



Research Brief

Seed System Resilience Assessment in Magwi 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.

The overall purpose of this assessment is to develop integrated context-specific seed sector pathways in selected areas of South Sudan, with the aim to:

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

The seed system resilience assessment was conducted in Magwi, Ikwoto and Torit 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-ecology¹, 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 Magwi County. Magwi county assessment captures the reality of local seed systems due to its position as a production centre, and its proximity to the border and consumption towns of Juba and Torit. The assessment was done in two locations Magwi Centre Payam and Obbo Payam. 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.

2. METHODOLOGY

2.1 ASSESSMENT SITES

The assessment sites in Magwi County included the cluster of Magwi Centre and Obbo Payams (Figure 1 & 2). Magwi County is located in Eastern Equatoria State. It borders Torit County to the north-east, Ikwoto County to the east, and Central Equatoria State (Juba and Kajo-Keji Counties)

to the west. It also has a long border with Uganda to the south. The county is a part of the highland forest and sorghum livelihoods zone. It is located within South Sudan's greenbelt region, making it a key area of food production for the country's food supply. The livelihood context of this cluster is agrarian, coupled with some



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 Magwi County is in the greenbelt zone, with flat lands having long two rainy seasons, Ikwoto County is made up of hilly areas and Torit County lies in the hills and mountains and partly within the greenbelt area.

households rearing pigs. The estimated population of the Magwi County cluster is 31,296 with 11,386 households. Due to the Magwi's border with Uganda and proximity to the major trade routes in South Sudan has historically allowed farmers to sell their crops in major markets such as Juba and Torit. As most of the county's formal food imports come from or through Uganda, the Kampala-Nimule-Juba trading route is extremely important. Magwi County is the largest populated Payam, with a proper road network, and Obbo Payam has a high production potential in Magwi County. The cluster totals around 70% of the county's population.

2.2 ASSESSMENT TEAM

A multidisciplinary team representing the knowledge institutes, private seed sector and UN Agency jointly conducted the assessment in Magwi 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 Tool² 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 separately conducted in Magwi Centre Payam and Obbo Payam with 20 key informants attended in each Payam: 10 were female and the other 10 were male; 20 were youth of both genders (18-32 years), so a total of 40 key informants.

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

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	320	75% female and 23% male*
4	Seed systems analysis	15	33% female and 67% male
5.	Seed value chain analysis	15	33% female and 67% 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>



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 320 respondents.

The fourth and fifth tool (tool 4: seed system analysis, and tool 5: seed value chain analysis) were applied at Magwi county level through multi-stakeholder workshop involving participants from key institutions of Magwi seed sector (Table 3). The workshop was organized on the 21st of October 2020 in Magwi Centre 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 Magwi County.

Table 3. Stakeholder participants in the Magwi county workshop

Public sector	Private sector	I/NGOs
Magwi County office	MASCO	IHO
County Department of Agriculture	Grain traders Association	Global Aim
Payam Agriculture Department		Farm Stew
		Base net

3. RESULTS

3.1 KEY DRIVERS OF FOOD CRISES

Conflict and insecurity

This cluster has undergone a series of conflicts in the past 30 years. The documented conflicts of the 1990's to the 2000's were the Lord's Resistance Army (LRA) insurgencies and war with the Ugandan Peoples Defence Forces (UPDF), Sudan People's Liberation Army (SPLA) and SPLA In Opposition, The Madi and Acholi land conflict, and conflict between pig herders and cassava producers; these conflicts have resulted in displacement and food storage.

The displacement of Dinka IDPs that had relocated to the area mainly from Jonglei State as a result of the spread of armed conflict of 2013 and 2016 fueled Madi frustrations in Magwi County, and the increasing presence of different opposition factions in the Eastern Equatoria State since 2016 contributed to growing insecurity in the county. Clashes between government forces and different armed factions were observed between 2016 and 2018, which led to the mass exodus of population back into Uganda.

Economic shocks and Covid-19

Insurgencies by LRA, the war fought with UPDF and communal fighting between the Acholi and Madi tribes have seriously interrupted crop production and market linkages. Suppliers were unable to access production sites during harvest and because of limited proper storage most of the produce was spoiled. Restriction due to Covid-19 negatively obstructed crop production, since most of the people engaged in the production areas are citizens of Uganda. As a result, the production and supply chain has become inconsistent.

Weather extremes and climate change

This cluster has been impacted by climate hazards such as drought, flood, pest infestation (fall armyworm, desert locust) and disease outbreak. These conflicts, coupled with weather extremes, have negatively affected crop production. This in turn has resulted in famine, displacement, and loss of seeds.

Causes of undernutrition: poor diets, diseases, and care practices³

These conflicts, coupled with weather extremes, have induced malnutrition since almost all livelihood activities have ceased, and acute dietary issues because of the interaction between insecurity (in particular LRA insurgen-

cies and land disputes between Acholi and Madi communities) and climate stressors. The inhabitants of Magwi centre and Obbo Payams were forced to leave their villages and took refuge in camps in northern Uganda because of inadequate food storage, outbreaks of disease and loss of lives.

Response of humanitarian assistance

Magwi County cluster, because of its production status, has attracted several interventions by I/NGOs such as FAO, CARITAS, GLOBAL AIM, CRS, NCA, Farm Project, UNHCR, WFP, and AAH, who have distributed food and health relief.

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 Magwi County cluster (Table 4). Over eighteen crops; coffee and sugar cane as strategic crops, fruits such as lemon, pawpaw and guava, and more than forty varieties of different field crops and tubers being cultivated by the farming communities. Crops for example Nyino, Groundnut (Makuru red), Cassava (Local varieties: Orogira and Kongogolada), Sesame (Local variety: Oturatata), Bull rush, Soybean, Sugarcane, Sunflower, Cowpea and Coffee have been reported as lost from the Magwi County.

Table 5 maps out the key reasons for growing these crop varieties on different scales; the challenges faced; the effects of crises and humanitarian interventions on availability and use of crop diversity; the crops, varieties and seed systems that are important to the group in dealing with future/expected shocks and stressors; and recommendations for an intervention plan.

Impact of shocks and stressors on availability of crop diversity

The main shocks and stressors impacting crop diversity and availability are conflict, insecurity, drought, erratic rainfall, introduction of new diseases and pests. For instance conflict between Lord Resistant Army (LRA) and Uganda Peoples Defence Force (UPDF) and LRA insurgencies from 1990's to 2008; internal conflict between Acholi and Madi 2013 to 2017. Drought, disease outbreak and pest infestation grasshopper (variegated type), fall

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 Magwi County

Crop diversity status	Magwi County
Crop grown by many farmers in large area	Sorghum (Improved variety: Macia, Local varieties: Oderi, Kabi), Maize (Local variety White maize; Improved varieties: Mukama 2, Longe-5), Sesame (Latino white seeds), Cassava (Improved variety: TME 14), Common Beans (Improved varieties: Roso Cocco , K132 and Yellow bean)
Crop grown by many farmers in small area	Groundnut, Okra, Cassava, Cowpea, Tomatoes, Eggplant, Sorghum (Local variety: Gaya, Improved variety: Sesso 3)
Crop grown by few farmers in large area	Sweet potatoes, Common Beans (Improved variety: Nabe bean), Maize, Cassava, Sesame (Improved variety: Sesame 2, Local variety: Ladongo)
Crop grown by few farmers in small area	Sunflower, Pumpkins, Lemon, Pawpaw, Eggplant, Maize (hybrid, Longe-10H), Mango, Guava, Banana, Onion (Bambay red, Red ceole and Bulking) Other vegetables, Sukumawik
Lost crops	Nyino, Groundnut (Makuru red), Yellow maize, Cassava (Local varieties: Orogira and Konggolada), Sesame (Local variety: Oturatata), Bull rush, Soybean, Sugarcane, Sunflower, Cowpea and Coffee

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

Cop diversity status	Key strengths	Key challenges
Crop grown by many farmers in large areas	Local food security crops, income, higher market demand, higher yield, sorghum is grown for food and source of income exchange with livestock, drought tolerant, less damaged by birds, short maturity period	Labour cost is very high during planting and weeding, high cost of transport due to poor road condition, pests and diseases (fall army worm, termites, bird's money and rats), flood and post-harvest losses (during handling and processing), inadequate storage facilities, lacks threshers
Crop grown by many farmers in small areas	High value crop, high market demand, high nutritional quality, easy crop management, adaptability to local condition, high oil content, ability to withstand pests and disease, market demand in Uganda	Insufficient volume of seeds, lack of capital, unfavourable land tenure system, poor road network, low market demand due to surplus supply and lack of market information, excessive rainfall reduces yield, termites and pollen beetles
Crop grown by few farmers in large areas	Food security and income, farmers ability to hire labour for production; farmers growing these crops have access to ox-plough, tractor, land availability with good soil and weather, crop production is carries out in group, high market demand, farmers have technical knowledge and skills to grow and manage these crops, access to good roads and transport facilities, access to storage facilities	Bad roads for transportation to market, casual laborer's are expensive, pests and diseases, weed infestation (black jack and striga weed)
Crop grown by few farmers in small areas	Short cropping cycle, crops are planted in two season, readily available market within the community and outside, high cash return, easy crop management (for example weeding), higher market demand, food and nutrition security	Pest/disease, lack of pesticides, poor transport, lack of irrigation equipment, conflict, thieves, lack of knowledge on production, high production cost for some crops such as hybrid maize and only few farmers can afford
Lost crops		Crops lost mainly due to the war and conflict, introduction of Rice replaced other crops, the grains of Yellow corn are difficult to grinds, crops have poor market, Bull rush millet are liked by birds and the damage is very high, lack of labour for chasing bird's due to children being in school, poor palatability and eating quality

armyworm and desert locust of 2020. This occurrence resulted into displacements and migration of farmers. This exodus results into introduction of new diseases, pest and disappearance of some locally adaptable crop varieties. Farmers in Magwi County expressed their interest in having improved varieties of pigeon pea, maize, groundnut, sweet potatoes, cassava and common beans. However, access to market and conservation of the locally available genetic resources are two main factors for all stakeholders of seed system in Magwi County to consider.

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 informant farmers participated in a two-day workshop in each Magwi Centre and Obbo Payams.

Farmers preferred crops and preference criteria

Both female and male farmers prioritized their most preferred crops on the same sets of six criteria: good yield, drought tolerant, flood tolerant, good eating quality,

high market demand and less damaged by birds. Male farmers had two additional preference criteria which was not prioritized by their female counterparts: short maturity periods of crops and disease tolerance. Based on these preference criteria, male and female farmers prioritized their most preferred crops. Male farmer's ten most preferred crops are maize, cassava, sweet potatoes, pigeon pea, common beans, sesame, groundnut, collards, onion and sorghum (Figure 3). Female farmer's ten most preferred crops are pigeon pea, groundnut, maize, sweet potato, common beans, cassava, sesame, sorghum, collards, and onion (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

Male farmers from Magwi Centre-Obbo cluster ranked Long-5 an improved variety as most preferred ones while female farmers preferred the Yellow corn which is sweet

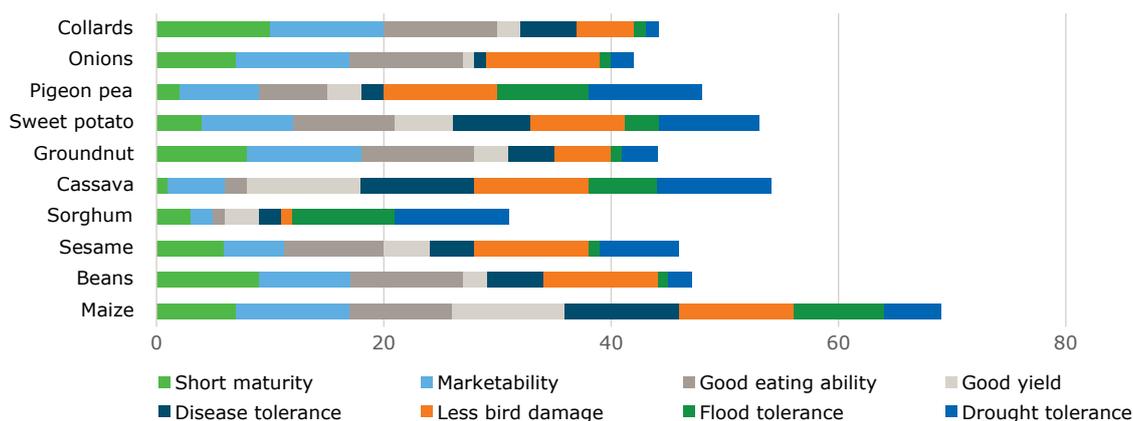


Figure 3. Male farmers preference ranking of different crops in Magwi County

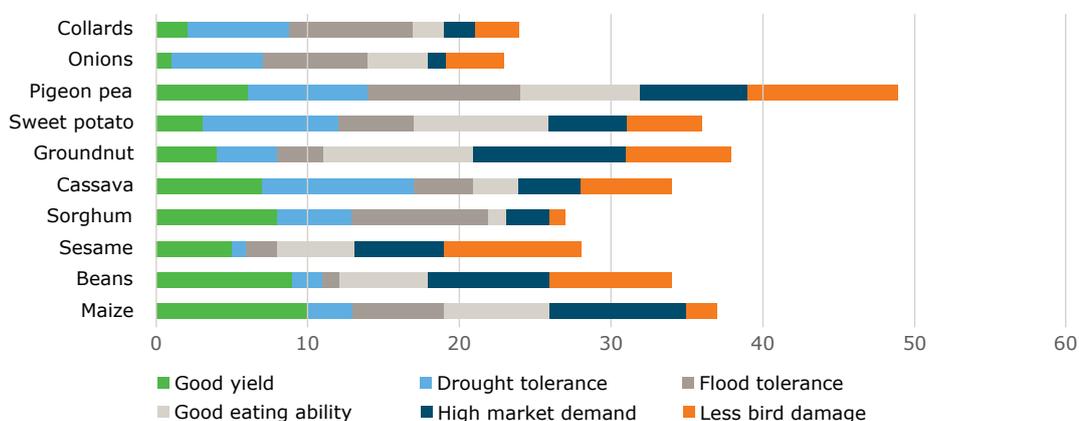


Figure 4. Female farmers preference ranking of different crops in Magwi County

Table 6. Female and male farmers preferred varieties in Magwi County (varieties appearing in first are most preferred ones)

Crops	Female	Male
Maize	Yellow corn (U), Longe-5 (I)	Longe-5 (I), Mukawa (L)
Bean	Roso Coco (I), Yellow Bean (I), Agwede (U)	Agwede (U), Nabe-4 (I), Roso Coco (I), Yellow Bean (I)
Groundnut	Angatonga (L), Lamayido (L), Red Beauty (I)	Red Beauty (I), Angatonga (L), Najamba Kirikicha (L)
Pigeon pea	Improved variety- early maturing (name not known), Local variety perennial (name known)	Improved variety- early maturing (name not known), Local variety perennial (name known)
Cassava		TME-14, (I), Oresita (I), Nyalobeke (L)
Sweet Potato	La Can Mti Kipi (L), Orange flesh (I), Lokoliris (L)	

Note: L = Local variety, I = Improved variety, U = Unknown type of variety

Table 7. Key drivers (hazards) of climate change impacting the farmers and community livelihoods in Magwi County

Payams	Climate hazards	Impact on livelihood	Severity of impact (Highest to Lowest) [+++ , ++, +]
Magwi Centre	Drought, flood, high relative humidity, high crop pest infestation, introduction of new pests and diseases	Crop production	+++
	High crop disease and viral incidences such as Cowpea Mosaic Virus and Cassava Brown Streak	Crop production	++
Obbo	Heavy rainfall, floods, disease and pest severity	Crop production	+++
	Dry spell, delayed rain, introduction of new crop disease and pests	Crop production	++
	Early or delayed onset of rainfall	Crop production	+

and early maturing. In common bean, farmers preferred unknown varieties Agwede followed by improved varieties, early maturing and disease resistant Nabe-4 and Roso Coco. Local varieties of groundnut in order of preference over an improved early maturing and drought tolerant variety Red Beauty are Angatonga and Lamayido the most preferred by farmers. Female farmers choose pigeon pea as their crop of choice and they mentioned lack seeds and absence of an improved varieties of Pigeon pea as major challenges.

Farmer-preferred root and tuber crops

Male farmers in the cluster indicated that an improved variety of cassava TME 14, high yielding and with high level of resistance to disease was their most preferred variety, followed by local varieties Oresita is the second preferred and Nyalobeke. Female farmers preferred an improved variety of sweet potatoes Orange Flesh, rich in precursor of vitamin A and high yielding is their preferred variety. However, local varieties La Can Mati-Kipi and Lokoliris were equally preferred.

Farmer-preferred vegetable crops

Farmers preference for vegetables in this cluster ranges

from vegetables for household consumption and commercial purpose such tomatoes (Money Marker) an improved variety, collards (1000 heads), carrot (unknown variety), eggplant (Black Beauty) an improved variety and okra (Pusa Swana) an improved variety. The farmers of this cluster belief there is huge market for vegetables in Juba and vegetables have undisputable nutritional benefits.

3.3 CLIMATE RESILIENT CROPS AND VARIETIES

Climate hazards impacting livelihoods

Farmers and local communities in Magwi County perceived various climate hazards that impact their livelihoods. Drought, flood, heavy rainfall, delayed rain, increase disease and pest incidences are the major climate hazards; they severely impact the crops production and cause disruption of the local food system (Table 7).

Climate resilient crops and varieties

Pigeon pea, Cassava and Sorghum were ranked as the most climate resilient crops in Magwi county (Figure 5). Comparatively improved varieties are more resilient in maize, cassava, and common beans crops while local varieties are more resilient in sesame and groundnuts

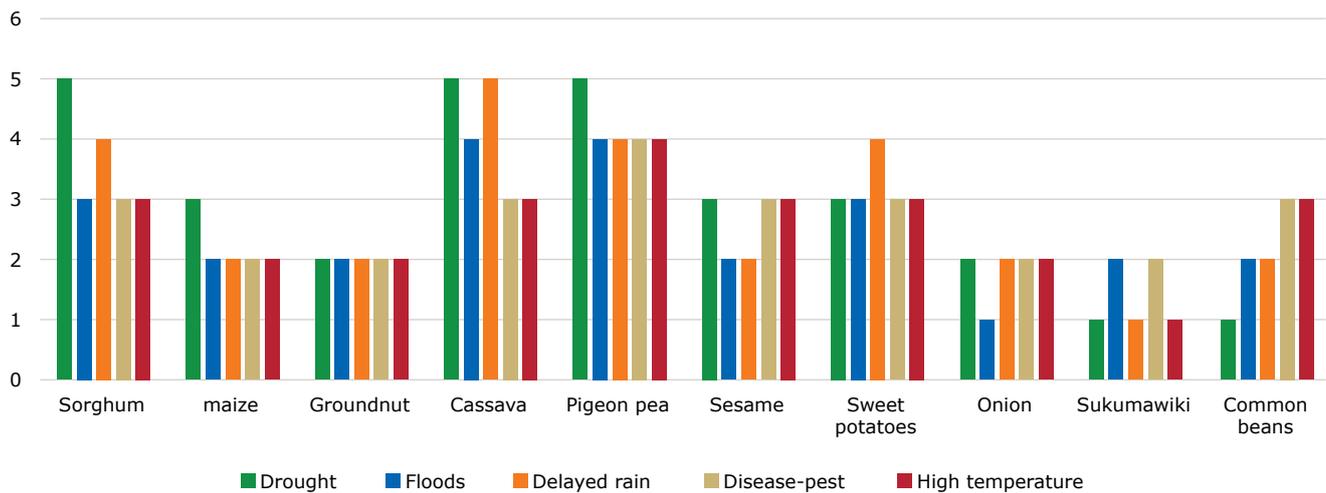


Figure 5. Analysis of climate resilient crops based on farmer perceptions in Magwi County (higher value = more resilient, lower value = less resilient)

Table 8. Analysis of climate resilient varieties based on farmer perceptions, Magwi County

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.	
Maize	Longe-10H	Improved	4	3	3	4	3	17
	Mukama	Local	4	2	3	4	3	16
	Longe-5	Improved	3	1	4	3	4	15
Cassava	Nylon (TME 14)	Improved	5	3	4	4	3	19
	Oresita	Improved	4	3	4	3	4	17
	Maragwa	Local	5	3	4	2	3	17
Common beans	Roso coco	Improved	4	3	4	3	4	18
	Nabe 4	Improved	4	2	3	2	3	14
	Agwede	Local	5	3	3	3	3	17
	Yellow beans	Unknown	3	2	3	3	2	13
Sesame	Gure	Local	4	3	4	3	3	17
	Latino	Local	3	3	4	3	4	15
	Sesame 2	Improved	3	3	4	2	2	14
	Ladongo	Local	2	4	3	3	2	14
Groundnut	Lomayido	Local	4	3	4	4	3	18
	Red beauty	Improved	3	2	4	5	3	17
	Najamba	Local	4	3	3	2	2	14
	Angatonga	Local	3	2	2	3	1	11
	Lokoya	Local	2	1	2	3	2	10

(Table 8). The major seed sources of these climate resilient crops and varieties in Magwi county cluster are the farmers' own seed savings, local grain markets and the seed distribution programmes of Red Cross, Global Aim, BASE NET, and CARITAS Luxembourg.

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

IDPs and Refugees are key actors of the local seed system in Magwi

Farmers and members of the communities access the seed of maize, groundnut, sesame, sorghum, egg plants, , cassava, beans, and several vegetable crops through their social seed network. The members of the communities include local farmers, IDPs, refugees, returnees, and local traders, I/NGOs, and government institutions. This shows that social seed network plays the most fundamental role in building trust and reciprocity between the local farmers and members of their communities, which involves refugees, IDPs, returnees, and other actors (Table 9).

Interestingly, IDPs and refugee are found to have an important role in the access and exchange of seeds and actively sharing the seed with local farmers. For example, upon returning home from refugee camps returnee-farmers have the possibility of adopting new crops or new crop varieties and accessing these seeds through bartering. The proportion of exchanges with friends/family within the Payam is higher for nodals (96.5%) compared to non-nodals (81.8%). Most exchanges take place on a free basis (80.7%) while 16.2% involved cash. Magwi market is both source of seeds (142) and recipient of seeds (28) as some people go to Magwi market and buy seeds from there. Local farmers (mean 1.5) tend to exchange more crops with the same recipient (multi-crops exchange) than IDPs (1.1). 55.1% of exchanges are taken by 3 crops: Eggplant (11%), Groundnut (18.3%) and Maize (25.9%) in Magwi County.

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

Out of the 260 farmers involved in the social seed network, 72% were female farmers. The average age of the respondents was 38.7 years (Table 9). Female farmers (mean 4.1) tend to be part of significantly more exchanges of seed than male farmers (mean 2.98). Female farmers (mean 1.5) contribute as source of seed more than male farmers (mean 1.12). While, male framers in a greater proportion of exchange are with friends/family outside the Payam (24.19%) compare to female farmers (12.01%).

Free seed and cash purchase are the key mechanisms of seed access and supply

Free seed is the dominant mechanism in Magwi County cluster which represented by 81%. Cash purchase of seed

is the second dominant mechanisms which represented by 16% (Table 10).

The study revealed that farmers and their communities are involved in seed access and distribution of at least 23 different crops. However, maize (26.3%), Groundnut (18.6%), Egg plant (11.2%) and sesame (8.3%) and sorghum (6%) are the most exchanged crops in the

Table 9. Farmers and their members of the communities in seed network in Magwi County

Categories	Number	Percentage
Local farmer	220	84.6%
IDPs	24	9.2%
Refugees	9	3.5%
Returnee	2	0.8%
Host of refugees	0	0.0%
Market trader	1	0.4%
I/NGO	2	0.8%
Public government extension or similar function	1	0.4%
Public research institution or similar function	0	0.0%
Others	0	0.0%
No data	1	0.4%
Total	260	100%
Female		71.8%
Male		26.2%
Market/organisation		2%
Average age of respondents		38.7 years

Table 10. Seed access and exchange mechanisms in Magwi County

SN	Seed access and exchange mechanisms	Number of exchanges	Percentage
1	Free	734	80.7%
2	Exchange/barter with same variety seed	9	1.0%
3	Exchange/barter with another other variety	6	0.7%
4	Exchange/barter with different crop	10	1.1%
5	Exchange/barter with labour	3	0.3%
6	Exchange/barter with other methods	0	0.0%
7	Cash purchase	147	16.2%
8	Vouchers/coupons	0	0.0%
9	Seed on credit/ loan	0	0.0%
Total		909	100%

network. They represent 70% of all exchanges (Table 11).

Magwi Market, Red Cross, Global Aim and IDPs are major source of seed in Magwi

In this cluster, fifteen central nodes have been identified that play a central role in access and supply of seed to the farmers in Magwi County cluster (Table 12). Central nodes are identified by their highest direct connections with many farmers in seed access and supply. Among these central nodes, Magwi market; programmes implemented by the Red Cross and Global Aim and female farmers are the four major types of sources of seed to the farmers (Figure 6). Importantly, three IDPs are among of them who supply seed to several other farmers. A total of 50% of central nodes are represented by the humanitarian and development organisations programmes. This indicates the role of these organisations are very important in Magwi County seed sector development. At the same time, this is also challenging for long-term stability and sustain-

ability of local seed supply since the external programmes could also create dependency to the farmers.

3.5 SEED SYSTEMS AND CHALLENGES

Major seed systems

Farmers and their communities access the seed through seven different seed systems in Magwi County which are clustered into informal seed systems (represented by household seed saving, social seed network and local market), intermediary seed systems (represented by community-based seed production schemes and seed relief) and formal seed system (represented by government/public seed programme and private seed companies). A detailed characterisation of each of these seed systems is presented in Table 13, 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

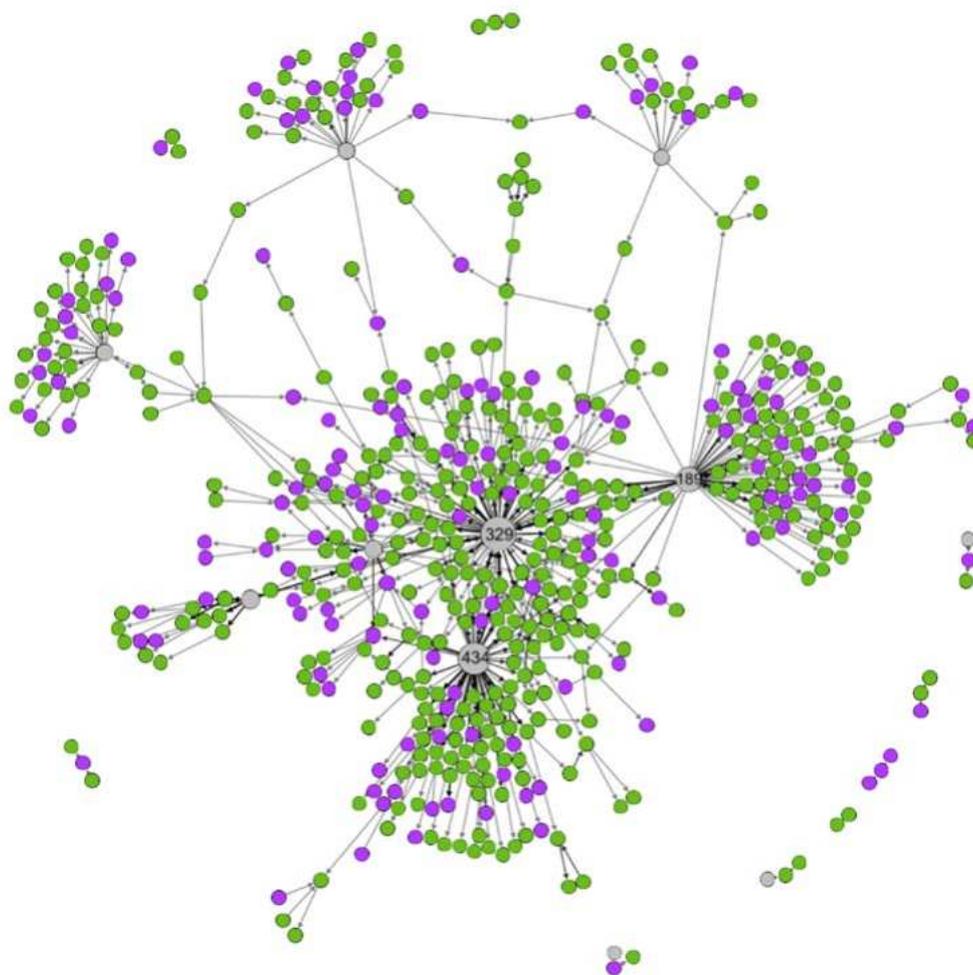


Figure 6. Social seed network map showing the central role of local market, humanitarian and development organizations and female farmers as major source of seed in Magwi County cluster. Code 329, 434 and 189 represent the Magwi market, Red Cross and Global Aim respectively. The larger the size of node indicate the higher connection with many farmers. Green color nodes represent the female farmers, purple color nodes represent the male farmers and grey color nodes represent the local market or I/NGOs programme.

Table 11. Types of crops exchanged through the social seed network in Magwi County

Crops	Number of exchanges	Percentage
Maize	242	26.30%
Groundnut	171	18.60%
Egg Plant	103	11.20%
Sesame	76	8.30%
Sorghum	55	6%
Okra	43	4.70%
Cabbage	39	4.20%
Cassava	38	4.10%
Tomatoes	37	4%
Onion	33	3.60%
Beans	31	3.40%
Peas	17	1.80%
Green Pepper	11	1.20%
Sukumawiki	10	1.10%
Sweet potatoes	9	1%
Cowpeas	8	0.90%
Soya	3	0.30%
Carrot	3	0.30%
Potatoes	2	0.20%
Sugar Cane	2	0.20%
Millet	1	0.10%
Pumpkin	1	0.10%
Nakati	1	0.10%
Total	909	100%

Table 12. Organisations and farmers playing a central role in local seed supply in Magwi County

Id	Name	Gender	Category	Age
329	Magwi Market	-	Local market	-
434	Red Cross	-	I/NGO	-
189	Global Aim	-	I/NGO	-
124	Care International	-	I/NGO	-
179	FAO	-	I/NGO	-
125	Caritas	-	I/NGO	-
491	Save The Children	-	I/NGO	-
334	Margret Akot Henry	Female	Local farmer	30
501	Spudup NGOs	-	I/NGO	-
46	Alal	Female	Local farmer	-
299	Kevin Aloyo	Female	IDP	-
369	Natalina Amal	Female	Local farmer	60
493	Sebit Abonga	Male	IDP	21
510	Sunday Oyela	Female	IDP	20
369	Natalina Amal	Female	Local farmer	60

Table 13. Seed system characterization, Magwi County

	Informal seed system	Intermediary seed system		Formal seed system	
Seed systems types	Farm-saved seed, seed network and local grain market	Community-based seed production	Seed relief	Public seed programmes	Private seed companies
Key stakeholders	Female and male farmers, refugees, returnees, IDPs, host of refugees, traders in local grain market	Obbo Seed producers Palwar, Palotaka, Lobone, African Action, Tic en Kwo seed producers	South Sudan Red Cross Global Aim, Base-net, Farm stew, Caritas Luxemburg, Wind Japan Save the Children South Sudan Red Cross SPEDP, Welt Hunger FAO, LWF	Research CAD Palotaka Seed Basic Centre	MASCO, Pro Seed, Seed Grow, Green Horizon, Nile Agro Tech
Major crops and varieties	Maize (yellow corn, Langure, Mukamba), Common beans (Yellow bean, Agwede), Cassava (Local Okonyo Ladagi, Orokira, Akena Improved, Karangwa, Okoroci, Oreste), Sweet potatoes, Tomatoes, eggplant, Pearl millet, Sesame (Gure, Latino Oturoteta, Lango), Sorghum, Groundnut (Red beauty, Non-too, Laiaba, Kirikica) Soybean (Namsoya-2)	Maize (Longe-5), Beans, Sorghum (Sesso 3, Sekedo, Serena), Cow pea, Groundnuts (Serenut 2 & 4, Igola), Sesame (local variety), Common bean (K132, K20, Roso coco, yellow bean), Cassava (TEM 14), Soya bean (Namsoya 2)	Maize (Longe-5), Sorghum (Sesso 3), Cowpea (Secow 2), Sesame (Sesame 2), Groundnut (Red beauty), Tomatoes (Money maker), Okra (Ladies finger), Eggplant (Black beauty), Kale/Sukumawiki (1000 heads), Onion (Bambay red and Red ceole), Green pepper (unknown), and Carrot (unknown)	Maize (Longe-5/NARD 1), Cassava (PAL) Cowpea (AGRAC-116, 216, 316), Groundnut, Sorghum, Maize	Maize (Longe 5), Common bean (K132) Groundnuts (Serenut 2 & 4), Sesame Cowpea (Secow 2), Sorghum (Sesso 3, Sekedo, Serena)
Types of varieties	Local (landraces), improved	Improved	Improved, hybrid	Improved	Improved
Seed quality	Local seed, trusted seed	Quality declared seed, certified	QDS	Certified	Certified, truthfully labelled
Seed dissemination	Freely given, informal seed exchange, cash purchase in local market	Cash involved, local marketing	Free seed distribution, seed fair, and seed voucher system	Marketing through agro-dealers	Direct sales, Marketing through agro-dealers
Estimated seed supply	63%	7%	22%	1%	7%

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 Magwi County cluster. It is estimated about 63% of the seed supply to the farmers in Magwi 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, cassava, maize, common bean, sesame and soybean are major crops. Varieties are mostly local (landraces) as well as improved ones. Magwi market is 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): Seed relief is the second dominant seed system in Magwi. It contributes to 22% of the total seed supply in Magwi. Maize, sorghum, cowpea, sesame and vegetable are major crops. Key stakeholders operating within the seed relief seed system are South Sudan Red Cross, Global Aim, Base-net, Farm stew, Caritas Luxemburg, Wind Japan, Save the Children, Welt Hunger, FAO, LWF. The community-based seed production scheme is involved in the seed multiplication groups, block farmers, farmers' associations, and cooperative societies/unions. Key stakeholders operating within the seed system are groups of local seed producers such as, Obbo Seed producers Palwar, Palotaka, Lobone, African Action, and Tic en Kwo seed producers. It contributes 7 % of total seed supply in Magwi.

Formal seed system (government/public seed programmes, private seed companies): Public seed programmes, mainly implemented by the Directorate of Research, researchers deployed in Magwi County, Basic Seed Multiplication Centre contributes to 1 % of the seed supply in Magwi, focusing on cassava, cowpea, groundnut, sorghum and maize crops. The private seed sector, represented by private seed companies, contributes to 7% of the seed supply in Magwi, so represents the third major suppliers of seed. Major crops include maize, common bean, groundnuts, sesame and cowpea. The agro-dealers network plays a major role in seed dissemination.

Seed system development challenges

The seed systems development in Magwi County cluster are affected by series of fighting and insurgencies creating unbearable state of disorder in the county. More precisely, LRA and UPDF fighting from 1990's to 2008 and LRA

brutal attacks on civilians and fight with UPDF; inter communal fighting and influx of cattle keepers from Jonglei. The climate hazards that disrupted livelihood activities are drought, disease outbreak, and pest infestation such as desert locust, fall armyworm, variegated grasshopper, icy rainfall and flood.

The common challenges faced by the seed systems are (in decreasing order of significance) poor storage-ability and health status of the farm-saved seeds, slightly expensive and storability, grains sold as seeds often poses viability and genetic purity issues, under relief seed authenticity of some seed lots are questionable and delivery is often inconsistent with cropping calendar and under private companies seeds produced are insufficient quantity with high market price.

Under the farm-saved seed system challenges such as conflicts, drought, disease and pest outbreak flood results into poor quality of produce and delayed field operations such as weeding and harvesting under this seed system. Whereas, under the community-based seed system the challenges are, LRA insurgencies, presence of armed cattle keeper, communal fighting (Aholi and Madi land dispute), under-capacity storage facilities, heavy rainfall, and abnormal payments. Whereas, the relief seed system faces challenges such as denial of access to certain areas like Pajok Payam, bureaucracy of government at all levels (enabling environment) resulting into late delivery of seeds. The government/public seed system is obstructed by insurgency and communal upheaval and budgetary limitation is pronounced. Whereas, private seed system faces, insecurity, absence of warehouses, limited market opportunity due to the communal and relief seed system as a result their seeds end up to be used as grains.

The interaction between conflict and instability and climate hazards have resulted unusual roadblocks, hindrance of all production operations, since farmer could not access their production sites, zero or reduced yield were reported in the county resulting into hunger, whereby inhabitants moved to refugee camps in Kenya and Uganda, some resettled in internal displaced camps in surrounding Payams as a result of famine and death associated with low yield and unbearable climate condition.

3.6 SEED VALUE CHAIN AND CHALLENGES

The seed value chains and key challenges were analysed in formal, intermediary and informal seed systems of Magwi County. The formal seed system seed value chain and its main challenges are explained in Table 14. This seed system is represented by government/public seed programmes and private seed companies. Major seed operators and service providers are Research CAD Palotaka Seed



Table 14. Seed value chain analysis of formal seed system

Seed value chain steps	Challenges (risks)
Crop breeding and variety development	Lack of financial support for crop breeding programmes, lack of technical capacity of crop breeders, lack of participation of farmers in breeding programmes and on-farm trials, limited availability of new improved varieties, lack of national gene bank for conservation of crop and forage genetic resources, high relative humidity, drought, flood, diseases, pests, weeds and reduction in cropping land
Early generation seed	Inadequate volume of foundation seed, mostly imported from Uganda, small quantity of foundation is available for seed companies to bulk, contamination and seed quality deterioration in bulking phase, and lack of quality assurance on foundation seed.
Seed production and quality assurance	Lack of formal seed quality assurance system. However, Seed Quality Control Board has been established by FAO at community level for Quality Declared Seeds (QDS), lack of seed testing laboratory at county level, lack of experts at county level to do seed quality assurance, normally seed companies involve the Directorate of Research at Ministry of Agriculture and Food Security in conducting quality assurance, but this no longer occurs. Seed companies carry out their own quality assurance with their limited capacity.
Seed processing and storage	Inadequate investment in seed processing and storage facilities, high post-harvest losses due to poor handling, processing, and storage, existing facility in Palotaka is being used for processing and storage which are conventional type and capacity are not enough, poor roads, poor market information.
Seed distribution and marketing	Poor feeder roads, insecurity, unorganized marketing systems, high seed price and higher taxes, and lack of seed market information systems.
Seed extension	Poor road network, lack of logistics support for government extension staff, high wage bills, few extension staff coupled with inadequate knowledge on quality seed production, high illiteracy level among the farmers
Seed enabling environment	Lack of national seed policy, limited funding to the seed sector development, less priority of the government to the seed sector development

Table 15. Seed value chain analysis of intermediary seed system

Seed value chain steps	Challenges (risks)
Crop breeding, adaptive trials	Poor varietal performance due to droughts and floods, NGOs mostly distribute imported seeds without conducting adaptive field trials, increase pressure from exotic pests and disease, poor timing between seed delivery and season; Poor varietal performance. Poor adaptability resulting in reduced yield, Pest and diseases, Weather vagaries, post-harvest losses, Low production Unreliable rain fall Pest infestation especially the Fall Army Worm (FAW).
Early generation seed	CARITAS Luxembourg do import foundation seeds, however, it only import small quantity of maize that is not enough to meet the needs of it seed multipliers; high cost of foundation seed and misplacement of seed quality parameter. Government does not grant licence to NGOs import other most need seeds. Community based seed production groups uses certified seed as starter. The quality is not superior; however, post-harvesting and storability becomes an issue due to the volume produced and processed.
Seed production and quality assurance	Only a few improved varieties are available for seed production, poor varietal adaptability resulting in reduced yield, post-harvest losses, low production due to unreliable rain fall, pest infestation especially the Fall Army Worm (FAW), lack of seed quality control process, seed handled as grain, so seed lots are prone to factors that impede quality.
Seed processing and storage	Palotaka Basic Seed Centre are being used however it is inadequate due to limited processing and low storage capacity.
Seed distribution and marketing	Poor timing between seed delivery and cropping season, for low level of adoption of improved varieties (specially in cowpea), huge risk associated with delayed seed delivery, price fluctuation of both grain and seed, poor roads, limited mobility, inadequate support and limited coordination in seed marketing, and poor communication network.
Seed extension	The ratio of extension worker to farmer is way less and a result farming systems are conventional, lack of improved varieties and new technology to promote with farmers, poor road condition.
Seed enabling environment	Lack of national seed policy, lack of seed certification body

Table 16. Seed value chain analysis of informal seed system

Seed value chain steps	Challenges (risks)
Crop diversity maintenance	Loss of crops and local varieties, for example Groundnut (Makuru red), Cassava (Local varieties: Orogira and Kongogolada), Sesame (Local variety: Oturatata), Bull rush, Soybean, Sugarcane, Sunflower, Cowpea and Coffee; increase drought and floods resulting lower yield, increase incidences of pest and diseases, lack of recognition of women farmers role in crop diversity maintenance and seed supply, 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, and insufficient supply of quality seeds, lack of recognition of local market as source of new crops varieties and starter seed
Crop-seed production and storage	Lack of training to the farmers on quality seed production and basic agronomic practices, farmers and communities use temporary stores or community stores, increase storage pests, lack of good storage facilities, lack of seed processing machines, increase spell of droughts, late rain, floods and higher temperature resulting less crop yield.
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	Lack of recognition local grain traders, women, refugees, IDPs and returnees as key modal point for seed access and dissemination at local level, poor roads, insecurity, poor storage facilities, unorganized marketing systems
Enabling environment	Lack of policy recognition of women farmers role in crop diversity maintenance and seed supply, lack of policy recognition of local crop diversity, lack of policy recognition of local grain traders, women farmers, refugees, IDPs and returnees as key actors of local seed system development.

Basic Centre, and private seed companies: MASCO, Pro Seed, Seed Grow, Green Horizon, and Nile Agro Tech.

The intermediary seed system seed value chain and its main challenges are explained in Table 15. This seed system is represented by community based seed production scheme and seed relief programmes. The analysis based on two indicator 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, and grain traders in local market. The informal seed system seed value chain and its main challenges are explained in Table 16.

4. SEED SYSTEMS RESILIENCE PATHWAYS

4.1 Country level

- The Government of South Sudan should ensure that the country, States and Counties have a functional seed policy and regulations, early generation seed bulking, and varietal development for adaptation.
- In the absence of this the Government of South Sudan at the State level should institute a Seed Quality Board (SQB) at County level to regulate seed activities; identified lead farmers, together with partners, should embark on early generation seed bulking; and the national government should make research grants available to breeders for the purpose of varietal development for adaptation. In addition, local government at County level should catalogue all existing and lost varieties to maintain and develop varietal development and support the conservation of existing food and forage crops diversity.
- International and national organizations should procure seeds from local seed producers to kick-start seed companies with local context that can introduce new varieties that are tolerant to climate hazards and have resistance to diseases and pests. CARITAS Luxemburg has signed a MOU with the National Ministry of Agriculture and Food Security to oversee training of local seed multipliers in Magwi County. CARITAS Luxemburg has also introduced a voucher system for making locally produced seed available to farmers.
- The private sector should create an enabling environment through creation of a competitive environment to provide good quality seeds in affordable prices.

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 frame-

work 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.

- Government/public seed system at State level should be the sole source of foundation seeds and regulate the import of seeds.

4.3 Magwi County level

Formal seed systems

- Private seed companies should produce high quality seeds in order to compete in the markets, invest in seed research, establish twin-ship with foreign companies, to be specialized in terms of crops and focus on their niche.
- Currently, small quantity of foundation seed is available for seed companies that is largely imported from Uganda. The foundation seed available to the seed companies are not sufficient to meet the demand. Therefore, government should also allow and support the private seed companies to produce their own foundation seeds.
- Breeders need to work together with seed companies on bulking/ conducting adaptive trials at field level. Private sector research departments have technical personnel who can train farmers so it helps to reduce the risk when government systems fail.
- Seed companies should increase the field demonstration and on-farm trials to raise the awareness on new varieties, selection of most adapted and preferred varieties by the farmers.
- At county level, extension workers are involved in training farmers contracted by seed companies. Government should put in place a seed quality assurance body at county level, support private sector quality assurance, build capacity of both county and seed company staff.

- The seed companies need to put in place their own community storage facilities to be constructed for cooperatives, credit facilities need to be given for private sector to invest in the community stores and seed processing equipment, government should improve the community roads, handouts must be phased out slowly.
- Government extension staff at county level need capacity building training on quality seed production, good agriculture practices and seed quality assurance. For this purpose, the University of Juba School of Agricultural Sciences and trained technical manpower from AGRA funded project should be further mobilised in building the capacity of county government extension staff.

Intermediary seed systems

- Humanitarian and development organizations should help government fast-track seed policy, initiate the establishment of a decentralised SQB 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, promote local seed producers to become seed companies.
- Humanitarian and development organisations 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 cassava (Maragwa), Common bean (Agwede), Sesame (Gure, Latino), maize (Mukama), groundnut (Lomayido, Najamba), and sweet potato (La can Mti Kipi).
- The I/NGOs should deliver seeds and other inputs before March (at least a month before commencement of first rainy season in April) or before the end of June (before the onset of the second rainy season starting in July).
- 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.

Informal seed systems

- 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.
- The Magwi market 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 marketplaces could be further strengthened by

sharing quality seed-related information through training, and by linking with local seed producers to purchase good quality seed.

- Female farmers play a dominant role in local seed supply in Torit County (over 72%); 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. In addition to this, there are specific nodal seed farmers who play a central role in access and supply of seed to several other farmers including refugees, IDPs, and returnees. The relationships are built upon trust and reciprocity. These nodal seed farmers could be further empowered through training on good quality seed production so that they can become a reliable (sustainable) source of seed dissemination of new and improved varieties within the county level.
- 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).

4.4 Cluster level

Cluster - Magwi-Obbo: greenbelt agro-ecology, urban linkage, production site

- Due to its huge production status, the existing informal seed system is more reliable; seeds under this system are affordable, available, and accessible.
- Investing in purchase of improved varieties seeds has enormous dividends, so local purchase will give them the chance to source those improved crop varieties.
- Seed delivery by I/NGOs should follow the local cropping calendar, to avoid persistent feedback by the food security cluster in the Magwi County that seeds arrived and were distributed late.
- Farmers are ready to try new crops and varieties if I/NGOs introduces and distributes these crops. Their proximity to Uganda has exposed them to new agricultural technologies, making them early adopters.

Farmers suggested the establishment of a sustainable community seed bank that could be a source of seeds in case any member lost their seeds of preference

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

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