farmers give due attention for AFP than monocropping. This is because AFP requires lower input costs and hardly any use of modern inputs like fertilizer. The other finding from survey result was shortage of grazing land. Due to lack of enough land size, there is no grazing land left for livestock. This inexistence of grazing land will have negative impact on farming income, that the farmers can't produce extra production rather than their family consumption. This result is consistent with the study carried out by Adekunle (2009) in Nigeria that found that the majority of respondents (45%) have a farm size of between 1 and 2 hectare and thirty-eight percent of respondents have a farm size of less than one hectare and he said that this group of people can only produce what they need for their own family with little or no extra being offered for sale. Also the result corroborates with similar study by Alemu (2013) that shows that the average landholding of the sample respondents is 0.93 hectares.

Farmers in the study area rear different type of livestock, such as cattle, shoat and poultry but never pack animals like donkeys. As it is indicated in table14, the highest number of livestock holding in TLU among the livestock types dominant in the study area were goat and sheep (65.13TLU and 64.61 respectively); there are no horse, donkey and mule. Farm animals have an important role in rural economy.

The dominant source of income in the study area is from agricultural activities, such as crop production and livestock production whereas marginal farmers obtained their income additionally from off-farm activities. Off-farm activities have a great potential to provide additional incomes during the slack season to rural households in the area. The result shows that from the whole sampled household heads about one-third (36.77%) were involved in off farm activities and more than half (63.23%) were dependent on agricultural income only (table 15).

3.2. Extent of MBAFP in the study area

In Konso district moringa tree based agroforestry practice (MTBAFP) is the known for its livelihood supporting strategy. Moringa in the area is a multipurpose tree which: is used to fill gaps associated to drought impacts; has a very high nutritional advantage; is economically valuable in generating income for RHHs; and is used for shade.
In Goc'ha the rural communities are heavily dependent on MTBAFP. For example, it is very common to see different types of small and big trees inside and around the farm land. The best example in the area is the cabbage tree Moringa Stenopetala (locally also called to be Moringa). They also harvest variety of crops throughout the year.

These unique mixed agriculture practices enabled them to cope up the climate change impacts during unpredictable environmental conditions. However, the detailed study, hard facts and figures were not available to substantiate the claims and to scale up the practice. Thus, without a formal study, hard facts and figures, the economic benefits generated by the practice may remain

3.3. Components of Moringa Tree Based Agroforestry system

It is very common to see different types of small and big trees species inside and around the farm land of the study area. Based on the focus group discussion, and field observations the most common tree species in the area are Moringa stenopetala (locally also called to be Moringa) and Terminalia browenii. Other tree species in the area are: *Juniperus Proccera, Euphorbia, Olea Africana, Ficussori, Cordia Africana, Sterculia Africana, Accia Abysinica, Acacia asak, Graveillia Robusta, Cupricious Lustanica, Rhus natalenis, Balanites aegyptica, Cajanus cajan, Berchemia discolor, Ehretia cymosa and Ficus spp.* Table 16 shows the result of tree species inventory in the sample households.

Table: 3. Distribution of tree Species per farm land of the respondents

Number of species	Frequency	Percent
2-6	37	23.87%
7-12	103	66.45%
13-16	15	9.68

Source: own survey (2014)

There are minimum and maximum of 2 and 16 tree species respectively in farms of the sample households and the majority of sample households (66.45%) have tree species number laying in between number of 7 and 12.

Among the species some of them are cash crops. The major cash crop in the area is chat. Coffee and "*Gesho*" also rarely exist in the area. Moreover avocado, mango, orange and "*zeytun*" are from fruits existing sparsely in the area.

The maturity age, life span and rotation age of different trees in the agroforestry system is not the same. The estimated maturity age, life span and the productivity of some fruit tree in the agroforestry practice were listed in table17. The maturity age in this study means the age at which the trees start to give output. Whereas the life span in this study means the age at which the productivity of tree start decline but not mean its production already cease. In this age the trees still give the output but the quality and quantity of output declines negatively. The Moringa and Terminalia start to be harvested after five to six years of planting. Coffee gives fruit after four and three years of plantation respectively. However, banana gives the fruit after seven month.

The maturity age and the life span of coffee are four and thirty four years respectively. Similarly the maturity age and the life span of chat are three and thirty four years respectively. The maturity time and life span for Terminalia to be harvested as animal fodder and moringa to human feed are four and forty years respectively. Again the maturity age and life span of avocado is seven and thirty years and mango is six and twenty five years respectively. The maturity age of these components indicate that the time horizon of coffee and chat components is less than the time horizon of avocado and mango components. The shortest time horizon in the system is banana's maturity age. And an avocado and mango component has longer life span than other components.

The productivity level of each component is not the same throughout its respective life span. The economic contribution of moringa tree based agroforestry system directly related with their maturity age and their life span in the area. They start to contribute on household's income directly after their maturity and they contribute more on their middle life age, i.e. at their middle age their output is higher than the young age and the old age. As indicated above the life span means not the age which trees cease production, but it is the age of trees that their product or harvest from them start to decline. For example, the yield harvested from moringa before four years is very low, that is if it harvested the amount of leaves collected for consumption is very low.

The components of trees in the agroforestry system are also known for their additional benefits. These additional benefits are obtained from components of agroforestry practice irrespective of its maturity age. For example, leaves of so many tree species existing in the area serve as fodder for livestock in dry season.

Table: 4. Maturity age, life span & productivity of trees in MTBAFP

Components of MTBAFS	Maturity age	Life span	Average annual yield/tree(bunch)
Moringa	3 years	30 years	728 aqara[1]/tree
Terminalia	3 years	30 years	29 esir[2]/tree
Banana	7month	4 year	7zelela[3]/ bunch
Avocado	7 years	30year	5qt/tree
Mango	6 years	25year	3qt/tree
Coffee	4 years	34 year	0.5qt/tree
Chat	2 years	8 years	18 aqara/tree

Source: own survey and FGD (2014)

3.4. Estimation of costs and benefits of MTBAFP [4]and monocropping systems

The cost benefit analysis was based on the inputs used for both land use and the output produced from respective land uses and some additional benefits gained from each alternative land uses was used to compare the benefits from both practices. The estimated market price of Moringa leaves as a vegetable, animal fodder, fuel wood, and construction materials obtained from agroforestry practice/monocropping system and others were involved in benefit cost analysis. The market value of these benefits was based on its current market price in its respective local units. For example the one *Shakim* of fuel wood and fodder were 30ETB, the one *aqara* moringa leave for home consumption and chat is 3 birr, which was estimated during FGD.

The yield obtained from each component of the systems and price of outputs sold in local market were used to calculate the revenue of each land use. Total revenue[5] is calculated by multiplying total unit of output obtained from each component by its price in local market. After calculating the benefits of each item in the system the total revenue of the system was calculated by summing up revenues of respective land uses. And each cost incurred such as, labour cost, fertilizer cost, pesticide cost, and others were summed up to get total cost[6] incurred in one single year. Then the net benefit (NB[7]) calculated by deducting total cost from total revenue. Then NPV, BCR and AEV were calculated for each land use by using financial discount rate[8] of 10% and time 30 years.

[1] Aqara means the local unit helps to measure the leaves of Moringa when sold in market. 1 aqara costs 3 ETB.
[2] Esir is a local unit to measure both fodder and moringa leaves also. It is bigger than aqara.
[3] Zelela means local unit helps to measure banana and has equivalent meaning with bunch
[4] MTBAFP=Moringa Tree Based Agroforestry Practice
[5] Total revenue= $\sum_{i=1}^{n} PqQ$,where Q=Quantity produced in each components
P_q= unit price of quantity produced in each components.
[6] total cost= $\sum_{i=1}^{n} TFCi + \sum_{i}^{n} TVCi$ where, TVC_i=total variable cost of each components
TFC_i=Total fixed cost of each components
[7] NB=TR-TC
[8] Financial discount rate refers to financial rate of return that could be expected if money were invested in other project.

Table: 5. Estimation of costs and benefits of MTBAFP and monocropping systems

No	Description	Mono-cropping	MTBAFP
1	Costs		
	Inputs	2969.35	885.92
	Labor	1230.97	2461.94
	Tax	30	30
	Total cost	**4230.32**	**3377.87**
2	Revenues		
	Moringa		3,439.55
	Fodder		11,113.06
	Cash crops		9,681.90
	Root crops		1,454.98
	Cereals	12,126.25	
	Fruits		1,596.48
	Others		1,157.91
	Total revenue	**12,126.25**	**28,843.88**
3	**Net benefit**	**7,895.93**	**25,466.01**

Source: own survey (2014)

Table18 shows that the net benefit of the Moringa-tree based agroforestry system was higher in the study area than the net benefit of the monoculture. The net benefit of MTBAFP, which was 25,466.01 ETB, is more than three times higher than the net profit of monocropping system which was 7,895.93 ETB. The cause for this high net benefit of MTBAFP is may be due to agro ecological suitability (topographic factor) of the area, the existence of different components in the system with multiple benefits, and low input cost. When compared the revenue of MTBAFP with its cost the input cost for the practice in the study area is very low, this makes the system more profitable than other system, but in the case of monocropping the input cost was high, this makes the NB of monocropping practice less than NB of MTBAFP.

This finding is similar with the findings of Getahun (2012) who studied the economic analysis and determinants of fruit tree based agroforestry system in Wondo district, Ethiopia and with that of Alemu (2013) who studied the financial analysis and determinants of income from fruit tree based agroforestry practice in Hadero Tunto Zuria woreda, Kembata Tembaro zone, South Ethiopia. Both studies revealed that the net profit of FTBAFP was nearly about two times higher than the net profit monocropping. In the same way the study carried out in Pakistan on economic comparison of agriculture with agroforestry shown that the net benefits of tree based sugarcane system were eighty six percent more than trees free sugarcane system. Rasul and Thapa (2002) also studied the Evaluation of Agroforestry System under Different Marketing and Institutional Environments and shown that the Profitability of agroforestry is about four times higher and is an attractive land use system than other land use systems. Other study which was carried out at Case of Chittagong Hill Tracts of Bangladesh on Ecosystem services and agricultural land use practices by Rasul. (2009) revealed that the profit from AF system was almost twice greater than annual cash crop system. Similarly, profitability analyses that were carried out in southern Africa region show that the various agroforestry technologies are profitable relative to conventional production practices where trees are not grown (Franzel, 2004; Ajayi et al., 2006).

3.5. Financial Performance Evaluation

The NPV, BCR and AEV were used in this study to evaluate financial performance of agroforestry and monocropping systems. The benefits and costs of different land uses were discounted in to present value based on principles of benefits and costs when calculating performance evaluators. According to principles of benefits and costs, benefits occurring in the future are worth less than the same level of benefits that occur now and Costs occurring in the future are less burdensome than the same level of costs that occur now. Similarly, costs occurring in the future are less burdensome than the same level of costs now.

Table: 6. Comparison of the land uses for their economic performance using NPV, BCR, and AEV decision criteria

Financial indicator	Agroforestry land use (MTBAFP)	Mono crop land use
NPV	263,893.26ETB	81,822.18 ETB
BCR	8.54 ETB	2.87
AEV	25,466.01	7,895.93

Source: own survey (2014)

The result in table 19 shows that the NPV of moringa-tree based agroforestry practice was found to be more than three times of the NPV of mono-cropping system. Thus, the NPV of moringa-tree based agroforestry practice is 263,893.26 ETB where as that of monocroping system was 81,822.18 ETB. This indicates that agroforestry practice has better financial performance than mono-cropping system in the study area. This may be due to the existence of multiple components of land use systems with multiple benefits in agroforestry practice.

The financial performance of the two land uses using evaluation criteria of BCR also shows that the benefit from the agroforestry system outshines than that of monocropping. The BCR implies that the land use system with higher ratio is more profitable than land use with lower ratio. Thus the benefit cost ratio of MTBAFP was 8.54, and that of monocropping was 2.87, showing that MTBAFP has higher BCR than overall other monocropping land uses. This implies that MTBAFP is more profitable land use system than monocropping. The reasons for may be due the existence of higher cost of production for monocropping than agroforestry practice and the existence of multiple benefits in the agroforestry practice. In majority of the cases, monocropping relays on the use of external inputs that increases the cost of the system.

Similarly, the annual equivalent value (AEV) for the moringa-tree based agroforestry practice indicated that the expected annual income of the moringa-tree based agroforestry practice is 25,466.01 ETB per annum, whereas the AEV for monocropping is 7,895.93 ETB per annum. Therefore, the AEV result also confirmed that moringa-tree based agroforestry practice has potential to generate the highest expected annual income throughout the life of the project than monocropping system (Table 19).

The above performance indicators show that agroforestry land use system is more profitable land use system in the study area than monocropping land use system. This finding is unswerving with the study conducted by Alemu (2013) in the Hadero Tunto Zuria woreda of Kembata Tembaro zone in South Ethiopia who indicated that BCR of the fruit tree based agroforestry practice was higher than that of mono cropping system. The result is again similar with that of Neupane and Thapa (2001) who carried out the study in on slightly similar title of my study in Middle Nepal. They indicated that the CR for the improved agroforestry based farming system was considerably higher than that of the conventional system. In the same way, Rasul and Thapa (2006) studied on the degraded agricultural lands of Chittagong Hill Tracts of Bangladesh and revealed that the economic returns from agroforestry practice were greater than shifting cultivation. A study conducted in southern Africa by Franzel (2004) revealed that agroforestry practice generate a NPV of US$388 per hectare, which is six times higher than the net benefit obtained in conventional maize fallow systems. Ajayi *et al.* (2009) confirmed that the net benefit of agroforestry practices is 44 to 58% superior to non fertilized continuous maize production practice). Another study carried out in the Northern Bangladesh by Rahman et al. (2007) also showed that the NPV of multi-strata agroforestry practice was 5 times higher than the NPV of traditional monoculture. The finding is also similar the study by Getahun (2012) at Wondo Genet who reveal that agroforestry practice has higher AEV than monocropping system.

3.6. Sensitivity analysis

The sensitivity analysis was carried out on evaluation of NPV of agroforestry practice and monocropping system for change in some key variables, such as increase/decrease in price of output, increase/decrease in wage, increase/decrease in yield and increase/decrease in discount rate. Farmer's net benefit decline if the opportunity cost of labour use and discount rate increases and price of output and quantity of output decrease. The opposite will happen if the opportunity cost of labour use and discount rate decrease, and price of output and amount of output produced increase. Therefore, sensitivity analysis is conducted for the decrease/ increase in the selling prices of output, increase/decrease of opportunity cost of labour, and increase/ decrease in discount rate. The yields of annual crops are prone to the weather, calamities, pests and diseases. The risks of output losses due to these reasons are considered by a sensitivity analysis of decrease in yields. Although it is not common, there is also situation that yield of annual crops and other agroforestry trees increase more than a usually condition. Therefore, sensitivity analysis was also conducted for the increase in output of monocropping and agroforestry practice.

Table: 7. Sensitivity analysis for change in the key variables

Description	Mono cropping	MTBAFP
	NPV change %	NPV change%
*Price decrease by (*10%)	-52.76	-24.39
*Price increase by (*10%)	2.42	3.71
*Wage increase by (*10%)	0.57	1.55
*Wage decrease by (*10%)	0.57	1.50
*R increase by (*10%)	-18.22	-4.21
*R decrease by (*10%)	3.48	6.06
Yield increase *by (*10%)	4.48	11.33
Yield decrease *by (*10%)	-24.54	-14.50
Best scenario	7.87	12.52
Worth scenario	11.34	16.52

Source: own survey (2014)

The decrease in price for each land use has negative impact on NPV of respective land use (see table 20), but the magnitude of change on NPV was not the same in each land use. In opposite the increase of output price has positive impact on NPV; still the magnitude of change is different between the two land uses (monocropping and agroforestry practice). From table 19 it can be observed that for 10% increase/decrease of output price the NPV of monocropping system will increase or decrease by 2.42% or 52.76% respectively where as NPV of MTBAFP will increase or decrease by 3.71% or 24.39% respectively. This indicates that the magnitude of change in agroforestry and monocropping system for increase/decrease of price by 10% is not similar. There is more change in monocropping system. From this we can understand that for the increase/decrease of output price agroforestry practice is less sensitive than monocropping system.

The other variable was the change of output (yield) of both monocropping system and agroforestry practice. For 10% increase/decrease of output of respective land use the NPV of monocropping system will increase or decrease by 4.48% or 24.54%, respectively, but NPV of MTBAFP will increase/decrease by 11.33%/14.50 % (Table, 20). The result indicates that there is positive/negative impact on NPV of respective land uses for increase/decrease of output respectively even if the magnitude of change is different. This also shows that agroforestry practice is less sensitive than monocropping system for increase/decrease of output.

The above two variables, output price and yield of respective land use are important variables that affect revenue of farmer. The revenue can increase if and only if one of these variables increases. That is, revenue is the product of price and output. If the price or yield of agroforestry practice and monocropping system decreases the revenue of respective land use will decrease, but the percentage of change in its NPV is not the same between two practices. As can be seen from the result above, monocropping system is more sensitive than agroforestry practice. This is because, there are diversified components in agroforestry practice but in the case of monocropping there is no diversification of components and benefits. This is consistent with finding of Alemu (2013) who carried out study on financial analysis and determinants of income from fruit tree based agroforestry practice in Hadero Tunto Zuria woreda of Kembata Tembaro zone in South Ethiopia who revealed that agroforestry system is less sensitive to the change in prices of perennial crops and fruit trees. The study is also consistent with that of Pham (1999**)** who studied the Socio-Economic Analysis of Shifting Cultivation versus agroforestry system in the upper stream of lower Mekong watershed in Daklak Province that revealed that agroforestry system is less sensitive to the change in prices of perennial crops and fruit trees. Similarly, the study conducted in Wondo Genet by Getahun (2012) revealed that agroforestry practice is less sensitive than monocropping system for change of price and output.

4. CONCLUSIONS AND RECOMMENDATIONS

Even though the agroforestry practice in Konso in general and in the study area in particular is ancient and long time history farming system, there is danger in the sustainability of it because of switch to monocroping system of farming which is mainly cash crop cultivation. The reason to switch to monocropping farming system in the area is mainly due to underestimated value to the financial benefit from the MTBAF practice; that is because of there is no documented study on financial analysisy. Even if the need of switch to cash crops is to get exportable cash crops with high yield, their value is not stable and open to the risk in the area like Goc'ha of Konso. The landscape of the area by itself is more suitable for agroforestry practice than monocropping.

Therefore this study was conducted in Goc'ha Kebele, Konso District, South Ethiopia to carry out Financial analysis of Moringa tree based agroforestry practice against mono-cropping system. Regarding to financial analysis focus has been given to the analyzing financial profitability of two land uses (agroforestry versus monocropping system). The agroforestry practice investigated was Moringa tree based agroforestry practice whereas from monocropping system sequential and non sequential crops such as sorghum, maize, teff and few other monocropping systems were analyzed.

The result of financial analysis showed that the Moringa tree based agroforestry practice is more profitable land use than monocropping land use system. The net present value of the Moringa tree based agroforestry practice is more than three times higher than the net present value of monocropping system.

In comparison with monocroping, the Moringa tree based agroforestry system is not only profitable than the monocroping but also the system is less sensitive for changes in price, yield and discount rate.

Even if moringa-tree based agroforestry practice is more profitable and less sensitive for change in price than monocropping system, some farmers in the study are engaged in production of monocropping especially, in teff production because of its short maturity age and they were switching from agroforestry practice to teff and some others. It would be better to provide improved varieties of agroforestry trees with short maturity age in order to make farmers not switch from agroforestry practice and make agroforestry practice to serve the economic and environmental development goals.

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