Current status and contributions of multi-purpose legumes in rural livelihoods of Diga and Jeldu field sites of Ethiopia

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Report on *Legume CHOICE* Project Baseline Survey

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Introduction

Legume Choice project is a BMZ-funded project that is fully aligned to the Humidtropics CRP-'Integrated Systems for the Humid Tropics'. The project is implemented in three countries, Ethiopia, Kenya and DRC Congo, representing eastern and central African countries. The project is aimed at improving food and nutrition security, reducing poverty, and enhancing the production environment of smallholder farmers and rural populations, in particular women, through facilitation of the smart integration and use of multi-purpose legumes, providing food, protein, feed, fuel, and/or organic matter in crop-livestock systems. The purpose of the project is to provide knowledge and tools to farmers and development partners facilitating farmers to make rational decisions for enhancing short and long-term contributions of multi-purpose legumes to farmer livelihoods including aspects of legume production, input supply systems, and markets. The project intends to reach at least 1,500 smallholder farmers in each target Humidtropics Action Site through legume intensification and system diversification with legumes, based on specific needs and niches identified in cooperation with R4D platform partners.

Farming system diagnosis and related entry points for multi-purpose legumes in farming systems and synthesis of lessons learnt across all action sites is one among the *four outputs* to be delivered by this project. In Ethiopia, two Humidtropics Field Sites, namely *Diga* and *Jeldu*, were selected and current contributions/functions of legumes in farming systems and constraints to enhance these functions were assessed through a quick baseline survey. This reports presents the results of this survey for Ethiopia.

Background of the field sites

Diga and Jeldu field sites are the two Legume Choice field sites located in East Wellega and West Showa Zones of Oromia Region State, respectively. Diga is located about 340 kms to the west of the capital Addis Ababa, whereas Jeldu is located at 120 kms to the north-west of Addis Ababa. The livelihoods of the population in both field sites is mainly depend on crop-livestock

farming. The traditional oxen-plough is the major tillage practice used for crop production. Potato, barley, wheat, teff, faba bean and field pea are among the commonly cultivated major food crops in the livelihoods of the Jeldu field site, whereas, maize, ground nut, common bean, sesame, sorghum, millet, wheat, teff and faba bean are major food crops cultivated in the Diga field site. Other crops including linseed, chick pea, grass pea, fenugreek, noug *(Guizota Abssynica)*, lentil, oat, inset, garlic, onion, shallot, carrot, beet root, tomato, cabbage, climbing bean, pigeon pea, soya bean and sweet potato are sometimes cultivated in either of the two field sites. Moreover, dasho *(Pennisetum pedicellatum)* grass (around homestead and on soil conservation structures), and tree lucerne and sesbania (as hedgerows around homestead) are frequently grown for livestock feed and soil conservation purposes as well as for income generation. Livestock, particularly cattle, sheep, horses and donkeys are an integral part of the farming system and play an important role in the economy of both field sites.

Chillanko and Kolu-Galan, which are among the 63 kebeles of Jeldu field site, and Lalisa-Dimtu and Fromsa, which are among the 22 kebeles of Diga field site, are Legume Choice implementation sites representing good and medium market access kebeles, respectively. A description of key agro-ecological parameters for the selected implementation sites is given in Table 1.

Table 1. Description of Ethiopia Legume Choice project implementation sites

Implementation sites	Field site	Total no. of households	Latitude	Longitude	Average altitude	Agro-ecology	Market access
Lalisa-Dimtu	Diga	700	09°02'62"N	36°24'80"E	1306	Lowland	Good
Fromsa	Diga	550	09°03'19"N	36°45'53"E	2140	Mid-altitude	Medium
Chillanko	Jeldu	500	09°20'87"N	38°11'33"E	2943	Extreme highland	Good
Kolu-Galan	Jeldu	1150	09°22'29"N	38°09'95"E	2685	Highland	Medium

Purpose of the survey

The main aim of conducting the survey was:

- To gather baseline information on the status and contribution of legume production to livelihoods in the area.
- To help to select farmers for a more detailed farm characterization survey.

Sampling method

All implementation sites were purposively selected to cover both medium and good market access kebeles of the respective field sites. There are 3 zones in each of the implementation sites such that the first zone is nearest and the last zone is farthest away from the main road (implication on market access). Farmer households on both sides of transect were randomly selected within each zones and used for data collection.

Data collection and analysis

Transect walks were done from October 31 to November 2, 2014 at Diga and from 01-03 April, 2015 at Jeldu across those pre-defined zones to cover areas, far from and near to the main road. Farmers' households on both sides of the transect were randomly visited and questions were asked according to the pre-prepared quick survey tool to cover 10% of the total farming households. Accordingly, 51, 114, 68, and 58 (a total of 291) farmer household heads were interviewed from Chillanko, Kolu-Galan, Lalisa-Dimtu, and Fromsa, respectively. Homestead GPS points and respondents' contact details were taken to be able to revisit for monitoring and evaluation purposes, and/or for reuse in case the households would subsequently be selected for the farm characterization survey, or later invited to future focus group discussions. The survey was filled by enumerators together with the farmer during the quick transect walk taking in all the respondent farmer households. Data on household demographics, land holding and land allocation, different legumes grown, cropping systems practiced, livestock holdings, rate of chemical fertilizer applied and current grain legume productivity were collected in this quick survey. Data entry was entered twice using CSPro version 5.0 by two independent individuals and data was then validated by correcting any discrepancies. Finally, the validated

data was exported to the appropriate software and simple descriptive statistics were used for data analysis using SPSS and Microsoft Excel.

Result and discussion

Household demographic characteristics

The survey results showed that the household heads in all implementation sites were predominantly male. Out of the total households interviewed, only 13.2%, 5.9%, 5.9%, and 1.7% were female headed households for Kolu-Galan, Chillanko, Lalisa-Dimtu, and Fromsa implementation sites, in that order (data not shown). Kolu-Galan in Jeldu had relatively more female-headed household than the remaining implementation sites. Age of household head ranged from 25-85, 30-90, 21-81, and 22-80 years for Kolu-Galan, Chillanko, Lalisa-Dimtu, and Fromsa, respectively. The median age for household heads was 53.0, and 44.6 years for Jeldu and Diga field sites, respectively. There was an average family size of 8.0, 7.0, 7.0, and 6.9 for Kolu-Galan, Chillanko, Lalisa-Dimtu, and Fromsa, respectively, with mean family size being 7.6 individuals for Jeldu, and 7.0 individuals per household for the Diga field site. The proportion of different age classes of the household members is shown in Figure 1. Assuming that labor force is likely to be provided by individuals above 14 years old, both age classes between '14 & 24' and >24 years were combined in one category. In all implementation sites, the largest proportion (nearly 53%) of family size was accounted for those working age classes > 14 years old (Figure 1). This and the family size of 7 or more individuals per households, indicates the availability of adequate labor power in all sites. Age classes < 6 years constitutes only 17% of the total household members in all implementations sites, whereas the proportion of those age group between 6 and 14 years were slightly higher (35%) at Fromsa and on average 28% in the remaining implementation sites (Figure 1).

The survey result across all implementation sites indicates that nearly 11% of all household heads had attained secondary level education, whereas very small numbers had attained tertiary-level education. Lalisa Dimtu and Chillanko are the two sites where the largest

proportion of household heads had attended secondary school (Figure 2). However, averaging across the implementation sites, 45% of the household heads have attended only primary school, whereas a significant proportion (43%) of the household heads have no formal education at all (Figure 2).

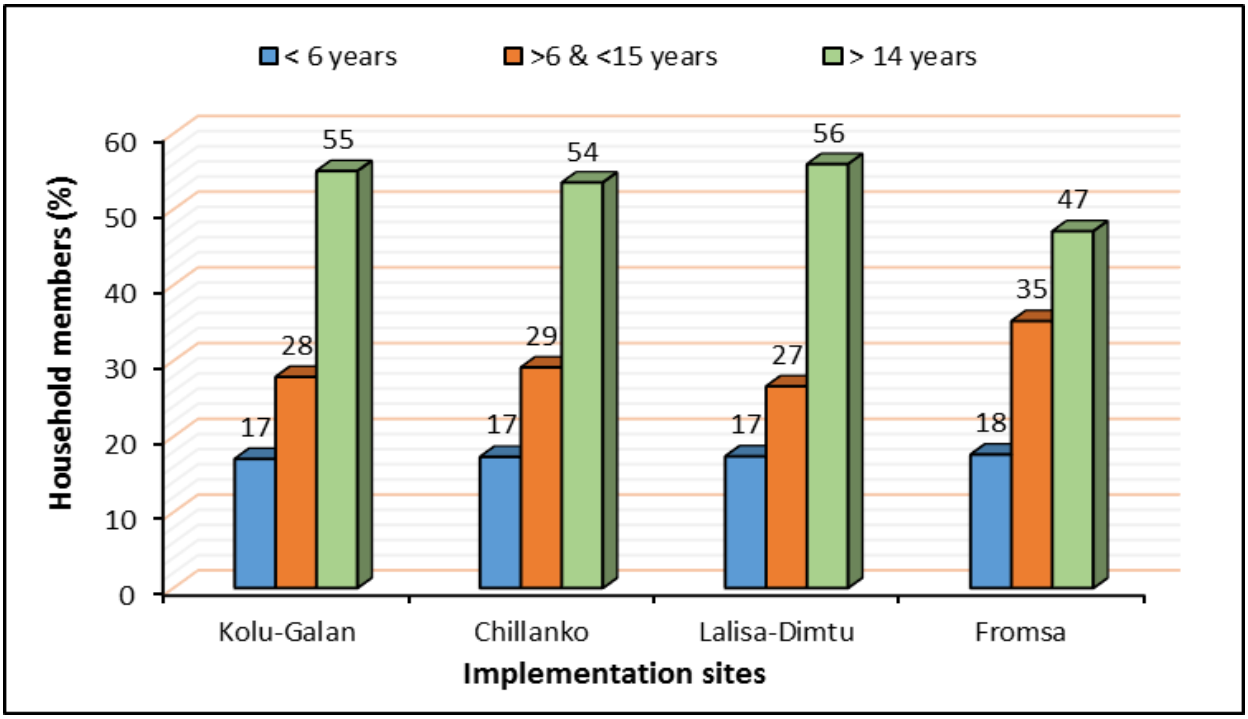

Figure 1. Proportion of different household members age classes to the total family size in four implementation sites.

This could be among the major reasons that lack of awareness was identified as major constraining factor influencing legume production and productivity, hence training should be a major component of any future intervention activities.

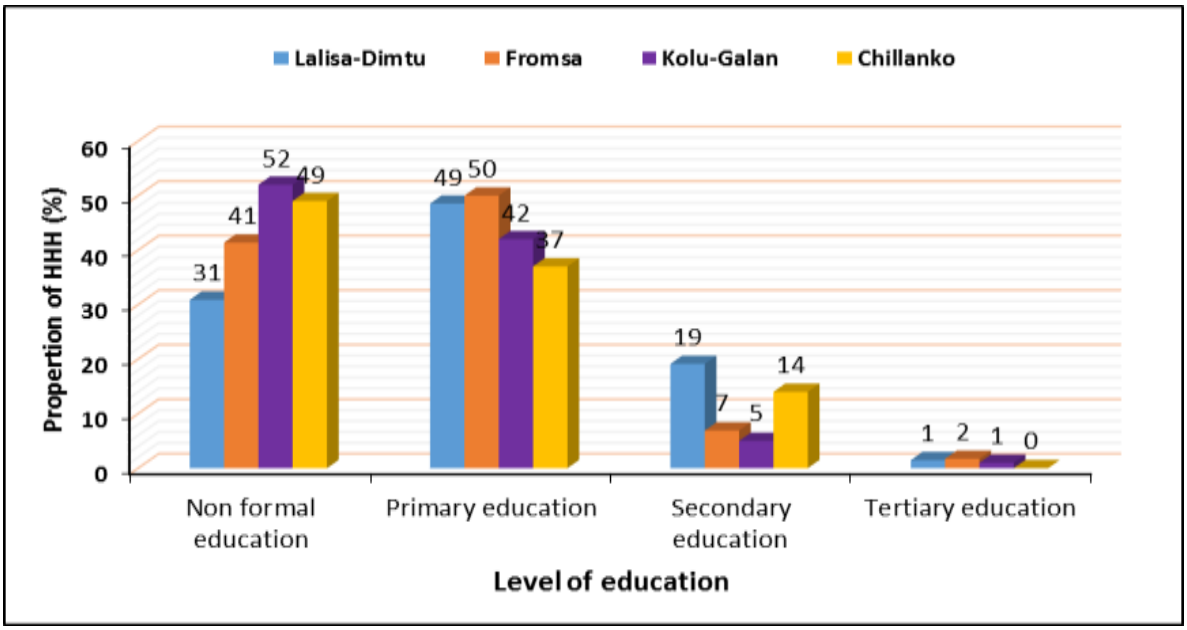

Figure 2. Level of education of the household heads in four implementation sites.

Table 2. Mean, minimum and maximum land holding (ha) of the four implementation sites

Implementation sites	Number of farmers interviewed	Land size (ha)		
		Min	Max	Mean
Kolu-Galan	114	0.50	12.00	3.02
Chillanko	51	0.75	9.25	3.56
Lalisa-Dimtu	68	0.50	14.00	3.28
Fromsa	58	0.25	6.00	2.40

The farm size thresholds and average land holdings and the proportion of farmers in each type is indicated in Table 3. Based on the pre-defined farmer type thresholds fixed for land size through discussion on village meetings, the largest proportion of households in all implementation sites were found to be medium resource farmers followed by high resource farmers. The proportion of low resource farmers was a bit higher (24%) in Fromsa followed by Kolu-Galan and Lalisa-Dimtu at 20% each compared to 16% in the Chillanko implementation site (Table 3).

Table 3. Proportion of farmer households, and range and average land holdings of each farmer type of the four implementation sites.

Farmer type	Lalisa-Dimtu			Fromsa			Kolu-Galan			Chillanko		
	Land size (ha)	Average	% of HH	Farm size (ha)	Average	% of HH	Farm size (ha)	Average	% of HH	Farm size (ha)	Average	% of HH
High resource	≥ 4	5.42	36	≥ 3	4.36	24	> 3.375	4.89	39	> 3.875	5.58	37
Medium resource	≥1.75 & < 4	2.70	44	≥1.25 & < 3	2.18	52	>1.375 & ≤3.375	2.23	41	>1.5 & ≤3.875	2.82	47
Low resource	0.5 to < 1.75	1.03	20	0.25 to < 1.25	0.90	24	0.5 to <1.375	1.04	20	0.75 to ≤1.5	0.95	16

Individual farmers' land allocation for different purposes is indicated in Figure 3. The largest share of the household land was allocated for crops other than legumes. The percentage of land allocated to this purpose ranged from 49% for Lalisa-Dimtu to 61% for Chillanko. Moreover, with the exception of Lalisa-Dimtu, in the remaining implementation sites, grazing was the second most important purpose for which farmers allocate their land. Of the different study sites the allocation of land for grain legumes was highest in Lalisa-Dimtu followed by Fromsa, and the lowest allocation was in Chillanko. Out of the total land allocated for food crops, 21.0%, 9.0%, 7.3%, and 4.5% of the land were covered by legume crops at Lalisa-Dimtu, Fromsa, Kolu-Galan, and Chillanko, respectively. Despite the significant portion of farmland allocated for grazing, however, a very limited portion of land (< 1%) was allocated for fodder crop production across all sites (Figure 3). Thus despite the high importance of feed shortage in the study area, there appear to be various constraining factors that prevent farmers from devoting significant portions of their land for fodder production. Eucalyptus wood lots are another important sector sharing more than 7% of household land in Kolu-Galan and Chillanko. The portion was less at Lalisa-Dimtu and Fromsa implementation sites where about 4% of farm land was allocated for woodlots (Figure 3).

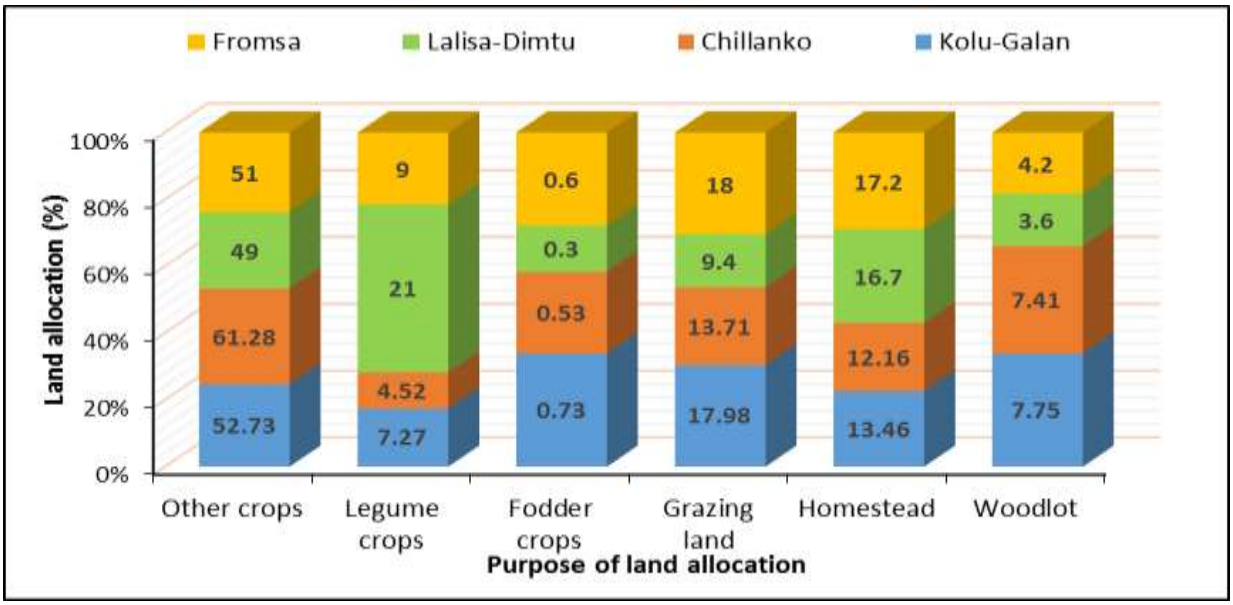

Figure 3. Household land allocation for different purposes in Fromsa, Lalisa-Dimtu, Kolu-Galan, and Chillanko implementations sites.

Legume species grown and legume cropping system

Regardless of the differences in agro-ecologies, legumes are an important and integral part of crop production activities in both Diga and Jeldu field sites. Different legume species grown in the implementation sites are indicated in Figure 4. Based on the results, while perennial climbing bean is very popular around homesteads, ground nut and bush type haricot bean are widely cultivated annual grain legumes in Lalisa-Dimtu. In Fromsa, faba bean is the most important grain legume cultivated followed by bush type haricot bean, annual climbing bean and field pea. Chick pea and pigeon pea occur infrequently in Fromsa and Lalisa-Dimtu, respectively (Figure 4a). Results from Jeldu field site reveals that faba bean and field pea are the most important annual grain legumes commonly cultivated in both Kolu-Galan and Chillanko implementation sites, whereas chick pea, lentil, and grass pea are sometimes cultivated using residual moisture as a double crop in the late season either after a harvest of early-sown potato or barley (Figure 4b). On the other hand, sesbania in Lalisa-Dimtu and Fromsa, and tree lucerne in Kolu-Galan and Chillanko, were the most widely grown perennial tree legumes in the form of hedgerows around homestead either for livestock feed or for fencing purposes.

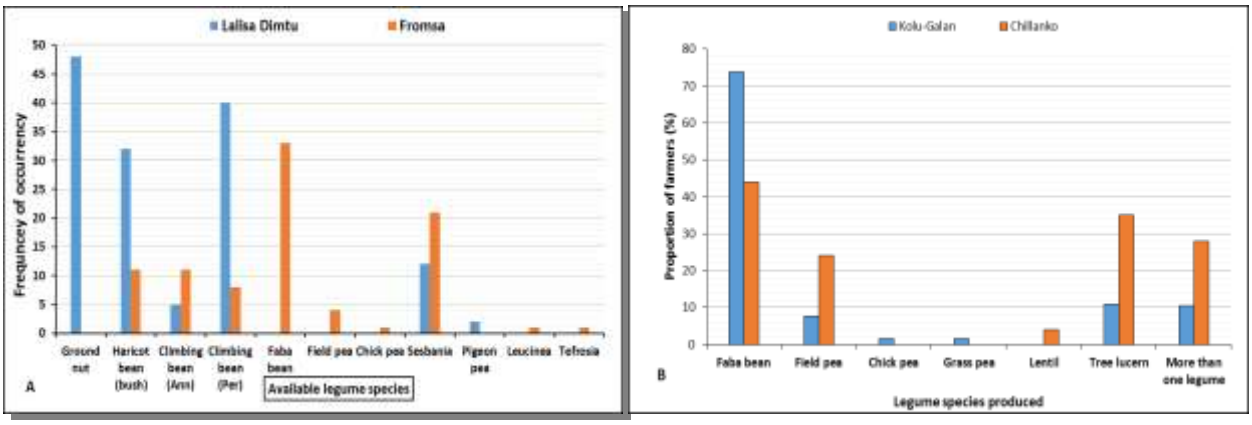

Figure 4. Different legume species grown in Lalisa-Dimtu and Fromsa (A), and Kolu-Galan and Chillanko (B) implementation sites.

Figure 5 displays different legume cropping systems practiced in the implementation sites. Legume sole cropping and intercropping with maize are common in Lalisa-Dimtu and Fromsa Sole cropping, and double cropping in the late season after potato or barley using residual moisture are common in Kolu-Galan and Chillanko. The largest proportion of interviewed farmer households, 46% and 43% in Lalisa-Dimtu and Fromsa, respectively, and 47% each in Kolu-Galan and Chillanko, were producing legumes using the sole cropping system. Legume-maize intercropping was found to be the second most important legume cropping system in the Diga field site, whereas double cropping was the second most important in the Jeldu sites. About 18% and 12% of farmers interviewed were producing legumes as intercrops with maize in Lalisa-Dimtu and Fromsa, respectively (Figure 5a). Bush-type haricot bean and annual climbing bean are the major legumes produced through intercropping with maize. However, due to lack of knowledge of spatial and temporal arrangements of the component crops, farmers are getting very low yields from the intercropped legumes.

The proportion of farmers with no legumes on their farm was 9% in Lalisa Dimtu and 29% in Fromsa. In highland agro-ecology sites, Kolu-Galan and Chillanko, faba bean and field pea are the predominantly grown annual grain legumes cultivated as sole crops. Only an insignificant portion of the interviewed farmers (1% in Kolu-Galan and 2% in Chillanko) were practicing

double cropping of chick pea, grass pea and lentil either after potato or barley. Moreover, about 8% of farmers in Kolu-Galan cultivate legumes as both sole crops and using double cropping. However, 44% and 51% of the interviewed farmers from Kolu-Galan and Chillanko, respectively, had not produced grian legumes at all in the last 12 months (Figure 5b).

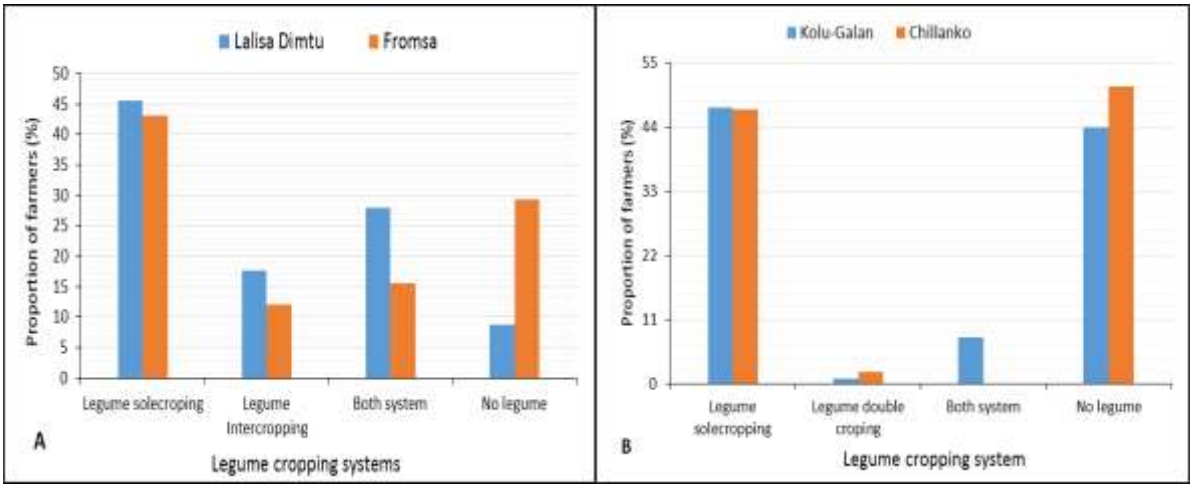

Figure 5. Different annual grain legumes cropping systems pracitced in Lalisa-Dimtu and Fromsa (A), and Kolu-Galan and Chillanko (B) implementation sites.

Table 4. Livestock holdings of Kolu-Galan, Chillanko, Lalisa-Dimtu and Fromsa implementation sites.

Implementation sites	Livestock holding	Cattle			Small ruminants		Equines	
		Adult Oxen	Young Oxen	Cows	Sheep	Goat	Horse	Donkey
Kolu-Galan	Holding (%)	29.3	17.6	53.1	90.5	9.5	77.7	22.3
	Average (heads /hh)	1.7	1.0	3.1	5.4	0.6	1.3	0.4
Chillanko	Holding (%)	35.9	16.5	47.5	96.6	3.4	66	34
	Average (heads /hh)	2.0	0.9	2.6	6.8	0.2	1.3	0.7
Lalisa-Dimtu	Holding (%)	25	20	55	40	60	92	8
	Average (heads /hh)	1.69	1.38	3.82	0.47	0.72	0.18	0.01
Fromsa	Holding (%)	25	19	55	76	24	100	0
	Average (heads /hh)	1.57	1.19	3.41	2.52	0.79	0.52	0

Livestock holding

As livestock is a major component of the farming system across the Ethiopian highlands including Diga and Jeldu field sites, livestock holding, particularly the number of draught oxen owned by farmers was identified as a major criteria for classifying the farmers into different types. The results from baseline survey regarding livestock holding of individual farmers are summarized in Table 4. This summary focused only on most important livestock including cattle (young and adult oxen, young and adult improved and local cows), small ruminants (sheep and goats), and equines (horse and donkey). Accordngly, out of the total cattle population, the numbers of cows were larger in Kolugalan (53.1%), and in Fromsa and Lalisa-Dimtu (55% each) than the numbers of young and adult oxen. The summed proportion of both adult and young draught oxen was larger than cows in Chillanko (52.4%). For small ruminants, sheep were the most numersous in all implementation sites except in Lalisa-Dimtu, where goats are more important. Similarly, horses are more numerous than donkeys across all implementation sites, although the numbers kept by Diga farmers (Lalisa-Dimtu and Fromsa) are relatively small compared that of Jeldu sites.

Figure 6 shows the percent distribution and numbers holding of draught oxen and other cattles across the low, medium and high resource farmers of the respcetive implementation sites. The proportion of draught oxen among different farmer types was ranged from 4.8% for Lalisa-Dimtu low resource farmers to 52.5% for Chillanko high resource farmers. The number of oxen per individual household was ranged from 0.7 heads/hh for Lalisa-Dimtu low resource farmers to 4.6 heads/hh for Fromsa and Lalisa-Dimtu high resource farmers (Figure 6). The distribution of draught oxen was 13.7%, 33.8%, and 52.5% with 1.9, 2.3, and 3.8 heads per individual household for low, medium, and high resource farmers of Kolu-Galan, respectively, whereas, it was 7.4%, 39.6%, and 45.6% with 1.4, 3.1, and 3.6 heads per individual household for low, medium and high resource farmers of Chillanko implementation site.

In Jeldu implementation sites, the largest proportion of cattle was kept by high resource farmers, in Diga sites medium resource farmers had most cattle. The proportion of cattle kept by the low resource farmers across the implementation sites ranged from a low of 8.1% for

Chillanko to a high of 22.7% for Fromsa. Generally, the gap between different farmer types, in draught oxen and other cattles ownership was very narrow in Lalisa-Dimtu and Fromsa compared to Kolu-Galan and Chillanko (Figure 6).

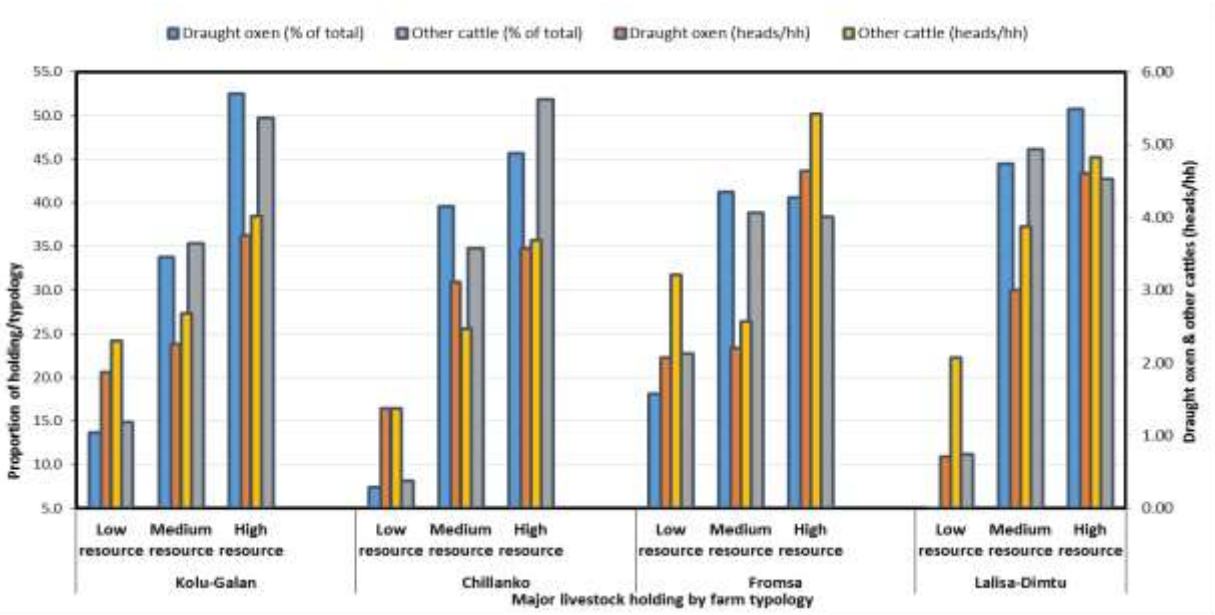

Figure 6. The distribution of major livestocks in number and in % among the three farmer types across implementation sites.

The rate of chemical fertilizer applied by individual farmers is indicated in Figure 7. The majority of farmers interviewed in Kolu-Galan and Chillanko were apply between 100 and 250 kg ha^{-1}, but the figure was between 50 and 100 kg ha^{-1} in Lalisa-Dimtu and Fromsa. The rate ranged from 0 to 420 kg ha^{-1} with an average of 142 kg ha^{-1} per individual, and from 45 to 500 kg ha^{-1} with an average of 195 kg ha^{-1} in Kolu-Galan and Chillanko, respectively.

Similarly, the rate of chemical fertilizer applied in Lalisa-Dimtu was ranged from 0 to 300 kg ha^{-1} with an average rate of 90 kg ha^{-1}, whereas it ranged from 0 to 400 kg ha^{-1} in Fromsa with an average of 51 kg ha^{-1}. About 24% and 7% of farmers did not apply chemical fertilizer at all in Lalisa-Dimtu and Fromsa, respectively, whereas only 1% of the farmers in Kolu-Galan were not used chemical fertilizer on their farm. All farmers in Chillanko were applied chemical fertilizer on their plot during the last 12 months (Figure 7).

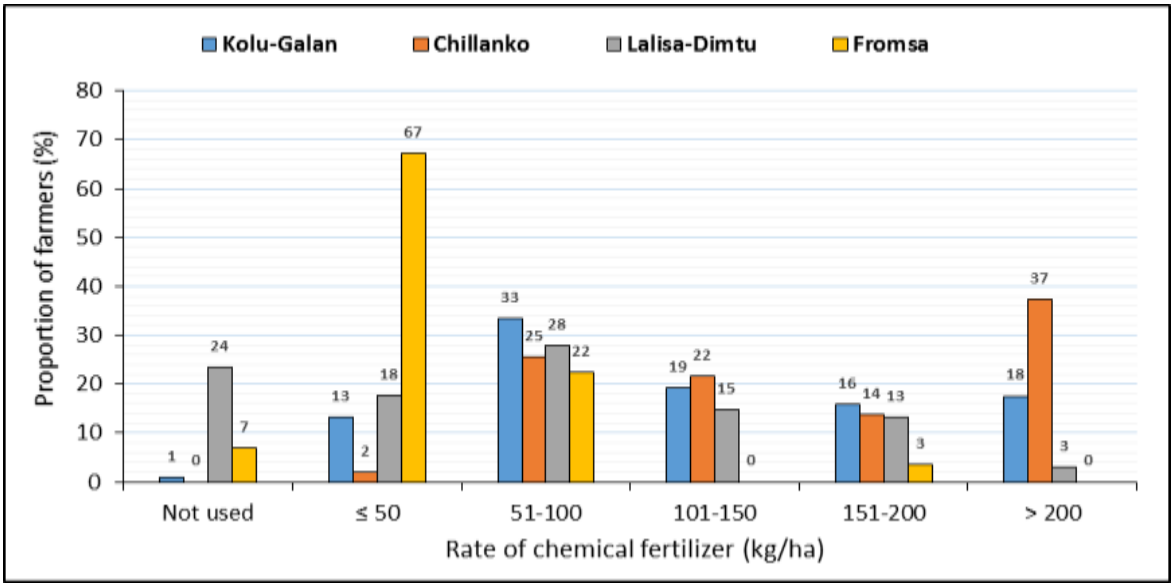

Figure 7. Proportion of farmers applied different fertilizer rates in all implementation sites

The higher rate of chemical fertilizer used in Kolu-Galan & Chillanko compared to Lalisa-Dimtu & Fromsa was due to the high fertilizer requirments of the widely cultivated Irish potato as a cash crop by the majority of farmers in the area. However, the lower rate used in Fromsa is linked to the wider use of animal manure by the majority of the farmers through the traditional coralling system.

Legume productivity

The average yield harvested from major grain legumes grown in the respective implementation sites is shown in Table 5 alongside national averages and the genetic potential of the crop. Ground nut, haricot bean and faba bean in Diga sites, and faba bean and field pea in Jeldu sites were identified as major grain legumes produced based on the frequency of farmers growing them. The result from the analysis indicates that all crops were unable to deliver the expected yield. They were delivering from 40.4% to 84.8% less than the national average yield for faba bean and haricot bean, in that order, whereas the gap was as high as 77.7% to 94.2% less for ground nut and haricot bean as compared to the crop genetic potential. Haricot bean was the least productive legume crop followed by ground nut, field pea and faba bean, in that order (Table 5).

Table 5. Current yield of major grain legumes in the implementation sites as compared to the national average and the crop potential.

Major legumes	Average yield across sites (kg/ha)	National average (kg/ha)	% less than national average	Crop potential (kg/ha)	% less than crop potential
Faba bean	980	1644	40.4	5000	80.4
Field pea	704	1280	45.0	4000	82.4
Haricot bean	192	1262	84.8	3300	94.2
Ground nut	670	1380	51.4	3000	77.7

The crop national average was taken from ***Agricultural Sample Survey bulletin, 2013***

A number of factors including lack of improved seed of the respective legume species among the farmers, high disease pressure, soil fertility degradation, lack of knowledge of different crop management options, especially on spatial and temporal arrangement of the component crops where haricot bean is intercropped with maize would have been contributed to this evident wider gap between the current yield of the crops and the national average and/or the crop potential yield.

Conclusion

The livelihood of the study areas primarily depend on the crop-livestock farming system. Legumes are a major component of this farming system in all implementation sites. Regardless of the differences in level and frequency of use, both grain, forage and/or tree legumes are cultivated in all sites. With the exception of the implementation site with lowland agro-ecology, Lalisa-Dimtu, where a very diversified range of legumes is cultivated accounting for 21% of the food crops area, the area allocated for legumes in the remaining sites was very limited. Moreover, the current productivity of grain legumes is very low ranging from 192 kg ha^{-1} for haricot bean to 980 kg ha^{-1} for faba bean, which is 40.4% to 84.8% less than the current national average yield for faba bean and haricot bean, respectively. The importance of feed shortage in the implementation sites was evident from the current significant portion of land that individual farmers are allocating for grazing purposes. This however, is at odds with the negligible portion of land cultivated for fodder production, hence matching this gap should be among one of the future intervention strategies in alleviating the existing feed shortage.