

Forage seed production for sustainable ruminant livestock intensification in Tanzania

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Abstract

*Sustainable intensification of beef and milk production in any country will rely on cultivated forages. Success of cultivated forages is not possible without the support of an aggressive and dynamic forage seed production to meet an increasing demand that currently stands at 22,954 tons while the production stands at 11.41tons per year in the country. Forage seed production in the country is less developed than food crop seed production. Currently there is no locally produced certified forage seed in the country. The seeds of most cultivated forage species and cultivars are either imported as certified seeds or acquired locally as naturalized varieties without certification. Uncertified seeds lack agronomic management record and encourage forage diseases and pest spread in the country. Tanzania, however, is a point of diversity of several potential forage grasses and few legumes species that have been adapted elsewhere. Typical example is *Brachiaria brizantha* cv. Marandu and *Panicum maximum* cv Tanzania with a participation of 70 % and 10 % in the Brazilian pasture seed market and by 1999 growing season *B. brizantha**

and *P. Maximum* covered 35,000 and 6300 ha, respectively. The two grass pasture species obtained from Tanzania are not yet domesticated in the country and are still retaining their wild characteristics attributes which aid their natural spread but difficulties for their commercial seed production. As a consequence from 2019 to 2022 in total, 25.1 tons of 10 grasses, 2 legumes and 1 forb seeds have been imported for forage cultivation and soil conservation purposes. The imported grasses included *B. Brizantha* cultivars, *Panicum maximum*, *Eragrostis curvula*, *Eragrostis teff*, *Chloris gayana*, *Cynodon dactylon*, *Pennisetum clandestinum*, *Lolium perenne*, *Phleum pretense*, and *Poa pratensis*. The imported legumes were *Trifolium repens* and *Medicago sativa* and the forb was *Cichorium intybus* (Commander Chicory). Adequate forage seed availability for sustainable ruminant livestock intensification in the country is possible, through development of an aggressive and dynamic forage seed production sub-sector supported by official research. Studies on agronomic factors influencing the adaptability of forage species, varieties or ecotypes would be useful for determining seed production technologies to increase seed production. These studies should go hand in hand with collection, preservation and characterization of our local forage germplasm resources to bring out the elite varieties or ecotypes for breeding and seed commercialization. Forage seed regulations chapter should also be included in the current seed act or grazing land and feed act. In order to commercialize forage seed production in the country, however, as for the food crop seed production Public Private Partnership must be engaged. This review paper therefore tend to expose the strengths, weakness, opportunities and threats of forage seed production for sustainable ruminant livestock intensification in Tanzania.

Key words: *Cultivated forages, certified seeds, commercial seed production, public private partnership*

Introduction

Tanzania has the second largest ruminant livestock population in Africa comprising of 33.9 million cattle, 24.5 million goat and 8.5 million sheep (NBS 2021). This is a ruminant livestock population of about 40 million TLU (1 TLU =250 kg l. wt.) (MLF, 2021) that require about 160 million ha of grazing land (MLF, 2020). The available grazing land is, however, about 9.3 mill ha (NAFORMA, 2015) out of 94 mill ha of the country land mass. With increased human population there has been an increased activities on the available land including expansion of crop cultivation, settlement, mining, transport infrastructures and even expansion of nature conservation to ameliorate tourism industry. Even if land for crop cultivation about 26.4 mill ha (NAFORMA, 2015) is also used for grazing of which is occasionally used in agro pastoral areas especially in the north-western zone of the country will just be 35.7 mill ha that is below 50 % of the required land for full grazing capacity. Unfortunately, both crop and livestock productivity in the country is extremely low. The food demand from both crops and livestock products by an increasing human population in the country can either be met by increasing cultivated and grazing land or through intensive production. The first option leads to destruction of vegetation cover, loss of biodiversity, forests, reduce ecosystem services and depletion of carbon stocks, therefore, undesired. The second option is to impart knowledge on improved agricultural and livestock production practices to crop and livestock farmers. The conversion of natural conserved land such as forests or savannah into cropland or grazing land should be avoided because

it has significant consequences in terms of loss of biodiversity and natural carbon stocks. Globally, the loss of carbon due to land-use change (LUC) is responsible for about 10% of the total emissions of greenhouse gases (Tubiello *et al.*, 2015). The concept of *sustainable intensification*, which entails production of more food or livestock products from the same area of land while reducing associated environmental impacts, is of particular importance currently than before due to an ever-increasing demand of beef, milk and cereal crops (Johnston, 2011, Beddington *et al.* 2012).

In order to intensify ruminant livestock productivity there should be an acquisition of grazing land, efficient soil and water management, use of improved forage seed varieties, integrated weed/bush management and appropriate use of productive forages. Among these five constraints to intensify ruminant production in Tanzania availability of good quality certified forage seed for every agricultural zone in the country is becoming the most important constraint. Forage seed production in the country is less developed than food crop seed production. The commercial seed in Tanzania is restricted to a narrow range of food crops led by hybrid maize, and small amounts of cash crops such as sunflower, cotton and vegetables. Currently commercial forage seed is rarely mentioned in the country.

Status of forage seed production in Tanzania

Cultivation of forages in Tanzania started way back in 1930s (MWLD, 2005). Forage research emphasis was on pasture establishment, management and utilization and was conducted on station in various agricultural ecological zones in the country (Kusekwa, 1987). The seeds of forage cultivars tested were, however, imported from mainly tropical Australia regions, but

some of such cultivars e.g. *Cenchrus ciliaris* cv Beloela according to FAO (1990), was introduced to Australia from Dodoma Tanzania in 1937 by Commonwealth Scientific and Industrial Research Organization (CSIRO) where it was tested at Rockhampton Queensland and further developed at Biloela Research Station, Australia where its name originated. It is sad that scanty research activities have been geared towards forage seed in the country. Therefore, use of improved forage seed in Tanzania remains a major challenge for development of a strong and steady animal feed resource base. In 1973, the government laid a policy framework to implement the formal seed system. The Seed Act No. 29 of 1973 led to the formation of the Tanzania Seed Company Limited (TANSEED), a public seed company entrusted with seed production, processing and marketing. Under the seed Act No 18, 2003, Tanzania Official Seed Certification Institute (TOSCI) was established responsible for seed certification and promotion of quality agricultural seeds, either produced or imported into the country for sale, and establishment of Government foundation seed farms. However, since then the forage seed system in the country operates largely at informal level, compared to food crop seed system which is rather developed. Thus, most farmers can access food crop seeds much easier than forage seeds from agro input shops (AGRA, 2016). The main forage seed sources in the country include research institutions (Tanzania Livestock Research Institute Mpwapwa, Uyole, Tanga and Mabuki), training institutions (Livestock Training Agency Tengeru and Sokoine Univesity of Agriculture), government livestock multiplication unit of Mafinga and Mabuki, government forage seeds farms of Lagwira and Vikuge and few private farms or companies such as Arusha Seed Companies, ASAS Group of Companies, East West Seed Company, Kibebe

Farm, Krishina Seed Company ltd, Ndoto Farm and Ilandutwa Dairy Farm. Out of eight informal forage seed/planting materials multipliers surveyed by Ngunga and Mwendia (2020), *Chloris gayana* (Rhodes grass) was established in all farms followed by *Pennisetum purpureum* (elephant grass) established in seven farms and *Brachiaria spp.* was third while *Tripsacum laxum* was the least liked established on in one farm (Table 1). The popularity of Rhodes grass could be due to its ability to produce large quantity of viable seeds and ease of hay making while high productivity favoured elephant grass especially to the smallholder dairy farmers. *Desmodium spp* was the most liked forage legume planted in five out of eight farms and the second was *Medicago sativa* established in only four farms. On the other hand, *Leucaena spp.* and *Calliandra spp.* were established in five out eight farms.

Table 1. Most popular forage species established for seed production in the Country

S/No	Grassess	Out of eight farms surveyed (%)
1	<i>Chloris gayana</i> (Rhodes grass)	100
2	<i>Pennisetum Purpureum</i> (Elephant grass)	87.5
3	<i>Brachiaria spp</i>	75
4	<i>Setaria splendida</i>	50
5	<i>Cenchrus ciliaris</i>	50
6	<i>Tripsacum laxum</i> (Guatemala grass)	12.5
Legumes		
1	<i>Desmodium spp</i>	62.5
2	<i>Medicago sativa</i> (Lucerne)	50
3	<i>Neonotonia wightii</i> (Glycine)	12.5
4	<i>Macroptilium atropupureum</i> (Siratro)	12.5
Multipurpose trees		
1	<i>Leucaena spp</i>	62.5
2	<i>Calliandra spp</i>	62.5
3	<i>Gliricidia sepium</i>	50

Source: Ngunga & Mwendia 2020

Demand of forage seeds

A well scientifically quantified demand of different forage species seeds has not yet been documented in the country. Recent data, however, from the Ministry of Livestock and Fisheries states that in total the demand of forage seeds stands at 22,954 tons while the production stands at 11.41tons per year in the country. An increased demand of forage seed among the livestock farmers has been largely due to the shrinking of available grazing land due to increased use of land by other activities such as crop production,

settlement, mining and nature conservation. This has led some livestock farmers to reduce their indigenous stock and start keeping improved dairy cattle that do not need walking long distances grazing but an appreciable amount of good quality cultivated forage around the farmer's home stead. The NGOs empowering smallholder farmers through ruminant livestock production has also led to an increased forage seed demand to meet their goal. Recent transport infrastructures development including railway and roads have also increased demand of forage seeds especially those with high value in soil erosion control and tolerance of salinity such as *Chloris gayana* cultivar Katambora and *Cynodon dactylon* cultivar Bermuda. To back stop an increased demand of various forage seeds for various purposes from 2019 to 2022 in total, 25.1 tons of forage grasses, legumes and forb seeds were imported (TOSCI 2022) (Table 2). A total of 10 grasses were imported led by *Eragrostis tef* a short growing season, prolific, annual tuft grass and valuable in water-logged areas and black cracking clay soils thus suitable for stabilizing newly constructed road and railway embankments. Other imported grasses included *Chloris gayana*, *Panicum maximum* and *Cynodon dactylon*. Most of these imported grass species such as *Brachiaria brizantha* and *Panicum maximum* were obtained in Tanzania and participate at 70 % and 10 % in Brazilian pasture seed market as *B. brizantha* cv Marandu and *P. maximum* cv Tanzania and by 1999 growing season were covering 35,000 and 6300 ha, of pastureland, respectively (Andrade, 2001). The two grasses species however, are not yet domesticated in Tanzania and are still retaining their wild characteristics attributes which aid their natural spread but difficulties for commercial seed production. The potential consumers for forage seeds in the country include; smallholder dairy farmers, government farms,

parastatal farms, non-governmental organization and soil conservation projects.

Table 2. Importation of different forages seed from 2019 to 2021 in Kilogram

S/No	Forage species	2019	2021	2022	Total weight
Grasses					
1	<i>Chloris gayana</i>	5,284	1,560	-	6,844
2	<i>Brachiaria brizantha</i>	150	70	45	265
3	<i>Panicum Maximum</i>	3872	1050	20	4,942
4	<i>Cynodon dactylon</i>	968	3500	-	4,468
5	<i>Eragrostis tef</i>	4312	700	-	7,012
6	<i>Eragrostis curvula</i>	968	-	-	968
7	<i>Lolium perenne</i> (Ryegrass)	500	-	-	500
8	<i>Phleum pretense</i> (Timothy grass)	50	-	-	50
9	<i>Pennisetum clandestinum</i>	-	75	-	75
10	<i>Poa pratensis</i> (Kuntucky grass)	9.07	-	-	9.07
					25,133.7
Legumes					
1	<i>Trifolium repens</i> (White clover)	-	125	-	125
2	<i>Medicago sativa</i> (Lucerne)	-	-	250	250
					375
Forb					
1	<i>Cichorium intybus</i> (Commander Chicory)	-	25	-	25
Grand Total					25,533.07

Source: TOSCI (2022)

Factors limiting forage seed production

The main limiting factors forage seed production include (i) lack of qualified staff in areas of germplasm collection, preservation and characterization; forage breeding; forage seed production, processing and preservation; (ii) high cost of production in terms of controlling factors of seed production such irrigation facilities in case of dry period, diseases pathogens, pests, and seed drying and processing facilities; (iii) there is scanty information on the quantity of the seed produced and projected demand and therefore reduce motivation in increasing production of forage seed; (iv) low volumes of seed in trade is partly due to no seed certification mechanism and regulation enforcement on forage seeds in the country; (v) the stockists encounter several constraints while acquiring the seeds from suppliers due to uncertain price of seeds scanty information of the quality of the seeds.

Potential of forage seed production

Critical analysis of the strengths, weakness, opportunities and threats of forage seed production is important in developing an aggressive and dynamic forage seed production sector to supply the internal demand.

Strengths: Most important forage species in the world occur naturally in Tanzania. These include grasses such as *Panicum maximum*, *Brachiaria brizantha*, and *Cenchrus ciliaris* and legumes such as *Nenotonia wightii*, *Clitoria ternatea* and *Sesbania sesban*. The country is second in ruminant livestock population in Africa and thus more forages seeds for increased forage cultivation to feed these animals. Well-developed food crop seed system that could easily incorporate forage species. Internal and external research institutes interested in forage

development such as TALIRI, ILRI and CIAT. Demand of forage is on the rise due to increased number of high yielding livestock kept in smallholder dairy farmers. The inauguration of the guideline in grazing land acquisition and utilization December 2021.

Weaknesses: Lack of qualified staff to collect, characterize and preserve forage germplasm of the forages adapted to various agro ecological zones in the country. Shortage of quality seed supply. Lack of enforcement of the forage seed regulations. Limited technical capacities in efficient forage seed production. Lack of forage seed market linkages. Over reliance on natural forage grasses despite their poor nutritional quality. Low rate of acquisition of private grazing land discourage forage cultivation.

Opportunities. Develop new grasses and legume cultivars from several naturally occurring forage species. Develop training material to increase capacity on the ground on forage seed production. High and growing demand for forage seeds can support vibrant seeds market internally and export. Existence of private seed companies that could include forage seed production

Threats: Climatic changes such as frequent prolonged drought. Forage diseases and pests.

Strategies in improving availability of good quality forage seeds

The strategies to improve availability of good quality forage seed for sustainable intensification of ruminant livestock in the country should include (i) improve the number of technical staff in forage breeding, management, seed production, processing and packaging (ii) collection, preservation and characterization of elite

forages cultivars adapted to various agro-ecological zones in the country. (iii) Pick the elite cultivars and test their seed production performance under various agronomical practices and commercialize the proven cultivars (iv) Review the seed policy, act and regulations to enhance seed certification, quality control and marketing (v) Encourage private forage seed producers by improving seed marketing linkages. However, for a short term strategy a borrow and pay forage seed scheme among smallholder livestock farmers could be adopted at district level (vi) Coordinate seed production centers so as to document demand and supply of forage seed at any time of the year.

Conclusion

Increased land use activities due to expansion of land based project has reduced the size grazing land in Tanzania. However, ruminant population is growing and currently the second in Africa. Frequent deaths of ruminant livestock following shortly prolonged dry season is a sign of overstocking and in most cases operating at the economic optimum stocking rate region. This is disastrous to the range health and livestock farmers' welfare. The most viable strategy to get away with rangeland degradation and livestock deaths is to intensify the production. That is production of more livestock products to meet the famers demand without rangeland degradation and animal deaths. Sustainable intensification of ruminant livestock production in any country will rely on high biomass of good quality cultivated forages. Success of cultivated forages is not possible without the support of an aggressive and dynamic forage seed production. Despite being the home of various famous tropical grass and legume species that has revolutionized ruminant livestock elsewhere, Tanzania forage seed industry is still infant with lots of

constraints to clear so as to effect sustainable intensification of livestock production. Constraints such as lack of technical staff for seed research and production, elite forage cultivar seeds, well organized seed quality regulatory and marketing organs must be overcome.

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