



The Contribution of Crop Cultivation to the Livelihood Diversification of Agro-pastoralists in Dalifage District of Afar Region, Ethiopia

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ABSTRACT

In Ethiopia, rural households engaged in diverse off-farm and non-farm livelihood activities to cope with survival challenges such as drought. Due to unstable climatic conditions and reduced access to grazing land and water, the sustainability of livestock systems in Afar pastoralists is greatly affected. As a result, pastoralists look for alternative means of livelihood to reduce their vulnerability to adverse effects. Hence, this study was designed to investigate the contributions of crop production for the agro-pastoralists in Dalifage district. Multistage sampling techniques were used to draw about 150 sample households from 2 kebeles of the district for survey. Both qualitative and quantitative research approaches were used to collect data of study samples. The data were analyzed using SPSS packages. The survey results revealed that the agro-pastoralists were highly involved in crop cultivation as an alternative means of livelihood, though participants mainly practiced traditional way of production system. About 46.7% of the participants were diversified their livelihood due to crop production. Most of the agropastoral households (68%) claimed that crop cultivation increased the availability of food and feed sources, thereby enhancing their livelihood, minimizing morbidity and mortality loss of herds during the dry season. But some respondents (32%) indicated that crop cultivation was influenced by many internal and external factors, including shortage of water, pests, lack of inputs and market access. In conclusion, a significant number of agro -pastoralists in the Dalifage district were able to diversify their livelihood through crop production. Though, there is still a need for supporting and encouraging them through the provision of integrated extension services to motivate vast number of participants get into the system, there by diversifying their livelihood activities.

Keywords: Afar, Agro-pastoralists, Crop cultivation, Dalifage district, Livelihood diversification.

Abbreviations: HH: household; LhD: Livelihood Diversification; PADO: Pastoral & Agricultural Development Office.

INTRODUCTION

The arid and semi-arid lowland (ASALs) of the Horn of Africa (HoA) are characterized by a relative abundance of land and animal resources. In Ethiopia, the arid and semi-arid lowland regions comprise the Afar and Somali regional states and partly cover the Borena, the Southern Nations and Nationality People (SNNP) and the Gambella Region. They make up about 60 percent of the country's area and are endowed with 22% of the country's cattle population, 40.7% of sheep, 60% of goats and 100% of camels. Pastoralists and agro-pastoralists of Ethiopia are predominantly found in these regions constituting about 12% of the national population [1].

Although the Afar region is known for its livestock production, crop production is also practiced in some parts of the region [2]. The region is endowed with many permanent and seasonal rivers suitable for irrigation, of



which Awash River is the main one. The region possesses vast areas of irrigable land and crop production can be boosted to ensure food supplies in the region and the country in general [3]. Use of irrigation facilities has been expanding and currently about 100,000 hectares of land are developed under irrigation. Among the major food crops in Afar, cereals contributed 88.52%, where maize, sorghum, wheat, and teff accounted for 28.75%, 17.11%, 15.86% and 15.71% of the grain production, respectively [4].

Reports of several studies showed that in Afar, pastoralist livelihoods are increasingly under pressure and caught in a downward spiral of resource depletion and diminishing resilience against recurrent drought [5], resulting in loss of livestock and shrinking rangelands. According to the multi-agency assessment report of July 2017, a total of 654,611 people in Afar region are facing survival deficit [6]. As a result of all such challenges Afar pastoralists are forced to engage in diversified livelihoods. For instance, the emergence of agro-pastoralists in the last decade, involved in production of multipurpose crops has been a breakthrough, as food and income diversification are increasingly important means of managing risks [7].

Dalifage district is one of the promising and tremendous potential for large-scale irrigation, possessing two permanent Rivers flowing along the districts. However, the contribution of crop production for the livelihood of agro-pastorals in the area has not yet been studied. In other words, there is lack of pertinent documents related to the contribution of crop production for the livelihood of agro-pastorals in the study area.

Thus, this study was aimed to assess the role of crop cultivation for livelihood diversification of the agro-pastoralists in Dalifage district of Afar regional state. The study attempted to estimate the contribution of crop production as income diversification to agro-pastoral households based on empirical evidences.

RESEARCH METHODOLOGY

The study was conducted in the Dalifage district (Figure 1) of Afar regional state, Ethiopia. It is located in 100 39'59.99''N and 400 14'60.00''E; 235 km to west of Samara town with altitude ranging between 460-650 m.a.s.l. There are 11 pastoral kebeles in the district; of which 4 kebeles are occupied by Agro-pastoralists, while the rest 7 kebeles are entirely pastoralist. The total population of the district is 60,747; of which 7.95 % are agro-pastorals and 92.05 % are pastoralists. The average household size is 6 and nearly half of population are under the age of 15 and above 64 years old. The agro-ecology of the district is classified as hot and arid zone. The average annual temperature is about 33oC and the average annual rainfall is below 400 mm [8].

Research Design and Procedures

In this study a cross-sectional research design was employed using descriptive statistics to explain both the qualitative and quantitative data set. The explanatory variables of the livelihood framework were employed for analysis of the data, as it is very important since it provides researchers with the ability to assess qualitative and quantitative differences in experiences with livelihood diversification strategies.

The data used in the study pertain from both primary and secondary sources. This study primarily relied on primary data which were collected by using a semi-structured interview questionnaire (SIQ), key informant interviews (KII) and focus group discussions (FGD). Before embarking on the collection of primary data, enumerators were trained on the content of the questionnaire. To check similar understanding by all enumerators a pilot test was conducted after which some minor adjustments were made before full data collection was started. In addition, relevant secondary data were collected from regional Pastoral and Agricultural Development Bureau, from zone Administration and Agricultural offices and NGOs working in the district. The data were collected from published and unpublished documents, websites and literature.

Sampling Techniques

In this study, a multistage sampling technique was employed to select sample households and collect the necessary data. This sampling method allowed selecting the correct samples of agro-pastoralists from the target population. In the first stage, Dalifage district was selected purposively from Hari-Rasu zone, the reason behind was that this Woreda is major crop-producing Woreda among five woredas in Harri Rassu zone. In the

second stage, from this Woreda, 2 kebeles were selected Cluster sampling techniques based on the abundance of agropastoral community who are regularly involved in crop cultivation as subsistence farming, where the total population size in the two kebeles are 570. At the third stage, out of the total target population in 2 kebeles, 150 agro-pastoral households were selected by employing systematic random sampling.

The simplified formula to determine the sample size was described by [9] is given by:

$$n = \frac{N}{1 + (e)^2}$$

Where; N= total agro-pastoral households in two kebeles of Dalifage district; (= 570)

n = the minimum sample size required.

e = Level of precision (margin of error) = 0.07

$$\begin{aligned} n &= \frac{N}{1 + (e)^2} \\ &= \frac{570}{1 + 570(0.07)^2} = 150 \end{aligned}$$

Hence, 150 sample agro-pastoral respondents were taken from the two representatives Kebeles proportionally to their number of households (Table 1). The list of agro-pastoral households was obtained from development agents in each kebele. A systematic random sampling procedure was employed to obtain the sample of agro-pastoral households for interview.

Table 1: Distribution of sample households by Kebele

Kebele name	Households	Sample taken	Percentage
Dalifage	355	93	62
Jara	215	57	38
Total	570	150	100

Methods of Data Collection

For primary method of data collection household survey using well-structured questionnaire, focus group discussion, in-depth interview and direct observation methods were employed in order to assess the role and contribution of crop production for the livelihood of agro-pastoralists. For secondary data, various activity reports of governmental and non-governmental organizations and other empirical studies on relevant topics were critically reviewed. Moreover, Woreda and regional Pastoral Development Offices periodic reports and evaluation documents, leaflets, CSA statistical bulletins and abstracts were used as a secondary source.

The primary data were mainly used to gain information on farm level input used for production such as fertilizer, seed, and chemicals), amount of labor (human and oxen), productivity and total yield obtained. In addition, demographic and socio-economic and institutional data were collected from the primary source. The secondary data was focused on information related to crop production trends, input supply and extension services to clarify and support the interpretation of the primary data.

Data Analysis and Presentation

Both qualitative and quantitative data analysis methods were used. Most of the survey data used in the analysis



were categorical, where the numeric variables are often not normally distributed. Descriptive statistics such as mean, percentage, frequencies, variance and standard deviation were used to analyze and describe the socio-demographic data. Background variables to livelihoods and the basic elements of explanatory variables were examined using this tool. In addition, statistical tests of association or significance test was employed using chi-square test in order to validate the existence of any significant relationship between social capitals and livelihood diversification among agro-pastoralists. The analytical tests for many parts were supported by descriptive statistics, which involves percentages of single variables and average outcomes. The quantitative data gathered through the household survey were analyzed using the latest SPSS statistical software (version 16). Although the major data analysis was descriptive statistics like mean, standard deviation, t and X2 tests, diversity index and one-way ANOVA, simple and multiple correlation and regression analysis were also done. Finally, a multinomial logit model was fitted to discriminate the determinants of livelihood diversification.

RESULTS AND DISCUSSIONS

Demographic Characteristics & Livelihood Diversification Status of HHs

Gender of sampled households

Sex of the sample respondents is an integral and inseparable part of rural livelihoods. According to the survey results presented in Table 2, from the total sampled HHs, male headed HHs accounted for 74% of the respondents, while female-headed HHs accounted for 26%. Out of diversified households, 79.4% were male respondents and only 20.6% of them were female. This indicates that males are engaged nearly four times more in diversified livelihood activities than female.

The result also showed that only 46.7% of the HHs in the study area were diversified, but the remaining 53.3% were not diversified their livelihood by crop production. The reason for the later may be due to inadequate (small) land size and shortage of inputs, as mentioned in section 3.3.

Age of the sampled households

Age is an important demographic characteristic of the household assumed to influence differences in livelihood diversification among agro-pastoral households. As indicated in Table 3, (67.14%) of diversified HHs were under the age of 18 to 35 years, while only (13.75%) of HHs under the same age category were not diversified. On the other hand, 40.0% of non-diversified HHs fall under the age category of 51 to 64 years, while only 11.43% of HHs within the same category were diversified.

On comparison, the diversified HHs were a younger age group than those not diversified. It is generally amenable that younger pastoralists are more active than the older ones. Mean age of a diversified household was 34.8 years and of non-diversified was 50.6 years. [10], also came up with similar result, in his study on Challenges and contributions of crop production in agro-pastoral systems in Borana Plateau.

Educational level and LhD of the Sampled Households

The educational level of the household head is an important human capital which is likely to affect the LH diversification level of HHs. That is, the more the educational level of the HH, the more likely the household to diversify their livelihood and so the less likely the HH to become food insecure. The result in Table 4 showed that out of the total sampled households 64% were illiterate, whereas the rest 28% were basic education and 8% elementary school complete.

About 80.7% of non-diversified and 45.8% of the diversified HHs were illiterate; whereas 2.56% of the non-diversified and 13.9% of the diversified HHs were in level of elementary school. The χ^2 analysis result showed the existence of highly significant differences ($p < 1\%$) between the diversified and non-diversified HHs based on educational status of HHs (Table 4). Hence, the result suggested that the education level of the HHs had a considerable influence on livelihood diversification status of pastoral households. The same result was reported by [11].

Farm land Size and LhD of the households

The size of cultivated land by HHs can more likely affect the food security and Livelihood status of the HHs. That is, HHs with larger cultivated lands has more chance to diversify their lives than those with smaller land sizes. Results of the farm size survey analysis revealed the presence of high variation in the size of farm land owned by the sampled HHs, ranging from 0.24 ha to 7 ha. About 98.6 % of the diversified HHs possessed land sizes above 2.1 ha; whereas 51.25% of the non-diversified HHs had land sizes below 2 ha, as low as 0.24 ha. Moreover, there was a highly significant difference in the mean cultivated land size between the diversified and non-diversified HHs (Table 5).

Generally, the result suggested that there was a positive association between the sizes of crop lands and the diversification status of HHs in the study area. i.e., the bigger land sizes favored more diversification of HHs, whereas the smaller land sizes tend to lower the diversification status of HHs. The reason for the later may be due to the insufficient crop yields obtained per unit area of land. This result is in agreement with that of [3]

Family Size and LhD Status of Sampled Households

The mean total family size of the sampled HHs in Adult equivalent (AE) was 5.49 (SD=2.33) with a maximum of 10.0 and a minimum of 1.0 (Table 6). The result revealed that the distribution of sampled HHs with regard to family size, measured in AE, showed a significant difference ($p < 5\%$) between diversified and non-diversified HHs. The mean family size for diversified HHs is 4.66, and the mean family size for non-diversified HHs is 6.33. In addition, of the total non-diversified HHs, majority (51.3%) had a family size ranging from 7 to 10. This indicated that HH family size was negatively correlated with LhD status of agropastoral HHs. The higher the family size, the lower the diversification status, and the lesser family size, the more diversified HHs due to crop production. Similar results were reported by [10] and [11]. The reason for non-diversified HHs could be related to inadequate production, yield/person ratio and the high dependency ratio. High DDR refers to a large family with a few productive individuals, where, most of the family members are dependent on the work of one or a few persons.

Key Informant Interviews (KII) and Focus Group Discussion (FGD)

According to the key informant interviews (KII) and focus group discussion (FGD) results on the economic status of the HHs, crop land size, family size and livestock size (data not presented), are the three major wealth indicators in the study area. [10], categorized agro-pastoral groups based on relative wealth status as follows:

Households with more than 2 ha of land, an average of more than 6 family size and having about 30 camel, 50 cattle, 40 sheep/goats were considered as the Better-off; while HHs having land size of 2 ha, with an average family size of 4 and possessing 8 camel, 10 cattle, 15 sheep/goats were considered as the Middle (Tudagoyta). Whereas, HHs holding less than 2 ha of cropland with an average family size of 3, and about 2 camel, 3 cattle, 10 sheep/goats classified as the Poor (Aydidu).

Accordingly, in this study, the majority (51%) of the sampled HHs were fallen under the middle class; while the poor and the better-off constitute 32% and 17% of the total HHs, respectively.

These results generally indicated that land size, family size and livestock number are the most important determinants of the relative economic status of the households. The FGD result showed that these factors were directly associated to the livelihood diversification status of the households. Accordingly, the better-off class of the HHs had better chances of diversifying their livelihood, whereas the middle and the poor classes with limited resources were found less likely to diversify.

The Status of Crop Production and its Utilization by the Community

According to in-depth interviews as well as FGD, crop production has vital role to improving their livelihood systems for agro-pastoralists in Dalifage district. Most of the respondents stated that after they have been engaged in crop cultivation their life got better. Now a days, in Dalifage district, many were engaged in a

mixed pastoralism, such as crop production and had access to market linkages. The youths are commonly engaged in crop production practices and are able to diversify their livelihoods. One of the FGD discussants (agro-pastoralist) remarked that:

I started crop production in the previous year and I produced 10 quintals of maize on rain fed in last summer season. I also have planned to cultivate different crops like, mung bean, sesame and fruits by next season using both irrigation and rainfed system. We must diversify our livelihood strategies (Ali, FGD, Aug, 2022).

The field observation data also support the survey results, where we observed the area having enormous potential for irrigation-based crop production. The Dalifage district has two permanent rivers that offer good access for irrigation farming. There are also limited supports from the government like extension services and provision of inputs such as improved seed, fertilizers, water pumps and small farm tools.

Regarding benefits of crop production, the majority of the respondents argued that the crop they produced was mainly used to diversify their income (36.7%) and increase food availability of HHs (28%). Some of the rest respondents also mentioned that crop farming improved their livestock production and seed availability for the next cropping (Table 7).

The FG discussant also remarked “*as crop production has expanded in the area, enormous socio-economic and land use changes followed. The area of land under private holdings has increased due to settlement practices by the government and by the promotion of crop production*”. Although crop-based livelihoods are a relatively recent occurrence in the study areas, currently, much of the rangelands that had been used for dry season grazing along major riverbanks have been transformed into crop lands.

Livelihood Diversification Strategies of the Agro-pastoralists

As shown in Table 8 and Fig.2, the HHs had diversified income sources. Raising animals (45.3%) and crop production (32.7%) were the most important income sources, followed by livestock trade and casual labor contributing for 12.7% and 6.0% respectively of the total income of the HHs. Participants of the FGD explained that their cultivated cropland included maize, sorghum, fruits and vegetables, cash crops like sesame, mung bean, wheat, and groundnut. The same result was reported by [12].

The role of crop production to LhD of Agro-pastoralists

Table 9 indicated that 68% of respondents replied that crop cultivation increased their food availability, whereas 32% reported as no benefit from cropping activities due to failed crop production from a shortage of water and prolonged droughts. The respondents were asked if they could increase livestock population when they had better access for animal feed during crop production. About 80% of respondents agreed that crop cultivation deserved these benefits, mainly for milking cows and oxen. This result is in agreement with that of [13] findings.

A chi-square test showed there was a significant relationship between the wealth of HHs and the availability of crop residues for livestock feed. However, there was no significant difference for educational level, gender and age class (Table 10).

Both FGD and KII, remarked the existence of promising potential of feed sources in the study area in both dry and wet season feed demands, including natural pasture, diversified browser species, subsistence crop residues, and stubble grazing from cropland, especially during the early dry season.

CONCLUSION

The study revealed that there is a general trend of shifting from a pure pastoralism to agro-pastoral production system. Likewise, crop cultivation was found to be a key means of income-generating option, and plays an integral part in livelihood diversification of the agro-pastoralists in the have Dalifage area. The study also



showed that education, age, family size, and farm land size significant impacts on the livelihood diversification of the agro-pastoral households.

Above all, crop cultivation provided remarkable advantages to the agro-pastoral households, and a significant number of the community are engaged and benefited from crop production activities. It is evidenced by the growing trends of agro-pastoralists in expanding the crop production practice and using it as an alternative means of rebuilding their lives.

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Authors contribution

Author 1: The conception, design & execution of the study and acquisition of data

Author 2: Data analysis and interpretation, drafting the article, and revising it critically

Author3: Supervising the study and final approval of the version to be submitted

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Tables and Figures

Table 2. Sex of Household Heads and LhD Status

Sex of HH heads	Male	Female	Total	χ^2
Frequency	111	39	150	
Percentage	74	26	100	
Diversified HHs by Sex				
Frequency	104	27	131	
Percentage	79.4	20.6	100	3.503*

Source: own survey data, 2022. N = 150; * = significant at P < 0.05 level

Table 3. Age group of sampled HHs and LhD Status

Age category (years)	Diversified HHs (n= 70)		Non-diversified HHs (n=80)		Total (n= 150)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
18-35	47	67.14	11	13.75	58	38.67
36-50	12	17.14	26	32.5	38	25.33
51-64	8	11.43	32	40	40	26.67
> 65	3	4.29	11	13.75	14	9.33
Mean	34.84		50.6		42.72	
SD	14.15		14.28		16.6	
t-value	7.1279**					

Source: own survey data, 2022. N = 150; ** = significant at P < 0.01 level

Table 4. Educational Status and Livelihood Diversification of HHs

Educational Level of HH heads	Diversified HHs		Non-diversified		Total		χ^2 -
	(n= 70)		(n=80)		(n= 150)		value
	Frequency	Percent	Frequency	Percent	Frequency	Percent	
Read & write	29	40.3	13	16.7	42	28	
Illiterate	33	45.8	63	80.7	96	64	
Elementary	10	13.9	2	2.56	12	8	
Total	72	100	78	100	150	100	14.91**
Mean	24		26		50		

Table 5. Farmland Size and Livelihood Diversification Status of HHs

Land size (in ha)	Diversified HHs (n= 70)		Non-diversified HHs (n=80)		Total (n= 150)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0.24-2.0	1	1.42	41	51.25	42	28
2.01-3.50	13	18.57	32	40	45	30
3.51-5.0	35	50	7	8.75	42	28
5.1-7.0	21	30	0	0	21	14
Mean	4.47	100	20	100	37.5	100
SD	1.323		1.062		1.326	
t-value	6.026**					

N = 150; * = significant at $P \leq 0.01$ level.

Table 6. Family Size and Livelihood Diversification Status of HHs

Family size	Diversified HHs		Non-diversified HHs		Total	
	(n= 70)		(n=80)		(n= 150)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1.0-2.0	17	24.29	8	10	25	16.7
3.0-4.0	18	25.71	12	15	30	20
5.0-6.0	20	28.57	19	23.75	39	26
7.0- 10	15	21.43	41	51.25	56	37.3
Mean	4.66	100	6.33	100	5.49	100
SD	2.31		1.8		2.33	
t-value	5.7828*					

N = 150; * = significant at $P \leq 0.05$ level.

Table 7. Benefits and utilization of crop production in the study area

S.No	Utilization	Frequency	Percent	Rank
1	Increase food availability for consumption	42*	28	2 nd
2	Diversify income level of the household	53*	36.7	1 st
3	Create social reciprocity networks	7	4.7	7 th
4	Increase seed availability for next planting	25*	16.7	4 th
4	Increase livestock production and productivity	27*	18	3 rd
5	Crop residue used as alternative feed sources	15	8.7	5 th
6	Create grain loans opportunity	9	6	6 th
	Total	150	100	

* Multiple responses = respondents with more than one response

Table 8. Diversified activities adopted by the agro-pastoral HHs

Types of activities	Frequency	Percent
Animal husbandry	68	45.3**
Crop & forage sale	49	32.7
Livestock trade	19	12.7
Causal labour	9	6.0
Pension allowance	5	3.3
Total	150	100

** = maximum

Table 9. Contribution of crop production to livelihood of Agro-pastoralists

Activities	Respondents	Frequency	Percent
Increase food availability	Yes	98*	68
	No	52	32
Increase Livestock no.	Yes	125*	80.7
	No	25	19.3
Increase feed availability	Yes	100*	75
	No	50	25

Table 10. Chi-square analysis for the association of demographic factors and crop residue utilization by HHs

Demographic factors		Do you use crop residues as livestock feed?				
Wealth	Category	Yes	No	X ₂	Prob.	Sig.
	Rich	6	5			
	Medium	31	15	14.081	0.001	**
	poor	29	21			
Sex	male	89	21	9.111	0.003	*
	female	14	16			
Education	Illiterate	68	42			
level	Literate	19	10	3.682	0.298	Ns
	1 st level	8	2			
	2 nd level	1	0			
Age	18-25	25	10	4.243	236	Ns
	26-35	32	15			
	36-45	27	12			
	> 45	21	8			

**, * = significant at $p < 0.01$ and at $p < 0.05$ levels; Ns = not significant

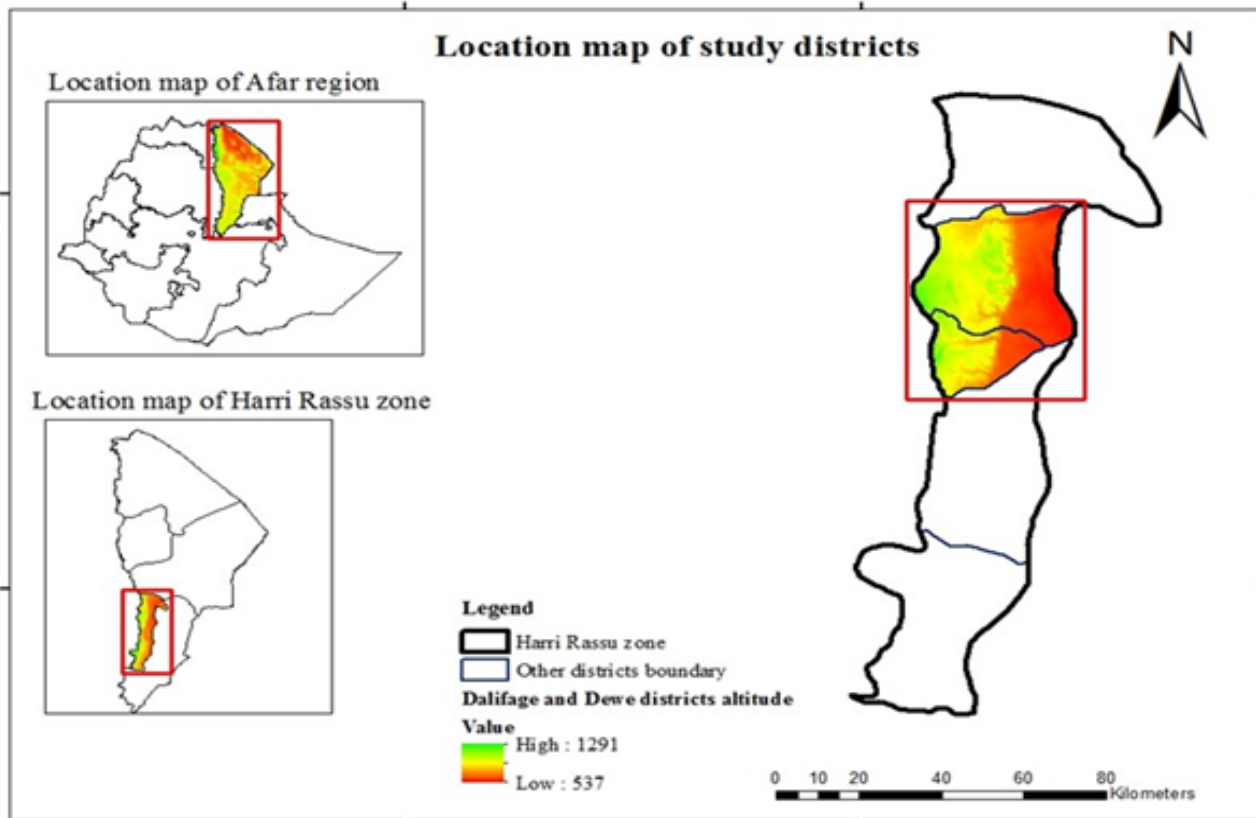


Figure 1: Map of the study area.

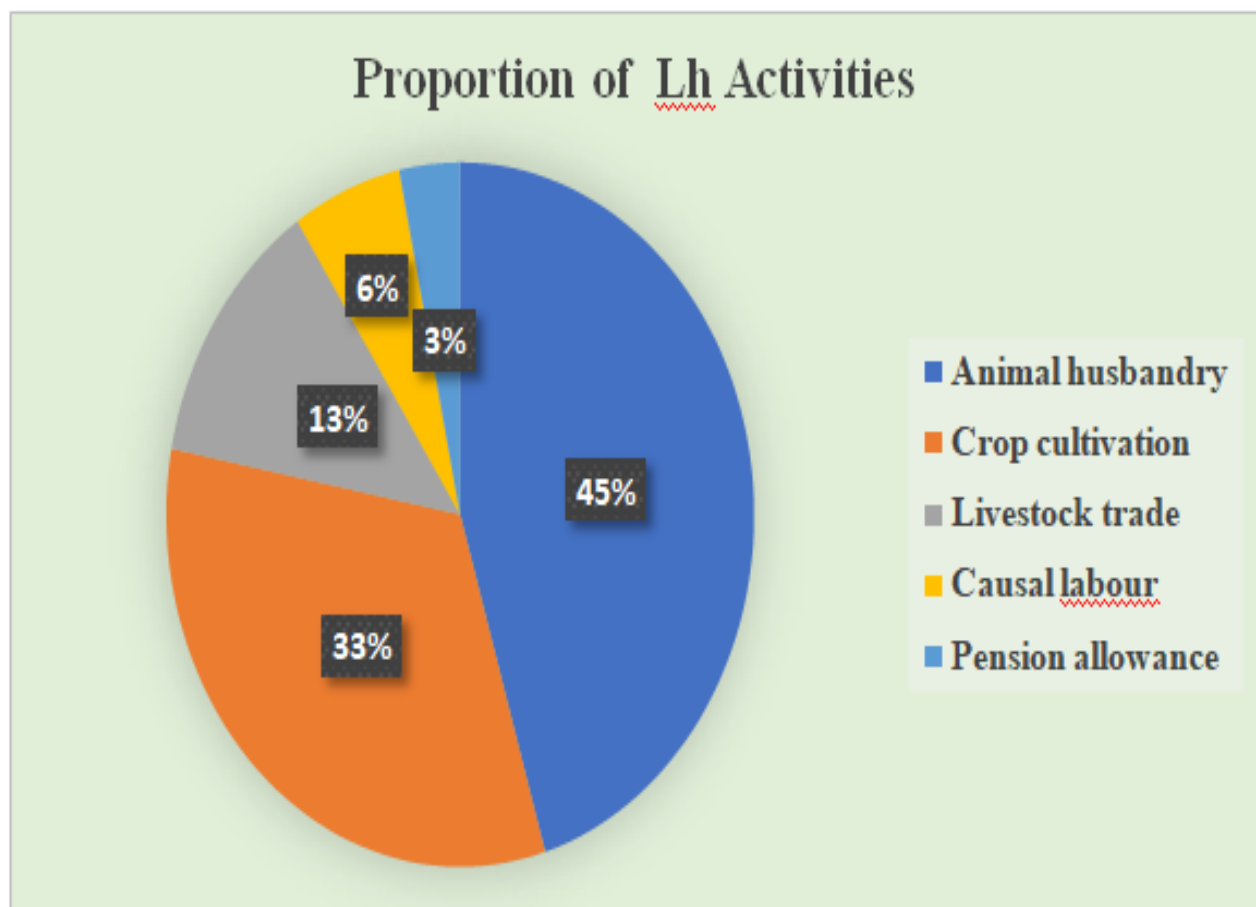


Fig. 2: Proportion of livelihood options adopted by the HHs in the study area

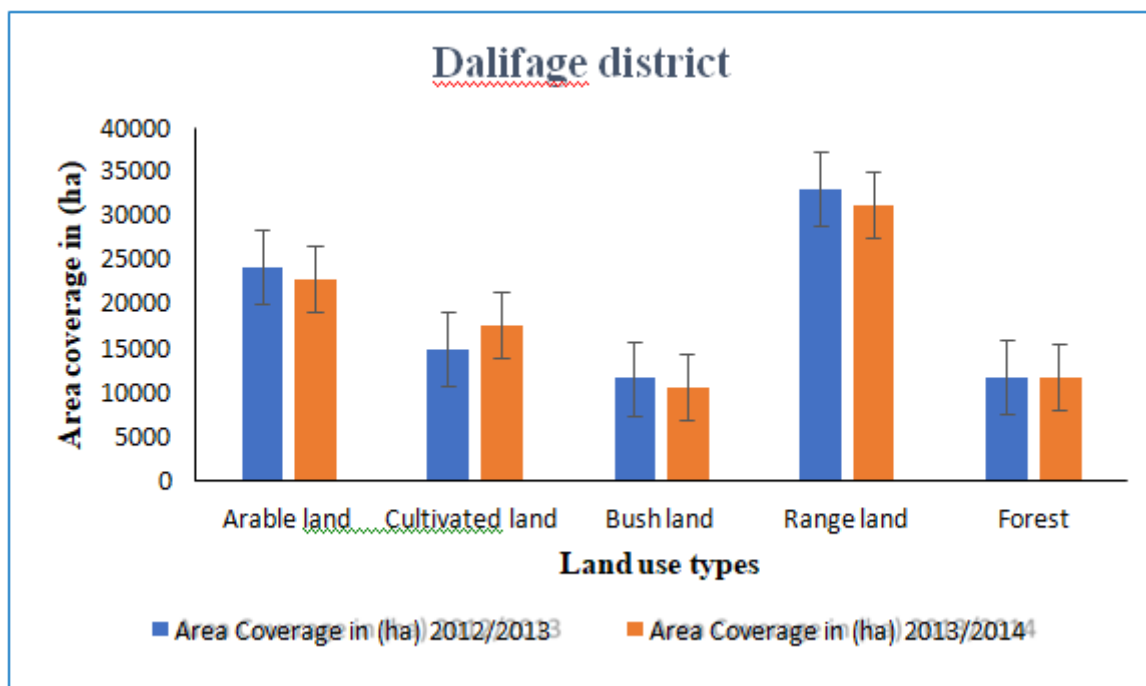


Fig. 3: Land use map of Dalifage District in 2012/13 and 2013/14