CASSAVA APPLIED RESEARCH FOR FOOD AND INCOME SECURITY IN NORTHERN UGANDA PROJECT

CASSAVA BASELINE SURVEY REPORT 2017

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PART I: CASSAVA VARIETIES, PESTS AND DISEASES SURVEY REPORT, 2017

1. Introduction

Cassava is the most important staple crop in northern Uganda and plays a big role in the livelihood of a big population in this region. The region is the second largest producer of cassava in Uganda accounting for 34% of the national production. Cassava production in northern Uganda had been affected by the long civil war that lasted 20 years, poor weather conditions, poor faming skills and lack of quality seeds for farmers.

Production of the crop has also been constrained by many pests and diseases, the most important of which is cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). As part of the efforts to increase cassava production and productivity in northern Uganda, Cassava Applied Research for Food Security in northern Uganda initiated activities to address the above constrains. A baseline survey was conducted in February 2017 in the region to determine the pests, diseases and cassava varieties status in the project areas. The baseline information would be used at the end of the project to establish the effects of intervention strategies put in place during the course of the project. We hereby report the findings of the survey.

2. Objectives

- To determine the status of major cassava pests and diseases in the project areas
- To identify the major cassava varieties grown in the project areas

3. Materials and methods

Field observations and assessments were carried out in 120 farmers' fields from 8 sub counties in the two districts. In each district, 4 sub counties were surveyed. Of the four sub counties, 3 were hosting the project (project sub counties) and one was non-project Sub County used as control. During the survey, 80 cassava fields of between 3-6 months old were assessed for pest and disease incidence and severity on foliar parts, while 40 fields of 10 months or older were assessed for CBSD root symptoms. In each district, cassava fields were selected at regular intervals of 7-10 km between sites or until a cassava field was found. Thirty plants were assessed along the two diagonals of each young (3-6 months old) field while ten plants were treated the same for the old (>10 months old) fields.

3.1 Parameters assessed

3.1.1 Cassava mosaic disease (CMD)

The parameters assessed for CMD were symptom severity and infection type. Severity was scored on a scale of 1-5 where 1 represented no symptoms and 5 the most severe symptoms. Infection types were categorized as "C" (cutting-borne) and "W" (whitefly-borne) infections.

3.1.2 Cassava brown streak disease (CBSD*)*

The parameters for CBSD foliar assessment were leaf symptom severity and stem lesions. Severity was scored on a scale of 1-5 where 1 represented no symptoms, 2 leaf symptoms without any stem lesions, while 3, 4 and 5 had leaf symptoms together with stem lesions where 5 had the most severe symptoms.

3.1.3 Whitefly (Bemisia tabaci) abundance

Adult whitefly (*Bemisia tabaci*) was counted on the top five fully-expanded apical leaves of the 30 plants assessed per field and the totals were recorded separately for each plant.

3.1.4 Cassava bacterial blight (CBB*)*

Cassava bacterial blight (CBB) severity was determined by scoring its severity on the 30 assessed plants using a scale of 1-5, where 1 represented no symptoms and 5 the most severe symptom which included stem dieback.

3.1.5 Cassava green mite (CGM*)*

The severity of CGM was assessed on a scale of 1-5, where 1 represented no symptoms and 5 the most severe symptom which included leaf drop and stem dieback commonly called "candlestick".

3.1.6 Cassava mealybug (CM*)*

The severity of CM was assessed on a scale of 1-5, where 1 represented no symptoms and 5 the most severe symptom which included stem dieback.

3.1.7. Leaf sample collection and virus diagnostics

i. *CMD leaf samples*

Two CMD symptomatic leaf samples were collected in each field, one from a plant showing the most common symptoms and the second one from a plant showing the most contrasting symptom severity. Each leaf sample was labelled, put in a 1.5mL microfuge tube containing 70% ethanol to preserve it. The samples were then carried to the laboratory at the end of the survey for processing.

ii. *CBSD leaf samples*

Five CBSD symptomatic leaf samples were collected in each field from plants showing symptoms, while in fields without CBSD symptoms, 5 asymptomatic leaf samples were picked. From each field, leaf samples were collected at random from 5 plants assessed along the two diagonals and the leaves were preserved in a herbarium press until RNA extraction.

iii. *Laboratory diagnosis of virus samples*

Nucleic acids were extracted from CMD and CBSD leaf samples for subsequent virus diagnosis using modified Dellaporta *et al*., 1983 and CTAB (Lodhi *et al*., 1994) methods respectively. Primer pairs specific for ACMV (AL1/F and ARO/R), EACMV-UG (AL1/F1 and ACMV-CP/R3) and EACMV (UV-AL1/F and UV-AL1/R) were used to amplify fragments of DNA-A of cassava mosaic geminiviruses (CMGs).While (Deus) primers were used to detect CBSVs present in the CBSD leaf sample extracts. Polymerase chain reaction (PCR) were performed on the nucleic acid extracts and the amplicons were electrophoresed in a 1.2 % agarose gel stained with ethidium bromide and run at 85 volts for1hour in x1 Tris-Acetate-EDTA (TAE) buffer of pH 8. The gels were then visualized under UV light and photographed using gel documentation equipment.

4.0 Results

4.1 Cassava brown streak disease

Cassava brown streak disease assessment showed that CBSD was more prevalent in Oyam (13%) than in Pader (5%), (Table 1). Oyam district had higher incidence at 19.8 % and lower was in Pader at 0.2 % giving an overall incidence of 10.0% for the entire survey (Table 1). In Oyam, Loro Sub County had the highest CBSD incidence (48.3%), while Kamdini had the lowest incidence (10.3%), (Table 2 & Figure 1). In Pader district, CBSD occurred only in Puranga Sub County at 0.7%, (Table 2 & Figure 1).

CBSD severity was relatively higher in Oyam (2.2) than in Pader (2.0), (Table 1). However, in the sub counties, CBSD severity was highest in Aber and Minakulu in Oyam district at 2.3 each, while Puranga

in Pader and Kamdini in Oyam recorded the lowest severity at 2.0 each. This level of prevalence, incidence and severity indicate low disease pressure in the entire surveyed areas.

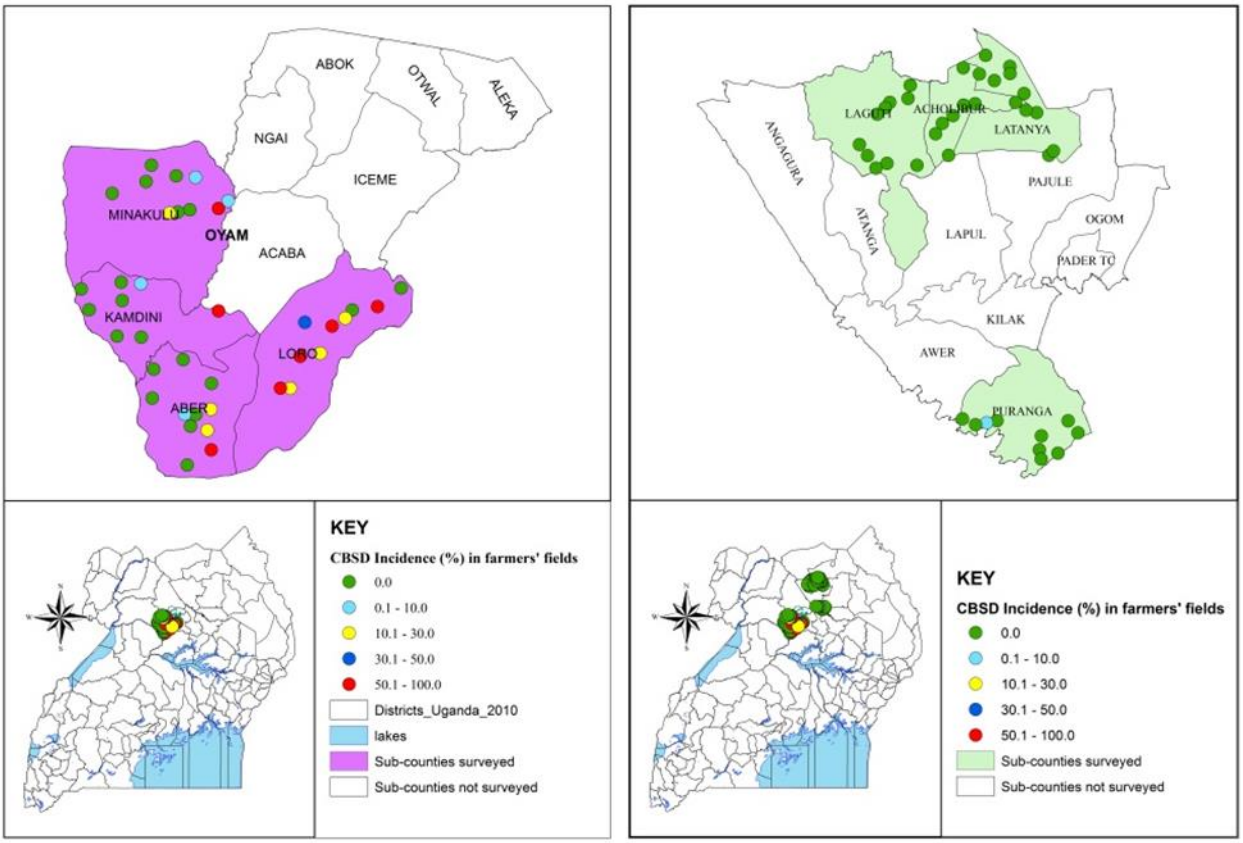

Figure 1: Map showing CBSD incidence in the surveyed locations in Oyam (left) and Pader (right), February 2017

4.2 Cassava mosaic disease

Assessment of cassava mosaic disease indicated that the disease occurred in the two districts with the highest prevalence in Oyam (30%) while Pader had 10% prevalence (Table 1). CMD incidence was higher in Oyam (14.0 %) and lower in Pader (3.0%) giving a mean incidence of 8.5% for the entire survey (Table 1). Cutting-borne infection (13%) was more frequently encountered in Oyam than in Pader (3.0%) while the whitefly-borne infection (1%) was observed only in Oyam (Table 1). The two districts had the same level of CMD severity (2.4), (Table 1).

While the observed levels of CMD severity and incidence indicates that CMD is moderate in the two districts. The very low whitefly-borne infection indicates that there is no immediate threat of CMD epidemic occurring in the surveyed areas.

4.3 Whitefly (*Bemisia tabaci*) abundance

Whitefly (*B. tabaci*) adult number per plant shoot was lower in Pader (0.3) than in Oyam (2.3), (Table 1). In the sub counties, whitefly abundance was highest in Aber (20.0) in Oyam district than in any of the sub counties assessed (Table 2). The low abundance of *Bemisia tabaci* in the surveyed areas indicates that most of the disease is being perpetuated by use of infected planting materials.

4.4 Cassava green mite (CGM)

CGM incidence was very high in both districts with the higher incidence recorded in Oyam (79.3%) while Pader had 75.8% giving an average of 77.6% for the entire survey (Table 1). CGM occurred in

all the fields assessed though at varying levels of incidence and severity. The severity of CGM (2.7) was the same in both districts indicating moderate pest damage in the project areas (Table 1).

4.5 Cassava mealy bug (CM)

CM was only observed at one location, Abolokoma Village, Kamdini Sub County, Oyam district at 0.3% incidence and severity of 3.0, (Table 1). The low occurrence suggests that either the environment is not suitable for the pest or there is a natural enemy controlling its population.

4.6 Cassava bacterial blight (CBB)

Cassava bacterial blight occurred in the two districts at very low levels with the highest incidence observed in Pader (3.3%) while Oyam had 2.6% incidence (Table 1). CBB severity was very low in both districts with Oyam recording 2.1and Pader 2.0 giving mean incidence of 2.0% for the entire survey (Table 1). The observed low levels of CBB suggest that the environment surveyed may not be conducive for CBB or that the period at which the survey was done was not suitable for CBB flourishing.

4.7 Cassava varieties prevalence

The assessment of the prevalence of cassava varieties being grown by farmers in the two districts showed that a total of 14 cassava varieties were encountered. Of the 14 varieties encountered, 9(64.3%) were improved ones while 5 (35.7%) were landraces (local), (Table 3). The frequency of occurrence of the cassava varieties showed that improved cassava varieties (76.0%) occurred more frequently than the landraces (24.0%). Pader district had higher frequency (82%) of occurrence of improved varieties than Oyam (70%), (Table 3). Of all the cassava varieties encountered, TME 14 is the most prevalent (42%) while Bao (14%) is the most commonly grown landrace. The high frequency of occurrence of improved varieties in the districts suggests that there is high rate of adoption probably because of their high yield or level of disease tolerance when compared to the landraces.

4.8 Virus diagnostics

4.8.1 Cassava mosaic geminiviruses (CMGs)

Virus diagnoses results for CMGs showed that out of the 28 symptomatic samples tested, 22(78.6%) reacted positive to the test while 6 (21.4%) showed negative results.

Of the 22 samples that gave positive results 20 (91%) had *African cassava mosaic virus* (ACMV) alone, 1 (4.5%) had *East african cassava mosaic virus*-Uganda 2 (EACMV-UG2) alone and 1 (4.5%) had both virus types in mixed infections (Table 4). The only virus type in Pader was ACMV while in Oyam, both ACMV and EACMV-UG2 occurred but overall, ACMV was more prevalent than EACMV-UG2.

4.8.2 Cassava brown streak viruses (CBSVs)

Diagnostics of CBSVs indicate that Ugandan cassava brown streak virus (UCBSV) was the most prevalent virus type (66.7%) than either *Cassava brown streak virus* (CBSV), (23.3%) than the mixed infection of the two viruses (10%). The results further showed that Pader district had only one virus type the UCBSV while Oyam had both CBSV and UCBSV in both single and dual infection (Table 5).

5.0 Discussion and conclusions

The pest and disease baseline survey of Oyam and Pader districts of northern Uganda showed that cassava mosaic disease (CMD) is still the most important constraint to cassava production while CBSD poses a greater threat to same this is because there are no resistant varieties to CBSD. Spread of the two viral diseases was mostly due to the use of infected planting materials since whitefly populations

were very low in the surveyed areas. The high prevalence of improved varieties could explain why there is low incidence of CMD. For CMD management, most farmers had been able to obtain CMD-resistant varieties as this was recorded in the entire survey unfortunately; these varieties have broken down to CBSD and this poses a bigger challenge to farmers.

The most frequently observed pest was cassava green mite (CGM). The predatory mite, *T. aripo*, which had been widely prevalent across the cassava-growing districts of Uganda, was found to be present only in Oyam at very low incidence and was rare and limited in distribution to only 7 of the 80 young fields surveyed. The limited distribution could explain the high incidence of CGM in the surveyed areas. To contain the pest, it would be useful to make additional releases on cassava in the districts to enhance CGM control.

The occurrence of both CBSV and UCBSV in Oyam district and only UCBSV in Pader could explain why there is relatively higher CBSD incidence in Oyam compared to Pader. This could be explained by the aggressive and virulent nature of CBSV compared to UCBSV.

The high incidence of ACMV in the surveyed areas suggests the mild severity observed on most plants since symptoms associated with ACMV is always mild as opposed to EACMV-UG2 which is associated with severe symptoms on infected plants.

The relatively high pressure of CMD, CBSD and the associated viruses in Oyam suggests that Oyam is a district suitable for testing new materials being developed and deployment of materials to contain the diseases. Pader which has very low disease pressure would be suitable for the establishment of multiplication centers to supply other areas of the country with clean planting materials.

6.0 Recommendations

- Continued monitoring and diagnostics of CMD and CBSD to target control, monitor pattern of spread and determine virus changes with time.
- Multiplication and dissemination of CMD resistant and CBSD tolerant varieties in areas of high CMD and CBSD pressure.
- Re-distribution of *T. aripo* to the whole of the cassava growing areas in the country should be considered.
- Creation of awareness on CBSD management techniques needs to be emphasized

7.0 Acknowledgements

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8.0 References

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Table 1: Occurrence of major diseases and pests of cassava in Oyam and Pader, February 2017

Parameters	District		Overall
	Oyam	Pader	
Altitude (m asl)	1056	993	-
Mean crop age (months)	5.6	5.3	**5.4**
CBSD prevalence (%)	13.0	5.0	**9.0**
CBSD severity (scale 1-5)	2.2	2.0	**2.1**
CBSD incidence (%)	19.8	0.2	**10.0**
CMD prevalence (%)	30.0	10.0	**20.0**
CMD severity (scale 1-5)	2.4	2.4	**2.4**
Total CMD incidence (%)	14.0	3.0	8.5
CMD whitefly infection (%)	1.0	0.0	**0.5**
CMD cutting infection (%)	13.0	3.0	**8.0**
Adult (*B. tabaci*) number	4.8	1.3	**3.1**
CGM severity (scale 1-5)	2.7	2.7	**2.7**
CGM incidence (%)	79.3	75.8	**77.6**
T. aripo incidence (%)	3.3	0.0	**1.7**
CBB severity (scale 1-5)	2.1	2.0	**2.0**
CBB incidence (%)	2.6	3.3	**3.0**
Improved cassava variety prevalence (%)	70.0	83.0	**76.5**

Table 2: Occurrence of major diseases and pests of cassava in sub counties of Oyam and Pader, 2017

Mean parameters	District								
	Oyam				Pader				
	Aber	Loro	K'dini	M'kulu	A'bur	L'guti	P'ranga	L'tanya	**Overall**
CBSD incidence (%)	10.7	48.3	8.3	12.0	0.0	0.0	0.7	0.0	**10.0**
CBSD severity (1-5)	2.3	2.2	2.0	2.3	1.0	1.0	2.0	1.0	**2.2**
CMD incidence (%)	21.7	0.7	24.7	9.0	1.1	0.0	9.3	1.7	**8.5**
CMD severity (1-5)	2.4	2.0	2.5	3.0	2.0	1.0	2.5	2.6	**2.4**
Adult (whitefly) #	20.0	1.7	2.6	0.2	0.3	0.8	0.1	0.2	**3.2**

Key: K'dini = Kamdini; M'kulu = Minakulu; A'bur = Acholibur; L'guti = Laguti; L'tanya = Latanya; P'ranga = Puranga

Table 3: Occurrence of cassava varieties in Oyam and Pader, February 2017

Variety	**District**		
	Oyam	Pader	**Overall (%)**
1. Landrace (local)			
Bao	21	7	**14.0**
Jaia (Nyaraboke)	6	4	**5.0**
Omot	-	4	**2.0**
Tongolo	-	3	**1.5**
Njule	3	-	**1.5**
Overall (%)	***30***	***18***	***24.0***

2. Improved (%)	Oyam	Pader	**Overall (%)**
TME14	36	48	**42.0**
TME204	12	7	**9.5**
NASE13	2	15	**8.5**
NASE12	11	1	**6.0**
NASE14	5	1	**3.0**
NAROCASS1	5	-	**2.5**
I92/0067 (Akena)	-	5	**2.5**
NASE3	-	3	**1.5**
I92/0057 (Omongole)	-	3	**1.5**
Overall (%)	***70***	***82***	***76.0***

Table 4: Prevalence of *Cassava mosaic geminiviruses* in Oyam and Pader, February 2017

District	No of samples		Virus type		
	Analysed	Positive	ACMV	EACMV-UG	ACMV + EACMV-UG
Oyam	21	17	15	1	1
Pader	07	05	05	0	0
Total	28	22	20	1	1
Overall	**100%**	**78.6%**	**91.0%**	**4.5%**	**4.5%**

Table 5: Prevalence of *Cassava brown streak viruses* in Oyam and Pader, February 2017

District	No of samples		Virus type		
	Analysed	Positive	CBSV	UCBSV	CBSV + UCBSV
Oyam	44	26	7	16	3
Pader	06	4	0	4	0
Total	50	30	7	20	3
Overall	**100%**	**60%**	**23.3%**	**66.7%**	**10.0%**

PART II: SOCIO-ECONOMICS BASELINE SURVEY REPORT, DECEMBER 2016

1.0 Introduction

1.1. The cassava sub sector

Cassava is grown for both food security and income generation by a large proportion of Uganda farmers. UBOS (2008/2009) indicates that over 3 million cassava plots were planted by 1.67 million farm households, making it one of the most widely distributed crop in Uganda. Plot sizes are generally smaller than for other crops, averaging 0.24 ha. As a food security crop, it is appreciated for its ability to grow in poor soils, resistance to drought as well as ability to produce reasonable yields year after year. FAO indicated that yields in Uganda have remained at approximately 13 Mt/ha for the past decade, with harvested area in 2010 at around 415,000 ha for a total production of fresh roots of 5,300,000 Mt. Cassava easily tolerates the short dry season in Uganda, but it is adversely affected by flooding. While cassava is grown throughout Uganda, production is clustered in the east in Pallisa, Kamuli, Soroti, Tororo, Bugiri, Kumi, and Iganga districts, and in western and northern Uganda in the districts of Masindi, Kyenjojo, Kasese, Nebbi, Arua, Maracha Apac, Oyam, Yumbe, and Lira.

1.2 Background

The project was purposely to improve Food Security in Northern Uganda through promotion of cassava production, processing and marketing being implemented by twelve groups in selected four sub counties in the districts of Oyam and Pader by Africa 2000 Network and NARO with support from Oxfam Novib. The three years project is expected to contribute to improvement of the food and income security situation in the two districts in Northern Uganda with a focus on cassava. The project is expected to benefit 25,000 people comprising of women, children, men and youth. This number was estimated basing on the fact that each farmer group comprised of 30 members and each member represents a household of about seven people. The project envisions 60% of the beneficiaries to be women. The northern region was selected because it has the highest rate of food insecurity in Uganda compared to other regions and 59% of its population was food and energy deficient between 2009 and 2010, with 12% of the households depending on a single meal per day. Furthermore, in Acholi sub region, 262,432 persons are categorized as phase 2 (borderline food secure/stressed), while 98,412 are in phase 3 (high malnutrition levels), experiencing food gaps and high malnutrition rates. This situation is attributed to the civil war which lasted over 20 years in this region, thus the region became net food importers with heavy reliance on food aid.

Presently, increasing agricultural production is seen as the driver to poverty eradication and economic growth in northern Uganda and this entails promoting the major food and cash crops grown among which is cassava. For the past 150 years cassava has progressively grown in importance to become the second major staple crop in Uganda, providing a cheap source of calories for both rural and urban communities. Cassava is an important food security and income generation crop because of its high yields per unit of land relative to other crops. Cassava's significance as a strategic crop for Uganda is owed to its resilience to drought and low fertility soils compared to other staples. It also has flexible planting and harvesting periods, making it a famine reserve crop.

As a result, this project, came up with initiatives to boost production, value addition and marketing of cassava to bring about food and income security in households to enable them purchase quality nutritious foods and afford basic life necessities such as shelter and education. The project is being implemented through a Public Private Partnership (PPP) model comprising of Africa 2000 Network Uganda (A2N–U) and National Agricultural Research Organization (NARO). The District Local Governments are expected to strengthen the project dimension by integrating the project interventions

into the district planning and budgeting system. All this will strengthen the Public- Private Partnership (PPP) model.

1.3. General objective

The overall objective of this project was to improve the food and income security situation of 2500 direct beneficiaries (60% women) in the districts of Oyam and Pader in Northern Uganda through boosting production, processing and marketing of cassava.

1.4. Specific objectives

i) Evaluate and test near-release cassava genotypes together with farmers
ii) Increase farmers' knowledge on cassava disease management
iii) Increase farmers access to quality cassava planting materials
iv) Improve quality of cassava and cassava products for better mar

Table 1: Farmer **g**roups hosting the project

Group name	District	Sub County	Parish	Village
Konyekeni farmers group	Pader	Acholi Bur	Gem Onyot	Leebit
Genbadi farmers group	Pader	Acholi Bur	Gem Onyot	Aritlatwong
Pitek farmers group	Pader	Laguti	Lapyem	Namirembe
Orukitic farmers group	Pader	Laguti	Lapyem	Burgweng
Oribcing farmer group	Oyam	Aber	Atura	Ocampar
Adyegi Women Health Network	Oyam	Aber	Adyegi	Terao
Lapitpeol farmer group	Oyam	Kamdini	Kamdini	Amati
Kanicaonote iyeatwero	Oyam	Kamdini	Juma	Onea
Lapurpetur farmer group	Pader	Puranga	Apwor	Onyede
Akonykori farmer group	Pader	Puranga	Oret	Canberibedomot

2.0 Materials and methods

2.1. Study area

The study was conducted in Pader (Acholibur, Puranga and Laguti sub-counties) and Oyam district (Aber and Kamdini sub-counties) northern Uganda. These two districts were purposely selected because they are dominantly cassava growing areas in the region where the proposed project will be implemented with cassava farmers. The main purpose of the study was to collect both qualitative and quantitative data through household surveys and focus group discussions to assist the project to measure its success and impact at the end.

2.2. Sampling and sample size

The survey targeted cassava farmers who belong to a specific group. To select the farmers, a cluster sampling strategy was adopted. The district was stratified based on the concentration of farmer groups who are likely to benefit from the proposed project. Using the knowledge of Africa 2000 Network staff

who has been working with the farmer groups in the district for several years, a list of all farmers in the various groups at sub-county level was generated. Using this list as sampling frame, households were selected using a simple random sampling technique. From each district, 80 farmers were selected making a total of 160 households. The research team moved from preselected household to household who are already involved in farmer groups requesting for an interview with the farmer. Snowball sampling technique was employed to select farmers for the study. This sampling technique was done in both Pader and Oyam district.

2.3. Data collection procedure

Data were collected through interviews with farming households. Interviews were based on the research instruments designed by NaCRRI, which were pre-tested before actual primary data collection was done and modifications were made by the research team in guidance with NaCRRI to capture the specific issues according to the survey objectives. The interviews were conducted by seven research assistants and a field supervisor. Before the interviews, the research assistants were trained on the type of information being sought for in the baseline and how to conduct the interviews. It was a face to face interview between the enumerator (research assistant) and the respondent where the enumerator asked questions following the questionnaire and recorded responses as well. But in addition, Focus Group Discussions (FGDs) were conducted to corroborate and explore information collected using the questionnaire. One FGD was held with each farmer group selected by the project in Pader and Oyam districts. Each group comprised of about 15 people including men and women in each district. Key Informant Interview Guide was designed to solicit information from technical and opinion leaders, and civil society organizations in Pader and Oyam districts. The Key Informants included District agricultural Officer as well as officials from Non-Governmental Organizations (NGOs) operating within the sub counties where the project is being implemented.

2.4. Data processing

The data were coded, entered in CSPro 4.1 program and exported to Statistical Package for Social Scientists (SPSS) for analysis. Descriptive statistics including frequencies and means were used to present the information in form of tables, graphs and figures. Furthermore, information from the FGDs and open-ended questions in the questionnaire was analyzed using content analysis to summarize the discussions. Some of the qualitative data was analyzed and reported as either direct quotes or in descriptive statements. Besides, emerging common themes and patterns in respondents' comments enabled the consultant to describe and interpret information as it related to farming challenges and opportunities that exist in Pader and Oyam district.

3.0 Results and discussion

3.1. Socio-demographic characteristics of respondents

The study considered selected socio-demographic characteristics to describe the target population. The characteristics included among others Age, sex, marital status, education level and the main source of income: Majority (53.1%) of the farmers were male, with a mean age of about 43.7 years (Table 3). About 48.9% were women with a mean age of 45.3 years. Most (85.6%) were married. A small (2.5% and 11.2%) proportion of them were divorced/separated and widows/widowers respectively and the rest were single. The level of education was low with 63.8% attaining primary education, 22.5% secondary (ordinary level), 1.2% secondary (advanced level) and only 4.4% had studied beyond secondary level education.

Table 2: Socio-economic characteristics of cassava farmers (N=160)

Variable	Frequency	Percentage
Sex		
Male	85	53.1
Female	75	46.9
Marital status		
Married	137	85.6
Single	1	0.6
Divorced/separated	4	2.5
Widow/widower	18	11.2
Educational level		
No formal education	13	8.1
Primary	102	63.8
Secondary (Ordinary level)	36	22.5
Secondary (Advanced level)	2	1.2
Tertiary	7	4.4
Main occupation		
None	7	4.4
Farming	144	90
Salaried employment	1	0.6
Self-employed off-farm	6	3.8
Off-farm worker	2	1.2
Mean Age (years)		
Male	84	43.7
Female	76	45.3
Total	**160**	**44.4**

3.2. Main economic activities

The main economic activity was farming at 90% (Table 2). Besides farming, the remaining respondents (10%) of the respondents were engaged in other secondary activities as their main sources of income and these include; (0.6%) salaried employment, (3.8%) self-employed off-farm (which is termed as small business by the respondent) this kind of activities is done by women and (1.2%) are employed to do off-farm work.

3.3. Major crops grown in Pader and Oyam districts

Survey results revealed that high proportion of farmers (33%) in Pader district grew cassava as a major crop, followed by Sorghum (28%), while 18% of the farmers grew beans, sunflower was ranked fourth at 14% and 5% of the farmers grew soybean. Other crops grown in this area included maize, G. nuts, simsim and pigeon peas among others. While in Oyam district, 40.3% of the farmers grew cassava, followed by beans at 22%, ground nuts in the third place at 18.7%, fourth was rice at 11.7 % and simsim was ranked fifth at 6%. Farmers also grew other crops like Pigeon peas, sorghum, sweet potatoes, and maize and soy beans among others.

It was also noticed that farmers from the two districts grew cassava as their number one food security crop but not as an income security crop. This was due to many reasons including lack of market information, fluctuating/ low prices of cassava and limited market for the crop which makes the crop non-profitable. This has led to many farmers substituting cassava with other competitor crops which fetch more money like sweet potato and beans. This calls for more innovations especially in value

addition and product development so as to increase and improve on cassava products which can earn farmers more income. Charcoal burning, brewing alcohol and brick laying were the major sources of off farm income in households for both districts.

3.4. Access to training

Results from the household survey revealed that, 85% of the sampled households in the study area belonged to either producer or farmer groups. Majority, 67.7% of the households reported that their groups had women in leadership positions although men actively participated in making final decisions of the groups. Due to culture, farmers from Pader and Oyam still believed that men are the best decision makers and therefore, women cannot decide on something in a group without men. 63.4% of the households also reported that they had received some training in crop production including cassava. The training was provided by a number of institutions and NGOs including NARO, Africa 2000 Network, AGRI EXIM among others as shown in figure 1 below. However, farmers complained that the training was not sufficient enough to make a change in farming and recommended for more training especially in post- harvest handling and value addition to improve on the quality of cassava and its products and also training in cassava production especially in disease identification, prevention and control. Activities trained by these agencies include: agronomic practices, record keeping, financial management and post-harvest handling of output. However, responses from non-group members showed that 87% of the farmers did not get training. This is an indication that in Northern Uganda, most NGOs work with organised farmers groups and therefore, formation of more farmer groups should be encouraged to enable farmers get services.

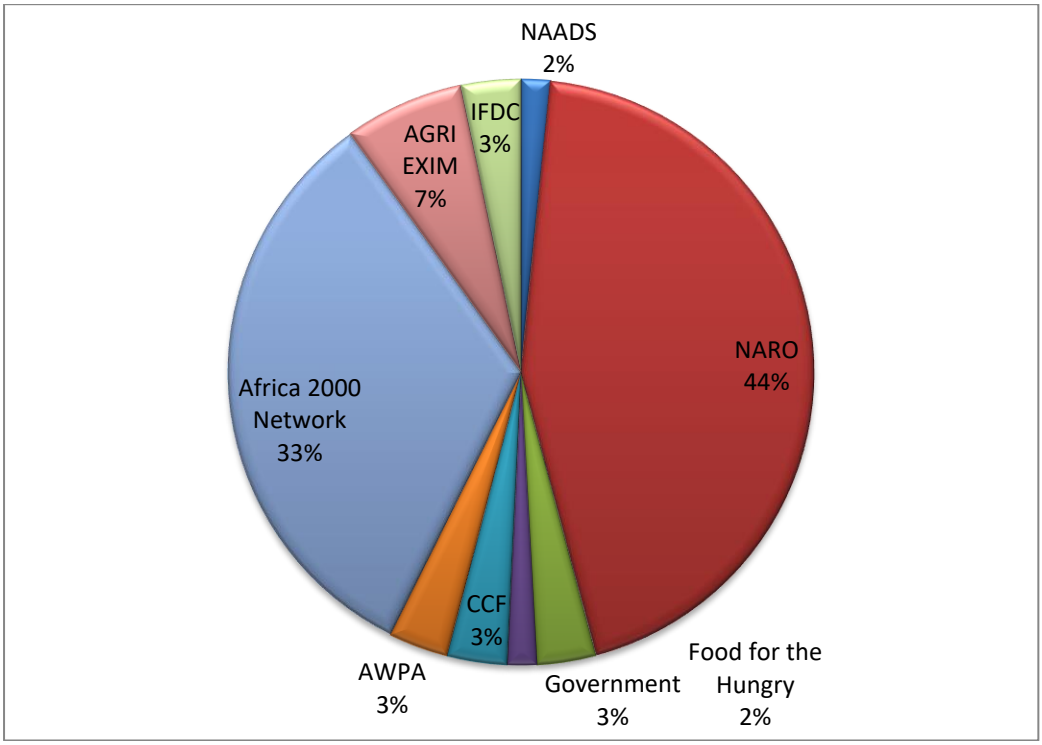

Figure 2: Organisation that offered training to farmers

3.5. Condition of housing and ownership of assets

About 1.6% of the households owned semi-permanent houses (Poles, mud, wattle, iron sheets), 1.6% of the households owned permanent houses made of iron sheets, bricks and cement. However, 96.4% of the households owned temporary houses which were grass thatched with mud walls. Most

respondents owned bicycles, radios and motorcycles and about 29% of the households owned at least one cow while 48.4% owned at least one goat. The implication of statistics above indicate that majority of the farmers are still living in poor conditions.

3.6. Cassava production trends in Oyam and Pader in districts

Secondary data was compiled from district reports to show the trend in cassava production. Results from available data indicated that cassava production in both Pader and Oyam district has been on the increase for the past three years, as indicated in figure 2. This is evidenced from the increase in the number of farmers producing cassava which has moved from 38,500 in 2013 to 45,750 in 2014 and to 58,890 tons in 2015. While in Pader the increase in cassava production has also been significant from 11,000 tons in 2013 to 78,000 tons in 2015. This has been attributed to districts enacting the food security ordinance stipulating that every household must have at least an acre of cassava and other root crops. In addition, acquisition of improved cassava varieties has also significantly contributed to the increased cassava output over the last three years. Results from figure 2 further indicate that cassava production in Oyam district is still low compared to that in Pader district. This might be because of the high disease pressure in Oyam district.

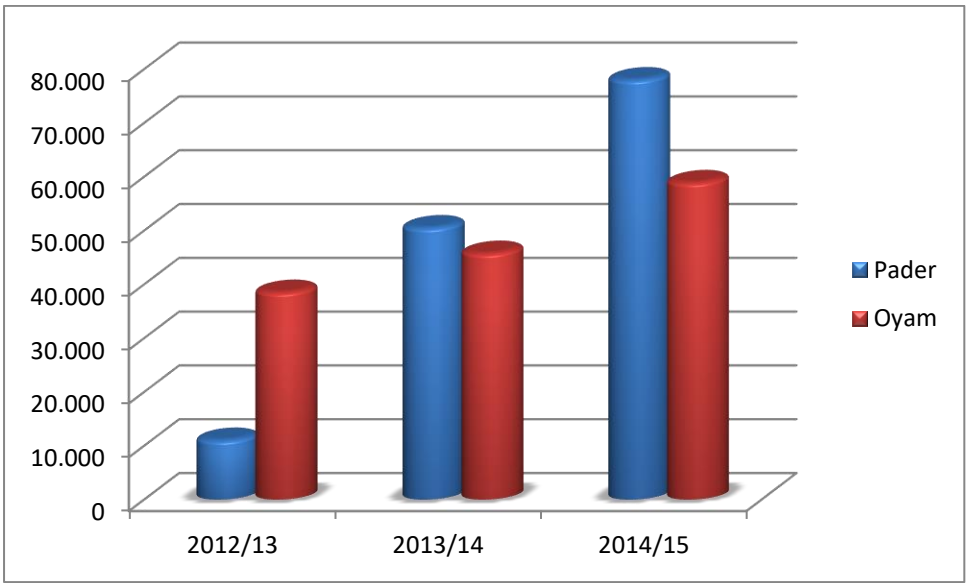

Figure 3: Cassava production trends in Pader and Oyam districts
(**Source:** *District Agricultural Office, Pader & Oyam*)

3.7. Cassava varieties grown

The most commonly grown cassava varieties by farmers from the two districts include TME14 45%, followed by Bao, Nyaraboke and NASE13. Other varieties cultivated include: Akena, TME204, Okonyoladak, NASE14 and NASE19 among others. Farmers liked their local varieties (Bao and Nyaraboke) because they are sweet, mealy and they have a good cooking ability. However, TME14 was grown because it almost had the same characteristics like the local varieties and it was early maturing compared to the local varieties. It was also reported by farmers that TME14 was resistant to CMD and a bit tolerant to CBSD compared to Nyaraboke and Bao. Furthermore, it was reported by farmers during FGDs that local varieties are high yielding, and are disease tolerant but with bitter taste while TME series varieties have experienced yield decline and are susceptible to CBSD. The average yields of the cultivated varieties are presented in figure 2. The recommended and most appropriate

varieties to be grown in the districts are NASE14, NAROCASS1 and NASE19 since they are tolerant to most diseases, have high yield and good taste.

Table 3: Commonly grown cassava varieties in Pader and Oyam districts

Cassava varieties grown	Pader district %	Oyam district %	Total %
Bao	6.3	27.5	35.8
TME14	23.9	22.1	45.0
Okonyoladak	3.0	0	3.0
NASE14	1.8	6.7	8.5%
Nyaraboke	9.1	4.2	13.3
NASE14	0	2.6	2.6
Akena	3.6	1.8	5.5
TME204	3.0	1.2	4.2
NASE19	0	1.2	1.2
Other varieties	0.65	1.2	1.85

3.8. Land Utilization

3.8.1. Average size of land owned by households

About 98.4% of the farm households reported that they had access to land. Household survey findings further revealed that, about (54.4%) reported having below 2 acres as land owned by households and 33.6% owned between 2 to 9 acres, while 10% and 2% owned 10 to 20 acres and above 20 acres respectively. Majority, 75.6% and 82.5% in Pader and Oyam respectively reported that, they rent land for agricultural activities.

Table 4: Average size of land owned by households (N=160)

Land size (acres)	**Percentage (%)**
Below 2	54.4
2 – 9	33.6
10 – 20	10
Above 20	2

3.8.2. Land ownership

Results from the survey revealed that, 87% of the household owned freehold without a title, 5.9% rented land from other individuals, 3.1% occupied communal, 2.5% freehold with title while 1.1% occupied an “owned land” and only 0.3% owned Mailo land. However, majority (92%) of the land owners were men and only 8% of the women owned of which majority of these women were widows. This indicates that although women play a big role in agriculture production, they don’t own land and in most cases, men decide for them on which crop/s to grow. This has negatively impacted on agriculture production in the area.

3.9. Farm inputs

3.9.1. Source of planting materials

Household survey findings indicated that, most of the cassava cuttings are obtained from family and friends (54%), followed by NARO (20%), NGOs (10%) while 8% obtained planting material from

farmer groups and 8% from own gardens. More than a half of the farmers reported acquiring free planting materials (from fellow farmers or own garden). This is probably due to lack of awareness of the danger of recycling planting material leading to disease accumulation. Most farmers were not sensitized about the existence of tolerant and high yielding planting materials and therefore, they ended up picking them from any source available. This could be one of the reasons why there is a wide spread of CBSD and CMD which are mainly spread through farmers planting infected cassava stem cuttings.

Table 5: Sources of planting materials used by the households (N=160)

Source	Percentage (%)
NGOs	10.0
NARO	20.0
Family and friends	54.0
Farmer groups	8.0
Own garden	8.0

3.9.2. Labour utilization

3.9.2.1. Use of hired labour in the cassava enterprise

About 75.6% and 82.5% of households in Pader and Oyam respectively were reported to have used hired labour in cassava enterprises. Hiring labour in the two districts was mainly done during first ploughing and weeding since during this time labour is normally very expensive due to scarcity. This is the pick time of the season when everybody is in need of labour. However due to high labour cost, many farmers could not afford labour and therefore, ended up operating on a smaller scale. None of the interviewed farmers hired labour during fertilisation and spraying. This could be because farmers in Uganda rarely use such practices.

Table 6: Usage rate of hired labour in cassava production

	District			
	Pader		Oyam	
Activity	Yes	No	Yes	No
Land clearing	15	85	13.3	65.7
1st ploughing	50.7	49.3	53.4	46.6
2nd ploughing	16.9	83.1	34.7	65.3
Planting	14.9	85.1	47.9	52.1
Fertilizer application		100		100
Weeding	40.8	59.2	59.2	40.8
Spraying		100		100
Harvesting	30.3	69.7	38.9	61.1
Conservation structures		100		100

3.9.2.2. Cost of hiring labour

The cost of hiring male and female casual workers on the farm in Pader district per day was higher at 3,000/= (SD=1137) compared to Oyam district were the average cost of hiring a casual labourer per day was 2,300/= (SD=947). Use of hired labour for farm activities was constrained by high costs as reported by about 86% of the respondents and scarcity of labour as reported by about 14% of the

respondents. The results above indicate that cost of production of cassava in Oyam district is lower than that of Pader.

3.9.2.3. Types of equipment used

Majority (85.1%) use only local hand hoes in cassava growing while others (14.9%) use ox-ploughs. In all the two districts, the ox-plough was the only modern cultivation equipment used in cassava production as reported by the respondents. The limited use of Ox-plough is due to the vegetation cover in the area. It was realized that Pader district had a lot of stumps and shrub which could not easily allow the use of the modern technology.

3.10. Post-harvest handling and management practices (PHMP)

The most common PHH practices to improve on quality of cassava included harvesting little for consumption, proper drying under sunshine on turplines and good storage practices as indicated in table 12. Majority (50%) of cassava farmers keep their stock in their own houses. Table below shows that farmers' post- harvest handling practices are still poor; this automatically affects the quality of flour thus low prices.

Table 7: Post-Harvest Handling Practices in cassava

Quality assurance activities	Percentage (%)
Cutting into pieces so as it dries to avoid wastage	4.8
Proper drying on tumplines' under sunshine	58.6
Good storage practices	1.9
Ensure no cutting in the process of harvesting	3.2
Selling well dried cassava	4.8
Stored in dry form and in sacks	11.3
Washing after peeling	1.6

3.10.1. Cassava processing

3.10.1.1. Processing levels and challenges faced

The survey results further indicated that 64% of the farmers processed cassava into flour and other products like alcohol while others eat fresh cassava. The most common cassava varieties processed in the districts are, TME14 and Nyaraboke but processing is at low scale. These two varieties were preferred because they dry very fast, roots are soft and easy to peel, produce white flour with high starch level. However, majority of the farmers did not like processing Bao since it had low dry matter content and therefore, takes long to dry. This affects the quality of cassava flour especially during wet season. The processing was mainly done at a local level by either using fabricated machines or local equipment like a pestle and mortar or grinding into flour. Types of products processed include starch, waragi and flour and current market outlets for the processed products are South Sudan, Lira and Gulu.

Challenges in cassava processing in the districts were attributed to low coverage of processing machines and lack of processing skills. Most farmers showed interest in cassava processing and marketing of processed products since they fetch higher price from the market.

Table 8: Gender role in cassava processing

Activity	Men	Women	Male children	Female Children
Harvesting	√		√	
Transporting home	√	√		√
Peeling		√	√	
Washing		√	√	
Chipping		√	√	
Drying		√	√	
Pounding		√		√
Transporting to the market	√			√
Marketing		√		

It can be noted from table 8 above that cassava processing and marketing is mostly done by wemen and female children. Responses from farmers during group discussion indicated that farmers men were only active when cassava processing was done in bulk/large scale. This meant that if processing is for home consumption, every activity was done by women and children. The reason given from the several FGDs conducted was that according to tradition, it is the role/ responsibility of women to process cassava and to make sure that food is on table.

3.11. Marketing

Survey findings indicate that about 83% of the households market their cassava individually. They also reported most of the cassava (80%) is bought by traders/ middle men who always pay farmers very little money. The average distance to the nearest market was reported to be 3km and the marketing was mainly done by women but a final decision for money allocation is done by men.

3.11.1. Marketing channels and average prices

Generally most farmers in the districts sell their cassava and cassava products at farm gate, in local markets and in trading centers. Fresh tubers, dry cassava chips and cassava flour are sold in local markets, while fried cassava chips are sold in trading centers. The average price per kilogram of fresh tubers was 300/= with a bag of fresh cassava selling between 50,000/= to 120,000/= depending on the size of the bag and season while a kilogram of cassava flour and dry cassava chips were sold at around 1,000/= and 500/= respectively. This indicates that value added cassava products fetch more money and therefore farmers should encouraged to add value to cassava for increased income.

3.11.2. Transporting cassava to markets

About 77.8% of the households reported that they were transporting cassava to the nearby market. The major transport means used by cassava growing households in the study area included head load and bicycles. It was also noted that cassava farmers had not made any contractual arrangements with cassava buyers. Only 4.8% of the households reported that contractual arrangements with cassava buyers and of which these contracts were informal mostly and not legally binding.

3.12. Sources of market information

Through the FGDs, most farmers reported that access to market information on cassava in Pader and Oyam districts is not readily available though some little information is access through; local FM radios, friends who visit other markets, traders and on rare occasions in the group meetings. Limited access to market information has led to farmers being paid at a lower price which has discouraged

them from massive production. Therefore, government should device means availing market information to farmers in time especially before or during harvesting period.

3.13. Marketing challenges faced by cassava farmers

Marketing challenges faced by cassava farmers in the districts were attributed to quality issues which lower the product price, perishability of tubers, lack of market information, price fluctuations, high market dues, as well as lack of transport and few buyers from within since every household has a garden.

3.14. Keeping Farm records

About 90% of cassava growing households reported that, they were not taking records about cassava production and sales and the 10% who tried to keep records did not have sufficient information especially in production record reported that records such as input used, sales and field activity records were incomplete and not usually updated.

3.15. Decision making in households

Household survey findings indicate that about 61.9% reported that it is men who make decisions in the household, while 20.1% reported that it is women who make decisions. About 18% reported that it is both women and men who make family decisions while 8% reported that the whole family makes decisions.

3.16. Participation of household members in cassava production

Roles played by men, women and youth in cassava production are presented in tables 16 and 17. About 54.8% of the households reported that both men and women participate in weeding and planting. Other activities done by both men and women included land preparation, harvesting as well as transporting cassava from garden as reported by 45%, 45.2% and 29% of the households respectively.

Table 2: Participation of household members in cassava activities

	Household members Participation (%)		
Activity	Men	Women	Both
Land preparation	22.6	21.0	45.1
Weeding and planting	4.8	30.6	54.8
Pruning	8.1	9.7	3.2
Harvesting	6.5	33.9	45.2
Transporting from the garden	16.1	25.8	29.0
Peeling	3.2	35.5	21.0
Fermenting	38.7	12.9	38.7
Drying	-	40.3	24.2
Sorting	6.5	43.5	30.6

Table 3: Roles played by men, women and youth in cassava production

Gender	Role played
Men	• Source for planting materials • Land preparation • Harvesting and Marketing
Women	• Weeding • Marketing • Small value addition of slicing, drying, pounding and bagging
Youths	• Land preparation • Weeding • Source for planting materials • Marketing

3.17. Access to Agricultural Finance

Although there are Financial Institutions that offer agricultural finance to farmers, survey findings indicated that most households did not have access to use loans and a few who accessed loans did not it for cassava production. The current sources of agricultural finance in Pader district include loans from Banks such as AGARU and Bayport and the newly entered Pride Micro Finance, grants support from NGOs and other donors as well as Government funds under PMG for provision of extension services while in Oyam district agricultural loans can only be accessed through SACCOs and Centenary bank. It was noted that these Financial Institutions offer borrowing terms which are not favorable to the farmers because of high interest rates, strict follow up processes and short repayment periods.

3.18. Opportunities and gaps at the district level

Existing production opportunities for the cassava sub-sector in Pader and Oyam district include fertile soils, stable market for cassava products, availability of cassava cuttings, enough land and favorable district policies. In the district as a whole, there is limited processing of cassava products, poor post-harvest handling and shortage of quality cuttings. Besides, stray animals are a problem especially during dry seasons.

3.18.1. Cassava production challenges

The main limitation hindering cassava productivity as presented by households include, climate change associated with droughts and floods, very low cassava prices, lack of processing skills and equipment, inadequate planting materials, no proper market for cassava, cassava pests and diseases, poor transport network and stray animals which destroy cassava gardens during dry season.

4.0 Conclusion and recommendations

4.1. Conclusions

The commonly grown cassava varieties in Pader and Oyam districts were TME14, Akena and Nyaraboke. Both districts have reported a significant increase in cassava outputs in the last three years from 2013 to 2016 and this has been attributed to the availability of improved cassava variety to the farmers. Despite this increase in cassava production farmers are facing challenges of low prices due to lack of processing equipment, unreliable weather conditions (floods and drought), pests and diseases, bulkiness of the cassava, lack of access to credit and training.

- Majority of the farmers (90%) in both Pader and Oyam don't keep record
- Results indicated that although farmers were trained in cassava production, most of them did not adopt the technology and therefore need for more training.

- About 95% of the farmers could not identify and reorganise infected cassava plant with CBSD.
- Post-harvest handling and Value addition is still very poor combined with limited processing material

4.2. Recommendations

The project should focus on increasing farmers' access to improved cassava cuttings by assisting farmer groups to set up multiplication gardens and training them in good agronomic practices. Furthermore, the project should facilitate creation of partnerships between farmers and other private actors such as processors and other big buyers of cassava so as to create better market for the farmers to supply cassava cuttings.

Emphasis should be put on the promotion of improved post-harvest handling practices and strengthening farmer groups with value adding technologies through provision of knowledge and skills to process various products from cassava.

Dissemination of market information such as produce prices and markets to farmers should be supported. The project should, consider facilitating a framework for market intelligence and e-information flow using mobile phones to the farmers possibly in partnership with private actors to facilitate trade. Farmers should be assisted to form marketing groups and set up collection centers. This will help them in marketing their cassava and collectively bargain for better prices and beat the traders and middlemen who tend to exploit their disorganized inefficient marketing structures.
Farmers should be trained on entrepreneurship skills and record keeping should also be encouraged since it's the only way to grow cassava as a business.