Tracing the benefits of ILRI forages to livestock producers in East Africa

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HIGHLIGHTS

- Alfalfa (*Medicago sativa*), Sesbania (*Sesbania sesban*) and Napier grass (*Pennisetum purpureum*) are the most important protein-rich fodders for poor smallholder farmers.
- ILRI genebank has 183 accessions of *Sesbania*, 86 accessions of alfalfa, and 11 accessions of Napier. Over 1,600 samples of these forage species were distributed between 1984 to 2017 in Kenya and Ethiopia.
- 2,569 participants from 180 villages in Ethiopia and Kenya took part in focus group discussions to assess the impact of ILRI projects.
- The results confirmed farmers' preferences for specific forage species for their uses as feed for livestock. Soil fertility improvement and soil erosion control were identified as important benefits linked to the adoption of alfalfa, *Sesbania*, and Napier.

Forage Genetic Diversity: Present and Future

Forage availability and diversity play a crucial role in the livelihood of an estimated one billion poor smallholder livestock rearers and their households. Hence, the conservation of forage genetic diversity is of great importance for economic development, particularly in poorer regions of the world. Unrelenting pressure from drivers of change especially underscore the imperative urgency for conservation. The demand for livestock products, and consequently forages, is anticipated to significantly increase with the advancing structural transformation of economies. Moreover, increasing climate change variability underscores the need to have adapted forages that can function in ever-changing ecosystems.

The importance of diversity notwithstanding, population increases exert continuous pressure on natural resources—leading to the conversion of marginal tracts of land to agricultural use and contributing to the loss of forage diversity. The continued assurance of forage availability and quality, in the context of the aforementioned pressures, is contingent on the existence of a diverse genetic reservoir of forages.

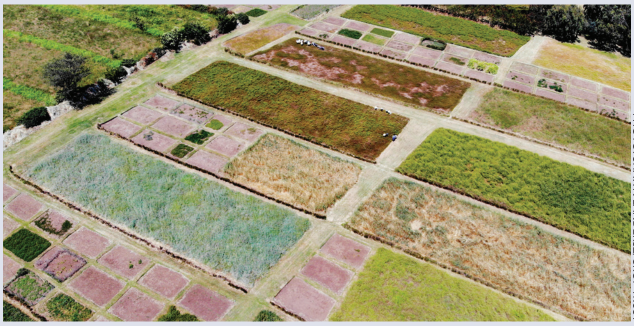
The International Livestock Research Institute (ILRI) has led significant efforts to conserve forage genetic diversity. The genebank at ILRI has been of great utility to many countries, most notably Ethiopia and Kenya, who rank first and second in forage germplasm distributions given their vibrant livestock sectors.

BOX 1 The ILRI Genebank

The International Livestock Research Institute (ILRI) genebank, formed in 1983, is located in Addis Ababa, Ethiopia. The genebank has both medium and long-term storage facilities for the conservation working and base collections respectively. The genebank's mandate is primarily centered on the conservation of high and mid-altitude subtropical forages, with a focus on those native to Africa.

The collection, comprising of forage legumes, grasses and fodder trees is one of the most taxonomically diverse collections held in any genebank globally. The genebank holds approximately 20,000 accessions representing over 1,000 species. The collection is overwhelmingly dominated by wild species followed by traditional cultivars and improved cultivars.

Legumes dominate the collection with *Trifolium*, *Vigna* and *Stylosanthes* being the most represented genera in the



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aforementioned order. That said, the grass collection though smaller than the legume collection, is hailed as one of the world's major grass collections which is unsurprising given that forage grasses currently in use partly originated in Sub-Saharan Africa. The genebank also has field genebanks situated at Zwai and Debre Zeit in Ethiopia for grasses whose seed lifespan is brief and also "shy seeders" (that is grasses that rarely produce seeds).

This study documents the benefits attributable to ILRI's genebank in several ways. First, we perform a detailed analysis of the distribution data (1984-2017) to identify major patterns in germplasm distribution. Second, CGIAR genebanks have often been referred to as the "genebanks of the poor" given their affiliation and devotion to smallholder agriculture. To illustrate this point, we seek to gain an understanding of farmer-preferred traits of forages which can serve as an important foundation for setting priorities in conservation and encouraging widespread adoption by analyzing data on preferences from the ILRI forage impact study. Third, we apply a mixed methods approach to understand the benefits of the three species on smallholder farmer welfare in Ethiopia and Kenya respectively.

Analytical approachThe data for this study were obtained from two sources: the ILRI germplasm distribution data records and the forage impact study. The ILRI germplasm distribution data details the distribution of germplasm from the year from 1984 to 2017. Each germplasm request was accompanied by a request number, accession number, lot number, genus, species, plant type category, institution name, country, and in some cases use purpose.

The forage impact study was a joint effort by the Feed and Forage Development and the Policy, Institutions and Livelihoods programs of ILRI. The village level survey was conducted in Kenya and Ethiopia between the months of May and September of 2015. The objective of the survey was to assess the impact of improved fodder material from the ILRI genebank and other organizations in Kenya and Ethiopia.

In Kenya, the study was conducted in 12 counties. Counties were purposively selected on the basis of significant dairy activity as well as on the basis that fodder material originating from ILRI among other institutions was dispensed in these areas. The total sample of villages was 180. In Ethiopia, the study was conducted in four regions and a total of 180 woredas (districts) were selected for participation in the survey. The survey regions in Ethiopia were selected based on the agro-ecosystem and on the basis that improved fodder material had previously been distributed in these regions.

Table 1.10 most requested accessions in Ethiopia for the period 1984-2017

Species	Accession number	Number of times requested
Medicago sativa	6984	149
Desmodium intortum	104	145
Desmodium uncinatum	6765	143
Chloris gayana	6633	131
Sesbania sesban	10865	118
Stylosanthes scabra	140	105
Leucaena leucocephala	70	101
Stylosanthes guianensis	4	101
Macroptilium atropurpureum	69	100
Leucaena pallida	14203	97
Grand Total		**1190**

Source of data: ILRI genebank

A semi-structured questionnaire was used to guide the Focus Group Discussions (FGDs) in each of the surveyed villages. Focus group sizes typically ranged from 5 to 15 participants per session. FGD participants were selected on the basis of their knowledge about forages and their ability to provide general information about the village, including population structure, land use patterns, and forage practices. Data on individual households or persons was not collected.

The total number of participants in the FGD was 2,569; 1,477 participants in Ethiopia and 1,092 in Kenya respectively. The questionnaire included detailed information about the village under several different modules including but not limited to forage production, forage benefits, forage diseases, forage climate, livestock production, milk production and milk prices.

A mixed method approach, comprising of quantitative and qualitative techniques, was employed to analyze the data collected. Quantitative analysis was employed to investigate farmer-preferred traits for the selected species. The study assessed based on two indicators: observed adoption in villages (percentage of villages in which at least one farmer is known to have adopted the species) and benefits derived from distributed germplasm as explained by FGD participants, using the ILRI forage use data. Secondary literature documenting the use of these accessions was also examined in order to understand the diverse pathways through which distributed germplasm has influenced research. The resulting information from the qualitative interrogation of the literature was then corroborated with findings from the forage survey as well as the distribution data.

Table 2. 10 most requested species in Kenya for the period 1984-2017

Species	Number of times requested
Sesbania sesban	326
Lablab purpureus	141
Pennisetum purpureum	79
Cajanus cajan	67
Cenchrus ciliaris	52
Stylosanthes guianensis	51
Cytisus proliferus	49
Medicago sativa	41
Sesbania bispinosa	40
Leucaena leucocephala	34
Grand Total	**880**

Source of data:ILRI genebank

Main findings

In Ethiopia, *Medicago sativa* (alfalfa) takes the lead as the most distributed legume accession (Accession number 6984) whereas *Sesbania sesban* (sesbania) takes the lead in the browser category (Accession number 10865) (Table 1).

In Kenya, *Pennisetum purpureum* (Napier) is the most frequently distributed species in the grasses category (Table 2). The demand for *Medicago sativa* and *Sesbania sesban* is motivated by the recognition that poor feed

BOX 2 The Genebank Impacts Fellowship

The Genebank Impacts Fellowship experience has been a truly fulfilling experience from a cultural, networking and technical perspective. The commencement of the fellowship, which was marked by the genebank impacts bootcamp in Bonn, was a wonderful opportunity for me to forge diverse friendships with my fellow Genebank Impacts Fellows who represent diverse cultures. The bootcamp also afforded a wonderful opportunity to interact and receive important instruction from leading researchers involved with genebank impact evaluation.

I am grateful to Dr. Alieu Mortuwah Sartie and Dr. Jean Hanson for the hands on mentorship at the ILRI genebank in Ethiopia. I appreciate the time they took to personally familiarize me with the genebank dataset as well as their advice regarding the selection of species for the focus of this study. I am grateful to Solomon, Tekle and Gebrehiwot for taking the time to orient me to the practical aspects of genebank operations. I am also grateful to Simret Yemane for ensuring my stay in Ethiopia went seamlessly. I would like to thank Dr. Nils for his guidance in aspects of impact evaluation whilst in Nairobi and to Dr. Chris Jones for facilitating both the technical as well as administrative aspects of this fellowship, without which this experience would not have been possible.

Finally, I am grateful for the technical experience gained during this fellowship. I worked extensively on the genebank distribution dataset which tremendously improved my analytical skills. I conducted interviews with selected genebank staff – an exercise that enhanced my understanding of the forage genebank given my limited experience at the start of the fellowship.

quality (i.e. low protein content) is a significant contributor to poor livestock productivity not only in Ethiopia but also in many countries situated in the tropics.

Medicago sativa has often been referred to as the "queen of forages" given that it has the highest yield of protein per unit area among all forage grains and legumes. Similarly, *Sesbania sesban* has been heavily promoted in Ethiopia as an affordable fodder source that can supplement the low protein basal diets. The browse fodder ranks very highly in the protein hierarchy among the fodder tree options amenable to the tropics. In the case of Kenya, the demand for Napier grass is fuelled by its dominance in the intensive and semi-intensive dairy farming systems in Kenya.

Concerning adoption, we find that *Sesbania sesban* was the most extensively adopted fodder according to counts of village occurrence, followed by *Medicago sativa* and finally the two Napier cultivars, Kakamega 1 and 2. Concerning farmer-perceived benefits, soil fertility improvement, soil erosion control and crop protection were identified as the main secondary benefits linked to the adoption of *Sesbania sesban* (Table 3) and *Medicago sativa* (Table 4) in Ethiopia

In Kenya, the main benefit attributed to the two Napier cultivars, Kakamega 1 and 2, was soil erosion control (Tables 5 and 6). We also find considerable documentation in the secondary literature on the utilization of ILRI accessions in evaluation trials as well as in the mitigation of serious agricultural challenges beyond fodder production such as Striga, infestation, stem borer infestation and Napier Grass Stunt disease.

Table 3. Farmer perceived benefits of *Sesbania sesban* in Ethiopia

Benefits	Occurrence by count of villages
Acidity	1
Coffee shade	2
Construction	2
Crop protection	83
Desalinization	21
Erosion control	118
Fence	5
Push pull technology	18
Soil fertility	117
Source of income	1
Weed break	1
Wood	5
Grand Total	**374**

Source of data: ILRI forage survey

Table 4. Farmers perceived benefits *Medicago sativa* in Ethiopia

Benefits	Occurrence by count of villages
Crop protection	30
Desalinization	7
Erosion control	37
Push pull	6
Soil fertility	41
Weed break	1
Grand Total	**122**

Source of data: ILRI forage survey

Table 5. Farmer perceived benefits of Kakamega 1 in Kenya

Benefits	Occurrence by count of villages
Crop protection	3
Erosion control	22
Mulching	1
Push pull technology	2
Soil fertility improvement	3
Source of income	1
Grand Total	**32**

Source of data: ILRI forage survey

Table 6. Farmer perceived benefits of Kakamega 2 in Kenya

Benefits	Occurrence by count of villages
Erosion control	13
Mulching	1
Push pull technology	1
Soil fertility improvement	2
Source of income	1
Grand Total	**18**

Source of data: ILRI forage survey

Conclusions and further considerations

The study provides useful findings regarding the benefits from direct utilization of ILRI forage germplasm. First, the study reaffirms the substantial contribution of ILRI germplasm to the enhancement of smallholder livestock systems through the provision of a diverse forage portfolio conserved to the highest possible standard.

Secondly, the findings point to an even greater role of forage diversity in the management of serious infestations within the agricultural domain. While it is beyond the mandate of this paper to assess the range of economic losses attributed to these infestations, it is evident that huge agricultural losses may accrue due to a limited genetic base in forage germplasm.

Further reading

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Additional details can be found in the paper on which this brief is based: Kavengi Kitonga, Alieu Mortuwah Sartie, Jean Hanson, Nils Teufel, Chris Stephen Jones, Nelissa Jamora and Melinda Smale. 2019. Tracing the benefits of ILRI forages to livestock producers in East Africa. Genebank Impacts Working Paper No. 8. CGIAR Genebank Platform, ICRAF, and the Crop Trust.

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