Strengthening resilience of agro-pastoralists in Karamoja region to enhance food and nutrition security

Implementing partnership:

- United States Agency for International Development (USAID): Integrated Community Agriculture and Nutrition Activity, Mirembe Business Centre, 3rd Floor, Wing A, Plot 46, Lugogo Bypass, Kampala, Uganda

- Nabuin Zonal Agricultural Research and Development Institute, National Agricultural Research Organisation, P.O. Box 132 Moroto, Uganda

Funder: United States Agency for International Development (USAID)

Project duration: 2 years
July 2019 to December 2021

Budget:

Introduction

Karamoja region is classified as one of the world's poorest areas, with high rates of malnutrition and a disproportionate number (61 percent) of its 1.2 million people living in absolute poverty (UNFPA, 2018). The region is characterised by low human social and economic development indicators and the lowest per capita cash expenditure relative to national figures (FAO, 2015). Food insecurity is a major and ongoing challenge, and increased climate variability and change have in addition exacerbated the frequency and duration of dry seasons, (Oxfam, 2008; UNFPA, 2018). This has undermined the already limited resources, complicated the situation of feeding livestock and crop production and therefore development in Karamoja. In the region, there are low employment opportunities, to a great extent attributed to low agricultural productivity and income from agriculture. Poor natural resources management has been identified as a contributing factor to environmental and rangeland degradation, resulting in poor pastures and low cop yields in Karamoja (IUCN, 2016). Therefore, building resilience and promoting Climate Smart Agricultural practices that can sustain and reliably increase food production, and serve as source of income for the farmers, while protecting or restoring the environment, requires serious attention.

Although livestock production is the dominant source of livelihood to the communities in Karamoja region, qualitative and quantitative forage shortage, particularly in the dry season, is the

major constraint to this pastoral/agro-pastoral system. Moreover, farmers have limited access to good quality pasture seed technologies and lack the knowledge on establishment, processing, and commercialisation of these to boost their incomes. We have always had to rely on supply from Kenya, which also has a demand they cannot meet. Livestock keepers therefore need to exploit adaptable and high quality feed resources to improve nutrition and productivity of livestock, but also conserve the environment and water in the soil, and improve soil fertility and soil structure. The farmers can also gain income from commercialisation of pasture seeds, preserved fodder (hay and silage), and leguminous tree technologies.

The strategies to address the constraints that face the Karamoja production system include establishing a pasture seed system to increase availability of good quality pastures in the grazing areas, and to address feed shortage in the dry season by growing pasture grasses and legumes and preserving them as hay or silage for feeding in the dry season. Leguminous tree technologies that are tolerant to drought or low moisture environment can also be incorporated in the farming system; the trees mitigate desertification, increase soil mineral N for soil fertility and enable nutrient cycling. The trees also increase plant water use efficiency, reduce heat stress, accumulate soil organic matter and increasing yield significantly (Gelaw et al., 2015; Sida et al., 2018a, b). The trees are also important in erosion control for crops, and enhance restoration of the vegetation and rehabilitation of rangelands. This impact on microclimate modification is very vital in these times when heat and moisture stress are likely to be more prevalent in the face of climate change, which poses a serious threat to food security.

Aim

Enhance food and nutrition security, and income from crops and livestock in the face of a challenging climate in Karamoja region

Objectives

- Establish a multi-stakeholder platform for sustainable production and commercialisation of good quality pasture seed and fodder
- Facilitate smallholder farmers to establish, process, conserve, utilise and market good quality pasture seed, and equip them with knowledge and skills
- Promote conservation of feed resources (hay and silage) to generate income and supplement animal feeding in periods of high vulnerability
- Promote leguminous tree species to enhance the restoration of vegetation and mitigate effects of drought on livestock and crop production
- Dissemination of technologies of pasture seed production and feed resources preservation (hay and silage)

Expected outputs

- An effective multi-stakeholder platform established to sustain production and marketing of pasture seed and fodder

- Farmers, students and extension workers trained on pasture seed production, preservation of hay and silage, and leguminous tree production
- Increased availability of good quality pasture seed and good quality fodder in the grazing areas
- Increased production and utilisation of preserved feed resources (hay and silage) for supplementing animal feeding, and reducing scarcity of feed resources for dry season
- Leguminous tree technologies promoted among communities to mitigate effects of climate change
- Technologies of sustainable pasture seed production and fodder disseminated to communities through appropriate communication channels

Expected outcomes

- Improved milk and weight gain of grazing animals and reduced production losses during the dry season
- Increased awareness of the communities about management of suitable and good quality pasture species and feed conservation techniques
- Environmental conservation: improved soil quality and more retention in the soil
- Enhanced household income and welfare (food, nutrition quality, health, education) among participating farmers, especially the women
- Increased marketing of farm produce among farmers

Goal

- Increased resilience of agro-pastoralists for food and nutrition security

Methodology

2.1 Project implementation area

This project will be implemented in Karamoja Region in northeastern Uganda from July 2019 to December 2021. The region consists of eight districts (Kaabong, Kotido, Abim, Moroto, Napak, Amudat, Nabilatuk and Nakapiripirit), and covers 27,511 km^2 (about 10% of Uganda). Two districts (Kotido and Kaabong) have been selected for implementation. Karamoja is bordered by South Sudan to the north and Kenya to the east. Rainfall is low (average 500-600 mm per year) with peak rainfall in April-May and July-September (Anderson and Robinson, 2009). Rainfall in Karamoja is characteristically episodic, alternating with a prolonged severe dry season, and considerable variation arises from year to year, which poses a significant challenge to livelihood security (USAID, 2017). Temperatures range from an average minimum of between 15°C and 18°C to an average maximum of between 28°C and 33°C (Anderson and Robinson, 2009). Food insecurity is a major and ongoing challenge and climatic variability and change undermine the

already limited resources and development in Karamoja through recurring droughts (USAID, 2017).

2.2 Project design

This project will be implemented in four sub-counties in Kotido and Kaabong Districts, through community groups, schools and agriculture related business entities in Karamoja region. Twenty farmer groups (each 20 members), 10 primary and secondary schools will be selected and engaged, in a consultation with various stakeholders in the districts. About 60% of primary project beneficiaries will be women, 25% of whom will be female youths. The District Local Governments in Kotido and Kaabong will engaged for farmer group mobilisation and formation, selection of sites for establishing various activities for the project.

The pasture species *Chloris gayana*, Silver leaf *Desmodium*, *Brachiaria brizantha*, *Pennisetum purpureum* (Napier grass, NARONAP III) and *Cenchrus ciliaris* will be promoted to improve the quality of grazing for animals, as source of seed for commercialisation and for conservation as hay or silage for dry season feeding and income. These pasture types are justified for the Karamoja semi-arid production system because the stand of these can develop quickly (4-6 months), the pastures can improve soil structure, improve organic matter level, develop good ground cover and effectively control soil erosion. *Chloris gayana* can tolerate heavy grazing, while the legumes *Desmodium* improves soil fertility. Sustainable pasture production can also improve sustainability in crop production if integrated in crop rotations or in alternating strips to combat soil erosion and improve soil organic matter content in this highly degraded ecosystem. Leguminous tree species *Leucaena leucocephala* and *Gliricidia sepium* have high rapidity of initial growth, add nutrients in the soil and improve herbage quality and quantity, remain productive during the critical dry season. The species conserve water in the soil, reduce evaporation and enhance precipitation for rainfall (Haque et al., 1985). Promotion of these and building the capacity of farmers may improve on livestock production.

Table 1. Implementation of the project objectives

Objective 1: Establish a multi-stakeholder platform for sustainable production and commercialisation of good quality pasture seed and fodder
▪ Base line study on availability and quality of pasture seed and fodder, and animal production levels ▪ Farmer group formation: one famer group in each of the 20 parishes in Kotido and Kaabong Districts. ▪ Training farmers on group basics, organisational management, leadership and membership relations, effective farmer group management ▪ Conduct a workshop with USAID, MAAIF, researchers, schools management, agriculture-related business entities, farmers' representatives and District Local Governments, to form a platform for a pasture seed system ▪ Forecasting and identifying seed market demand through market surveys ▪ Analyzing seed business solvency ▪ Drawing plans for actual production through contract agreements between farmer groups, schools, business entities, District Local Governments and Nabuin ZARDI ▪ Monitoring and evaluation of contract farmers, and stakeholders on progress of the project
Objective 2: Facilitate smallholder farmers to establish, process, conserve, utilise and market good quality pasture seed, and equip them with knowledge and skills
▪ Production of foundation and breeder seed by Nabuin ZARDI, NALIRRI and District Local Governments ▪ Establish 210 acres of pasture seed production sites (10 acres per parish, 1 per school); 40.2 acres for each of the pasture species *Chloris gayana*, Silver leaf *Desmodium*, *Brachiaria brizantha*, *Pennisetum purpureum* (Napier grass, NARONAP III) and *Cenchrus ciliaris* ▪ Participatory research with the farmer groups on the social and economic aspects of pasture production, animal utilisation ▪ Training of trainers of training (district extension workers and community farmer representatives) on agro-nomic practices and socio-economic aspects of pasture and fodder production and utilisation ▪ Train farmers and students marketing and enterprise (including forecasting and identifying seeds on demand), basic financial management for farmer groups, services offered by farmer groups ▪ Training and demonstration of climate change adaptation (including mitigating rangeland degradation and enhancing soil fertility) and innovation ▪ Train farmers in block farming (same pasture variety) techniques ▪ Practical-based field training and demonstration for farmers and students on establishment, pest and disease management, harvesting, processing, packaging of seed ▪ Production of certified/basic seed in commercial quantities by private firms and contract farmers to meet market demand
Objective 3: Promote conservation of feed resources (hay and silage) to generate income and supplement feeding in periods of high vulnerability

▪ Construction of barns for storage of hay and silage ▪ Practical-based training and demonstration of hay production, storage, entrepreneurship, marketing and utilisation to enhance animal production ▪ Participatory research with the farmer groups and students on the effect of supplementing dairy and beef cattle on preserved feed resources (hay and silage)
Objective 4. Promote leguminous tree species to enhance the restoration of vegetation and mitigate effects of drought on livestock and crop production
▪ Setting up demonstration sites (20 acres in 20 parishes) for management of leguminous tree technologies *Leucaena leucocephala* and *Gliricidia sepium* among farmer groups ▪ Field-based training and demonstration on establishment of nursery beds for the seedlings of *Leucaena leucocephala* and *Gliricidia sepium*, conservation around homesteads and grazing areas and utilisation for animal feeding ▪ Demonstration of harvesting of produce from the trees for marketing
Objective 5. Dissemination of technologies of pasture seed production and feed resources preservation (hay and silage)
▪ Feedback meetings with stakeholders ▪ Conducting field days to exhibit seed products and share reference information ▪ Conduct radio talk shows, especially those based in Karamoja, to create awareness about the need for growing pastures and their seeds production, the production methods and accessibility of seed and markets through farmer production schemes ▪ Produce brochures, leaflets and posters on pasture seed production, preservation of hay and silage in various languages: Ngakarimojong, Luo, Swahili and English. The information materials will be displayed at strategic places such as local markets, community centers, schools and churches

2.3 Organizational Background, including the expertise and experience

Nabuin Zonal Agricultural Research and Development Institute (ZARDI), located in Lorengedwat sub-county in Nabilatuk district, is one of the sixteen Public Agricultural Research Institutes under the National Agricultural Research Organization established by the NARS ACT (2005). The institute is mandated to conduct and manage applied and adaptive agricultural research and facilitate the development and dissemination of appropriate agricultural technologies that address the specific needs of the agro-ecological zone covering Teso and Karamoja sub-regions. Nabuin ZARDI is Research and development at Nabuin is implemented under three programmes, namely Animal Resources Research, Crop and Natural Resources Research, and Agricultural Technology Promotion. The institute has got high quality technical and support staff with vast experience in various technical and administrative disciplines. The staff also have adequate knowledge spanning years working in the zone which will be called on to effectively run this project to its logical conclusion and deliver the desired goal, objectives and outputs. Previously, Nabuin ZARDI has successively implemented a number of projects, including the Agricultural Technology and Agri-business Advisory Services (ATAAS), East African Agricultural Productivity Programme (EAPP), Agricultural Research and Training Project (ARTP).

2.4 Alignment with national and regional priorities

The project contributes to the second National Development Plan (NDP II) of Uganda, which emphasises increasing sustainable production for food and nutrition security, growth opportunities, sustainable land use and soil management. This proposed project is also in line with the Karamoja Integrated Development Plan (KIDP 2), which is a deliberate efforts by Government to intensify development interventions, by among others enhancing the production of sufficient food for households and incomes, improving livestock production and productivity and markets. The other government strategies are employment creation through fast tracking skills development and harnessing the demographic dividend and strong Public/Private Partnerships (PPPs) for sustainable development. The Development Strategy and Investment Plan (DSIP) puts meat and milk production among the top ten enterprises of choice in Uganda, and emphasises the development of the livestock sector, through among others provision of technologies, building expertise in livestock and alternative feed systems and encouraging growing of high nutritive pasture species and fodder in times of plenty to feed livestock during scarcity to ensure sustainable livestock production.

2.5 Community engagement methodologies

2.5.1 Gender approach

This project will place particular emphasis to empower women, through supporting and building their capacity, as an essential element to achieving the end of hunger and poverty. About 60% of primary project beneficiaries will be women, 25% of whom will be female youths. Despite the fact that women and youth play a key role in the agricultural sector, they are often neglected in key agricultural projects in Karamoja. Empowering women and youth to participate in dairy value chains is an efficient and sustainable way of increasing impact of this development project, to build economies in Karamoja, achieve internationally agreed goals for development and sustainability, and improve the quality of life for women, men, families and communities. Increasing access of women to productive resources and building their capacity in agriculture production and marketing can greatly enhance household income, food security, nutrition and community development. Women's empowerment is one of the 17 Sustainable Development Goals, but also integral to all dimensions of inclusive and sustainable development. Gender sensitisation workshops will be held in a participatory manner with community leaders, kraal leaders, and women leaders to sensitise participants on the need to incorporate gender into project activities and the benefits of having women at forefront of the pasture value chains. Information on women's contribution, resource needs and constraints will be integrated after the participatory engagement of the community. Involvement of women will increase the knowledge, standing and productivity of women within their households and the wider community. Increasing women's income from the sales of pasture products will enable them pay for school fees, medical care and other expenses for their children, and this will enhance household and community development.

2.5.2 Farmer groups and students in schools

The methods of training farmers will adopt a farmer field school approach, involving participatory research and group-based learning processes. This will involve a learning-by-doing approach by promoting farm-based demonstration and experimentation, group organisation and decision-making. In this way, the farmers will eventually 'own' and adopt the improved practices.

The groups will be empowered by helping them organise themselves and take charge (empowerment), build collective actions for the common good and for their growth and development. Active exploration and understanding of how the production systems work will be encouraged. New ideas will be introduced through guided exercises and discussion will be stimulated by 'farmers, for farmers', without the facilitators dominating the scene. The training will involve approaches to problem identification and seeking the right solutions by combining their indigenous knowledge with improved knowledge. The farmers will then be given chance to decide what works best through their testing and observations. The producer groups will first be taken through practical-based training and demonstration sessions both at Nabuin ZARDI and field-based training in the communities. Exchange visits with other farmer groups will be encouraged.

2.5.3 Monitoring and evaluation and community-based implementation planning

Monitoring and evaluation (M & E) will be very essential in providing timely feedback on the achievements of project results along the value chain. An M & E plan will be produced at the start of the project, in a participatory manner to facilitate impact-oriented project management and implementation, and ensure compliance with the project's goals and objectives. This will enable timely collection, processing and provision pf reliable and timely information/reports and adjustment of resources, actors and schedules for efficiency and effectiveness.

2.5.4 Sustainability

This project is designed to pursue sustainability at different levels. The crop and livestock activities proposed herein will always be considered a component for research and development at Nabuin ZARDI. This will ensure support for the producers and other stakeholders. Coordination and linkage with local government and non-government organisations in the region will facilitate future support in terms of on-the-ground technical back-stopping and tools for the producers for sustainable production and commercialisation. Establishing an effective value chain and marketing system will motivate farmers to produce more farm products to meet the demands in terms of quality and quantity. The business model will provide a continual stream of income for communities after the initial project funding has been exhausted. During project implementation, producers will be provided with skills on preparing project proposals, so that they can mobilise more funds to further support their initiatives. This project will develop skills of livestock keepers which will ensure sustainable production, commercialisation and utilisation of hay and leguminous

tree technologies to improve soils and rangeland production, and increase milk (by 60%) and beef production in the dry season.

Community leaders will have a central role in planning and implementation to facilitate community participation and build strong link between technical and local people. The leaders will complement the project by providing their indigenous knowledge and locally available materials, and participate in monitoring and evaluation, during and after the implementation of the project activities. he capacity of farmer groups in business management will be built, and they will be supported to form Village Savings and Loan Associations (VSLA), which will contribute to continuous financial support of the value chains.

Activity schedule

Activity	2019		2020				2021			
	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
Base line study and market analysis	√									
Farmer group formation and training on group dynamics	√	√								
Stakeholder workshop with USAID, MAAIF, researchers, schools management, agriculture-related business entities, farmers' representatives and District Local Governments, to form a platform for a pasture seed system	√									
Contract agreements between farmer groups, schools, business entities, District Local Governments, USAID and Nabuin ZARDI	√									
Production of foundation and breeder seed by Nabuin ZARDI, NALIRRI and District Local Governments	√	√								
Establishing pasture seed production sites on-station and with the farmer groups			√	√	√					
Participatory research with the farmer groups on the socio-economic aspects of pasture production and animal utilisation			√	√	√	√	√	√	√	√
Training of trainers of training on agronomic practices and socio-economic aspects of pasture and fodder production and utilisation		√	√							
Practical field-based training and demonstration to farmers and students on pasture establishment, pest and			√	√	√	√	√	√	√	√

disease management, harvesting, processing, packaging, marketing and entrepreneurship, climate change and adaptation and innovation										
Packaging of certified seed for marketing				√		√			√	
Construction of barns for storage of hay and silage		√								
Practical-based training and demonstration of hay production, storage, entrepreneurship, marketing and utilisation to enhance animal production			√	√	√	√	√	√	√	√
Participatory research with the farmer groups and students on the effect of supplementing dairy and beef cattle on preserved feed resources			√	√	√	√	√	√	√	√
Field-based training and demonstration on establishment of nursery beds for the seedlings of *Leucaena leucocephala* and *Gliricidia sepium*, conservation around homesteads and grazing areas and utilisation for animal feeding			√	√						
Setting up demonstration sites for management of leguminous tree technologies *Leucaena leucocephala* and *Gliricidia sepium* among farmer groups			√	√	√	√	√	√	√	√
Demonstration of harvesting of produce from the leguminous trees for marketing			√	√	√	√	√	√	√	√
Feedback meetings with stakeholders		√		√		√		√		√
Conducting field days to exhibit seed products and share reference information			√				√			
Conduct radio talk shows to create awareness		√		√		√		√		
Produce brochures, leaflets and posters on pasture seed production, preservation of hay and silage in various languages						√			√	
Monitoring and evaluation	√	√	√	√	√	√	√	√	√	√

Budget:

Activity/item	Budget (UGX) 000’		
	2019	**2020**	**2021**
Base line study and market analysis (In-land travel: per diems, vehicle maintenance, fuel and lubricants)	10,000		

Farmer group formation and training on group dynamics (In-land travel: per diems, vehicle maintenance, fuel and lubricants, stationery)	20,000		
Stakeholder workshop with USAID, MAAIF, researchers, schools management, agriculture-related business entities, farmers' representatives and District Local Governments, to form a platform for a pasture seed system (In-land travel: per diems, vehicle maintenance, fuel and lubricants, stationery, venue hire, refreshments)	30,000		
Production of foundation and breeder seed (In-land travel: per diems, vehicle maintenance, fuel and lubricants, procurement of seed, contracted casual labour, packaging)	30,000	20,000	
Establishing pasture seed production sites on-station and with the farmer groups (In-land travel: per diems, vehicle maintenance, fuel and lubricants, contracted casual labour on-station, farm equipment, laboratory equipment)	60,000	40,000	
Training of trainers of training (In-land travel: per diems, vehicle maintenance, fuel and lubricants, stationery, venue hire, refreshments)	10,000	10,000	
Practical field-based training and demonstration to farmers and students (In-land travel: per diems, vehicle maintenance, fuel and lubricants, stationery, hay baler, hay probe, planters, drillers)		60,000	60,000
Packaging of certified seed for marketing (seed packing equipment, packaging bags)		20,000	20,000
Construction of barns for storage of hay and silage	100,000		
Establishing nurseries for *Leucaena leucocephala* and *Gliricidia sepium* (In-land travel: per diems, vehicle maintenance, fuel and lubricants, contracted casual labour, building materials, procurement of seed)		50,000	
Setting up demonstration sites for management of leguminous tree technologies among farmer groups (In-land travel: per diems, vehicle maintenance, fuel and lubricants)		40,000	40,000
Feedback meetings with stakeholders (In-land travel: per diems, vehicle maintenance, fuel and lubricants, stationery, venue hire, refreshments)	20,000	20,000	20,000
Field days		30,000	30,000
Radio talk shows	3,000	3,000	3,000
Brochures, leaflets and posters	5,000	5,000	5,000
Monitoring and evaluation	15,000	15,000	15,000
Total	**303,000**	**313,000**	**`193,000**
Administrative overheads (6%)	**18,180**	**18,780**	**11,580**
Grand total	**321,180**	**331,780**	**204,580**

Results Framework

Objective Hierarchy	Objectively verifiable indicators	Means of verification	Assumptions
Goal: Increased resilience of agro-pastoralists for food and nutrition security	Cases of malnutrition reduced Income enhanced Households having adequate number of meals per day increased Improved vegetation cover and water retention in the soil	Impact assessment report District production reports	
Outcome 1. Increased body weight gain and milk production in grazing animals feeding on good quality pastures or supplemented with conserved feed resources (hay and silage)	Body weight gain and milk production in grazing animals increased by 40%	Field visits District production reports Project implementation reports, Monitoring and Evaluation reports	Livestock keepers adopt good socio-economic practices
Outcome 2. Increased awareness of the communities about management of suitable and good quality pasture species and feed conservation techniques	Increase in number of people with information good pasture management practices and availability or have access to good quality pasture seeds and fodder	Field visits District production reports Monitoring and Evaluation reports	Livestock keepers adopt good socio-economic practices
Outcome 3. Environmental conservation: improved soil quality, more retention in the soil and vegetation cover	Improved soil fertility in places established with herbaceous and tree legumes Improved water retention and vegetation cover in sites established with various pasture species	Field visits District production reports Monitoring and Evaluation reports	Livestock keepers adopt good socio-economic practices
Outcome 4. Enhanced household income and welfare (food, nutrition quality, health, education) among participating farmers, especially the women	Percentage increase in household income from sales of pasture seed, hay and silage Number of children with quality education, health and nutrition	Field visits District production reports Monitoring and Evaluation reports	Livestock keepers adopt good socio-economic practices

Outcome 5. Increased marketing of farm produce among farmers	Quantity of seed, hay and silage marketed by farmers Number of farmers with good market access and marketing farm produce	Field visits District production reports Monitoring and Evaluation reports	Livestock keepers adopt good socio-economic practices
Output 1. An effective multi-stakeholder platform (research, MAAIF, private seed business company, pasture seed stockiest, pasture seed growers and livestock farmers) established to sustain production and marketing of pasture seed and fodder	-Multi-stakeholder operations documented -A system for pasture seed production, processing and marketing -Reliable information on pasture seed marketing as a stimulant for seed productivity available -Favorable contract agreements between seed companies and/or agro-dealer and pasture farmers developed -Model for seed profit margin analysis for crop enterprise selection developed	Field visits Monitoring and evaluation reports Stakeholder feedback meetings Project completion report	Good adoption of the pasture and fodder technologies, and knowledge and skills by the farmers, students and extension workers Effective extension services
Output 2. Farmers, students and extension workers trained on pasture seed production, preservation of hay and silage, and leguminous tree production:	Number of farmers, students and extension workers trained: 400 farmers, 1,000 students, 10 extension workers trained maintenance techniques, harvesting, processing, packaging and marketing and entrepreneurship	Field visits Monitoring and evaluation reports District production reports Stakeholder feedback meetings Project completion report	Good adoption of the pasture and fodder technologies, and knowledge and skills by the farmers, students and extension workers Effective extension services
Output 3. Increased availability of good quality pasture seed and good quality pastures in the grazing areas	210 acres of *Chloris gayana*, Silver leaf *Desmodium*, *Brachiaria brizantha*, *Pennisetum purpureum* (Napier grass, NARONAP III) and *Cenchrus ciliaris* established by farmer groups and students in schools	Field visits Monitoring and evaluation reports District production reports Stakeholder feedback meetings Project completion report	Good adoption of the pasture and fodder technologies, and knowledge and skills by the farmers, students and extension workers Effective extension services

	Number of tonnes of pasture seed produced for planting or marketing Increased seed productivity with ensured genetic purity and quality control Number of farmers and business people accessing the pasture seeds Number of animals accessing good quality pasture for grazing		
Output 4. Increased production and utilisation of preserved feed resources (hay and silage) for supplementing animal feeding, and reducing scarcity of feed resources for dry season	Number of bales of hay, and tonnes of silage produced Number of farmers and animals experiencing reduced scarcity of feed resources in the dry season	Field visits Monitoring and evaluation reports District production reports Stakeholder feedback meetings Project completion report	Good adoption of the pasture and fodder technologies, and knowledge and skills by the farmers, students and extension workers Effective extension services
Output 5. Leguminous tree technologies promoted among communities to mitigate effects of climate change	Number of acres of land (at least 10 acres) established with leguminous tree technologies *Leucaena leucocephala* and *Gliricidia sepium* Number of seedlings of produced by farmer groups and schools (about 200,000 seedlings produced) Number of farmers and business people accessing the seedlings for the fodder trees	Field visits Monitoring and evaluation reports District production reports Stakeholder feedback meetings Project completion report	Good adoption of the pasture and fodder technologies, and knowledge and skills by the farmers, students and extension workers Effective extension services
Output 6. Technologies of sustainable pasture seed production and fodder disseminated for adoption to communities through appropriate communication channels	Two field days for technology exhibition and adoption conducted annually during the project implementation period	Field visits Monitoring and evaluation reports District production reports	Good adoption of the pasture and fodder technologies, and knowledge and skills by the farmers, students and extension workers

	Four radio talk show about pasture seed production system held every year during the project implementation period 1,000 brochures and 500 posters about seed production and marketing produced A simple manual on seed production and marketing developed for farmer reference	Stakeholder feedback meetings Project completion report	Effective extension services