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End of Project Report

DEVELOPING A SUSTAINABLE FARMER MANAGED PURE SEED PRODUCTION AND DELIVERY SYSTEM IN TESO-KARAMOJA SUB-REGION

Reg. Number CGS/1/5/14

FINALTECHNICALREPORT
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B: Project Completion Summary

Project Title:	Developing a sustainable farmer managed pure seed production and delivery system in Teso-Karamoja sub-region	
Reference No.	CGS/1/5/14	
Lead Organization	Nabuin ZARDI	
Principal Investigator	Samuel Kayongo Njuki	
Collaborating Organizations & Names of Project Implementers	**Organization**	**Name**
	Nabuin ZARDI	Herbert Okurut
	NaCRRI	Godfrey Asea (PhD)
	NaSARRI	Ebyau John
	Naseco Seed Co.	Katwere John
Purpose	Contribute to improved food and commercial crop productivity through development of viable and accessible high quality seed source systems within the confines of smallholder farmers	
Location (Districts, subcounties)	**District**	**Sub-county**
	Moroto	Nadunget
	Napak	Matany
	Nakapiripirit	Namalu
	Serere	Serere Satelite
	Bukedea	Kolir
	Amudat	Loro
Start Date	June 2014	
End date	December 2017	
Total Budgeted Cost	225,000,000 Ugx	
Total Actual Expenditure	225,000,000 Ugx	

PROJECT SUMMARY

Improving agriculture in the Teso-Karamoja sub-region, in particular crop productivity started with implementation of a comprehensive three year program of revitalizing a seed system by involving: Training and equipping farmers and other seed stakeholders with the practical knowledge of producing; quality control and marketing of pure quality seeds in a sustainable venture. Farmers (25 farmers from each farming community) were mobilized in groups for effective practical training and collective action in production. Initially the first farmers group (Lokere farmers) was situated in Komutulunyo village, Apietolim-Parish, Matany subcounty in Napak District; the second group (Lobulio farmers) was situated in Kawachi Village, Namalu sub-county, Nakapiripirit District. The third group is situated in Naitakwai village, Nadunget subcounty, Moroto District. These farmer groups were well-mobilized and commenced group commercial production of quality declared seeds (QDS) after receiving hands-on training in production, quality assurance of high pure quality seeds (PQS). The system of seed production revitalization program was organized under nucleus farms (about 5 acres) for farmer practical training through a perspective of Farmer Field School (FFS). Thereafter, upon improvement in basic and applied seed quality production, then individual households started growing seeds on individual household land as a business venture.

Currently, the project registered the following benefits including five established farmer field schools producing quality declared seeds (QDS); functional multi stakeholder Innovation Platform (MSIP); Farmers with knowledge of seed production 62.5% (717 maize seed growers), 28.2% (sorghum seed growers) and 9.2% (beans seed growers); with considerable tonnages of produced (62.5MT of maize, 25.7MT of sorghum and 15.1MT of beans) and commercialized (45.5MT of maize, 19.0MT of sorghum and 12.8MT of beans) seeds in Nabuin zone. Presently growers have knowledge of seed production and access to pure quality seeds. This seed venture has enabled trained farmers transformation from use of food grains for seeds to use pure quality seeds in increasing productivity. The values and benefits of using pure quality seeds are well understood by seed growers. Project continuity will enable more farmers adopt the technology hence making Nabuin zone a reliable area for seed production then seed import.

1.0 Project Background

Whereas other regions in Uganda have and still enjoying the relatively significant food increases in their agricultural productivity due to access to pure and improved crop seeds, the Eastern sub-region Karamoja in particular remained languished in its potential for agricultural productivity. Food

productivity is low hence a challenge to feed the increasing population estimated at 966245 (UBOS, 2002) (31 persons sq.Km^{-1}) from seven districts of Moroto, Kotido, Kaabong, Napak, Abim, Amudat and Nakapiripirit.

Low crop productions were attributed to limited access to pure improved planting materials and lack of knowledge to sustainably produce and maintain seeds genetic purity. Whereas the region had been crippled by insecurity, the situation today has been normalized by the government intervention with good services delivery. Many people are now concentrating on crop production around their homestead (*Manyata*) as a viable commercial option. Karamoja is endowed with vast cultivable land (27,000 Km^2) for which 145,391 households (50-400 persons in a *Manyata*) can be employed through farming. Farmers especially smallholder cultivators, have enthusiasm for crop productivity, and therefore urgently need a reliable source of planting materials to actively engage in sustainable crop production.

Usually many farmers do not plant improved seeds and hardly understand its values and benefits. Quiet often, farmer's source seeds from own saved grains of previous season, neighbours or mobile markets, which are usually food grains. This situation is contributed to because of lack of a reliable and constant seed supply especially at planting time. The little available indigenous planting materials in the sub-region have greatly degenerated in vigour, purity, resistance to diseases, genetically weak and are generally scarce. The available locally adapted crops include Maize, cassava, sorghum and beans with baked mixture of sorghum (*ngimomwa*) and cassava giving staple food called *Atap* while fermentation of sorghum and or Maize gives the most cherished local brew (*Kwete*) that many pastoralists survive on. Karamoja has positive potential for full basket productivity based on the good soil fertility and improving rainfall intensity (800mm). Presence of Nabuin ZARDI is greatly helping to make people realize the naturally comparative advantage in crop improvement and production.

Therefore, the primary objective of this project was to equip farmers with knowledge of producing and marketing pure seeds of maize (OPV type) and sorghum to sustainably access seeds for successive cropping seasons. Success could be achieved through developing a production platform between Research for production technologies; private sector (seed companies and agro-dealers) for input provision, seed distribution and marketing; NGO's for farmer group mobilization; and farmers for seed production using farmer field school (FFS) approach and nuclear farm production. The model crops selected in this project are maize, beans and sorghum due to their importance (food and income) in the farming system and better output after varieties were evaluated at NabuinZARDI. In this enterprise farmers will own seed production technology, access purely adequate and affordable seed of improved varieties. Therefore building a sustainable system of pure quality seed production will enhance

transformation of Karamoja sub-region into a better place for reliable commercial seed production; increased food production and a less importer of seeds and food from other sources.

1.1 Significance of Seed system development and use

Development of sound productive agriculture from subsistence farming to market oriented and commercial agriculture stems from effective use of production inputs such as seeds, fertilizers and cides for pests and diseases. Seed is the most important for crop production, and is the vehicle of technology transfer. Good crop husbandry alone increases yield by 25%, but using high quality seeds can potentially improve yield by over 50%. Therefore in order to obtain increased yields leading to enhanced nutrition levels and increased household incomes especially in rural areas, there has to be guaranteed and reliable supplies of good quality seeds of improved varieties for farming communities. Seeds are therefore the genetic potential for greater crop production and the change agent in both favorable and less favorable agricultural production situations.

Transformation of a crop into a health, highly vigorous plant, and uniform characters, with minimal variation in growth features gives an indication of pure seeds being used in production. When such values are coupled with grower knowledge of the seed variety, seed rates, viability then it ascertained that growers know and grow seeds. Whilst, the high yield accrued from better-grown plants, with uniformity and purity features in seed grains, the demand for such products is enormous because the produced seeds are pure. Such pure seeds are expensive and once used in production, under ideal conditions, the output is high.

1.2 Role of Agriculture sector in Uganda

Uganda's economy is predominantly agro-based with 23.6% GDP derived from agriculture, 24.5% from Industry and 51.9% from Services. Agriculture employs 82% of the population, and 31% of the export earnings are derived from agricultural sector (UBOS, 2012). Uganda has total land area of 199,807 Km2 of which 6.810MHa (16,828,000 acres) is under cultivation. Subsistence production remains a pattern where 70% of the area under cultivation is used to produce locally consumed food crops. Regarding labour use, women provide over half of agricultural labor force traditionally focusing on food rather than cash crop production. Uganda is able to rely on agriculture due to the country's regular rainfall, access to water sources and fertile soils relative to many other African countries, (Uganda's agriculture. html).

In National agricultural research institutes (NAR's), over 10 crop varieties were released in 2011 and eleven varieties released for production. The released varieties are Serenut5R and 6 R for ground nuts, Sesun 1H and 2H for sesame, SESO 3B and SESO 2W for sorghum, MM3 for maize, NABE 15

and 16 for beans, one banana hybrid and 2 sweet potato varieties (ASAR, 2011). Food crop productions are estimated at 1272000MT y^{-1} (Maize), 452,000MT y^{-1} (Beans), 5,179,000 MT y^{-1} (Cassava) and 497,000 MT y^{-1} (Sorghum), FAOSTA, 2009. The distribution of these crops varies according to region. For example, whereas coffee and plantains are major cash and food crop respectively in south western Uganda, Sorghum, maize and cassava have continued to provide a backbone for the farming households of Teso-Karamoja sub-region in terms of income and food. Nevertheless, liberalization of the economy and emergency of both regional and international agricultural markets has introduced new cash crops on the center stage (NAADS, 2006).

In Uganda, Karamoja sub-region in particular, food security and better livelihoods has been and are still below average standards of living among Ugandans. However, there indicators for situation improvement through increasing human support activities conducted by NGO's and the government of Uganda. In support activities, the region's potentially endowed natural resources availability have been identified and can be better utilized with agricultural productivity through basic agro-training and input provision. The once continuous semi-arid situation is slowly and indeed getting favorably improved with changing climate, for which intensive rains (1200mm) were received in the past two years. The farming season has been lengthened with slowly in-coming second season for the short maturing crop varieties. Therefore the improving situation justifies the need to explore basic ideas to assess and quantify the magnitude of seed system for better crop productivity. Therefore to ascertain the position of seeds and grains in the Karamoja sub-region, a survey on seeds system and crop germplasm have been conducted to determine prepositions to questions such as 'Do farmers in Karamoja understand seeds, their importance, values and benefits?, are there reliably defined seed chain and seed stakeholders (Seed companies, distributors, producers etc) for proper delivery and distribution? (NabuZARDI, 2000 un publ.). Based on the results, farmers listed cassava, sorghum, beans, and maize as the most important crops in the region. Non Government Organizations (NGO'S) have also intensified agro-activities in the region to correct the attitude of food aid reliance to sustainable food productivity enhancement. Agro- inputs such as implements, equipments, seeds and food are supplied in very small quantities and their utilization is below standards forcing a slow and negligible impact. The situation is attributed to partly due to growers lack of knowledge on benefits and values of use of production inputs especially seeds. Often, free supplied seeds are usually utilized in local brew production and or sold to others who rather use it for consumption purposes. And in most cases those who grow some crops use own saved seeds that are poor in genetic purity, highly susceptible to pests and diseases and therefore of poor results. Though some little seeds are supplied in the region by NGO's, the impact is negligible with stakeholders not seemed unified and

well coordinated in input distribution practices. There are no seed companies operating in the region and often many seed players hardly contact research for proper information on seed status and their performance in the region. The confusion leaves farmers with no option but plant whatever planting materials accessed whether food for consumption or seeds. Attempts to provide seeds by the private sector have been found to be very expensive (5000 Ug shs Kg^{-1} of maize, 7000= kg-1 of beans, and 4000= kg-1 of sorghum. The cost of seed is high due to the contributing investment costs incurred such as transport where over 600km in an attempt to deliver seeds.

Therefore lack of seed sources, knowledge for seed production and genetic purity maintainance, and a unified system for seed players compelled to seek funds and commence a project on seed system establishment.

Therefore improving food and commercial crop productivity through development of viable and accessible high quality seed source systems within the confines of smallholder farmers is considered the purpose of the project. While improving farmer's access and awareness of the importance and benefit of using pure quality seeds / planting materials is the adopted goal of the project.

The selected crops for the project include the following:

Beans: This is a leguminous crop that is widely demanded for consumption. The grown bean seeds are basically local varieties with low rate of viability. Varieties include the *tapara* (0.9MT ha-1) beans that are low yielding, less tolerant to drought and susceptible to pests and diseases such as bean fly and bean anthracnose. Bean varieties being considered to alleviate the problem include Nabe15 (2.5 MTHa-1), Nabe4 and K131 which have been tested and proved to be adaptable to the environment, early maturity and resistant to pests and diseases.

Maize: This is crop with duo purpose of food and income from sales of processes like local maize brew (*Obutia*). However, the crop has been hampered by very limited produce due to lack of good seeds for production. The only local maize variety is *Katumani* that is well adapted but with poor yields. The output cannot sustain the demand for food neither for making *Obutia*. Virtually there is no reliable source of good planting materials for farmers to grow. However with NabuZARDI's research efforts farmers have identified the newly introduced improved varieties (Longe5, MM3, VpMax, Hybrid10) with average yield of 5.0MT Ha^{-1}, are considered to be a solution to low maize of *Katumani* variety. The varieties are early maturing, disease and drought stress tolerant. Producing, multiplying and distribution of these adaptable varieties can help enhance the availability of planting materials in the sub-region.

Sorghum: This crop is also important for food (*Atapa*) and making local brew (*Ajon*). Sustainability on this crop had been lost due to pure yields (0.9MT Ha^{-1}) from available local varieties that are highly

susceptible to midge flies. With research (NaSARRI) efforts, new sorghum varieties (seredo and sekedo) that are high yielding with attributes for better *Ajon* were released but seeds are very limited and difficult to access and sustain by farmers. Therefore, there is need to multiply the varieties with farmer participation and establish a strong system of viable seed sources at affordable farm prices.

In general the seed companies operating in Uganda tend to avoid doing business in the region because of its location, it is very far and secondly smallholder farmers are considered uneconomical to them. In such circumstances, farmers are left with no option other than recycling local low yielding and disease susceptible varieties. The few farmers who have ability to buy improved seeds travel long distances of over 200 km to towns where local stockiest are located. Farmers also claim that local stockiest charge high prices for various seeds that are beyond the reach of small-scale farmers. There is need to empower farmers themselves to produce high quality seeds of improved varieties and be able to pass on these seeds to fellow farmers. This can be achieved by equipping farmers with the knowledge and skills of producing seed. This will be done through intensive on-farm participatory training, demonstrations and sensitization in seed production, with strong linkage with private sector (Seed Companies). In so doing, a farmer-based seed multiplication and delivery system that is effective and sustainable will be enhanced.

1.3 Rational for pure quality seed production

The agricultural system having been hampered by the civil insecurity in the region, the progress in crop productivity was also greatly affected and lowered, in particular, due to instability and more so to general lack of access to high quality seeds and clones as planting materials. Growers were lacking benefits accrued from value and benefits of using pure quality seeds. The potential for cultivation was high coupled with fertile soils and semi-bimodal rains but with no actual, reliable and sustainable source of seed inputs to farmers; whilst seed production technologies known by growers were very limited. As reported by AGRA (Baseline survey on seed system in Africa, 2014) formal use of improved seeds is very low (2.1%) with majority using home saved grains as seeds. This lack of reliable seed input source justified the need for a strong framework for immediate production and delivery of large quantities of high quality seeds of the most important diversified and adaptable crop varieties.

Equally there is need for reliable and less costly (monetary), production technologies. Farmers need to be trained to be aware of the value of improved seeds. The target could be achieved with packaging of seed as a business with view of food production, accessing seeds for next cropping season and profit making for household income.

Prices of seeds were high due to the contributing investment in costs incurred such as transport where over 500km are covered while delivering seeds from other regions. The little seeds provided were in

some cases found to be actually food grains with poor genetic quality and viability. Other constraints related to seed in the Nabuin zone is lack of credible agro-dealers. Therefore there is need to entice private sector especially seed companies to link up with farming communities so as to strengthen the seed production and delivery system.

Participation of farmers through FFS perspective in the project activities right from the initial stages, enabled farmers to own the technologies used in production, then purely, adequate and affordable seed of improved varieties were produced, availed and accessed by money other farmers. The perspective of seed production under FFS is therefore considered to be and remain sustainable even after the end of the project. Farmers were trained on seed production skills, conducting on–farm demonstrations, information transfer through field days, farmer exchange visits, local FM radio programs, poster production and pamphlets and local council mass mobilization and sensitization programs. Therefore building a sustainable method of pure quality seed production involved setting a strong framework for enabling the adoption of production technologies that best suits the production of pure quality seeds.

2.0 Project Objectives:

The main objective of the seed system development for Teso and Karamoja was to "Enhance increased use of pure quality maize, beans and sorghum seeds for high crop productivity", through increasing quantity and quality of domestic production and thus reducing the dependency on seed import and aids. The concept of quality seed production, certification and distribution would help reduce the cost of improved seeds to farmers and consequently increase their use. The little available seeds were often distributed freely through emergency operation by agro-based NGO's, however, the purity of distributed seeds were unknown, coupled with grower lack of knowledge for the values and benefits of using pure and improved seeds during productivity hence consuming them as food. To achieve the main objective a combination of actions with quicker term impact of sustainable farmer production and genetic maintenance of seeds; certification and distribution; and longer terms actions, such as varietal testing and maintaining fields for purity and preservation of the seed genetic base were adopted and implemented specifically through:

Specifically

1. Creating a multi stakeholder platform for commercial open pollinated variety (OPV) seed production
2. Equipping smallholder farmers with knowledge of pure seed production and quality control
3. Popularizing and promoting seed production and delivery enterprise on Maize and sorghum.
4. Increasing seed volumes through farmer-to-farmer block seed production.

3.0 Project Methodology

3.1 Area Design

Karamoja comprises of seven districts of Moroto, Kotido, Kaabong, Napak, Abim, Amudat and Nakapiripirit. It lies in the North-Eastern Corner of Uganda roughly between the limits of 1^0 and 4^0 North and 33^0 and 35^0 East. It's a large region measuring about 1000 sq. miles (27,200 sq Km), with ephemeral rivers (flow only periodically after heavy rains) characterized as flashy floods. These are important sources of irrigation water especially in the dry season. A large area is dry but notably the Western and Southern margins, receive considerably higher rainfall (600-890mm). The area also has 7 green belts for cultivation in during the second season. Therefore seed production were conducted in the green belts situated in districts of Nakapiripirit, Amudat, Kaabong, Abim and Napak, targeting atleast 20% of known 145,391 households (KADP, 2008) where each consists an average size of 5 members (Population census, 2002). People live in settlements called *Manyattas* with about 50-400 inhabitants.

3.2 Study one: Creation of a Multi Stakeholder Innovation Platform (MSIP) for commercial seed Production

3.2.1 Introduction to MSIP development and Seed commercialization

Success in establishing a farmer managed pure seed production and delivery system was achieved through developing a production platform between Research (for production technologies transfer); private sector such as Seed Companies and Agro-Dealers (for input provision, seed distribution and marketing); NGO's such as FAO, ACDI VOCA (for farmer group mobilization); and farmers (for seed production using farmer field school approach and nuclear farm production). The platform was formed to unite and bridge the gap between seed stakeholders for efficient and effective seed production, distribution and delivery system. In this platform farmers gained knowledge on production technologies from research, and also production according to market demand information provided by private sector. Market demand system was very useful in determining the kind and type of seeds to for profitability. Therefore establishing a strong platform was vital in developing a sustainable system of pure quality seed production that enhanced transformation of Teso-Karamoja sub-region into a better place for reliable commercial seed production; increased food production and a less importer of seeds and food from other regions.

3.2.2 Materials and Method used in this study

3.2.2.1 Multi-stakeholder Platform scope

The platform engaged different key stakeholders including the Research Scientists (Breeders, Agronomists, Pathologists, Socio-economists etc), private sector seed companies and seed dealers, the NGO's (ACDI-VOCA) operating in project areas of operation (Napak, Moroto, Nakapiripirit, and Serere districts), the Seed Inspector from the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) under National Seed certification Services (NSC's), farmer representatives and the Nabuin ZARDI advisory committee. Member representatives from the various stakeholder bodies formed the platform, effective in executing and tracking seed production and delivery systems.

3.2.2.2 Materials used for multi-stakeholder innovation platform (MSIP) establishment

Establishing a Seed production platform started with an inception workshop to inform and guide the members about the venture, its potential successes, and cohesion among the members and assigning the roles. The interaction of the stakeholders enhanced building a strong foundation for seed production and marketing. Other necessary materials used in MSIP establishment included simple, clear and affordable production knowledge (inform of simple reference fliers and booklets) and procurement funds for equipment and materials. Other necessary resources included land, production inputs (pure quality seeds, fertilizers, pesticides etc), market for commercial productivity and demand driven innovations.

3.2.3 Methodology adopted

The platform made inter-linkage in sourcing production and marketing information for effective seed system operation. It directly got involved in establishing a business venture through forecasting and identifying seeds on seed demand, the analysis of seed business profitability and drawing a plan for actual production through contract agreements with outgrowing scheme. The existence of platform existence enhanced farmers to produce seeds with knowledge of market demand for income benefit. In addition, the presence of seed business platform helped in stimulating productivity for increased seed revenue. Similarly, in order to ensure proper marketing, farmers were trained and registered as seed producer groups with guidance of the National Seed Certification Services (NSCS) of the Ministry of Agriculture, Animal Industry and Fisheries. Seed producers were also trained and engaged in developing memorandum of understanding (MoUs) with seed stockiest for collaborative production and marketing of quality seeds in the sub-region. Farmer groups and Agro-input dealers involved in the seed production and delivery were trained in business skills like; record keeping, entrepreneurship, product development and market penetration knowledge.

3.2.4 Achieved outputs for multi-stakeholder innovation platform

The following achievements were made as listed below

i. Platform (Research, MAAIF, Seed Companies, seed stockists and seed growers) for Seed enterprise established and made functional
ii. Precise system for seed production with concise plan developed
iii. Reliable information on seed marketing as a stimulant for seed productivity availed
iv. Favorable contract agreements between seed companies and /or agro-dealer and farmers developed
v. Model for seed profit margin analysis for crop enterprise selection developed
vi. Consolidated stakeholder views follows:

- **Seed companies (Naseco and Pearl Seed Companies) views:**
  - *Need to understand production and marketing of seed for successful profitable system.*
  - *Need for the seed system to be run as a profitable business under the concept of seed business value chain.*
  - *Management issues involving customer requirement (intellectual property and seed release procedures), establishing growers contracts advertisement and extension information*
  - *Strategic pillars supporting seed business: (a) Financial strategy: plan, budget, source of capital (b) Marketing strategy: know your market and pricing, distribution network (c) Production strategy: pure seed, processing, personnel, machinery etc*
  - *The need for partnership between seed companies and farmer communities especially in regards to market information, production and credit.*
- **Farmers**
  - *Emphasized willingness and commitment to devoting all resources (land, knowledge, labour) in producing and sustainably and strongly contribute to developing a seed system in the Nabuin Zone irrespective of the erratic rains.*
- **Seed Inspector**
  - *The emphasis was made on seed production protocol for ensuring quality control*
  - *Production fields will be inspected and certified for seed production*
  - *Farmer groups engaged in seed production will be registered as seed growers to enhance them indulge in seed market*

Stakeholders developed a multi-stakeholder innovation platform (MSIP) aimed at spearheading the revitalization of the seed system and made functions of the selected key players. The following were nominated and confirmed to preside over the MSIP

- ***Samuel Kayongo*** *(Research Officer) for Seed technology transfer; Project financing and control*
- ***Joseph Bazaale*** *(Seed Inspector – MAAIF) for Seed certification services*
- ***Peter Amodoi*** *(Farmer Leader) for Seed producers mobilizer*
- ***Godfrey Katwere*** *(Naseco Seed Marketing Officer) for Sourcing seed market information and Seed business value chain*

- ***Richard Masagazi*** *(Pearl Seed Company) for Seed quality control and drawing seed production contracts*
- ***Herbert Okurut Akol*** *(Retired Principal Research Officer, NARO) for creating cohesion among MSIP members and also spearheading project monitoring and evaluation.*



Figure 1: Shows MSIP inception deliberations



Figure 2: Shows members of the MSIP

Summary of achievements

Objective	Key activity	Results	Outcomes
Create a multi stakeholder platform for commercial open pollinated variety (OPV) seed production	Organizing a platform of agro-stakeholders to inter-link and engage in guiding seed productions, sourcing production and marketing information for effective seed system operation	i. Platform (Research, MAAIF, Seed Companies, seed stockists and seed growers) for Seed enterprise established	i. Platform for Seed enterprise established and functionalized.
		ii. Precise system for seed production with concise plan developed	ii. System of seeds production (FFS, nucleus and out-grower scheme) plan developed and implemented
		iii. Formed a communication phone- app for sharing information on seed production and marketing as a stimulant for seed productivity	iii. Phone- app for commercial seed production formed but yet to be programmed on phone networks
		iv. Favorable contract agreements between seed companies and /or agro-dealer and farmers developed	iv. Favorable contract agreements for commercial seed scheme developed and operationalized
		v. Model for seed profit margin analysis for crop enterprise	v. Model for seed profit margin analysis for crop enterprise

		selection developed	selection developed

3.2.5 Conclusion

The MSIP took the task of strengthen the platform functions for the success of the project. The functions included creating inter-linkages (by Seed Companies) sourcing and providing marketing information to the platform to enhance focusing and planning seed system operations. Forecasting and identifying seeds demands, sourcing quality seed stocks and developing production plans, drawing plans for actual production through contract agreements with outgrowing scheme (by Seed Companies), Farmer mobilizations (by Lead Farmer and ACDI-VOCA), Seed inspection (by NSCs under MAAIF) and seed marketing were identified as functions to strengthen in this seed system development.

3.3 Study two: Equip smallholder farmers with knowledge of pure seed production and Quality control

3.3.1 Introduction to growers training in seed production

The positively correlative attribute considered for high crop yield was but not limited to use of pure seeds in production. Seed purity is a pre-determinant for good crop establishment, healthy and good plant growth. Usually it's important to consider quality control involving seed plant isolation to control foreign pollen, good crop management (weeding, nutrient addition etc) physiological maturity and timely harvesting, seed processing, treatment, packaging and storage (post-harvest processes). All these aspects were considered perquisites for producing pure quality seeds. In addition it's important for growers to know the values (viability, good germination, good plant establishment and growth, and benefits (high yield, income from seed sells) for using pure quality seeds than grains meant for food production. However, farmers, Karamoja in particular, could hardly have access to pure quality seeds and also generally lacked knowledge for pure seed production yet comparatively, possess the potential and factors (land for maximum field isolation, tools for use in production, implicit labour) for seed production. Usually, majority (90%) of the farmers contacted were accessing seeds from neighbours, mobile markets and or from remains of the previous food harvests. Farmers were interested in crop production but success for high yield could be achieved if growers used pure seeds during production than planting grains that are ideal for food consumption. Therefore in this project there was need to train and equip farmers with technical knowledge for pure seed production.

3.3.2 Materials and Methods

3.3.2.1 Materials used in Seed production and quality control

Farmers received training mostly on open pollinated crop like maize, which is complex in maintaining genetic purity. Maize varieties used in seed production included Longe5, Vpmax and MM3 (Maize), while beans included Nabe15, sorghum (Seso3). Breeder and foundation seed stocks of Maize (700kg) and Beans (800kg) were obtained from National Crops Resources Research Institutes (NaCRRI) while Sorghum (500kg) was obtained from National Semi-Arid Resources Research Institute (NaSARRI). Seed varieties were added on the stock multiplied at Nabuin ZARDI during the first year of the project to increase the initial seed bank. Other inputs of significant importance included pollination bags, fertilizers and pesticides that obtained from procurements and private sector through commercial collaboration of contract farming.

3.3 Methodology adopted

3.3.1 Seed production activity Implementation

3.3.1.1 Technology Transfer

The most effective and efficient method of extending proven technologies to farmers, requires use of a perspective of farmer field school (FFS) (A R. Braun *et.al*., 2000) to quickly and sustainably impart practical skills necessary for seed and food production. FFS strategy of applied research that is mostly used in Farmer-Research interventions for gaining practical knowledge was adopted for this venture. FFS is a practical approach involving training and implementation of gained knowledge in increasing agricultural productivity. The half-sib crossing technology was introduced and farmers practically trained in making pollen crossing across selected plants of the same variety for production and maintenance of pure seeds

3.3.2 Farmer Field School (FFS) implementation strategy

3.3.2.1 Farmer groups

Seed production initially began with conducting farmer training where:

(i) Four farmer groups on basis of FFS (Gershon *et al*., 2004) were created from districts of Moroto, Nakapiripirit,
Serere, and Napak. The size of each group contained ≤ 30 farmers (50% gender).

(ii) Therefore the total number of farmers to train were summarized in the following model:
Trained farmers = (4 FGs*30 F/Grp) = 120 farmers to train initially in the first cropping year.

(iii) Allowing every farmer to prepare 1.0 acre of land for cultivation: ie 1*120= 120acres in total.

(iv) With 3 crop varieties, maize will take 50%, sorghum (30%) and beans (20%) of the 120 acres.

(v) Cumulative increase of the same number of groups per year

3.3.2.2 Study Plot

This is a field plot of land where practical training of farmers took place (for instance today and thereafter the next day each farmer executes the gained technology on his individual field). A plot size of 1.0 acre for each farmer group making four acres of study plots. Study fields involved the practice of learning and concurrently implement what has been learnt. For example, all series of activities ranging from field identification, siting, preparation, seeding, crop husbandry practices, breeding and harvesting. Therefore what was practically conducted at the study plot, each farmer also implemented it on his individual 1.0 acre within two days.

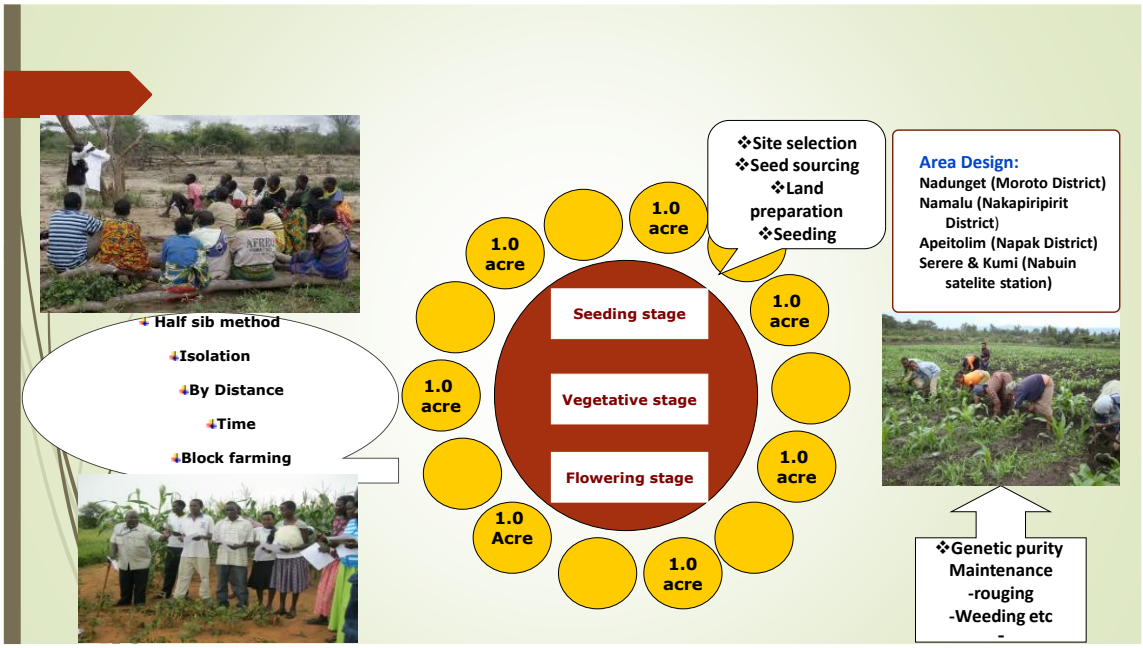

Figure 3*: showing the illustration of a study plot.*

3.3.2.3 Pure Seed production and maintenance (*Half sib method*)

Farmers were trained in application of ***half-sib*** (MacRobert, 2009) method to produce pure seeds from varieties with pure genetic control (Maize Program, 1999). Using half sib method allowed farmers to grow a variety crop like maize; with the field divided into two halves, then collect pollen from covered tassels of selected plants from either half. The pollen per half was then mixed together and used to pollinate and cover pollinated silks to avoid foreign pollen. If each farmer was capable of selecting and pollinating at least 300 plants ensuring enough pure seed are achieved hence the source of seed for the next cropping season.

3.3.2.4 Commercialization of seed production

Socio economists from NabuZARDI in collaboration with NASECO SEED CO trained farmers in marketing skills. The training involved forecasting and identification of seeds on demand, analysis of seed business profitability and drawing contract agreements with Seed companies. Farmers could then produce seeds with knowledge of income benefit and market demand. Similarly by ensuring proper marketing, trained farmers were organized and registered as seed producer groups, thereafter certified as seed producers (quality declared seed) by National Seed Certification Services (NSCS) of the Ministry of Agriculture, Animal Industry and Fisheries. Trainings were held for both local stockiest and farmer groups and a memorandum of understanding were reached between the two to have fair deals in production and marketing of quality seeds in the region.

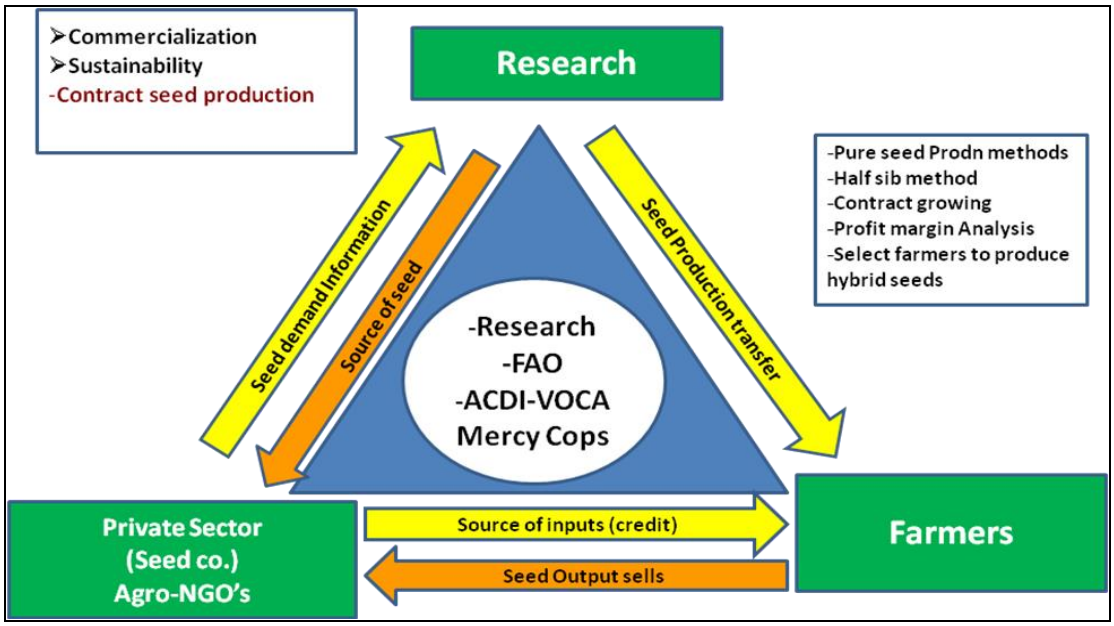

***Figure 4**: Showing the matrix for seed business commercialization*

Farmer groups and Agro-input dealers involved in the seed production and deliveries were also trained in business skills, for example; record keeping, entrepreneurship, product knowledge and marketing.

3.3.2.5.1 Achievement one: Creation of seed grower groups

Success in training seed growers was strategically modelled through establishing viable working grower groups among the farming communities, creating awareness with the help of opinion leaders (elders) and enhancing grower's certainty of the technology ownership for self-appraisal, implementation and success. Through group working, cohesion and learning based what the neighbor/friend/leader has implemented enhanced quick adoption rate seed production technologies regardless of the anticipated risks that could hamper the implementation of gained knowledge. Below (Table 1) shows the grower groups initially created for seed production.

Table 1: Established seed farmer groups (2014)

Group	Av. Members	location	Seed crop to grow
Naitakwai (Nalikonyen)	25	Moroto	Maize, Sorghum
Apeitolium (Komutulunyo Farmers)	30	Napak	Maize, Sorghum, Bean
Namalu (Kawachi Farmers)	30	Nakapiripirit	Maize, Sorghum, Beans
Kolir Farmers	30	Bukedea	Maize & sorghum
Serere Farmers (Serere Link Farmers)	35	Serere	Maize, Sorghum Bean

3.3.2.5.2 Achievement Two: Imparting seed production technologies to growers

At least 1148 of growers (table 2) were trained (fig.5a-c) in production of quality seeds of maize (62.5%), sorghum (28.2%) and beans (9.2%). The training concentrated on grower practical learning of applications for pure seed production, genetic seed purity control and maintenance (fig. 10), identification of off-types based on male and female flowers, architecture of leaves, post-harvest quality control (fig.7-12), stock and roots and general plant description. Also inclusive was the general agronomic (Fig.6-7) practices for ensuring proper growth of pollinated plants.

Table 2: Showing number of trained farmers in production of pure quality seeds

Year	Location	Farmer Groups	Total farmers Trained	Number of farmers trained		
				Maize	Sorghum	Beans
2014	Karamoja	6	206	104 (50.5%)	82 (39.8%)	20 (9.7%)
	Teso	4	72	52 (72.2%)	10 (13.9%)	08 (11.1%)
2015	Karamoja	4	150	116 (77.3%)	25 (16.7%)	09 (6.0%)
	Teso	2	60	45 (75%)	9 (15.0%)	6 (10.0%)
2016	Karamoja	6	201	120 (59.4%)	62 (30.9%)	19 (9.4%)
	Teso	2	56	24 (42.9%)	21 (37.5%)	11 (19.6%)
2017	Karamoja	8	315	210 (66.7%)	93 (29.5%)	12 (3.8%)
	Teso	3	88	46 (52.3%)	22 (25.0%)	20 (22.7%)
Total		**35**	**1148**	**717 (62.5%)**	**324 (28.2%)**	**105 (9.2%)**

Training in agronomic practices included production field siting and preparation, seed sowing using dribble method, nutrient (Urea 46%N) application and weeding at respective crop growth stages. At anthesis (crop flowering) stage, farmers were practically introduced to pollen crossing exercise using ***half sib*** method (Fig.10) to produce pure seeds from varieties with pure genetic control. Maize fields were divided into two portions and farmers selected (based on plant health, vigour, true to type and earliness) the best plants where they covered the emerged maize tassels with paper bags before due for dropping pollen, and also covered the developing ears before silks emergence. Short-while (after three days), pollen crossing was done at 5am before sunrise, then collected all pollen from the covered tassels per portion and mixed together. Farmers then learnt uncovering the silks, pollinated them and covered again to avoid other foreign pollen from contaminating the pollinate silks. The pollination exercise could continue and plants not tasseled by that period were suspended and considered late maturing. About 500 plants per study plot were pollinated. However, for sorghum (Seso3B) and beans (Nabe15) study plots, perspectives of isolation by distance were implemented prior to tasselling and off-types rouged out to ensure genetic purity maintenance.

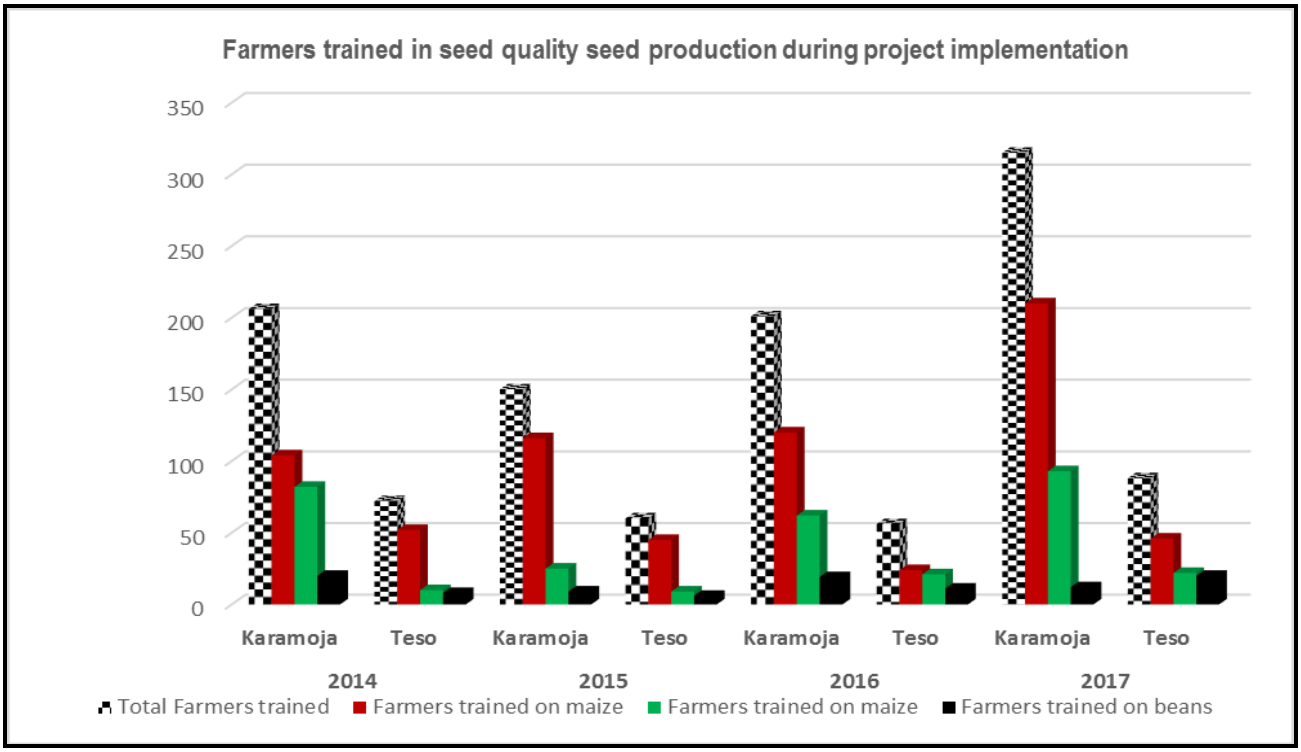

Figure5: Showing the number of beneficiaries trained quality seed production



Figure 5b: Seed crop establishment in Naitakwai, Moroto District



Figure 5c: Growers practicing seed sowing by dribbles



***Figure6**: Genetic purity maintenance of beans*



***Figure7**: Beans crop for seed production at Naitakwai*



Figure 8: Maize crop for seed production at Naitakwai



Figure 9: Beans sample pod sorting & grading by farmers



Figure 10: Using half sib method by a farmer in Moroto



Figure 11: Seed cob drying by farmers in Apeitolim, Napak



Figure 12a: Sample cob sorting and grading by farmers



Figure 12b: Seed grading farmers



Figure 13: Produced stock of pure quality maize using leant technologies

Summary of achievements

Objective	Key activity	Results	Outcomes
Equipping smallholder farmers with knowledge of pure seed production and quality control for commercial seed system	Training agro-stakeholders in production of pure quality seeds, maintaining genetic purity of seeds, quality control and marketing	Established thirty five farmer groups for commercial seed production	Five farmer groups under perspective of farmer field school (FFS) are operational and actively engaged in commercial seed production
		76.5% of farmers (1148) were trained in seed system development out of the intended 1500 farmers	Among trained farmers 62.5% (717 farmers) were trained in maize, 28.2% (324 farmers) trained in sorghum, 9.2% (105 farmers) trained in beans seed systems (production, quality control and marketing)

Conclusion

Training agro-stakeholders in quality seed system development and commercialization was and still remains one of the viable forms necessary for enhancing improved seed and food productivity within the confines of smallholder farmers. About 76% of targeted stakeholders were trained in seed (maize, sorghum and beans commodities) systems and are willing to continue growing pure seeds as part of the technique for solving hunger, through production and provision of pure quality seeds despite experienced long dry spells. Agro-stakeholders farmers in particular, now have good knowledge of what seeds are and how to produce and controlling quality of seeds. However, they still need to learn more on seed legislation and marketing for creating the demand for the produced seeds. Currently trained stakeholders developed a slogan that “A health seed is the way to improved livelihood”.

3.4 Study Three: Popularization and promotion of seed (maize, sorghum, beans) Production, Marketing and Deliveries

3.4.1 Introduction to seed popularization and promotion

The necessity to have reliable method for farmer access to pure quality seeds in the production system in Teso-Karamoja instigated the need to create awareness of the availability of quality maize (VpMax, MM3), beans (Nabe15) and sorghum (Seso 3B) seeds in production among the farming communities in Teso-Karamoja subregion. Farmers under a prescribed seed production protocol produced pure quality seeds, and established demonstrations under perspectives of "Method" and "Result" demonstration practices in Naitakwai (Moroto District), Namalu (Nakapiripirit District) and Apeitolim (Napak District) during cropping seasons. The significance of seed production demonstration was to enhance popularization of the available pure quality seeds in production. It was anticipated that by popularizing seed production through demonstration perspective, more 50% of growers could be allured into seed production hence the promotion and productivity of pure quality seeds.

Therefore, after farmer training in seed production and quality control, it necessitated expanding the scope for seed production system. Area expansion required alluring more farmers to production business and this was achieved when pure seeds were popularized and promoted for more farmer adoption. It was anticipated that the increase in number of farmers growing pure seeds could positively correlate with increase in productivity resulting in easy access and availability of pure quality seeds hence seed system development. Therefore to achieve results technology transfers involving demo establishment, holding field days, radio talk shows were implemented for technology diffusion.

3.4.2 Materials used in seed production popularization and promotion

Materials relevant in popularizing the venture for seed production and marketing included but not limited to the following: adaptable crop varieties of maize, sorghum and beans; actual land for demonstration fields; seed packaging materials; technology dissemination and reference materials such as production and processing cycle charts, posters, leaflets, sign posts, banners and brochures.

3.4.3 Methods employed in seed popularization and promotion

In order to have 80% of growers in seed production scope area, the following popularization measures were essentially implemented

3.4.3.1 Demonstrations Plots

During project implementation, one demonstration plot (1.0 acre) for every selected crop variety among the 5 farmer groups (1.0 demo* 3 crop varieties * 5 farmer groups = 15 Demo plots). Each plot had all crop varieties promoted by the project planted alongside local varieties for result demonstration. The demos enhanced seed growers and other stakeholders a chance to observe, compare and evaluate the performance of the improved seed varieties and also learn how to produce pure and high quality seeds.

3.4.3.2 Monitoring Seed Production Fields

Farmers selected 2 days in week to monitor the progress of the crops and notes / observations taking. This included recording their observations and operations like planting time, pest control, weed management and rouging. Researchers could regularly visit the project sites to check on the performance of the crops and to give technical advice to the farmers. At least four visits were made in a season; at early vegetative stage, at bud initiation and flowering, at pod/grain filling and at maturity.

3.4.3.3 Creation of awareness for quality seed production and delivery

3.4.3.3.1 Field day- Seed Production

Field days (Fig. 14-15) were organized when the seed crops are close to or at maturity stage, and during this time farmers could share their experiences and give suggestions for the way forward. It was also an opportunity for Researchers – Seed Co - Farmers to exchange views regarding the project progress (i.e. project evaluation) and what should be done next. These were among the best ways farmers could participate in evaluating the project and also have an opportunity to advertise and publicize the availability of the seeds with them.



Figure14: Exhibition of produce pure quality seeds



Figure15: Field tour during the field day in Nakapiripirit

3.4.3.3.2 Radio talk shows on Seed System

The project hosted live talk shows on radio stations in Karamoja (KFM 97.4FM) creating awareness about the need for knowing improved seeds, the production methods and seed accessibility through farmer production scheme.

3.4.3.3.3 Developing Seed Production posters and brochures

Brochures were developed and pre-tested by the project implementers and often given out to agro-stakeholders, detailing the processes involved in producing pure seed of improved crop varieties, availability and the different seed sources.

3.4.3.4 Achieved outputs in popularization and promotion of seed production venture

The following outputs were achieved:

(i) 90% of farmers in project implementation area joined the production system as allured from the established result and method demonstration fields
(ii) 90% of seed growers in project area monitored and or visited seed fields in addition managing the demonstration fields.
(iii) At least 70% of the farmers in the project area participated in the field days for technology exhibition and adoption
(iv) 50% of farmers listened to the radio talk shows about seed production system
(v) 500 brochures about seed production and marketing developed and printed
(vi) A simple manual on seed production and marketing developed for farmer reference drafted

3.4.3.4.1 Demonstrations fields

Initially, four plots depicting combined perspectives of method and result were established and demonstrated the following aspects:

- Dribble planting
- Management of field plants by weeding, fertilizer application and thinning
- Purity control by pollen crossing using half sib method
- Good quality plants Identification and selection based on tassel structure, healthy plants, vigour, and maturity period.

3.4.3.4.2 Monitoring Seed Production Fields

The growers according to their set-up working roles and functions, decided to monitor their respective seed production fields twice once every week till crop vegetative stage, and also planned to monitor the fields every twice a week in preparation for anthesis stage. In monitoring farmers 50% of growers were able to identify unhealthy plants from the population prior to anthsesis stage.

3.4.3.4.3 Field visit- Seed Production

Field visits were organized to enable farmers share experiences and be able to adopt new technologies. These were among the ways farmers could participate in evaluating the project and also have an opportunity to advertise and publicize the availability of the seeds with them. This time round we shared ideas with seed growers from South Sudan (Figure 16)



***Figure16**: Seed grower's field tour to seed production fields in Naitakwai, Moroto*

3.4.3.4.4 Field day / agricultural day for generated technologies

A field day was organized at one central place for seed growing groups and other implementing technologies in form of an agricultural day. Farmers exhibited their quality declared seeds and other technologies disseminated to them (fig. 17).



Figure17: Agricultural day for technology exhibition in Moroto District

- At least about 2500 people attended the agricultural day that was organized for 5 days.
- It was estimated based on the response that about 65% of people engaged in farming needed seeds and it's evidenced by the rate of farmers seeking for seeds.

3.5 Study Four: Increase seed volumes through farmer-to-farmer block seed production

3.5.1 Introduction to block farming

Production and availability of adequate pure seeds is a necessary system for enabling farmers have access to quality seeds that transform into adaptable plants. During the project implementation, seeds were produced and availed to various agro-stakeholders based on demand. Fields were established, planted and the harvest subjected to quality control, packaging and commercialized the seeds. Currently Nabuin ZARDI is the most reliable institute for quality seeds in demand by farmers and agro-NGOs. Seeds were grown both at on-station, among farmer groups and with out- growing scheme of contracted farmers. Among the methods for maintaining seed genetic purity especially in situations where isolation by time or distance is not possible, then implementing a system of all neighboring farmers in a given area growing the same variety is very useful in pure seed production. The same method was adopted and implemented during seed production. Therefore, block farming to produce seeds was a good method of easy production of high seed volumes.

3.5.2 Materials to use in production

The materials used in seed production included seeds, farming tools (hoes, ox-plough) and implements (sprayers etc), land and explicit human labour.

3.5.3 Methodology for block seed production

Both seed growers and food growers were given same type of seeds to grow. The essence was to avoid other or foreign variety mixture to contaminate the growing plants either through cross pollination or grain mixtures at harvest. It was planned that an area with 25 households could grow the same crop variety. Growing the same variety of like maize seeds would then enable reasonable productivity of the same variety. The productivity of 1.0MT/acre by the 25 households would enhance obtaining adequate of 25MT.

3.5.4 Achievement: Pure seed yields produced and commercialized

Producing seeds through block farming was implemented in Serere, Kumi and Bukeadea in Teso and Namalu, Apeitolim, Naitakwai, Kawachi in Karamoja based on the farmer capacity to handle and manage efficiently. Over 80% of seed volumes were produced at on-farm seed scheme and less than 15% at On-station.

The essence was to enhance and empower farmers be involved in seed production as way of revitalizing seed system in the region. Initially, 60% (24MT), 40% of sorghum (8.0MT) and 35% of beans (3.5MT) (tab. 3) were produced respectively out of planned out of 40MT (maize), 20MT (sorghum) and 10MT (beans). Subsequently, productivity was fluctuating due to the drought stress and cyclic changes in rain intensity. Initially, the interests by some outstanding farmers were high and indeed they implemented after learning, and thus started own commercial productions with cross border market of Kenya. Often expansions were directed towards training many more farmers (fig.5) for technology transfer, adoption and implementation.

Table 3: Seed volumes produced during project implementation

Year	**Location**	**Seed Production (Tonnage)**				**Seed Sales / commercialized**		
		Maize	**Sorghum**	**Beans**		**Maize**	**Sorghum**	**Beans**
2014	Karamoja	20.0	6.0	2.5		15.0	6.0	2.0
	Teso	4.0	2.0	1.0		3.0	1.8	1.0
Subtotal		***24.0***	***8.0***	***3.5***		***18***	***7.8***	***3.0***
2015	Karamoja	10.0	4.7	3.0		6.0	4.5	2.5
	Teso	7.0	4.0	0.8		4.0	1.2	0.6
Subtotal		***17***	***8.7***	***3.8***		***10.0***	***5.7***	***3.1***
2016	Karamoja	5.0	3.8	3.5		3.0	2.0	3.0
	Teso	3.0	2.0	0.6		2.5	1.0	0.5
Subtotal		***8.0***	***5.8***	***4.1***		***5.5***	***3.0***	***3.5***
2017	Karamoja	8.0	2.2	3.0		7.5	1.5	2.5
	Teso	5.5	1.0	0.65		4.5	1.0	0.65
Subtotal		***13.5***	***3.2***	***3.65***		***12.0***	***2.5***	***3.15***
Total		**62.5**	**25.7**	**15.05**		**45.5**	**19**	**12.75**

More seed production concentrated in Karamoja (fig. 18) due to high seed demand and general lack of its availability. Trainings were mostly done on Maize production (fig.10) due to its complexity in qenetic purity assurance. The success in learning quality maize seed production (cross pollinated) would enable production of other crops (self pollinated) more easier. More volumes of maize seed (fig. 19, 22) were produced due to extensive trainings and over 75% of harvet were sold out across production years. Over 80% of seed buyers were NGO's (IRC, FAO, OPM, samaritan purse etc) that would out scale crop production using pure quality seeds from Nabuin ZARDI.

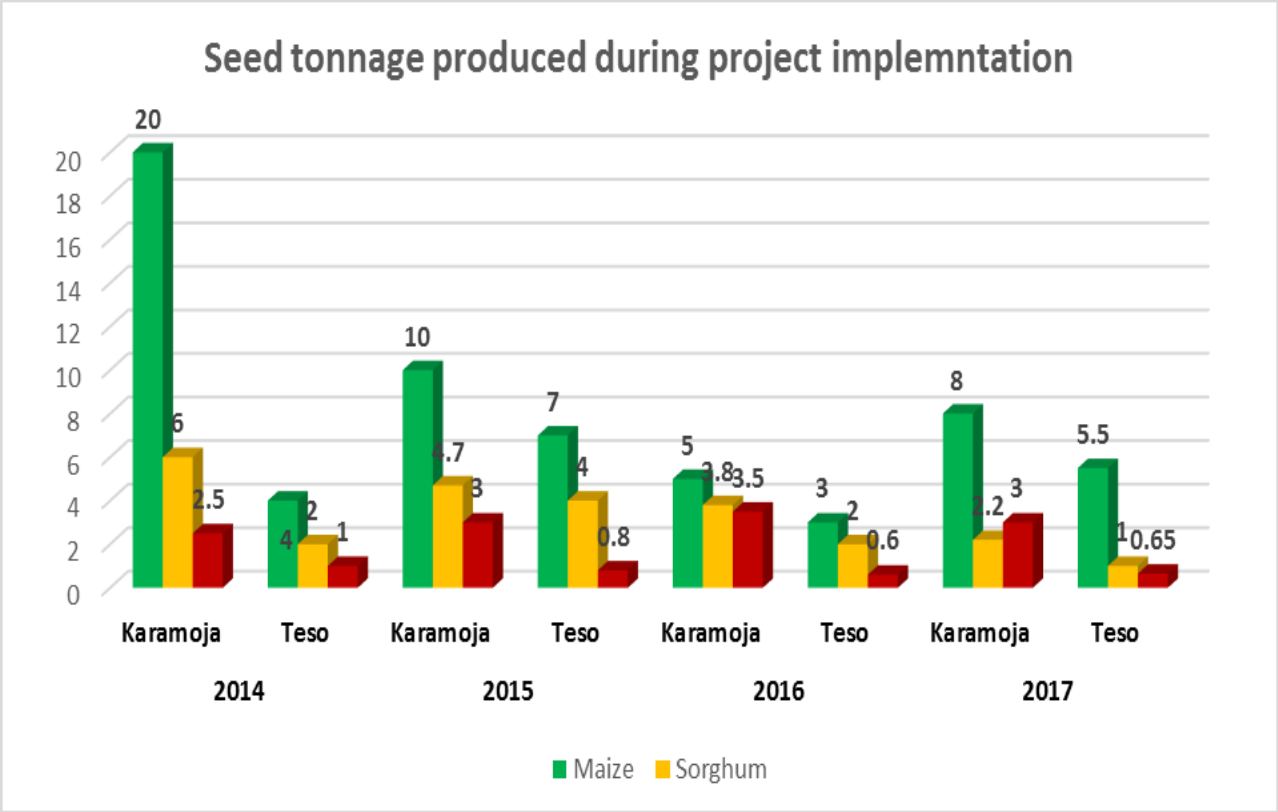

***Figure 18**: Showing Seed production (maize, sorghum, beans)*

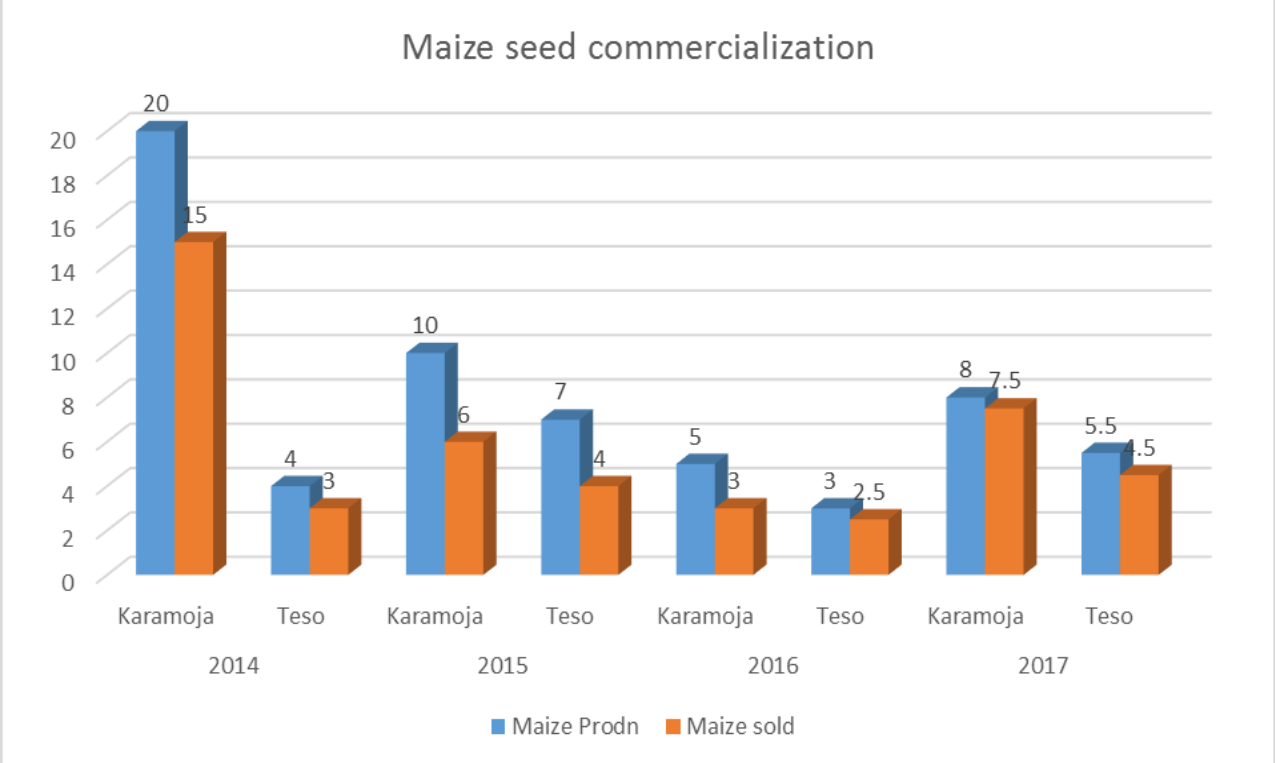

***Figure 19:** Showing the production and sales of maize seed*

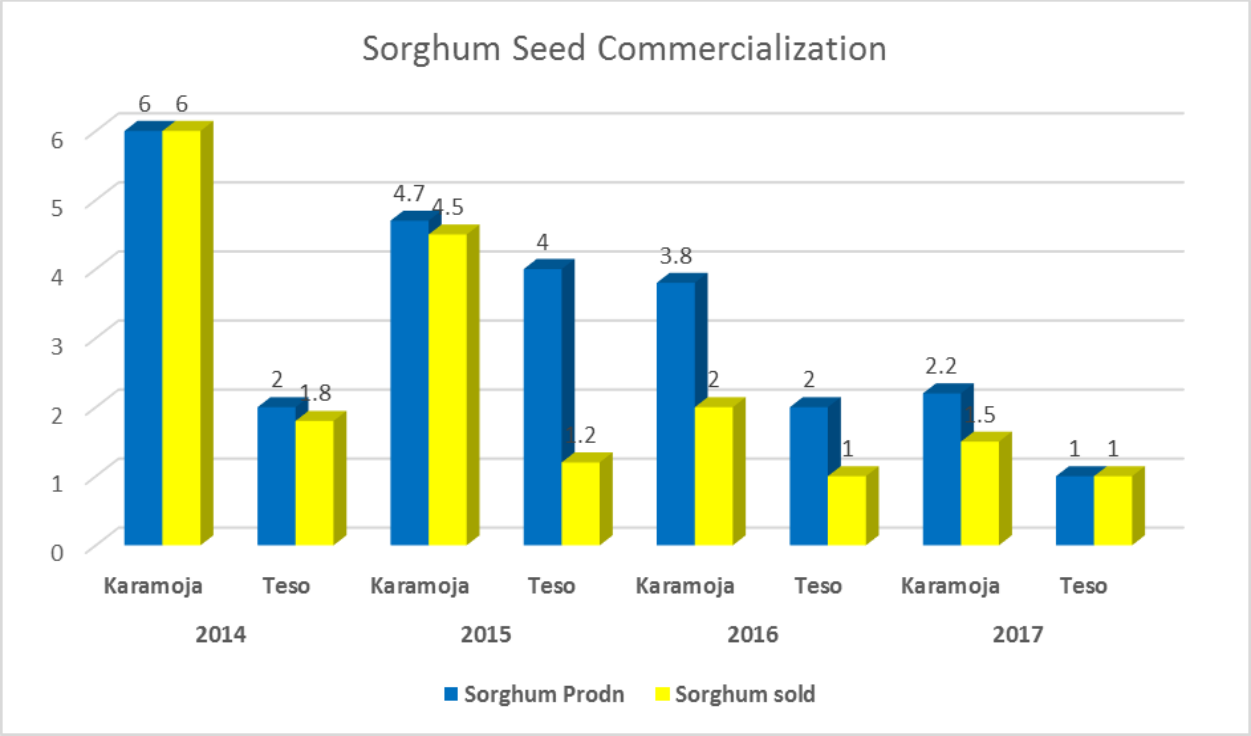

Figure 20: *Showing the production and sales of maize seed*

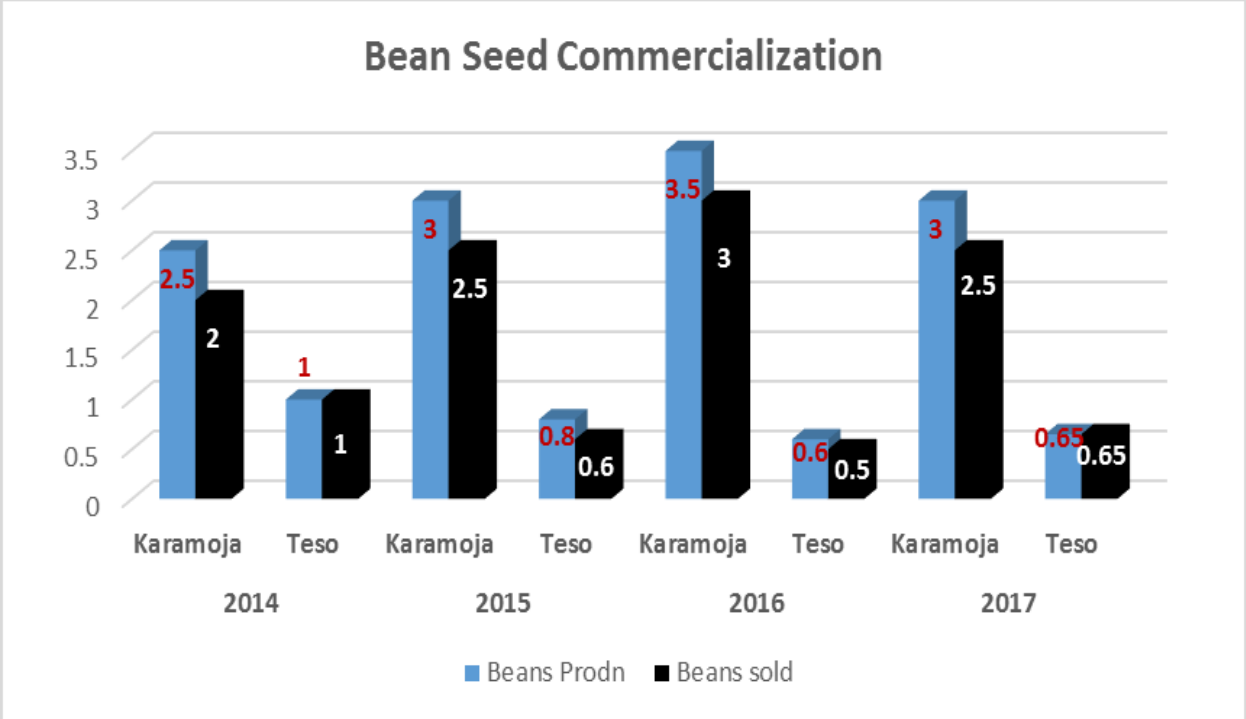

Figure 21: *Showing the production and sales of maize seed*

Growers were provided the produce to Nabuin ZARDI on basis of out-growing scheme, for sale as quality declared seed (QDS) since seed certification were not yet possible due to the requirements of company or registration as certified producers by the Ministry of Agriculture Animal Industry and Fisheries (MAAIF).More maize seeds (fig. 19) were produced and marketed as seed. The rate of sorghum and beans seed production (fig. 20 and fig. 21) were relatively lower due to challenge with drought stress

concerning variety adaptability. All seeds produced were subjected to quality control porcessing (fig.12a, 12b) for grading and grain treatment against pests.



Figure 21: Beans seed production field in Apeitolim Napak



Figure 22: Maize Seed production field at Kawachi, Namalu, Nakapiripirit District



Figure 23: Sorghum Seed production field at Nabuin ZARDI, Nakapiripirit District

Sorghum remains the most important food crop and seeds were grown and highly demanded for commercialization. Income accrued in sorghum were derived from sale of seeds (improved seeds) (fig. 20). All improved seeds were treated, packaged, labelled a NARO- Nabuin ZARDI product (fig. 24) and marketed.



Figure 24: Seed storage at Nabuin Research ready for sale

4.0 Conclusion and implication

Despite experiencing prolonged dry spell farmers still and are willing to continue growing pure quality seeds as major part of the system for solving hunger, through production and provision of pure quality seeds. A health seed is the way to improved livelihood. Farmers now have good knowledge of what seeds are; values and benefits and method for production. However, they still need to learn more on seed marketing for creating the demand for the produced seeds. Therefore seeds (maize, sorghum and beans) are readily available in the sub-region. However, farmers have the enthusiasm to produce and the little seeds produced (table above) could be bought by fellow farmers, agro-NGO's and or taken by private sector such as seeds companies. Access to pure quality seeds in the zone has enhanced increased crop productivity with improved crop growth success. Food aids and imports in the zone have reduced due to increased crop production. Intensive seed system development is anticipated to stimulate more demand hence enhancing commercialization and ultimately leading improved livelihood.

5.0 Additional Information

5.1 Lessons Learnt

- Farmer Field School (FFS) is the best approach for imparting skills for quality seed production
- Pure seed production is viable commercial business
- In dry land region success of seed production business is based on rain availability and or irrigation

5.2 Environmental Impact

Seed system development was conducted in a favorable environment with application of chemicals such as fertilizers (Urea, DAP); pesticides (Actellic super: *Pirimiphos methyl 1.6% + permethrin 0.3%*) for seed treatment; fungicide (*Mancozeb 80WP*) and herbicide (*Glyphosate 480g/L*) for better crop growth. The mentioned chemicals are among the registered and permitted for application by the Ministry of Agriculture Animal Industry and fisheries (MAAIF) under section 4 of the agricultural chemicals control Act, 2006.

5.3 Partnership and collaboration

Socio economists from NabuZARDI, NASECO SEED CO., NGO's (FAO, ACDI VOCA) and Agro-dealers farmers, teamed together in forming a matrix perspective for imparting skills of pure seed production and marketing among agro-seed growers and producers. The roles of Seed Co. included forecasting and identification of seeds on demand, analysis of seed business profitability; drawing contract agreements with farmers. The roles of farmers included seeds growing with knowledge obtained from Nabuin ZARDI Scientists; and credit offering of source of inputs used in seed growing. The roles of Nabuin ZARDI were for seed production technology transfer.

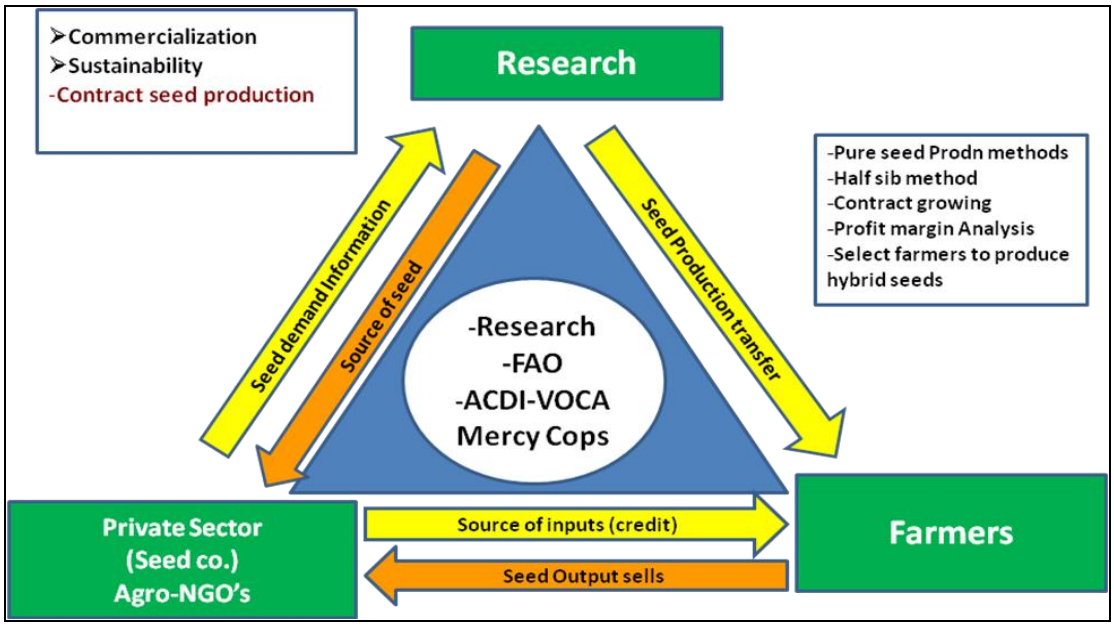

***Figure 4**: Showing the matrix for seed business commercialization*

Therefore the partnership and collaboration were key factors that enhanced the success of the project.

5.4 Economic impact

Table 4: Seed production and marketing is a viable business as indicated below

Production costs	**Total cost /item**	**Final output/acre Eg of maize**	**Total Revenue**	**Profitability**
Cost of seed	50,000	1200Kg/acre	1200*5000= 6,000,000	Cost/benefit ratio= 0.54 (2,120,000 / 3,880,00 = 0.54)
Land preparation				
Slashing	50,000			
1st ploughing	80,000			
2nd ploughing	80,000			
Harrowing	60,000			
Crop Management				
Weeding (3 times)	240,000			
Fertilizers (Urea)	300,000			
Fertilizer Application	100,000			
Detasseling off-types	30,000			
Facilities for purity maintenance				
Pollination bags (1000)	100,000			
Product processing				
Labour (drying, sorting, shelling, packing 1400kg)	250,000			
Chemical treatment	300,000			
Package materials (bags) 300bags @500	150,000			
Production filed guarding (2 months)	300,000			
Total	2,120,000			3,880,000

5.5 Social equity within the Project scope

Farmer groups engaged in the seed system development realized and considered the venture as an employment for food security and income generation based on the obtained outputs and cost benefit analysis (table 4). During the farmer field school practical training, roles were performed based on attendance, adherences and implementation of activities from gained skills. However, overall the farmer groups had more female farmers (58%) than male (42%) farmers. Land ownership is by freehold and every household could access an average of 3.0 cares for seed production.

Annexes

1. List of internal reports produced and submitted

1st Report Inception: Developing a sustainable farmer managed pure seed production and delivery system in Teso - Karamoja sub-region
Date: 8th August 2014

2nd Progress Report: Developing a sustainable farmer managed pure seed production and delivery system in Teso - Karamoja sub-region
Quarter: July –Sept 2014

3rd Progress Report: Developing a sustainable farmer managed pure seed production and delivery system in Teso - Karamoja sub-region
Quarter: Jan – June 2015 (2 qtrs)

4th Progress Report: Developing a sustainable farmer managed pure seed production and delivery system in Teso - Karamoja sub-region
Quarter: Jan – Mar 2016

5th Progress Report: Developing a sustainable farmer managed pure seed production and delivery system in Teso - Karamoja sub-region
Quarter: Apr – June 2016

6th End of Project Report: Developing a sustainable farmer managed pure seed production and delivery system in Teso - Karamoja sub-region

2. List of Information materials obtained from other sources and provided to farmers

1st Seed Company profiles (Naseco and Pearl)

2nd East Africa Seed Company Toolbox for reference

3rd Book: Seed Business Management in Africa

3. Information materials produced for farmers and other stakeholders

1st Simple seed production manual for reference

2nd Seed Production agreement

3rd Seed traceability table (tracking produces)

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