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Farming systems and forage cultivation in Western Kenya and SNNPR Ethiopia

RHoMIS baseline survey report

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Farming systems and forage cultivation in Western Kenya and SNNPR Ethiopia

RHoMIS baseline survey report

Caroline Waweru
Birthe Paul

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Napier grass is planted by farmers to prevent soil erosion in the Kenya's Tana River Basin. GeorginaSmith/CIAT

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Researchers work with farmers to measure and weigh forage grasses in field trials to find better forage feed varieties project 📷 Georgina Smith/ Alliance of Bioversity International and CIAT

1. Introduction

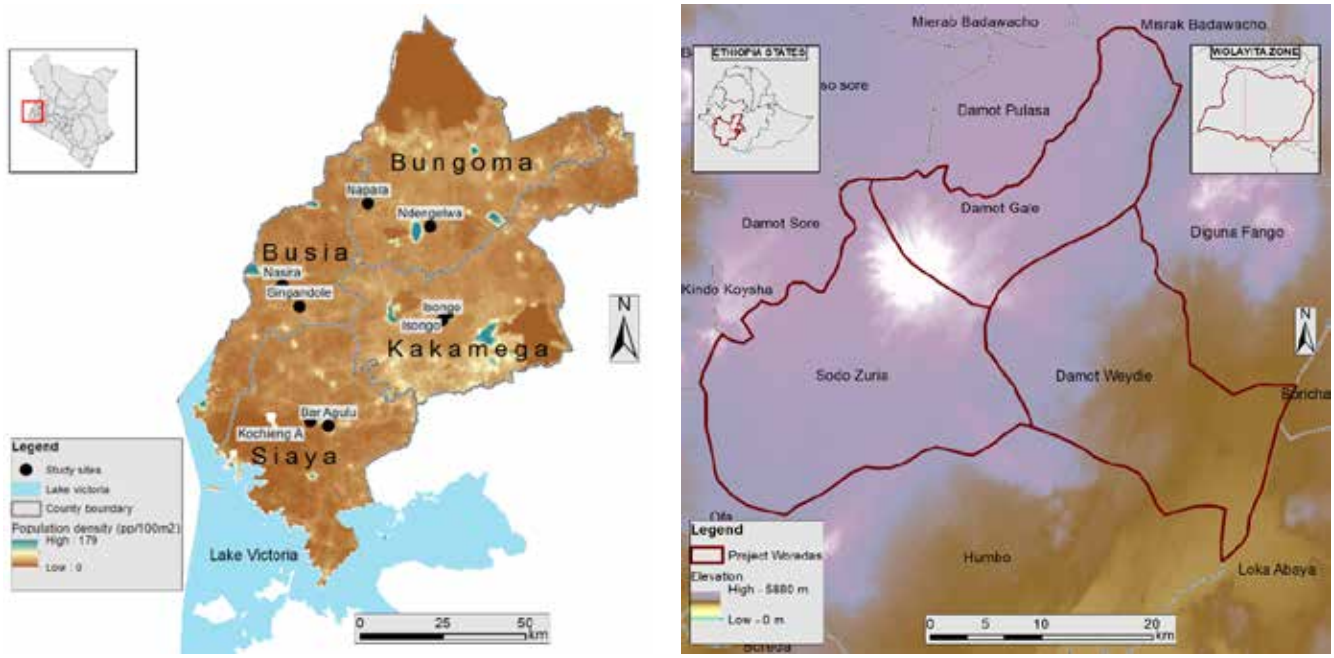
Livestock production is a key sector in Kenya and Ethiopia, and a major contributor to household income and nutrition. Besides milk and meat, livestock serves as a capital asset that acts as insurance against monetary requirement as well as a key source of farmyard manure. However, one major challenge in the sector is the inadequate livestock feeds which is vital in increasing livestock productivity (Hall et al., 2007). This may be due to the adverse effects of climate change (Hall et al., 2007), coupled with a lack of investment capacity to adopt a range of other technological changes such as improved animal breeds that go hand in hand with improved livestock feeding (Ndah et al., 2017). There is also a general lack of knowledge on the impact of improved forage technologies on livestock production (Ndah et al., 2017). Increased farmers' access to feeds is therefore vital in improving livestock productivity. The Grass2Cash project therefore aims to increase the adoption of forage technologies and management techniques for increased livestock productivity as well as increased incomes. The project covers both Kenya and Ethiopia as illustrated in Figure 1 below. Kenya has eight project sites distributed over four counties (two in each county) while Ethiopia has six project sites distributed over three woredas (two in each Woreda).

This report presents results from descriptive analysis of the baseline survey data, aiming to:

a. 'Locate' the project or demo farmers in the overall farming population;

b. Describe general farming and livestock systems, the role of dairy, feeding systems and forage cultivation

Figure 1: Maps of study counties/woredas in Western Kenya (left) and SNNPR Ethiopia (right).



Researchers work with farmers to measure and weigh forage grasses in field trials to find better forage feed varieties project together with KALRO, Send a Cow and Advantage Crops. 📷 Georgina Smith/ Alliance of Bioversity International and CIAT

2. Materials and Methods

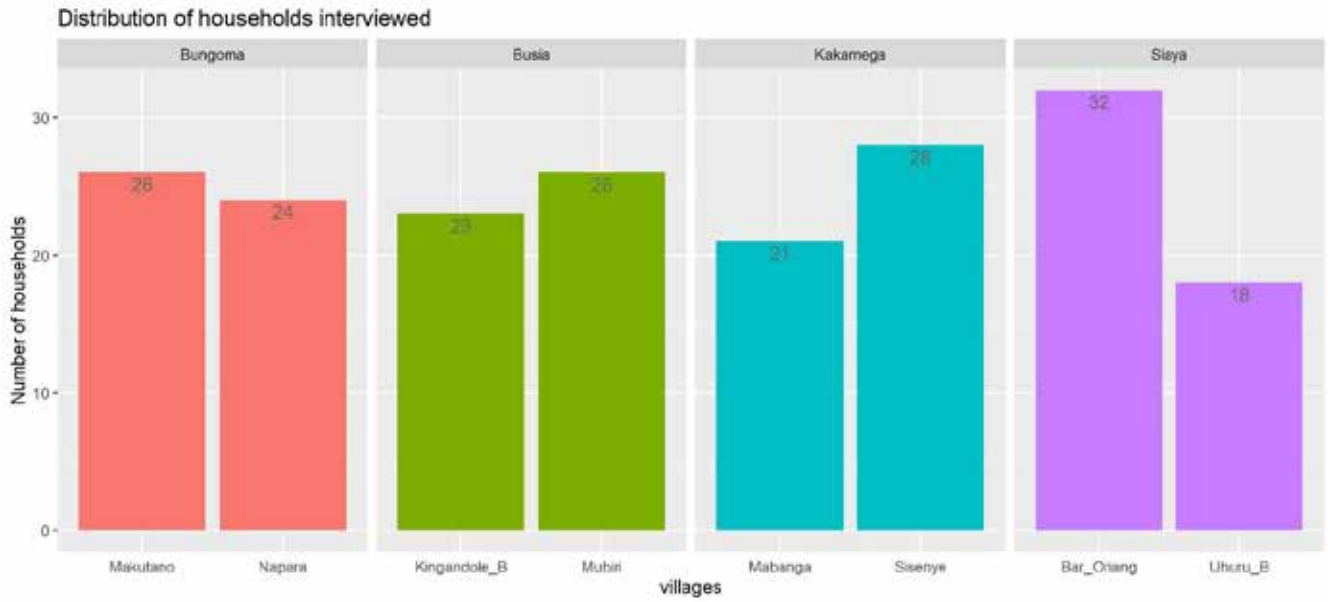
2.1 Data collection

The baseline survey was conducted between April and May 2019 in both countries where 203 and 198 farmers were interviewed in Ethiopia and Kenya respectively. The project used the Rural Household Multi-Indicator Survey (RHoMIS) tool which is a standardized digital data collection tool for interviewing smallholder farm households. Presently, over 30,000 households have been interviewed using this tool in 31 countries. An additional module on forages was added to the standard tool to help us address the project objectives.

Farmers belonged to one of two categories - demo and non-demo farmers. The demo farmers are part of project beneficiaries where they received farmer training as well as received planting materials. Their plots were used as demonstration plots with replicated trials involving all forage varieties. Each project site had at least one demo farmer, four percent demo farmers in Kenya and two percent demo farmers in Ethiopia. Various household characteristics were compared between these two groups of farmers as shown in section 3.

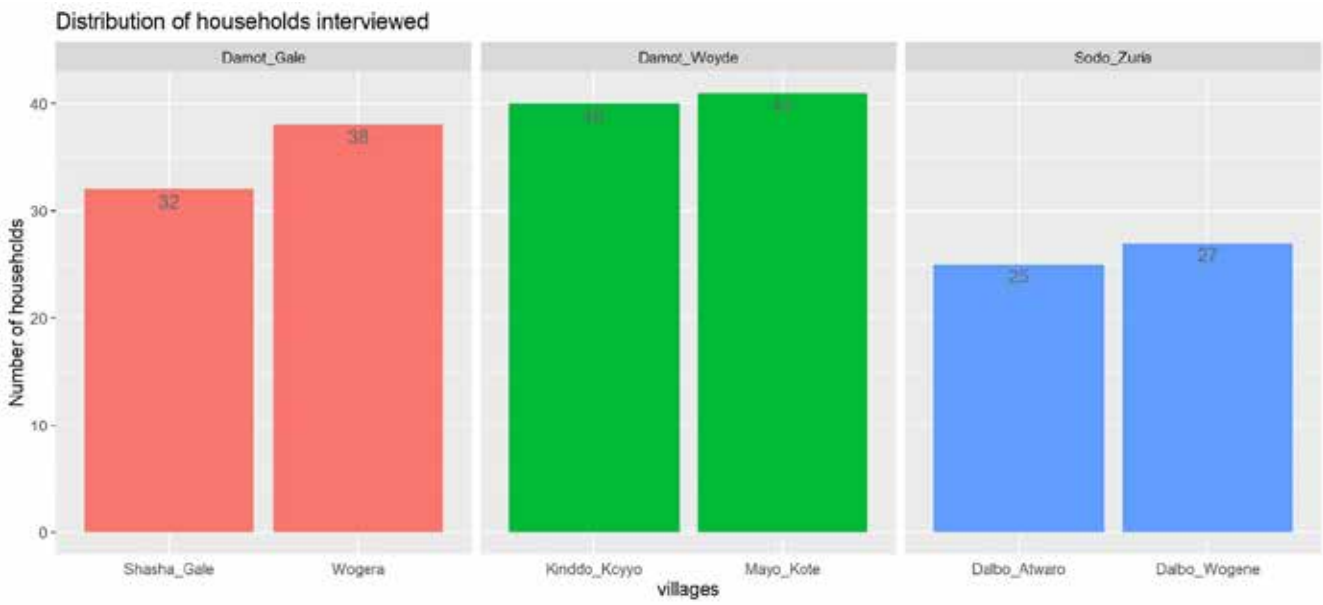
In Kenya, a total of 198 households were interviewed in eight villages during the survey. Figure 2 presents the number of households interviewed in the eight villages from four counties in Kenya. Most of the households interviewed were in Siaya and Bungoma counties with 50 households each followed by Kakamega and Busia counties which had 49 households each. Bar Oriang village had the highest number of households interviewed than the rest of the villages with Uhuru B recording the least number of households interviewed.

Figure 2: Distribution of households interviewed across villages and counties in Kenya.



203 households were interviewed in Ethiopia from Damot Gale, Damot Woyde, and Sodo Zuria Woredas (subregions). The project sites are located in six kebeles (villages) within the woredas; Shasha Gale, Wogera, Kindo Koyyo, Mayo Kote, Dalbo Atwaro, and Dalbo Wogene. The highest number of farmers were interviewed in Damot Woyde woreda while the lowest number of farmers interviewed were in Sodo Zuria.

Figure 3: Distribution of households interviewed across woredas and kebeles in Ethiopia



The datasets were published on CIAT Harvard Dataverse (Paul et al. 2020a; 2020b).

2.2 Data analysis

We first cleaned the data collected and analysed using R Version 1.4.1717 (R Core Team, 2021), data organization (Wickham, 2007; Wickham, 2021; Wickham et al., 2021 and Ren & Russell, 2021), and data visualization (Kassambara, 2020; Auguie, 2017; Wilke, 2020; Neuwirth, 2014; Wickham, 2016; Wickham and Seidel, 2020) packages.

Dennis Nyongesa and his wife have boosted his milk yield and income since using new grass varieties introduced by the Grass to Cash project. 📷 Georgina Smith/ Alliance of Bioversity International and CIAT

3. Comparison between demo and non-demo farmers

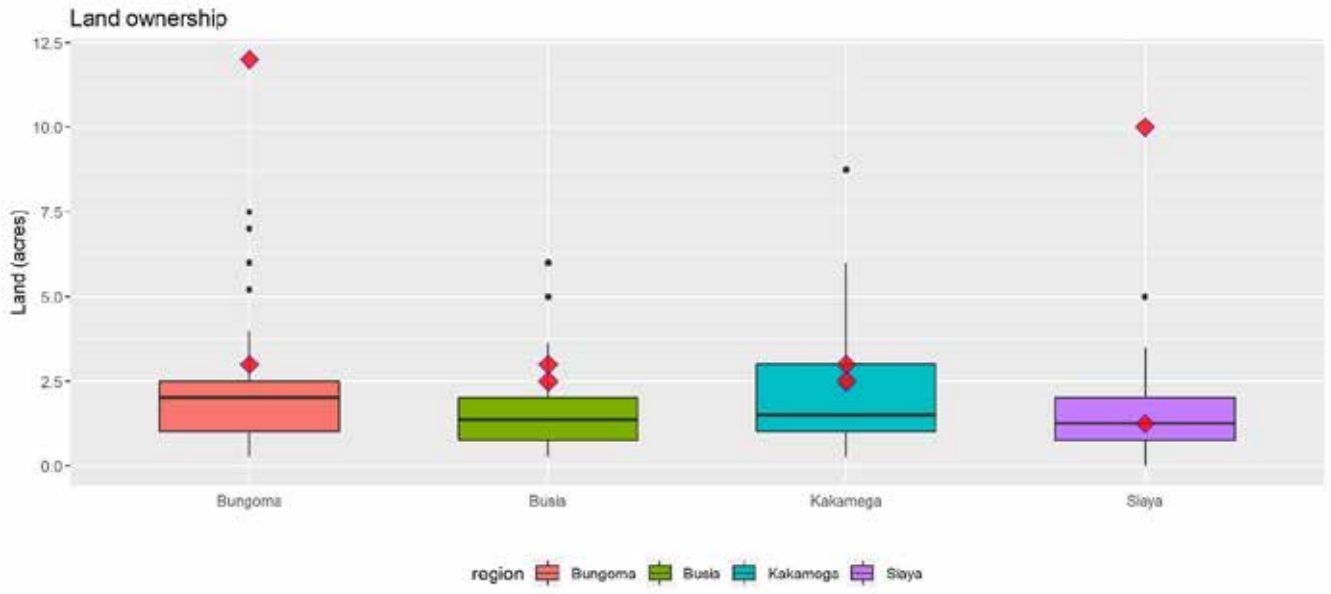
This section compares the household characteristics between demo and non-demo farmers, aiming to 'locate' the demo farmers within the wider farming systems population.

3.1 Kenya

Land size and cattle feeding systems

Figure 4 compares the size of **land owned** by demo farmers with that of non-demo farmers in Bungoma, Busia, Kakamega, and Siaya counties. Generally, the demo farmers have a higher median land owned as compared to the non-demo farmers in all the counties. It is important to note that among the demo farmers the *n* was only two for each county. Among the non-demo farmers, Bungoma had the highest median land owned (two acres) while Siaya had the lowest median land owned (1.25 acres). Bungoma recorded a farmer with the highest land owned (12 acres) and was followed by a farmer in Siaya (ten acres) who were both demo farmers. Among the non-demo farmers, the farmer with the highest land owned (8.75 acres) was in Kakamega County.

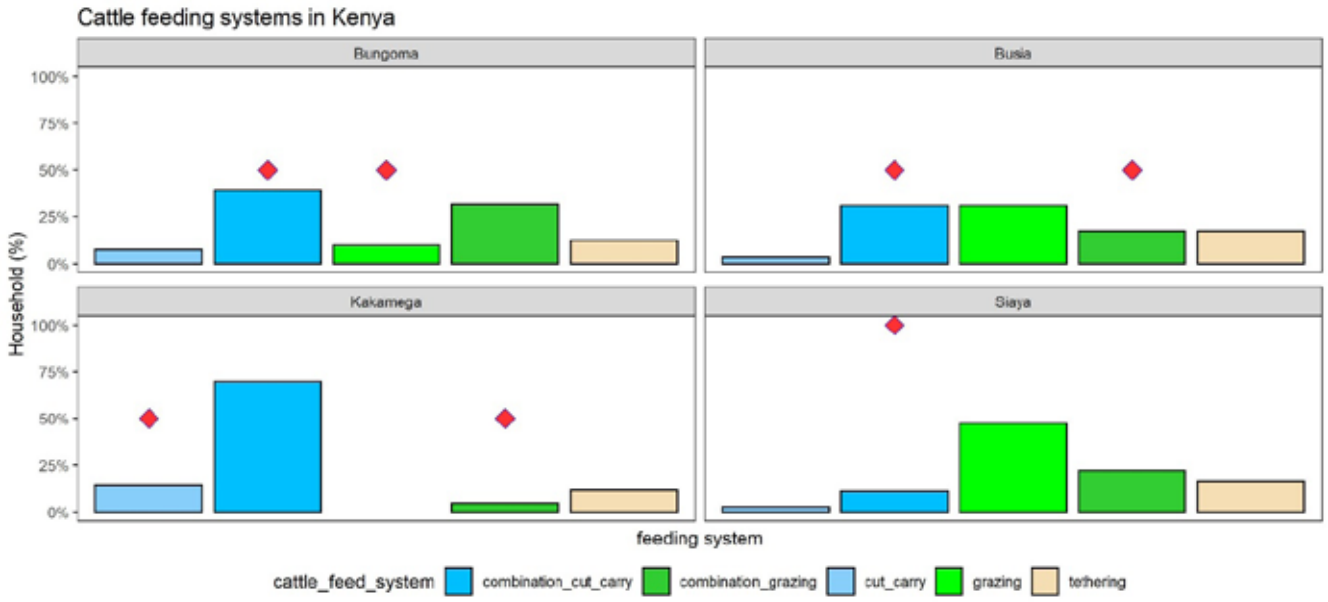
Figure 4: Land ownership across counties in Kenya. Demo farmers are represented by red diamonds.



We further compared the **cattle feeding system** for demo and non-demo farmers in Kenya as shown in Figure 5. The cattle feeding systems were categorized into five categories (i) grazing, (ii) tethering, (iii) cut and carry, (iv) combination grazing, and (v) combination cut and carry. The cut and carry system is also known as zero-grazing, where farmers cut fresh grass daily and feed their sheltered cattle. Combination cut and carry is a mix of more than one feeding system, but the cut/carry is predominant. Combination grazing refers to the use of more than one feeding system, but grazing is more dominant.

Both farmer categories prefer using a combination cut carry system compared to other types of feeding systems. Non-demo farmers also indicated the use of tethering as cattle feeding system which is not used by the demo farmers.

Figure 5: Cattle feeding systems by county in Kenya. Demo farmers are represented by red diamonds.



Other household characteristics

We asked the **highest level of education** completed by household heads which we then assessed based on the farmer categorization in different counties. In Bungoma and Siaya, the demo farmers had higher education levels than most farmers (secondary), but not so in Busia and Kakamega. The majority of non-demo farmers indicated primary education as their highest level of education. Among the non-demo farmers, Bungoma has the highest percentage of farmers with secondary education (35%) while Kakamega has the highest percentage of farmers with post-secondary education (19%). Siaya recorded the lowest percentage of farmers with secondary (4%) and post-secondary education (4%) and the highest percentage of farmers with no schooling (33%) among the non-demo farmers.

Figure 6: Highest level of education completed by household head across counties in Kenya. Demo farmers are represented by red diamonds.

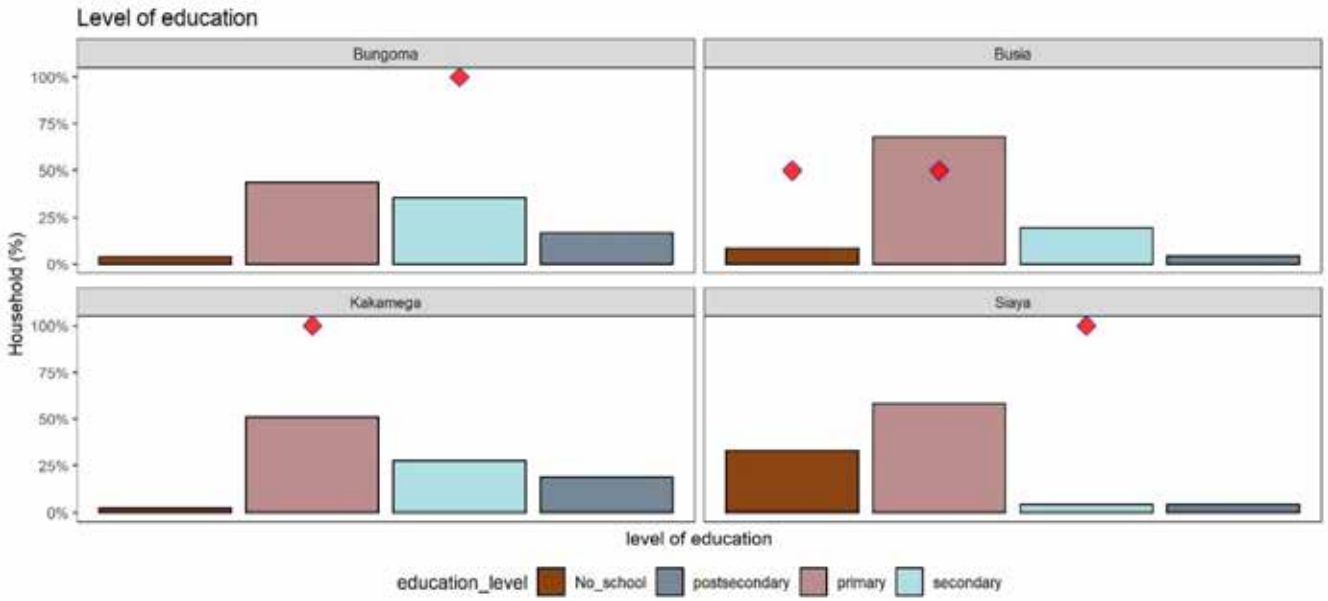
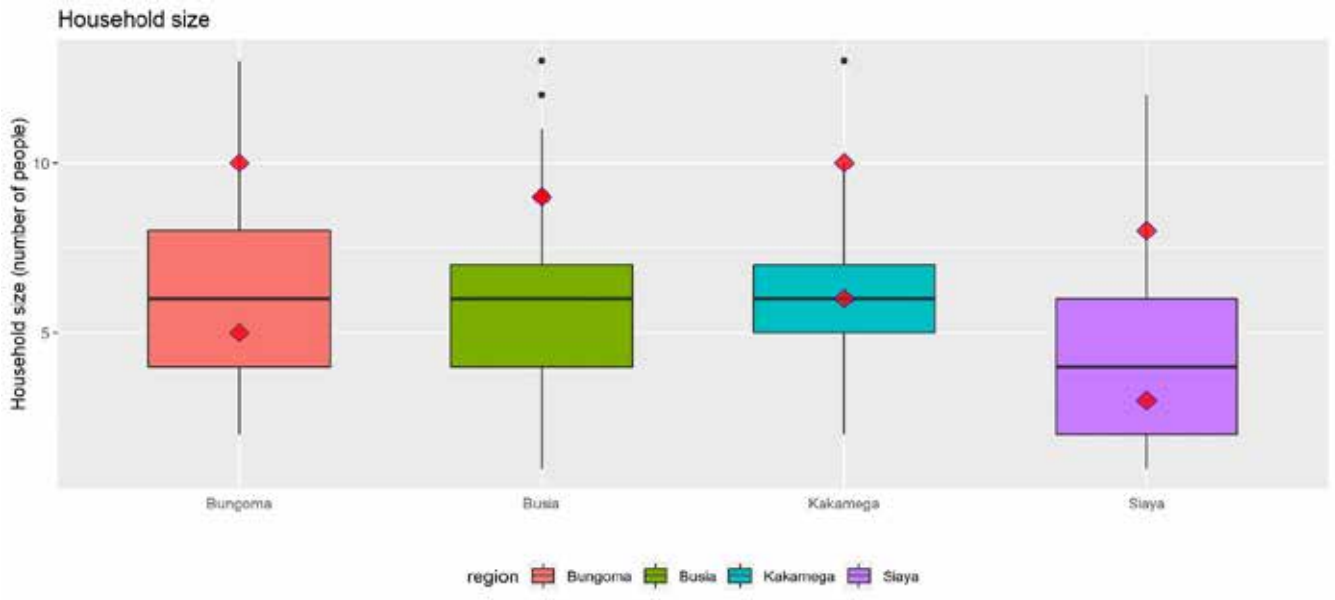


Figure 7 shows **household size** for farmers in different counties. The demo farmers have a higher median household size as compared to the non-demo farmers in all the counties. Among the demo farmers, the largest household size was recorded in Bungoma and Kakamega (10) while the smallest household size was recorded in Siaya (3). Interestingly, among the non-demo farmers, Bungoma, Busia, and Kakamega counties have the same median household size (6). Siaya County has the lowest median household size (4) while Kakamega County recorded the largest household size (14) closely followed by Busia County (13).

Figure 7: Household size across counties in Kenya. Demo farmers are represented by red diamonds.



The **age of the household head** ranged between 18-87 years among female headed households and 15-83 years among male headed households. This was further analysed based on farmer categories across all the counties. The demo farmers seemed to have relatively older female heads compared to most of the households in Kakamega county while they were more comparable to most farmers in Busia County. Siaya County recorded the highest median age for the female heads among the non-demo farmers (57.5 years) and the oldest female head among the demo farmers (63 years). Siaya County also recorded the oldest female head (87 years). The youngest male head was in Bungoma County (15 years) while the oldest male head was in Kakamega County (83 years).

Figure 8: Age of female head across counties in Kenya. Demo farmers are represented by red diamonds.

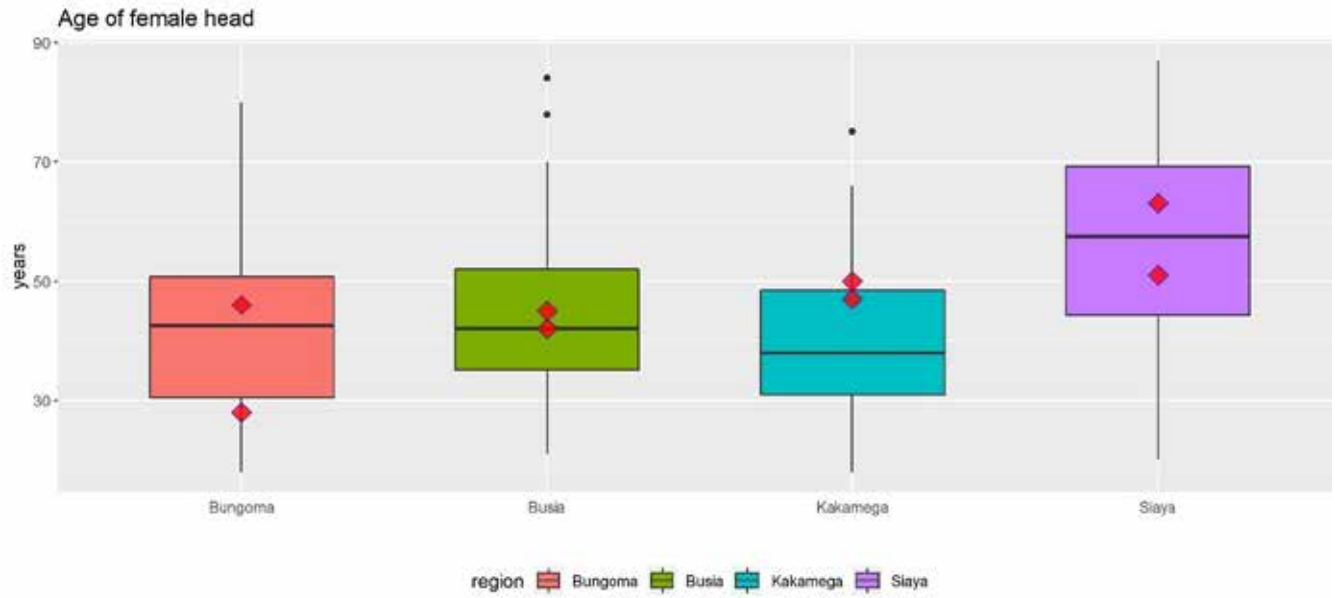
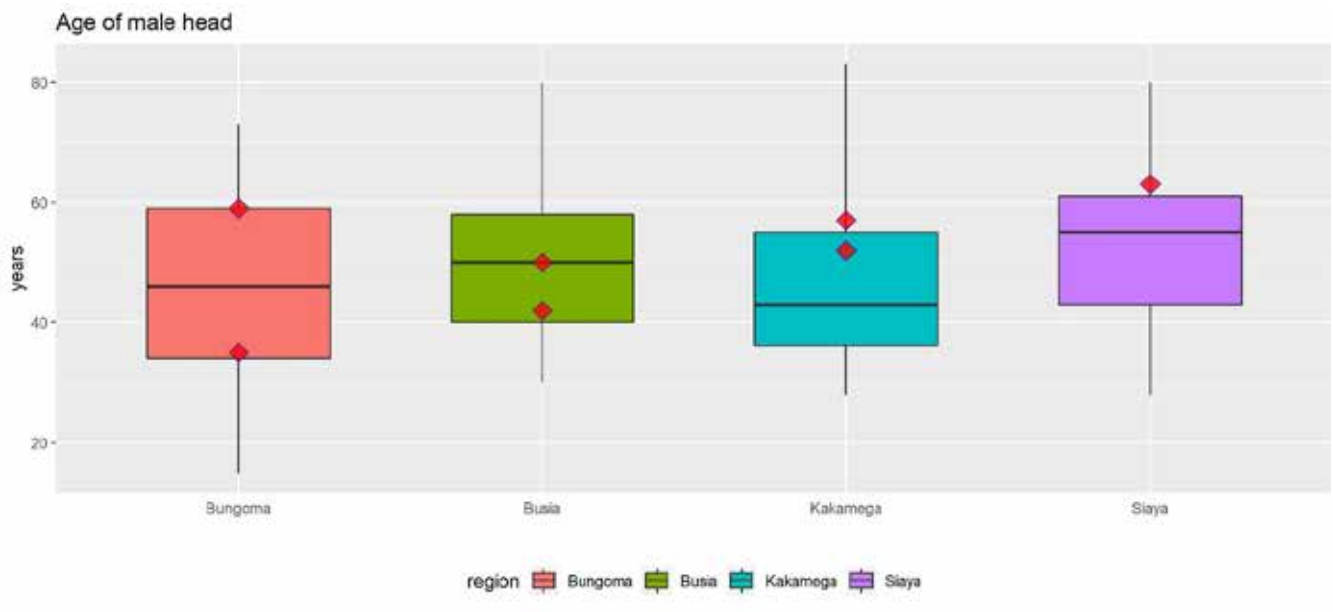


Figure 9: Age of male head across counties in Kenya. Demo farmers are represented by red diamonds.

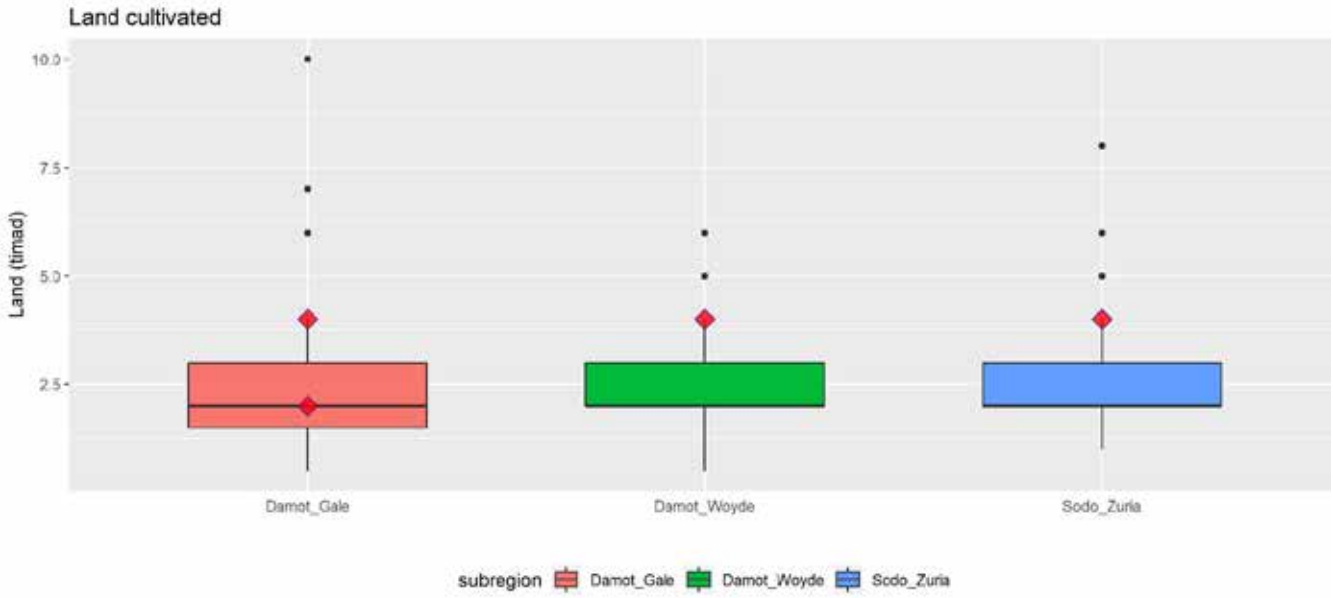


3.2 Ethiopia

Land size and cattle feeding systems

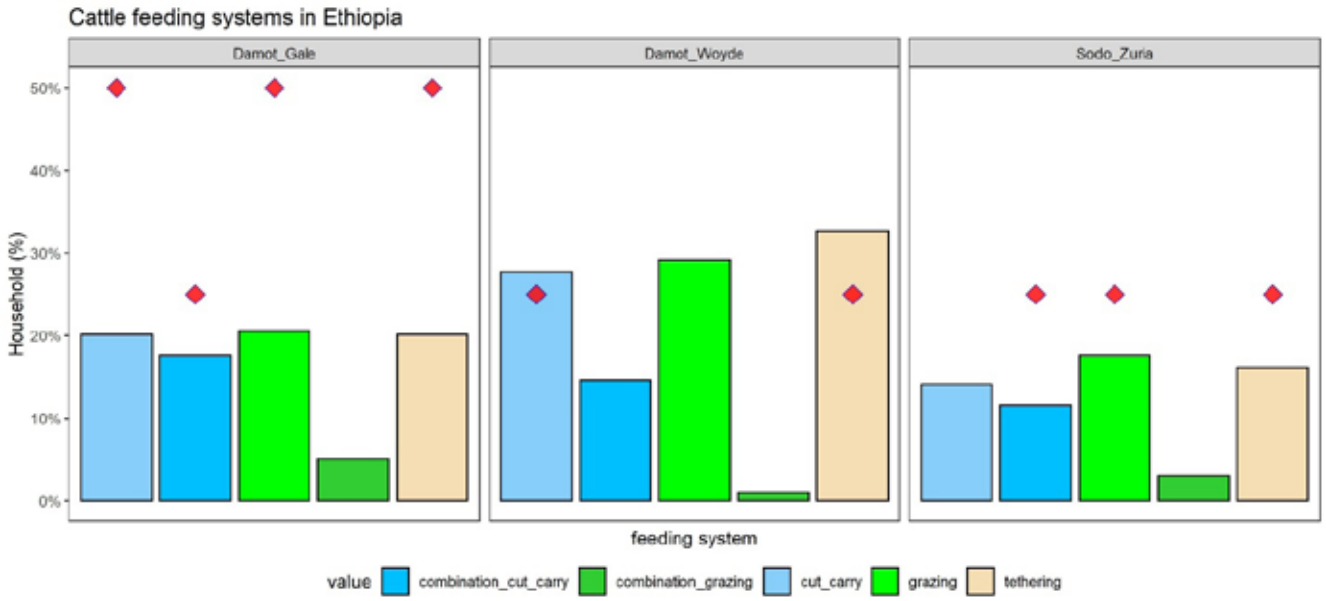
In Ethiopia, land was measured in timad. The median land size cultivated per household was higher among the demo farmers (four timad) compared to non-demo farmers (two timad) with the highest variation in Damot Gale. Damot Gale also recorded the farmer with the highest land cultivated (ten timad).

Figure 10: Land cultivated by surveyed farmers across woredas in Ethiopia. Demo farmers are represented by red diamonds.



The cattle feeding systems were compared between demo and non-demo farmers. Combination grazing was only used by the non-demo farmers while grazing was used by both the demo and non-demo farmers. The demo farmers in Damot Gale used a greater number of systems (4) as compared to Damot Woyde (2). Tethering and cut carry feeding systems were used by both the demo and non-demo farmers.

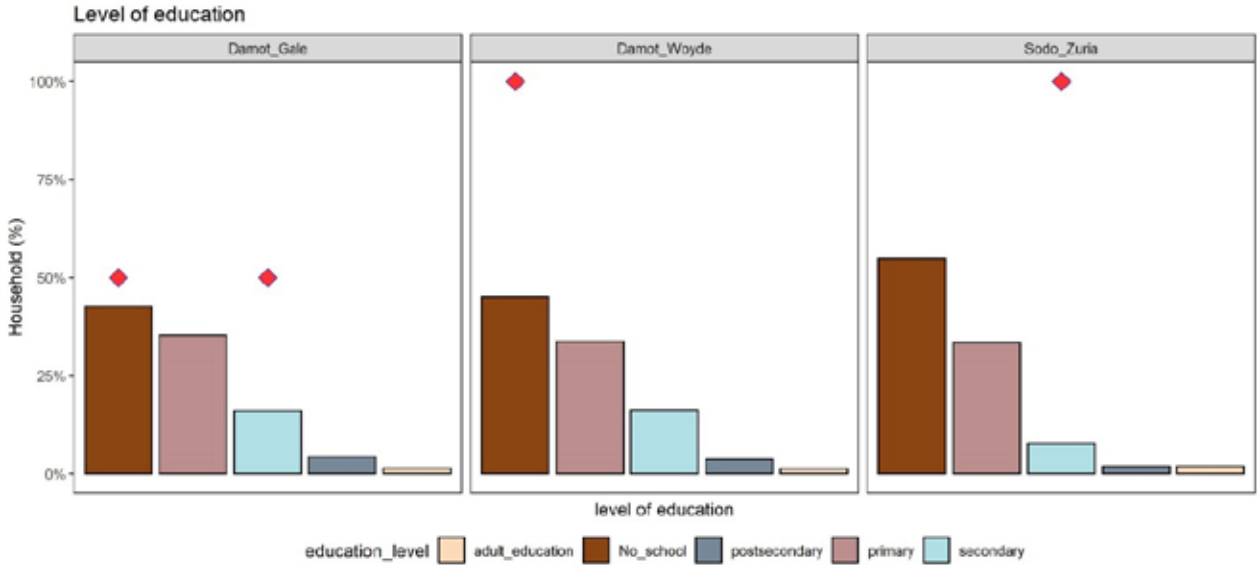
Figure 11: Cattle feeding systems across woredas in Ethiopia. Demo farmers are represented by red diamonds.



Other household characteristics

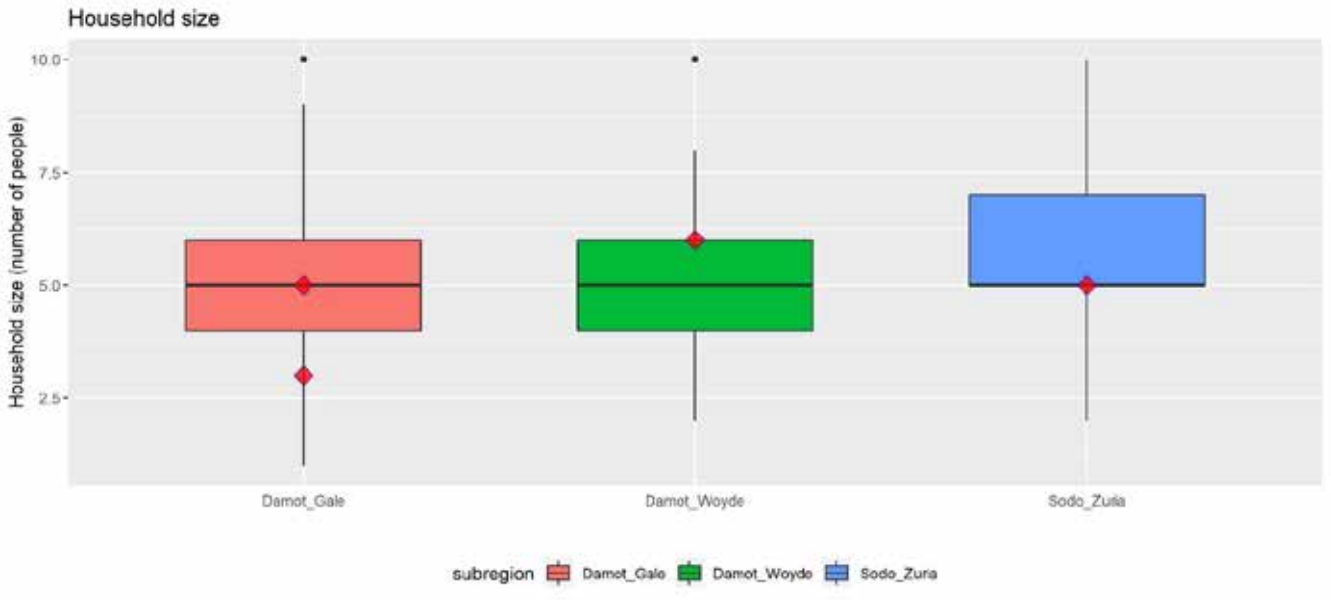
The **highest level of education** attained by the household heads was compared between demo and non-demo farmers for all the regions as illustrated in Figure 12 below. The demo farmers were similar to most of the farmers in Damot Gale and Damot Woyde with no education but the demo farmer in Sodo Zuria was more educated (secondary education) than most of the farmers in the woreda. Damot Gale also had one demo farmer with secondary education which was higher than what most farmers had attained in the region. The majority of the non-demo farmers had no schooling with Sodo Zuria having more than 50% with no education. Primary education was attained by 35% of the households in Damot Gale, 34% in Damot Woyde, and 33% in Sodo Zuria. Very few households (< 5%) had attained postsecondary education in each of the three woredas. Adult education was also not common in the regions where farmers were interviewed.

Figure 12: Level of education across woredas in Ethiopia. Demo farmers are represented by red diamonds.



The **household size** for the demo farmers in Damot Gale and Sodo Zuria was similar to the majority of the farmers in those regions. The median household size for the non-demo farmers was five for each of the woredas with ten people per household being the largest household size. Damot Gale had the smallest household size of one person while Sodo Zuria had relatively larger household sizes compared to the other woredas.

Figure 13: Household size across woredas in Ethiopia. Demo farmers are represented by red diamonds.



The female heads among the demo farmers were younger than most of the farmers in Damot Gale and Sodo Zuria while in Damot Woyde, they were older than most of the households in the region. Similarly, the male heads among the demo farmers were older than majority of the households in Damot Woyde. The oldest female head was 70 years in each of the three woredas as shown in Figure 14 and 15. The male heads recorded the oldest household head (85 years) as well as the youngest household head (18 years). The male heads were generally older than their female counterparts in all the woredas.

Figure 14: Age of female head across woredas in Ethiopia. Demo farmers are represented by red diamonds.

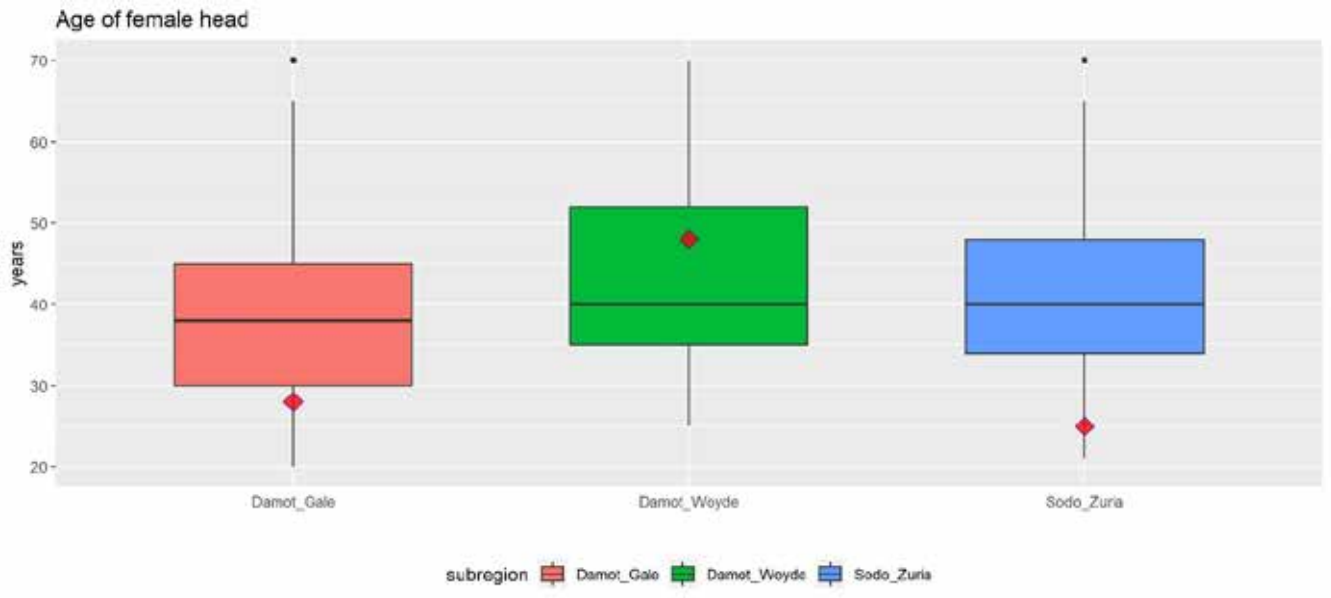
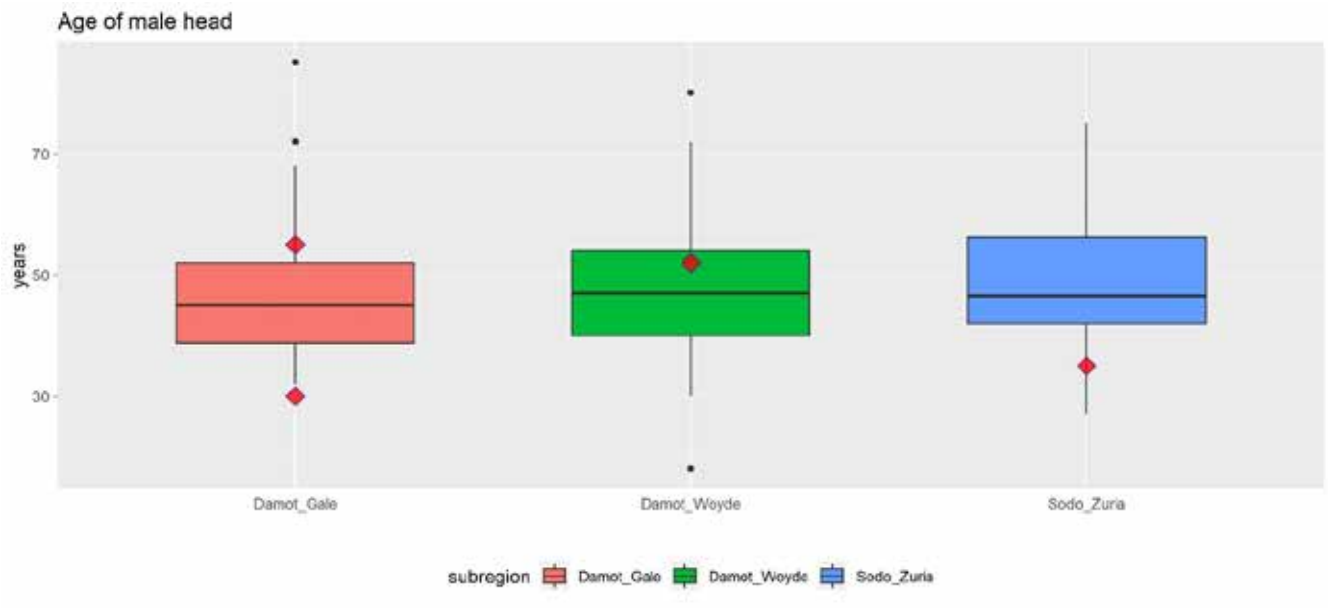


Figure 15: Age of male head across woredas in Ethiopia. Demo farmers are represented by red diamonds.



Desho and Napier grass grown next to each other in a contour in SNNPR, Ethiopia. An Notenbaert/CIAT

4. Characterization of forage cultivation, livestock production and feeding systems

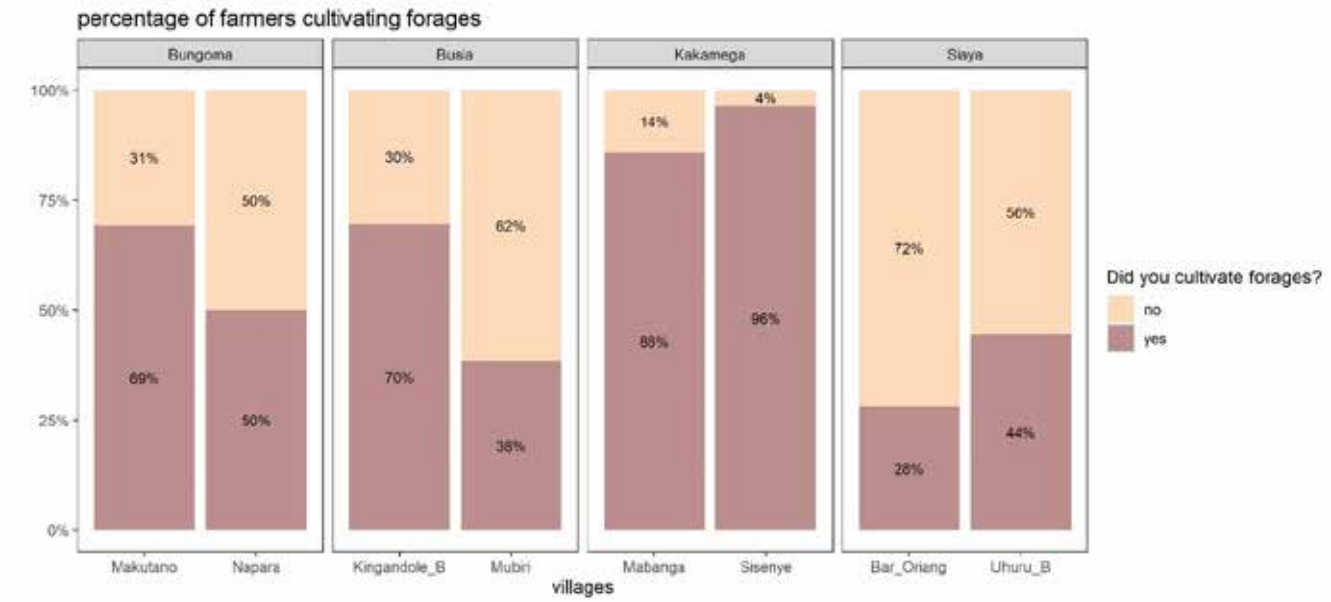
This section describes forage cultivation, livestock production and feeding systems in our project sites.

4.1 Kenya

Forage cultivation

Majority of the farmers in Kenya (60%) cultivated forages. Figure 16 shows the result of the survey where interviewed farmers were asked whether they cultivate forages or not. Kakamega County has the highest forage cultivators in both Sisenye and Mabanga villages. Project sites with less than 50% forage cultivators include Napara (50%), Mubiri (38%), Bar-Oriang (28%), and Uhuru-B (44%). The lowest forage cultivators were from Siaya County (Bar-Oriang).

Figure 16: Percentage of farmers cultivating forages in the project villages in Kenya.



In Busia, Kenya new grasses introduced in the Grass to Cash project are boosting milk yields. 📷 Georgina Smith/Alliance of Bioversity International and CIAT

a. Forage grown

Figure 17 shows the types of forages cultivated by the non-demo farmers. Majority of the households cultivate Napier grass followed by Mulato II and other types of forages. Figure 18 illustrates forage cultivation for the three most common types of forages across the regions. Napier was the most common cultivated forage across all the regions with Kakamega having significantly more households cultivating the forage. It is important to note that Siaya had the lowest number of households cultivating

Napier grass probably because it also had the lowest percentage of forage cultivators.

Figure 17: Types of forages cultivated in Kenya.

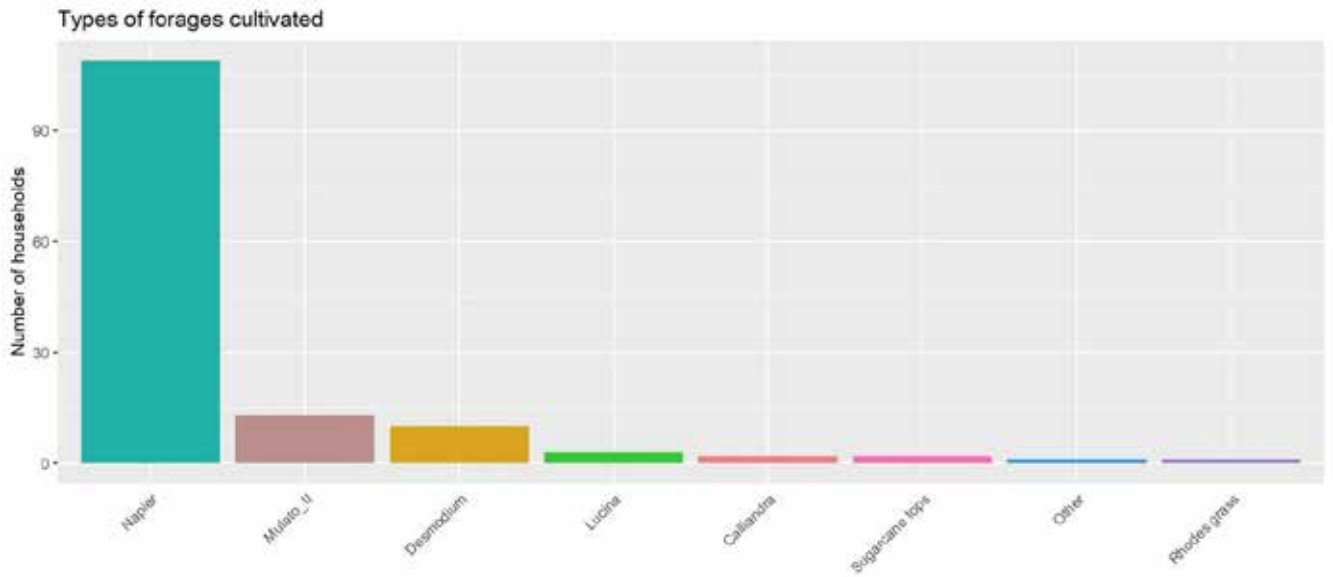
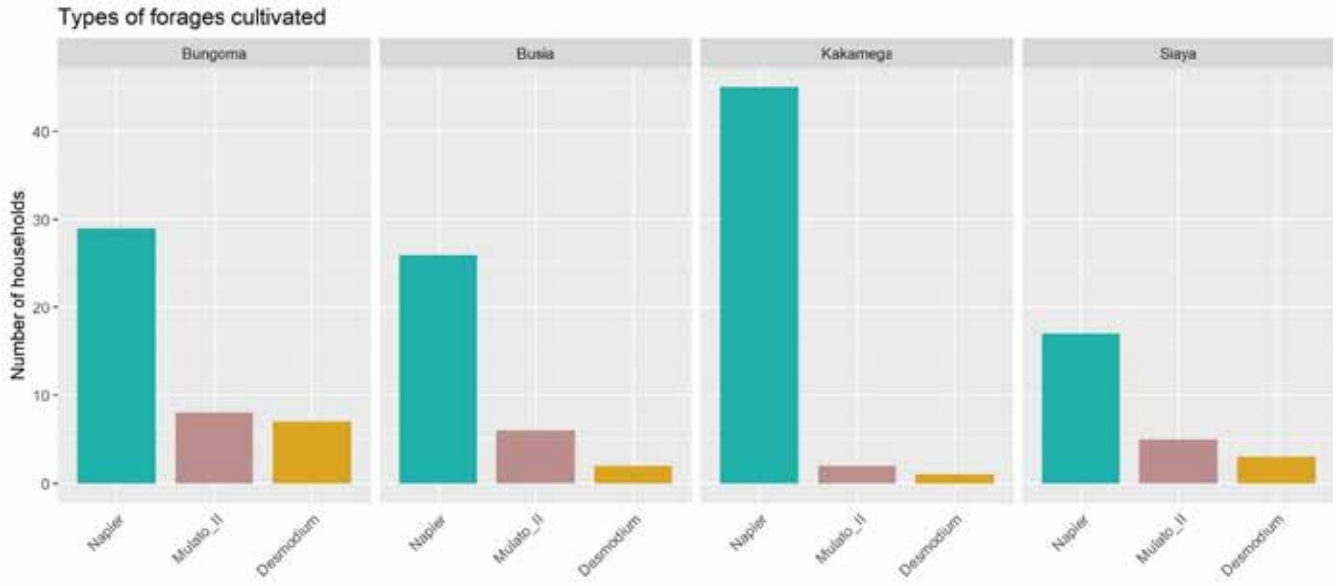
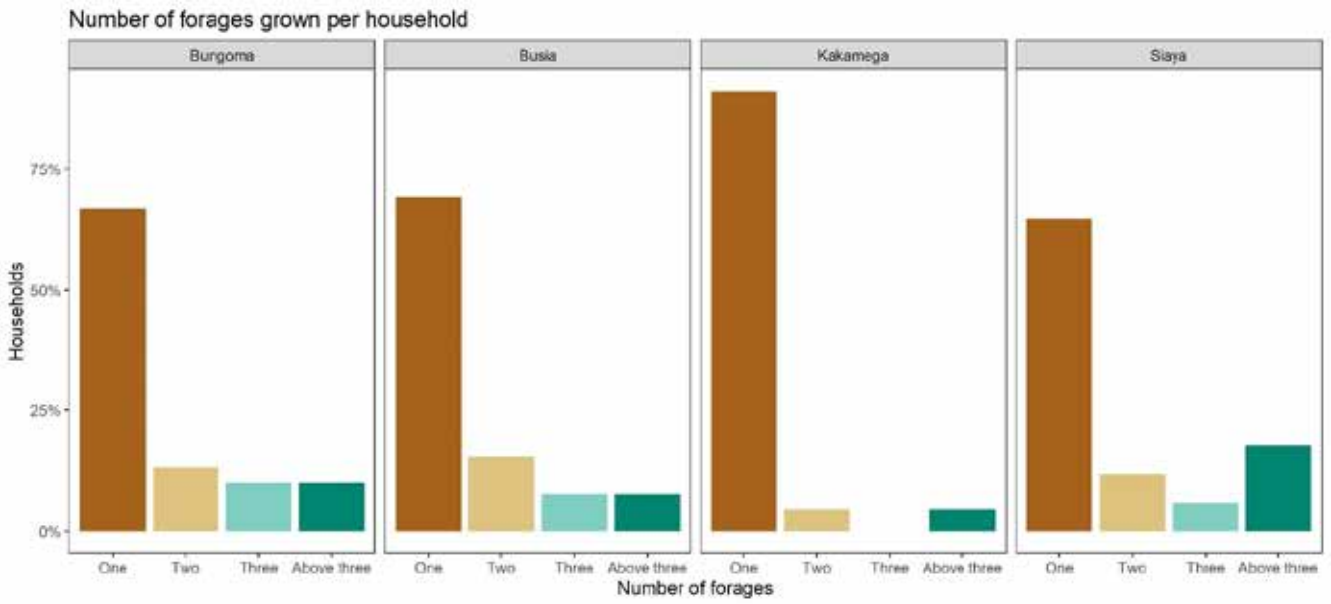


Figure 18: Types of forages cultivated per county in Kenya.



We further looked at the number of forages cultivated per household. Most farmers were cultivating three types of forages or less, with substantially higher number of farmers cultivating only one forage. Kakamega County had the highest percentage of households cultivating one type of forage. The proportion of households cultivating one type of forage ranged between 64-69%. Interestingly, Siaya had the highest percentage of farmers cultivating above three forages.

Figure 19: Number of forages grown per household across counties in Kenya.



Farmers were asked about the sources of planting materials for forages. Most farmers indicated that they acquired planting materials from friends and relatives (86%) since we assume it is the cheapest and most convenient way of acquiring planting materials. However, others noted that they acquired planting materials from research organizations, NGOs, and extension officers. Extension officers (4%) were cited as the least source of planting materials farmers used. We further compared how farmers acquired planting materials in Kakamega, Bungoma, Busia, and Siaya counties. The majority of farmers in Kakamega County indicated they acquired planting materials from friends and relatives, and research organizations compared to Bungoma and Busia county farmers who rely on families, friends, NGOs, and research organizations. However, farmers in Siaya county rely mostly on NGOs and the only county that acquired planting materials from extension officers as illustrated in Figure 20.

We further asked farmers whether the planting material acquired was vegetative or seeds while cultivating Napier, Mulato II, and Desmodium. Figure 21 indicates most farmers use vegetative planting material in cultivating Napier grass (a few questionable responses indicated seed as the planting material but we filtered them in the graph) and use seeds in cultivating Mulato II and Desmodium forages.

Figure 20: Source of forage planting material per project village in Kenya.

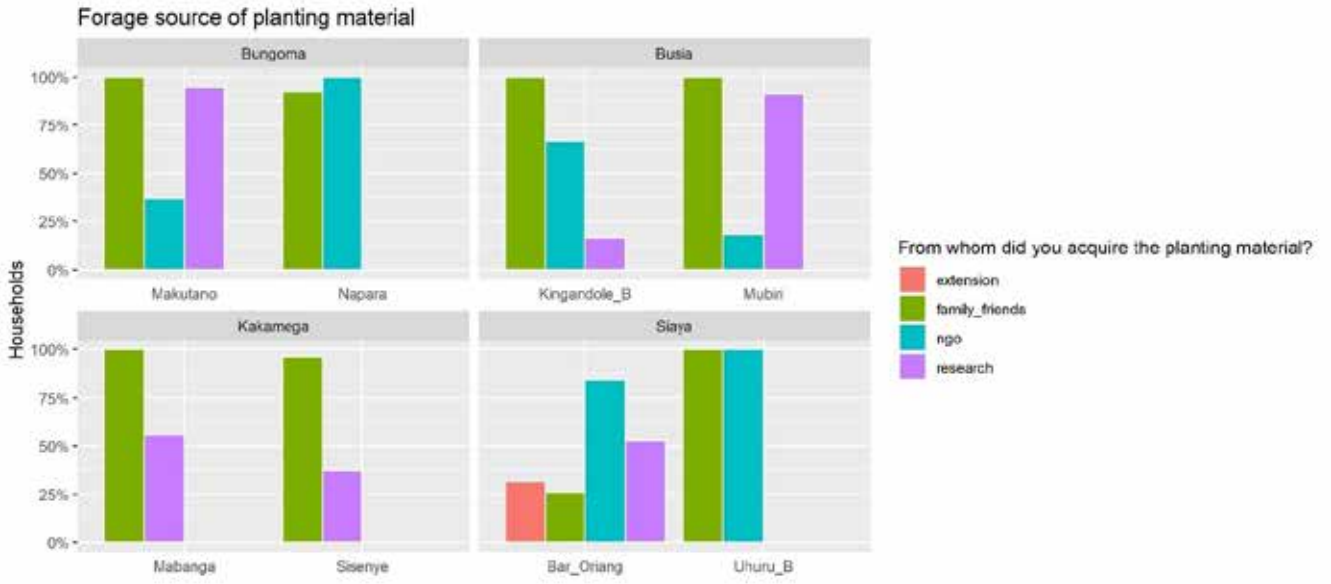
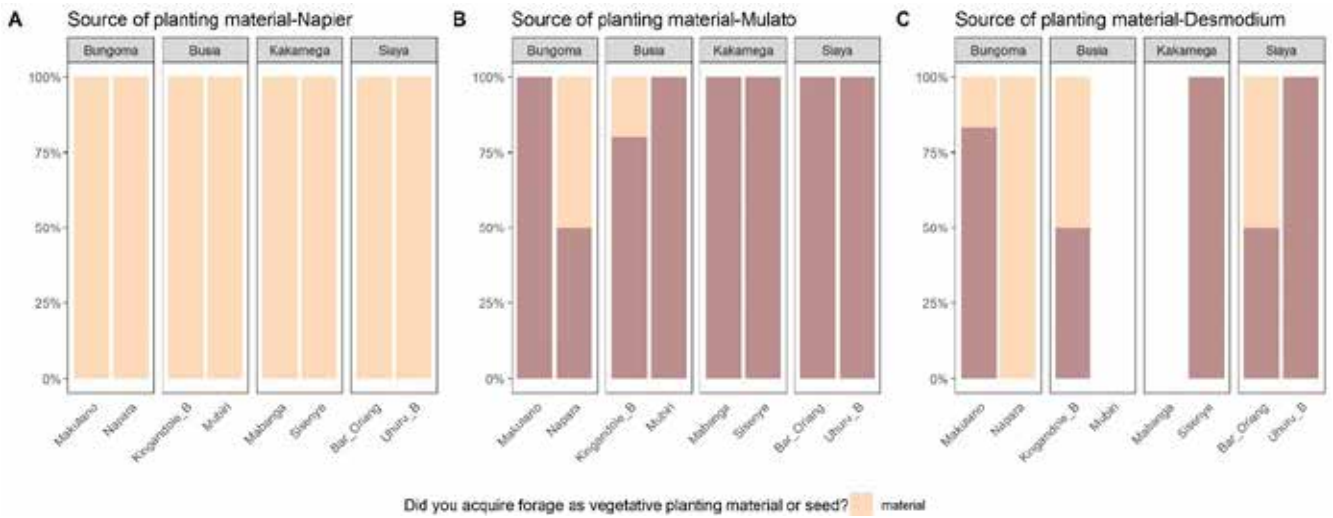


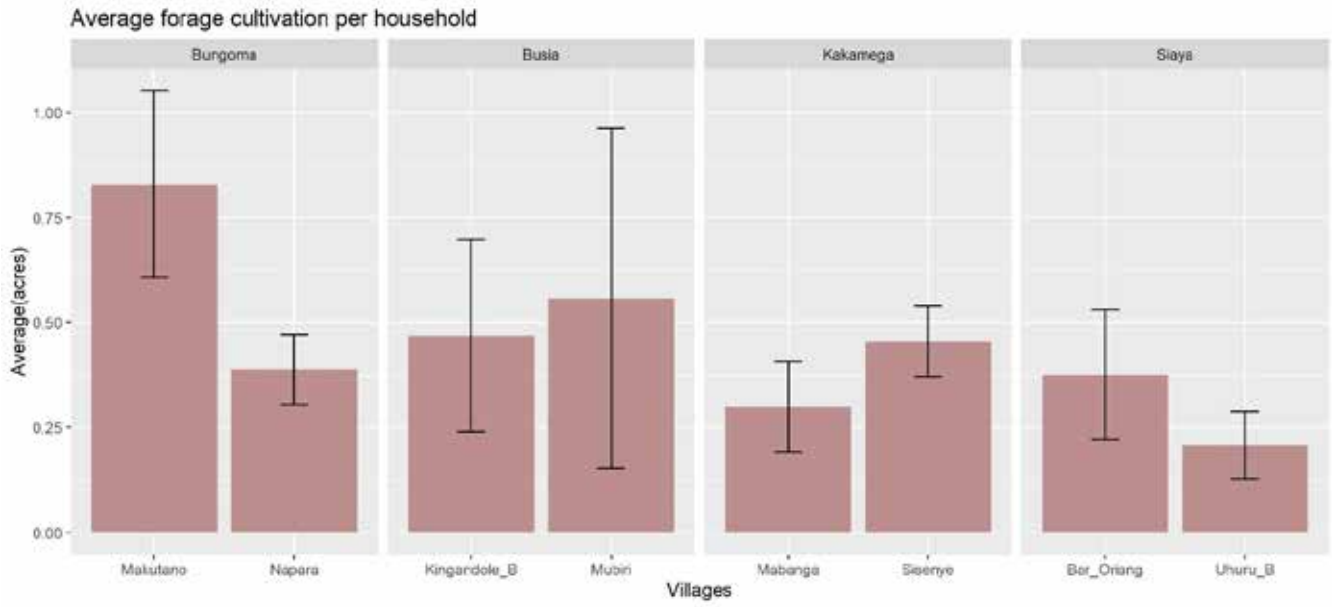
Figure 21: Use of vegetative planting material vs. seeds for the most common types of forage in Kenya.



b. Forage acreage

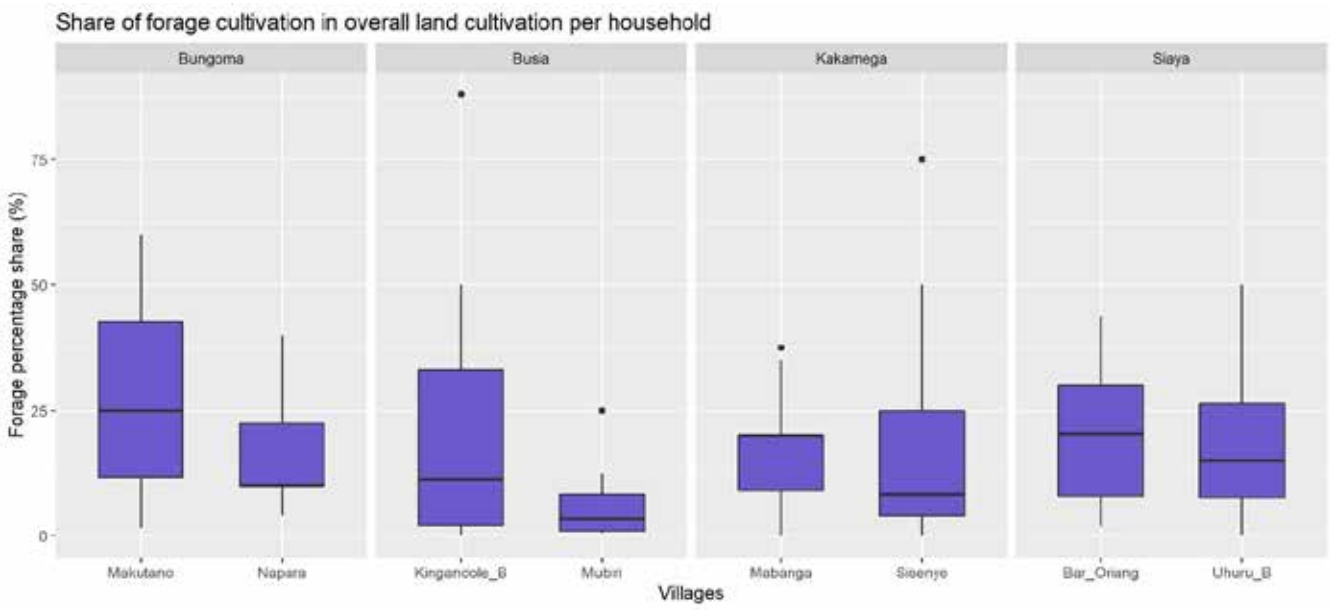
We compared the average farm size used for cultivating forage in each project site. Each of the project sites was cultivating forage on less than one acre (average) of land. Most farmers cultivate forages on over 0.25-acre land with Makutano (Bungoma) farmers cultivating on over 0.75 acres of land and Uhuru-B (Siaya) farmers cultivating on the least piece of land; less than 0.25 acres. Mubiri had a greater variation compared to the other project sites.

Figure 22: Average forage cultivation area per household across villages n Kenya.



The average share of forage cultivation in overall land cultivation per household varied in various counties. Farmers in Makutano (Bungoma) allocated more land to forage cultivation compared to other villages across all the project sites. The median share of land allocated to forage was 25%, substantially higher than villages in Siaya, Busia and Kakamega, where the proportion of cultivated land allocated to forage was less than 20 percent. However, some farmers in Busia and Kakamega had committed more than 75% of their land to forage cultivation. For instance, a farmer in Kingandole B village apportioned 87.5 % of the land to forage cultivation while a farmer in Sisenye village allocated 75% of his land to forage cultivation.

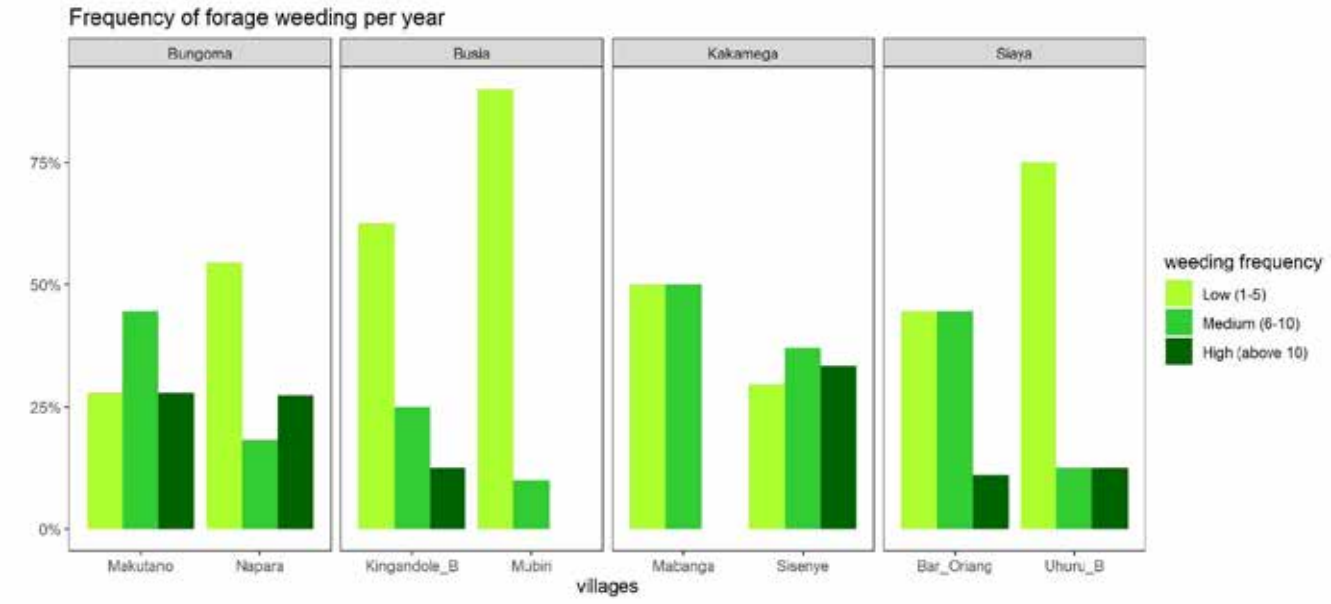
Figure 23: Share of forage cultivation in overall land cultivation across villages in Kenya.



c. Forage management and harvesting

As illustrated by Figure 24 and 25, farmers in Kakamega, Busia, Bungoma, and Siaya counties use various methods to manage forages. The methods most used are forage weeding and fertilizer application. Majority of the households have a low weeding frequency (one to five times) per year and a few others with a high weeding frequency (above 10). Sisenye (Kakamega) highly practice forage weeding followed by Makutano and Napara of Bungoma County while Busia and Siaya counties rarely practice forage weeding.

Figure 24: Annual frequency of forage weeding across villages in Kenya.



The majority (74%) of farmers applied fertilizer on their forage. Kakamega County farmers highly use fertilizer application as forage management with both villages within Kakamega having 88% of households applying fertilizer. Siaya County had the lowest percentage of households applying fertiliser on their forage. The various types of fertilizers farmers use include manure, D-Compound, Urea, DAP, and CAN. Farmers from different households prefer using manure to other inorganic fertilizers.

Figure 25: Percentage of farmers applying any type of fertilizer on forages across villages in Kenya.

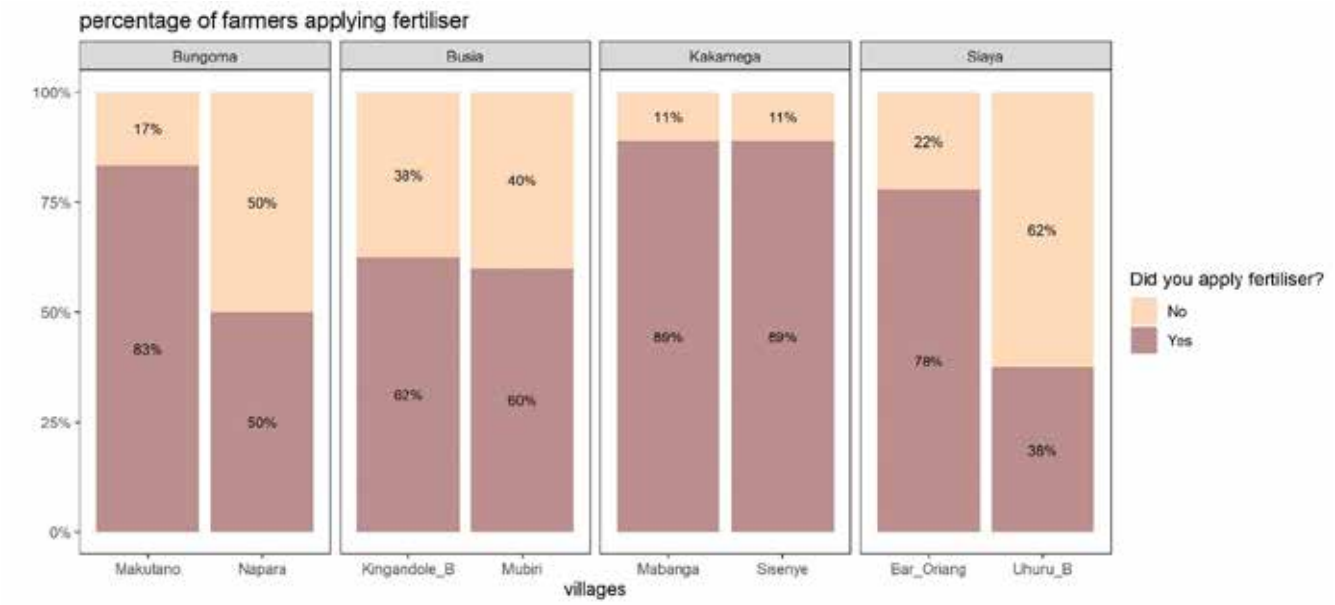
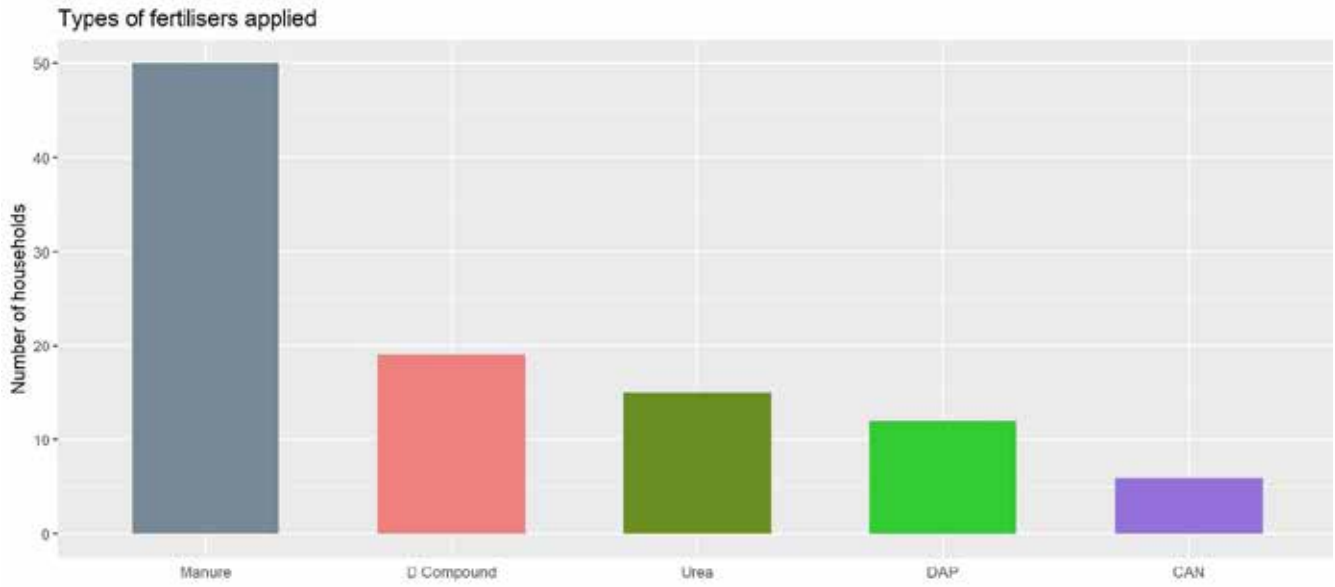
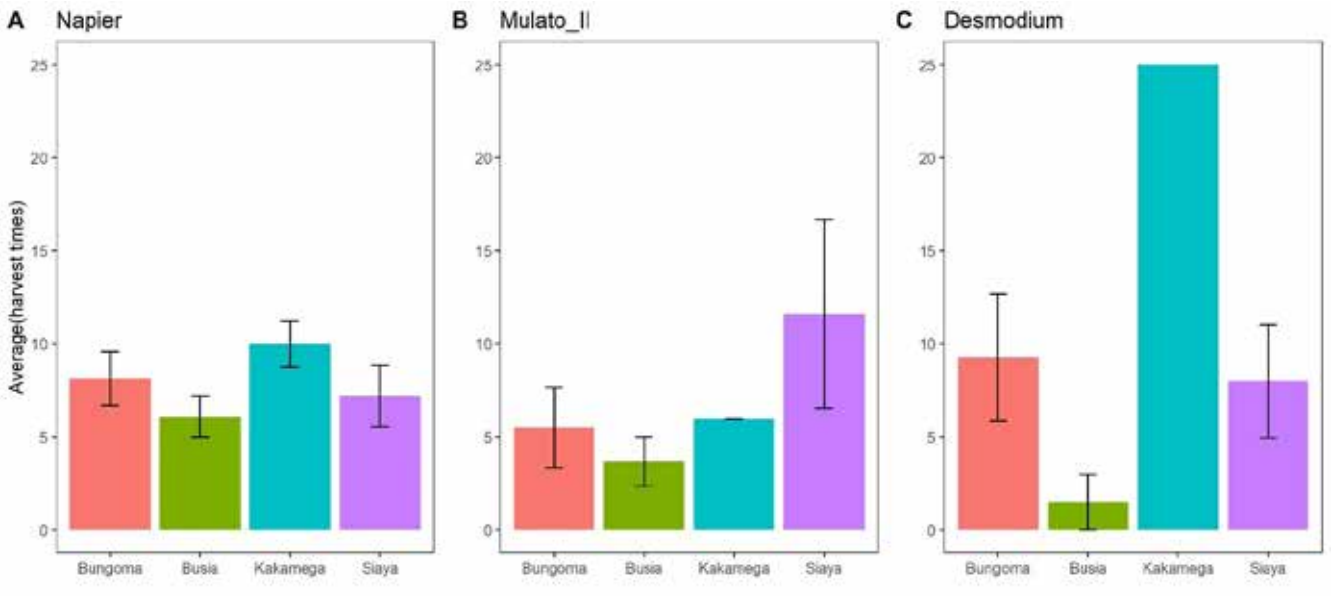


Figure 26: Types of fertilizer applied on forages in Kenya.



The following harvesting cycles are for forage owned by more than 10% of the households cultivating forage. The interviewed households have different harvesting cycles as illustrated in the graph below that shows the frequency in which farmers harvest forages. Generally, farmers harvest all forages more than five times annually, highly harvesting Desmodium (nine times), Napier grass (eight times) then Mulato II (seven times). Napier, Mulato II, and Desmodium forages are highly harvested in the four counties. Interestingly, Desmodium was highly harvested in Kakamega (25 times) but this was only one farmer. Napier grass was also highly harvested in Kakamega (ten times). Mulato II was highly harvested in Siaya County followed by Kakamega, Bungoma, and Busia counties. Busia did not record any high harvesting cycle for any forage.

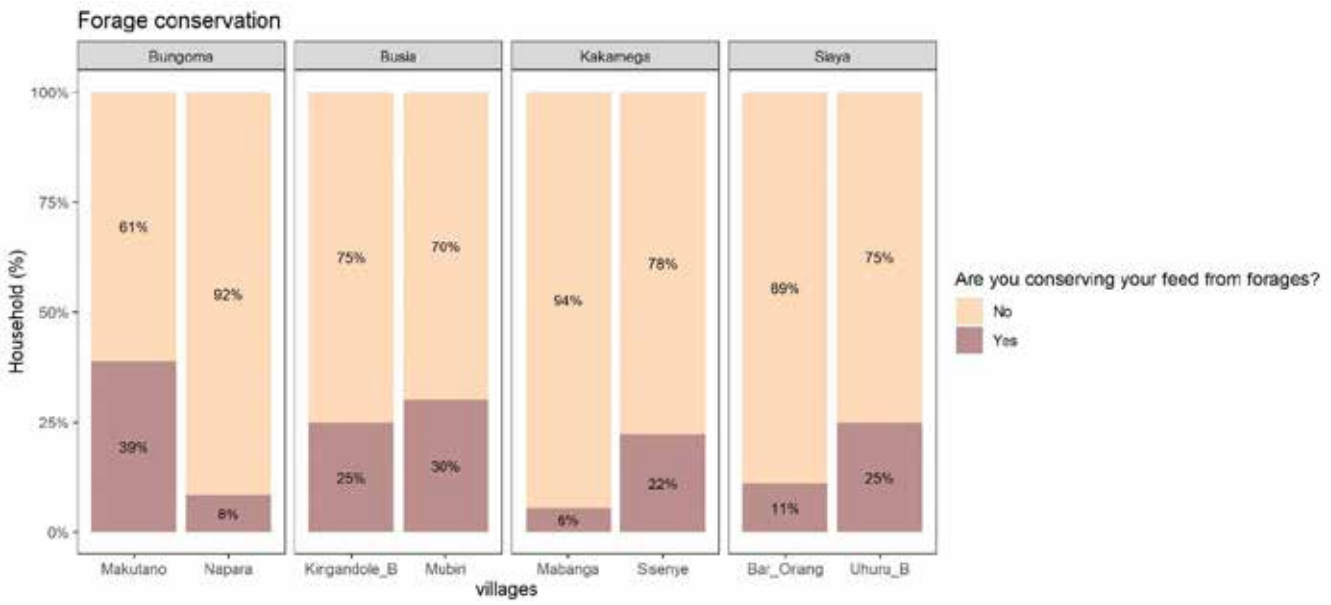
Figure 27: Average times forages are harvested annually across counties and forage in Kenya.



d. Forage conservation

We also assessed the percentage of households conserving feed from forages across all the project sites and the results indicate that less than 40% of the households were conserving feed in each site. In comparison to the other counties, Busia had more farmers conserving feed from forages and Kakamega had the least percentage of farmers conserving feed from forages.

Figure 28: Forage conservation across villages in Kenya.



e. Forage years of cultivation

We asked farmers when (which year) they planted their current forage which we then used to cultivate the average years of cultivation from planting year to 2019. As shown in Figure 29, most forages have been cultivated for more than one year. Lucina and Sugarcane tops have been cultivated for an average of three years with a high variation, followed by Desmodium and Napier grass that has been cultivated for an average of more than two years with the rest of the forages having been cultivated for less than two years. We further compared the average years that the two most common forages have been in cultivation in various counties as illustrated in Figure 30 below.

Figure 30 shows that farmers in Napara village in Bungoma County have the most experience in Napier grass cultivation (four years) while the rest of the project sites each had an average ranging from 2.5 to 3 years. Mulato II has been in cultivation for a much lower period ranging from 1 to 1.6 years in all the project sites with an exception of Makutano whose farmers have been cultivating Mulato II for an average of 2.6 years. Farmers in Bungoma (Napara and Makutano) have been cultivating both Napier grass and Mulato II for a longer period compared to the other counties.

Figure 29: Average years of forage cultivation by species in Kenya.

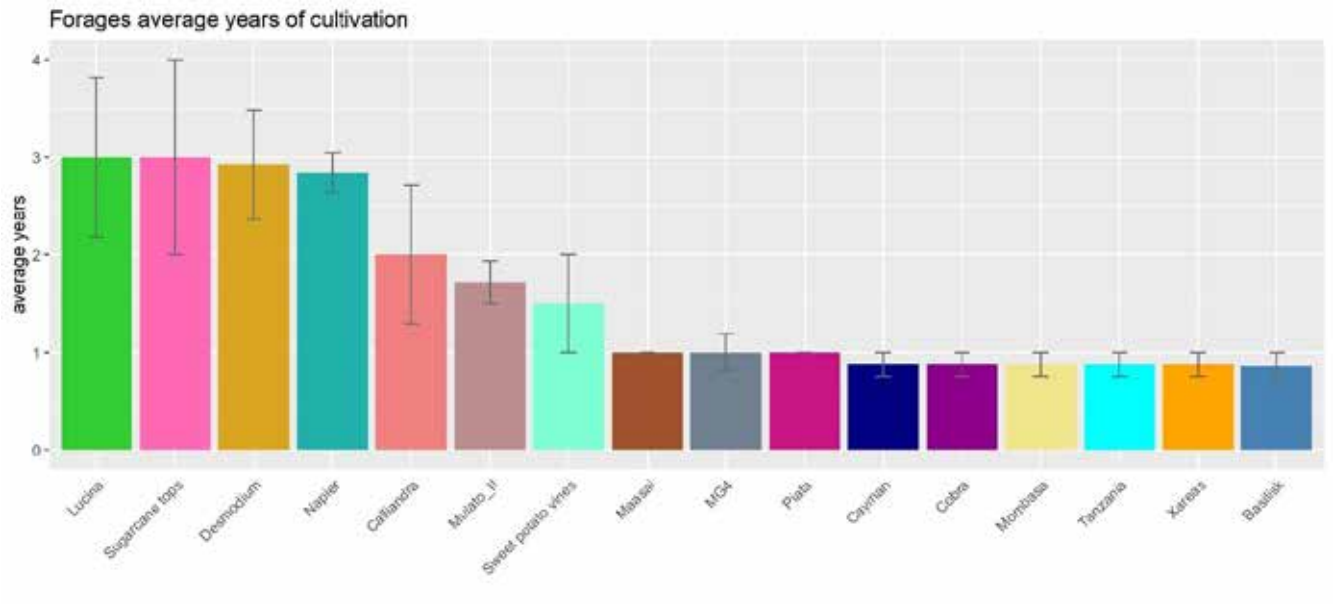
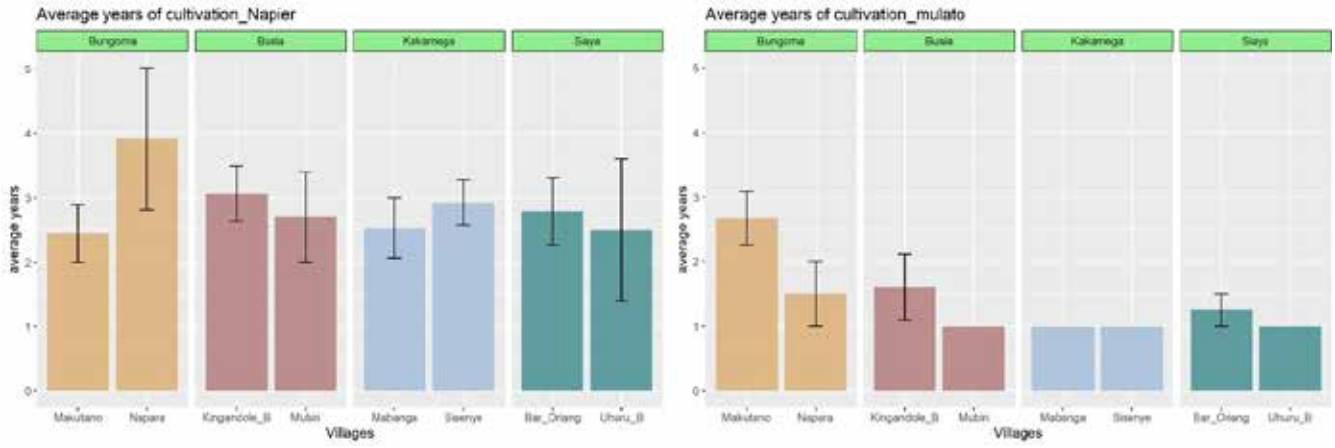


Figure 30: Average years of cultivation per village in Kenya for Napier grass and Mulato II.



f. Important forage characteristics

To understand the most important forage attributes that farmers consider before choosing the type of forage to plant, we asked farmers the important forage characteristics that they consider before planting any forage. Figure 31 illustrates the response of farmers on MOST important forage characteristics in the project counties. Overall, yield was the most important characteristic, followed by drought tolerance and nutrition. Figure 32 further illustrates the first, second and third most important forage characteristics across all the counties. Nutrition was the second most important characteristic while palatability was the third most important characteristic.

Figure 31: Most important forage characteristic in Kenya.

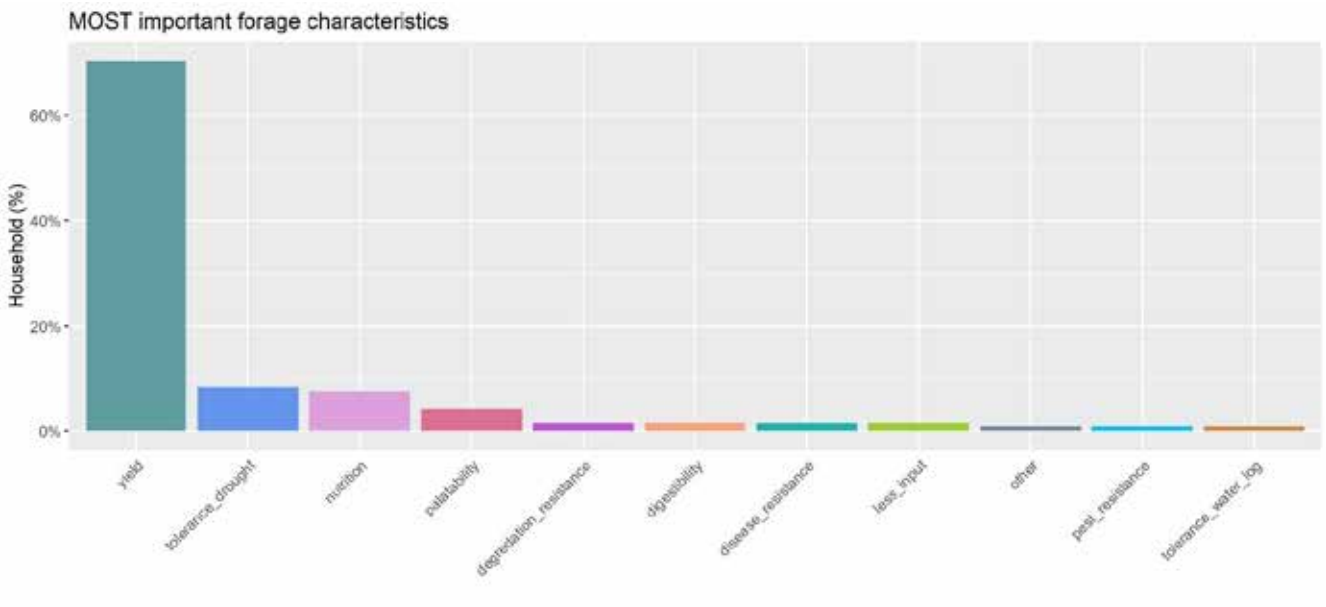
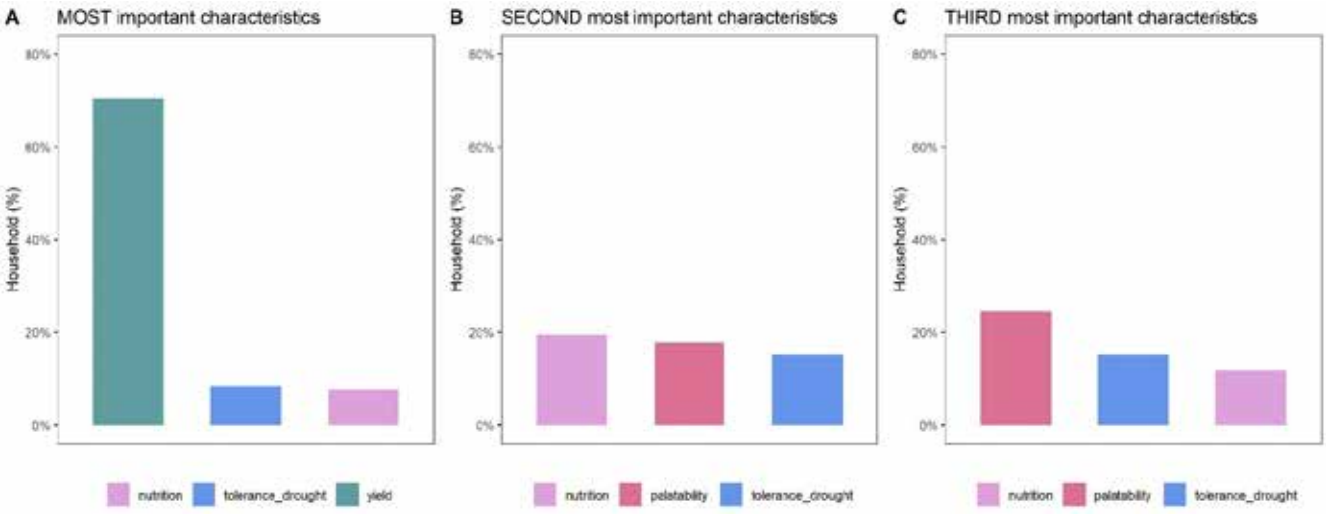


Figure 32: Three most important forage characteristics in Kenya.



Researchers work with farmers to measure and weigh forage grasses in field trials to find better forage feed varieties. Alliance of Bioversity International and CIAT

Livestock production

a. Livestock types owned

Traditionally farmers in Kenya have practiced livestock production over the years and the majority (94%) of them own livestock. We asked farmers about the type of livestock owned in various households across the various project sites. As illustrated by Figure 33, most farmers indicated that they own chicken (85%), cattle (84%), and goats (32%). We further compared commonly owned types of livestock in the project counties. Across all the project sites, most households owned more chicken and cattle compared to goats. For instance, nearly all the household owned cattle in Sisenye and Makutano villages in Kakamega and Bungoma County respectively. At the same time, all the farmers in Napara village, Bungoma County owned chicken. Despite goats being the third most common livestock owned overally, Busia County had the least number of households owning goats, where no household in Kingandole B village owned a goat.

Figure 33: Types of livestock owned in Kenya.

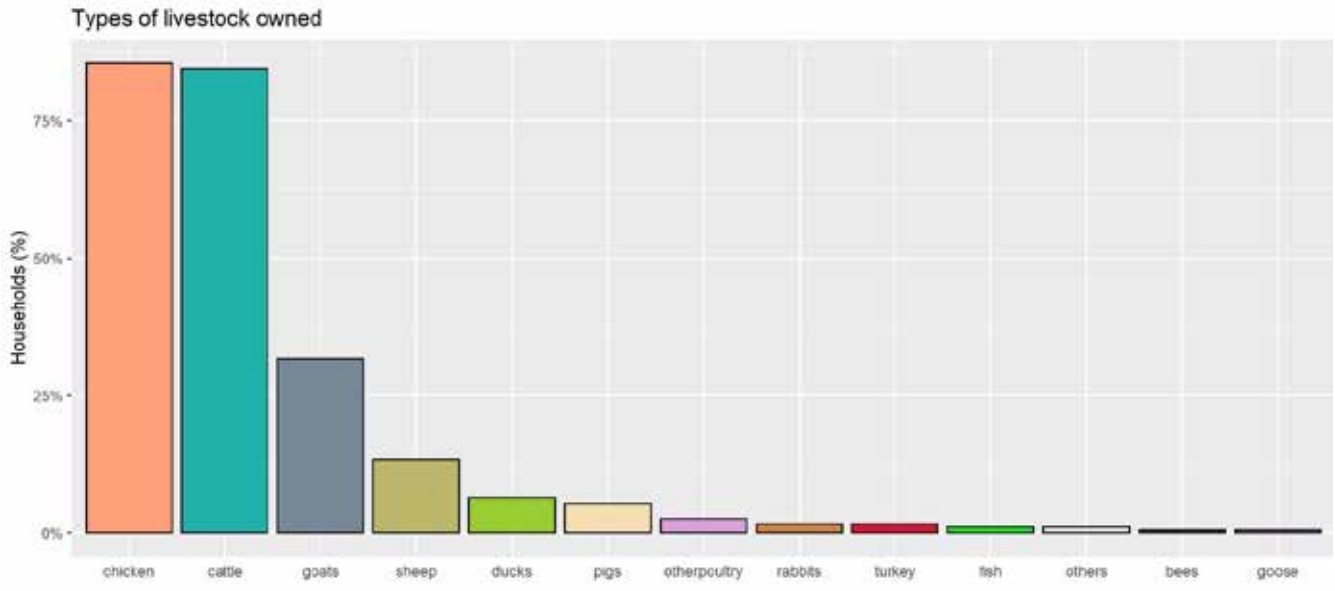
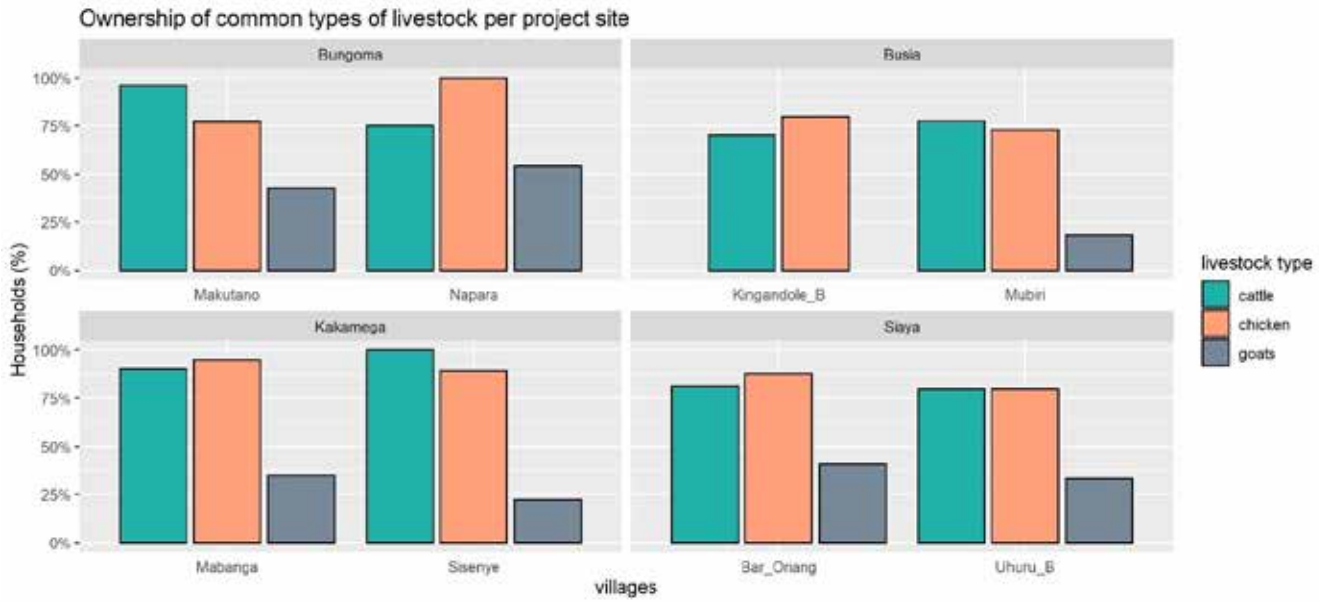
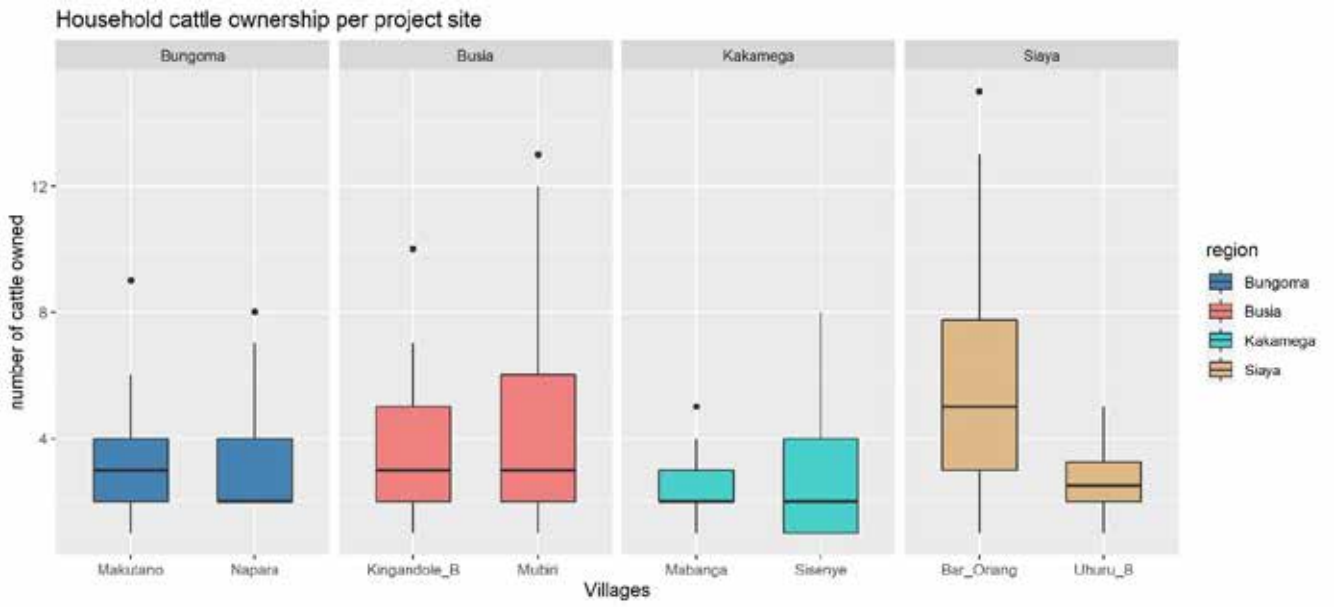


Figure 34: Common types of livestock owned per project village in Kenya.



We further asked cattle owners about the number of cattle owned per household. Farmers owned between one to five cows and 17% owned more than five cows. The majority of the farmers indicated that they own two cows (27%) per household. We also compared cattle ownership of different households per project site. Farmers in Bar Oriang (Siaya) have a significantly higher median of cattle ownership (five cows) compared to the other project sites that have a lower median of cattle ownership (below three cows). Bar Oriang also recorded a farmer with the highest number of cows owned (15 cows).

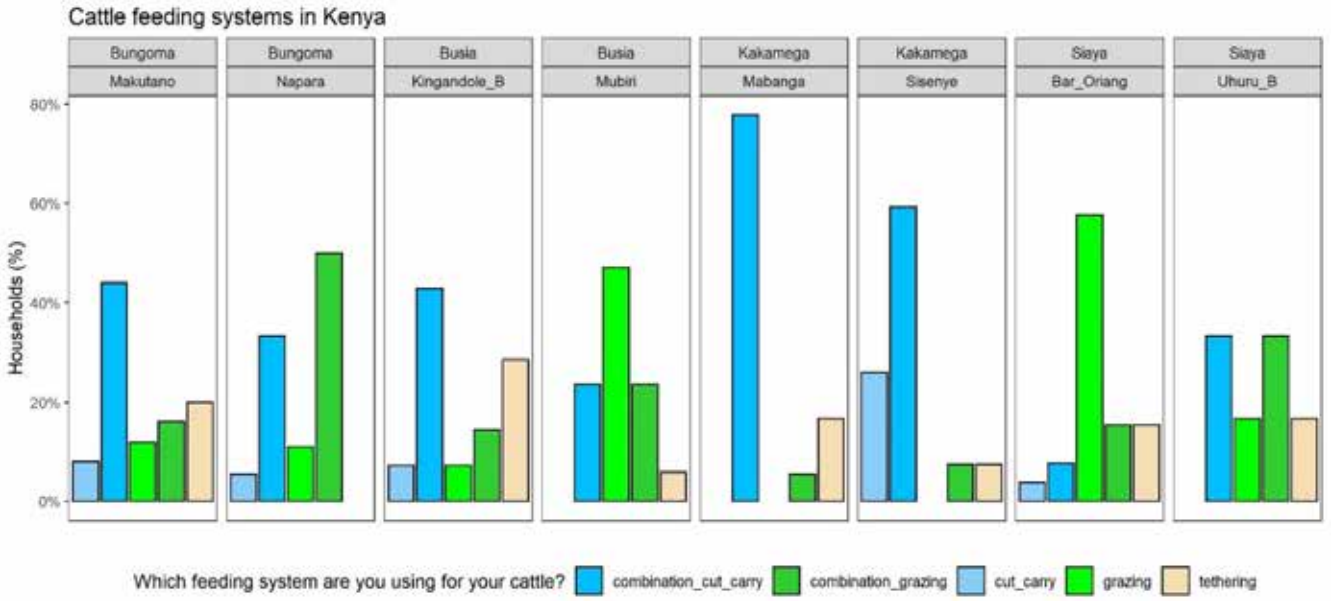
Figure 35: Cattle ownership per project village in Kenya.



b. Feeding systems and feed sufficiency

The main cattle feeding systems identified in the project sites include cut carry, combination cut carry, grazing, combination grazing, and tethering. We asked farmers which type of feeding system they use for their cattle. Combination cut carry (40%) was the most common feeding system in Kenya followed by grazing (20%), and combination grazing (19%). As shown in Figure 36, Mabanga and Sisenye (Kakamega) farmers highly use combination cut carry in their cattle feeding system compared to other counties. We notice that farmers in Bar Oriang (Siaya) highly use grazing as a feeding system compared to the other counties. However, few farmers indicated the use of tethering and cut carry feeding systems.

Figure 36: Cattle feeding systems per project village in Kenya.



Grazing sufficiency

Overall, majority of the households experienced shortage in grazing during the first three months of the year. August, September, and October appear to be the most grazing sufficient months (Fig 37). The same pattern is exhibited in all the counties with little variations by project sites as shown in Figure 38. For example, in most villages all the households indicated that they were grazing sufficient in August, September and October, with exception of Napara village where some households who experienced grazing insufficiency in these months, albeit by a very small proportion.

Figure 37: Share of households reporting grazing insufficiency by month in Kenya.

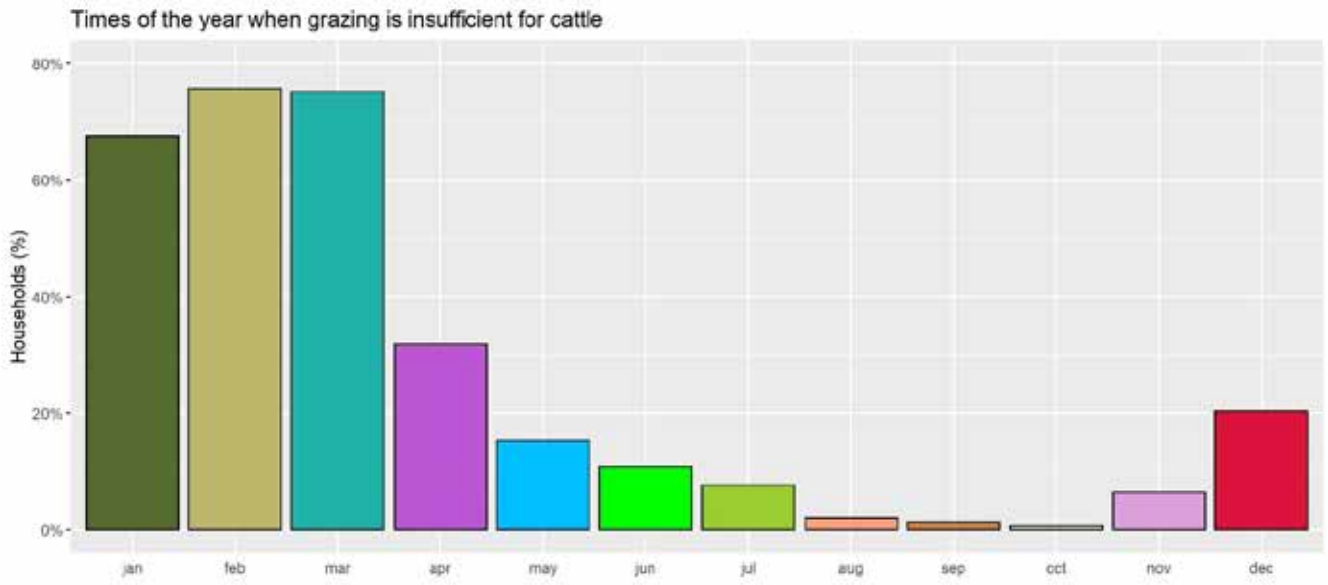
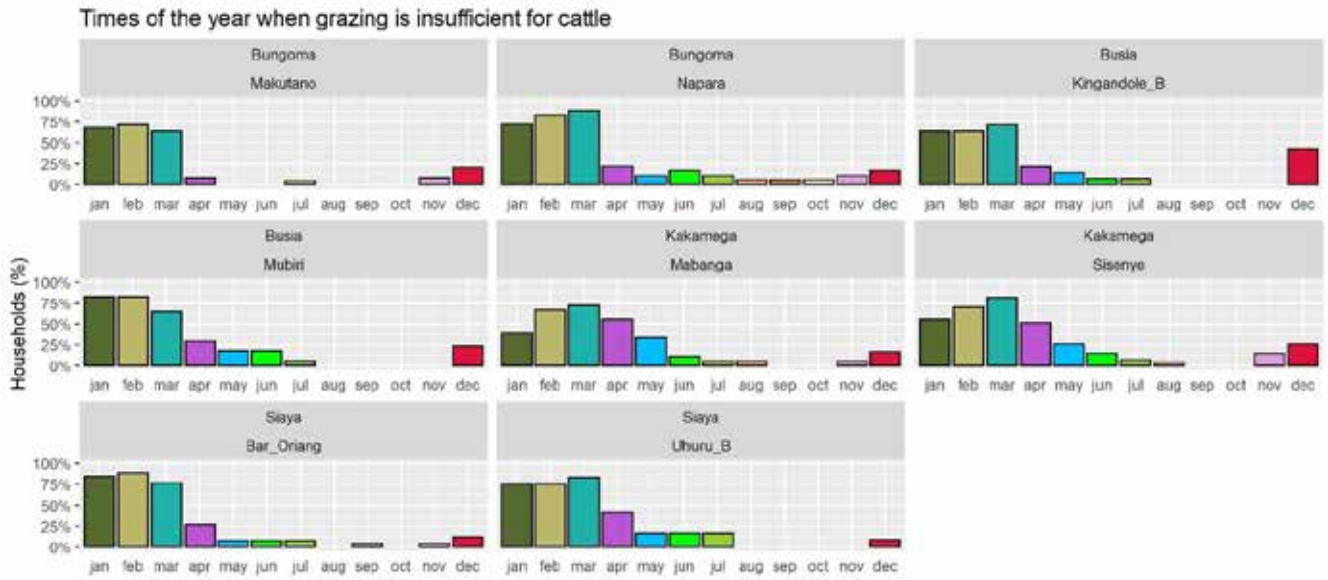


Figure 38: Share of households reporting grazing insufficiency by month and village in Kenya.



Collected feeds sufficiency

More than 50% of cattle owners reported that January, February, and March as the times of the year when collected feeds were insufficient for cattle. 36% of households experienced collected feeds insufficiency in April with an even lower percentage experiencing the insufficiency in the subsequent months up to December.

The majority of farmers across all the counties reported March to be the worst month in terms of collected feeds insufficiency except for Bar Oriang and Makutano who reported January and February as the worst months. All the project sites reported September and October as collected feeds sufficient months.

Figure 39: Share of households reporting collected feed insufficiency by month in Kenya.

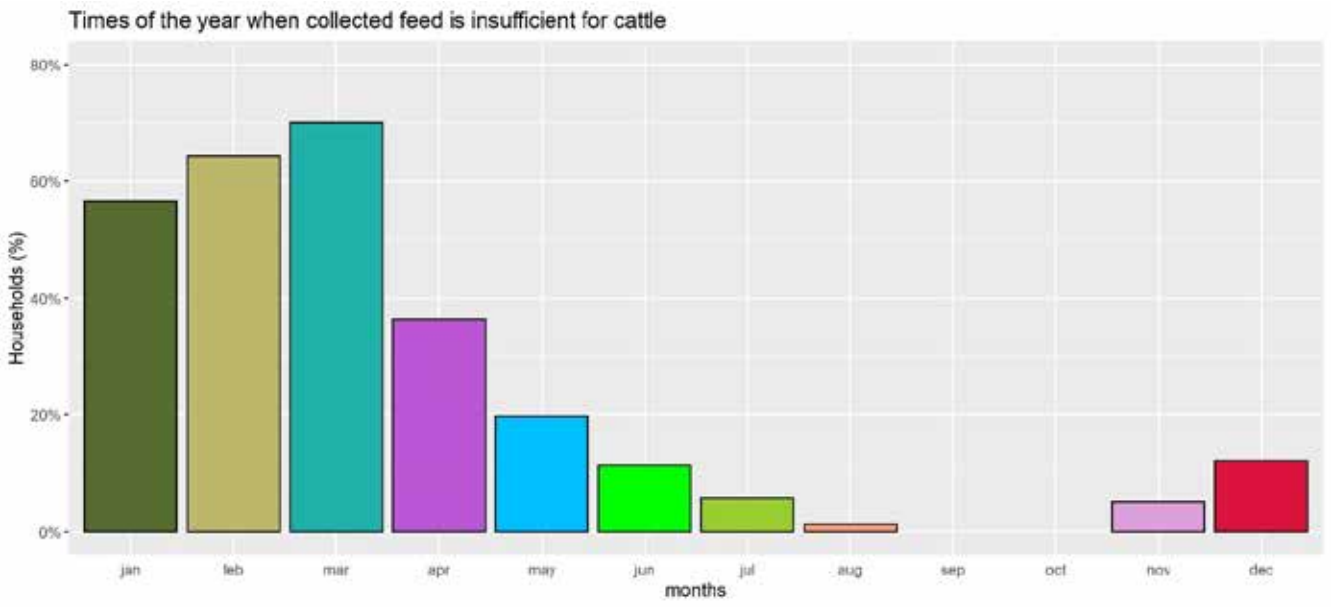
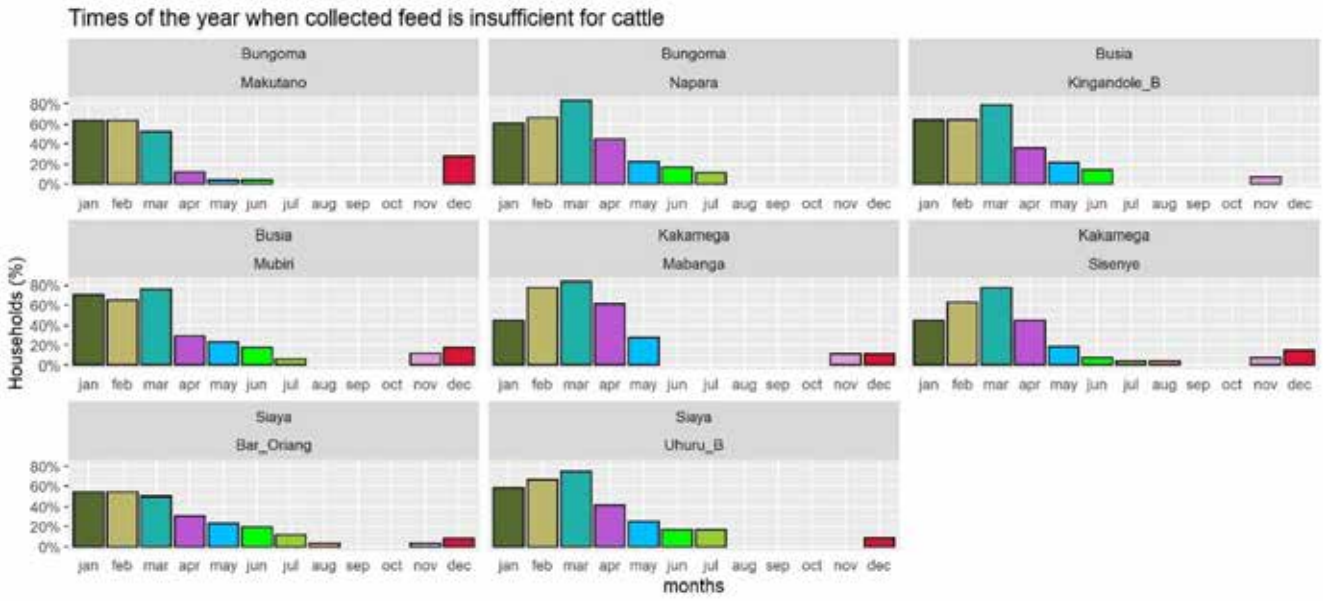


Figure 40: Share of households reporting collected feed insufficiency by month and village in Kenya.



Cultivated forages sufficiency

Similarly, the first three months were cited by more than 60% of the cattle owners as cultivated forage insufficient months with February being the worst month. Comparable to collected feeds sufficiency, September and October were cited as sufficient months for cultivated forages by all the cattle owners.

More than half of the cattle owners across all the project sites regarded January as a cultivated forage insufficient month except for Mabanga and Sisenye both within Kakamega County. Contrary to the other project sites, 6% of the cattle owners in Mubiri reported August as a cultivated forage insufficient month and they also did not experience cultivated forage insufficiency in December. In addition, less than 5% of the cattle owners cited November as a cultivated forage insufficient month in some of the project sites.

Figure 41: Share of households reporting cultivated forage insufficiency by month in Kenya.

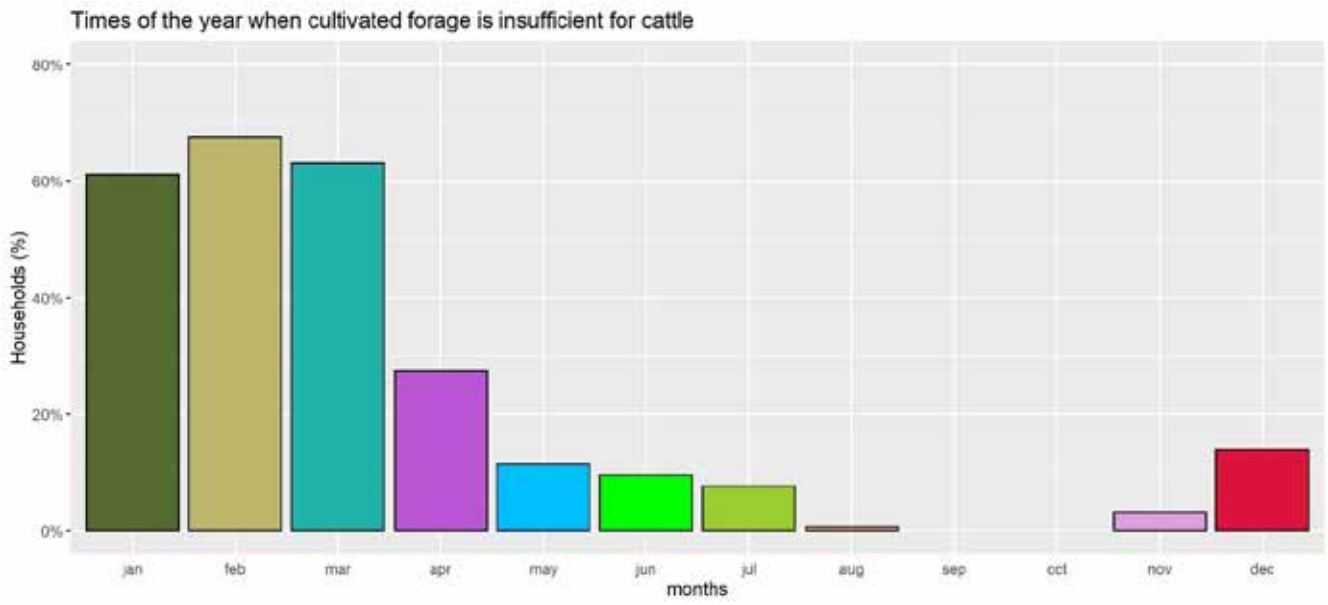
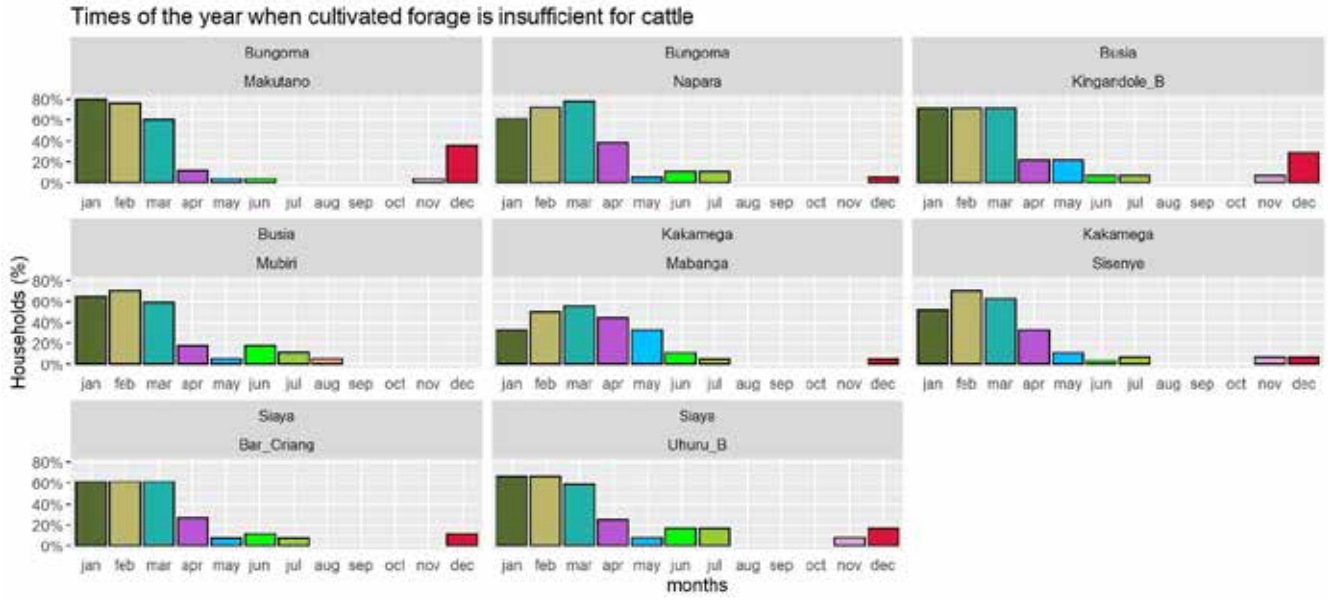


Figure 42: Share of households reporting cultivated forage insufficiency by month and village in Kenya.



Purchase of feed

Most feed are purchased during the months of January, February and March, the months which most cattle owners experience shortage of grazing, collected and cultivated forages. Purchased feed seem to supplement other forages. Nonetheless, the percentage of cattle owners purchasing the feed is not proportionate to the percentage of households experiencing forage insufficiency. This points to affordability of the feeds as the most likely explanation to fewer households purchasing the livestock feeds.

As shown in Figure 43, there are variations across and within the counties in the proportion of households purchasing livestock feeds. Unlike the other project sites, Bar Oriang and Mubiri had very few farmers (<20%) purchasing livestock feeds between January and April. Mubiri, Bar Oriang, and Uhuru B purchased feeds for only four months of the year while the other sites purchased feed for more than four months with a maximum of nine months. Generally, there was a very low percentage of farmers purchasing feed between May and December with September having no farmer purchasing livestock feed.

Figure 43: Share of households purchasing feed by month in Kenya.

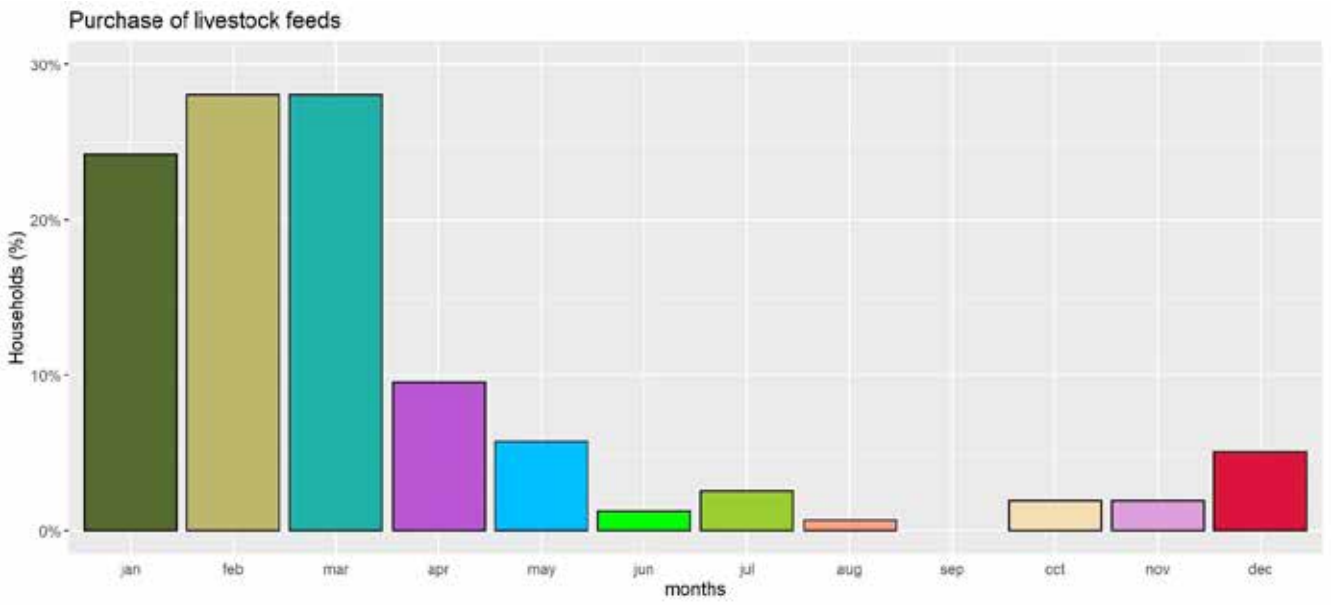
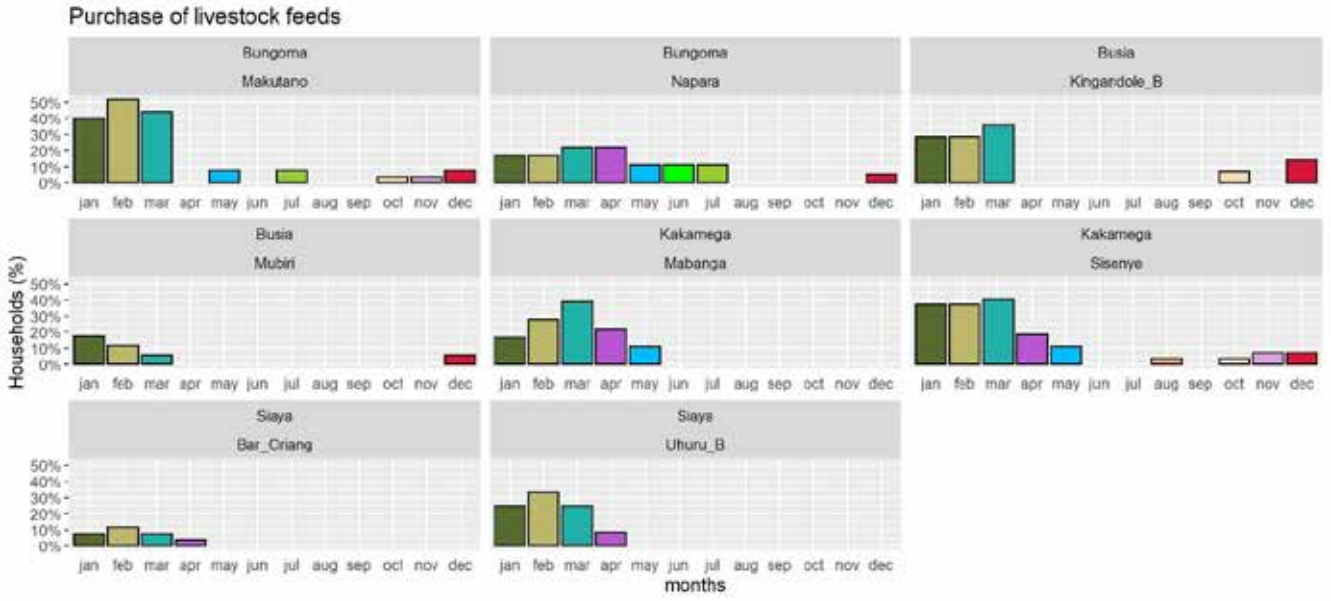


Figure 44: Share of households purchasing feed by month and village in Kenya.



c. Feed baskets

Many areas in Kenya experience wet and dry seasons which affects feed basket proportions. Figure 45 and 46 illustrate feed baskets proportions for both dry and wet seasons. Cultivated forages comprise the highest proportion (58%) of the wet season feed basket followed by fresh crop (55%) and gathered forages (44%) which are high compared to the rest of the forages. Vegetable fruits and brewery grains have the least proportion (6%) in the wet feed basket.

During the dry season, gathered forage (49%), cultivated forages (36%) and dried forage residue (30%) comprise the highest feed basket proportions as compared to other feed items. However, grains, vegetable fruits, and food waste feed items comprise the lowest proportion of the dry season feed basket but have higher proportions in the wet season feed basket. Gathered forage and dried forage residue comprised a greater proportion of the dry season feed basket in comparison to the wet season feed basket. Additionally, cultivated forage and fresh crops comprise a greater percentage of the wet season feed basket in comparison to the dry season feed basket.

Figure 45: Wet season feed basket in Kenya.

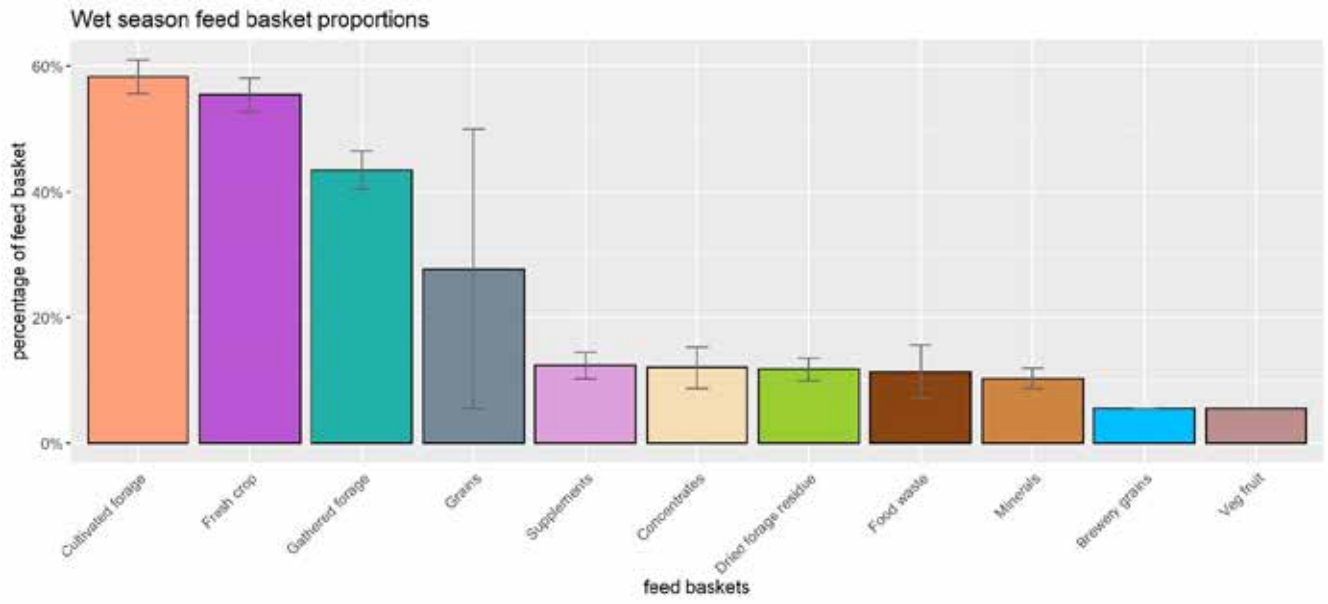
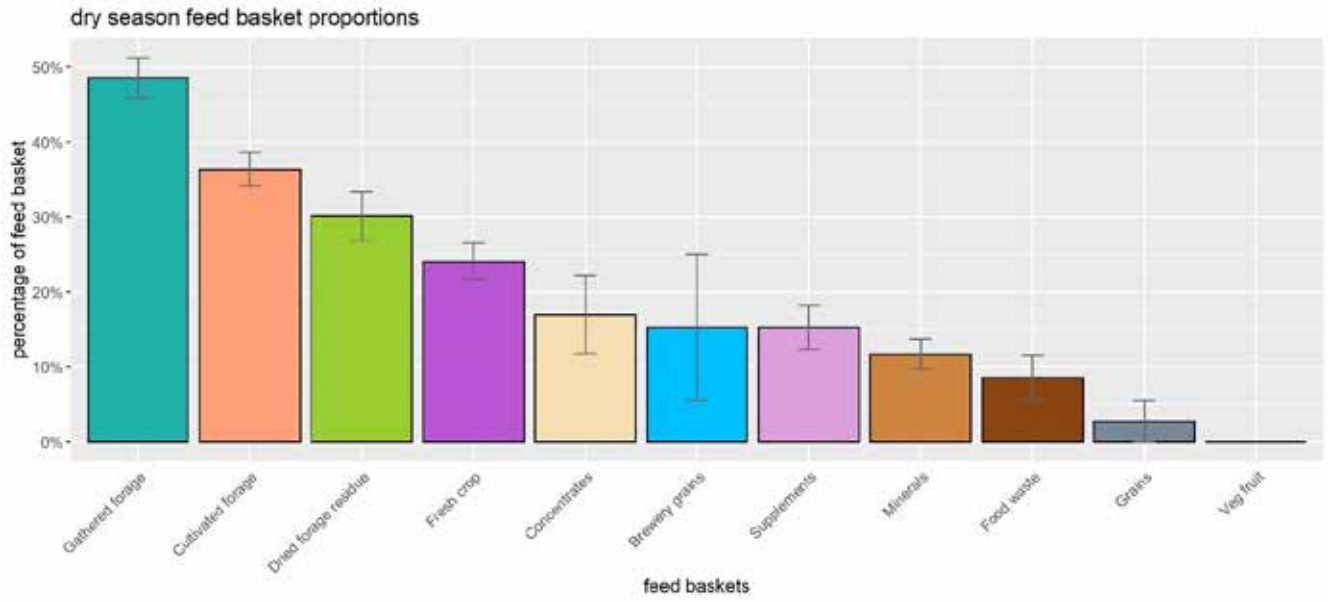
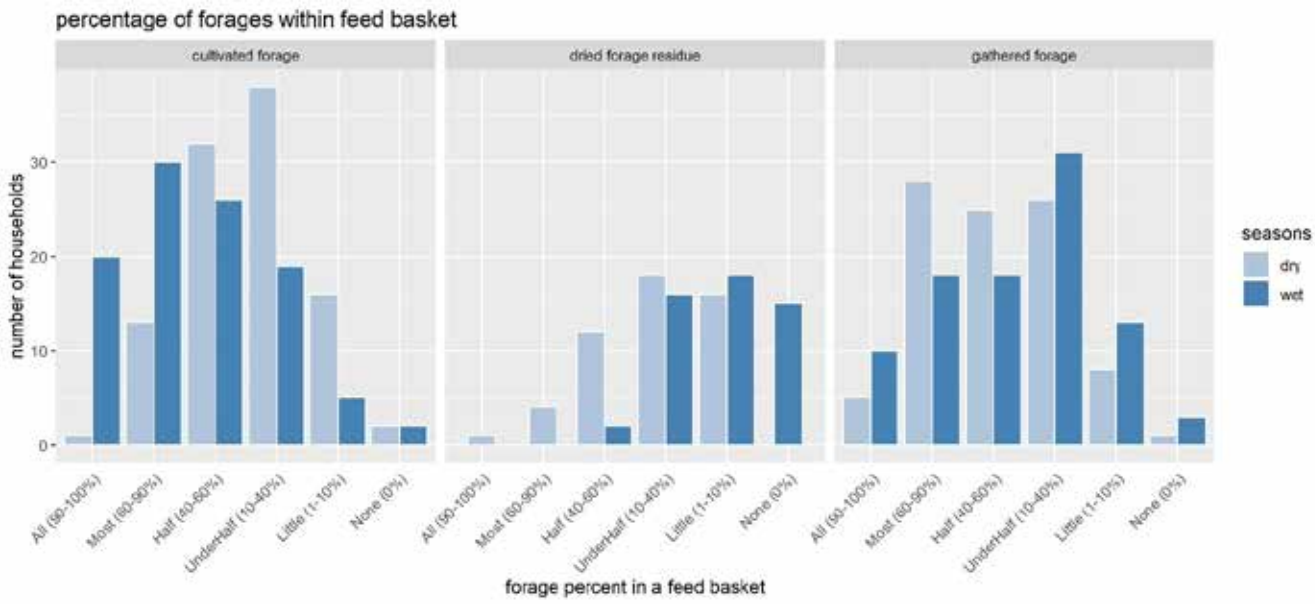


Figure 46: Dry season feed basket in Kenya.



We further assessed the percentage of cultivated, dried residue, and gathered forages within feed baskets per household as shown in Figure 47. Majority (>35) of the households indicated 10-40% of their feed basket comprised of cultivated forage during the dry season while cultivated forage comprised 60-90% of the wet season feed basket for 30 households. Additionally, 20 households indicated that cultivated forage comprises 90-100% of the feed basket proportions in the wet season. Dried forage residue was generally not used by many of the households. Majority of the households (18) had dried forage residue comprising 10-40% of the dry season feed basket. In the wet season, dried forage residue comprised between 1-10% of the feed basket for the majority of the households (18) and none for 15 of the households. Majority (31) of the households' gathered forage comprised under half (10-40%) of the feed basket proportion in the wet season while in the dry season it comprised a higher percentage of 60-90% for a majority of the households (28). Gathered forage comprised 90-100% for ten households in the wet season and five households in the dry season.

Figure 47: Percentage of forages within feed basket in Kenya.



Chopping feed in Busia, Kenya. Farmers are realizing the benefit of new forages grasses. Georgina Smith/Alliance of Bioversity International and CIAT

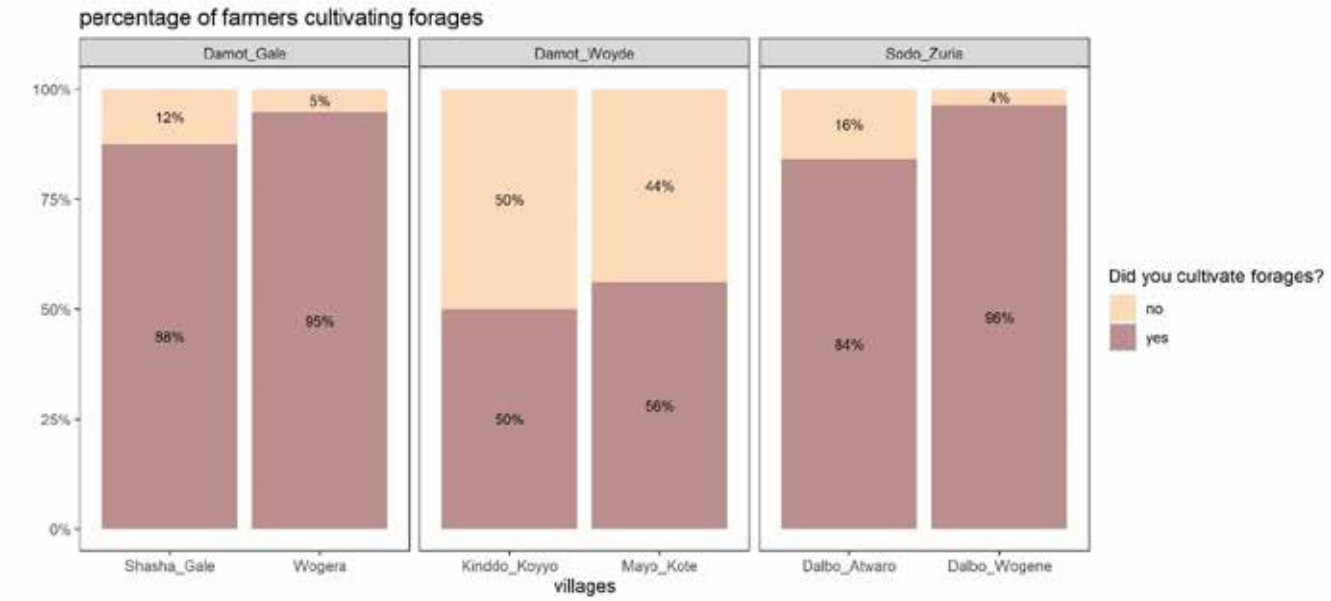
Dennis Nyongesa and his wife have boosted his milk yield and income since using new grass varieties introduced by the Grass to Cash project together with KALRO, Send a Cow and Advantage Crops. Georgina Smith/Alliance of Bioversity International and CIAT

4.2 Ethiopia

Forage cultivation

76% of the interviewed farmers in Ethiopia were cultivating forage. The farmer distribution of the households cultivating forage in the different project sites is shown in Figure 48. Damot Woyde had the least percentage (around 50%) of households cultivating forage in both kebeles while Damot Gale and Sodo Zuria had high percentages (close to 100%) of households cultivating forage.

Figure 48: Percentage of farmers cultivating forages in the project kabeles in Ethiopia.



a. Forage grown

Among the farmers cultivating forage, the most common cultivated forage was the Desho grass with over 130 households cultivating the grass. Napier grass and Mulato II were also commonly cultivated among the households. Figure 50 illustrates how these various types of forage were cultivated in different woredas. Damot Gale had the highest number of households cultivating Desho grass while Damot Woyde which had the least percentage of households cultivating forage also had the lowest number of households cultivating Desho grass. Mulato II was least common in Damot Gale.

Figure 49: Types of forages cultivated in Ethiopia.

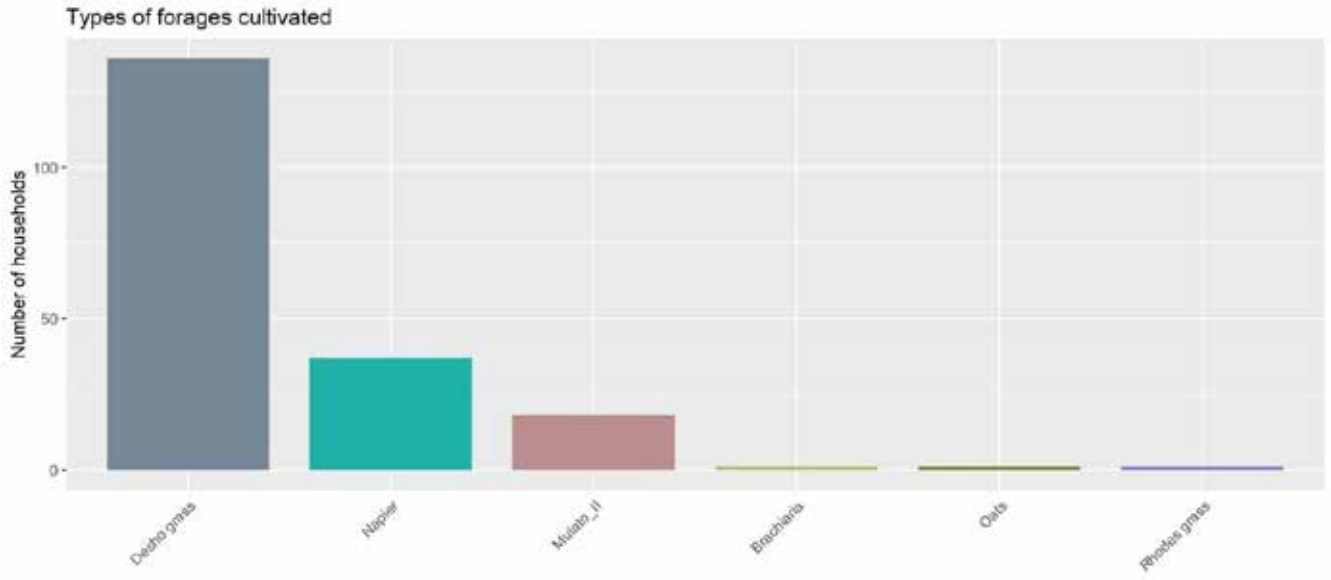
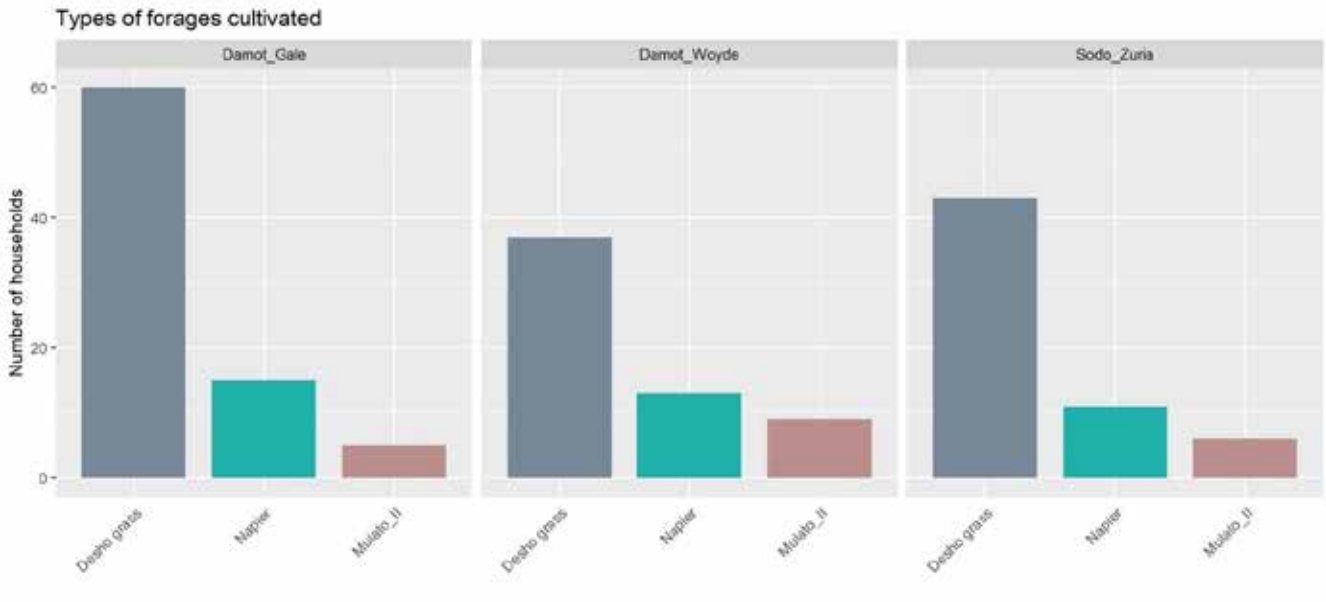
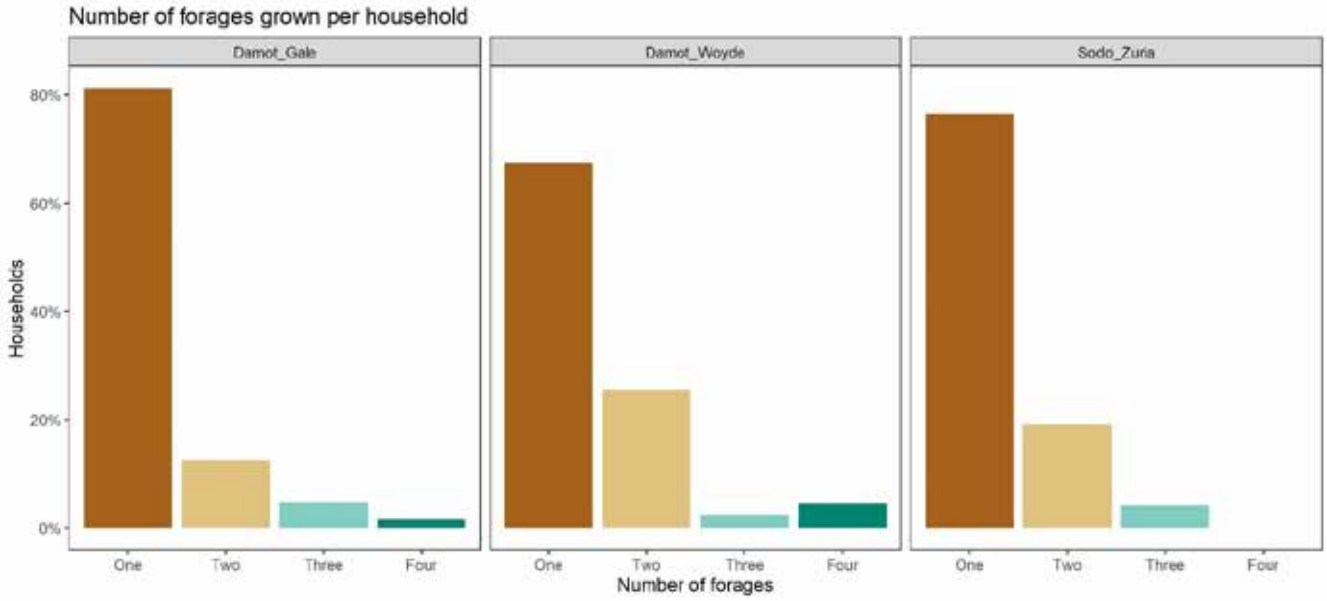


Figure 50: Types of forage cultivated by woreda in Ethiopia.



Over 65% of the households were cultivating only one type of forage with Damot Gale having the highest percentage (81%) of households cultivating one type of forage. Less than five percent of the households were cultivating three or four types of forage in each woreda.

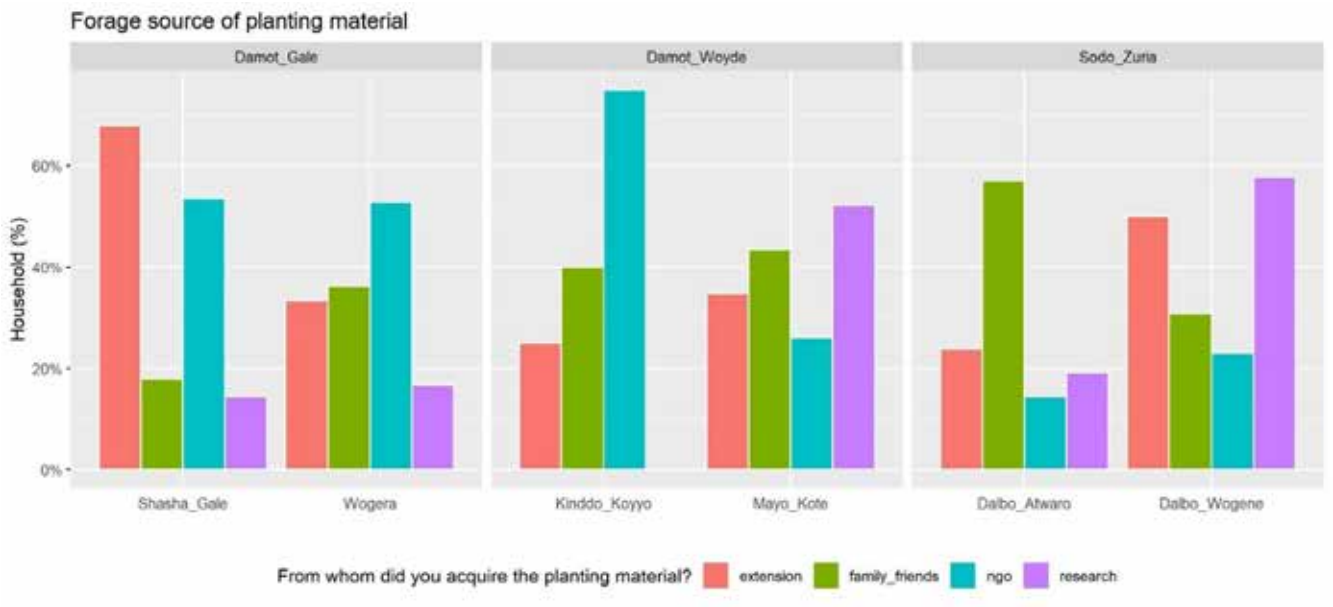
Figure 51: Number of forages grown per household across woredas in Ethiopia.



Farmers were further asked to describe where they acquire their forage planting material and the majority of them had more than one source of planting material. Non-Governmental Organisations (NGOs) were the most common source of forage planting material (42%). Extension officers were also a common source of forage planting material for 40% of the households whereas research organizations (27%) were the least common source of planting material.

NGOs were mostly preferred by farmers in Kindo Koyyo (>60%) and extension offices were mostly preferred by farmers in Shasha Gale (>60%). Family friends and research organizations were cited as a common source of planting material by more than 50% of the households in Dalbo Atwaro and Dalbo Wogere respectively.

Figure 52: Source of forage planting material per project kabele in Ethiopia.

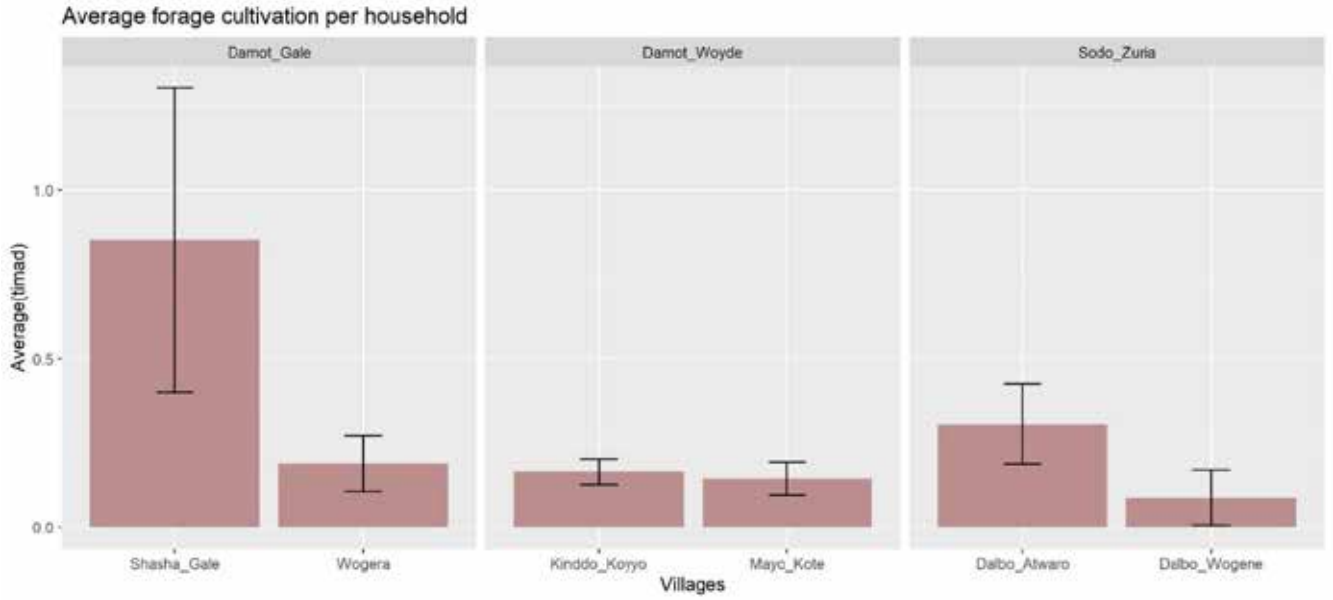


b. Forage acreage

105 households of those cultivating forages had not indicated their forage acreage. The majority (90%) of these households were cultivating Desho grass while only 13% were cultivating Mulato II and 25% were cultivating Napier grass. Therefore, this average forage acreage was only calculated for the people cultivating forages and had also indicated the forage acreage (49 households).

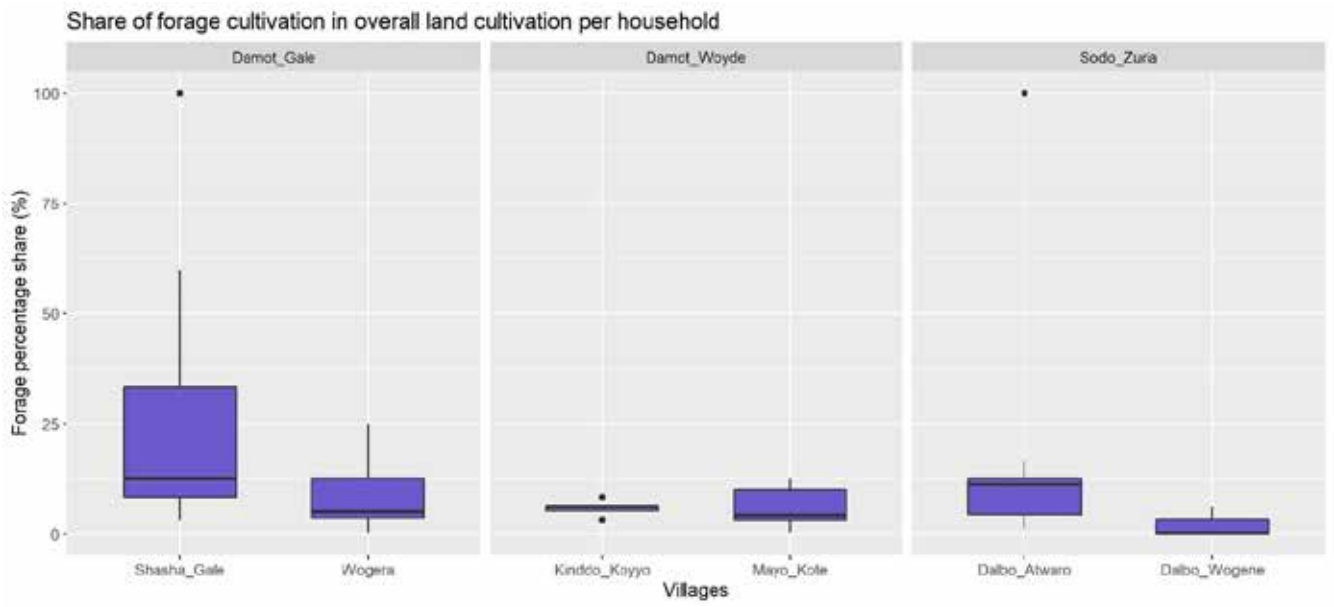
On average, all the woredas were cultivating forage on less than one timad of land. Shasha Gale kebele in Damot Gale had the highest (0.9 timad) average forage acreage while Dalbo Wogene in Sodo Zuria had the lowest (0.1 timad) average forage acreage. This could partly be because the *n* for Shasha Gale was the highest (13 households) while the *n* in Dalbo Wogene was the lowest (three households).

Figure 53: Average forage cultivation area per household across kabeles in Ethiopia.



As mentioned earlier very few farmers (49 households) had indicated the forage acreage therefore Figure 54 is based on these households only. All the project sites had a median of less than 20% share of land allocated to forage cultivation. Farmers in Shasha Gale had apportioned more land to forage cultivation as compared to the other project sites. The median share of land allocated to forage cultivation was lowest in Dalbo Wogene. It is interesting to note that Shasha Gale and Dalbo Atwaro each had one person who had committed their whole piece of land (100%) to forage cultivation only.

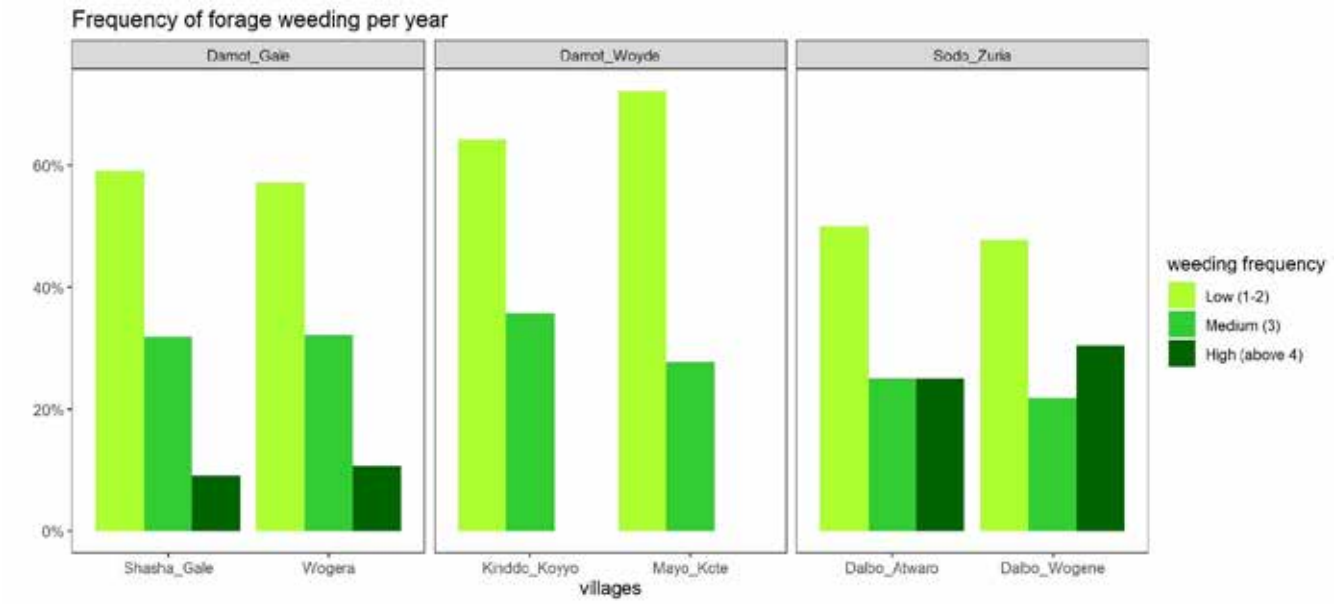
Figure 54: Share of forage cultivation in overall land cultivation across kabeles in Ethiopia.



c. Forage management and harvesting

Farmers were asked how often they weed their forage in a year and a majority of them stated that they only weed one to two times in a year. Generally, farmers in Sodo Zuria had higher weeding frequency compared to the other woredas as shown in Figure 55. Farmers in Damot Woyde weeded a maximum of three times per year whereas some farmers in Damot Gale and Sodo Zuria would weed up to four times in a year.

Figure 55: Frequency of forage weeding per year across kabeles in Ethiopia.



Oddly, only 37% of the farmers cultivating forage were applying fertilizer to their forage. Shasha Gale had the highest percentage of farmers applying fertilizer at 50% while Dalbo Wogene had the least percentage (12%) of farmers applying fertilizer. Interestingly, urea was the most common type of fertilizer applied by the majority of the households while manure was the least applied.

Figure 56: Percentage of farmers applying any type of fertilizer on forages in Ethiopia.

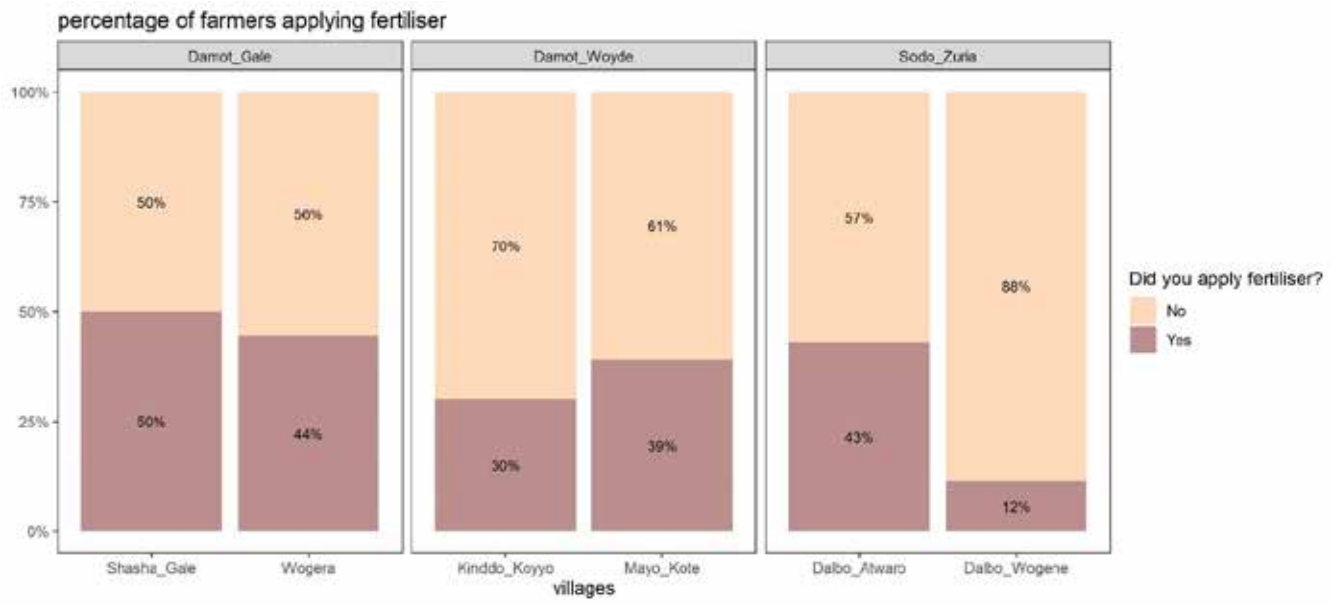
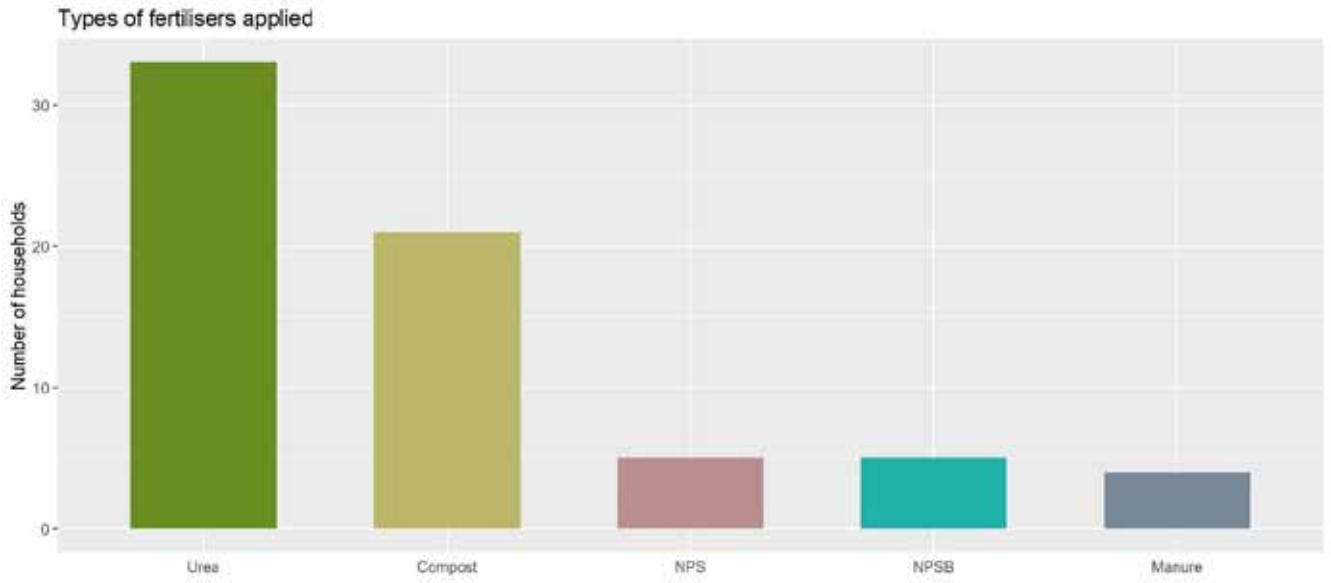
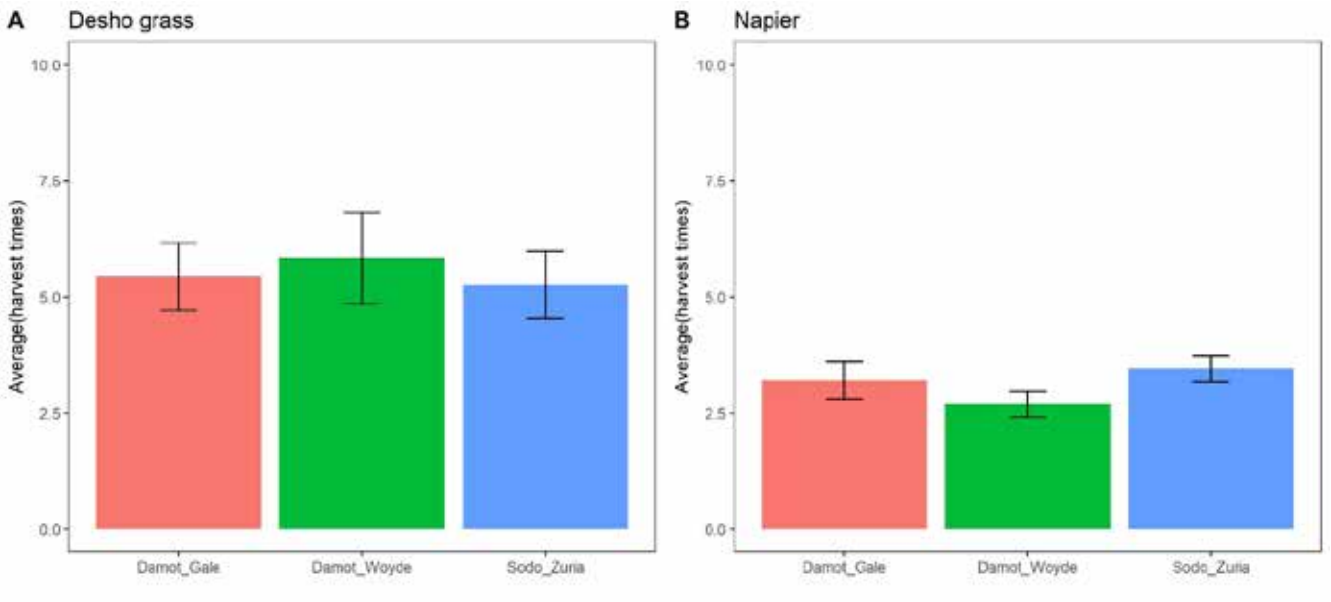


Figure 57: Types of fertilizers applied on forages in Ethiopia.



The annual frequency of forage harvesting is the number of times forage is harvested each year which was assessed for the three most common forages grown; Desho grass, Napier grass, and Mulato II. Desho grass was the most harvested with the highest average annual frequency of 5.5 times per year while Mulato II and Napier grass had a lower annual average of three times. Figure 58 illustrates the average frequency per woreda. Damot Woyde had the highest average frequency (six times) for Desho grass while at the same time it had the lowest average frequency (2.6 times) for Napier grass.

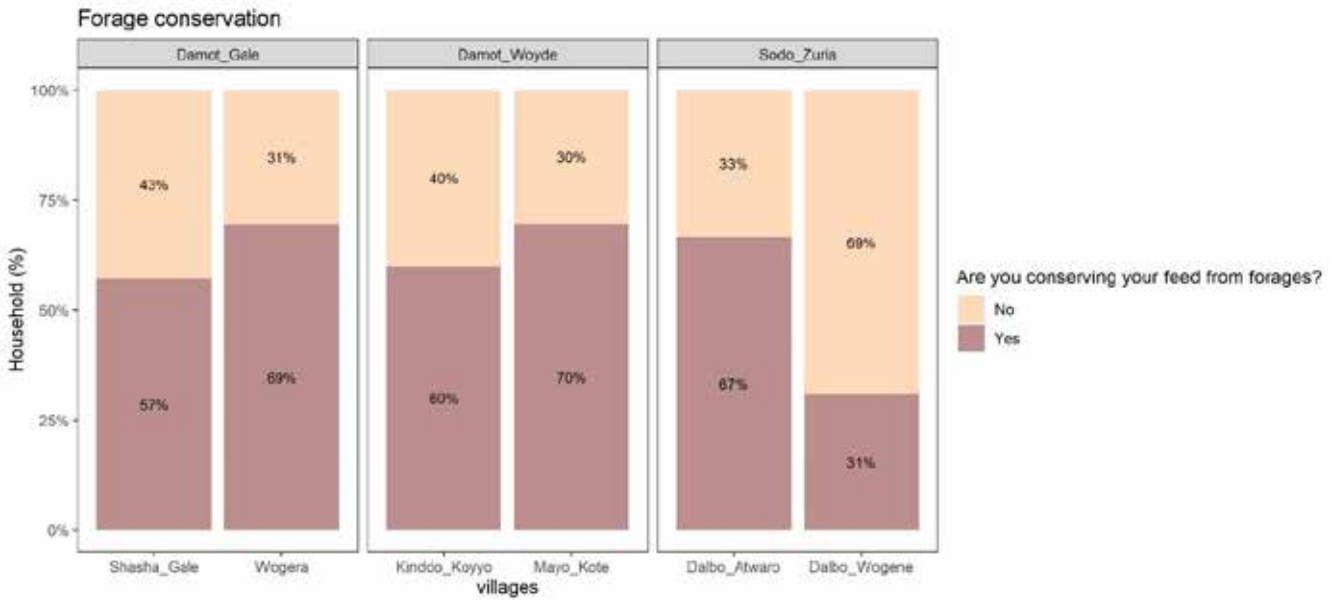
Figure 58: Forage harvesting cycles per woreda in Ethiopia.



d. Forage conservation

The study also assessed how many households were conserving feed from forages and it was observed that at least every project site had farmers conserving feed from forages. All the project sites had more than 50% of farmers conserving feed from forages except for Dalbo Wogene in Sodo Zuria that had very few farmers (31%) conserving feed from forages.

Figure 59: Forage conservation in Ethiopia.



e. Forage years of cultivation

All the forages had been cultivated for more than one year with Desho grass having been cultivated for more years compared to the rest of the forages. The variation in average years of cultivation was not high for the most common forages but there was no variation in average years of cultivation for Brachiaria, Oats, and Rhodes grass because they had a very low *n*. Figure 60 shows that all the farmers had cultivated Desho grass for at least two years with Mayo Kote having a higher average of more than three years. Napier grass had a lower period of cultivation compared to Desho grass with Dalbo Wogene having the highest average of slightly more than two years.

Figure 60: Average years of forage cultivation in Ethiopia.

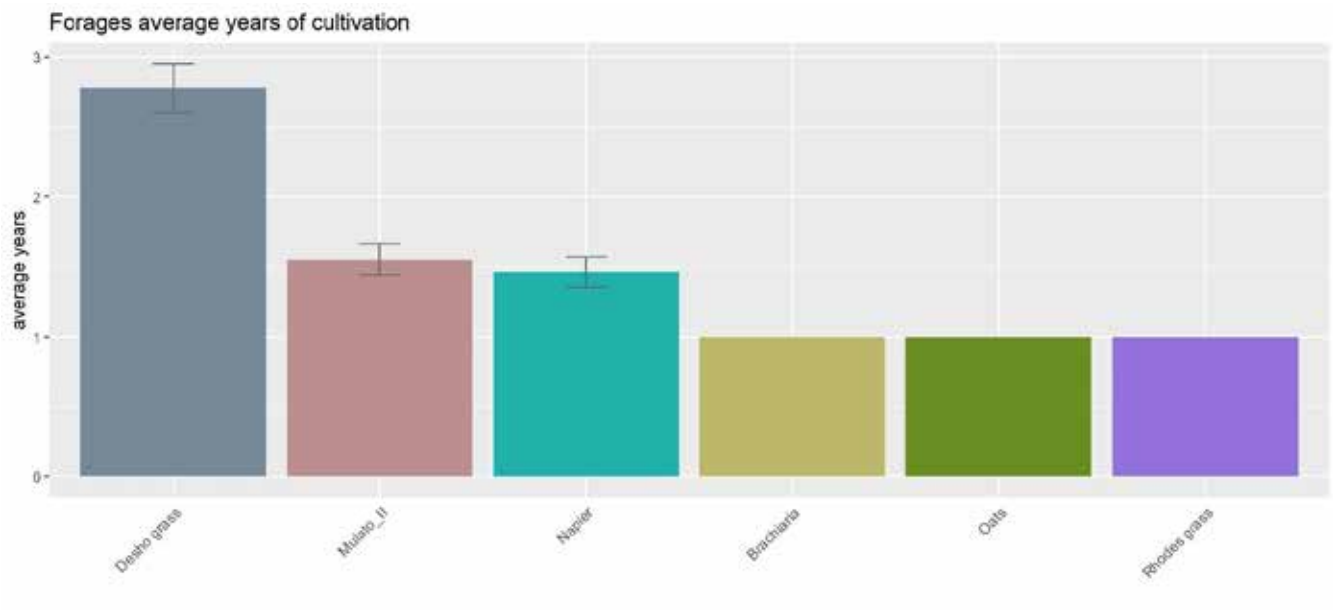
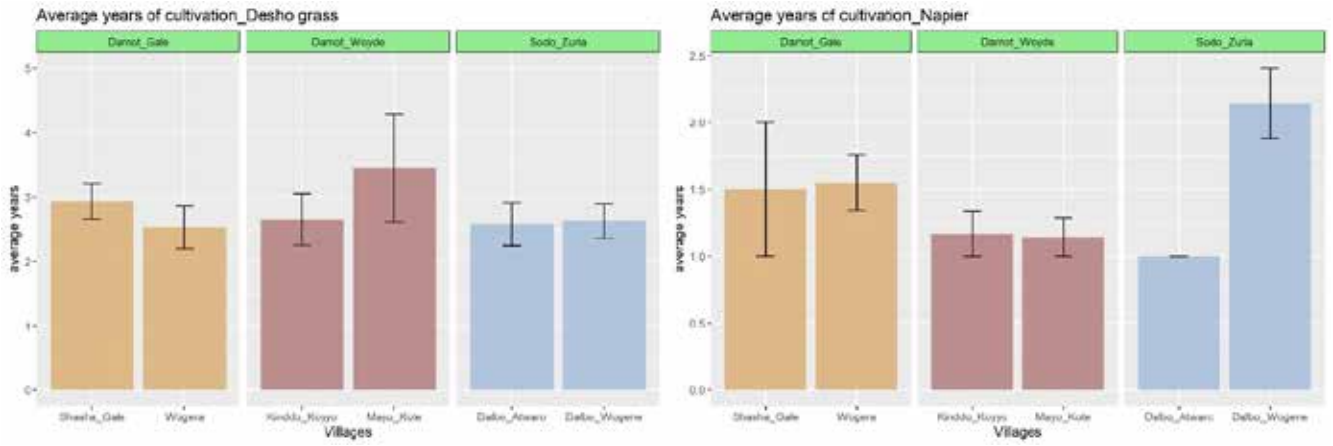


Figure 61: Average years of cultivation for Desho grass and Napier grass in Ethiopia.



f. Important forage characteristics

Farmers were asked to state the important forage characteristics that they consider before choosing the type of forage to plant. Yield was cited as the most important forage characteristic by 30% of the households followed by digestibility (21%) and drought tolerance (20%). Figure 62 illustrates these variations for the top three characteristics. Palatability was the second most important characteristic while tolerance to drought was the third most important characteristics as shown in Figure 62.

Figure 62: Most important forage characteristic in Ethiopia.

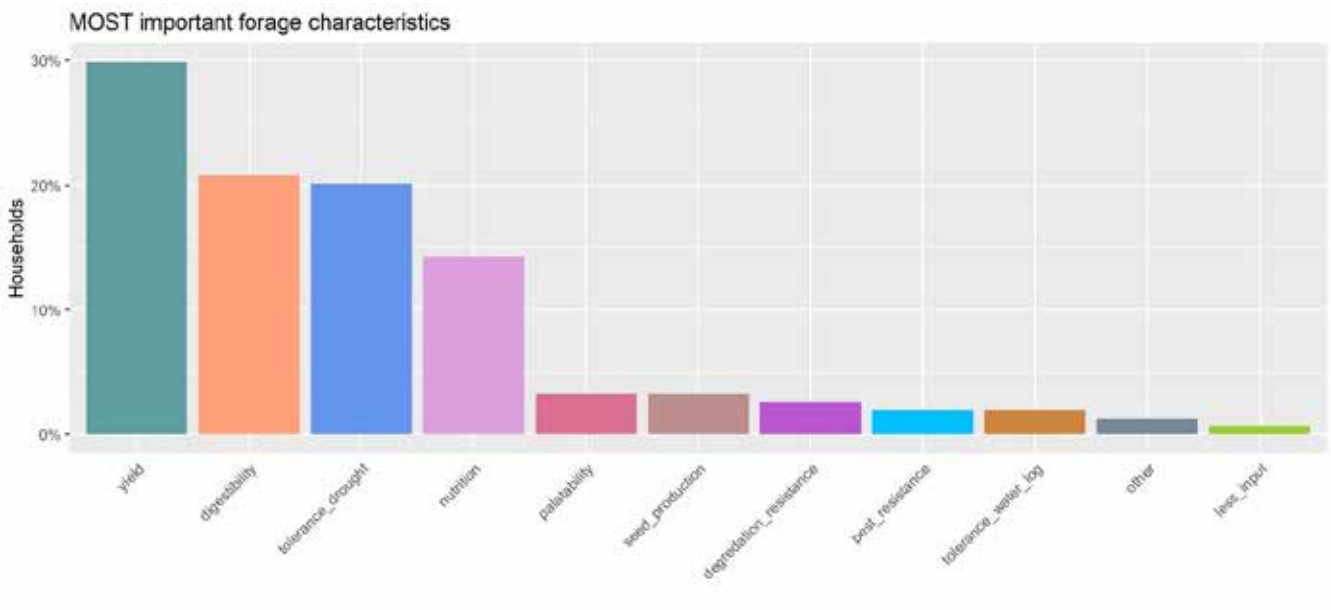
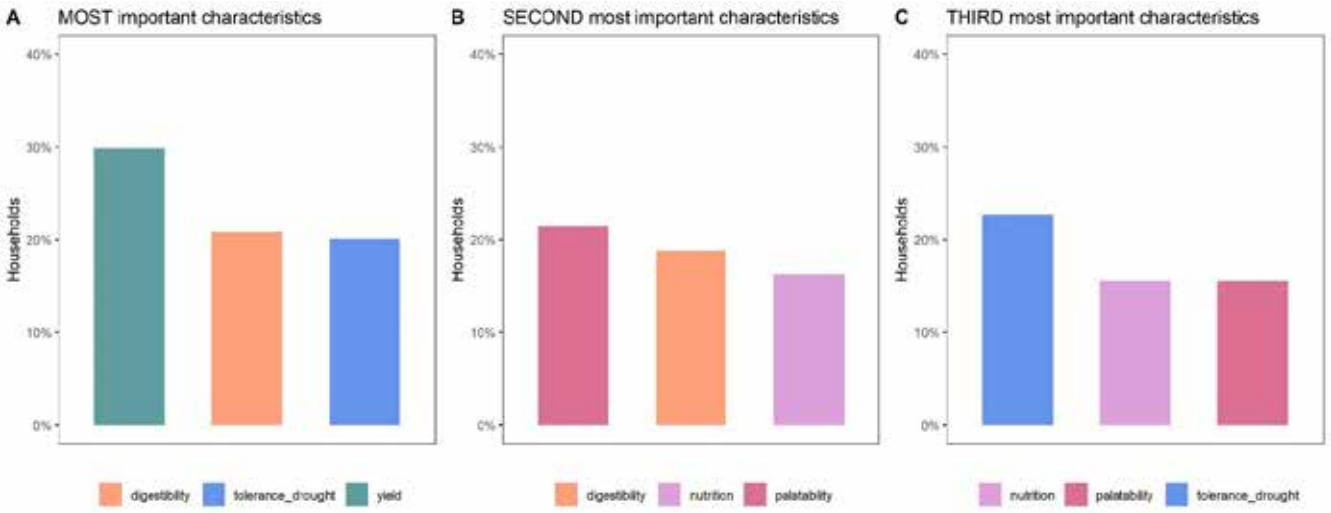


Figure 63: Three most important forage characteristics in Ethiopia.



Livestock production

g. Livestock types owned

Given that the livestock sector is a key sector in Ethiopia, majority (95%) of the farmers interviewed own livestock. The subsequent graphs in this section were drawn for the livestock owners.

Cattle were the most common type of livestock owned by 97% of the households, followed by sheep (52%) and chicken (32%). Horses, goats, and bees are the least common types of livestock owned. Types of livestock owned were also assessed across the project sites for the three most common types of livestock. Again, across all the project sites, cattle were the most common type of livestock owned followed by sheep and chicken. The percentage of households owning cattle was not considerably different across the sites, Wogera and Dalbo Wogene had 100% of households owning cattle while Dalbo Atwaro had the least number of households owning cattle (91%). Compared to the other project sites, Dalbo Atwaro also had the least number of households owning chicken (14%). Sheep ownership was more than 38% for all the project sites.

Figure 64: Types of livestock owned in Ethiopia.

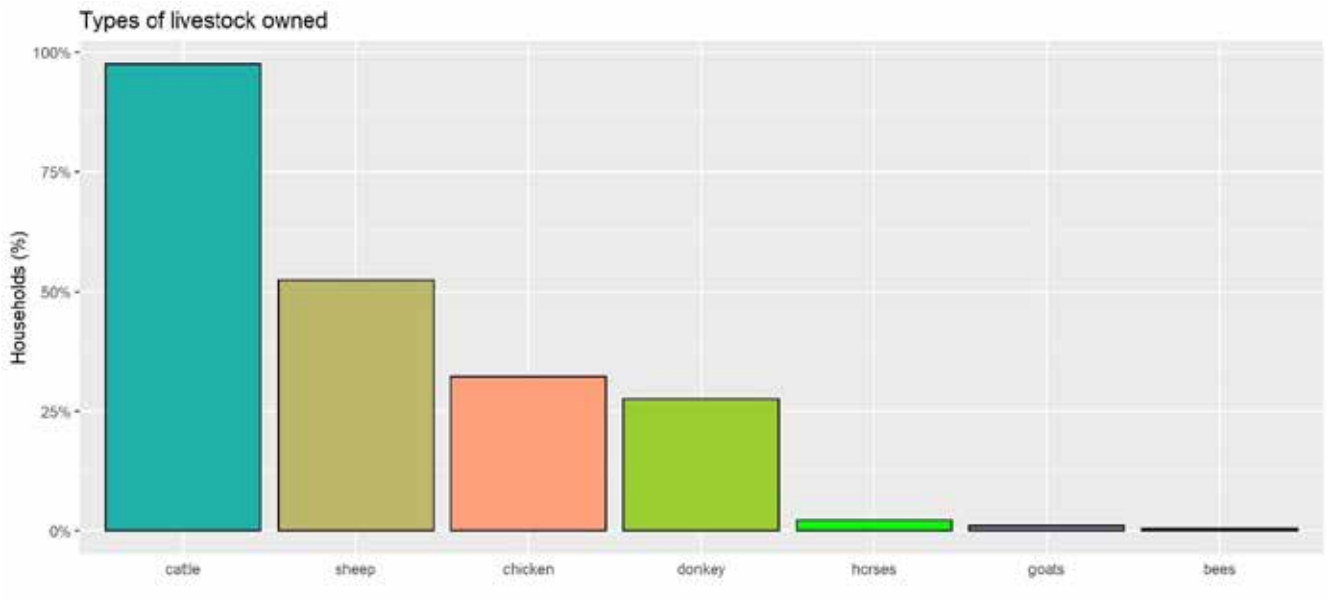
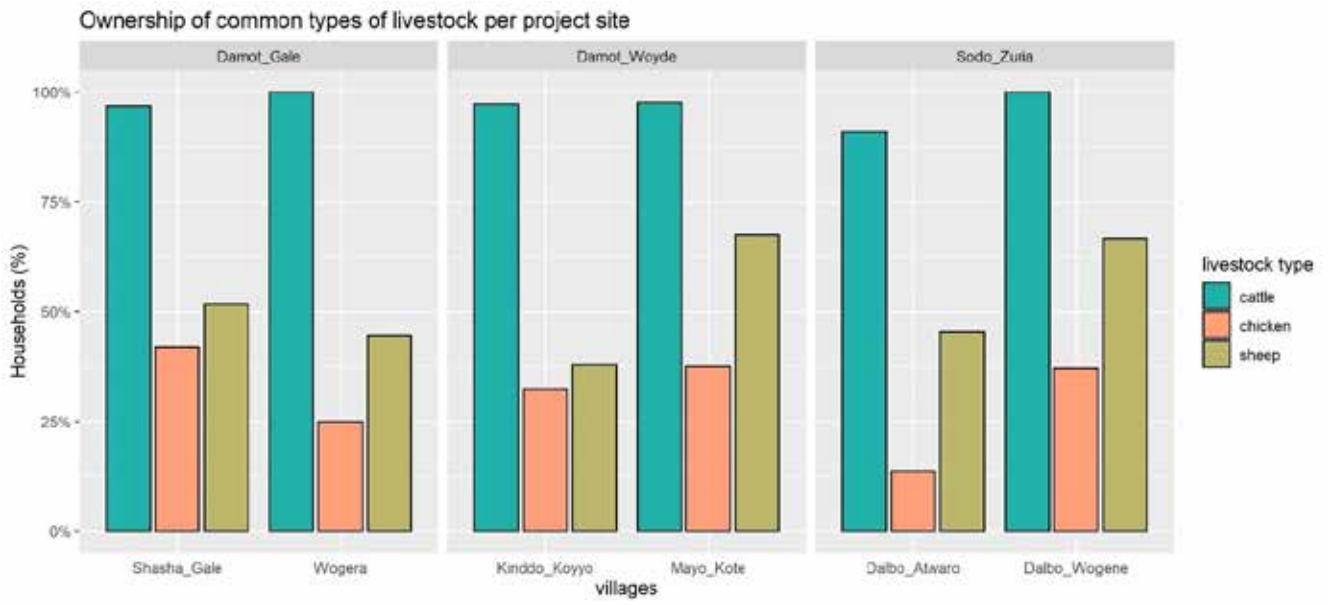
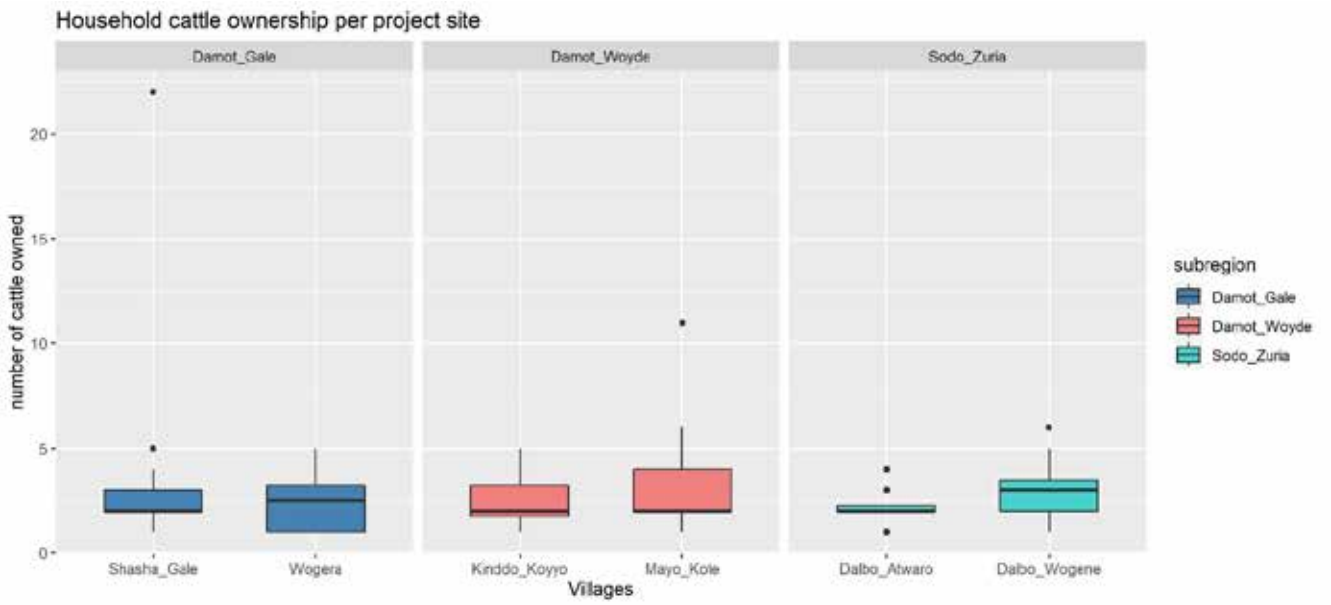


Figure 65: Types of livestock owned per project kabele in Ethiopia.



Among the households owning cattle, the majority of the farmers owned between one and five cows with a few others owning more than five cows. The greater percentage of households owned two cows (32%) and 24% owned three cows. Only two percent of the households owned more than five cows per household. Cattle ownership was also assessed per project site as shown in Figure 66. The median number of cattle owned was highest in Dalbo Wogene and lowest in Kinddo Koyyo. Damot Gale recorded a farmer with the highest number of cows (22) followed by Mayo Kote (11).

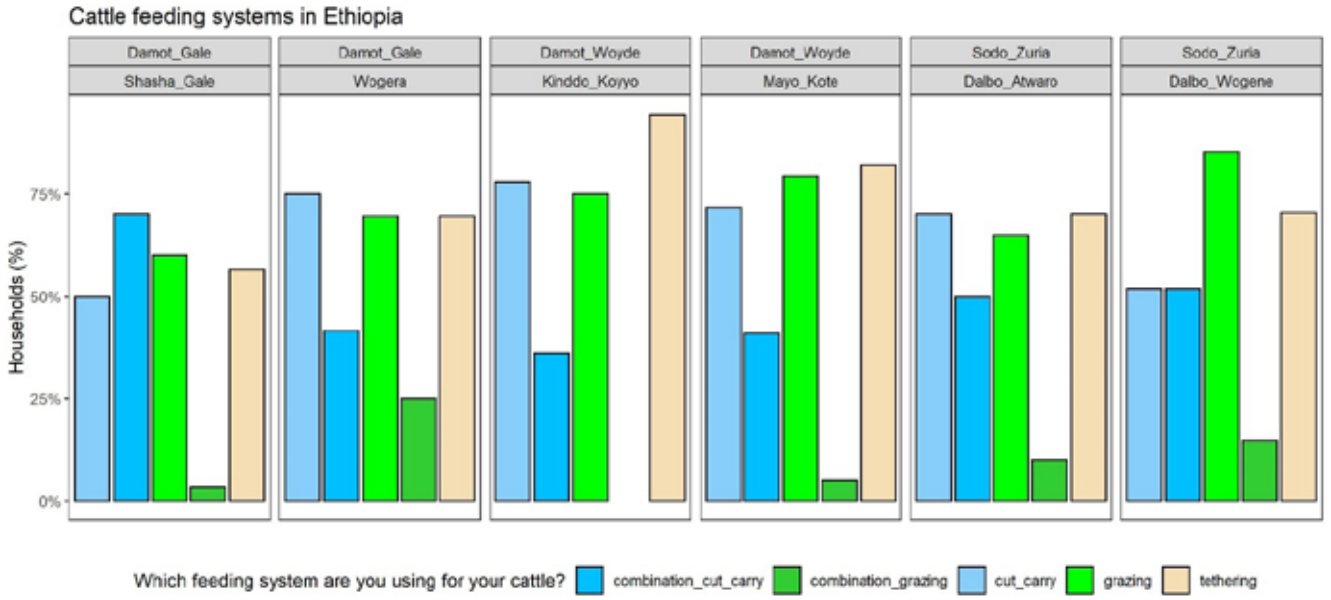
Figure 66: Cattle ownership per project kabele in Ethiopia.



h. Feeding systems and feed sufficiency

The cattle feeding systems in Ethiopia are grazing, combination grazing, cut carry, combination cut carry, and tethering. It is important to note that the cattle farmers in Ethiopia were using more than one feeding system per household. Tethering was the most common feeding system with 75% of the cattle owners using the system and was closely followed by grazing with 73% use. Combination grazing was the least common feeding system with only 10% of the cattle owners using the system. The feeding systems being used in Ethiopia were assessed for the various project sites. More than 55% of the households in all the project sites used tethering feeding systems with Kinddo Koyyo having the highest percentage (94%) of households using tethering. Cut carry was also common among many households with more than 50% of the households in all the project sites using the feeding system. Combination cut carry was generally less used as compared to cut carry in all the project sites except for Dalbo Wogene where the use was equal (52%) and Shasha Gale where the use of combination cut carry was higher (70%). Combination grazing was the least used feeding system across all the project sites with use ranging between 3% (Shasha Gale) and 25% (Wogera).

Figure 67: Cattle feeding systems in Ethiopia.



Grazing sufficiency

Given that grazing was a common feeding system among the cattle owners with 73% use, it was further assessed the times of the year when grazing is insufficient. More than 50% of the households cited between January and April as the times of the year when grazing is insufficient. February was the worst grazing month according to 96% of the households owning cattle and March was also cited by 95% of the cattle owners as a time when grazing is insufficient. Grazing was sufficient for all households between July and October. This was additionally assessed if there are any differences between the project sites as shown in Figure 68. All the project sites had a similar trend of grazing sufficiency. 100% of the cattle owners cited February as a grazing insufficient month in Mayo Kote and Dalbo Atwaro and only cited by 92% of the cattle owners in Wogera. November was only cited by 1% of the farmers in Shasha Gale as a grazing insufficient month.

Figure 68: Share of households reporting grazing insufficiency in Ethiopia.

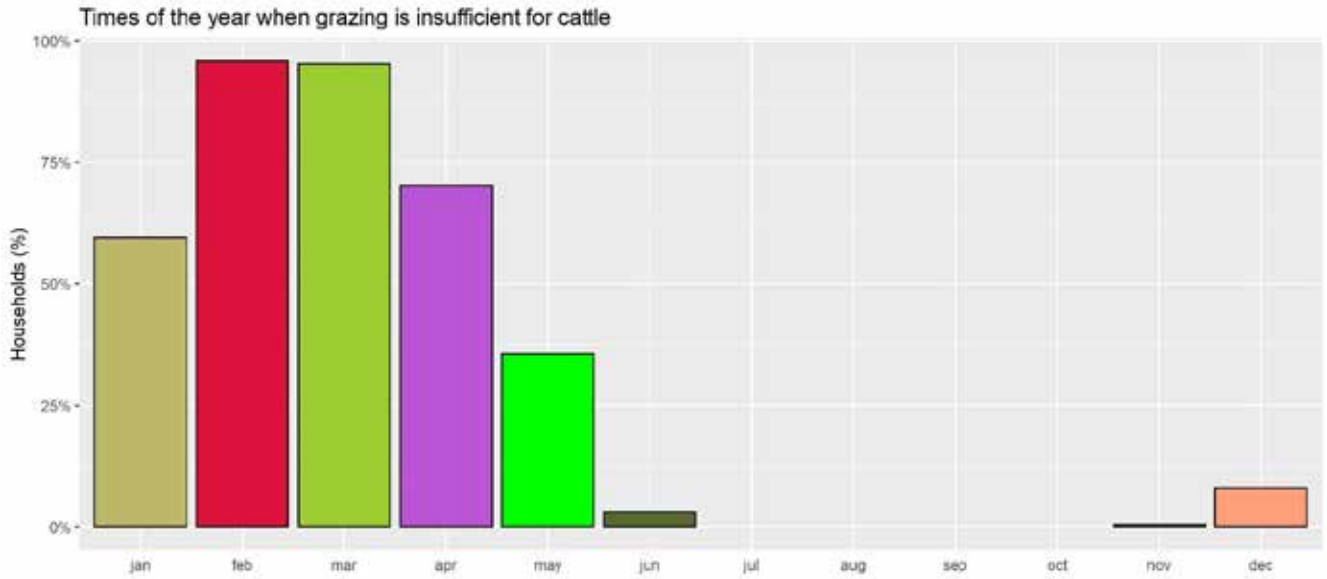
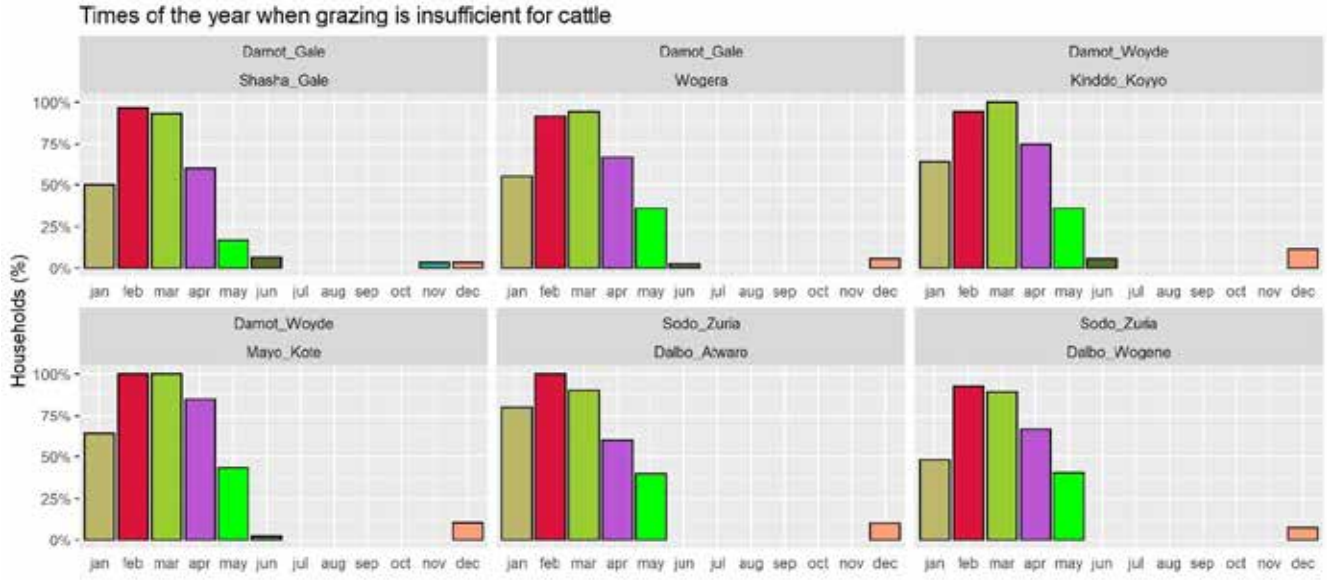


Figure 69: Share of households reporting grazing insufficiency by kabele and month in Ethiopia.



Collected feeds sufficiency

Collected feeds were generally insufficient between January and April as cited by more than 50% of the households owning cattle. May, June, and December were also cited by 33%, 10%, and 11% of the cattle owners as months when they experience collected feed insufficiency respectively. September and October were reported to be the most collected feeds sufficient months by the cattle owners. This was further assessed per project site as shown in Figure 70. Most of the households exhibited a similar trend of collected feed insufficiency between January and April with 100% of cattle owners in Mayo Kote citing February as the worst month. Compared to other project sites, Dalbo Wogene had more number of months when they experienced collected feeds sufficiency.

Figure 70: Share of households reporting collected feed insufficiency in Ethiopia.

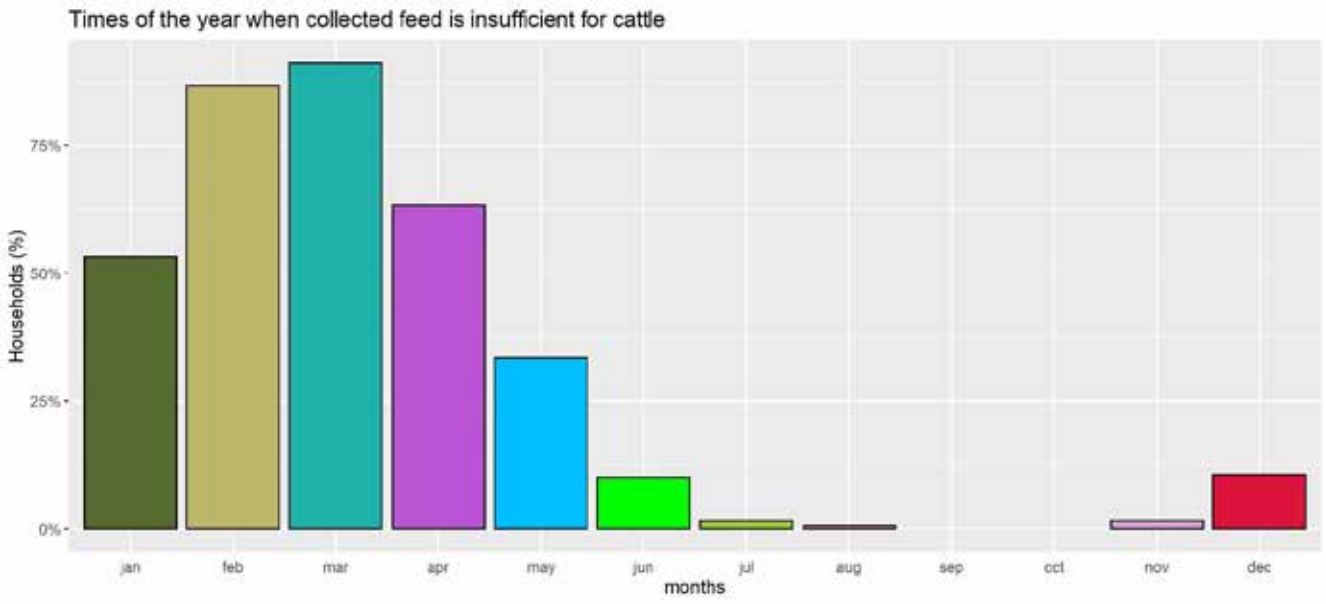
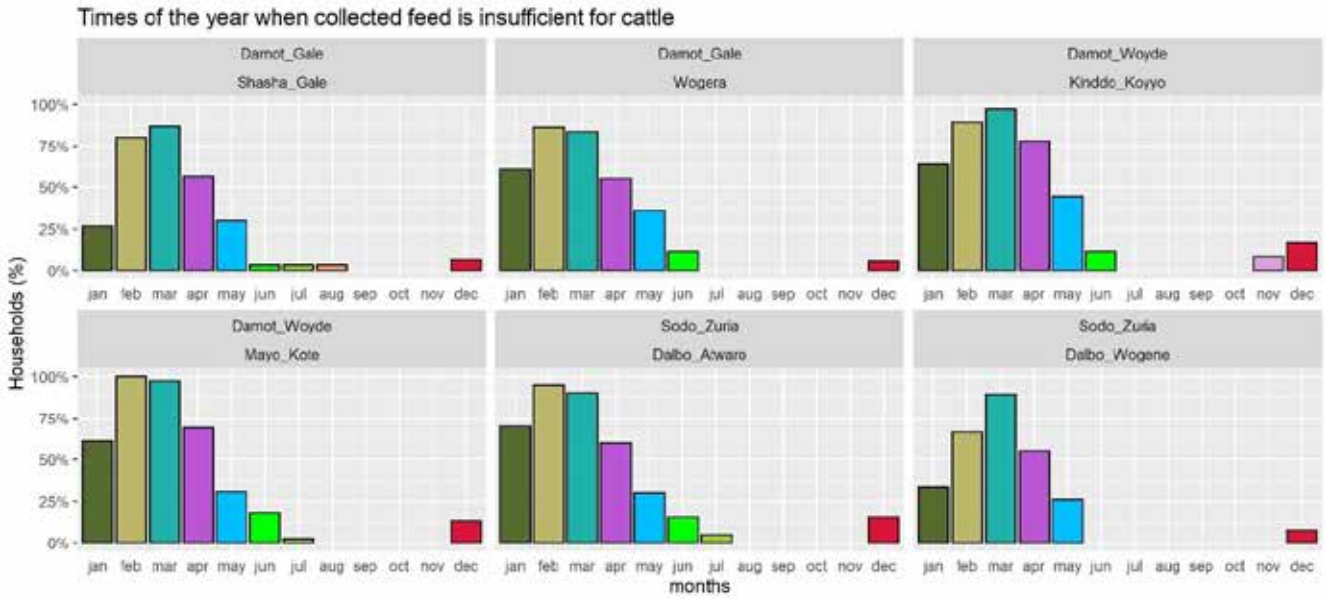


Figure 71: Share of households reporting collected feed insufficiency by kabele and month in Ethiopia.



Cultivated forages sufficiency

All the months were cited as cultivated forage insufficient months by more than 5% of the cattle owners. February, March, and April were cited by majority (>50%) of the cattle owners with August, September, and October cited by only 4% of the cattle owners. Interestingly, Shasha Gale is the only project site that did not record August to November as cultivated forage insufficient months as shown in Figure 72. Kinddo Koyyo recorded the highest percentage of farmers (89%) citing March as a cultivated forage insufficient month while Dalbo Atwaro recorded the highest percentage of farmers (90%) citing February. No project site recorded 100% cultivated forage insufficiency in any month.

Figure 72: Share of households reporting cultivated forage insufficiency in Ethiopia.

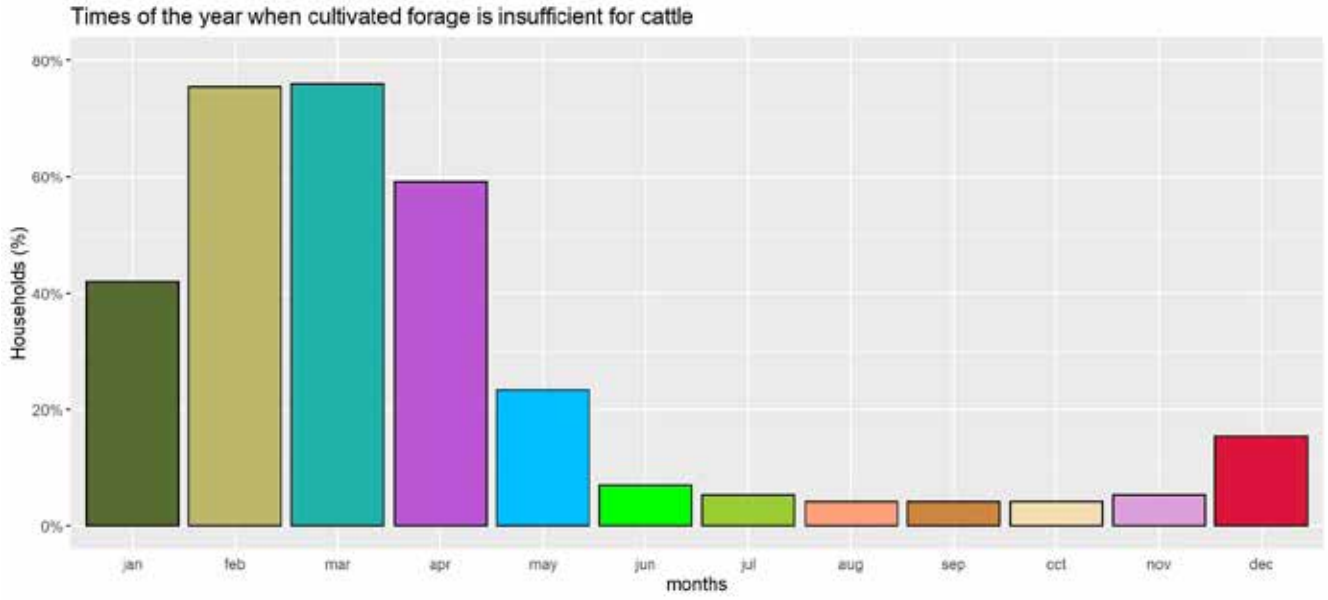
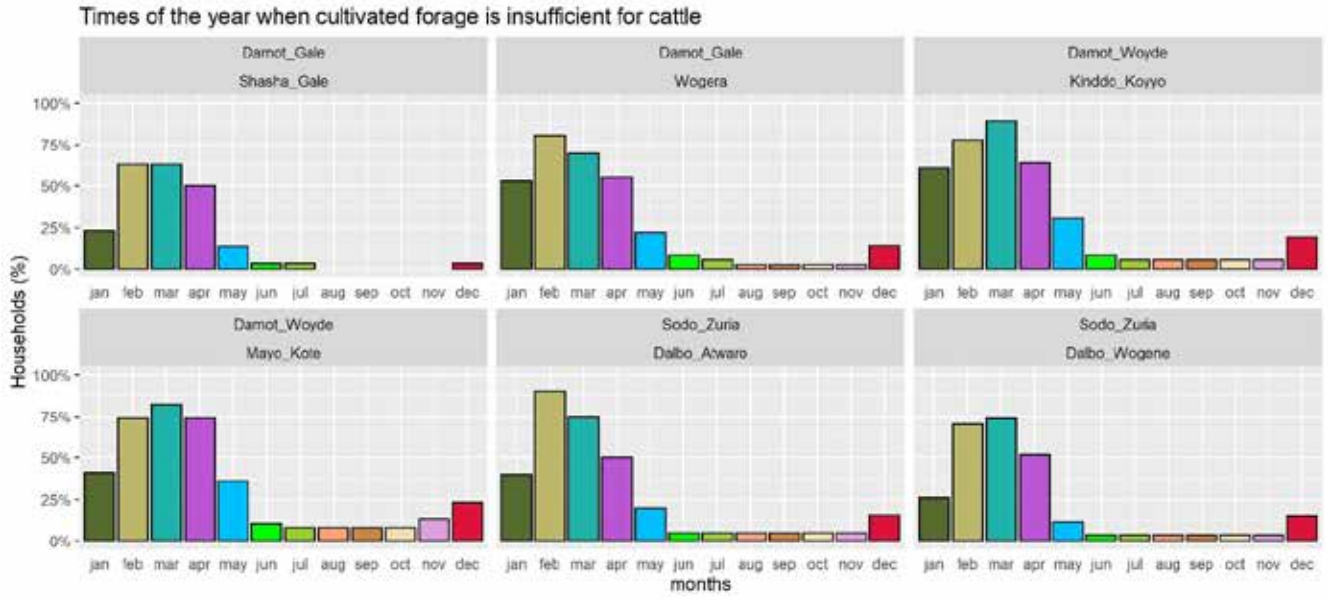


Figure 73: Share of households reporting cultivated forage insufficiency by kabele and month in Ethiopia.



Purchase of feed

Farmers were asked when they bought livestock feeds during the previous 12 months and the results are presented in Figure 74 below. Figure 75 further presents these responses across all the project sites. More than 50% of the farmers bought feeds in February (57%), March (73%), and April (52%). This coincides with when more than 50% of farmers reported grazing, collected feeds, and cultivated forage insufficiency in each of the three months. Less than 5% of the farmers bought feeds between June and December as this was generally not reported as feed insufficient months. Interestingly, only Mayo Kote bought feeds throughout the whole year. All the project sites did not buy feeds between July and November except for Kinddo Koyyo and Mayo Kote.

Figure 74: Purchase of livestock feeds by month in Ethiopia.

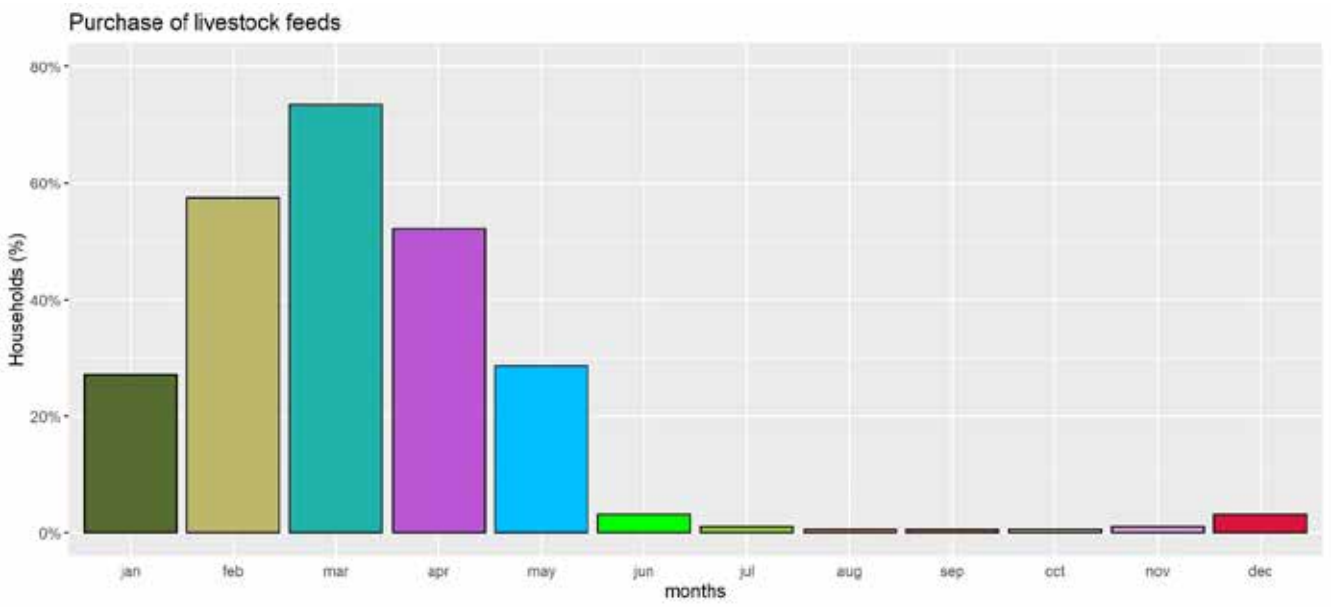
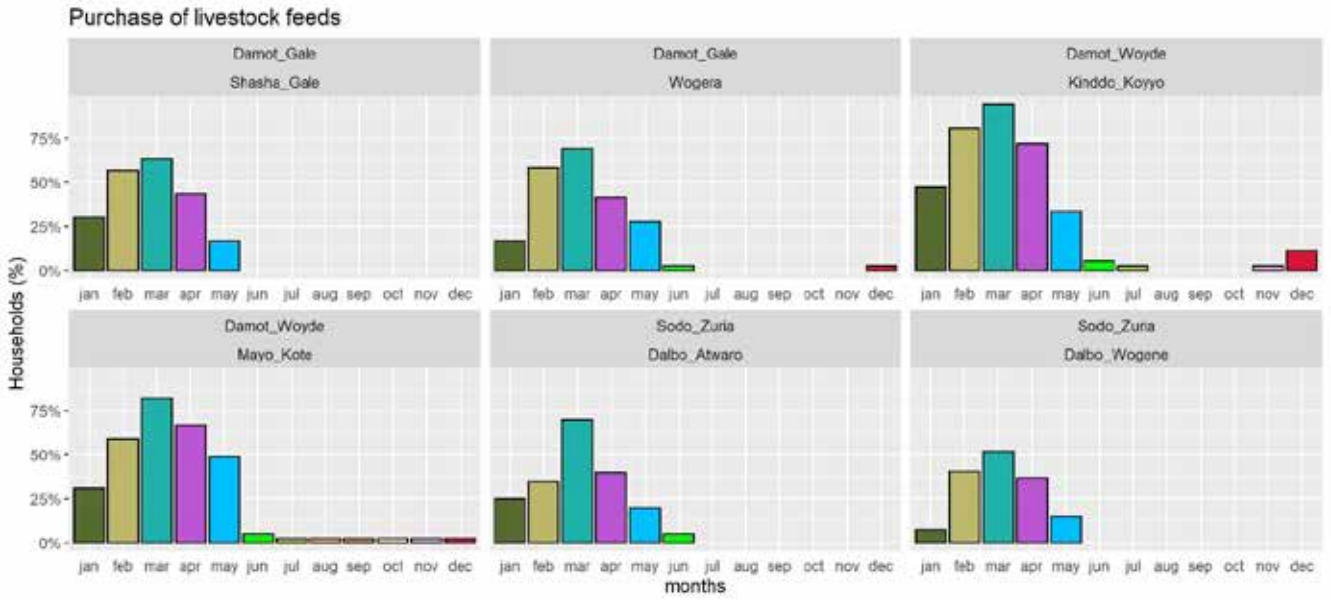


Figure 75: Purchase of livestock feeds per project woreda in Ethiopia.



i. Feed baskets

Farmers experience both dry and wet seasons and livestock has to feed in both seasons. Farmers were therefore asked their wet and dry season feed basket proportions and the results are presented in Figure 76 and 77 below. Fresh crop comprised the highest percentage (48%) of the feed basket in the wet season while in the dry season it comprised only 26%. Cultivated forage comprised the highest percentage (39%) of the feed basket in the dry season and comprised a slightly lower percentage of the wet season feed basket (36%). Fresh crop, gathered forage, and cultivated forage comprised more than 35% each of the wet season feed baskets while cultivated forage, gathered forage, and dried forage residue comprised more than 33% each of the dry season feed basket. Minerals had the smallest share in both the dry and wet season feed baskets.

Figure 76: Wet season feed basket in Ethiopia.

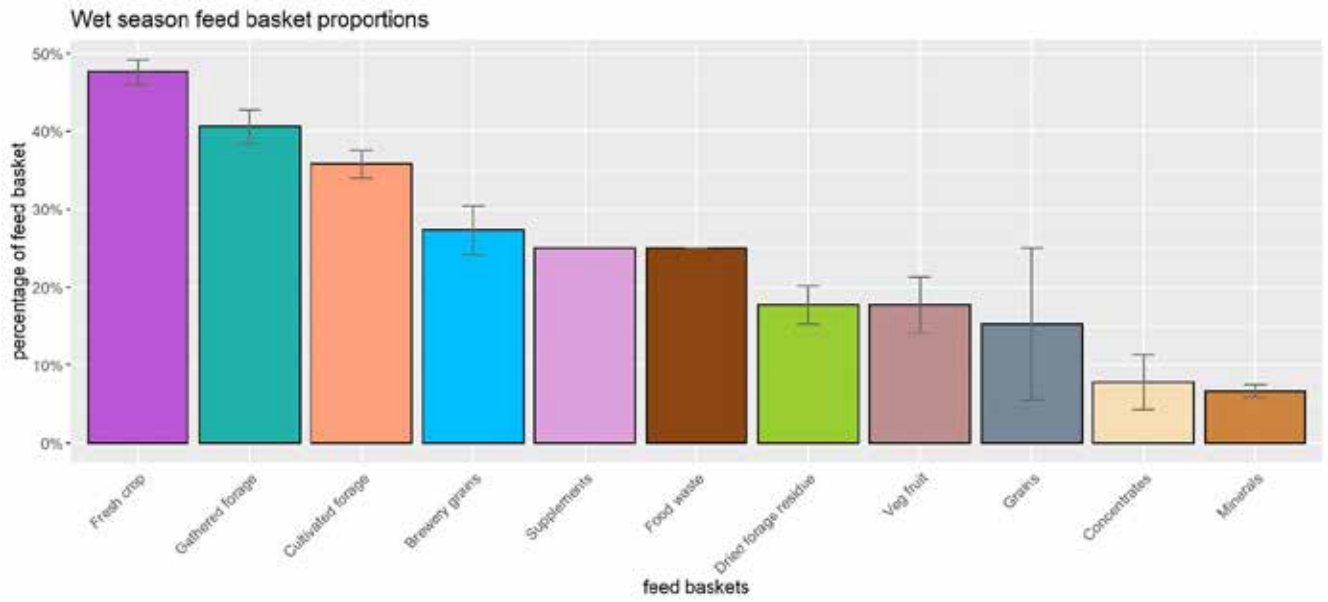
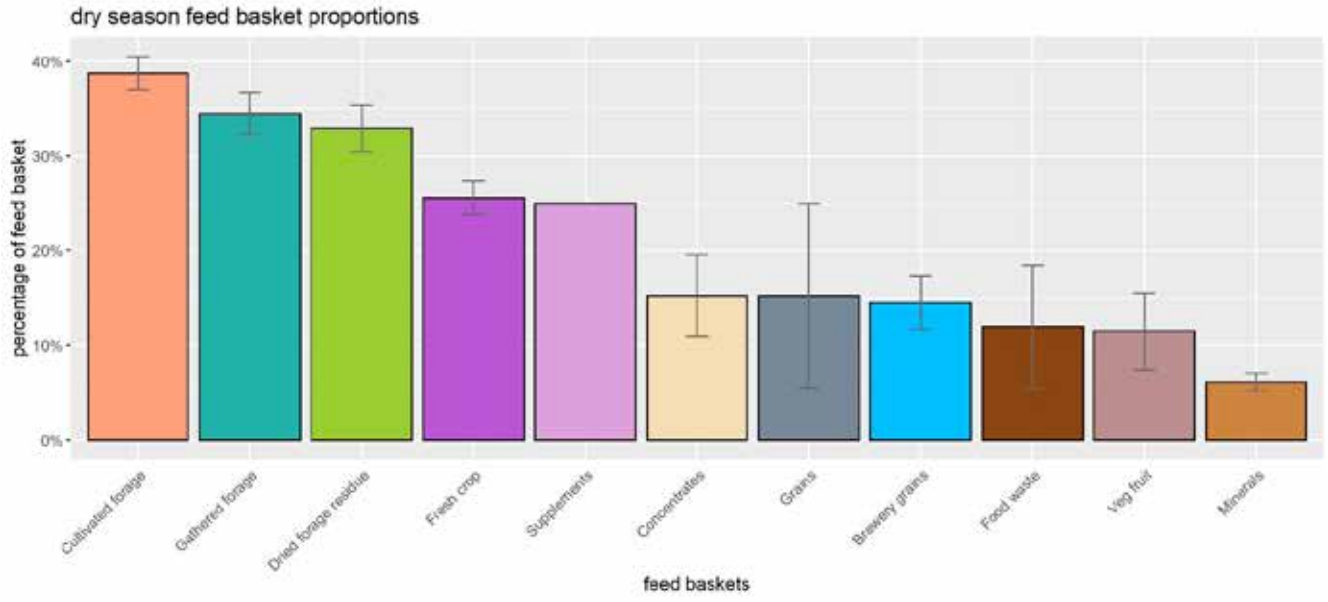


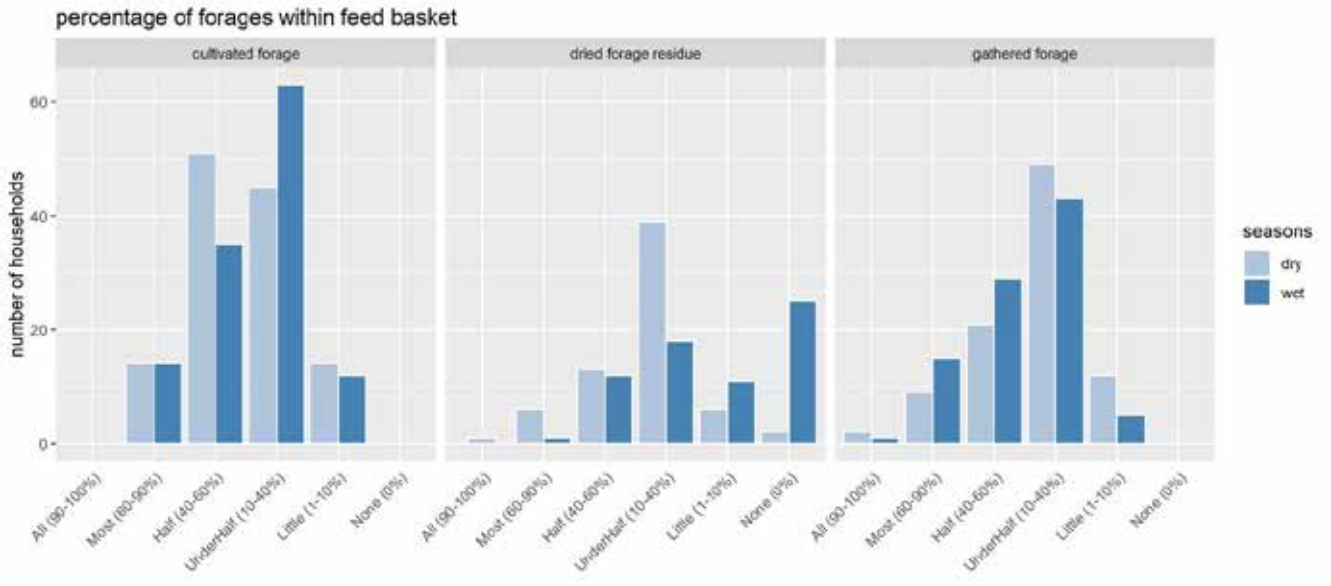
Figure 77: Dry season feed basket in Ethiopia.



The feed basket comprised forages in three forms: cultivated forage, dried forage residue, and gathered forage. These proportions were analysed for both the dry and wet seasons. Generally cultivated forage was used by more households compared to the other forms of forages. The majority of the households' feed baskets comprised 10-40% of cultivated forage in the wet season and a higher proportion (40-60%) in the dry season. The majority of the households had dried forage residue comprising under half (10-40%) of the feed basket in the dry season whereas the majority of the households did not use dried forage residue in the wet season. Gathered forage comprised under half (10-40%) of both the wet and dry season feed baskets.

Interestingly, there is a small number of households where gathered forage comprised all (90-100%) of the dry and wet feed basket proportions.

Figure 78: Percentage of forages within feed basket in Ethiopia



Various forage species grown on contours to prevent soil erosion in SNNPR, Ethiopia. Birthe Paul/CIAT

Researchers and farmers discussion advantages of various forage species in SNNPR, Ethiopia. An Notenbaert/CIAT

Researchers work with farmers to measure and weigh forage grasses in field trials to find better forage feed varieties project together with KALRO, Send a Cow and Advantage Crops. Georgina Smith/ Alliance of Bioversity International and CIAT

5. Summary and conclusions

A total of 198 farmers from eight different villages in four counties were interviewed in Kenya while 203 farmers from six kebeles in three woredas were interviewed in Ethiopia. In the following, we summarize their household characteristics, forage cultivation, livestock production and cattle feeding systems and feeds.

The farmers were categorized into demo and non-demo farmers. The demo farmers were project beneficiaries who received training on forage production, received planting materials, and their plots were used as demonstration plots. Various household characteristics were compared between these farmer categories. Kenya had a higher percentage of demo farmers (4%) compared to Ethiopia (2%). Land size in Ethiopia was assessed using land cultivated (land ownership data were missing) while land size in Kenya was assessed using land owned. Land size was measured in acres in Kenya and timad in Ethiopia. Generally, the median land size was larger among the demo farmers compared to non-demo farmers in both Kenya and Ethiopia. Farmers in Kenya largely had higher education levels compared to the farmers interviewed in Ethiopia. In Kenya, the majority of the demo farmers had secondary education whereas the non-demo farmers' majority had primary education. In Ethiopia, the majority of non-demo farmers had no formal schooling. Similarly, the majority of the demo farmers had formal no schooling except in Sodo Zuria where, they had attained secondary education. Generally, the household size in Kenya was larger than in Ethiopia. The median household size for the non-demo farmers was five for each of the woredas in Ethiopia while it was higher among the non-demo farmers in Kenya with three of the counties recording a median household size of six each. The farmers interviewed in Kenya were older than the Ethiopian farmers. The median age for the male head of the household was 50 years in Kenya compared to 46 years in Ethiopia. The median age for the female heads was also higher in Kenya (45 years) compared to 40 years in Ethiopia.

A greater proportion of farmers interviewed in Kenya (60%) and Ethiopia (76%) cultivate forage in their farms. Napier grass was the most common forage in Kenya while Desho grass was the most common forage in Ethiopia. Mulato II is a common forage in both Kenya and Ethiopia. Interestingly, there was greater forage diversity in Kenya than Ethiopia. In Kenya, most farmers had 18 types of forages in their farms which is substantially higher than Ethiopia where most farmers had six types of forages. In both countries, the majority of farmers cultivate only one type of forage with less than 30% of farmers cultivating more than one type of forage.

In Kenya, the average farming experience is about two years for Lucina and sugarcane tops, and about two years for desmodium and Napier grass. The rest of the forages have been cultivated in less than two years. In Ethiopia, the farming experience for all the forage is less than two years with an exception of Desho grass, which has been cultivated for an average of about three years.

Among households that had indicated forage acreage in Ethiopia, all the project sites were cultivating forage on less than 0.5 timad except for Shasha Gale that had an average forage acreage of 0.9 timad. In Kenya, all the villages were cultivating forage on less than 0.5 acres of land except for Makutano and Mubiri that had higher averages. All the project sites in Ethiopia had a median of less than 20% share of forage cultivation in overall land cultivation. Similarly, seven out of eight project sites in Kenya had a median of less than or equal to 20% share of forage cultivation in overall land cultivation.

The forage management methods used by farmers were weeding and fertilizer application. The frequency of weeding was higher in Kenya (1-5 times per year) than in Ethiopia (1- times per year). A considerably higher percentage of farmers were using fertilizer in forage cultivation in Kenya (74%) compared to Ethiopia (37%). We note that the most common type of fertilizer used in Ethiopia was Urea whereas the most common type of fertilizer used in Kenya was manure which in contrast was the least type of fertilizer used in Ethiopia.

NGOs were the most common source of forage planting material in Ethiopia whereas in Kenya family and friends were the most common source of planting material. Extension offices were more commonly used as a source forage planting material in Ethiopia (40%) compared to Kenya (4%). With regards to feed conservation, Kenyans were not keen on conserving feed from forages with only 21% conserving feed while in contrast, the majority of Ethiopians were conserving feed (59%). Forage yield was cited as the most important forage characteristic that farmers consider before choosing the type of forage to plant by the majority of farmers in both Kenya (70%) and Ethiopia (30%).

Livestock ownership in Kenya was similar to Ethiopia with 94% and 95% of the households interviewed owning livestock respectively. Chicken was owned by the majority of households in Kenya (85%) while it was owned by only 32% of the households in Ethiopia. Cattle was owned by a large percentage of farmers in both countries with Ethiopia having a higher percentage (97%) compared to Kenya (84%). Sheep was more common in Ethiopia (52%) compared to Kenya (13%). The majority of the cattle owners owned two cows per household, 32% in Ethiopia, and 27% in Kenya. 17% of the cattle owners in Kenya owned more than five cows per household while only 2% of the cattle owners owned more than five cows per household in Ethiopia.

Farmers in Ethiopia used more than one cattle feeding system per household compared to Kenya where households used only one feeding system. Combination-cut-carry was the most common type of feeding system in Kenya while tethering was the most common feeding system in Ethiopia. In addition, grazing and tethering feeding systems were more common in Ethiopia compared to Kenya.

Additionally, data was collected on the times of the year when livestock feed (grazing, collected, and cultivated forage) was insufficient for cattle. Generally, in both countries, the majority of the cattle owners reported having experienced livestock feed insufficiency during February and March, over 75% in Ethiopia, and over 60% in Kenya. Furthermore, over 40% of the cattle owners considered January as a livestock feed insufficient month in both countries. In contrast, April seemed to be a feed insufficient month for more cattle owners in Ethiopia as compared to Kenya. Farmers supplemented the feed insufficiency with buying livestock feed. More than 50% of the cattle owners bought feed during February, March, and April given that they were cited as feed insufficient months by the majority of cattle owners in Ethiopia. In contrast, fewer cattle owners purchased livestock feeds in Kenya, with the majority (28%) buying feeds in February and March although more than 60% of households cited these months as feed insufficient months.

Finally, comparison was made for the feed basket proportions during the dry season and the wet season. Fresh crop (48%) comprised the highest proportion of the wet season feed basket in Ethiopia while cultivated forages (58%) comprised the highest proportion of the wet season feed basket in Kenya. Cultivated forages (39%) comprised the highest proportion of the dry season feed basket in Ethiopia while gathered forage (49%) comprised the highest proportion in Kenya.

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