Research Brief

Seed System Resilience Assessment in Ikwoto County, South Sudan

Food and Nutrition Security Resilience Programme (REPRO)

South Sudan Programme

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1. PURPOSE

Building seed system resilience in protracted crises is an important goal of the Food and Nutrition Security Resilience Programme (FNS REPRO) of South Sudan. The programme employed a Seed System Resilience Assessment (SSRA) as a diagnostic and planning tool to co-create with local actors and stakeholders a better understanding of the behaviour of seed systems; that is, how they change and respond in the face of local shocks and stressors, change their current performance, and enable the development of a seed systems resilience pathway, enabling evidence-based programming to strengthen the robustness of local seed systems and their contributions to local food system performances for improved food and nutrition outcomes.

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1. reduce the number of people in IPC-3 (food crisis) through integrated seed sector development
2. reduce the number of people in IPC-4 (food emergency) through an effective seed insecurity response.

The seed system resilience assessment was conducted in Ikwoto, Torit and Magwi county of Eastern Equatoria, South Sudan in September-October 2020. These three counties differ significantly from one another in terms of food systems and the seed systems underpinning them. These differences are in terms of agro-ecology[1], livelihood systems, and drivers impacting on the food-seed systems (conflict and insecurity, economic shocks including Covid-19, and climate change).

This report presents the summary of key findings of the field assessment and the multi-stakeholder dialogues conducted in Ikwoto County. Ikwoto county assessment captures the reality of local seed systems in two unique contexts; one cluster is characterised by agro-orientation and border dynamics including the return of refugees (cluster 1 Ikwoto) and the other by agro-pastoralist livelihoods in a rural setting (cluster 2 Chahari). County based reports make it easier for both government, humanitarian actors, and local private seed companies to design specific interventions for each county to build seed systems resilience. The report builds on the findings of South Sudan seed security assessments undertaken by FAO and partners across South Sudan, including Ikwoto County.

2. METHODOLOGY

2.1 ASSESSMENT SITES

The assessment sites in Ikwoto County included two fundamentally different situations represented by two clusters (Figure 1 & 2). Ikwoto County lies in Eastern Equatoria state. It shares borders with Torit and Budi counties and international boundaries with Uganda.

- the Ikwoto cluster - representing Ikwoto (Ikwoto Town and surroundings) which included the Bira Payam,

Figure 1. Administrative map of South Sudan. Source: Wikipedia

Figure 2. Map showing the assessment sites in the Eastern Equatoria, South Sudan. Source: Wikipedia

1 Ikwoto County lies partly in the hills and mountains and partly within the greenbelt area; and Magwi County is in the greenbelt zone, with flat lands having long two rainy seasons.

Lobone Payam of Magwi County and neighbouring towns of northern Uganda
- the Chahari Cluster - representing Chahari, Chahari and Bur Payam in Ikwoto County

The Ikwoto Cluster is situated in the highlands with fertile land, and received two rainy seasons with agrarian and rearing livestock as major livelihood activities. The estimated population is approximately 60,122 with 7,039 households. This cluster has strong border dynamics with many returnees and internally displaced persons; by March 2021, 20% of the population were relocated (15% IDPS and 5% returnees) this mainly attributed to hunger. Basic/staple crops are sorghum and maize, of which about 97% is self-consumed.

Chahari cluster is characterised by agro-pastoralism; however, inhabitants of this cluster are known for cattle raiding and communal fighting. This cluster has a population of about 52,268 with 2,137 households. This cluster also falls within the two parts of hills and mountains and semi-arid agro-ecological zones. As a result of internal conflicts and climate stressors such as drought, erratic rainfall and shocks such as livestock disease outbreaks to mention few East Coast fever, Anthrax and infestation of desert locust people were forced to neighbouring Payams and some took refuge in camps in particular in Uganda, there they were exposed to new crops such as maize and vegetable production. Pearl millet is their staple food crop.

Table 1 Details of assessment team

S/No	Name	Affiliation	Representation and role
1	Tony Ngalamu, PhD	University of Juba	Knowledge institute (Field study team leader)
2	Madalina Kaku Daniel	University of Juba	Knowledge institute (Gender & socio-economist)
3	Obudra Francis Bile	Seed Grow Ltd	Private seed sector (Agronomist)
4	IVU Charles	FAO SSD	UN Agency (Agronomist)
5.	Abishkar Subedi, PhD	WCDI	Knowledge institute (SSRA methodology design and training to the field study team)
6.	Gerrit-Jan Van Uffelen, PhD	WCDI	Knowledge institute (SSRA methodology design and training to the field study team)

Table 2 Seed systems resilience tools and participants

S/No	Tool	No of key informants/ respondents	Gender (%)
1	Analysis of crop diversity availability & preference	40	50% male and 50% female
2	Climate resilience analysis	40	50% male and 50% female
3	Social seed network analysis	506	75% female and 23% male*
4	Seed systems analysis	17	29% female and 71% male
5.	Seed value chain analysis	17	29% female and 71% male

* remaining 2% represented by local markets and various organizations

2 https://research.wur.nl/en/publications/building-seed-system-resilience-in-protracted-crisis-situations-s

2.2 ASSESSMENT TEAM

A multidisciplinary team representing the knowledge institutes, private seed sector and UN Agency jointly conducted the assessment in Ikwoto County in strong co-ordination with and support from several local actors and stakeholders (Table 1). The field assessment team was trained by WCDI. Data analysis was done by both WCDI and the University of Juba team. In addition to this, a total of six field enumerators were hired to conduct the household interviews in the assessment sites.

2.3 SEED SYSTEMS RESILIENCE ASSESSMENT TOOLS

The assessment employs a newly developed seed system resilience assessment (SSRA), providing both a diagnostic and planning tool for evidence-based programming, by Wageningen Centre for Development Innovation (WCDI) of Wageningen University and Research in partnership with Juba University and FAO South Sudan as part of the learning agenda of FNS-REPRO programme.

The SSRA Facilitation Tool[2] offers several tools. The first two tools included the focus group discussion with key informants that included farmers and their communities which were made up of old and young, males and females, documenting the historical trend of conflicts and climate change impact on local livelihoods and food and nutrition security, and documenting the availability, use and

preference of crop diversity by farmers (tool 1: analysis of crop diversity availability & preference) and by climate resilience (tool 2: climate resilience analysis). The focus group discussion was conducted in Ikwoto Payam and Chahari Payam with 40 total key informants: 20 were female and the other 20 were male; 20 were youth of both genders (18-35 years).

The third tool analysed the dynamics of the social network due to the flow of crops, varieties, seeds and information between farmers, other groups competing for natural resources, and organizations linked with farmers and local markets. The continuity of this network builds trust, social cohesion, and reciprocity. In protracted crises, vitally, the social network often extends into IDP/returnee/refugee areas (tool 3: social seed network analysis). A total of 40 starting respondents consisted of local farmers, refugees, IDPs, and refugee hosts /returnees, representing the different age groups and genders from each cluster selected in the survey. In every next stage the number of participants increased, based on the snowball sampling method; finally there were a total of 137 respondents in the Ikwoto cluster and 369 respondents in the Chahari cluster.

The fourth and fifth tool (tool 4: seed system analysis, and tool 5: seed value chain analysis) were applied at Ikwoto County level through multi-stakeholder workshop involving participants from key institutions of Ikwoto seed sector (Table 3). The workshop was organized on the 15th of October 2020 in Ikwoto Payam. The workshop started by sharing a short synthesis of key findings of tool 1 and 2 to constitute the building blocks for the workshop. The workshop focused on the development of seed system resilience pathways for Ikwoto County.

Table 3. Stakeholder participants in the Ikwoto county workshop

Public sector	Private sector	I/NGOSs	Farmers Organization
State Ministry of Agriculture	Afroganics	UNICEF	Authur Cooperative Society
County Department of Agriculture		FAO	
Payam Agriculture Department		AVSI	
		BASENET	
		CARTIS Luxemburg	

3. RESULTS

3.1 KEY DRIVERS OF FOOD CRISES

Conflict and insecurity

Ikwoto cluster: This cluster per se has experienced several conflicts or insecurities in the past 30 years. The documented conflicts of the 1990's to the early 2000's were: insurgency by the Lord's Resistance Army (LRA); armed conflict between the Sudan People's Liberation Army (SPLA) and the Splinter group led by Dr Riek Macha; Ugandan Defence Forces and LRA conflict; and rampant killing and looting by armed thugs. Dr Riek Machar again rebelled against the government during 2013 to 2019 that resulted into forceful displacement of the communities in Ikwoto Payam. In addition, communal fights were reported and the main reasons for the disputes within the communities of Ikwoto Payam were uncontrolled grazing of livestock on crops, theft of livestock and land boundary issues.

Chahari cluster: TThis cluster is unique because of the types and nature of conflict it has witnessed over a period of three decades. The reported conflicts are the following: fighting between the Sudan People's Liberation Army (SPLA) and SPLA splinter groups in the 1990's and 2013; fighting between the Lord's Resistance Army (LRA) and Ugandan troops; and numerous conflicts within and between communities. All these conflicts have resulted in displacement and loss of livelihood activities.

Economic shocks and Covid-19

Ikwoto cluster: According to the AVSI 2021 report, inhabitants of Ikwoto Payam face water and health-related issues. The impact of Covid-restrictions is reflected in the disrupted crop production cycle, resulting in reduced crop yields.

Chahari cluster: TOver this period the most notable economic shocks experienced were the loss of economically important crops (in particular sorghum, millet, maize, groundnut, and sesame) and livestock (cattle, goats, and sheep). Cattle raiding and internal conflicts contributed to famine, forcing people to seek refuge in Uganda. Covid-19 has created isolation and theft has intensified since livelihood activities were disrupted.

Weather extremes and climate change

Ikwoto cluster: TThis cluster has suffered from a number of climate hazards such as drought, heavy rains resulting in serious floods, disease outbreaks (notably East Coast fever and anthrax in the year 1997 and 1998), and pest infestation, for instance swarms of desert locusts in 2020. Conflicts, coupled with weather extremes, have impeded all livelihood activities. According to the AVSI (2021) report, in Ikwoto only 36 % of the population had access to nutritious food, thus forcing inhabitants to relocate to refugee camps. As a result they lost crops and livestock.

Chahari cluster: The whole county registered climate shocks such as drought, erratic rainfall, diseases such as groundnut rosette virus, East Coast fever, anthrax, genuine worm, pests (desert locust) and weed infestation (*Striga hermonthica*).

Causes of undernutrition: poor diets, diseases, and care practices[3]

Ikwoto cluster: In this cluster, the FCS status revealed that 19% of the population had poor FCS. Periodic conflicts and instability, interacting with weather extremes, negatively affected peoples' livelihoods. The majority of the inhabitants in the cluster were forced to migrate due to food shortages, disease and the absence of personal and health facilities.

Chahari cluster: The interaction between conflict/ insecurity and climate stressors in this cluster resulted in the erosion of livelihood activities. The communities in Chahari Payam exchanged livestock for food and seed to survive famine. This is despite the fact that according to AVSI's 2020 report stating that 52% of inhabitants of Chahari Payam had access to nutritious food.

Response of humanitarian assistance

Ikwoto cluster: There have been some interventions by I/NGOs (AVSI, Red Cross, FAO, CARITAS, Norwegian Church Aid (NCA), Diocese of Torit Catholic Relief Services (CRS), the African Inland Church (AIC) and others), of seeds, food, nutrition and rehabilitation.

Chahari cluster: There was support by I/NGOs in diverse ways: Germany Agro-Action carried out livestock treatment after the disease outbreak; road construction and maintenance by Norwegian Church Aid; CordAid, Walter Hunger, FAO, CARE, AVSI and others were able to introduce improved vegetable seed assortments, and Caritas Luxemburg provided veterinary services and constructed water harvesting points for livestock.

3 Good nutrition goes beyond food security. Proper care practices, including breastfeeding and other recommended infant and young child feeding practices, hygienic environments, and access to health services are needed in addition to nutritious diets. Good nutrition is as much about ensuring an appropriate intake of nutrients as it is about ensuring that children are healthy enough to absorb those nutrients. Global Report on Food Crises, 2021.

Table 4. Mapping the status of crop diversity in Ikwoto cluster and Chahari cluster in 2020

Crop diversity status	Ikwoto cluster	Chahari cluster
Crop grown by many farmers in large area	Sorghum (Local varieties: Dotung, Osingo and Okleweng, Aderi and Naluyak), sesame (Improved variety: Sesame 2), maize, groundnut (Red Beauty), Cowpea (Local variety: Notononngnogwoa)	Sorghum (Local varieties: Aderi, Osingo, Akongloi), Common beans, Sesame (Anyim), Cowpea, Okra, Groundnuts (Lokoya), Sunflower Maize and Cassava (Local varieties: Agwana Ondwato, Agwana Onolek)
Crop grown by many farmers in small area	Finger millet, Pearl millet, Soybean, Sweet potatoes (Improved variety: Orange Flesh, Local varieties: Babule, Nacercri and Palotaka), Cassava, Cowpea, Pumpkin (Local varieties: Nabaru and Nanajar)	Groundnut (Red Beauty), Okra, Cassava, Cowpea, Tomatoes, Sweet potatoes, Egg plant Maize, Sorghum (Akele and Serena)
Crop grown by few farmers in large area	Groundnut (Local varieties: Lomide, Gurgura), Sesame (Local variety: Gura), Pigeon pea and Sorghum, Cucumber (Local variety: Nanyolili)	Sorghum (Local variety: Osingo), Cow peas, Sesame (Anyim), Figure millet, Cassava (Agwana Onolek)
Crop grown by few farmers in small area	Tomatoes (Local variety: Cherry type), Eggplant (Improved variety: Black beauty), Carrots, Cabbage, Pumpkin, Common beans, Cowpea, Lemon, Jute mellow, Irish potatoes, Sukumawiki and Sunflower (variety name unknown introduced from Uganda), Cassava (Improved variety: TME 5)	Pumpkins, Lemon, Pawpaw, Sweet potatoes, Eggplant, Red pepper, Maize, Mango, Guava Sukumawiki, Banana, Sunflower, Groundnut(Otukoni)
Lost crops	Nyino (*Hyptis spicigera*), Bambara nut, Long millet, Pearl Millet (Imajang), Groundnut (local variety: Moru)	Nyino (*Hyptis spicigera*), Groundnut (Akabiri/ Abusere), Pearl Millet

3.2 STATE OF CROP DIVERSITY

The crop diversity wheel tool was used to identify the types of crops and varieties that are currently available and that have been lost in Ikwoto Payam and Chahari Payam in Ikwoto County (Table 4). A total of twenty food crops, four strategic fruit crops and more than fifty varieties of different field crops and tubers being cultivated by the farming communities in Ikwoto County. Crops (for example bambara nut, nyino and varieties of Pearl Millet (Imajang, Teh) and Groundnut (Moru, Akabiri), Groundnut (Akabiri/ Abusere), Pearl Millet (teh) have been reported as lost from the Ikwoto County.

Impact of shocks and stressors on availability of crop diversity

The main shocks and stressors impacting crop diversity and availability are conflict, climate, and other factors. The main impacts of these are the disappearance of indigenous crops and some of their varieties (finger millet) and the introduction of new diseases and pests. For instance in 2019, desert locusts destroyed maize,

sorghum, and bulrush millet. Farmers in Ikwoto County felt the government of South Sudan should invest in varietal development, and that international agencies and non-governmental organizations should provide technical backstops and promote purchase of locally produced seeds. Farmers should know their seed needs and avoid consumption of distributed seeds, and national seed companies should embark on early generation seed bulking.

3.3 FARMER'S PREFERRED CROP DIVERSITY

Female-only and male-only focus group discussions were conducted to identify the preferences for specific crop traits, crops, and varieties. Twenty (10 female and 10 male) key informants farmers participated in a two-day workshop in each cluster in Ikwoto County.

Farmers preferred crops and preference criteria

Both female and male farmers prioritized their most preferred crops on the same sets of nine criteria: good yield, drought tolerant, flood tolerant, good eating quality, high market demand, storage ability, high market demand, nutritional benefits and less damage by birds and pests. Female farmers had one additional preference criteria which was not prioritized by their male counter-parts: crop early maturity. Based on these preference criteria, male and female farmers prioritized their most preferred crops. The male farmers most preferred ten crops are sorghum, cassava, sweet potatoes, pearl millet, sesame, beans, okra, cowpea, groundnut, and maize as depicted in figure 3. The female framers most preferred ten crops are sorghum, groundnut, maize, cassava, sesame, sweet potatoes, cowpea, eggplant, pumpkin, and okra as depicted in figure 4.

Farmers preferred varieties and preference criteria

Female and male farmers used a same sets of preference criteria as they used in the selection of preferred crops as elaborated in Figure 3 and 4. The most preferred varieties of their preferred crops are summarised in the Table 6.

Farmer-preferred cereal and oil seed crops

ISorghum: In Ikwoto Payam preference for sorghum varieties in all the clusters was for local varieties; however in the case of maize improved variety (Longe -5) and unknown variety (Yellow corn) was preferred. Aderi and Lopiti are the two most preferred local varieties of sorghum due to its high malting quality, drought tolerant, higher yield, disease and pest resistance and high market demand. Aderi is late maturing variety. Local variety 'Jani' was most preferred in Chahari cluster due to its drought tolerance, high market demand, good eating quality and good yield. Other important sorghum varieties are 'Akele' (a local variety with good eating quality); 'Serena' (an improved variety with high yielding ability); 'Osingo' (an early

Table 5. Key reasons strengths and challenges of promoting crop diversity in Ikwoto County in 2020

Cop diversity status	Key strengths	Key challenges
Crop grown by many farmers in large areas	Home consumption, food security, income generation, varieties are adapted to local conditions	Low yield, inadequate quantity of good quality seeds, pests and diseases, parasitic weeds (striga), heavy rainfall (flood), late delivery of seed by I/NGOs
Crop grown by many farmers in small areas	Because of profit, lack of labour for instance sweet potato is labour intensive during harvest, inadequate seeds of soybean and vines of improved sweet potatoes (planting materials), poor market price (like tomatoes when its season the price goes down)	Inadequate quality seeds, pests and diseases, distribution of grains instead of seeds, flood and drought, dependence on free seeds distributed by I/NGOS, poor yielders
Crop grown by few farmers in large areas	Staple crop in surrounding villages, Food and nutrition security, high market demand and income generation, ability to withstand stresses, tubers crops are early maturing, and they can be stored for a longer period, availability of market for black sesame for oil production	Pests and diseases, tuber of improved varieties are easily damaged compared to local varieties, Varieties of cucumber are susceptible to flood
Crop grown by few farmers in small areas	Contribution to nutrition security, income generation, quick returns and high market demand for vegetables and horticultural produce, short cropping cycle	Varieties are more prone to pest attack and climate stressors, lack of good quality seed, lack of inputs, inadequate seeds, attitude towards adoption of new crops, lack of skills and technical knowledge
Lost crops		Change in eating preference, migration from one site to another due to conflict and climatic hazards

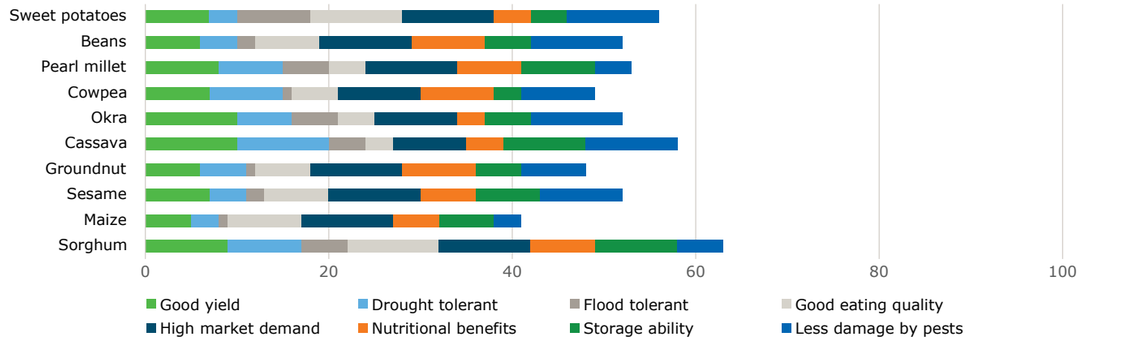

Figure 3. Male farmers preference ranking of different crops in Ikwoto cluster.

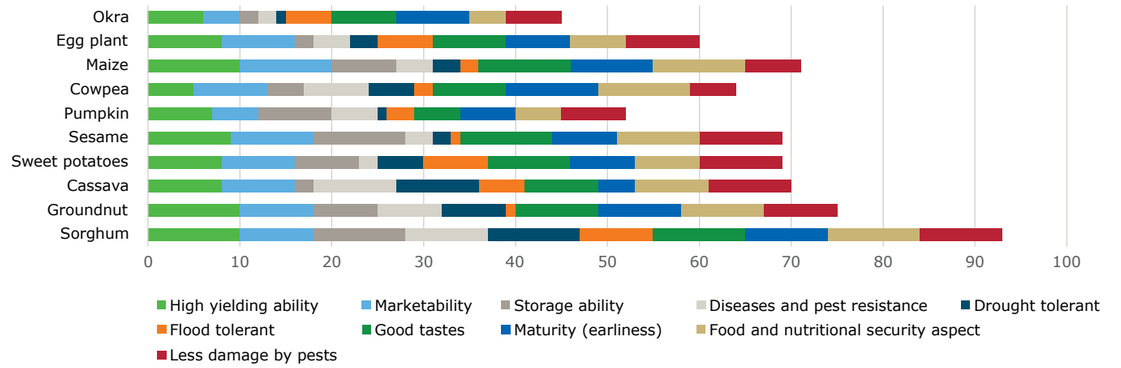

Figure 4. Female farmers preference ranking of different crops in Ikwoto cluster.

Table 6. Female and male farmers preferred crops varieties in Ikwoto cluster and Chahari cluster of Ikwoto County

	Ikwoto cluster		Chahari cluster	
Crops	Female	Male	Female	Male
Sorghum	Aderi (L), Naluyak (L), Sesson 3 (I), Osimgo Dutung (L), Nuba (L)	Aderi (L), Osingo (L)	Lopiti (L), Akele (L), Sesso 3 (I), Agura (L), Okoro (L), Osingo (L)	Lopiti (L), Akele (L), Okoro (L), Osingo (L), Agura (L), Odoko (L)
Maize	Longe-5 (I), Yellow corn (U), Katumari (U), Mukana (U)	Yellow corn (U), Longe-5 (I)		
Pearl millet		Khartrum (U, distributed by NCA), Jani (Adokon, L	Jani (L), Tulla (L), Lowdo (L)	Jani (L), Tulla (L), Lowdo (L)
Groundnut	Red Beauty (I), Gurunguru (L), Lomide (L)	Lomide (L), Guruguru (L), Red Beauty (I)	Firo (L), Ogome (L), Red Beauty (I), Busere (L)	Firo (L), Ogome (L), Red Beauty (I)
Sweet potatoes		Orange flesh sweet potato (I), Kamapla (U), Polataka (L), Nacercri (L), Babule (L)		
Cassava			Oresita (L), Mabaro (L), Kwanyadak (L), Karagwa (L), TME-14 (I)	Oresita (L), Mabaro (L), Kwanyadak (L), Karagwa (L)
Pumpkin	Nabaru (L), Nangajar (L)			
Okra	Tiktik (I), Mutakali (L), Nawaka (L)			Pusa sawani (I), Clemson spineless (I)
Tomato			Money marker (I), Cherry type (L)	

* L = Local variety, I = Improved variety, U= Uknown variety

Table 7. Female and male farmers preferred quality (traits) in different varieties in Ikwoto County

Crops varieties	Female	Male
Sorghum varieties	High yielding, seed quality (size), seed color (brown vs white), storage longevity, resistance to pests infestation, malting quality, drought tolerant, flood tolerant, good eating quality, tillering ability, resistance to striga weed, high damage, less damaged by birds	Eating quality, brewing taste, market demand, storage longevity, high yield, disease resistance, flood tolerant, drought tolerant, less damage by birds, early maturity
Maize varieties	High yield, seed quality (size), early maturity, storage longevity, drought tolerant, resistance to pests infestation, malting quality, drought tolerant, flood tolerant, good eating quality, high market, early maturity	Eating quality, taste of brew, market demand, storage longevity, high yield, flood tolerant, drought tolerant, less damaged by birds, early maturity
Pearl millet varieties	Good yield, high marketability, drought tolerance, good eating ability, flood tolerance, resistance to disease, less damage by birds	Yield ability, grain quality, number of tillers per hill, nutritional aspects, malting quality, drought tolerant, resistance to strigs, resistance to the pests and disease, flood tolerant, pests damage, food security aspect, market demand, maturity
Groundnut varieties	Yield ability, seed quality (desirability), number of seed per pod, oil content, paste quality, storage longevity, drought tolerant, flood tolerant, disease and pests resistance, less damaged by pests, good eating quality, high market demand, early maturity	Good yield, storage longevity, drought tolerant, disease and pest resistance, flood tolerant, less damage by pests, good eating quality, high market demand, early maturity
Sweet potatoes varieties		Yield ability, tuber quality, number of tubers per hill, nutritional aspect, distilling quality (pelled pericarps), storage longevity, drought tolerant, processing quality (chips and Naotarar), Disease and pests resistance, pests damage, food security aspects, market demand , maturity
Cassava varieties	Flour quality, good yield, high marketability, drought tolerance, good eating quality, flood tolerance, storage ability	Good yield, high marketability, drought tolerance. good eating quality, flood tolerance, pest damage
Pumpkin varieties	Yielding ability, high marketability, leaf harvest, drought tolerance, food and nutrition aspect, flood tolerance, Pest damage (rodent), storability	
Okra varieties		Good yield, high marketability, drought tolerance, good eating quality, flood tolerance,
Tomato varieties	Fruiting ability (Yield), high marketability, resistance to diseases and pests, drought tolerance, good eating ability. flood tolerance, perishability	

maturing local variety good for malting); 'Naluyake' (a medium maturing local variety); and 'Sesso 3' (an improved variety not prone to bird damage).

Maize: Longe-5 (an improved and high yielding variety) and Yellow corn (an unknown variety with high market demand and fresh good eating quality) are the two most preferred maize varieties. 'Mukama' (an improved and medium maturing variety) and 'Katumani' (an improved variety with big comb size) are other two preferred maize varieties.

Pear millet: Local variety 'Jani' was most preferred varieties due to its good eating quality, higher yeild, drought tolerance and less damaged by birds. 'Nakite' (a local variety, adaptable to local conditions); and 'Khartoum' (a nicknamed unknown but improved and high yielding variety introduced by the NCA) are two other preferred varieties.

Groundnut: An improved variety of groundnut 'Red Beauty' was preferred by female farmers in Ikwoto cluster due to its higher yield, high oil content, drought tolerance, good eating quality and high market demand. Male farmers preferred the local varieties 'Lomide' due to its good storage quality, drought and flood tolerance, good paste quality and less damaged by pest. In Chahari cluster both male and female farmers preferred the local variety 'Firo' due to its good yield, drought and flood tolerance, good eating quality and high market demand. Local variety 'Guruguru' (white seeded, extra early maturing) is another preferred variety.

Farmer-preferred root and tuber crops

Cassava: Local variety 'Lopiti' was selected by both male and female farmers in Chahari cluster due to its good flour quality, higher yield, good eating quality, high market demand, flood tolerance and longer storability. Local variety 'Karabgwa' is bitter but high flour quality.

Sweet potato: Improved variety 'orange flesh sweet potato' was the male farmer preferred varieties in Ikwoto cluster. This variety was reported with good processing quality (chips and Namotarar), high market demand, distilling quality (peeled pericarps) and higher yield. 'Kampala' (early maturing, food security variety); 'Babule' (a local variety with poor storage ability); 'Nacercri', (a local early maturing variety) are other preferred varieties while 'Polataka' (an unknown variety prone to wilting as it cannot withstand drought) is less preferred.

Farmer-preferred vegetable crops

The most-preferred vegetables were pumpkin, okra and tomatoes in Ikwoto Payam. Local variety of pumpkin 'Nabaru' was most preferred by female farmers due to its higher yield, high market demand, drought tolerance and longer storability. In Okra improved varieties 'Tiktik' was preferred by female farmers due to good sliming quality, less lodging and good eating quality, while male farmers preferred 'Pusa Sawani' an improved variety for its good eating quality and higher marker demand. An improved variety 'Money Maker' was most preferred by tomato variety due to its higher yield, resistance to pest and diseases and higher market demands.

3.3 CLIMATE RESILIENT CROPS AND VARIETIES

Climate hazards impacting livelihoods

Farmers and local communities in Ikwoto County perceived various climate hazards that impact their livelihoods. Drought, excessive rainfall, flood, high temperature, disease and pest to the crops and animals are the major climate hazards; they severely impact the crops and livestock management and cause severe disruption of the local food system (Table 8).

Climate resilient crops and varieties

Ikwoto cluster: Sorghum was ranked as the most climate resilient crops in Ikwoto cluster (Figure 5). Comparatively local varieties are more resilient in sorghum, cowpea, cassava, pearl millet and sesame crops while improved

Table 8. Key drivers (hazards) of climate change impacting the farmers and community livelihoods in Ikwoto County

Payam	Climate hazards	Impact on livelihood	Severity of impact (Highest to Lowest) [+++, ++, +)
Ikwoto	Drought, flood, high temperature, relative humidity (high and low), high crop and livestock pest pressure	Crop production and livestock	+++
	high incidences of crop diseases	Crop production and livestock	++
Chahari	Drought, disease and pest to the crops, animal diseases	Famine	+++
	Less rain	Famine	++
	Flood, more rain	Famine	+

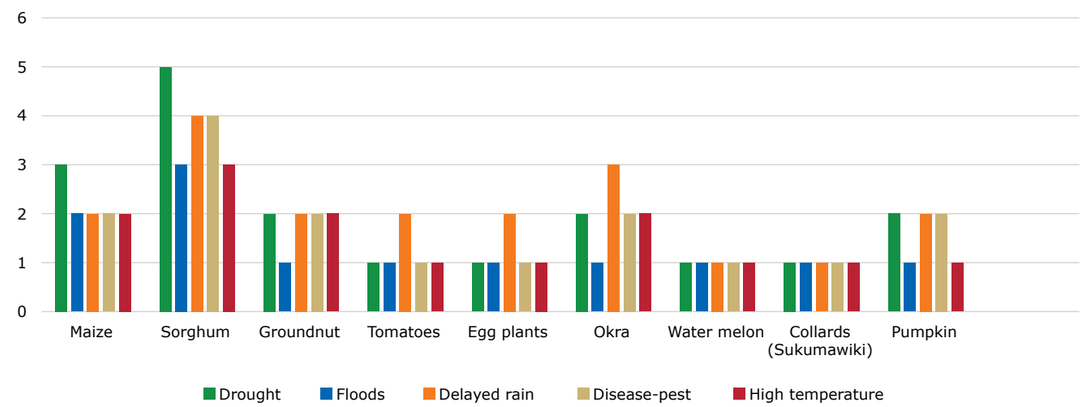

Figure 5. Analysis of climate resilient crops based on farmer perceptions in Ikwoto cluster (higher value = more resilient, lower value = less resilient)

Table 9. Analysis of climate resilient varieties based on farmer perceptions, Ikwoto cluster

Crops	Varieties	Types of varieties	Climate hazards ranking (1= least resilient, 5= high resilient)					Resilient variety (higher total rank = more resilient)
			Drought	Floods	Delayed rain	Disease-pest	High temp.	
Sorghum	Aderi	Local	4	2	4	4	4	18
	Osingo	Local	3	2	3	4	3	15
	Sesso 3	Improved	4	1	2	2	4	13
Cowpea	Notonong-nogwoa	Local	5	3	4	4	3	19
	Nagarawa	Local	4	3	4	3	2	16
Maize	Mukama	Improved	4	3	2	3	3	15
	Yellow Corn (Nagure)	Unknown	3	3	4	2	2	14
	Katumani	Improved	3	2	3	3	3	14
Okra	Spineless	Improved	4	3	4	3	4	17
	Pusasawan	Improved	3	2	3	4	3	15
Cassava	Karabgwa (bitter variety)	Local	5	4	4	3	2	18
	TME 14	Improved	5	3	3	3	3	17
Groundnut	Red Beauty	Improved	3	2	4	5	3	17
	Luomide	Local	4	3	3	2	2	14
Pearl millet	Khartoum	Unknown	5	4	4	4	3	20
	Nakite	Local	4	3	2	3	2	14
Sesame	Gure (Black)	Local	5	4	3	3	3	18
	Sesame 2 (White)	Improved	4	3	4	3	3	17
Beans	Yellow type	Improved	4	4	3	3	3	17
	Roso coco	Improved	3	4	3	2	3	15
Sweet potatoes	Orange flesh	Improved	4	4	3	3	4	18
	Kampala	Unknown	3	3	4	3	3	16

varieties are more resilient in maize, okra, beans and sweet potatoes crops (Table 9). The major seed sources of these climate resilient crops and varieties in Ikwoto cluster are the farmers' own seed savings, seed exchanged with other farmers, grain purchased from the local market, and the seed distribution programmes of FAO, AVSI and BRAC.

Chahari cluster: In Chahari cluster sorghum, cassava, pearl millet were reported as the most climate resilient crops (Figure 6). Local varieties of sorghum and cowpea are more resilient in Chahari cluster while improved varieties of are more resilient in maize, okra, and sesame crops (Table 9). The major seed sources of these climate resilient crops and varieties in Chahari cluster are the farmers' own seed savings, seed exchanged with other farmers, grain purchased from the local market, and the seed distribution programmes of FAO and AVSI.

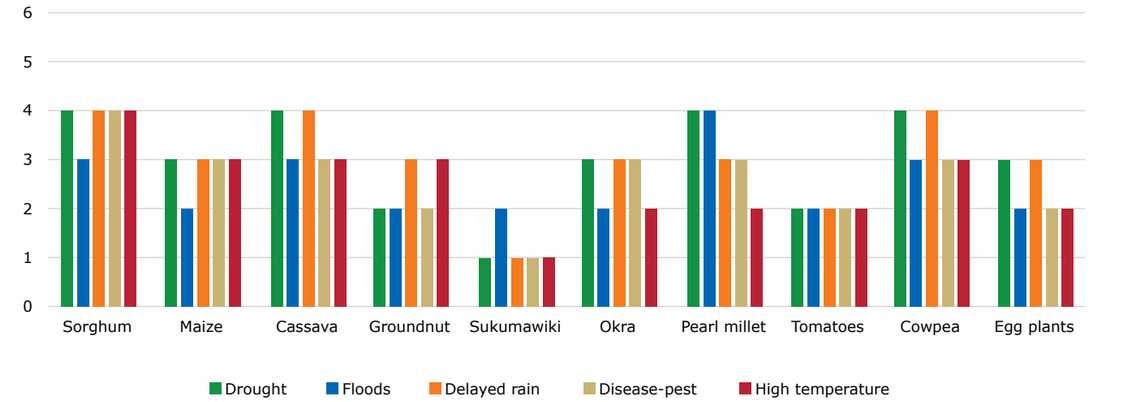

Figure 6. Analysis of climate resilient crops based on farmers perceptions in Chahri cluster (higher value = more resilient, lower value = less resilient)

Table 10. Analysis of climate resilient varieties based on farmer's perceptions Chahari cluster

Crops	Varieties	Types of varieties	Climate hazards ranking (1= least resilient, 5= high resilient)					Resilient variety (higher total rank = more resilient))
			Drought	Floods	Delayed rain	Disease-pest	High temp	
Sorghum	Aderi	Local	5	4	3	3	3	18
	Akele	Local	4	3	3	4	3	17
	Serena	Improved	3	2	3	4	3	15
Cowpea	Namaduro	Local	4	3	4	3	3	17
	Secow 2	Improved	3	2	3	3	2	13
Maize	Longe-5	Improved	3	2	2	3	4	14
	Yellow corn	Local	3	2	3	2	2	12
Okra	Ladies finger	Improved	3	2	3	3	3	14
	Tiktik	Improved	2	1	3	3	2	11
Groundnut	Gurguru	Local	4	2	3	3	4	15
	Red beauty	Improved	3	2	3	3	3	14
Sesame	Sesame 2	Improved	3	3	2	2	2	12
	Black simsim	Local	3	2	1	3	2	11

3.4 SOCIAL SEED NETWORK FOR BUILDING PEACE, TRUST, AND RECIPROCITY

Female farmers play a dominant role in the access and flow of seed in Ikwoto

Out of the 752 farmers involved in the social seed network, 75% were female farmers. The average age of the respondents was between 37-42 years (Table 11).

Ikwoto cluster: Female farmers (18%) tends to give seed to family/friends outside the Payam is higher than for male farmers (11.65%). Similarly, female farmers (18 %) received seed from family/friends outside the Payam is higher than for male farmers (11%). Female farmers use exchange/barter mechanism (22%) which is higher the male (14%). Male farmers (16%) tends to give the seed on 'cash basis' than female (8%).

Chahari cluster: Female farmers tend to exchange more with family/friends within Payam (84%) of their exchanges compared to 64% for males. Female framers (85%) tend to receive seeds more from family/friends within Payam compared to male (53%). Male farmers tend to receive seed more from district extension office (34%) and local grain markets (5%) than female farmers.

Exchange/barter and free seed are the key mechanisms of seed access and supply

Ikwoto cluster: The seed exchange and barter system was found to be the dominant mechanism for accessing seed in Ikwoto cluster. Over 70% of seed accesses and supply through this system, mainly involving seed exchange of the same variety or exchange of seed with different crops (Table 13). Seed on credit/loan, vouchers/coupons and cash purchase are the other notable mechanisms in Ikwoto cluster.

Chahari cluster: Free seed is the dominant mechanism in Chahari cluster which represented by over 77%. Cash purchase of seed is the second dominant mechanisms (Table 13).

Sorghum, maize, groundnut, and sesame are the key crops in seed network

The study revealed that farmers and their communities are involved in seed access and distribution of at least 23 different crops. However, sorghum (41%), Maize (13%), groundnut (7%) and sesame (7%) are the most exchanged crops in the network. They represent 68% of all exchanges (Table 14).

Female farmers, AVSI and Chahari local markets are major source of seed in Ikwoto

*Ikwoto cluste*r: In this cluster, a total seventeen nodal seed farmers have been identified who play a central role in supply of seed to many farmers among them 53% are female and maintain over 71% of seed exchanges in the seed network (Figure 7 and Table 15). The relationship between the nodal farmers and other farmers are based on trust, reciprocity and kinship. Nodal seed farmers provides the stability in the seed network.

Chahari cluster: In this cluster, AVSI programmes, Chahari market and female farmers play a central role in supply of seed to the farmers (Figure 8). In addition to these, Seraga local market and Isoke local market have also

Table 11. Farmers and their members of the communities in seed network in Ikwoto County

	Ikwoto cluster		Chahari cluster	
Categories	**Number**	**Percentage**	**Number**	**Percentage**
Local farmer	128	93.4%	331	89.7%
IDPs	2	1.5%	0	0.0%
Refugees	0	0.0%	2	0.5%
Returnee	1	0.7%	19	5.1%
Market trader	2	1.5%	0	0.0%
Public government extension or similar function	1	0.7%	10	2.7%
Public research institution or similar function	0	0.0%	0	0.0%
I/NGO (AVSI, SSD Red Cross, Plan International)	3	2.2%	7	1.9%
Total	**137**	**100%**	**369**	**100%**
Female		58.3%		81.6%
Male		39.8%		16.9%
Market/Organisation		1.9%		1.4%
Average age of respondents		41.7		37.6

Table 12. Seed access and exchange mechanism in Ikwoto County

		Ikwoto cluster		Chahari cluster	
S.N.	**Seed access and exchange mechanisms**	**Number**	**Percentage**	**Number**	**Percentage**
1	Free	19	5.6%	812	77.9%
2	Exchange/barter with same variety seed	60	17.8%	9	0.9%
3	Exchange/barter with different variety	40	11.8%	4	0.4%
4	Exchange/barter with different crop	60	17.8%	15	1.4%
5	Exchange/barter with labour	36	10.7%	3	0.3%
6	Exchange/barter with other methods	44	13%	2	0.2%
7	Cash purchase	22	6.5%	191	18.3%
8	Vouchers/coupons	21	6.2%	0	0%
9	Seed on credit/loan	24	7.1%	2	0.2%
10	Others	12	3.6%	4	0.4%
	Total	**338**	**100%**	**1042**	**100%**

Table 13. Types of crops exchanged through the social seed network in Ikwoto County

	Ikwoto cluster		Chahari cluster	
Crops	**Number of exchanges**	**Percentage**	**Number of exchanges**	**Percentage**
Sorghum	182	50%	392	37.3%
Maize	50	13.7%	128	12.2%
Millet	40	11%	63	6%
Sesame	26	7.1%	76	7.2%
Groundnut	20	5.5%	112	10.7%
Beans	13	3.6%	7	0.7%
Cassava	10	2.7%	7	0.7%
Okra	10	2.7%	41	3.9%
Egg Plant	6	1.6%	10	1%
Water Melon	2	0.5%	-	-
Cabbage	1	0.3%	1	0.1%
Cowpeas	1	0.3%	16	1.5%
Sweet Potatoes	1	0.3%	15	1.4%
Jute mallow	1	0.3%	-	-
Sukumawiki	1	0.3%	-	-
Onion	-	-	7	0.7%
Peas	-	-	11	1%
Soya	-	-	11	1%
Tomatoes	-	-	7	0.7%
Wheat	-	-	94	9%
Green Dodo	-	-	1	0.1%
Lubia	-	-	37	3.5%
Other vegetable	-	-	14	1.3%
Total	**364**	**100%**	**1050**	**100%**

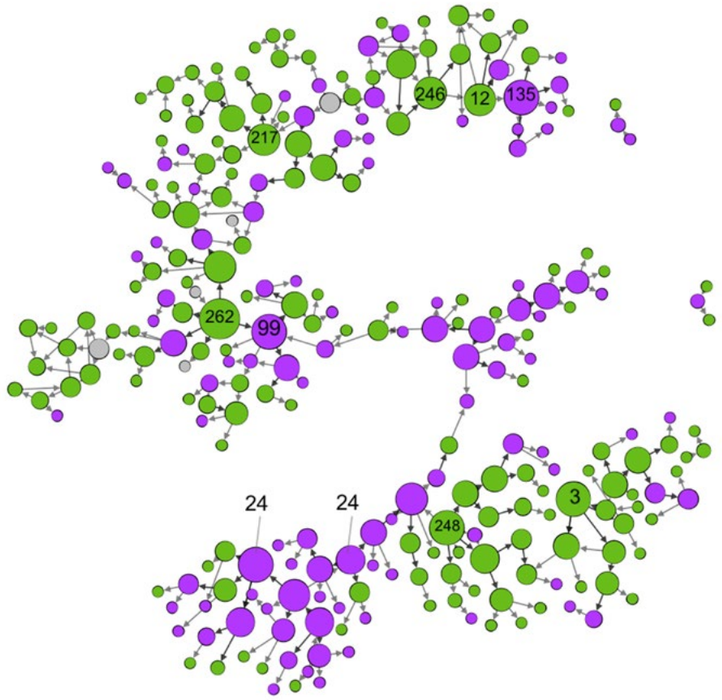

Figure 7. Social seed network map showing the central role of female farmers (nodal seed farmers) in Ikwoto cluster. The larger the size of node indicate the higher connection with many farmers. Green color nodes represent the female farmers and purple color nodes represent the male farmers.

Table 14. Nodal seed farmers in Ikwoto Payam cluster

Id	Name	Gender	Category	Age
262	Victoria Achida	Female	Local farmer	62
3	Achan Vicky	Female	Local farmer	28
24	Arkanjelo Lohatar	Male	Local farmer	40
99	John Moina Loyee	Male	Local farmer	45
135	Lodio Michael	Male	Local farmer	42
248	Teresa Iliha	Female	Local farmer	30
7	Akech Peter	Male	Local farmer	49
12	Albina Lopwanya	Female	Local farmer	56
23	Angelina Foni	Female	Local farmer	65
217	Regina Imana	Female	Local farmer	35
243	Taban James Lino	Male	Local farmer	40
246	Teresa Banda	Female	Local farmer	38
103	Jolly Mami	Female	Local farmer	50
158	Marcelo Lomina	Male	Local farmer	35
165	Mary Foni	Female	Local farmer	44
201	Paleng Amos	Male	Local farmer	48
259	Timon Teli	Male	Local farmer	41

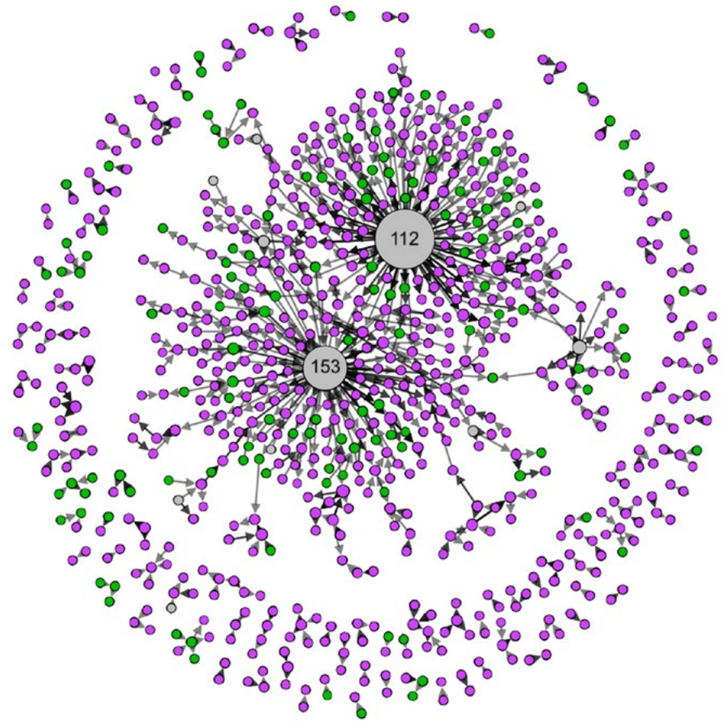

Figure 8. Social seed network map showing the central role of AVSI programme (ID 112) and Chahari local market (ID 153) in supply of seed to the farmers. The larger the size of node indicate the higher connection with many farmers. Green color nodes represent the female farmers, purple color nodes represent the male farmers, grey color nodes represent the market or organization.

Table 15. Local market and nodal seed farmers in Chahari Payam cluster

Id	Name	Gender	Category	Age
112	AVSI pogramme	-	NGO	-
153	Chahari Market	-	Market	-
201	Elizabeth Lometi	Female	Returnee	27
725	Seraga Market	-	Market	-
145	Cecilia Ihiju	Female	Local farmer	40
392	Katang Lodira	Female	Local farmer	58
329	Isoke Market	-	Market	-
399	Kelementina Tarara	Female	Local farmer	40
150	Cecilia Omongole	Female	Local farmer	50
173	Clementina Idwa	Female	Local farmer	50
192	Elia Lokeny Simon	Male	Local farmer	65
460	Lujina Aruko	Female	Local farmer	45
462	Lukeresia Ibalu	Female	Local farmer	23
669	Rejina Ihoto	Female	Local farmer	24
680	Rita Ometi	Female	Local farmer	20
693	Rose Ihisa	Female	Local farmer	20

important role in seed supply. A total of 12 nodal seed farmers have been identified in Chahari cluster among which 92% are female (Table 16). These local markets and nodal seed farmers have the highest number of direct connection with many other farmers in the community and maintain over 70% of seed access and exchanges in the seed network.

3.5 SEED SYSTEMS AND CHALLENGES

Major seed systems

Farmers and their communities access the seed through five different seed systems in Ikwoto County which are clustered into informal seed systems (represented by household seed saving, seed network and local market) and intermediary seed systems (represented by community-based seed production schemes and seed relief). The key features of Ikwoto County seed sector is the absence of formal seed system such as public/government seed programmes and private seed companies. A detailed characterisation of each of these seed systems is presented in Table 17, analysing the key stakeholders involved, types of crops and varieties covered, types of seed quality, and seed dissemination mechanisms. These different seed systems co-exist in parallel and supply the seed of different crops and varieties to the farmers and their communities, including IDPs, returnees, refugees, and refugee hosts.

Informal seed system (household seed saving, seed network and local market): Despite the co-existence of different seed systems, the informal seed system is the dominant source of seed of major food security crops in Ikwoto County. It is estimated about 74% of the seed supply to the farmers in Ikwoto is by this seed system alone. Key stakeholders involved are farmers and their communities that include IDPs, returnees, refugees, host of refugees, and grain traders operating in the local market. Sorghum, pearl millet, cowpea, maize, groundnuts, sesame and sweet potato are major crops. Varieties are mostly local (landraces) as well as improved ones. Marketplaces such as Chahari, Seraga and Isoke are the most important sources of seed to the farmers. Female farmers play a dominant role in seed production and seed exchange within the informal seed system.

Intermediary seed system (community-based seed production and seed relief): Community seed production scheme is the second dominant seed system in Ikwoto. It contributes to 16% of the total seed supply. This seed system contributes to seed supply of sorghum, maize, sesame, groundnuts, beans, yams, sweet potato, onion, cowpea and green-gram. Key stakeholders operating within the community based seed production scheme are farmers groups and farmers cooperatives. The seed relief seed system supply the 10% of seed. The seed relief programmes supply the major food security cereal crops as well as the vegetable crops. Key stakeholders involved in seed relief programmes are AVSI, Caritas Luxemburg, Catholic Relief Services (CRS), Lutheran World Federation (LWF), NCA/ NPA, CDOT, South Sudan Red Cross, FAO, Care International, and Germany Agro Action.

Seed system development challenges

The seed systems development in Ikwoto County are both affected by continuous conflicts and insecurities in the past 30 years. In addition, seed system development are

Table 16. Seed system characterization in Ikwoto County

	Informal seed system	Intermediary seed system	
Types/ organisations	Farm-saved seed, seed network and local grain market	Community-based seed production	Seed relief
Key stakeholders	Female and male farmers, traders in local markets, farmers groups, refugees, returnees, IDPs, host of refugees	Farmers groups, cooperatives	AVSI, Caritas Luxemburg, Catholic Relief Services (CRS), Lutheran World Federation (LWF), NCA/ NPA, CDOT, South Sudan Red Cross, FAO, Care International, Germany Agro Action
Major crops	Sorghum, Pearl millet, Cowpea, Maize, Groundnuts, Sesame, Sweet potato	Sorghum, Maize Sesame, Groundnuts Beans, Yams, Sweet potato, Onion, Cowpea, Green-gram	Sorghum, Maize, Sesame Cowpea (SECOW 2), Sesame, Pigeon peas, Pearl millet, Groundnuts, Vegetables (Okra, Kale, Onion, Eggplant, Carrot, Green Pepper, Tomato, Sweet pepper, Sukumawiki), Water melon
Types of varieties	Local (landraces), improved	Local and Improved	Improved, hybrid
Seed quality	Local seed, trusted seed	Partial inspection	Certified, truthfully labelled
Seed dissemination	Informal seed exchange, cash exchange, bartering with labour	Exchange, batter, cash	Free distribution or vouchers, seed fair, cash receipts
Estimated seed supply	74%	16%	10%

suffered from increased impact of climatic hazards such as drought, flood, high temperature, erratic rainfall and introduction of new pests and diseases as result of supply of undocumented varieties and low quality seeds. The reported effects were leaching of soil nutrients, high pest and disease pressure, obstruction of seed supply, compromised seed quality and poor field establishment. IDP/refugee/returnee have introduced new cropping system and equally introduced new seeds in the system. The interaction between conflict and instability and climatic hazards resulted into loss of varieties of indigenous crops, reduction in yield, migration of farmers to refugee camps in Uganda, internal displacement as a result of famine and death associated with low yield and unbearable climatic condition.

Key common challenges in the seed system development in Ikwoto are lack of recognition and promotion of local crops and varieties, empowerment of women farmers, poor storage facilities, poor efforts in market development, lack of seed certification body, poor road connection, late supplies of seeds, poor quality seed distribution, and absence of formal seed system. At other hand, availability of fertile land and cheap labor, availability of local crop diversity and local markets, and active presence of several humanitarian and development agencies are the unique opportunities to develop the seed systems in Ikwoto County.

Table 17. Seed value chain analysis of intermediary seed system

Seed value chain steps	Challenges (risks)
Crop breeding, adaptive trials	Absence of government institutions, universities and seed programmes in testing improved varieties and conducting adaptive field trials, NGOs programmes mainly distribute the imported seeds without conducting adaptive trails, poor performance of imported varieties due to climate shocks and stressors.
Early generation seed	Source of foundation seed in seed relief programmes are mainly from Uganda, East Africa, NARO, MASECO/SSD, FICA, EQUATOR SEED. Exposure of the imported seeds to number of seed deterioration factors (high temperature, humidity and presence of inert), source of EGS on community based seed production groups are mainly the bulk seed received from NGOs programmes and multiplied by progressive farmers or in block farmers. The quality is not superior; however, post-harvesting and storability becomes an issue due to the volume produced and processed.
Seed quality assurance	Field inspections and certifications are not regularly followed
Seed processing and storage	Seed processing under CBSP is expensive and cumbersome specially maintaining the vines of the crops like sweet potato, while seed relief agencies faces ill-timed delivery of seeds to partners and beneficiaries.
Seed distribution and marketing	Infrastructure and access to market are the main challenges, low level of adoption acceptance of the improved cowpea by farming communities, huge risk associated with delayed seed delivery
Seed extension	Acute shortage of seed extension workers, lack of motivation and incentives to the few available extension workers, inadequate field demonstration trials in farmers field, absence of new varieties for the promotion, poor linkage between plant breeders and extension programmes
Seed enabling environment	Lack of national seed policy; absence of Seed Authority and Seed Council; lack of QDS guidelines; lack of seed certification protocol; lack of harmony between seed unit in the MAFS and SSNBS, thus making seed trade more or less impossible

Table 18. Seed value chain analysis of informal seed system

Seed value chain steps	Challenges (risks)
Crop diversity maintenance	Droughts, flood, disease-pest (high infestation of Striga hermontica), low yield, loss of local varieties (Bambara nut, pearl millet, groundnut), lack of recognition of women farmers role in crop diversity maintenance, limited choice of improved varieties, lack of recognition and promotion of local varieties in seed production
Starter good quality seed	Lack of quality seed availability of several farmers preferred and climate resilient crops, late delivery of quality seeds
Crop-seed production and storage	Lack of field demonstration trials on good agriculture practice and quality seed production, lack of machineries for post-harvest processing, lack of knowledge to operate and maintain machines, some processing chemicals are absent, poor storage systems, lack of storage systems, lack of knowledge on safety measures on operation of the machineries and use of chemicals and acute shortage of extension workers.
Seed quality management	Lack of training on good quality seed selection, seed production and seed storage practices. Women farmers take the responsibility of seed selection and conservation, seed selection was based on traditional knowledge by selecting good-looking panicles before and after harvest, the selected panicles are stored in the kitchen (hung on the roof above the cooking stove to repel pests and maintain moisture).
Seed dissemination	Poor roads, insecurity, poor storage facilities, unorganized marketing systems
Enabling environment	Lack of business-friendly working environment, insecure mode financial system and physical insecurity, lack of recognition of local crop diversity

3.6 SEED VALUE CHAIN AND CHALLENGES

The seed value chains and key challenges were analysed in intermediary and informal seed systems of Ikwoto County. The intermediary seed system seed value chain and its main challenges are explained in Table 18. This seed system is represented by community based seed production scheme and seed relief programmes. The analysis based on two indicators crops for community based seed production (groundnut, and sweet potato) and two indicator crops for seed relief programmes (maize and cowpea). Major seed operators and service providers in community seed production scheme are block farmers, BRAC, AVSI and South Sudan Red Cross. The major seed operators and service providers in seed relief programmes are AVSI, Caritas Luxemburg, Catholic Relief Services (CRS), Lutheran World Federation (LWF), NCA/ NPA, CDOT, South Sudan Red Cross, FAO, Care International and Germany Agro Action.

The informal seed system is represented by farmers saved seed, social seed network and local market. Major seed operators and service providers are female and male farmers, farmers groups, refugees, returnees, IDPs, host of refugees, grain traders in local market, FAO and I/NGOs. The informal seed system seed value chain and its main challenges are explained in Table 19.

4. SEED SYSTEMS RESILIENCE PATHWAYS

4.1 Country level

- The government can play their role by creating an enabling environment for the INGOs/NGOs and monitor the interventions carried out. Government should also monitor the agro-dealers so that they import affordable agricultural inputs and good quality seeds; available and accessible to the farmers.
- The establishment of National Genetic Resource Unit/s, field research stations and provision of financial support can pave the way for the development of improved parental lines. The conservation of existing local crop varieties and setting up research unit for crop improvement to maintain the crop diversity. The improvement of adoption mechanism of new knowledge and technologies by strengthening the extension system.
- The development of policies that encourages local market and provision of financial support to seed companies. There is a huge opportunity for private companies because of huge demand in the neighbouring Counties.

4.2 Eastern Equatoria State level

- Eastern Equatoria State should develop an appropriate seed policy and seed regulatory framework to guide State level action. Such a policy and regulatory framework should not just be copied from stable economies with fully functional government and public systems, but rather account for the current protracted crisis situation in most of the state.
- There is absence of government or public seed programmes and private seed sector interventions in Ikwoto county. State government could play role in accessing and bulking the foundation seeds and its supply to the seed interventions programmes in Ikwoto County.

4.3 County level

Intermediary seed systems

- Capacity of community based seed producers groups should be strengthened in quality seed production, internal seed quality control, organisational development and strategic linkages with output market and seed service providers.
- Humanitarian agencies' seed programming should broaden their crop/variety portfolio. This can be done by promoting farmer-preferred and climate-resilient local crops & varieties, in particular crops such as sorghum (Aderi, Lopiti, Akele, Naluyak, Osingo), pearl millet (Jani), groundnut (Firo, Ogome, Gurunguru), and casava (Oresita, Mabaro).
- The seed extension can be strengthened by recruiting and training the extension workers to ensure efficient technology transfer.
- The seed distribution of free seed should be constituted based on set criteria and delivered timely.
- Humanitarian organizations should help government fast-track seed policy, initiate the establishment of a decentralised Seed Quality Board (SQB) at county level, and strengthen the capacity of technical staff. The SQB can only be functional at county level if it is decentralised in its operations, so that they take their own decisions following established rules/policies.
- Humanitarian agencies should, in consultation with the government, strengthen the local seed producers to become seed companies.
- The capacity of local seed producers (technical expertise and seed testing laboratories) should be strengthened to produce Quality Declared Seed (QDS) as governed by the seed law and regulation.
- The I/NGOs should deliver seeds and other inputs before March (at least a month before commencement of the first rainy season in April) or before the end of June (before the onset of the second rainy season starting in July).

Informal seed systems

- Female farmers play a dominant role in local seed supply in Ikwoto County (over 75%); women farmers need to be further empowered through targeted training on quality seed production, by promoting improved seed storage practices and involvement in seed related programming at county level.
- There are 29 nodal seed farmers which majority are female farmers (69%) who play a central role in access and supply of seed of several crops and varieties and it's supply to several other farmers in Ikwoto County. These nodal seed farmers could be further empowered through training on good quality seed production so that they can become a reliable (sustainable) local source of seed production and dissemination within the county level. These nodal seed farmers could rapidly deploy the new varieties due to their existing strong social trust and relationship with hundreds of farmers.
- Farmers under the informal seed system should have access to credit facilities using the land as collateral, and in the absence of such services I/NGOs should buy seeds locally to empower farmers to become financially independent.
- Producers under these seed systems opted for proper storage that had good carrying capacity; met the standards of seed stores; and that had suitable processing/value addition facilities (at present women do all the post-harvest operations; in most cases, this processing results in a loss of quality, reducing monetary gains).

- The Chahari market, Seraga market and Isoke markets contributes significantly to the local seed supply; farmers and communities frequently access the seed of major local food security crops from these local grain markets. The capacity of local traders in these market-places could be further strengthened by sharing quality seed-related information through training, and by linking with local seed producers to purchase good quality seed.

4.4 Cluster level

Ikwoto cluster: representing Ikwoto (Ikwoto Town and surroundings) which included the Bira Payam, Lobone Payam of Magwi County and neighbouring towns of northern Uganda

- There is need to create crop diversification in Ikwoto Payam through introduction of improved and well adapted varieties, promotion of superior-farmer preferred and climate resilient local varieties, early distribution of quality seeds on time by the organizations and introduction of organic pesticides and fertilizers.
- Introduction of exotic improved seeds of crops such as quinoa and embark on early generation seed bulking of the promising local varieties will be of help.
- Adopting the concept of Community Seed Bank will be necessary for recovery purposes and conservation of the local genetic resources.

Chahari Cluster: representing Chahari, Chahari and Bur Payam in Ikwoto County

- The development of irrigation system and water catchment for the crop production.
- The accessibility to the market needs to be improved so that the farmers can easily sell their produce and generate some income.
- The establishment of the community seed bank availing market opportunities to seed producers, improved extension services, availability, and accessibility of affordable quality seeds to strengthen community-based seed system.
- Encouraging the communities to promote peace across the different groups by organizing community dialogue, maintaining transparency, and acceptance and recognizing the traditional system.

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Keywords: Ikwoto County, South Sudan, Seed Systems Resilience Assessment, protracted crisis, food systems, food and nutrition security

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