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Return from Major Land Use Practices at Farm Level Both in Terms of Physical Yield and Economic Return in Bale Eco-Region, Ethiopia

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Abstract: In the Bale Eco-Region, production and productivity mainly suffer from fertility deterioration, skyrocketing prices of fertilizer, and unsustainable interactions among different land uses systems. This study was initiated to return from major land use practices at farm level both in terms of physical yield and economic return Bale Eco-Region. Data were collected through the household survey, group discussion, key informant interviews and field observation. The data collected was analyzed using both descriptive and econometric analysis. The finding of the study revealed that smallholder farmers were practicing different land use/farming system in their respective agro-ecological zone. The direct economic performance of each farming system in food and cash crop production, livestock production per TLU, and total farm level production was determined, analyzed and compared by using the benefit-cost ratio (B/C) efficiency measured. Therefore, encourage integrated farming and discourage mono-cropping especially in mid and lowlands of the Eco-region through improving the economic returns of integrated farming practices at the farm level.

Keywords: Economic Analysis, Major Land, Physical Yield

1. Introduction

Making agricultural production sustainable in terms of food ability systems to meet current and future demand is crucial. Nevertheless, adoption of economically sustainable land management practices and technologies is constrained by shortage of land and capital resources. For instance, improved fallows are constrained by land shortages; use of high value seeds and fertilizers by capital and access to markets; intensive dairying and horticulture by high transport costs and poor market access; late maturity cash crops such as tea or coffee and soil erosion control measures by land tenure. While off-farm activities may provide much-needed income to augment farming activities, they may take away productive labour from farms. When farmers sell their labour, they do so at the expense of their own farm activities and in the process, they may delay in preparing their own land for planting, weeding and/or harvesting, resulting in sub-optimal yields [1].

With all its limitations, smallholder agriculture is still the only option for a large proportion of rural populations in SSA. Among the limitations, the need to strike a balance between competing needs can be mentioned. This include maximizing labor productivity, provide livelihoods, reduce land degradation and avoid falling into poverty traps in the wake of declining farm size and endemic low soil fertility. Poverty characterizes many subsistence households and threatens the hope of transforming rural populations to achieve a better standard of living. Options to improve this well-being do not lie with increasing land areas because most cultivable land is already in production, but rather lie in improving efficiency with existing resources and the current technology base. However, many farmers practice low-input subsistence farming with the aim of satisfying food requirements and basic income demands. For such systems both productivity and sustainability are at risk unless measures are taken [2]

The importance of agriculture in this century is still magnificent. According to FAO (2013), between now and 2050, the world's population will increase by one-third. Most of these additional 2 billion people will live in developing countries. If current income and consumption growth trends continue, FAO estimates that agricultural production will have to increase by 60 percent by 2050 to satisfy the expected demands for food and feed. Agriculture must therefore transform itself if it is to feed a growing global population and provide the basis for economic growth and poverty reduction.

2. Methodology

2.1. Location

The study was conducted in Bale Eco-Region, South East Ethiopia. Bale Eco-Region (BER) lies 400km south east of Addis Ababa, the capital city of Federal Democratic Republic of Ethiopia. The Bale region is geographically found between 05°22'-08°08'N and 38°41-40°44'E [3].

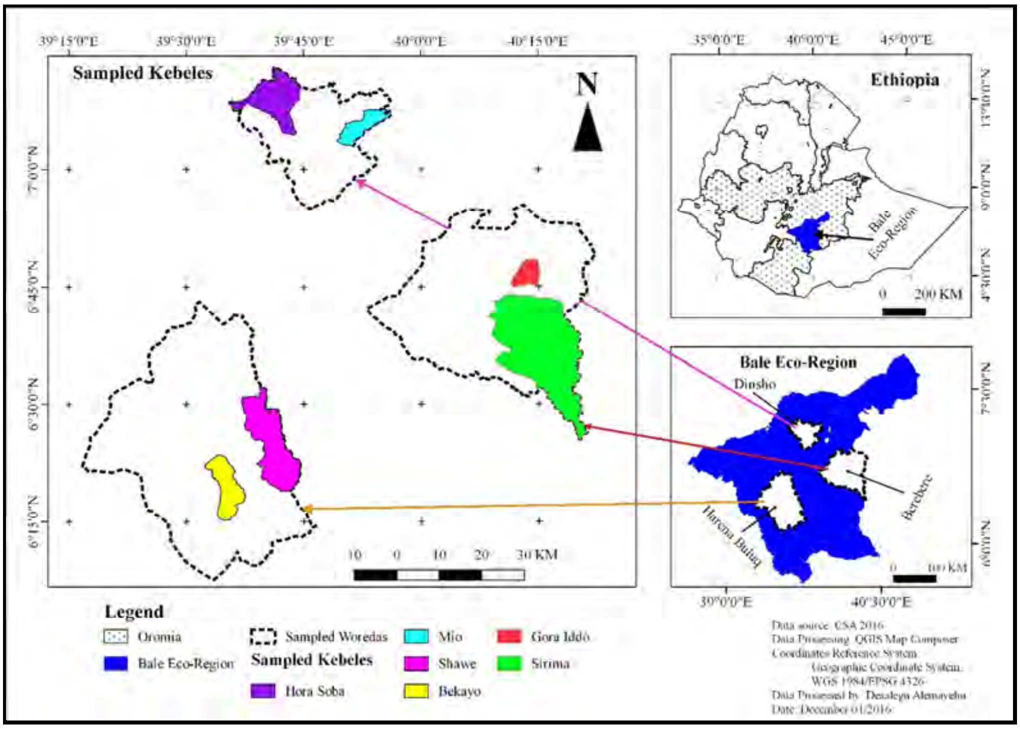

Figure 1. *Map of the Study area.*

2.2. Topography, Climate and Vegetation

The Afro-alpine plateau of central area of BER reaches more than 4000 meters above sea level. Containing *Erica*, Giant lobelia (*Lobelia rinchopatelum*) and *Helichrysum*, this is the largest remaining area of Afro alpine habitat on the African continent [4]. South of the plateau the altitude falls rapidly with moist tropical forest between 2600 meters above sea level and 1500 meters above sea level The moist forest is characterized by *Hagenia abyssinica* and wild coffee *(Coffea Arabica).*

The average annual temperature was 17.5°C (10°C to 25°C range). Average annual rainfall was 875mm with long rains experienced between June and October, and short rains between March and May [5]. The BER is rich in distinctive endemic flora and fauna because of its isolation from Ethiopian highlands bulk and its topography and climatic history [6].

North of plateau habitats, comprise of dry forest, woodlands, grasslands and wetlands, largely between 2500 meters above sea level and 3500 meters above sea level The dry forests contain high-value commercial species such as *Junipers procera* and *Podocarpus falcatus* as well as *Prunus africanus,* a threatened species. The lower altitude land of the south east of the BER, below 1500 meters above sea level, is dominated by acacia woodland [7].

2.3. Population

Demographically, BER falls within Oromia regional state, the most populous province in region with a population of 1,391,511 in 2007 [8]. The population density of district is about 46 persons per square kilometre. Based on census 2007, the total population of BER projected for 2016 is 1,811,892 of which 906,689 are males and 905,203 females (CSA, 2013) [9]. Accordingly, Dinsho woreda population is 49,574 with 24,312 males and 25,262 females; Harenna-Buluk woreda is 102,872 with 52,080 males and 50,792 females and Berbere woreda is 114,475 with 58,463 males and 56,012 females.

2.4. Land use and Agriculture

BER known for mixed farming i.e. crop production, predominantly food crops: barley, wheat, horse bean, field peas, potatoes, flax, Niger seed, and livestock rearing. The highland is moderately productive; Wheat, barley and pulses are dominant crops grown in this area Income is earned from sales of crops, livestock, fodder, and eucalyptus trees. Mid-altitude is moderately populated; main crops grown in this agro-ecological zone are Maize, Sorghum, Teff, Pulses, Wheat & Oil seeds (Niger, Sesame & Flax). Households also keep livestock (cattle & shoats). Lowland of BER was known dominated by Agro pastoralist livelihood strategies. Main crops practiced in this sub region are Sorghum, Teff and Maize and Livestock is composed of cattle and goats. For poorer households, significant part of their income is from farming, local labour and firewood collection/sales, which they use it for purchasing part of their staple food requirements during food shortage. They practice indigenous farming system.

Bale Zone with the land area coverage of 43,690.56 square kilometres is estimated to constitute 16.22% of Oromia region total area. From total area, cultivated land accounts for 10%, grazing land 24.6%, forest and bushes 41.8%, marginal wastelands 10.6% and others 13% [9].

2.5. Sampling Techniques

For this study, data were collected from sampled households' selected based on appropriate sampling techniques. Sampling is a technique, which help to understand parameters or characteristics of population by examining only a small part of it. Therefore, it is necessary that sampling technique should be reliable. Appropriate sample size depends on various factors relating to subject under investigation like time, cost, degree of accuracy desired, among others. But sample size and selection process procedure should assure population representativeness.

In this study, multistage sampling technique was employed to select respondents. In first stage, from BER, three districts /worade (namely Dinsho, Harena buluq and Berebere) were selected purposively. The main criteria used to select the three Woredas were representativeness agro-ecological variation highland, midland and lowland and by considering major land use practice/farm system. In second stage, two Kebeles were selected purposively. These selections were carried out by stratifying each Kebeles into three land use system/practices (Mon cropping, Livestock rearing and Crop-livestock mixed farming). In third stage, from each stratum households were selected randomly. The required sample size was determined in proportion to population size of Kebeles. Simple random sampling is the simplest form of probability sampling therefore each population element of simple random sampling has a known and equal chance of selection.

Accordingly, in this study, sample size selection was based on the rule of thumb $N \geq 50 + 8m$ developed by (Green, 1991) [10]. Where, N, is sample size and `m` is the number of explanatory variables (Xi) where i=1, 2…n. Where a total of 14 key variables were assessed for this research hence the sample size is determined as:

$$N \geq 50 + 8m;\ N \geq 50 + 8\ (14),\ N = 174\text{HHs}$$

Hence based on rule of thumb above, a total of 174 respondents from the selected PAs (*Kebeles)* of the district will be selected and interviewed.

2.6. Types and Source of Data

Both primary and secondary data regarding land use and production practices such as land size, cost and revenue of crop production, current farming practices, and research/farm field estimates of the productivity of crops per hectare were collected. And a review of secondary data such as reports of Ministry of Agriculture and Central Statistical Agency was made to estimate parameters of models for different scenario for household and aggregated models. Quantitative data collected from sample households and secondary sources were used to estimate costs and revenues of production per hectare of each land use system at farm level. Estimates of total land size, cost of production per hectare of land use type, estimated minimum production requirement for own consumption of each household and estimated productivity per hectare of land were obtained from primary data.

The secondary data were obtained from published and unpublished reports of agricultural bureaus at different levels (Region, Zone, Woreda, and Kebele), report of central statistical agency (CSA), different websites and different published articles. Besides, qualitative data regarding factors of cropland allocation, involvement, and land use system at farm level practices were collected using focus group discussions, household surveys, and key informant interviews.

2.7. Methods of Data Collection

For this study a combination of household survey and Participatory Rural Appraisal (PRA) techniques were used to collect relevant data. The PRA techniques were used in this study include Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), and field observations assisted by informal discussions with staff of NGO's working in the area (e.g. Farm Africa, SOS shale).

Key informant interviews

Individuals who had lived in the district for long time and model farmers in managing their farm lands as well as those believed to have better knowledge about issues at both household and community levels in their localities were selected for key informant interviews. Accordingly, key informants were selected from each *Kebele* administration and face-to-face interviews were conducted. Thus, key informants that were included in discussion were local community, government organization, and non-government organization. The questions raised during key informant interview were how land allocation decision at community level and household level is carried out, dynamics in land allocation decision and constraints to food production, and the possible solutions to the problems.

Focus group discussions

Focus group discussions was carried out with representatives of the community who had lived long in study area and had experience on how land allocation decision were made for alternative land uses in the area. The discussions were made with separate and independent groups of women, youth, and elders in selected Kebele and those a total of two focus group discusses in each Kebeles were conducted. The reason for including woman, men and youth in discussion was to produce relevant information on certain topics like on different functions of different spaces of land, who makes decision, what actors are involved in decision making on both communal and private lands, and other related issues stated in research objectives. The discussions were facilitated by researcher together with enumerators group members were encouraged to share ideas freely on discussion topics.

Field Observation

In addition to data collected through structured and semi-structured interviews, field observations accompanied by an informal survey were carried out. This would have enabled to have an insight on how land allocation decision is practically carried out, consequences of inappropriate land allocation, and whether there is differential allocation and outcome among households and among physical spaces.

Household Survey

Survey of a total of 174 farm and agro/pastoral HH units (initially determined by the rule of thumb) was carried out to collect primary data in sixth Kebeles study. To that effect, a semi-structured questionnaire was prepared for research topics separately (analysis of economic and environmental performance of alternative land use practice by using bio-economic modelling) and translated into Afan Oromo (local language). The questionnaire was first tested in all Kebeles during reconnaissance survey, consequently amended and administered to sample respondents in each Kebele via face-to-face interview conducted by trained enumerators and researchers.

2.8. Method of Data Analysis

In these study two types of data analysis techniques were used, namely descriptive statistics and econometric methods to analyze data collected at both community and household levels.

2.9. Descriptive Statistics

Descriptive statistics were used to estimate parameters of variables addressed based on household survey data. Summary statistics such as mean, frequency, and percentage are estimated. Tables and graphs were used to organize and data present. Hypothesis testing of mean difference between performances among different major land use were made. The analysis was carried out using Microsoft Excel 2010 and SPSS 20.

3. Result and Discussion

This part was divided in two main sections. The first section deals with socioeconomic characteristics of respondents. The second section is about return from major land use practices at farm level both in terms of physical yield and economic return.

3.1. Socio Economic Characteristics of Respondents

Socioeconomic characteristics of respondents were presented. The survey on household heads age, measured in years, provided a clue on working ages of households. In high land area, mean age of respondent was 42.2 ±8.4 (24-62 range) years old (Table 1). This result shows that mean age was within active labour age. Per central statistics agency of Ethiopia, report [9] age ranges from 15-64 are working age group. The result shows that household respondents were 39.5 ± 8.8 in low land (25-64 range). This is also the same as to central statistics agency of Ethiopia, [9] age ranges from 15-64 are working age group.

Farming experience is one of the most important issues to sanction farmers with knowledge of farming system and using alternative land use practices in farm land. The result indicates that average framing experience in years, households is 31.6 in low land. However, this varies between 11 to 64 years. This means that some households have as small as 11 years of experiences. Per key informants minimum farming experience indicate most of farmer in study area are spontaneous and others are government sponsored. In high land of BER, the average framing experience the households is 39.3 years.

Table 1. *Socioeconomic characteristics of respondent (continuous variable).*

variable	High land				Mid land				Low land			
	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD
Age	24	62	42.2	8.4	30	65	42.7	8.31	25	64	39.5	8.8
Family size	3	19	10.1	3.3	4	19	10.1	4.14	3	21	8.37	4.3
Education	0	10	3.55	3.14	0	8	2.26	2.3	0	8	1.82	2.3
Experience	16	62	39.3	10.2	15	65	36.1	11	11	64	31.6	15

Source: Own Survey 2016

The result in Table 1 shows that respondents have a mean family size 8.37±4.3 peoples ranging from 3 to 21 in low land. Bigger family size has contributed to boost volume of practices in study areas to impact for better participation in alternative land use practices. This is well supported by David (1998) [12] who stated that, demand side means more mouths to feed may promote expansion of cropland, while supply side means more hands to work land and more labour available for clearing land or for intensification of crop management practices.

Similarly, higher labour intensity of agriculture can take form of production on more marginal lands, less use of fallow, adoption of more labour, intensive methods of cultivation intensive investments in land improvement and/or adoption of more labour, intensive commodities (Pender, 2001) [13].

The result in Table 2 show that educational level of respondents have mean of 2.26± 2.3 of grade ranging from 0 to 8. In midland agro-ecology that respondents have average of 1.82 ± 4.3 (0-8) ranging educational level. This means that some households have no formal educational in the study.

3.2. Economic Performance of Major Land Use Practices at Farm Level both in Terms of Physical Yield and Economic Return

In order to examine the economic performances of each of the identified land use/farming system types in the three agro-ecologies on farm level production input and outputs was quantified and analyzed. From this results of analysis data on yield per hectare and price per unit of yields are based on farmers' estimates. The result uncovers that farmers with high access to productive resources are likely to invest large amounts of money in agriculture and are better off in both production and income earnings. However, per hectare inputs and output are very high in small farms compared to large farms. This highlights that there is greater intensification in smaller land size than relatively large farm size. It reflects that there is inverse relationship between productivity and farm size. Accordingly, estimations of important variables needed to measure the farm level production inputs, outputs, income and costs were computed (Note that the estimations were made based on the dominant crop varieties, regular inputs and costs, regular market prices, etc). The direct production inputs/cost measured were: inputs/costs for inorganic fertilizer, improve seed, weeding, management and labor costs, insecticide and pesticides, livestock purchase, livestock feed costs, livestock disease management costs, crop and livestock transport and marketing costs, among other costs.

And the farm level production outputs/benefits measured include: crop yield per ha, net income from crop production per ha income from livestock production per TLU; total net income from crop production, livestock production and total farm level production per year; income from other resource uses from farm land among others.

Table 2. *Farm level production inputs (costs), outputs and economic efficiency of major farming systems in BER.*

Agro-ecology	Farming system/ land use type	*Crop yield in quintal/ ha/ Year	Food and cash crop production cost in Birr/ ha/ Year	Livestock production cost/ in Birr/TLU/ Year	Total farm production cost in Birr/ ha/Year	Net income from food and cash cropping in Birr/ha/ Year
Highland	Cereal mono-cropping	23.83	2,806	536	2,933	8,054
	Crop-livestock mixed farming	21.62	2,483	452	2,610	9,411
Midland	Cereal Crop production	15.06	1,360	580.3	4109	3641
	Tree-crop- agro-forestry	13.2	1,404	470.46	3880	2436
	Agro-pastoralism	8.81	925	695	3814	4303
Lowland	Cereal crop production	10.5	892	628	1,136	2,691
	Tree-crop- livestock farming (Agro-silvo-pastoralism	11.23	780	565	2,108	1,623
	Pastoralism	8.62	483	613	3,405	1,304

Table 2. *Continue.*

Agro-ecology	Farming system/ land use type	Net income from livestock in Birr/ TLU/ Year	Income from forest & other sources in Birr/ha/ Year	*Total net farm income in Birr/ ha/ Year	Total net income in Birr/HH/ Year	Economic Benefit –Cost ratio (B/C) of the farming
Highland	Cereal mono-cropping	2,454	153	9,427	34,090	3.21
	Crop-livestock mixed farming	2,483	10.43	11,466	49,876	4.39
Midland	Cereal Crop production	1286	73.4	5275	8,800	2.91
	Tree-crop- agro-forestry	1550	1,284	8811	11,870	4.02
	Agro-pastoralism	805	834	4898	11,026	3.37
Lowland	Cereal crop production	1,797	285	3518	10,171	3.09
	Tree-crop- livestock farming (Agro-silvo-pastoralism	1,326	1,231	7194	11,854	3.41
	Pastoralism	2,357	769	16381	28,272	4.25

*Crop yield quantified in the highland were wheat and barley; in the mid-lands and lowlands barley, sorghum and maize per ha.

Based on the above quantifications, the direct economic performance of each farming system in food and cash crop production, livestock production, and total farm level production was determined, analyzed and compared by using the benefit-cost ratio (B/C) efficiency measure as according to table 2, the economic analysis, the farm production and economic variables measured between farming systems within an agro-ecology. The result show that in the highland, cereal food (mono) cropping were an average crop yield of 23.83 quintals per ha. This opposed by (Alemayehu S et.al..,

2010) an average cereal crop yield per hector in Ethiopia is 15.02 quintals per hector. And the average crop yield/ha from crop-livestock mixed farming was 21.62 quintals.

The result in table 2 shows that, the average total crop production cost for a cereal mono cropping HH was 2,806 Birr per ha/year and 2, 483 Birr per ha per year for mixed farming HHs in highland. Similarly, the total livestock production cost/TLU was 536 Birr per year for cereal mono cropping HHs and 452 Birr per TLU per year for farm units practicing mixed farming in the same agro-ecology (Table 2). The result shows that, the total net farm income per ha for cereal crop producer units was 9,427 Birr/HH/year and for crop-livestock mixed farming was 11,466 Birr/HH/ in high land.

The result in table 2 shows that, the economic efficiency measure (total direct benefit/total direct costs) of crop-livestock mixed farmers was 4.39 and 3.21 for cereal cropping units in the highland agro-ecology. The result shows that, the relatively higher economic performance of crop-livestock mixed farming compared to mono crop production is largely due to the greater TLU (livestock holding) per HH. This result is line with the study by Vinod Gupta, *et al*... (2012) [14] which states that by an integrated farming system/crop-livestock mixed farming consists of a range of resource-saving practices that enables to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment. The result in table 2 shows that, compared to the two farming systems in the highland agro-ecology of the BER and the three land use/ farming practices of HHs in midland agro-ecology have shown remarkably lower crop yield per ha.

The result in Table 2, shows that the average crop yield/ha of a Cereal crop producer farm unit in the mid agro-ecology was 15.06 quintals (sorghum or maize), while the average crop yield measured for the same crop in tree-crop agro-forestry systems was 13.20 quintals per ha and it was only 8.81 quintals per ha for agro-pastoral HHs in the same agro-ecology.

The result shows that, in terms of cash and Cereal crop production costs, the average total Cereal and cash crop production cost for a Cereal cropping farm unit (HH) was 1,360 Birr/ha/year while it was 1,404 Birr/ha/year for farm units practicing tree-crop-coffee agro-forestry in the same agro-ecology. The result shows that, the crop yield, the average total Cereal and cash crop production cost of an agro-pastoral HH in the mid agro-ecology was 925 Birr/ha/Year.

Similarly, show that the total net income and benefit-cost ratio of the three farming practices are compared and tree-crop-coffee agro-forestry was found to produce the highest economic return of an average total net income of 11,870 Birr/HH/Year followed by agro-pastoralist with an average total net income of 11,026 Birr/HH/Year while food crop production in the mid altitude provides an average total net income of 8,800 Birr/HH/Year. The economic efficiency (B/C ratio) of tree-crop agro-forestry system was 4.02; agro-pastoralist was 3.37 and the economic efficiency measure for crop production was 2.91.

The result in Table 2 show that in lowland agro-ecology the three most dominant land use/farming system types identified were pastoralism, tree-crop-livestock mixed farming (Agro-silvo-pastoralism) and food crop production. The result shows that, the average crop yield per ha was 10.5 quintals per ha per year for food crop producer HHs, 11.23 quintals per ha per year for tree-crop-livestock mixed farming HHs and 8.62 quintals per ha per year for pastoral HHs. In terms of food and cash crop production costs, the average total crop production cost for a food cropping farming unit was 892 Birr/ha/year and for tree-crop-livestock mixed faring unit it was 780 Birr/ha/year while the average total crop production cost for pastoral HHs was 483 Birr/ha/year (Table 2). The result show that, the average total net income per ha of land used for food and cash crop productions was 2,691 Birr/ha/year, income from crop production for tree-crop-livestock mixed farming was 1,623 Birr/ha/year and the average net income from crop production for pastoral HHs was only 1,304 Birr/ha.

The result in Table 2, show that the net incomes per TLU of livestock are estimated and the highest income is earned by pastoral HHs with an average net income of 2,357 per TLU/year. The result shows that, for crop producers were 1,797 Birr and 1,326 Birr for tree-crop-livestock mixed farmers in low land. The income of tree-crop-livestock mixed farmers from additional sources such as coffee and Chat was higher, estimated at 1,231 Birr/HH/year, compared to HHs using the other two farming systems.

The result in Table 2, show that pastoral HHs earn a total average net income of 16,381 Birr/ha/year, while the same income for tree-crop-livestock mixed farm units was 7,194 Birr/ha/year and for crop-producer was 3,518 Birr/ha/year. As a result the economic efficiency of land use (total benefit/total costs) under pastoralism was 4.25, tree-crop-livestock (agro-silvo-pastoral) mixed farming with economic efficiency measure of 3.14 and lowland crop production was 3.09. The result shows that the efficiency of the same crop production was the highest economic efficiency under pastoralism and least in food crop production in the mid-agro-ecology of the Eco-region.

4. Conclusions and Recommendations

Economic development for food security and alleviating poverty plays an important role in an ongoing or future small scale farmers farming use/system. This study was conducted in three different agro-ecologies of the BER to analyse the economic performance of alternative land use practices by smallholder farmers The Findings from this study have shown the need to improve economic and physical yield at farm level of alternative land use practices of smallholder farmers in the BER. Five major farming systems/land use practices are currently being used by rural HHs of the BER.

According to the findings of the economic analysis, most of the farm production and economic variables measured have shown significant differences between farming systems within an agro-ecological zone. In high land the effectively integrating food crop and livestock production through mixed farming system in the highlands of Bale not only provides higher economic returns from farming at farm level production.

In the mid altitude agro-ecology, the results showed that tree-crop farming (agro-forestry) and crop-livestock agro-pastoralism provide better economic returns and synergetic effects to farm level production process in addition to providing additional income from cash crops such as coffee, honey, fruits, chat etc.

Compared to the two farming systems discussed in the highland agro-ecology of the BER, the three land use/ farming practices of HHs in midland agro-ecology have shown remarkably lower crop yield per ha.

in the mid altitude agro-ecology, the result show that in addition to providing additional income from cash crops such as coffee, honey, fruits, chat and etc.

In low land pastoralism and tree-crop-livestock mixed farming can and do have the potential to provide higher economic returns for rural HHs in the lowlands of the BER.

On the basis of the results of this study, the following points were recommended to improve that economic and economic and physical yield at farm level of alternative land use practices of smallholder farmers in the study area.

1. Improve the economic and productivity at farm level of alternative land use practices of smallholder HHs and farming systems such as crop-livestock mixed farming, tree-crop mixed farming, tree-crop-livestock integrated farming and agro/pastoralism through improved farm production technologies, improved crop varieties, improved water storage and use systems etc
2. The result shows that on the farm level production of economic efficiency of mono-cropping systems in mid altitude and low land less economic efficient. Therefore, encourage integrated farming and discourage mono-cropping especially in mid and lowlands of the Eco-region through improving the economic returns of integrated farming practices.

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