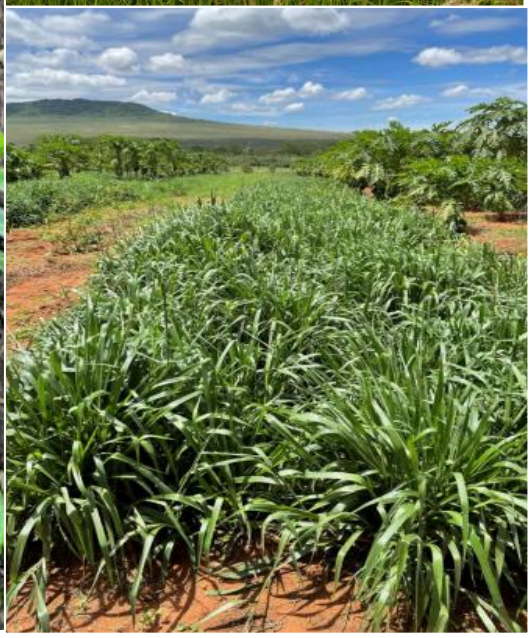


Final Working paper
for
ADVANCING FORAGE SEED MARKETS IN UGANDA

Jos Creemers
Felix A. Opinya

ProDairy East Africa Ltd

Nairobi, November 2022

ABBREVIATIONS AND ACRONYMS

COMESA	Common Market for Eastern and Southern Africa
COMSHIP	COMESA Seed Harmonisation Implementation Plan
DUS	Distinctiveness, Uniformity and Stability
EGS	Early Generation Seed
FAO	Food and Agriculture Organization of the United Nations
IP	Intellectual Property
ISF	International Seed Federation
ISSD	Integrated Seed Sector Development
ISTA	International Seed Testing Association
KEPHIS	Kenya Plant Health Inspectorate Service
Listed variety	Any variety that has been released by the NVRC and is on National Variety List.
LSB	Local Seed Businesses
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MaRRCI	Makerere University Regional Centre for Crop Improvement
NaLIRRI	National Livestock Resource Research Institute
NARO	National Agricultural Research Organization
NAVRC	National Variety Release Committee
NEADAP	Netherlands East African Dairy Partnership
NGO	Non-Governmental Organisation
NPT	National Performance Trails
NSB	National Seed Board
NSCS	National Seed Certification Services
NVL	National Variety List
ODA	Overseas Development Authority
OECD	Organization for Economic Cooperation and Development
OIC	Orange International Certificate
QDS	Quality Declared Seed
PGS	Pure Germinable Seed
PIP	Plant Import Permit
PLS	Pure Live Seed
PVP	Plant Variety Protection
PVoC	Pre-import Verification of Conformity to standards
RoU	The Republic of Uganda
TASAI	The African Seed Access Index
SANSOR	South African National Seed Organization
SICP	Seed Industry Code of Practice
SIP	Strategic Intervention Program
SNV TIDE	SNV The Inclusive Dairy Enterprise II project
SW Uganda	Southwest Uganda
UPHIA	Uganda Plant Health and Inspectorate Agency
UPOV	International Union for the protection of New Varieties of Plants
USTA	Uganda Seed Trade Association
VCU	Value for Cultivation and Use
VRC	Variety Release Committee

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF MAPS

LIST OF TABLES

LIST OF BOXES

Acknowledgements

This report about the forage seed sector market in Uganda is the result of the collaboration between SNV Uganda, The Inclusive Dairy Enterprise (TIDE) Project and the Netherlands East African Dairy Partnership (NEADAP). NEADAP is financed by the Government of the Kingdom of the Netherlands. The authors Jos Creemers and Felix Opinya wish to thank the stakeholders in Uganda who contributed to this report by patiently and diligently responding to the questions of the (lengthy) questionnaire, and/or by sharing their views and knowledge when being interviewed.
Special thanks also to Geert Westenbrink, coordinator of NEADAP and Martin de Jong, Team leader of SNV- Uganda TIDE for his hospitality, Paul Kimbugwe of SNV-Uganda/TIDE for organizing the forage workshop in Uganda and their valuable input.

The authors
Jos Creemers - NEADAP (consulting for ProDairy EA Ltd)
Felix A. Opinya - NEADAP (consulting for ProDairy EA Ltd)

FOREWORD

Forage seeds including seeds of pasture grasses and legumes are crucial for the development of the Ugandan forage seed sector. Without a vibrant forage seed sector, sustainable intensified forage production will be difficult to achieve while improved forage production is needed to support the (ruminant) livestock sector which is expected to grow in the next 30 years. This growth is driven by the increased demand for animal protein-based products (milk, meat) from the increasing part of the population with medium income or higher. An advanced forage seed sector will be the foundation for increasing yields, animal productivity, guarantee feed security, employment generation and improved livelihoods and farmers income in Uganda.

The genetic characteristics of the forage seeds determine to a large extent the production potential and the capacity to withstand diseases, pests and drought or flooding however the genetic potential of the seeds can only be realized if best agronomic and feeding practices are applied.

For farmers to benefit from the potential of improved forage seed varieties they need access to a wide range and diverse choice of good quality forage seeds of affordable but superior varieties. This will enable them to achieve good, reliable yields as well as secure yields under different environmental conditions and under changing climatic conditions. Enhanced quantity and quality of the forage produced will increase the potential for sustainable livestock intensification and thus food security (animal protein) and farmer income.

The commercial forage seed value chain in Uganda is still at its infancy but it has the potential to grow very fast in the next decennia following national adoption of robust and aggressive strategies to increase the share of livestock to the national exports and Gross Domestic Product.

This forage seed sector report brings together challenges and opportunities in the forage seed sector in Uganda. It ranges from strengthening the regulatory environment, creating incentives seed suppliers in the formal market to increasing early generation (breeder, foundation) seed production, and from improving seed marketing and distribution to farmers taking up improved forage seeds.

In this report we may from time to time draw comparisons between Uganda and Kenya. We do this because the two neighbouring countries are close trading partners, and they follow the same harmonized seed processes in their effort to comply with the COMESA regulations regarding seed registration and certification. In other instances, useful lessons can be learnt from South Africa or Australia. It further builds on the existing seed laws, regulations and policies in place in Uganda and COMESA.

The main purpose of this report is therefore to describe the steps needed to transform the current forage seed sector into a vibrant, competitive forage seed sector, able to cater for the diverse needs of Uganda's livestock farmers.

BACKGROUND

Deliverables of the Study

NEADAP-2 initiated this forage seed value chain study to identify opportunities and constraints for a market-led/based intervention in Uganda, resulting in an advice on prototypes of scalable NEADAP products and in a proposal on testing these products in Uganda. The deliverables are as follows;

i. a concept note on prototypes and testing of scalable products,
ii. a background document on the status of the forage seed value chain in Uganda and
iii. a concise issue paper on regulatory bottlenecks.

These deliverables are prepared in collaboration with staff of SNV-TIDE.

Methodology

The approach of this forage seed market study in Uganda consists of a combination of desk study of publications and reports, questionnaires, interviews and field visits; in accordance with the scope of study as follows:

i. Identify the stakeholders in the formal and informal seed market (e.g. seed breeders, seed bulkers, seed harvesters, seed distributors and buyers), who supply and purchase forage seeds for ruminant livestock in South West (SW) Uganda. List suppliers, seed material, prices, volumes traded, availability, suitability, accessibility, sources, etc.
ii. Map suitable and scalable seed varieties for SW Uganda, available or being trialled in Uganda by NARO and other research organisations (e.g. CIAT, ILRI) and private sector (e.g. Simlaw, Advantage Crops, Corteva, Advanta, Papalotla, Barenbrug SA). Investigate and report on their suitability (e.g., climate range, yields and management), availability, registration status, and cost.
iii. Map local forage seed production companies and their dealer network as well as agents of international companies active in selling seeds and their dealer network.
iv. Gage the likely interest and willingness of dairy farmers in Mbarara to pay regarding improved varieties presently available in the market.
v. Identify the key constraints at farm level in making optimal use of improved varieties
vi. Compare the present regulatory framework with that of Kenya and international best practices (quick benchmark).
vii. Carry out desk study and interviews with experts on PPP-arrangements in other sector in the context of development cooperation.

The annex 5 presents the list of seed companies, research institutions, key resource persons representing relevant organisations who received a questionnaire or were interviewed. The recipients of the tool were informed by an existing data base (Uganda seed Trade Association members) available on TASAI website. Only three (3) responded via questionnaire. Most feedback was obtained via actual field visits, face to face interviews, phone calls and information collected from the websites of the list of seed suppliers and producers in Uganda. The major limitation of this Ugandan study was the poor response to questionnaires.

Layout of this report

This report is structured as follows:

- Chapter 1: Introduction followed by the role of cultivated forages in the forage value chain and a short history of pasture seed production in Uganda.
- Chapter 2: Describes the forage seed market sector in Uganda
- Chapter 3: Inferences from the questionnaire. This details the feedback that further builds up on the deliverables discussed earlier under the methodology.
- Chapter 4: Highlights Key lessons and recommendations.

CHAPTER 1: INTRODUCTION

1.1 Introduction

The growth of livestock sector in Uganda like in other East African countries depends on availability of pasture grasses, legumes and other cut and carry forages all-year round. Most forages contributing to basal animal diets include tropical grasses as pasture or as cut and carry grasses and supplemented by legumes, crop residues and concentrates (Creemers *et al.,* 2019). Despite this, availability of improved forage crop seeds and planting materials at farm level in the cattle corridor is still very low, which explains why progression of the value chain is slow. However, there have been efforts to promote adoption of forage crop seeds and planting materials particularly under the SNV-TIDE II project to broaden the forage basket (Mulongo *et al.,* 2017).

The current problems as regards availability and access to reliable and quality forage seed and planting material is likely to be exacerbated by the increased forage demand resulting from increased demand and consumption of milk (-products) and beef. The demand is further fuelled by the expanding dairy production occasioned by the increased demand from a rising population, and improved income particularly in the urban centres (Kabirizi, 2016).

Low quality forage seed in Uganda is largely attributed to: **(i)** insufficient field supervision and inspection services in seed production and multiplication, **(ii)** processing and testing of forage seeds (varietal purity, germination rate), **(iii)** low investment in forage seed research & innovation, (the effort is mostly in multiplication) and **(iv)** limited skills and technical expertise. This partly explains the low uptake and use of certified forage seeds and consequently low forage production and productivity of livestock using the forage. This continues to stifle the potential of the dairy sector (Maina *et al.,* 2022). Insufficient feed of good quality is the most critical and widespread technical constraint in Uganda (Creemers *et al.,* 2019). The main feed resources currently are natural grazing pastures and poor-quality roughage, such as crop residues and hay of poor quality.

Figure 1. Forage production value chain

Market disruption is in contrast with the fact that a competitive and vibrant seed sector results in the availability of affordable high-quality seeds for farmers (Waithaka *et al.,* 2019). A vibrant seed sector requires a technically trained labour force. However, feed and forage value chains are to date not well developed, and thus opportunities in the livestock sector are not utilized effectively, denying the expansion and development of the livestock, including the dairy sector.

The goal of making the forage seed market more competitive and introducing any improved forages variety in the formal forage seed sector in Uganda is to improve livestock feeding and productivity. It needs to be noted however that while developing and encouraging investments in the formal sector, the demand for seeds sold by the formal sector is lowered by free forage seeds provided by governmental and development organizations in support of the livestock sector. The free forage seeds cause over dependence by the farmers (Lukuyu *et al.,* 2019) and disruption of the market for forage seeds (Tolera *et al.,* 2017).

1.2 The role of cultivated forages in the forage production value chain

The advantages of cultivated forages include:

- opportunity to use a range of species and varieties and agronomic practices recommended for specific locations and production systems as a source of high-quality forage.
- ease of production close to the farm, including areas which are difficult to access or inaccessible for suppliers of farm inputs.
- possibility of integrating (e.g., rotating) forage production with food crops to improve soil management.
- relatively low cost of production per kg dry matter/ha.
- benefits to environmental protection and natural resource management.
- possibility to increase feed intake of forages with higher nutritional density.

Box 1. History of Pasture Seed production in Uganda

From 1950–1970, pasture seed production was based at Serere Research Station in Eastern Uganda where grass and legume seeds were harvested opportunistically, sold to the Department of Agriculture and later sold to livestock farmers. This was followed by farmers in Serere and Central Uganda getting involved in producing pasture seed. At this time, a wide range of mainly tropical and pasture and fodder species were introduced. The aim was to broaden the genetic base for evaluation and to select suitable species and cultivars for the diverse agroecological conditions of the country (Mwebaze, 2006). The ODA-funded Uganda Seed Multiplication Project (USMP) enhanced seed production activities at Serere and opened new sites in Mbarara, Kigumba and Ngetta. Research on pasture seed production was begun but was not successful because more emphasis was put on crop seeds.

By 1977 most farmers and pickers were discouraged. This led to lack of pasture seeds in the country. From 1974 to 1983 pasture seeds (grasses and legumes) where imported from Kenya; although between 1984–1988, no seed was imported.

In 1989, the African Development Fund (ADF) gave a grant to import pasture seeds, grasses and legumes from Kenya. This same year, the UNDP/FAO Dairy Industry Development Programme imported some seeds and in conjunction with DVS&AI, Makerere University and Namulonge Research Institute began pasture seed production.

From 1990–1992, UNDP/FAO purchased pasture seeds from the contracted farmers in Mpigi, Mukono and Mbarara Districts and sold them to livestock farmers nation-wide. The World Bank, through the Livestock Services Project (LSP) in the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), carried on with pasture seed production activities began under UNDP/FAO as well as training both staff and farmers in various technologies of forage production and utilization.

Over the period 1992–1997, over 50 farmers had been contracted and produced about 58,000 kg of grass and legume seeds. MAAIF, field extension staff responsible for pasture improvement in the districts managed to keep a few farmers involved in seed production as they found markets for the seed amongst livestock owners. Planting material of vegetatively propagated grasses such as Napier Grass, Guatemala, Giant Setaria and leguminous tree seedlings (multi-purpose trees) Calliandra, Gliricidia and Leucaena, is produced by research institutions and some NGOs.

In 2003, Uganda officially introduced an out-grower model for pasture seed under the Strategic Intervention Program (SIP). Government provided incentives in the form of start-up seed, fertilizers and pesticides on top of extension and advisory services to farmers and advisory services, import business and free certification services to the seed company.

By the end of 2005 at the end of the SIP, there were close to 5 known out grower schemes purely marketing pasture seeds (true seed).

By that time fodder production and marketing of vegetative seed especially along the Lake Victoria crescent and urban centers within the national milk sheds was vibrant and lucrative because of incentives provided by NARO and International NGOs agencies, notably Heifer International, Send a Cow Uganda and FAO.

In 2007, government revamped commercial pasture seed by attracting and engaging other seed companies. However, the seed companies were to compete for the market and available out growers' schemes in line with the national trade policy. This resulted in over production at farm level but uptake of improved seed was still very low due to knowledge inadequacies.

By 2010, a number of private sector driven programs with a focus on commercial fodder and seed production were registered.

In 2019 SNV TIDE in collaboration with CIAT established demonstration plots of improved varieties of Brachiaria, Panicum varieties and Crotalaria. CIAT and ILRI established demo plots through the KIT/NWO project in the period 2019-2021. To date many players in the development sector are supporting this important value chain of the livestock sector.

CHAPTER 2: FORAGE SEED MARKET SECTOR IN UGANDA

2.1 Seed Systems

The Uganda's forage seed sub-sector consists of three co-existing segments: the informal, the semi-formal and formal sectors (MAAIF, 2018; Mabaya, 2020).

2.1.1 Formal

The formal seed sector is comprised of established and formally recognized state and commercial institutions engaged in seed research, development and distribution. Most research is focused on yield with some other agronomic traits such as disease and drought resistance.

Formal procedures for forage seeds, like other seeds, need to follow the regulations for variety evaluation, release and registration through the National Seed Certification Services (NSCS). Before a variety can be recognized and entered in the National Variety List (NVL), it must be tested both for agronomic value also referd to as the value for cultivation and use (VCU) and for Distinctness, Uniformity and Stability (DUS). The testing for agronomic value is carried out by the breeders while the DUS testing is the responsibility of the NSCS (Ssebuliba, 2010; Maina, 2022).

Furthermore, NSCS ensures that only those varieties which undergo National Variety Performance Trials (NVPT) for two seasons are released for commercial production. Where a variety is already released in another country, such variety undergoes National Variety Performance Trials (NVPT) for at least one main growing season before release, provided that the breeder of such variety provides data used for release in similar agro-ecological zones (Ssebuliba, 2010; Maina, 2022).

2.1.2 Key players in the formal seed sector in Uganda and their roles

Table 1. Key players in Uganda's formal seed sector

Role	Key players
Research and breeding	National Crops Resources Research Institute (NaCCRI), National Semi-Arid Resources Research Institute (NaSARRI), Makerere University Regional Centre for Crop Improvement (MaRCCI), Consultative Group on International Agricultural Research (CGIAR) centres, foreign universities.
Variety release and regulation	National Seed Certification Services (NSCS), National Variety Release Committee (NVRC).
Seed production and processing	Seed companies (local and foreign owned), private seed laboratories.
Education, training, and extension	Seed companies, Uganda Seed Trade Association (USTA), Uganda National Agro-Input Dealers Association (UNADA), Non-Governmental Organizations (NGOs), Department of Agricultural Extension Services.
Distribution and sales	Seed companies, agro-dealers, National Agricultural Advisory Services (NAADS).

Source: *Adapted from The African Seed Index Brief, TASAI.*

A seed system encompasses an associated network of stakeholders and the pathways by which farmers access seed for a certain crop in a specific area. The functioning of seed systems is dependent on three key dimensions: (1) seed availability, (2) seed access, and (3) seed quality.

Table 2. Key dimensions of a functioning seed system

Dimension	Definition
Seed availability	Farmers have enough locally acceptable seed of the right forage crops (including grasses and legumes), the right quality at the right place and time suitable for their location.
Seed access	Farmers have money or other resources in order to obtain forage seed of their choice. **Access is affected by the following three factors:**
i. Awareness	Information is available about different seeds: Where to get them, best agronomic practices, how to use the seeds, best conservation and feeding practices how to utilize the forage.
ii. Distribution	Seed is available at the point of purchase or use.
iii. Affordability	All farmers who could benefit from the forage seed are able to purchase the seed.
Seed quality	This encompasses the following four factors:
i. Genetic quality	Genetic purity, varieties, and biodiversity (such as local crop varieties).
ii. Health level	Pests and diseases fall below specified threshold levels.
iii. Physiological quality	Seed is of the appropriate physiological age.
iv. Physical quality	Seed is of appropriate size and shape, without mechanical damage.
Use and control	Farmers can apply forage seed for positive benefits (animal productivity) and control seed application and related agronomic practices as well as livestock production (utilisation) factors.
Benefits from use, and control over benefits	Farmers can obtain benefits from selling the forage they grow from the seed (commercial fodder production) or control the benefits (increased animal productivity) and income they generate from forage production.

Source: *Adapted from Bentley et al., 2018.*

2.1.3 Informal

The informal sector refers to a system in which seed is produced, maintained, and distributed through informal networks (Mabaya *et al.,* 2021). Seeds can be gifted, exchanged, shared or sold between individual farmers or artisanal traders. This includes individual farmers saving seed; exchanging seed with their neighbours; or obtaining seed through local markets, social networks, community-based initiatives (such as cooperatives or seed banks), and seed aid programs run by non-governmental organization (Bentley *et al.,* 2018). Seed multiplied in the informal sector is of variable varietal purity, germination rate and physical and sanitary quality. In Uganda, 85% (in Kenya this is estimated at 78%) of the national seed requirement, is supplied by the informal sector (MAAIF, 2015). The national forage seed requirement is likely to be supplied the informal sector by more than 95%.

The informal system does not supply hybrids, so all farmers buy their hybrid forage seeds (Brachiaria hybrids) and hybrid maize seeds through the formal seed system. However, for the true breeding seed and the vegetatively propagated forage crops the informal market offers a diverse range of forage seed, incl. agro forestry seeds and vegetatively propagated plant material, in terms of types, quality and volumes. Seed multiplication in the informal sector (farmer to farmer) that do not pass through

the regulations (in other words are not quality declared seed (QDS) or certified seed) is ideally done by farmers who take into consideration selection of healthy and true to type seed on their farms to save and sell to neighbouring farmers. There is however reason for doubt if this can be expected from farmers, for example, is Chloris (Rhodes) grass multiplied in the informal sector still true to genetic (varietal) purity? To maintain these quality aspects Chloris (Rhodes) grass in Uganda is made available by NARO for multiplication under the QDS system and is also commercially made available through Simlaw Seeds, a subsidiary of the Kenya Seed Company.

Some seed companies in Uganda engage in seed processing, which includes sorting, drying, seed treatment, packaging and labelling. However, smaller entities such as start-up companies and farmer groups lack enough capacity in terms of equipment to process forage seed. A key challenge in the informal sector is the storage of seed from season to season and additionally, the level of technical know-how is still low and would require capacity building.

The formal, semi formal and informal forage seed systems operate parallel to each other and mostly cater for different crops and crop value-chains as summarised in the table below.

Table 3. Comparison of key features of informal, semi-formal and formal seed segments in Uganda (Source: Second Schedule Crops)

Criteria	Informal Local/Farmer	Semi-formal Public-Private	Formal Private commercial
Type of crops	Major food and cash crops & forage crops	Major food crops & forage crops (inc. grasses and legumes	Cash crops and Forage crops (inc. grasses and legumes)
Key forage crops	Cloris gayana, Napier grass, Desmodium, Centrosema	Cloris gayana, Napier grass, Dolichos bean, Desmodium, Siratro, Stylo	Hybrid maize or maize/sorghum Imported grasses
Type of varieties	Local varieties	Improved	Improved
Seed quality	Farmer selected	Certified (C2) QDS	Certified (Internal quality assurance)
Distribution and marketing	Farmer saved and exchanged; local sales	Local sales, barter and markets	Imported, Agrodealers

In the formal system, food crops such as maize, sorghum, some pulses and vegetables are dominant, but sorghum and maize used for forage are also under this system. The informal and semi formal system, the latter making use of Quality Declared Seed (QDS), largely cater for crops such as forages, grasses and fodder legumes that are not yet picked up by the private sector. Some examples are Rhodes grass (*Chloris gayana),* Dolichos bean *(Lablab purpureus)* and reproduction of vegetative planting material for Napier grass.

2.2 Seed Policies and regulations in Uganda

2.2.1 National Authorities, Policies and Regulations

The Ministry of Agriculture, Animal Industry and Fisheries, through the Directorate of Crop Production, is the national authority with the mandate to regulate the seed industry (including forage seeds), with the National Seed Certification Services (NSCS) responsible for seed certification (MAAIF, 2019). The Ugandan government is responsible for developing research capacity, while the private sector is expected to carry out seed production, seed processing and marketing.

The government also heads up the creation of an enabling environment and oversees regulations. The National Agricultural System Act (2005), National Seed Policy (2018), Seeds and Plant Act (2006) and Plant Variety Protection Act (2014) are in place and operational implementation is guided by the National Seed Strategy. The Seeds and Plant Act is the principal legislation for the seed industry. The government regulates the official release of new varieties, licensing and oversight of seed merchant activities, especially regulating importing/exporting seeds, quality assurance in seed production, seed processing and local seed trade, and overall regulatory framework implementation (MAAIF, 2019).

The National Seed Policy of 2018 provides for the transformation of the NSCS into the Uganda Plant Health and Inspectorate Agency (UPHIA). This semi-autonomous agency is expected to improve efficiency of service delivery and will be responsible for all phytosanitary services, seed regulatory services, and agricultural and plant-related chemical regulatory services (RoU, 2018).

Additionally, the national seed regulations are to be fully harmonized with the COMESA Seed Trade Harmonization Regulations (COMESA, 2014) and alignment with the regulations in the Plant Variety Protection Act, 2014 need to be arranged (Mabaya, 2020; COMESA, 2014). See annex 3a for the latest, summarized status (2021) of policies and regulatory framework.

Uganda's National Seed Policy aims to guide, promote, develop and regulate the seed sector, including the forage seeds, in order to ensure the availability of and access to safe and high-quality seed for all stakeholders (RoU, 2018). To achieve this goal, the government supports the gradual transition from the informal sector to the formal sector through the piloting of the Quality Declared Seed (QDS), agricultural advisory services, and the provision of clean improved seed to farmers (RoU, 2018).

2.2.2 Quality Declared Seed

With respect to seed classes, pre-basic seed, basic seed, first generation certified seed; and second-generation certified seed is the use of Quality Declared Seed (QDS) in Uganda. To encourage more farmers to buy quality seed, the national seed policy was changed in 2014 to allow the production of Quality Declared Seed (QDS), a less stringent seed class than certified seed. This allows for a quality control system that is locally based and less stringent alternative to formal seed certification (Seed2b, 2019).

It is noted that in the COMESA Seed Regulations, Quality Declared Seed is not a listed seed class. Rwanda, Uganda and Zambia have fully implemented the COMESA Seed Regulations and the 3 countries provide also for a QDS system (COMESA, 2022).

The QDS was prepared and promoted by Food and Agriculture Organization of the United Nations (FAO) to reduce the burden of full certification. It places more responsibility on the producer to carry out quality assurance and monitors compliance through random or systematic inspection. The purpose of QDS is to offer an alternative, which can be used for those crops, areas and farming systems in which highly developed seed quality control activities are difficult to implement or make relatively little impact (FAO, 2006).

The introduction of Quality Declared Seed (QDS) by MAAIF with support from the Integrated Seed Sector Development (ISSD) which offers training to farmers on the production of quality seeds, includes pasture seeds, further widens the market for the informal sector and creates awareness of the benefits of seed multiplication which is driven by a pyramid structure. The MAAIF through research institutes provides foundation seeds for forage seed such as *Chloris gayana* and Napier grass and

Dolichos bean multiplication under a zoning system and carries out seed verification and certification services.

There is high competition among stakeholders, especially in the formal seed sector. The pool of farmers who access forage seeds through the formal sector is very small compared to those accessing through the informal sector. The informal sector can attract new customers, farmers and commercial fodder producers by offering relatively low prices of forage seed compared to the formal sector (Maina *et al.,* 2022). Not taken into consideration is a possible difference in varietal purity, gemination rate and physical and sanitary quality of the forage seed (grasses and legumes) sold in the (semi) informal sector. Formal sector stakeholders who must pay for and submit their pasture seeds for vigorous testing before (batches) the seeds can be released in the commercial forage seed market perceive this as unfair competition. In the forage market seed suppliers and other stakeholders have only just started to create awareness among livestock farmers for them to appreciate the value of improved forage including pasture seeds.

2.2.3 Special considerations for forage crops seeds

The main components of certification have been described which are common to all seed schemes, but forage crops, particularly tropical grasses may present some additional challenges such as listed below:

- Varieties may not be well-defined and less uniform than is normally the case in grain crops such as cereals and legumes, and there are also far fewer varieties.
- Management of the crops and field inspection may be more difficult due to their tillering habit or branching habit and perennial growth, which means that seed can be harvested in successive years from the same crop. This is common practice in the informal market of seed multiplication.
- Seed quality attributes such as purity and germination rate are often more difficult to determine accurately. Therefore, it may be necessary to adopt specialized testing procedures and accept relatively low standards for certification purposes.
- Some forage crops are propagated by cuttings or root splits and may not produce seeds. It is still possible to certify these vegetative materials, but the procedures are completely different.
- The agricultural value (VCU) of forage crops is determined not only by the highest biomass yield/ha but by the best combination of dry matter yield/ha and nutritive value of the forage crop and/or functional properties e.g., conservation of the crop as hay or silage.

2.3 Seed programme

The components of a forage seed programme include plant breeding, variety release, seed production (multiplication), seed processing, seed certification, seed marketing and extension. These components must be interlinked in order to function towards the desired goal.

In Uganda, plant breeding work is carried out by both public (NaLIRRI, NARO) and private institutions, whose new varieties are released through the Variety Release Committee (VRC). Regarding forage seed this plant breeding work is mainly done abroad by the private sector. Several private organizations and NGO's have been involved in the importation and marketing of (improved) forage seeds. The impression is that the Republic of Uganda has so far considered importation of grass seeds

on a case-to-case basis. Stakeholders found it difficult to specify detailed procedures and/or standards the seed had to comply to or specific testing the forage and pasture seed had to go throughon importation (Creemers *et al.,* 2019).

The Seeds and Plants Act 2006, provides for the registration of seed suppliers (merchants); producers, dealers, conditioners, importers and exporters as well as the establishment of the National Seed Certification Service (NSCS) as a regulatory unit within the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF).

2.3.1 Seed Certification

Seed certification is a system for ensuring the production of genetically pure, good quality seed of improved varieties. The task of seed certification is accomplished through various steps: determining the eligibility of cultivars, verifying that the seed source is authentic, field inspection, lot examination, sampling, seed testing, labelling and sealing and establishing and evaluation of pre-and post-control plots.

For seed of local varieties and varieties developed through participatory plant breeding under the QDS system, the minimum standards may be different from varieties developed through conventional plant breeding approaches. Some of the aspects considered in Uganda in seed production and certification include inspection of off-types, maturity rate of the seed, purity of seed, germination rates of the seed (Maina, 2022).

The aim is that also for forage crops seeds, like for food crops, once the harmonisation of policies and regulations of the seed sector under COMESA has finalised, the parameters as stipulated in annex 3b, will be followed. The harmonization of seed laws under the COMESA Seed Harmonization Implementation Plan (COMSHIP) was adopted by the COMESA Council of Ministers in 2014, as a strategy to trigger seed trade, which is currently low across the region.

Once policies and regulations are in place, implementation should follow, this requires laboratory capacity and human expertise. Seed testing for example requires a high degree of accuracy and reproducibility, and it is important that standardised methods designed to produce the same results universally (within an acceptable range) are applied. The International Seed Testing Association (ISTA) describes the procedures and optimum conditions for carrying out tests in order that the results are fully comparable between different laboratories. ISTA however does not specify any quality standards, which should be achieved. The quality standards for tropical grasses regarding germination and purity are determined by the national authorities.

Uganda's seed certification system is to date closely aligned with the COMESA seed certification system with regards to the field and laboratory certification standards, seed labelling, the issuing of certificates, and seed classification. Uganda's sanitary and phytosanitary measures for seed are guided by the Plant Protection and Health Act of 2015 (The Uganda's quarantine pest list has not been harmonized with the corresponding COMESA list).

The COMESA Seed Trade Harmonization Regulations require three types of documentation to accompany imports and exports of seed within and from the region: a seed testing certificate, a plant import/export permit (PIP), a phytosanitary certificate for exports, and a re-export phytosanitary certificate for re-exports. When the conditions prescribed in these documents are not met, importing countries may issue a non-compliance notification (Mabaya, 2021; COMESA, 2022).

In the COMESA Seed Trade Harmonization Regulations, 2014, seed certification standards have been specified in for Beans, Maize, Rice, Groundnut, Cotton, Wheat, Sunflower, Sorghum, Soybean, Pearl Millet, Cassava and Irish Potatoes. Certain seed kinds however are more difficult to test than others. Some of the tropical and sub-tropical grasses fall within this group. Tropical perennial grass seed quality can vary markedly between seed production years, depending on seasonal, harvesting and storage conditions. Quality may also vary among species of tropical perennial grasses. Low germination rate is a characteristic for many tropical grasses and the minimum germination standards reflect the production problems which result in low seed quality.

Minimum germination percentage standards for some forage species in Australia are for instance: Grasses*, Brachiaria decumbens* 15%, *Chloris gayana* 20% and *Cynodon dactylon* 60% and for Legumes*, Desmodium intortum* 70%, *Macroptilium atropurpureum* 70%, Stylosanthes *hamata* 60%. (annex 1).

While dormancy is not usually considered a problem for temperate forage seed lots, little is known about dormancy breaking methods for germination testing of tropical and subtropical forage species or of effective methods for reducing dormancy in seed lots for sowing. While on the other hand dormancy can be seen as a mechanism of the grass to deal with sub optimum conditions for germination. Seed quality standards are required by seed companies for seed certification, for seed sale and for seed imports. The purpose of a standard needs to be defined if it is to offer protection to the buyer, the level at which the standard is set must be able to serve this purpose (McCormick, 2009). This means that if for example the standard for germination for tropical grasses is set to high seed companies will not bring seeds of these grasses on the market.

This raises the question if there is a need for tropical and subtropical species, with often very low germination standards to review these standards now. Registration and certification of forage seeds including tropical and sub-tropical grasses for Uganda and the wider COMESA region is nearing. This review of standards of tropical and subtropical species applies equally to locally produced Quality Declared Seed (QDS) and imported seed lots. Seed import standards must always be technically justified, provide the required level of biosecurity protection, and not impose unjustified technical barriers to trade.

These challenges in seed certification do exist in Uganda as well as in Kenya. For instance, seed companies in Kenya indicate that there is a lack of a clear seed certification criteria, especially for tropical grasses. For example, the germination rate for grasses is set to be above 50%, whereas most germination rates for tropical grasses are below 40% (see annex 1).

Because of the growth habit and/or the long period over which seed heads are produced, both analytical purity and germination are often low in tropical grasses. The *Chloris gayana* for example typically has a germination rate of between 20 and 50%, while seed lots may contain from 40-60% pure seed. Because of this the concept of pure live seed (PLS) is often applied for tropical grass seed lots, where PLS = pure seed (%) x germination (%)/100 (Parihar, 2010).

Similarly, Brachiaria varieties also differ in germination rates; thus, when set standards by KEPHIS are adhered to, certain varieties fail to pass and are considered not fit (Maina *et al.,* 2022 and Creemers *et al.,* 2021). In the Quality Declared Seed System (FAO 2006) for example, the germination rate is set at minimum 15% and analytical purity at minimum 50% for both *Urocloa (Brachiaria) decumbens* and *Urochloa (Brachiaria) humidicola.* This illustrates that harmonizing forage seed standards in East Africa and COMESA regarding QDS and the formal seed certification system is needed and to publish and

share the forage seed standards that are adaptable and applicable to specific varieties and to the specific seed system. For trade purposes, it is often necessary to compare seed lots to determine their relative value, based on two or more measurements of seed quality.

The indices more commonly used are Pure Germinable Seed (PGS) and Pure Live Seed (PLS). PGS is determined by multiplying pure seed (%) and germination (%) and then dividing the product by 100. PLS is also determined similarly, except that per cent viable seed is used instead of germination. Therefore, expression of seed yield as PGS is considered to be more realistic as germination of seeds can range from 0-62 %, which makes it impractical to express seed yield in terms of other, than PGS. This is a procedure which has been followed consistently in Kenya and which has certainly contributed to the reliable reputation of Kenyan grass seed. Kenya is a leading exporter of tropical grass seed and with a quality of about 25 per cent PGS (McCormick *et al.,* 2009; Parihar, 2010).

To overcome the challenges with tropical grasses, most reputable seed companies in Australia and South Africa adopt the voluntary Seed Industry Code of Practice (SICP) which provides minimum labelling requirements. This code includes a full seed analysis certificate being available at the point of sale.

Kenya and Uganda can be at the forefront to open the COMESA market for improved forage seeds because both countries are most advanced in the process to harmonize policies, regulations and institutes with COMESA. However, for seed suppliers to start the process of registration and certification of forage seeds, the requirements of seed standards for forage crops need to be transparent and agreed upon between the countries and the national institutes need to have the capacity and expertise to implement and execute the policies and regulations.

To date, only 7 (Kenya, Uganda, Rwanda, Burundi, Zimbabwe, Malawi and Zambia) of COMESA member states have fully implemented the COMESA Seed Regulations, which will have an impact on marketing varieties in practice. Countries, like Kenya, Uganda and Rwanda that have implemented the COMESA Seed Regulations might not recognize the regulatory procedures of countries that have not implemented the rules, decreased the predictability of regional processes and leading to additional procedural steps (for example, trials or further steps for marketing approval).

2.3.2 OECD seed certification

The Organization for Economic Cooperation and Development (OECD) provides certification schemes to facilitate international trade in seeds. These focus on eight different groups of crops, one of which includes 86 grass and 54 legume species. The species list does not differentiate on the basis of use and while many of the grasses are used for forage, the legumes include both food and feed species.

OECD schemes relate specifically to varieties and no standards for purity and germination of seeds are specified because these are matters of national legislation. In practice, seed moving under OECD labels would generally be accompanied by an Orange International Certificate (OIC) issued by a laboratory accredited by the International Seed Testing Association (ISTA).

In East and Southern Africa, the only member countries are Kenya, South Africa, Zambia and Zimbabwe. Among these, only Kenya and South Africa are in the herbage scheme. The certification agencies in those countries are Kenya Plant Health Inspectorate Service (KEPHIS) and South African National Seed Organization (SANSOR).

Uganda and other OECD member states and stakeholders however view the Quality Declared Seed system (QDS) as an important bridge between the formal and informal seed systems. It needs to be noted that QDS is not incompatible with formal seed certification done in accordance with the Organisation for Economic Co-operation and Development (OECD) Seed Schemes. (Seed2b 2019).

Regarding the forage seed quality standards, it may be of interest where this concerns tropical grasses and other tropical forages to align standard and practices with other countries such as Kenya, South Africa or Australia where the quality standards are different from potential important trading partners in tropical forages.

2.3.3 Seed handling

Seeds are sensitive and require proper handling and thus, proper storage conditions are important. The main factors influencing the quality during storage are moisture, heat and pests. Lack of adequate storage, as well as high cost of packaging materials affect the production and processing of forage seeds for farmers.

For tropical perennial grasses, the use of seed coating has been an industry response to overcome the difficulty of sowing light, fluffy seeds. However, while seed coating does improve the flow of seed through sowing machinery, it also can markedly increase seed weight, with little effect on purity or germination. Additionally, seed coating may mask the presence of undesirable weeds and inert matter, reinforcing the need to obtain a seed analysis certificate before buying. The increase in seed weight due to the coating needs to be considered when calculating both sowing rates and the costs.

2.3.4 Plant Variety Release

Plant variety release is the process by which new varieties undergo various tests for yield, Value for Cultivation (agricultural value) and Use (VCU), and Distinctness, Uniformity, and Stability (DUS). Varieties that perform satisfactorily in these tests are approved for release by the National Variety Release Committee (NVRC). A vibrant seed sector has a functional variety release system that is well understood by the relevant actors and is followed diligently. Lengthy and/or costly variety release processes can limit the number of released varieties, which can adversely affect farmer choice.

In Uganda, the process involves national performance trials that are conducted by the breeders. The DUS tests are conducted by the NSCS. The total time to go through the process in Uganda is about 1 year (2 seasons). Names of the released varieties will then be on the National Variety List. The cultivars on the list will have been tested as to their Distinctness, Uniformity, Stability (DUS) and agricultural/agronomic value (VCU).

In Uganda, the variety owner/breeder is required to submit an application to the National Seed Board (NSB), including data provided on the variety's performance based on advance yield trials and a sample of the seed. The NSCS is responsible for conducting the Value for Cultivation and Use (VCU) and Distinctness, Uniformity, Stability (DUS) tests. However, since the NSCS does not have the capacity to do this, NARO conducts these tests on behalf of the NSCS.

2.3.5 New Varieties

For a new variety that has not been tested elsewhere, VCU tests are run for two seasons and the DUS test is run for one season. The test data is then compiled in a technical report that the NSCS submits

to the NVRC for consideration for variety release. The NVRC meets twice a year to deliberate on applications for release. Approved varieties are published in the official gazette, after which they can be multiplied and marketed as seed in Uganda.

The owner/breeder of the variety then applies to have the variety registered in the national variety list and common catalogue and pays the applicable registration fee of US$ 28. On the national variety list of 2019, the publicly available list, no forage varieties such as pasture grasses or legumes are listed.

On the COMESA Variety List available online (May 2022), Advanta Seeds has registered 2 forage crop varieties namely Sugargraze and Nutrifeed. In 2019 Western Seed Company registered 4 maize varieties and Seed Co registered 8 food crop varieties namely 4 maize, 3 soya bean and 1 sorghum varieties on the COMESA Variety List through the registration and certification process in Uganda.

The publishing of approved varieties in the official Uganda gazette, the updating of the common catalogue and its publication for wider accessibility are infrequent. This means that seed companies and farmers may not be aware of the newly released varieties. It is not always clear if the latest publicly available NVL of Uganda is the most updated one.

Seed companies from outside Uganda (similar sentiments are expressed in Kenya) find this process to be cumbersome, more so for forage crops and pasture grasses and legumes as the demand for these improved forage varieties will still need to be developed. The cost and time to register new varieties are especially significant for new seed companies, which limits the flow of new varieties into the market.

Table 4. COMESA Variety Release & Registration Process Requirements

COMESA Variety Release & Registration Process – Requirements		
Varieties Released in 2+ COMESA Countries	**Varieties Released in 1 COMESA Country**	**New Varieties**
• Application for Reginal Catalogue entry • Submission of necessary DUS & VCU Data • Initial Registration Fee • Annual Registration	• Application for Regional Catalogue entry • Submission of necessary DUS & VCU data from 1st Member State • Proof of release in 2nd Member State (only one season of DUS and VCU required) • Initial Registration Fee • Annual Registration	• Application for Catalogue entry • Two seasons of DUS and VCU Testing • Proof of release in two Member States • Initial Registration Fee • Annual Registration • Suggested Variety Name • Reference sample provided to National Seed Authority

Source: *Seed2b 2019 (based on the COMESA Seed Trade Harmonization Regulations, 2014)*

Once registered in the COMESA Variety Catalogue, a variety is intended to be freely marketed in all COMESA member states.

In the COMESA Plant Variety Catalogue as of February 2019, a reported 56 varieties of seven different species have been registered (Seed2b, 2019). In May 2022 the number of listed varieties still stood at 56 (COMESA Website, May 2022).

In the National Variety List of Uganda as well as in the COMESA Plant Variety Catalogue, new varieties are registered and categorized per food crop (species). This categorization is confusing for varieties of the same species which can be used either as a food crop or as a forage crop. An example is the registration of Sorghum varieties. The Sorghum variety PAC 501 is a hybrid of medium maturity with an average yield of 4.5 MT/ha while the Sorghum variety Sugargraze is a hybrid of medium maturity with an average yield of 20.0 MT/ha. In this case only the variety name gives an indication that the variety is used as a forage crop but with the Pearl millet variety Nutrifeed and with Maize varieties which are generally given a code name (combination letters and figures) this will be difficult to conclude.

The FAO in the Quality Declared Seed uses the following categories, Cereals and pseudo cereals, Food legumes, Oil crops, Forage crops – Poaceae, Forage crops – Fabaceae, Industrial crops, Vegetables.

2.3.6 Cost of Variety Release Process

In well-functioning seed systems, the costs of releasing a variety should not be so high as to disincentivize variety releases altogether. The official VCU test costs US$ 222 while the DUS test costs US$ 98, based on the current seed regulations (RoU, 2017). However, in practice the costs are higher. They are set following negotiations between the applicant and the responsible entities at NARO. For instance, the private sector reported an average cost of between US$ 1,111 and US$ 3,732 for DUS tests compared to the published cost of roughly US$ 100.

2.3.7 Seed suppliers / merchants

The presence of more active seed companies trading in forage seeds increases competition and creates incentives for companies to innovate and improve service delivery to farmers. A vibrant seed sector including forage seeds depends on a robust private sector in which seed companies invest in developing, producing, processing, and marketing improved forage seed varieties to farmers.

Local seed companies have basic seed production activities on-farm or with seed growers, mainly pasture seeds. Major seed selling outlets are facilitated by the government, agro-dealer distribution networks and non-governmental organizations operating in different regions of the country.

This section tracks the number of registered seed companies that produced and marketed forage seeds. Out of the 43 companies in Uganda active in seed production and distribution, 23 are active in forage seed distribution (USTA, 2020) including commercial maize seed that is used as fresh maize or silage maize to feed to cows. Not all of them stock forage seeds such as maize, sorghum, alfalfa, Desmodium, oats, Rhodes grass (varieties Boma, Katambora), sudan grass (sorghum × *drummondii*), columbus grass (sorghum x *Almum parodi*), sunflower and beans such as dolichios bean and mucuna bean. Most of these companies are involved in the import and marketing of seeds.

Public organisations (like NARO) dispersed over Uganda reproduce forage seeds on government and private farms (Creemers *et al.,* 2019). In Uganda, five entities are involved in forage seed production (both own production and through farmers) and certification (Maina *et al.,* 2022).

The uptake of certified hybrid maize, sorghum and beans is increasing (Mabaya *et al.,* 2021) as well as registration of new varieties on the National Variety List, 2019. These are the same hybrid maize seed used for silage making. As forage maize is, it is important to understand that the variety with the highest biomass may not be the variety with the highest nutritional value. Instead, the variety with

the highest grain yield is also likely to give the highest nutritional value of the forage maize, provided the kernels are processed and best practices used during harvesting and ensiling. Forage sorghum and forage pearl millet include two specific forage varieties namely Sugargraze and Nutrifeed.

The 100% ownership of seed companies is now possible for foreign-owned companies in Uganda but there is still another factor that may limit commercial seed companies to register, produce and distribute forage seeds in Uganda. This is membership of Uganda to the Union for the Protection of New Varieties of Plants (UPOV). UPOV seeks to safeguard the property rights of plant breeders in their varieties. Additionally, intellectual property rights are not well protected in Uganda. Companies indicate that strong breeder rights and membership of UPOV would be an advantage for producing and distributing forage seeds in Uganda.

2.3.8 Seed Import and Export Processes

Efficient seed import and export processes extend the seed market beyond national borders. While seed companies benefit from an expanded market, farmers can access a wider range of seed varieties from across the region. The length of import process in days is the sum of the number of days needed to obtain import documentation (import permit, phytosanitary certificates and Orange International seed lot Certificate (OIC), if applicable), and the number of days to clear seed at the border point of entry. It excludes transportation time. The OIC is issued by a laboratory accredited by ISTA when both sampling from the seed lot and testing of the sample are carried out by the same laboratory.

Three forms must accompany seed lots destined for import/export from COMESA member states and for movement within these states. The **Seed Testing Certificate** must be presented at entry and exit points. In addition, all seeds imported by the COMESA member states must be accompanied by a **Plant Import Permit (PIP)**, which is presented to inspectors at entry and exit points. All seeds exported by a COMESA member state must be issued a **phytosanitary certificate**, which also must be presented to inspectors at entry and exit points. If a seed lot does not have the proper certificates or fails to meet the conditions of the plant import permit, or if a quarantine pest has been found, the importing member state may issue a non-compliance notification (Seed2b, 2019).

In 2019, five seed companies imported a total of 1,111 metric tons (MT) of maize from Kenya and South Africa. Of this, 1,031 MT came from Kenya, a COMESA country. However, only 450 MT of this seed had a COMESA label. This label enables companies to trade in seed that is registered in the COMESA catalogue without having to be subjected to more tests in any of the 21 COMESA member states (ISF, May 2022).

There are private companies that mainly import and resell seeds in both Kenya and Uganda. Some private companies buy locally and resell, as in the case of Kenya; others buy locally, multiply and sell, as in the case of Uganda (Mabaya, 2021). In 2019 the Pre-import Verification of Conformity to standards (PVoC) certificate was introduced by the Uganda National Bureau of Standards and the Kenya Bureau of Standards as an additional requirement for seed imports. This requirement affects all seed imports since they are either sourced from Kenya or transit through Kenya to Uganda. Following consultations with relevant ministries in each of the two countries, stakeholders agreed that the new requirement did not have any additional value in terms of quality assurance and was therefore not necessary.

2.3.9 Value and volume of seeds import and export in Uganda

Uganda imported in 2019, 400 MT field seeds which includes seed of pulses, cereals, industrial crops and forages with a value of 2 million US$. The country exported 33,000 MT field seeds which includes seed of pulses, cereals, industrial crops and forages with a value of 7 million US$. The commercial forage seed value chain in Uganda is only a fraction of the imported and exported seed volumes and the figures of the International Seed Federation (IFS) show that the seed sector is still at its infancy but it has the potential to grow very fast in the next decennia.

2.3.10 Service input providers

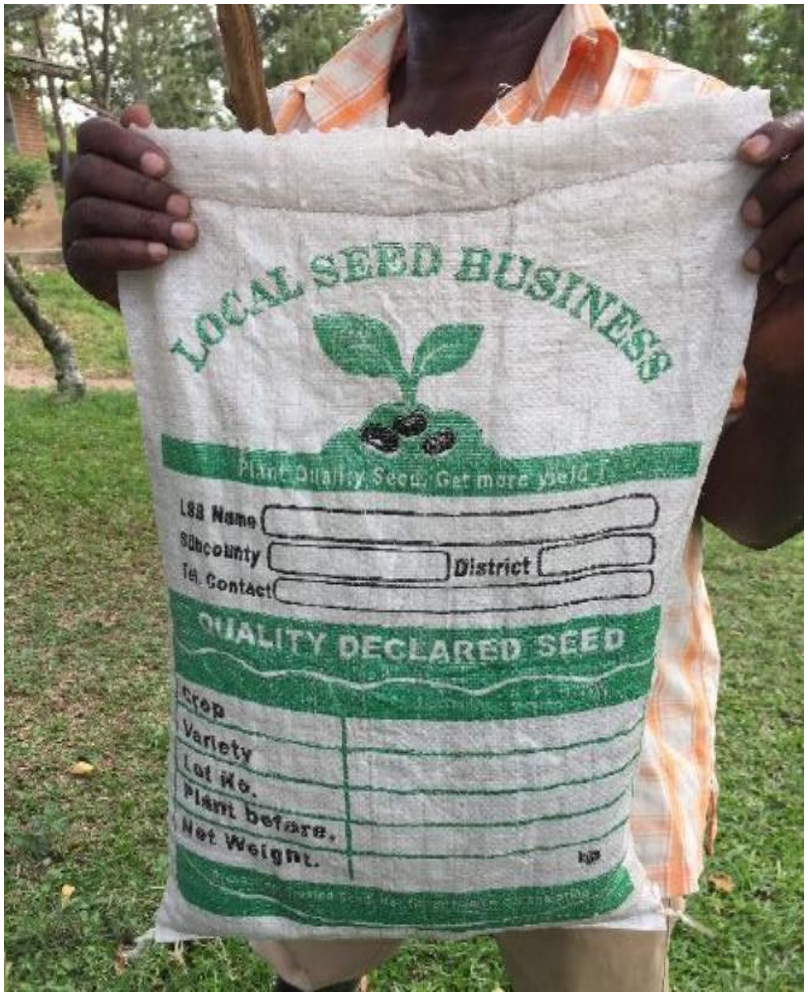
In Uganda, most seed companies often do not stock a lot of forage varieties due to low demand. Some private seed producers producing QDS have resorted to marketing forages through weekly adverts in local newspapers and use of social media platforms.

Stockists, agro-vets, often lack knowledge to advice the dairy farmer on best practices such as agronomic, time of harvesting, conservation and utilisation and in addition nutritional information of the forages (Maina, 2020).

2.3.11 Livestock farmers

There is a lack of farmer awareness on the existence and importance of improved forages for increased animal production and productivity of the enterprise (Creemers *et al.,* 2019). Exposing farmers through demonstrations and field days of internationally and nationally proven and promising varieties will capacitate them to make informed discission. This can be strengthened by sharing and publishing list of recommended forage species and varieties.

Picture 1. Packaging and labelling of forage seed by a local seed business under the Quality Declared Seed system.


LOCAL SEED BUSINESS
LSB Name
Subcounty
District
Tel. Contact
QUALITY DECLARED SEED
Crop
Variety
Lot No.
Plant before.
Net Weight.
kg

CHAPTER 3: QUESTIONNAIRE FINDINGS

This chapter summarizes findings from the questionnaire and feedback from key informants and supplemented with information from others studies with regard to the forage seeds sector in Uganda.

3.1 Details of Seed suppliers

Question 1(a) – (g): Table 1 and 2 summarizes question 1 (a to f) of the questionnaire. They entail contact details of the seed suppliers/research organisations who responded to the questionnaire (14) as well as an inventory of the forage seeds they supply.

The growing demand for improved animal nutrition has encouraged several companies to venture into the forage seed and vegetative split business in Uganda. The annex 5 presents companies and their contacts registered with USTA supplying seeds, including forage seeds in Uganda. The list includes those that responded to the questionnaire (highlighted in green).

Most of these companies have local ownership in Uganda but with international partnerships, where they produce forage seeds like NARO holding, Robran holdings and Rhino seeds (Lukuyu *et al.,* 2020). Other companies and NGO's are involved in seed multiplication such as Heifer International, while others import, process and package the seeds. Seed suppliers like Simlaw seeds, East African seeds (also trading under the brand name Syova), Advantage Crops and partly Robran holdings import seeds from other countries, mainly Kenya.

Companies and development organizations (Heifer International, SIDA, SAREC, ISSD) that contribute to forage seed production also contract farmers whom they offer training in seed production agronomy practices, quality assurance seed, marketing, and field and post-harvest management (Lukuyu *et al.,* 2020). Other disciplines of engagement with their local partners include producer sensitization and training of farmers in pasture/fodder establishment and maintenance, fodder conservation, feeding and nutritional composition of different forage varieties; procurement and distribution of different forage crops /pasture planting materials and development of forage crop /pasture model farms as farmer learning centres (model demonstration farms).

Geographically, a good number of forage seed companies have their operational base in Central Uganda (such as the districts of Kayunga, Kiboga, Kyankwanzi, Mityana), extending their catchments to South Western Uganda, Northern Uganda (e.g. Gulu, Dokolo districts) and Eastern Uganda (Ngora, Amuria, Bugiri) - see Map below.

Map 1. Districts in Uganda

Source: *www.ugandatravelguide.com*

Incidentally, improved grasses such as *Chloris gayana* or forage grain crops like Pearl millet, Sorghum and Maize used for forage production are stocked more, followed by legumes such as *Desmodium ssp.*(mainly greenleaf), Alfalfa/Lucerne and *Centrosema ssp*. and a few leguminous agro-forestry trees and more recently Brachiaria Hybrids and Panicum maximum cv Siambaza. The table below shows different forage seed varieties produced and supplied by each company.

Table 5. Inventory of improved grasses and forage seeds and/or planting material available through seed suppliers/stakeholders in Uganda

Company	Forage Seed
Simlaw Seeds Company	*Chloris gayana* (Rhodes grass) variety Boma, Katambora, X-Tosi *Desmodium intortum* (Green leaf) *Lablab purpureus* (Dolichos bean) *Medicago sativa* (Lucerne/Alfalfa) *Pennisetum glaucum* (Pearl millet) variety Nutrifeed *Sorghum drummondii* (Forage sorghum) variety Sugargraze
East Africa Seeds (U) Ltd	*Chloris gayana* (Rhodes grass) variety Katambora *Desmodium intortum* (Green leaf) *Medicago sativa* (Lucerne/Alfalfa) *Pennisetum glaucum* (Fodder Pearl millet) *Sorghum bicolor* (Sudan grass) *Zea mays* (Forage maize)
Rhino Seeds Africa Ltd	*Cajanus cajan* (Forage pigeon pea) *Cenchrus purpureum* (Napier grass) *Chloris gayana* (Rhodes grass) variety Boma, Katambora, X-Tosi *Desmodium intortum* (Green leaf) *Sorghum drummondii* (Forage sorghum) *Vigna unguiculata* (Forage cow pea) *Zea mays* (Forage maize)
National Forestry Authority Government	*Calliandra calothyrsus* (Calliandra) *Leucaena leucocephala; Leucaena trichandra* (Leucaena) *Sesbania sesban* (Sesbania)
NARO Holdings Ltd	*Cenchrus purpureum* (Napier grass) *Centrosema ssp.* (Centro) *Chloris gayana* (Rhodes grass) variety Boma *Desmodium intortum* (Green leaf) Brachiaria hybrid varieties *Lablab purpureus* (Dolichos bean) *Medicago sativa* (Lucerne/Alfalfa) *Macroptilium atropurpureum* (Siratro)
ROBRAN Holdings Ltd	*Calliandra calothyrsus* (Calliandra) *Cenchrus ciliaris* (African Foxtail) *Cenchrus purpureum* (Napier grass) *Centrosema ssp.* (Centro) *Chloris gayana* (Rhodes grass) variety Boma *Desmodium intortum* (green leaf) *Gliricidia sepium* (Gliricidia) Brachiaria hybrid varieties *Lablab purpureus* (Dolichos bean) *Leucaena leucocephala* (Leucaena) *Medicago sativa* (Lucerne/Alfalfa) *Megathyrsus maximus* (=*Panicum maximum;* Guinea grass) *Mucuna pruriens* (Velvet bean) *Pennisetum clandestinum* (Kikuyu grass) *Sesbania sesban* (Sesbania)

Advantage Crops Ltd	*Crotolaria juncea* (Sunn hemp) *Desmodium intortum* (green leaf) Brachiaria hybrid varieties - *Mulato II, Cayman, Cobra, Camello* *Panicum maximum* cv Siambaza
U-Farm Holdings (U) Ltd	*Crotolaria juncea* (Sunn hemp) Brachiaria hybrid varieties - *Mulato II, Cayman, Cobra, Camello* *Medicago sativa* (Alfalfa/Lucerne) *Panicum maximum* cv Siambaza *Vicia villosa* (Hairy vetch)
Heifer International (through partnerships)	*Pennisetum glaucum* (Pearl millet) variety Nutrifeed *Sorghum drummondii* (Forage sorghum) variety Sugargraze *Chloris gayana* (Rhodes grass) variety Boma *Desmodium intortum* (Green leaf)
Kazo Dryland	*Chloris gayana* (Rhodes grass) variety Boma *Centrosema ssp.* (Centro) *Macroptilium atropurpureum* (Siratro) *Lablab purpureus* (Dolichos bean) *Zea mays* (Forage maize)

3.2Forage seed registration and regulations

Question 2. (a.) Which forage seed varieties do you sell/have in stock, what is the cost per kilogram, recommended seed rate per acre and estimated/predicted yield per acre for each variety?

The table 6 below details retail prices, recommended seed rate and estimated yield per acre for forage seed varieties stocked by various suppliers.

.

Table 6. Forage seeds against their current prices (December 2021), recommended seed rate and estimated yield per acre.

Forage seed varieties	Cost per KG (UGX)	Recommended seed rate per acre	Estimated yield per acre
Improved Grasses			
Cenchrus purpureum (Napier grass)	25,000.00 - 50,000.00	1,800-2,000 cuttings	3-5 tonnes per acre/cut
Hybrid Brachiaria			
- variety Mulato II	144,200.00	2 kg	
- variety Cayman	144,500.00	2 kg	
- variety Cobra	144,500.00	2 kg	-
Panicum maximum variety Siambaza	138,000.00	2 kg	2.8 tones
Megathyrsus maximus (= Panicum maximum) (Guinea grass)	30,000.00		
Pennisetum clandestinum (Kikuyu grass)	40,000.00		
Chloris gayana (Rhodes grass)			
- variety Boma	30,000 - 45,000.00	4 kg	8 tonnes irrigated
Forage grain crops			
Pennisetum glaucum (Pearl millet) variety Nutrifeed	40,000.00	3-4 kg	30 tonnes
Sorghum drummondii (Forage sorghum) variety Sugargraze	20,000.00 - 30,000.00	5-6 kg	50 tonnes
Sorghum bicolor variety Sudanese (Sudan grass)		5-8 kg	-
Zea mays (Maize)	2,300.00	10-12.5 kg	
Legumes			
Medicago sativa Lucerne/Alfalfa	57,000.00 - 120,000.00	6-10 kg	4.3-8 tonnes (green)
Crotalaria juncea (Sunn hemp)	16,000.00	16-20 kg	3.2 tonnes
Centrosema spp. (Centro)	30,000.00 - 40,000.00	2 kg	
Vicia villosa (Hairy vetch)		10-12 kg	2.6 tonnes
*Desmodium intortum (*Green leaf)	141,200.00 - 150,000.00	1 kg	
Lablab purpureus (Dolichos bean)	20,000.00 - 40,000.00	4 kg	
Vigna unguiculata (Cowpea)	4,000.00		
Cajanus cajan (Pigeon pea)	5,800.00		
Macroptilium atropurpureum (Siratro)	30,000.00		

Mucuna pruriens (Velvet bean)	40,000.00		
Rangeland grasses			
Cenchrus ciliaris (African Foxtail)	45,000.00 - 50,000.00	10 kg	-
Agro Forestry Trees			
Calliandara calothyrsus (Calliandra)	90,000.00 - 140,000.00	Planted in tree nursery	
Sesbania sesban (Sesbania)	50,000.00 - 60,000.00	Planted in tree nursery	
Gliricidia sepium (Gliricidia)	50,000.00	Planted in tree nursery	

Note: *Prices for forage varieties vary amongst suppliers.*

Question 2. (b) Among the forage seeds you sell, which ones are registered in the National List of Crop Varieties?

One respondent indicated *Chloris gayana* to be in the list, however, on verification with the NVL of Uganda (2019), no forage varieties were found.

Question 2. (c) Do you stock any seeds that are in the actual sense food crops but are widely used by farmers as forage crops (maize, sorghum, beans etc)?

Yes, maize seeds (Longe 9 and 10) are both used for forage and food for human. Some stockists also sell sorghum and pearl millet varieties that are not distinctly meant for forage, but farmers grow them for both food and forage.

Question 2. (d) Do you have any forage seeds that are currently in the National Variety Performance Trials (NVPT) with the Directorate of Crop Inspection and Certification (National Seed Certification Services)?

Yes, maize seeds (Longe 9 and 10).

Question 2. (e.i) What are the key challenges (maximum 5) that you experience in your business as a forage seed supplier with regard to registration of forage seed varieties in Uganda?

The seed companies face several challenges that hinder the process of seed registration as shown in table 7 below. The responses integrate those adapted from (Lukuyu *et al.,* 2020).

Table 7. Challenges that hinder the process of seed registration in Uganda.

Obtaining foundation seed	**Production**
• Limited access to foundation seeds hence lengthening period of obtaining them. • Limited available quantities. • High prices. • Lack of germplasm.	• Seasonal changes. • High labour demands. • High cost of production. • Limited land. • Lack of financial resources. • Lack of skilled labour. • Low and unreliable demand. • Pests and diseases. • Time of seed trials in different ecological zones take too long to be established and approved.
Processing and packaging	**Marketing**
• Lack of appropriate machines like for cleaning and drying. • High labour intensity. • Expensive packaging material. • Lack of enough storage.	• High competition from the informal seed producers. • Poor infrastructure e.g., condition an road network. • Low and unreliable demand.
Testing and registration regulations	
• Uganda is in the process of harmonizing its seed policies with COMESA. The speed of the process however seems to be time consuming. • Seed regulations are ignored/not adhered to.	

- No clear variety protection guidelines.
- Seed regulations also ignore forage seeds, which complicates marketing of forage seeds without certificates/certification.
- No clear procedures on testing and registration of new forages varieties. The absence of suitable test protocols for evaluating performance of entries, suitable checks/controls (similar forage in the same category) against which performance of entries can be gauged.
- High costs of seed registration and testing.
- Lack of decentralized service in acquiring permission for plant import permits/forage seeds imports into Uganda.

Source: *Adapted from Lukuyu et al., 2020.*

Question 2. (e.ii): Suggestions to address the challenges above.

- Seed regulations (including on quality control systems) should be properly enforced by all parties concerned.
- Seed variety registration procedures should be compiled and reviewed.
- The seed variety registration and release procedures should be published together with the protocols on variety registration.
- Capacity of foundation seed production must be increased.
- Seed policy should be in place covering forage/fodder seed production.
- Seed regulations should cover fodder and pasture seeds.
- Reduce registrations fees which are prohibitive and exorbitant.

Question 2. (f) According to your expertise, which parameters should be used to test forage crop varieties for registration on the National List of Crop Varieties? Please list and explain.

Parameters that guide testing of forage crop varieties for registration on the National Variety List (NVL) are cross cutting. The responses hereunder are those obtained from this study, as well as those adapted from the forage value chain study in Kenya (Creemers *et al.,* 2021).

- Yield (forage/fodder biomass production) and dry matter yield - Should yield significant quantities of forage per unit area.
- Nutritional quality i.e., Crude protein/nitrogen, energy (ME), fibre (NDF) minerals and digestibility Should produce forage biomass that is nutritious and palatable for livestock.
- Adaptability to important biotic (e.g., pests and diseases) and abiotic (e.g.,drought) factors/challenges encountered in the different production environments.
- Palatability/acceptability by livestock. High palatability to encourage intake, and slow lignification to promote digestibility.
- Distinctness (part of DUS test).
- Uniformity (part of DUS test).
- Regeneration after cuts, number of cuts etc. - Ability for multiple harvests after planting is important since fodder/pasture seed is expensive. It is critical to consider fodder varieties that allow farmers to harvest many times before the need to plant again (perennial versus annual). T Response to different cutting intervals, this also depicts grazing intensity/tolerance to grazing.
- Ecological suitability (agro climatic zones) Site specific germination rates, etc.
- Germination rate (Seed testing)

- Availability of quality seeds/vegetative planting materials.
- Genetic purity. (Seed testing)
- Fast growing. It is better to consider varieties that grow fast within the short rain period so that the fodder can be harvested and stored when the nutritional value is still high.

Question 2. (g) Give suggestions on how the registration process can be made more attractive and friendly.

- The registration process should be clear and less complex; cost manageable; short with less demand on local trials especially where data is already available in other jurisdictions with similar agroecological zones
- Time for seed trials should be reduced e.g., to two years.
- Registration process should be brought closer e.g., should be handled at district or zonal agricultural research station instead of national levels i.e., Kawanda and MAAIF offices in Entebbe, which is time consuming.

More responses to the question are reflected in question 2 (e.ii) above.

Question 2. (h) What are the obstacles in regard to current government policies for commercial forage seed supply business?

Responses to this question are also merged with question 2 (e.ii) above.

3.3 Establishment and Production

Question 3. (a). Classify your forage varieties (including grasses and legumes) into their recommended Agro-Ecological Zones (AEZ).

Table 8. Classification of forage varieties into their recommended Agro-Ecological Zones (AEZ) according to the seed suppliers

Climatic zone	Forages
1. Arid ***Rainfall (100-400mm)***	**Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; **Forage grain crops:** *Pennisetum glaucum* (Pearl millet) variety Nutrifeed; *Sorghum drummondii* (Forage sorghum) variety Sugargraze. **Legumes:** *Centrosema spp.* (Centro).
2. Semi-Arid ***Rainfall(400-600mm)*** ***Altitude (1,000-1,800mm*)**	**Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; Hybrid Brachiaria varieties Mulato II, Cayman, Cobra, Camello; Cultivar Brachiaria varieties Xaeres, Piata, Basilisk, MG4; *Panicum maximum* variety Siambaza. **Forage grain crops:** *Pennisetum glaucum* (Pearl millet) variety Nutrifeed; *Sorghum drummondii* (Forage sorghum) variety Sugargraze. **Legumes:** *Centrosema spp.* (Centro); *Crotalaria juncea* (Sunn hemp)*; Desmodium intortum* (Green leaf)*; Lablab purpureus* (Dolichos bean); Stylo (*Stylosanthes guianensis*). **Agro forestry trees:** *Gliricidia sepium* (Gliricidia).
3. Warm, Wet (Sub – humid) **Medium Altitude** ***Rainfall (600-1,200mm)*** ***Altitude (1,200-1,850mm)***	**Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; Hybrid Brachiaria varieties Mulato II, Cayman, Cobra, Camello; Cultivar Brachiaria varieties Xaeres, Piata, Basilisk, MG4; *Panicum maximum* variety Siambaza. **Legumes:** *Crotalaria juncea* (Sunn hemp)*; Desmodium intortum* (Green leaf)*; Lablab purpureus* (Dolichos bean); *Mucuna pruriens* (Velvet bean); *Macroptilium atropurpureum* (Siratro).
4. Cool, Wet (Sub – humid) **Medium Altitude** ***Rainfall (600-1,200mm)*** ***Altitude (1,850-2,400mm)***	**Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; Hybrid Brachiaria varieties Cayman; *Panicum maximum* varieties Siambaza; *Pennisetum clandestinum* (Kikuyu grass). **Legumes:** *Crotalaria juncea* (Sunn hemp)*; Desmodium intortum* (Green leaf)*; Lablab purpureus* (Dolichos bean); *Mucuna pruriens* (Velvet bean).
5. Cold, Wet (Moist sub-humid) **High Altitude** ***Rainfall (1,200-1,500mm)*** ***Altitude (2,400-3,000mm)***	**Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; Hybrid Brachiaria varieties Cayman; *Panicum maximum* varieties Siambaza; *Pennisetum clandestinum* (Kikuyu grass). **Legumes:** *Crotalaria juncea* (Sunn hemp)*; Desmodium intortum* (Green leaf)*; Lablab purpureus* (Dolichos bean); *Mucuna pruriens* (Velvet bean).
6. Humid ***Rainfall (> 1,500mm)***	**Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; Hybrid Brachiaria varieties Mulato II, Cayman, Cobra, Camello; Cultivar Brachiaria varieties Xaeres, Piata, Basilisk, MG4; *Panicum maximum* varieties Siambaza. **Legumes:** *Crotalaria juncea* (Sunn hemp)*; Desmodium intortum* (Green leaf)*; Lablab purpureus* (Dolichos bean); *Mucuna pruriens* (Velvet bean).

Question 3 (b): Do any of your forage crop varieties that require specific soil conditions? Yes/No. If yes, please list and describe.

The forages listed below do well in a wide range of soils (fertile soils rich in organic matter, less acidic, pH above 5.5) except extended waterlogged/swampy conditions e.g., Black cotton soils.

- **Improved forage grasses:** *Chloris gayana* (Rhodes grass), hybrid Brachiaria varieties, *Panicum maximum* varieties Siambaza and *Cenchrus purpureum* (Napier grass).
- **Forage grain crops:** *Pennisetum glaucum* (Pearl millet) variety Nutrifeed and *Sorghum drummondii* (Forage sorghum) variety Sugargraze.
- **Legumes:** *Crotalaria juncea* (Sunn hemp); *Medicago sativa* varieties (Lucerne/Alfalfa) and *Lupinus albus* (Lupin).

Question 3 (c): Which particular agronomic practices are important for your forage crops to realize their full potential?

Responses to this question also borrow from the forage value chain study in Kenya (Creemers et.al., 2021)

- Some forage seeds require first establishment in a nursery for better germination rate; as direct planting or broadcasting can result in low germination.
- Practice early land preparation
- Prepare soils/seedbed adequately in readiness for transplanting e.g., proper tillage to ensure fine seedbed.
- Use of recommended seed rate/correct planting density to facilitate quick establishment.
- Correct planting density.
- Fence off the gardens/paddocks/plots well to avoid premature grazing by stray cattle, goats and sheep.
- Ensure adequate watering at the beginning for good establishment.
- Maintain soil moisture and nutrient management.
- Apply fertilizers at recommended rates/correct soil amendment according to crop requirements.
- Timely management of incidental pests and diseases that may hamper productivity. You may also practice integrated pest and disease management.
- Soil moisture and nutrient management.
- Control weeds on time.
- Practice rogueing
- Harvesting: Cut at the right stage based on the crop utilization objectives e.g., vegetative stage, flowering stage with optimal energy or crude protein. Also, cut at the right stubble height to facilitate regeneration. It is always advisable to apply nitrogenous fertilizers (farmyard manure, compost, intercropping with legumes, synthetic fertilizers) after every cut or 2-3 cuts.
- For some forages, dry/wilt after harvesting before conservation.

3.4 Feeding (utilization) of forage seed varieties

Question 4 (a): What is the targeted category of livestock for your forage crops? (Beef/Dairy/Dual purpose/Small ruminants).

The forage varieties most suitable for use in beef, dairy, dual purpose and small ruminants:

Forage grasses

- *Cenchrus purpureum* (Napier grass).
- *Chloris gayana (*Rhodes grass) varieties Katambora, Boma.
- Brachiaria cult ivar varieties Xaeres, Piata, Basilisk, MG4.
- Brachiaria hybrid varieties Mulato II, Cayman, Cobra, Camello.
- *Panicum maximum* variety Siambaza.
- *Pennisetum clandestinum* (Kikuyu grass).

Rangeland grasses

- *Cenchrus ciliaris* (Buffel grass/African Foxtail)

Forage grain crops

- *Pennisetum glaucum* (Forage Pearl millet) variety Nutrifeed
- *Sorghum drummondii* (Forage sorghum) variety Sugargraze

Leguminous forage crops

- *Centrosema ssp.* (Centro)
- *Crotalaria juncea* (Sunn hemp)
- *Desmodium intortum* (green leaf)
- *Lablab purpureus* (Dolichos bean)
- *Lupinus albus* (Lupin)
- *Medicago sativa* (Alfalfa/Lucerne)
- *Vicia villosa* (Hairy vetch)

Agro Forestry Trees

- *Calliandara calothyrsus* (Calliandra)
- *Sesbania sesban* (Sesbania)
- *Gliricidia sepium* (Gliricidia)

Question 4 (b): In which farming system(s) are your forages mostly used? (Cut and carry-zero grazing)/Extensive grazing/Both systems)

Both Intensive (cut and carry-zero grazing) farming and extensive farming (free grazing)

- **Improved forage grasses:** *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; Hybrid Brachiaria varieties Mulato II, Cayman, Cobra, Camello; Cultivar Brachiaria varieties Xaeres, Piata, Basilisk, MG4; *Panicum maximum* variety Siambaza; *Pennisetum clandestinum* (Kikuyu grass).
- **Legumes:** *Medicago sativa* (Lucerne/Alfalfa); *Vicia villosa* (Hairy vetch); *Centrosema spp.* (Centro).

- **Forage grain crops:** *Pennisetum glaucum* (Pearl millet) variety Nutrifeed; *Sorghum drummondii* (Forage sorghum) variety Sugargraze.
- **Rangeland grasses:** *Cenchrus ciliaris* (Buffel grass/African Foxtail)

Cut and carry only

- **Legumes:** *Crotalaria juncea* (Sunn hemp); *Desmodium intortum* (Green leaf).
- **Forage grain crops:** *Sorghum drummondii* (Forage sorghum) variety Sugargraze.
- **Agro forestry trees:** *Calliandara calothyrsus* (Calliandra); *Gliricidia sepium* (Gliricidia); *Sesbania sesban* (Sesbania).

Question 4 (c): In which form can your forages be used and fed? (Hay, silage, fresh)

Hay, silage, fresh

- Hybrid Brachiaria varieties Mulato II, Cayman, Cobra, Camello; *Panicum maximum* variety Siambaza; *Cenchrus purpureum* (Napier grass).

Hay, fresh

- *Chloris gayana* (Rhodes grass) varieties Katambora, Boma.
- *Crotalaria. juncea* (Sunn hemp); *Desmodium intortu*m (greenleaf); Medicago sativa (Alfalfa/Lucerne); *Vicia villosa* (Hairy vetch).
- *Cenchrus ciliaris* (Buffel grass/African Foxtail).

Silage, fresh

- *Sorghum drummondii* (Forage sorghum) variety Sugargraze; *Pennisetum glaucum* (Pearl millet) variety Nutrifeed.

Silage

- *Sorghum drummondii* (Forage sorghum) variety Sugargraze.

Fresh

- *Calliandara calothyrsus* (Calliandra)
- *Gliricidia sepium* (Gliricidia)
- *Sesbania sesban* (Sesbania).

Question 4 (d): Describe the management skills required to feed/utilize the forage crop(s) to increase animal productivity (stage of harvesting, type of grazing system, level of fertilization)

Low-moderate

- *Cenchrus ciliaris* (Buffel grass/African Foxtail); *Chloris gayana* (Rhodes grass) varieties Katambora, Boma; *Cenchrus purpureum* (Napier grass); Hybrid Brachiaria varieties Mulato II, Cayman, Cobra, Camello.
- *Pennisetum glaucum* (Pearl millet) variety Nutrifeed; *Sorghum drummondii* (Forage sorghum) variety Sugargraze.
- *Calliandara calothyrsus* (Calliandra); *Gliricidia sepium* (Gliricidia); *Sesbania sesban* (Sesbania).

Moderate to High

Moderate to high management would include observing aspects like. Proper seedbed preparation, planting grass seed/planting in straight lines, fertilizer application, handling of small/treated seeds, weed control in pasture, proper use of insecticides, handling of hand spray pumps/knapsack spray pump, farm record keeping, fodder harvesting, hay baling and storage, conservation i.e., hay rack construction/silo preparation, feeding silage or hay and rotational grazing (for extensively grazed forages). Forages that demand moderate to low management include;

- *Crotalaria juncea* (Sunn hemp); *Medicago sativa* (Lucerne/Alfalfa); *Vicia villosa* (Hairy vetch); *Lupinus angustifolius* / *Lupinus albus* (Lupin); *Centrosema spp.* (Centro); *Desmodium intortum* (Greenleaf; *Lablab purpureus* (Dolichos bean).
- *Panicum maximum* varieties Siambaza.

Question 4 (e): What is the maximum (analysed) nutritional value for ruminants that can be realised for each forage variety under good agricultural practices?

The table below shows the estimated nutritional value for ruminants that can be realised for each forage variety under good agricultural practices.

Table 9. Estimated nutritional value for ruminants that can be realised for various forage varieties.

Forage seed varieties	Digestibility		CP	NDF
Improved forage grasses				
Cenchrus purpureum (Napier grass)	-		6-8%	-
Brachiaria hybrid varieties - Mulato II, Cayman, Cobra, Camello.	66-68%		16-18%	34-42%
Panicum maximum variety Siambaza	75%		14-16%	34%
Chloris gayana (Rhodes grass) varieties Katambora, Boma	75%		8%	71%
Forage grain crops				
Pennisetum glaucum (Pearl millet) variety Nutrifeed	65-82%		16-20%	50-65%
Sorghum drummondii (Forage sorghum) variety Sugargraze	-		10-12%	50-60%
Legumes				
Medicago sativa (Alfalfa/Lucerne)	80-90%		22-28%	25-30%
Crotalaria juncea (Sunn hemp)	-		19%	-
Vicia villosa (Hairy vetch)	-		17-25%	-
Lupinus albus	-		25-30%	-
Rangeland grasses				
Cenchrus ciliaris (Buffel grass/African Foxtail)	50%		10%	85%

Note: *These are after 40 days of regrowth.*

3.5 Forage seed adoption, Distribution and Marketing

Question 5 (a): How does the forage seeds you supply get to the end user?

The formal seed sector is important in distributing quality certified seed in Uganda. The major customers of the seeds are Individual farmers, government institutions like Operation Wealth Creation (OWC), NGOs like FAO, farmer groups, dairy cooperatives and Agro-vet stockists. The Figure below represents a distribution pathway through which seeds get to these final consumers in the formal sector in Uganda.

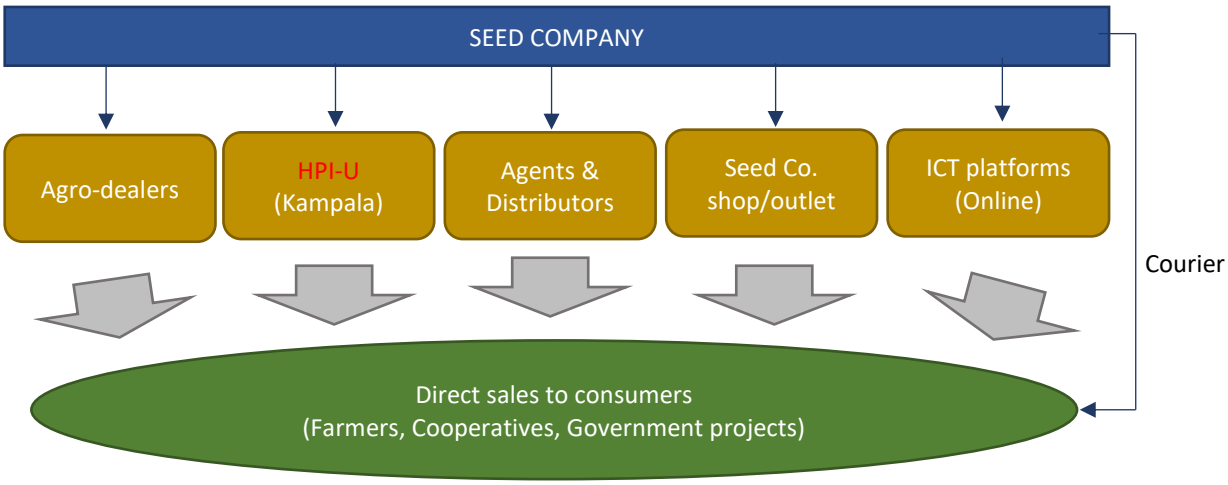


Figure 2. Distribution channel for formal seed suppliers in Uganda.

The seed companies trading in the formal seed sector are not very competitive compared to seed producers in the informal sector who have a direct link with farmers and further sell seeds at a lower price. The higher prices set by companies trading in the formal sector are ascribed to the absence of a market mechanisms that would otherwise control the pricing and marketing of forage seeds in Uganda. The informal sector further benefits from the introduction of Quality Declared Seed (QDS) by MAAIF with support from ISSD, which offers training to farmers on quality seeds production (Lukuyu *et al.,* 2020). The Figure below represents a distribution pathway through which seeds get to these final consumers in the informal sector.

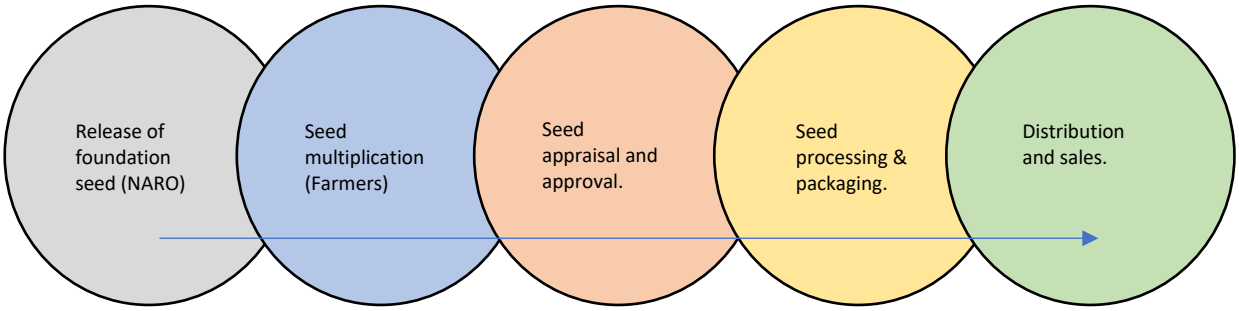


Figure 3. QDS (informal) processes

Question 5 (b): Rate the likely interest and adoption rate of improved forage seeds by the ruminant livestock value chain actors.

The figure below shows graphical presentation of the interest and adoption rates for some common forages in Uganda, as informed by responses. The adoption and interest rates for improved grasses such as Napier, Chloris and Brachiaria are highest followed by the forage grain crops; whereas for the legume are lowest.

Generally, the interest rate remains higher than the adoption rate, which directly imply the demand. It is predicted that the demand for forage seeds is likely to increase in the coming years mainly because of the efforts by the Ugandan government to create awareness of improved forage seed varieties; mainly to improve animal nutrition. The key challenge however, is the abundant availability of grazing lands, which discharges farmers from investing improved forage seeds.

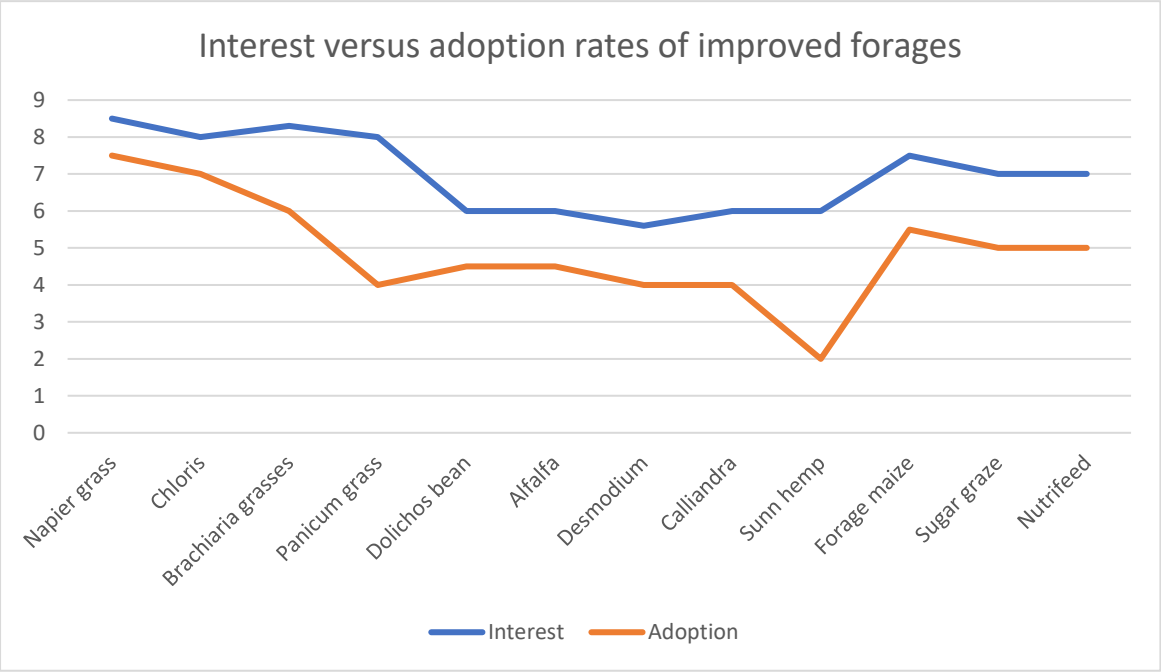


Figure 4. Interest versus adoption rate of improved forages in Uganda.

Question 5 (c): Ways or interventions on how adoption rate can be increased

The adoption rate of the forages can be increased by interventions such as;

- Make information on the different forage variety options widely available to farmers so that they can make informed decisions on the varieties to adopt.
- Make deliberate mechanization of land preparation, planting, weeding, and harvesting of fodder and at affordable costs.
- Increasing farmer access to affordable financing to promote investments in farm structures, such as paddocks, silage silos, hay barns and farm development. These in one way or another directly impact on farmers interest regarding adoption of improved forages.
- Organizing farmers into cooperatives for collective bulking and marketing of livestock products. Fodder production can then be one of the collective services to increase and sustain livestock productivity.

- Roll out funding to promote fodder production and thus enhance adoption rate. The funding can be through Cooperatives, SACCOs or development partners.
- Support the creation of forage demonstration and/or model farms through lead farmers who can encourage other farmers.
- Support community-based seed production enterprises as sources of affordable quality seeds.
- Support farmers to access lucrative, reliable and sustainable markets as a pull factor for more production and eventually better feeding; which encourages more adoption of forage production incl. fodder conservation and increased milk production.
- Capacity building of practical dairy training farms (PDTFs) on improved forage production through training.
- Community sensitization by extension staff on improved forage varieties. Sensitization can also be through (local) radio and television stations.

Question 5 (d): Ranking the method(s) used to disseminate information on forage (seed) products to farmers.

The figure below shows a graphical presentation of the methods seed companies use to disseminate information on forage seeds to farmers.

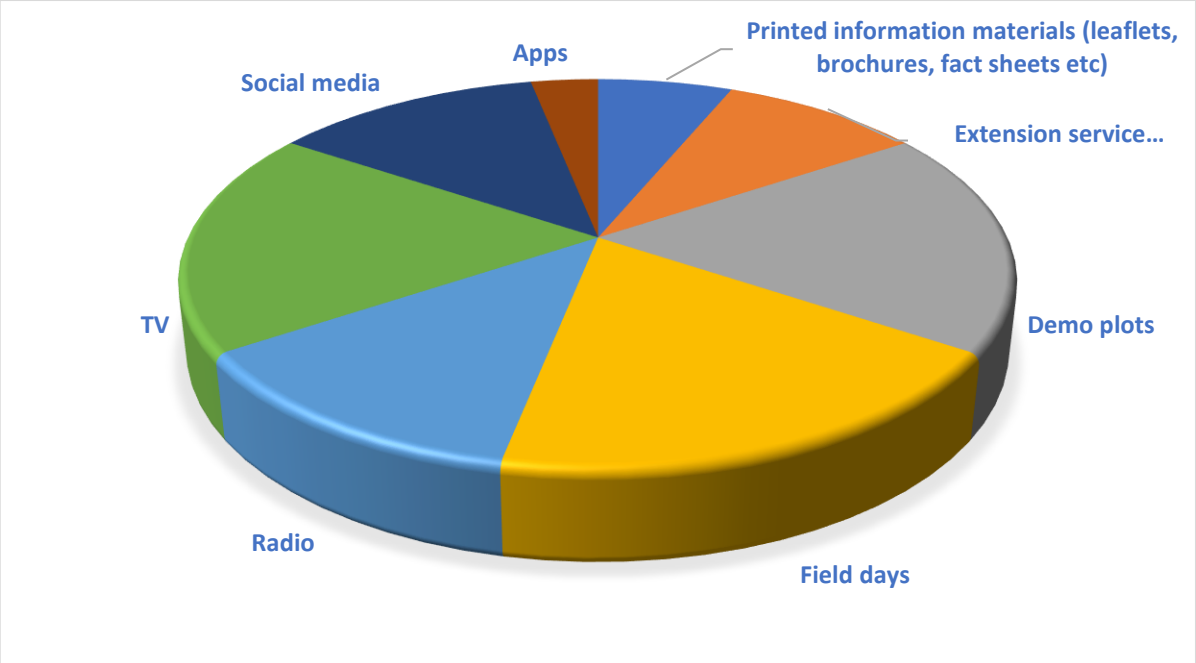


Figure 5. Method of information dissemination

From the information gathered, apps were least effective while the most effective channels were television, field days and demonstration plots whenever they were used. Radio and social media were moderately effective.

Question 5 (e): Most pressing challenges/problems faced when trying to penetrate the market and/or increase market share for forage seeds in Uganda.

- Inadequate dissemination of information about the (improved) forage varieties.

- Inadequate training of extension service providers and agro input suppliers to provide information about the (improved) forage to farmers.
- Forage varieties have not been sufficiently demonstrated in in the different parts of Uganda to expose more farmers to the newly introduced (improved) varieties
- Most forage seed varieties in the market are not yet registered in the NVL.
- Conservatism caused by traditional husbandry practices that do not value new technologies, or that contradict with new technologies.
- High cost of forage establishment (high cost of labour, fertilizer, primary production activities e.g., land opening) and maintaining fodder gardens (weeding, etc.) discourage farmers.
- Limited market incentives to increase farm production.
- Farmers experience poor market prices compared to cost of production and conservation.
- Trading related costs i.e., high costs of business permits, taxes.
- Lack of organized market structures for certified forage seed market systems.

3.6 Opportunities, Innovations and Involvement of TIDE 2 / NEADAP-2

Question 6 (a): Opportunities that can benefit forage seed suppliers, livestock farmers, pastoralists and commercial forage producers; and nature of support required from TIDE 2/NEADAP-2 or potential investors to achieve these opportunities with the aim to increase adoption rate in Uganda.

Opportunities that can benefit forage seed suppliers and stakeholders

- Forage marketing/promotion: Product advertising and wide dissemination of information on forage varieties and associated forage products to improve demand. This can also be done through product information materials e.g., fact sheets, brochures, training materials, etc.
- Technical support/capacity building of extension service providers, agro-input suppliers and farmers on good forage production practices and utilization.
- High demand for milk and beef especially in the dry season
- Unpredictable weather patterns leading to frequent lack of feed/pastures for livestock during prolonged dry seasons.
- Proliferation of commercial fodder producers.
- Establishment of seed distribution network for the target varieties to increase farmers access to seeds.
- Registration and certification of new forage varieties.

Nature of support required from TIDE 2 / NEADAP-2 or potential investors to seize opportunities

- Financial resources to facilitate;
    - production and dissemination of the information.
    - capacity building of extension service providers, agro input suppliers and farmers.
    - trials to generate data for variety registration (NVPT) and registration fees.
- Dairy: Promotion of nutritive fodder varieties and conservation of fodder among dairy farmers to enhance milk production.
- Beef: Promotion of nutritive fodder varieties and conservation of fodder among beef farmers to enhance fattening of beef animals for the market; linking beef feedlot farmers to

commercial fodder producers; supporting commercial fodder producers to expand production and get linked to beef farmers.

- Market linkage for commercial fodder producers: promotion of marketing of conserved fodder, mechanization of fodder production and conservation.
- Incentives to lower costs of fodder seeds.
- Supporting research on forage production. Marketing of existing academic studies of biodiversity and ecosystem health.

Question 6 (b): Some of the ongoing youth and women-led activities, business innovations and potentially revolutionary technologies in forage value chain across Uganda.

- Youth forage service provider group/network to;
  - establish fodder gardens,
  - make silage for interested farmers at a fee,
  - produce silage and sell to farmers during periods of scarcity.

Question 6 (c): Plans to roll out or scale up forage seed operations in Uganda.

- All the companies that responded have plans to scale up operations in Uganda. Areas of interest include Central Uganda, South Western Uganda and Northern Uganda.

Question 6 (d): Interventions that proved to be successful in helping penetrate the market in Uganda.

The figure below shows interventions that proved to be successful in helping penetrate the forage seed market in Uganda.

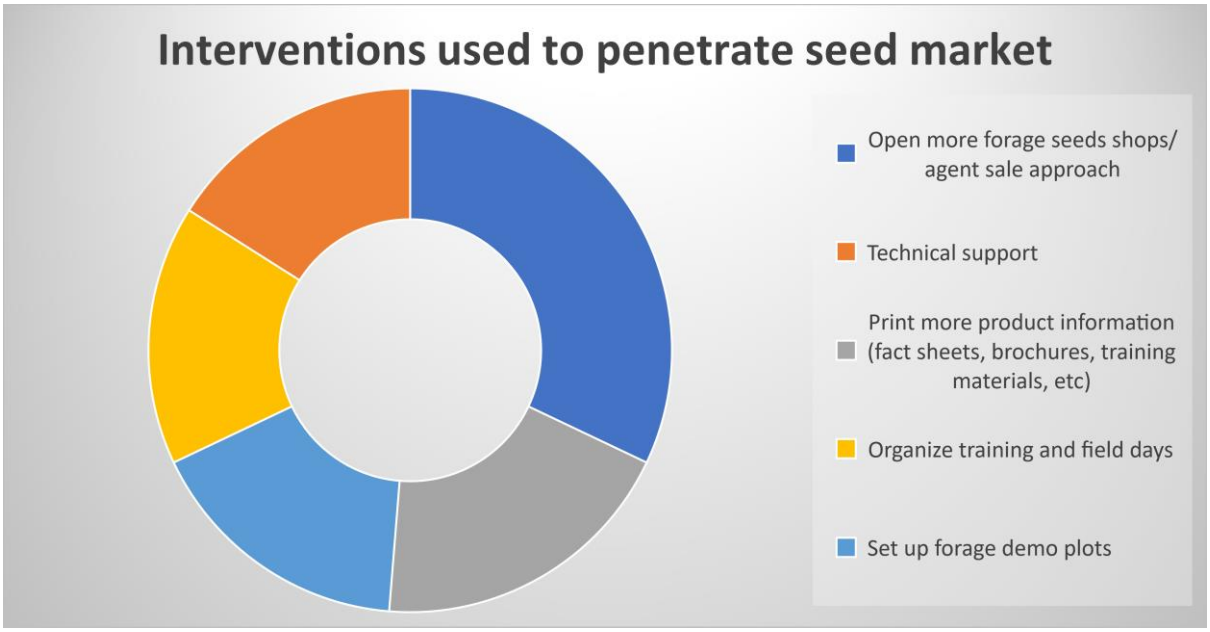


Figure 6. Ranking interventions helpful in penetrating Ugandan market (1, x)

Question 6 (e): Ongoing collaborations regarding promoting uptake of improved forages with NGO Projects/Government/Farmer Groups/Cooperatives?

The respondents shared some of the current interventions with different partners to depict growth as shown in the table below;

Table 10. Summary of interventions with different partners.

Partner	Nature of collaboration
CIAT/ILRI	Supply of forage seeds to beneficiaries
SNV-TIDE II	Supply of forage seeds, stakeholder capacity building, interventions on seed policy and regulations.
East Africa Seed Company	Supply of farmers with improved seed; technical training of farmers and extension workers.
NaLiRRI	Forage conservation and trainings on improving efficiency of utilisation of locally available feed resources.
Dairy farmer producer organizations	Model farmers with different grown forage crops identified, co-financed to purchase pulverisers to support fodder processing into silage. Farmers have been linked to commercial tractor hire services to enhance land preparation for forage establishment; lead farmers/learning centres supplied with forage seeds; forage seed distributors supported to penetrate deeper into the remote livestock farming areas through field days, radio programs and on farm trainings.
Vermipro U Ltd	For sale and distribution of probiotics for enhancement of soil health and silage production without molasses.
Dutch ISSD	Promotion of pasture seed production
IGADA Centre for Pastoral forages and livestock production	Harmonisation of pasture and fodder policies.

CHAPTER 4: KEY LESSONS AND RECOMMENDATIONS

Key lessons and recommendations provide a summary of key issues and gaps in the forage seed market in Uganda, recommendations for further action and a vision of an advanced and vibrant forage seed sector in Uganda in the nearby future.

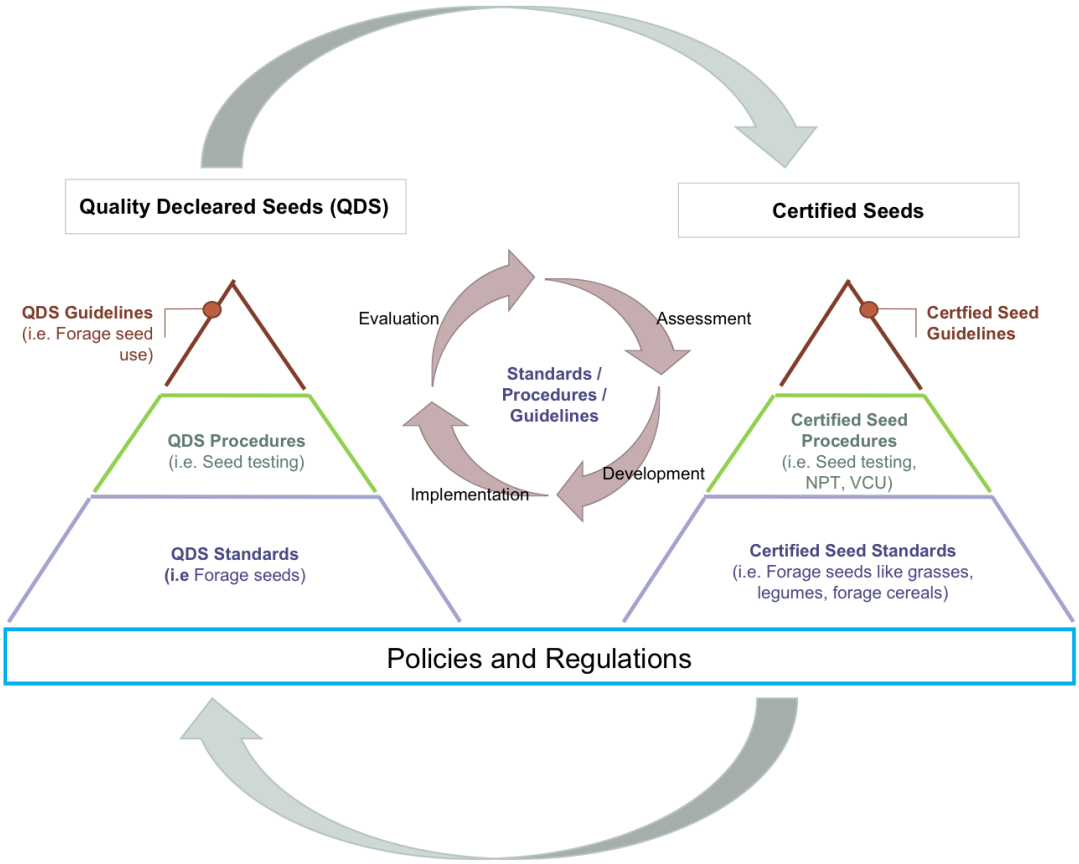
4.1 Key lessons and gaps

- In Uganda the informal sector remains the primary system through which farmers acquire forage seeds. The pool of farmers who access seeds through the formal sector is small compared to those accessing forage seeds through the informal sector.
- A key challenge in the informal sector is the storage of forage seeds from season to season while, the level of technical know-how on forage seed handling and storage is low. Training and guidelines are needed to build the required capacity.
- There is limited availability of forage seeds in Uganda this affects access to improved forage seeds and planting materials and has a negative impact of ruminant livestock production systems.
- Under the Quality Declared Seed (QDS) system as well as in the formal seed system, the number of forage seed varieties available is a fraction of seeds for food crops that are annually registered and released. This limits the choice for farmers when deciding which forages crop seeds and pasture mixes could be best to improve dairy farm systems. As a result, the limited choice could hamper biodiversification as well as improved forage production and grassland systems.
- The plant variety release and registration process for new varieties is rather lengthy/time-consuming and costly, limiting the number of released varieties. For example, the total time taken to go through the national performance trials is about 1 year (2 seasons). Seed companies from outside Uganda find this process to be cumbersome as success is not guaranteed and the market for forage seeds still needs to develop. These further limits the flow of new, high potential forage varieties into the seed market and adversely affects farmer choices for improved forages.
- The publishing of approved seed varieties in the official Uganda gazette, the updating of the common catalogue and its publication for wider accessibility are infrequent. This means that if seed companies start to avail seed for testing and registration farmers may not be aware of the newly released varieties.
- Data on suitability of new forage species /varieties for example for different agro-ecological zones, favourable cost of production (DM yield/ha) and nutritional value (ME and CP yield/ha) as well as farmer experience on the potential contribution of improved forage species/varieties in total balanced rations should be well documented. These are relevant for stakeholders and private companies as it will provide them with indications on the market potential of improved forages.
- Improved forage seeds are expensive, which requires that farmers are made aware of the benefits, initial production cost implications and management requirements to be able to make an informed decision.
- Expensive forage seed is expected to limit the adoption rate by farmers.

4.2 Opportunities

- CIAT, concludes that there is enormous market of forage seeds in Uganda and globally this is further substantiated by figures of the International Seed Federation (ISF) which shows that import and export quantities and value of seed are still low in Uganda.
- There are many dairy farmers and livestock keepers in Uganda with, in the short term, a growing number of ruminant livestock kept on their farms. This will result in an increasing demand for animal feed including forage.
- At the same time the population in Uganda is growing with an increase of the number of people with a medium deposable income this contributes to increase in consumption of animal protein.
- There is, now Uganda is nearing the finals stages of the harmonization process of its seed registration system as per the COMESA guidelines, the possibility to update and publish the requirements in regard to forage seed standards, processes and guidelines, in regard to forage seed which is marketed under the QDS system and that of the formal system (UAFIA) as in figure 7 below.
- Government, private sector stakeholders and NGO's need to develop a clearer, agreed understanding of the roles and interactions of the seed sub-sectors (formal, semi formal and informal) this could help in building a better understanding about trends in forage seed demand and forage seed requirements in different areas in Uganda.
- Efficiency in the forage seed sector can be further improved by matching the needs of livestock farmers and or dairy cooperatives with seed companies, seed producer groups, Local Seed Businesses (LSB's), NGO projects such as TIDE II, and local government demands for the supply of Early Generation Seed (EGS).

Figure 7. Schedule for integration of Forage Seed systems in Uganda



4.3 Recommendations

Community of Excellence for Forage Seed System Improvement:

Get together a Community of Excellence of Forage Seed System Improvement to engage and put forward a case for greater investment in a vibrant, competitive forage seed system by drawing attention to the need for greater awareness, access, affordability, adoption and demand from ruminant livestock farmers, stronger support to emerging private seed companies with focus on forage seed supply, production and multiplication, finalize the process of harmonizing (COMESA) seed regulation, and encourage, possibly by providing some incentives, seed suppliers, national and international to register and certify forage seed crops, this may involve quality standards of forage seeds and systems for testing and regulating quality of forage seeds, as well as enhancing effective engagement with national partners.

National Seed Authorities

1. Reliable, up-to-date data on the forage seed systems, formal, semi-formal and informal are not available which is a considerable barrier for management, quality control, decision making and investment by private and public sector stakeholders.
2. Develop and improve a separate, transparent QDS regulatory framework for forage seeds (see figure 7) such that the seed systems are integrated and mutually supporting (e.g. quality

insurance of forage seeds produced by private or public stakeholders by in independent body).

3. Evaluate and transform the system of Early Generation Seed production (EGS) for forage seed and planting material and consider public private partnerships regarding quality assurance and production capacity.
4. For the formal sector make transparent, publicly accessible information from UPHIA available among stakeholders about the forage seed certification, registration/release procedures as well as forage seed standard for individual species/varieties.
5. Create an electronic seed certification system so that the process of certifying and listing seed in the National Variety List will be easier, with more automated updates of the NVL and in the future fast and efficient alignment with the COMESA Variety Catalogue.
6. Align with international best practices in seed standardization in particular, tropical forages (grasses and legumes) both for the semi formal (QDS) and the formal forage seed system. More so now the harmonization process of the seed policies with COMESA is nearing completion.
7. This calls for further integration and expansion of the number of listed forage varieties between the countries that are in the fore front of harmonization of seed policies and regulation. For example, align with the 1991 act of the UPOV convention, which is the most advanced international standard for IP protection for plant varieties.
8. Intellectual property rights are not well protected in Uganda. Seed companies indicate that strong breeder rights and membership of UPOV would be an advantage for producing and distributing forage seeds in Uganda.
9. Facilitate private sector companies and public sector stakeholders to successfully self-certify forage crops.
10. Create and support development of appropriate training materials, structures and incentives for seed exchange network improvement in the semi-formal (QDS) seed sector (see figure 7) as well as improved access to forage seeds in the formal sector by incentivising private and public sector stakeholders to register and coordinate quality forage seed production and expand their distribution network.
11. Streamline and facilitate trade across the region in particular, starting with the countries who finalized the harmonization process of the seed sector as per COMESA guidelines.,
12. For forage crops, contrary to food crops, yield per ha is not the only parameter which is of importance when comparing a variety with existing varieties on the NVL. Include information on purposes/use of grasses and legumes. For example, cultivated grasses, rangeland grasses or grasses for lawn and playing fields.
13. Include suitable test parameters to determine nutritional quality for ruminants (e.g., ME, CP and NDF at the preferred or recommended harvesting stage) and protocols for evaluating and benchmarking performance of entered varieties is recommended. This will give the farmer information about benefits and specific characteristics of the forages on the NVL. Other parameters which would give farmers added information when deciding which forage variety is most suitable for their farm includes disease/drought resistance, performance in different climate/altitude/temperature conditions.

Seed suppliers

1. The occurrence of fake seed, at times encouraged by seeds purchased by NGO's and given for free to farmers, undermines the credibility of the formal seed sector. This is likely also an issue in the forage seed system. Better quality assurance and information management systems, supported by all seed systems stakeholders, including the government agencies are needed to resolve the issue.
2. Involve the private sector into the seed inspection, quality assurance and certification process, to reduce costs for RoU and enable scaling of certification.
3. Support more efficient and cost-effective seed certification processes to allow sharing of new varieties that are approved in one country with neighbouring countries (starting with COMESA member states), to reduce time to market and costs for the private sector.

Farmers

1. Farmers should have the opportunity to make informed choices about which forage seeds they plant to best suit their personal circumstances, whether protected by intellectual property rights or not. Enhancing a farmer's ability and awareness to make an informed choice requires the availability of suitable forage seed options, data on the viability of the forages including utilisation and knowledge of any limitation that may restrict the use of varieties chosen.
2. Demonstration of internationally and nationally proven and promising varieties.
3. Developing and maintaining a list of 'promising' varieties, in the semi-formal and the formal forage seed system for the different agro-ecological zones & farming systems in Uganda.

Youth and Women

1. Facilitate formation of youth owned commercially viable business start-ups i.e., service provider groups in forage seed multiplication in the informal and semi formal system , forage crop production and conservation support businesses.
2. Introduce capacity building of youth and women groups to equip them with requisite skills to become trainers and providers of forage seed multiplication in the semi formal system as well as providing forage extension services for farmers.

4.4 Vision of an advanced and vibrant forage seed market in Uganda

- A mix of minimal 4 international and minimal 5 national forage seed companies are active in the market, each has a relevant, well-documented portfolio of forage species and varieties and has an extensive marketing and distribution network.
- The forage seed companies in the market compete in a fair way for market share.
- Larger companies have quality control systems in place and guarantee germination rate and purity. Smaller companies, farmer groups or individual farmers use Quality Declared Seed system. The leading companies have sales/advisory services to support and guide clients in applying good agronomic and utilisation practices for the forage crops.
- The seed systems, formal, semi-formal and informal are integrated and mutually supportive.
- Companies have a good number of new varieties in their portfolio and some of these are undergoing NPT-trails for registration. Kenya, Uganda, Rwanda, Burundi and Zimbabwe. There is a growing interest among the wider farming community for improved forage production, with increasing demand for forage seeds, based on positive results and improved animal performance among the early adopters.
- There is a ppp-arrangement for developing and publishing an annual list of recommended forage species and varieties. Varieties are scored on DM, nutritional value, disease/drought resistance, harvesting stage or interval, ease of establishment, soil fertility requirements, suitability for grazing, cut and carry, haymaking or ensiling.
- The national seed authority aligns standards, processes and guidelines with international best practices and has accepted seed testing of ISTA accredited laboratories and streamlined forage seed trade between COMESA member states.
- NPT-trails are evaluated by an independent PPP-committee based on a comprehensive and relevant set of criteria; while cost of both competent authority-led and company-led NPT trials are fair.
- New registered varieties are introduced to farmers through demonstration plots during field days and visits to early adopters.
- Key, evidence-based, farm economic data are available on relevant forage production and conservation systems.
- Easily accessible, detailed and evidence-based Good Agricultural Practices are available for the different forage species/varieties, specified for the different agro-ecological zones and farming systems in Uganda.
- There is an active community of forage researchers, companies, advisors, lecturers, trainers and lead farmers for knowledge sharing, policy adaptation and formulation and running a broad set of training courses.
- Forage production and conservation is included in all formal trainings, courses and curriculum on ruminants.
- Scaled agro-contracting services are available for small, medium and larger scale forage crop establishment (including pastures), forage crop maintenance, harvesting and conservation.

REFERENCES

Bentley, J. W., J. Andrade-Piedra, P. Demo, B. Dzomeku, K. Jacobsen, E. Kikulwe, P. Kromann, et al. 2018. Understanding Root, Tuber, and Banana Seed Systems and Coordination Breakdown: A Multi- Stakeholder Framework. *Journal of Crop Improvement* 32 (5): 599–621

Blackmore I., Ringler C., Meinzen-Dick R., Gender Gaps In Agricultural Growth And Development: Opportunities for Improving Gender-Responsive Programming, Evidence Brief, Gender, Climate Change and Nutrition Integration Initiative (GCAN)May 2022

Comesa Seed Trade Harmonization Regulations. (2014). Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA).

Comesa Variety Catalogue database. (2022). https://varietycatalogue.comesa.int/varietycatalogue

Creemers J., and Aranguiz A, A. Netherlands East African Dairy Partnership (NEADAP). (2019). Quick Scan of Uganda's Forage Sub-Sector. - Working Paper Supplement.

Derek Bewley, J., Black, M., Halmer P., (2006). The encyclopaedia of seeds: Science, Technology and Uses.

FAO, (2006a), Quality Declared Seed systems

Hampton, J.G., (2015). Forage Seed Quality: Dormancy, Standards, Quarantine, The XXIII International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi from November 20 through November 24, 2015.

IGAD Centre For Pastoral Areas and Livestock Development. July (2018). Policy Brief on Enhancing Feed Security in the IGAD Region.

International Seed Federation. May, (2022). https://worldseed.org/

Kabirizi, J. M. (2006). Effect of integrating forage legumes in smallholder dairy farming systems on feed availability and animal performance. Unpublished Ph.D thesis, Makerere University, Uganda.

Longley, C., Ferris S., O'Connor A., Maina M., Rubyogo J.C., and Templer N., (2021). Uganda seed sector profile. A Feed the Future Global Supporting Seed Systems for Development activity (S34D) report.

Lukuyu B., Namutebi P., (2020). The forage seed systems in Uganda.

MAAIF (Ministry of Agriculture, Animal Industry and Fisheries). (2018). National Seed Policy. Entebbe Uganda.

Mabaya, E., Waithaka, M., Tihanyi, K., Mugoya, M., Kanyenji, G., Ssebuliba, R. and Kyotalimye, M. (2021). Uganda 2020 Country Study - The African Seed Access Index (version September 2021)

Maina, K., Baltenweck, I., Lukuyu, B., Teufel, N., Mwendia, S., van Mourik, T. and Peters, M. (2022). Assessment of the forage seed sector in Kenya and Uganda. ILRI research report 94. Nairobi, Kenya: ILRI. https://hdl.handle.net/10568/116651

Mastenbroek, A.; Otim, G.; Ntare, B.R. Institutionalizing Quality Declared Seed in Uganda. Agronomy 2021, 11, 1475. https://doi.org/ 10.3390/agronomy11081475

McCormick, L.H., Lodge G.M., Boschma S.P., Murray, S., (2010). Simple rules to use when buying seed of tropical perennial grasses, Proceedings of the 24th Annual Conference of the Grassland Society of NSW

McCormick, LH, Boschma, SP, Lodge GM & Scott, JF. (2009). Producer constraints to wide spread adoption of sown tropical grass pastures on the North-West Slopes of New South Wales, Tropical Grasslands 43 (in press)

Michael Waithaka, John Mburu, Mainza Mugoya, Krisztina Tihanyi. 2019. Kenya Brief 2018 -The African Seed Access Index. Available at: tasai.org/reports.

Mulongo, D.M., (2017). Fodder and Pasture Seed Production Status in Uganda

Mwebaze, S.M.N., (2006). Uganda - Country Pasture/Forage Resource Profiles. FAO

Parihar, S. S., (2010). Status of seed science research in tropical range grasses and future needs., Range Management & Agroforestry 31:79-86.

Position papers adopted and new leaders elected at ISF World Seed Congress. (2018). http://www.worldseed.org/resources/position-papers/#sustainable-argiculture

Seed2b (2019). Manual on Regional Seed Regulations in the Common Market for Eastern and Southern Africa.

Ssebuliba R.N., Baseline Survey of the Seed Sector in Uganda, in relation to Regional harmonization of Seed Legislation, Uganda Seed Trade Association (USTA), Kampala, Uganda, September 2010

Strauss, P., Dannhauser C.S., Pletsen van W., Venter, W.D., (2010). Seed testing - The Chaffy Grasses, South African National Seed Organisation, Lynnwood Ridge, South Africa

The CGIAR Community of Excellence for Seed Systems Development. (2022). https://pim.cgiar.org/cgiar-coe-seed-systems-development/

The Republic of Uganda. 2018. The National Seed Policy. https://www.agriculture.go.ug/ wp-content/uploads/2019/05/Ministry-of-Agriculture-Animal-Industry-and-Fisheries-National-Seed-Policy.pdf

The Seed sector in Uganda. (2018). https://www.accesstoseeds.org/app/uploads/2018/11/Uganda-1.pdf

The Seed Systems Group. (2022). https://seedsystemsgroup.org/

Tolera, A., (2017). Good Practices in Fodder and Fodder Seed Production and Marketing for Increased Private Sector Investment, Proceedings of a Regional Workshop Organized by ICPALD/IGAD, Conducted from April 6 to 7, 2017 at Pelican Resort, Elementaita, Kenya.

Turner, M., Assefa, G. and Duncan, A. (2019). Forage seed quality in Ethiopia: issues and opportunities. ILRI Project Report. Nairobi, Kenya: ILRI.

ANNEXES

Annex 1. National (Australian) Seed Quality Standards for Certified Seeds

The National Seed Quality Standards are the voluntary minimum standards for physical seed quality agreed to by the Australian Seed Federation (ASF) and the Grains Council of Australia. These standards are applied to all certified seed of public cultivars and to seed sold by ASF members. In many cases seed companies will apply physical standards well in excess of these. The national standards may be used as a guide to determine an acceptable level of physical seed quality prior to purchase.

Tropical grasses

Species	Minimum Pure Seed % by mass	Minimum Germination % by count	Maximum Other Seeds % by mass
Bahia grass	60	60	2.00
Buffel grass	90	20	2.00
Guinea grass	40	25	0.70
Kikuyu grass	95	60	1.00
Lovegrass	97	70	0.50
Rhodes grass (Diploid)	80	20	4.00
Rhodes grass (Tetraploid)	75	10	4.00
Seteria	60	20	1.20

Legumes

Species	Minimum Pure Seed % by mass	Minimum Germination % by count	Maximum Other Seeds % by mass
Joint vetch	95	50	2.00
Kenya white clover	97	50	1.00
Lucerne	98	60	0.50
Red clover	97	60	0.50

Annex 2. Value for Cultivation and Use (VCU)

- Productivity
  - Fresh yield
  - DM yield
  - Crude protein content
- Quality aspects
  - Fiber content (NDF, ADF, ADL)
  - Digestibility
- Palatability
- Climate Zone
- Location
- Soil characteristics and Soil fertility
- Purpose of use
- Susceptibility to diseases (disease resistant)
- Drought resistant

Annex 3a. Summarized status (2021) of policies and regulatory framework

Topic	Status	Comments
Seed policy	Uganda Seed Policy was ratified in 2018	The policy existed is six different drafts, but final document has since been ratified. It recognizes QDS as a class of seed
Seed law and amendments	National Agricultural Systems Act 2005, Seed and Plant Varieties Act 2006 and Plant Variety protection Act 2014	The three acts are operational and form the basis of seed regulations. Seed laws have been amended to conform with COMESA protocols
Seed regulations	Seed and Plant Regulations 2010 amended in 2016	The regulations are operational and were amended in 2016 to include Quality Declared Seed (QDS
Legal classes of seed recognized	Breeders, Pre-basic, Basic, Certified 1st and 2nd Generation and Quality Declared Seed (QDS)	QDS is a class of seed recently added in the amended regulations for purposes of making seed readily available to farmers
Membership in regional entities	Member of Common Market for Eastern and Southern Africa (COMESA), East Africa Community (EAC) and African Regional Intellectual Property Organization (ARIPO)	EAC is not fully operational due to delay in harmonizing standards. Uganda harmonized its seed laws with the COMESA ones in 2016
Membership in international seed bodies	International Seed Testing Association (ISTA), Organization of Economic Cooperation and Development (OECD) seed schemes	NSCS is accredited to OECD for field seed certification although it remains highly incapacitated
Legal issues currently on the radar screen	Work on operationalizing recently passed seed policy of 2018 ongoing, Genetic Engineering Regulatory Bill 2018 meant to ensure safe development and application of biotechnology was passed in 2018	Bio safety law not fully operationalized

Source: *Longley C., Uganda seed sector profile 2021.*

Annex 3b. Seed certification as per COMESA harmonizing

To be registered and released in the COMESA variety list, varieties must show proof of satisfactory testing for:

i. Distinctness, Uniformity, and Stability (DUS) in accordance with the guidelines of the Union for the Protection of New Varieties (UPOV); and
ii. Value for Cultivation or Use (VCU) or National Performance Trials (NPT).

New varieties to be registered in the COMESA variety list must show results of two seasons of testing for both DUS and VCU and proof of release and registration in two COMESA member states. new varieties must also include the suggested variety name and a reference sample provided to the relevant National Seed Authority. National Seed Authorities may set minimum requirements for germination, species and analytical purity, health, and moisture content of seed submitted as a reference sample (Comesa Seed Trade Harmonization Regulation, 2014).

Varieties that have been registered and released in one COMESA member state are eligible for "fast track" process, where only one season of DUS and VCU testing is required (confirmation test), along with DUS and VCU information from the original member state. Proof of release in a second member state is also required.

If a variety has already been registered and released in at least two COMESA member states, no additional testing is required, and an application can be made for immediate entry in the COMESA Variety Catalogue, provided that the application contains the necessary DUS and VCU.

As regards the submission of the seed sample and analysis being carried out clearly described and shared operation procedures, which the applicant can review before the application is made, are missing.

- Seed sample reception
- Purity analysis
- Seed moisture testing
- Germination analysis
- Vigour testing
- Seed health testing
- Genetic purity analysis
- Issuance of Seed Testing Certificate

COMESA member states need to use the following field parameters and laboratory methodologies during seed certification:

(a) minimum previous cropping season;
(b) isolation distance (m);
(c) maximum off-types (%) or (m2);
(d) minimum number of inspections;
(e) minimum germination (%);
(f) minimum pure seed (%);
(g) maximum moisture (%); and
(h) diseases.

Pure Seed

Pure seed definitions of many tropical grasses are indicated in the ISTA rules (ISTA 2008). Fifteen descriptive categories (pure seed definition 28 to 43, pages 3-28 to 3-31) cover most tropical and subtropical species.

Germination rate

A germination test assesses the potential performance of a seed lot under optimal conditions. Seeds of different species require different conditions to be able to germinate to their full potential. Optimum condition can also vary depending upon the physiological state of the seed. Seed testing protocols (viz. suitable substrate, optimum temperature, test duration, light requirement, pre-treatments etc.) may not have been worked out for majority of tropical grasses that are being used.

Annex 4. COMESA Variety Release System

Variety Catalogue Content

The COMESA Variety Catalogue shall contain the following information:

(a) species, botanical or common name;
(b) variety name, synonyms, code and type;
(c) countries and years of release;
(d) date of regional registration;
(e) owner;
(f) maintainer or seed source;
(g) recommended agro-ecological zone;
(h) duration to maturity;
(i) yield potential; and
(j) special attributes or characteristics.

Annex 5. List of Uganda Seed Trade Association (USTA) members

i. USTA Ordinary members			
Company	**Contact person**	**E-mail and Website**	**Phone**
AYELLA-PE Agro Services Limited	Mr. Ambrose Ojok	ayelapeagro@yahoo.com	+256 784 151 531
BRAC SEEDS - Social Business Enterprises (U) Ltd	Mr. Dr. Ziaur Rahman	BSBE.allstaff.uganda@brac.net W: www.brac.net	+256 758 768 213
Busoga Seed Solution Limited	Mr. Peter Dhamuzungu	busogaseedsolutions@gmail.com pdhamuzungu@gmail.com	+256 773 559 653 +256 704 144 463
Centre for Agriculture Inputs International (CAII)	Mr. Simon Mayanja	simonbbale.caiiseeds@gmail.com	+256 787 491 602 +256 701 843 000
Crown Seeds	Mr. Stephen	crownseeds17@gmail.com blessedtreeplanters@gmail.com W: www.blessedtreeplanters.com	+256 774 001 520
Daylight Agrotech Limited	Mrs. Gloria Abong	daylightagroltd@gmail.com	+256 784 247 277
Equator Seeds Limited	Mr. Tony Okello	equatorseeds@yahoo.com	+256 782 620 830
Farm Inputs Care Centre (FICA) Limited	Mr. Narcis Tumushabe	ficauganda@gmail.com narcis.tumushabe@ficaseeds.com info@ficaseeds.com W: www.ficaseeds.com	+256 414 566 631 +256 772 980 233 +256 701 880 233
General and Allied Ltd	Mr. B.N.S. Gowda	gal@infocom.co.ug	+256 757 549 498
Golden Bull (U) LTD	Mr. N. S.R Babu	goldenbullug@gmail.com W: www.goldenbullafrica.com	+256 757 889 922
Green Firm Africa Ltd	Mr. Amos Owamani	greenfirmafrica@gmail.com	+256 789 777 188 +256 782 527 454
Grow More Seeds and Chemicals Ltd	Mr. G.N. Mohana Rao	growmoreseeds@gmail.com maryam@growmoreseeds.com indianassociation22@gmail.com	+256 701 340 087 +256 414 578 380 +256 312 261 487
Kazinga Channel Seed Company Ltd	Mr. Adam Bwambale	ngcu@utlonline.co.ug	+256 772 486 575

Kinoni Seeds Ltd	Mr. Matovu Bruno	kinoni@ymail.com	+256 772 463 114 +256 752 463 114
Masindi Seed Company Ltd	Mr. Luzige Eugine	masindiseed@gmail.com leugine@yahoo.co.uk	+256 772 550 802
Mukwano Industries (U) Limited	-	rwab@mukwano.com admin@mukwano.com W: www.mukwano.com	+256 414 313 313 +256 312 313 313 +256 772 744 743
NASECO (1996) Ltd	Mr. Nicolai Rodeyns	nasecoseeds@yahoo.com rodeynsnicolai@yahoo.com W: www.nasecoseeds.com	+256 414 236 365 +256 392 960 712 +256 772 618 001
Otis Garden Seeds (OTIS)	Mr. Peter Otim Odoch	otisgard@yahoo.com otimodoch@gmail.com	+256 772 442 962 +256 414 269 520
Pearl Seeds Ltd	Mr. Richard Masagazi	pearlseedltd1@gmail.com W: www.pearlseedsltd.com	+256 700 464 116
Rhino Seeds Africa Limited	Mr. Patil G. S	info@rhinoseeds.net W: www.rhinoseeds.net gspatil@reliefline.net W: www.reliefline.net	+256 702 363 165
Sahara Seed Company (U) Limited	Mr. Christopher Oyeng	saharaseed@gmail.com	+256 750 312 030
Samsun Holdings (U) Ltd	Mr. Derrick Mugambwa	info@samsunholdings.com	+256 754 807 060
Sarwa Agrobased Seeds Company Ltd	Mr. Yasin Keeya	sarwaagrobasedseeds@gmail.com gracebakaira@gmail.com	+256 393 228 740 +256 788 408 922
Savana Seeds Ltd	Mr. Moses Mugabirwe	savanaseedsltd@gmail.com mosesmugabirwe@yahoo.co.uk	+256 782 476 607 +256 778 000 288
Seed. Co Mr.	Mr. Patrick Banage Kasaija	kasaija@seedcogroup.com W: www.seedcogroup.com	+256 706 222 557 +250 733 222 557
Select Seed Ltd	Mr. Geoffrey Mau	selectseedsltd@gmail.com	+256 772 539 851 +256 704 600 944
Simba Seeds Ltd	Mr. Tom Balegeya	simbaseeds@gmail.com	+256 772 417 150 +256 702 527 396
Simlaw Seeds Company (U) Ltd	Mrs. Sylvia N. Kyeyune	simlaw@simlawseeds.ug	+256 414 250 544

		sylviakyeyune@simlaw.ug W: www.simlawseeds.ug	+256 782 323 334 +256 700 323 334
Supa Seeds Africa Ltd	Mr. Paul Kagimu	supa.seed@yahoo.com	+256 772 349 032 +256 312 291 895
Syova Seed (U) Ltd	Mr. Reddy H.C V	info.ug@easeed.com W: www.easeed.com	+256 392 773 321 +256 414 566 585
United Seeds (U) Ltd	Mr. Herbert Okello	unitedseeds.ug@gmail.com W: www.unitedseeds.co.ug	+256 392 908 190 +256 782 711 322
Victoria Seeds Limited	Mrs. Josephine Okot	victoriaseeds@infocom.co.ug info@victoriaseeds.com	+256 414 346 763 +256 772 467 365
ii. (More) Respondents to interviews			
Advantage Crops Limited	Charles Wasonga	cjw56c@gmail.com	+254 729 152 473
Heifer International (U)	William Matovu Richard Wanyama	William.matovu@heifer.org Richard.Wanyama@heifer.org	+256 782 477 325 +256 414 233 48
Kazo Dryland Hus Agro Pastoralists	Erison Tumusiime	erisontumusiime@gmail.com	+256 783 976 368

Annex 6. Questionnaire for Forage Seed Suppliers in Uganda

Questionnaire for Forage Seed Suppliers in Uganda

Introduction

The Netherlands and East Africa share a long history of cooperation in the dairy sector, contributing to the formation and inception of The Netherlands East African Dairy Partnership (NEADAP) in 2018. NEADAP offers a platform for exchange of knowledge and experience to tackle current challenges and leverage further development in East African dairy. In its first phase, NEADAP organised exchange, learning and documentation around animal fodder, milk quality and inclusive dairy business. In the second phase (2021–2023), NEADAP-2 is focusing on testing and adaptive scaling of these and other proven approaches and technologies East and Central African countries, among them Uganda. NEADAP is financed by the Government of the Kingdom of the Netherlands.

*In order to contribute to sustainable dairy farming systems in Uganda, NEADAP-2 seeks to strengthen forage seed markets as one of its products, steered by SNV with The Inclusive Dairy Enterprise project (TIDE II). This has led to commissioning a forage value chain study to identify (regulatory) constraints, risks, opportunities and other relevant information in the forage value chain for a market-led/based intervention in Uganda. Please find below a questionnaire for information gathering from forage seed suppliers. Filling of the questionnaire may take about 1 hour. We request for your support to answer the questions below and return to **jos@prodairy.co.ke** and/or **felix@prodairy.co.ke** preferably by 19th March, 2022.*

Seed suppliers are defined for the sake of this questionnaire as private seed companies, research institutions, government bodies, parastatals, or any other service provider involved in breeding, selection, registration, distribution and sales for forage seeds or vegetative materials (either/or).

Thank you for your cooperation,
ProDairy EA Ltd.

Date of filling the questionnaire (dd/mm/yy): _____
Name/contacts of person filling the questionnaire: _____

Questions

1. Seed Supplier Details

a) Name of seed supplier: _____
b) Location _____
c) Ownership: ☐ Local ☐ International
d) What is the geographical coverage of your operations in Uganda?
_____
e) Please list your partners such as international seed companies or researchers, supplier and consumer farmer groups, cooperatives with the seed material traded?

i)	**International partners (Seed companies and researchers)**	**Forage seed material (incl. grasses & legumes)**
ii)	**Local partners (Seed companies and researchers)**	
iii)	**Farmers, farmer groups (informal & formal), cooperatives, farmer-based organization**	
iv)	**Other partners (including seed associations)**	

f) What role(s) do you play in the forage seed subsector
☐ Seed selection ☐ Breeding ☐ Multiplication ☐ Seed collection ☐ Importing, repackaging, distribution & marketing ☐ Others (specify) _____

g) Please rank your traded volume(s) of forage seeds (incl. grasses and legumes) for each variety. (1, Most traded – 5, Least traded)

Forage seed variety	Volume ranking

2. Forage Seeds (incl. grasses and legumes) Registration and Regulations

a) From the forage seed varieties ranked in question 1(g). what is the cost per kilogram, recommended seed rate per acre and estimated/predicted yield per acre for each variety?

Forage seed variety	Cost per kilogram (UGX)	Recommended seed rate per acre	Estimated yield per acre

b) Among the forage seeds you sell, which ones are registered in the National List of Crop Varieties?

Forage seed variety	Registration number/ code	Trade name (traded as)

c) Do you stock any seeds that are in the actual sense food crops but are widely used by farmers as forage crops (maize, sorghum, beans etc)? ☐ Yes ☐ No

If yes, please list the varieties_____

_____

d) Do you have any forage seeds that are currently in the National Variety Performance Trials (NVPT) with the Directorate of Crop Inspection and Certification (National Seed Certification Services)? ☐ Yes ☐ No

If yes, please list them _____

_____

e) What are the key challenges (maximum 5) that you experience in your business as a forage seed supplier with regard to <u>registration</u> of forage seed varieties in Uganda? Rank the challenges (1, Most pressing – 5, Least pressing) and give suggestions to address them.

Challenges	Rank	Suggested solutions

f) According to your expertise, which parameters should be used to test forage crop varieties for registration on the National List of Crop Varieties? Please list and explain.

_____
_____
_____

g) Give suggestions on how the registration process can be made more attractive and friendly.

_____
_____
_____

h) What are the obstacles in regard to current government policies for commercial forage seed supply business?

_____
_____

3. Establishment and Production

a) List and classify your forage varieties (incl. grasses and legumes) into their recommended Agro-Ecological Zones (AEZ).

Climatic zone	**Grasses**	**Legumes**
1. Arid *Rainfall (100-400mm)*		
2. Semi-Arid *Rainfall(400-600mm)* *Altitude (1,000-1,800m*)		
3. Warm, Wet (Sub – humid) Medium Altitude *Rainfall (600-1,200mm)* *Altitude (1,200-1,850m)*		
4. Cool, Wet (Sub – humid) Medium Altitude *Rainfall (600-1,200mm)* *Altitude (1,850-2,400m)*		
5. Cold, Wet (Moist sub-humid) High Altitude *Rainfall (1,200-1,500mm)* *Altitude (2,400-3,000m)*		
6. Humid *Rainfall (> 1,500mm)*		

b) Do any of your forage crop varieties require specific soil conditions? ☐ Yes ☐ No
If yes, please list and describe.

Forage crop variety	Specific soil condition required

c) Which particular agronomic practices are important for your forage crops to realize their full potential?

_____

_____

4. Feeding (utilization) of forage seed varieties

a) What is the targeted category of livestock for your forage crops?

Livestock category	Forage crop varieties
1. Beef cattle	
2. Dairy cattle	
3. Dual purpose	
4. Small ruminants (Goat & Sheep)	

b) For which farming system(s) are your forages recommended?

Forage variety	Farming systems (cut and carry-zero grazing)/ extensive grazing/ can be used in both systems)

c) In which form can your forages be used and fed?

Forage variety	Forms of usage (hay, silage, fresh)

d) Describe the management skills required to feed/utilize the forage crop(s) to increase animal productivity (stage of harvesting, type of grazing system, level of fertilization)?

Forage variety	Description of management skills required

e) What is the maximum (analysed) nutritional value for ruminants that can be realised for each forage variety under good agricultural practices?

Forage seed variety	Parameters			
	Digestibility	Crude protein	Fibre (neutral detergent fibre)	Starch content

5. Forage seed adoption, Distribution and Marketing

a) How does the forage seeds you supply get to the end user?

_____

_____

b) Please rate the likely interest and adoption rate of improved forage seeds by the ruminant livestock value chain actors, including those promoted by NaLirri, NARO, ILRI, CIAT and other parties.

Forage crop variety	Rank Interest rate (10, Highest – 0, Lowest)	Rank Adoption rate (10, Highest – 0, Lowest)
Napier grass		
Chloris gayana (Chloris)		
Brachiaria grass		
Panicum		
Dolichos bean		
Lucerne		
Desmodium		
Calliandra		
Forage maize		

Sugargraze		
Nutrifeed		
Others (List)		

c) Please suggest ways or interventions on how the adoption rate be increased?

_____

_____

_____

d) Please tick the method(s) you use to disseminate information on your forage (seed) products to farmers and rank on a scale of 1 to 5 the most effective method.

Method	**Tick**	**Rank (1, Most effective – 5, Least effective)**
Printed information materials (leaflets, brochures, fact sheets etc)		
Extension service providers		
Demo plots		
Field days		
Radio		
TV		
Social media		
Apps		
Others (List) _____		

e) What are the 3 most pressing challenges/problems faced, when trying to penetrate the market and/or increase your market share for forage seeds in Uganda?

_____

_____

6. Opportunities, Innovations and Involvement of TIDE 2 / NEADAP-2

a) Which opportunities (maximum 5) do you see, that can benefit forage seed suppliers, livestock farmers, pastoralists and commercial forage producers? Which support is required from TIDE 2 / NEADAP-2 or potential investors to achieve these opportunities with the aim to increase adoption rate in Uganda?

Opportunity	**Nature of support required**

b) Are you aware of ongoing youth and women-led activities, business innovations and potentially revolutionary technologies that can change forage value chain across Uganda and need collaboration to roll out or scale up?

☐ Yes ☐ No. If Yes, please list.

_____

_____

_____

c) Do you have any plans to roll out or scale up your operations in Uganda? ☐ Yes ☐ No If yes, specify the region. _____

d) What type of interventions proved to be successful to penetrate the market with your forage seed varieties?

Type of support/involvement	**Rank (1, Highest – 5 Lowest)**
1. Open more forage seeds shops/agent sale approach	
2. Technical support	
3. Print more product information (fact sheets, brochures, training materials, etc)	
4. Organize training and field days	
5. Set up forage demo plots	
6. Other (specify)	

e) Do you have ongoing collaborations regarding promoting uptake of improved forages with NGO Projects/Government/Farmer Groups/Cooperatives? ☐ Yes ☐ No. If yes, please state the nature of collaboration.

Organization	**Collaboration**	**Description**

****END THANK YOU****