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ILRI_SIMLESA II Annual report

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Capitalizing on the role of livestock for a sustainable intensification of the mixed crop-livestock in the SIMLESA sites: fodder interventions in Ethiopia and Tanzania

1. Ethiopia

Fodder interventions towards CA based sustainable intensification

The farming system in the highlands of Ethiopia is small holder mixed crop-livestock farming. In this system, crop cultivation and livestock rearing complement each other with the latter, serving as the main source of farm power, food of animal origin, cash income, and manure, while the former serving as a source of feed in the form of crop residues and grain. Due to population pressure in rural areas of the highlands, grazing lands have been continuously converted to arable lands, and the traditional livestock feed resource base has declined. As a result farmers have been forced to heavily rely on crop residues for the nutrition of livestock. In Ethiopia, on average 50% of the current feed resource for livestock originates from crop residues. In the southern Ethiopia SIMLESA sites, the share of crop residues in the diet of ruminant is even higher than the national average. Nutritionally, the feeding value of crop residues especially that of cereals, is poor containing low levels of crude protein (3-4%) and organic matter digestibility (less than 50%). Crop residue based diets as a result rarely fulfill nutritional requirements for maintenance. On the other hand, complete removal of crop residues from the field for various purposes including livestock feed has led to a declining soil fertility, reduced crop productivity. Breaking this vicious circle of low crop-livestock productivity and insuring the sustainability of the system appears a priority development agenda in light of the prevailing climate change induced stresses upon smallholder farming communities.

One of the development strategies to break these vicious circle in the mixed system is to promote the adoption of improved forage cultivation and utilization practices within the smallholder context. ILRI in collaboration with national partners has led a systematic identification of the farming system constraints, livestock related constraints and opportunities, and periodization of forage technologies that work best under the given context using FEAST and Techfit tools. Based on the outcomes of the analysis forage technology scaling and demonstration plans have been developed for Ethiopia and Tanzania sites with the objective of improving the quality and quantity of forage biomass available for livestock and reducing the existing heavy dependence on crop residues for livestock feeding. This was further supported by scenario analysis to identify which livestock production alternatives can provide optimal return while contributing significantly to the environmental sustainability of the mixed smallholder system in the SIMLESA sites.

Achievements towards scaling forage technologies

In Ethiopia, ILRI has held planning meetings with national partners to identify forage options that can be promoted at a wider scale. Accordingly forage varieties which have been selected for their productivity and adaptability were identified for scaling through various means (farm demonstrations, field days and pamphlets). These included 11 annual and perennial legume and grasses forage options: Cowpea, Lablab, Lupine, Napier, Brachiaria, Desmodium, Oats, Vetch, Desho grass, Pigeon pea, and Rhodes grass. Farmers were trained on basic agronomic practices for the

production of forage biomass for livestock feeding and seeds/planting materials for further expansion of the forage varieties. A total of 261 farmers were reached as direct beneficiaries, with the total land covered with forages reaching at 33.53 ha across the intervention sites in the 2016 planting season (Table 1).

Table 1. Achievements in scaling improved forages across the SIMLESA research sites during the 2016 planting season

Region	District	Forage	Purpose	No. of farmers	Total area covered (ha)
Amhara	South Achefer	Cowpea/maize	Forage	9	2.25
Amhara	South Achefer	Labalab/maize	Forage	20	5.00
Amhara	South Achefer	Lupine (Pure)	Grain for sheep fattening	28	7.00
Amhara	South Achefer	Lupine/Maize	Grain for sheep fattening	29	3.63
Amhara	South Achefer	Lupine	Seed production	15	4.70
SNNPR	Hawassa Zuria	*Brachiaria mutica*	Forage	4	0.04
SNNPR	Hawassa Zuria	*Brachiaria mutica*	Forage	1	0.01
SNNPR	East Badawacho	*Desmodium unc.*	Seed production	2	0.30
SNNPR	East Badawacho	Cowpea	Seed production	1	0.10
SNNPR	East Badawacho	*Brachiaria mutica*	Seed production	1	0.06
SNNPR	East Badawacho	Oats and Vetch	Forage	5	0.05
SNNPR	East Badawacho	Desmodium unc.	Seed production	3	0.45
SNNPR	East Badawacho	Brachiaria mutica	Seed production	1	0.06
SNNPR	East Badawacho	Oats Vetch	Forage	5	0.05
SNNPR	Meskan	Oats Vetch	Forage	7	0.07
SNNPR	Meskan	Oats Vetch	Forage	6	0.06
SNNPR	Meskan	Brachiaria mutica	Seed production	2	0.12
SNNPR	Meskan	Desmodium unc.	Seed production	2	0.30
SNNPR	Meskan	Cowpea	Seed production	1	0.10
SNNPR	Meskan	Oats Vetch	Forage	6	0.06
SNNPR	Meskan	Oats Vetch	Forage	8	0.08
SNNPR	Meskan	Cowpea	Seed production	1	0.10
SNNPR	Meskan	*Brachiaria mutica*	Seed production	1	0.06
SNNPR	Meskan	*Desmodium unc.*	Seed production	1	0.15
Oromia	Gobosayu	Rhodes grass	Seed production	18	1.44
Oromia	Gobosayu	Labalab	Seed production	10	0.10
Oromia	Gobosayu	Desho grass	Seed production	5	0.05
Oromia	Gobosayu	Pigeon pea	Seed production	10	0.01
Oromia	Gobosayu	*Brachiaria mutica*	Seed production	10	0.03
Oromia	Illu Gelan	Rhodes grass	Seed production	14	0.32
Oromia	Illu Gelan	Labalab	Seed production	10	0.10
Oromia	Illu Gelan	Desho grass	Seed production	5	0.05
Oromia	Illu Gelan	Pigeon pea	Seed production	10	0.01

Oromia	Illu Gelan	*Brachiaria mutica*	Seed production	10	0.03
Total				**261**	**35.53**

In addition to the direct beneficiaries, more farmers were reached in the forage scaling through demonstration, field days and pamphlets, the total of which reached approximately 4827 households (Table 2)

Table 2. Total number of farmers reached indirectly through trainings, field days and media outlets on improved forage cultivation

	Activity	**Training events**	**Field days**	**Brochures and pamphlets**	**Number of total beneficiaries reached**
1	**On farm Seed production**				
1.1	Sweet Lupin	1	1	200	315
1.2	Napier	3	2	100	480
1.3	cow pea	2	2	175	335
1.4	lablab	3	2	350	560
1.5	Desmodium	3	2	200	507
1.6	Bracheria	3	2	200	505
1.7	Rhodes grass	2	1	100	300
1.8	Pigeon pea	2	1	100	300
2	**Scalable forage technology**				
2.1	Sweet Lupin	1	1	300	550
2.2	cow pea	1	1	75	145
2.3	lablab	1	1	75	135
2.4	Bracheria	1	1	100	295
2.5	Napier	2	1	100	400
	Total	**25**	**17**	**2075**	**4827**

Figure 1. Annual oat-vetch (a) and perennial desho grass (b) in the farmers' backyards

Evidence for impact towards improving yield, environmental sustainability and reducing risks

Livestock production in the SIMLESA sites has been heavily constrained by poor quality of available feed resources and seasonal shortages in feed biomass supply. The forages scaled across the intervention sites contributed considerably towards addressing both the problems of quality and quantity. Farmers were able to harvest varying levels of yield from the forages cultivated, ranging from 5-10 ton/ha at one harvesting time. From the perennial forages such as desho grass, it was possible for farmers to obtain biomass at least three times per year. When the forages cultivated are looked in terms of nutritional profile, for example oat-vetch mixture contained crude protein in the range of 14-16%, and metabolizable energy in the range of 9.5 to 10.3.

As farmers do not have access to commercial concentrate supplements to provide nutritional balanced rations to their dairy or fattening animals, the forages showed a huge potential to serve as cheaper sources of supplemental feeds for dairy and fattening animals consuming low quality basal fields. Farmers who adopted the improved forages showed interest to acquire highly productive crossbred animals for dairy production. This interest has an important implication towards reducing the downward risk, through replacement of large herd sizes with smaller number of productive animals at household level. Farmers who have engaged in improved forage cultivation have also interest in involving in market oriented livestock production that would stimulate off-take and reduce pressure on available feed resources. Market oriented livestock production is expected to benefit farms financially, while at the same time protecting the environment due to lesser feed demands at the time of feed scarcity.

Integration of suitable forages species in the cropping system, either through intercropping, alley cropping or on soil bunds has become effective in producing significant amount of feed biomass, while controlling soil erosion, nutrient leaching and improving soil moisture content. The integration has resulted in a simultaneous increase in feed and crop production. In this respect desho grass has been evaluated by farmers to be highly effective when planted on soil bunds. It stabilizes soil bunds, reduce runoffs and increase the soil moisture content. This appears to have a considerable positive impact on crop yields. The fodder yield exceeds 16 ton/ha with a potential three times harvest

per year. Nutritionally, the fodder has a mean crude protein content of 9.5% and a metabolizable energy content of 7.7 MJ/kg dry matter, with a potential to produce a liter of milk from feeding a kg of dry matter of this fodder.

Table 3. The productivity of desho grass fodder as influenced by altitude, growing niche and management

Factors	Dry matter yield (ton ha^{-1})					
	Midland areas			Highland areas		
	Wet season	Early dry season	Mean	Wet season	Early dry season	Mean
Niche						
Soil bund	9.18	6.84	8.12	8.00	8.70	8.35
Backyard plot	8.97	7.12	8.16	8.46	6.65	7.52
Roadside	7.82	4.35	6.36	8.59	4.75	6.67
P-value	ns	***	*	ns	**	ns
Management						
Weeding and manuring	8.65	7.13	8.17	8.10	7.06	7.41
Weeding only	7.10	4.75	4.96	8.60	5.09	7.04
P- value	ns	***	***	ns	***	ns

Figure 2. Desho grass on soil bunds (left) and lablab intercropped with maize crop

Benefits from gender perspective

Women and youth are mainly responsible in taking care of animals around the homestead and grazing lands. Better access to feed resources is expected to directly benefit women and youth, as it reduces the extra effort they should make to collect feed for their animals. Focus group discussions with women headed households in the southern region revealed that the engagement in forage cultivation and improved utilization technologies has reduced the time they spend looming for feed. An improvement in dairy production was also reported by households who adopted cultivation of different forage species on larger plots.

In some of the sites, such as Abchikly district of Amhara region, there are active dairy cooperative with members owning on average of 2 crossbred cows. The cooperatives are run both by women and men groups, collect milk and process into butter cheese, as well as sell fluid milk at reasonable price. These cooperatives have benefited from planting Rhodes grass, Napier grass and Sesbania. Members mentioned that, in addition to dairy products, there is a very good market for male cross calves for veal in big hotels. For example, a two years old calf can be sold for Birr 25,000 – 30,000 in Bahirdar. Commonly, incomes from the sale of milk and dairy products is mainly managed by women, even in male headed households. It is therefore very logical to assume that the increase in dairy production as a result of the fodder interventions improves access to and control over resources by women, which has a positive impact on child nutrition. Children and adults in families who own cross-bred dairy cow/s look better and healthy as compared to those without any dairy cow. In turn, the cows whose feeds are supplemented with improved forages look better and healthy as compared to those without supplements.

Benefits for youth employment and agribusinesses

Youth unemployment has become a national agenda in recent years and through public and private partnership efforts are underway to engage youth in income generating activities. One of the potential employment opportunities identified has been involvement in small scale animal production activities. Budget has been allocated from the central and regional governments to provide credit services for youth groups who come with their own business plans. It is thus reasonable to assume that the fodder intervention that has been promoted across the SIMLESA sites can create opportunities for the youth to access forage planting materials, cultivate homegrown forages and generate income either by selling the forage biomass or by feeding to fattening or dairy animals. During focus group discussions in southern region, it has been documented that households have realized the new market opportunities for livestock products and they appear more willing than ever to allocate a plot of land for fodder production and engage their family in market oriented fattening practices. These farmers started to calculate and compare the financial benefit that they get from growing crops such as wheat and fattened animals (bulls and rams) on a given piece of land. The trajectory is that the market price for beef and dairy products is increasing rapidly while that of stable crops such as wheat and maize remains stable. This appears to be mainly because of the increasing urban population over the past decades. As feed is the most important input (accounting for upto 70%) of the cost of livestock production in commercial settings, availability of good quality forages are of paramount importance to stimulate the agri-business in livestock production.

Business opportunities are also opening up in the area of forage seeds and planting materials. Although public institutes and NGOs have been the primary buyers of forage seeds in previous times, the increasing awareness and involvement in fodder production increased the demand for forage seeds and planting materials. The national campaign on soil and water conservation has also added another demand for forage planting materials, as physical soil and water

conservation structures need to be reinforced with biological means. Therefore, forage seed agri-businesses are emerging opportunities for farmers and agro-dealers nationally.

Figure 3. Small ruminants as potential employment opportunities for youth groups

Key messages to farmers, agribusinesses and extension

In the mixed crop-livestock farming system, improved fodder production has become not an option but a necessity for farmers, because traditional livestock feed resources have become scarce. To ensure the environmental sustainability of the farming system, forages need to be effectively integrated in the system and the heavy reliance on crop residues for feed needs to be reduced. This can be achieved through context specific scaling of forage technologies and utilization practices. The current market prices and demand for livestock products dictate that there is a huge potential for farmers to realize their livelihood opportunities through effective engagement in livestock production. This need a paradigm shift in the livestock production, from the traditional subsistence production to market oriented production, which demands promotion of proven technologies in the area of animal nutrition, genetics, disease control and marketing strategies.

In 2017, partner engagement paradigm has extended from only research institutions to inclusion of development partners (NGOs) to speed up the scaling of the forage varieties which have been proven by research and on-farm verifications to the wider crop-livestock farming communities in the project woredas and beyond. Moreover, 3 MSc students have been identified to generate evidences of farmers' benefits through feeding of the improved forages in the project woredas.

2. Tanzania

Intensification of crop-livestock interactions by enhancing feed availability from fodder & crop residues in Mbulu and Karatu Districts

Feeding of livestock continues to be a challenge to smallholder farmers due to lack of high yielding forages and lack of knoweldge to utilize locally available feed resources; including knowledge on animal requirements based on available genotypes. These problems are aggravated by lack of access to and high cost of feed inputs. The use of cheap and readily available local feed resources has great potential to increase livestock productivity. The motivation of this project is to design and test strategies that can overcome seasonality driven milk fluctuations, by improving feed availability in SIMLESSA II sites of Karatu and Mbulu Districts of Manyara region, Tanzania in order to alleviate feed shortages especially in the dry season. The feed intervention packages promoted by the project aims to enhance forage biomass of higher quality and also improve utilization of abundant crop residues. Further the interventions also aim to narrow the knowledge gap in feed production and enhance benefits from the potential of forages improving soil nutrients which are important for crop production. This project adopted a novel methodological framework for developing scenarios of feeding management decisions through a stakeholder-driven process that produced qualitative and quantitative outputs of feeding decision features that reflect different contexts and stakeholder perspectives as well seasonal milk fluctions in study areas. Faced with changes and trade-offs between bio-physical, socio-economic, cultural and environmental sustainability goals; approaches that combine 'bottom up' perspectives (farmer-led) with 'top down' research backstopping and data sets that can be used to assess potential impacts on feeding and how these interact with agro-ecology, production systems and seasons for ensuing seasonality driven milk fluctuation hence poverty reduction were promoted.

Achievements towards scaling best-bet forage technologies

The main achievement in promoting effective use of feed resources in the SIMLESA districts was developing a menu of forage options for farmers. The menu was drawn up based upon the need to scale forage innovations tested under the Africa RISING (Africa Research in Sustainable Intensification for the Next generation) Project in Babati districts. Decisions were also based on feed assessments and feed planning carried out with farmers in Mbulu and Karatu districts. Options selected varied by agro-ecological zone, feeding systems, farmer preference and by the resource-level of the farmers. Therefore, the menu of forage options presented to farmers in Karatu and Mbulu districts included:

- Grasses, such as *Bracharia decumbens*, Cv. Mulato 1 and Rhodes grass (Cv. Boma Rhodes)
- Fodders – Napier grass (KK1, KK2, ILRI 16835, ILRI 16837)
- Legumes such as desmodium, Vicia (*Vicia vilosa*), Cowpea, Mucuna, and Lablab
- Intercrops of different forages (grasses, fodders and legumes)
- Conservation methods such as hay baling and silage
- By-products such as sweet potato leaves and maize stover
- Feed processing, e.g., chaff cutters and pulverizers
- Concentrates, such as dairy meal, and feed ration formulations

Forage options selected by farmers in Mbulu and Karatu are indicated in Table 1.

Table 1: Summary of forage trials in Mbulu and Karatu districts:

Districts	Environment (Villages)	Forage Category type	Forage type
Mbulu Karatu	Tumati, Dongobesh, Hydom Rhotia, G-Arusha, Ayalabe	Grasses	Bracharia Mulato II; Rhodes grass
		Fodders	Napier grass - KK1, KK2, ILRI 16837, ILRI 16835
		Legumes	Desmodium, Lab lab, Vicia, Mucuna, Cowpea
		Intercrops	KK1/Vicia vilosa; KK2/Desmodium; Bracharia/Desmodium; ILRI16835/Vivia vilosa; ILRI 16837/Desmodium; Bracharia/ Lab lab; KK2/Desmodium

- A total of 18 farmer groups have been selected in collaboration with extension personnel in the six project villages of Mbulu and Karatu districts.
- A total of 18 farmer group meetings were held in six villages to sensitize farmers about the activities, exchange ideas, and agree on activity work plans. Farmers were assembled by groups to design scaling strategies.
- Volunteer farmer trainers for the forage interventions were selected after discussions with farmer groups, local administration and extension officers. Volunteer farmers were selected anticipatorily, based on agreed criterion at these meetings. A total of 18 farmers trainers have been recruited through groups and trained to host field trials.
- Volunteer farmers were trained on processes of managing research activities i.e. data collection, forage establishment and management as well as how to host and teach fellow farmers.
- Forage seeds and planting materials used for planting (Table 1), were sourced from the Africa RISING project villages in Babati district and delivered to farmers.
- Volunteer farmers through participation of their respective groups prepared land for planting forages. The land availed by the farmers ranged from ¼ to ½ acre.

- Data collection from forage plots using simple data collection tools developed by researchers is on-going. Focal area extension personnel were identified and trained and are helping the volunteer farmer trainers with data collection.
- The research team is in the process of collecting forage samples for quality analysis at the Institute of Sub-Tropical Agriculture, the Chinese Academy of Sciences in China facilitated by ILRI.
- Field days and participatory farmer assessments of the planted forages are yet to be conducted
- Two community based forage bulking plots established in Tumati village (Mbulu District) and Ayalabe village (Karatu District) to provide planting materials for farmers and group members.
- To enhance processing and utilization of crop residues, 18 farmer groups selected in collaboration with extension personnel from Mbulu and Karatu districts to host the forage trials will participate in forage processing and utilization. This activities will be undertaken in the 3rd quarter of this year.
- To build capacity around feed technologies A total of 200 farmer group members drawn from the six villages of Mbulu and Karatu districts were assembled per group and trained on forage establishment and management; and crop residue management and utilization.
- Volunteer farmers who are currently hosting the forage trials will also host the feed management and utilization activities.

Impacts realized and expected

- Improved access and availability of high yielding forage pastures, planted fodder and legumes in Mbulu and Karatu districts.
- Widened improved fodder options suitable to different climatic conditions in Mbulu and Karatu districts.
- Increased skill and capacity of farmers
    - A total of 200 farmers trained on improved feed and forage technologies
    - A total of 18 volunteer farmer trainers recruited and trained to host forage trials, forage; and feed processing and utilization activities.
    - Two community based forage bulking plots established in Tumati village (Mbulu District) and Ayalabe village (Karatu District) to provide planting materials for farmers and group members.
    - A total of 18 farmer groups selected and sensitized on feed development in project sites
    - The active participation of farmer group members in project feed and forage activities indicates farmer groups' ownership and cohesion that will build a sound base for testing and scaling technologies.
    - Adoption of forages and better use of crop residues has potential to reduce environmental degradation in project sites

Posters

Aberra Adie, Melkamu Bezabih, Endalkachew Wolde-Meskel, Peter Thorne. Scaling of Improved Forage Varieties at Selected ILRI-SIMLESA Project Locations in Ethiopia and Tanzania: Poster Presented at the workshop "Taking stock on Sustainable Intensification Research for Impact in ESA: Implications and Strategies for Future Work", 20-22 June 2017 Arusha, Tanzania.

Aberra Adie, Melkamu Bezabih, Endalkachew Wolde-Meskel, Peter Thorne**.** Scaling of Improved Forage Varieties at Selected ILRI-SIMLESA Project Locations in Ethiopia: presented at the Workshop and Exhibition on **'Promoting Productivity and Market Access Technologies and Approaches to Improve Farm Income and Livelihoods in Ethiopia: Lessons from Action research projects',** 8- 9 Dec. 2016 in ILRI campus-Addis Ababa