

Back to office report of a visit to West Nile region in Uganda

Huib Hengsdijk, Marleen Hermelink, Henk van Reuler (all WPR), Asaah Ndambi (WLR), Marlene Roefs, and Thomas Tichar (both WCDI)

October 11, 2019

Introduction

From October 7 to 13, a WUR delegation visited the Arua district in Uganda for three WUR projects, the KB rural areas project, NiGi project and the OKP project. The WUR delegation consisted of Huib Hengsdijk, Marleen Hermelink, Henk van Reuler (all WPR), Asaah Ndambi (WLR), and Marlene Roefs and Thomas Tichar, both from WCDI. Marlene is involved in all three projects, Henk is involved in NiGi and Thomas in the OKP project. Huib, Marleen, and Asaah were involved in the KB rural areas project. In addition, Herman Fler, a Dutch entrepreneur/consultant in Uganda, and Pieter Temminck of the Zone college in Twello were in Arua for the OKP project and joined the KB workshop and field trip. This report only describes the activities for the KB rural areas project and the NiGi project.

The objectives of the visit were to:

- 1) Understand the current food system in Arua as well as to identify opportunities and constraints.
- 2) Meet with stakeholders to understand their needs and how research can support a more inclusive and sustainable food system.

First, the itinerary is summarized followed by a description of findings for the major elements of the food system in Arua.

Itinerary

Date	Activity	Who
October 7	Arrival at Entebbe	Huib, Marleen, Henk, Asaah, Pieter, Thomas, Marlene
October 8	- Flight to Arua	Huib, Marleen, Henk, Asaah, Pieter, Thomas, Marlene
	- Meeting with Denis Asigna, livestock specialist at Abi Zonal Agriculture Research Institute, Arua	Huib, Marleen, Henk, Asaah
	- Visit to Agro input shop in Arua	Huib, Marleen, Asaah
	- Individual meetings with Dutch agricultural entrepreneur Herman Fler	Huib, Marleen, Henk, Asaah
October 9	Food systems mapping workshop at Muni University, Arua. See Annex for the answers to the questions	Huib, Marleen, Henk, Asaah, Pieter, Thomas, Marlene
October 10	Visit to Omugu refugee camp and the highlands SW of Arua	Huib, Marleen, Henk, Asaah, Pieter, Thomas, Marlene
October 11	- Meeting with Sadik Kassim, Director at Abi Zonal Agriculture Research Institute, Arua. - Meeting with Emmanuel Odama, Soil Scientist at Abi Zonal Agriculture Research Institute, Arua. - Meeting with Denis Asigna, livestock specialist at Abi Zonal Agriculture Research Institute, Arua. - Meeting with head livestock of districts office. - Meeting with head crop production of districts office and aquaculture specialist. - Visit local market	Huib, Marleen, Henk, Asaah
October 12	- Visit several farms with local extension officer	Huib, Marleen, Henk, Asaah
October 13	- Work on back-to-office report - Transfer to Entebbe - Return to Amsterdam	

Enabling environment

- Research: Abi Zardi Agricultural research and development institute in Arua city is the regional hub for crop and livestock research. It has own experimental facilities and about 20 permanent staff of which we met several. NiGi has a project office at the Abi Zardi compound.
- Government District office: The District office is responsible for agricultural statistics, extension and implementing agricultural development projects. The goal is to have one extension officer per 500 farmers, but because of understaffing it is rather one extension officer per 4,000 farmers. Agricultural statistics are not up to date and agricultural data are not published using standard metrics.
- Infrastructure: Outside Arua city few roads are paved; dirt roads are in poor shape especially during the wet season. The trip from Arua to Omugu settlement, approximately 50 km, took 1.5 hrs by car. Farmers living further from the main dirt roads are only reachable through small trails, therefore limiting market access.
- Electricity / mobile communication network: Electricity from the grid outside Arua city is rare. Many farmers have solar panels for light and recharging mobile phones. The mobile communication network was generally fine, also in the Omugu resettlement.



Homestead with a solar panel.

- Land ownership: Generally, land is owned by the local communities. Part of the land is designated by the community as communal grazing land, and the rest has been allocated to farmers. The farmers "own" the land, i.e. they can do whatever they like with it without fear of it being taken away from them by the community, and their family can inherit it. However, to sell the land, a farmer must get consent from the community. As a result, it is relatively difficult to buy or sell land.

Agricultural production

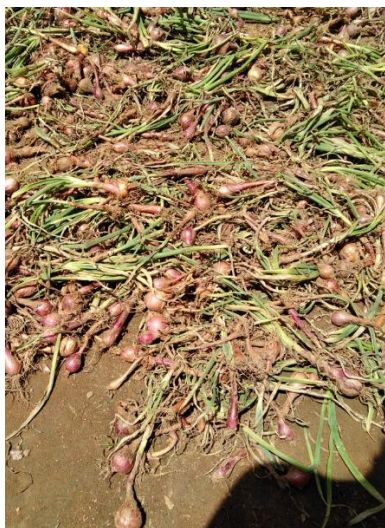
Crop types:

The major crops grown in Arua are cassava, beans, simsim (sesame), groundnuts, cow peas, millet, maize, matooke (plantain), and sweet potatoes. These crops are grown mainly for consumption of the household (subsistence), any surpluses are sold by the women in the household. Some of the vegetables that are grown are tomato, onions, sukuma wiki, amaranth (both leafy greens), cabbage, okra, eggplant, pumpkin, carrot, and sweet pepper. The vegetables are grown around the homestead for home consumption or if grown on the farm they are sold as cash crops. Most farmers keep some fruit trees around the homestead such as mango, guava, banana, and citrus, which they consume and also sell the surplus of. There are also some farmers producing tobacco, which is grown as a cash crop and sold to big tobacco companies.

Land use and yields:

Most farmers are subsistence farmers, and a few are commercial farmers. Cassava and simsim are slowly becoming cash crops. There is little data available on yield levels but estimates of the head agricultural extension officer are shown in the table below for local and improved varieties. Yields in general are very low.

Crop	Local variety yields (kg/acre/season)	Improved varieties (kg/acre/season)
Cassava	700-800	14,000
Beans	150-300	1,200
Simsim	600-700	3,000



Onion harvest. Notice the small size of the onions.



Cassava plants in the field.



Pumpkin plants in the field. The extension officer is showing a diseased leaf of the vine.

Crop management, inputs, and labour:

The long cycle crop cassava is sown in March and can be harvested at the end of the year, around November. For traditional cassava varieties, part of it can be left in the ground and harvested up to a few years later. Short cycle crops are grown in either the shorter first rainy season (March to May) or the longer second rainy season (July to November) All field and post-harvest activities (ploughing, sowing, weeding, fertilization, harvest, curing, drying, milling, and transporting) are performed manually. Animal traction or mechanization are not used. It is common for farmers to hire some casual labour for some of these activities, which costs them 5,000 UGX per half day of work. Soil and water conservation measures such as mulching or ridge planting are used to some extent and are encouraged by the extension. Organic fertilization also occurs to some extent and is also encouraged, using crop residues, household waste and the little manure that is available (as livestock is quite scarce). Mineral fertilizers, on the other hand, are not used nor actively encouraged. Farmers consider mineral fertilizers expensive and they are not convinced that fertilizers will result in an economic benefit, as they already have some yield without fertilization. Crop protection products are also little used, because of the costs.

Farm size and fragmentation:

The farm sizes of the local farmers range between 0.5 to 2.5 acres (0.2 to 1.0 ha). The land owned by farmers is often fragmented in small plots (e.g. 0.25 acres) that are far away from each other. As a result, farmers spend quite some time walking between fields and homestead. Although few farmers own a motorcycle, most farmers walk. The small size of the farms is the result of the custom of inheriting the land to the children (sons) and dividing it amongst them. This has been occurring for many generations,

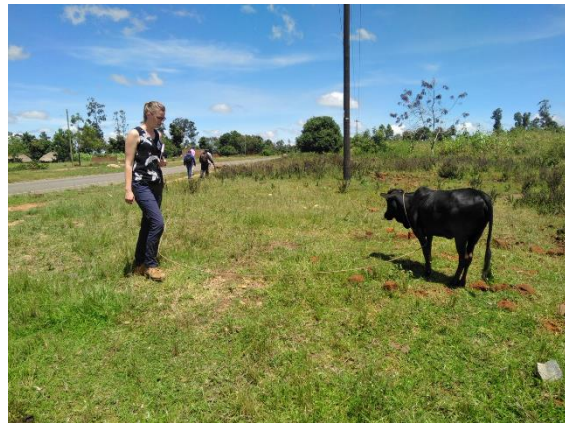
and each generation the farms become smaller. Moreover, the difficulty in buying land is an obstacle for consolidation of larger plots of land.

Minor role of cattle:

In general, there is little livestock in Arua. Farmers generally own some poultry and a (few) goat(s). Few farmers own some cattle (between 1 and 10 cows generally) and some own pigs. Due to the land scarcity in the area, the livestock must "compete" for land with the crops, and as a result there is little feed and room available, leading to low livestock ownership. The livestock that is kept is generally fed (a) through extensive grazing on communal grasslands, (b) are tethered, or (c) are left to scavenge. Closer to the Nile (not visited) more grazing land is available and more livestock.



Scavenging pigs, chicken, and geese.



Tethered full grown cow. Notice the very small size of the cow.

Lack of market orientation

In general, the level of market orientation of the farmers is low. It is uncommon for farmers to perform a cost-benefit analysis of their management practices. Although the farmers are keen on increasing their income, they make their decisions based on short-term factors and on gut feeling. For example, a farmer might decide not to grow tobacco because he "does not see any money in it", even though he has not calculated the costs and benefits of its production. Similarly, fertilizers are not used because of (a) the lack of cash in the short term and (b) the lack of understanding that this investment might lead to a net increase in income. Farmers are very constrained in their income, and credit is hardly available (except for tobacco), allowing them little room to manoeuvre financially. Moreover, their general level of education is very low (often primary school level). Both factors are likely contributors to the lack of market orientation of the farmers.

Tobacco farmers

Tobacco farmers are supported by extension officers from the tobacco companies rather than by the extension officers of the local government. They are therefore regarded as working in a separate system. The tobacco farmers are compelled by the companies to follow certain practices, such as a crop rotation of 1:6 (but in practice it is much shorter) and the use of inorganic fertilizers. However, it is unclear whether such rules are strictly monitored. The fertilizer is sold to the farmers at the beginning of the growing season as a loan, at a price below market price (128,000 rather than 150,000 UGX). After harvest, the input costs are deducted from the tobacco sales. The tobacco seedlings are started in the dry season (in January/February), planted at the start of the first rainy season (March), and harvested continually up to June or July. A second crop is sown on the same field after the tobacco, which benefits from the residual fertilizers. The tobacco is cured using wood-fuelled fire and transported to the tobacco companies, both of which tasks are very labour intensive.



Tobacco curing facility.

Post-Harvest

Storage

There are little to no storage facilities used for the crops. The harvested products are stored in bags inside the house. This has led to losses from rodents. Traditional (bitter) cassava varieties can be stored in the ground as it can keep for a few years.

Processing

There are almost no large-scale processing facilities in the area. The curing of cassava and tobacco is performed by the individual farmers at their homesteads. Maize and groundnuts are ground in small-scale mills, which are owned by some farmers and rented out. The flour is either consumed or packaged in small plastic bags and sold at the market. Cooking at the homes is normally done on wood or charcoal fires.



Elderly lady of the homestead preparing amaranth leaves.



Manually removing maize from the cob.



Curing cassava at the homestead.

Markets

The food is sold by the farmers (generally by women) at local markets including Arua city. Some of the food is also exported to Democratic Republic of Congo (DRC) by small aggregators. In Arua, the crops are sold at informal small stalls on the sidewalks and at the local market.



Matooke and bags of ground groundnuts being sold in Arua



Groundnuts drying and being sold in Arua

Consumption

Food Availability

It is unclear whether the food availability is high enough in Arua. Although there was no visible hunger problem, we did not manage to get a clear answer whether most families in urban, rural, and refugee settlement homes have enough to eat. During the workshop (Annex), stakeholders mentioned that both host and refugee communities depend on food aid.

Nutritional Value

The local diet is based to a large extent on carbohydrates (cassava, sweet potato, maize, yams, beans, matooke, rice). Meat is consumed 2 to 3 times a week in urban households and sporadically in rural households. Vegetables are also consumed but form a relatively small part of the diet. Although there is no data available on the local diet, the general impression was an imbalance towards starches.



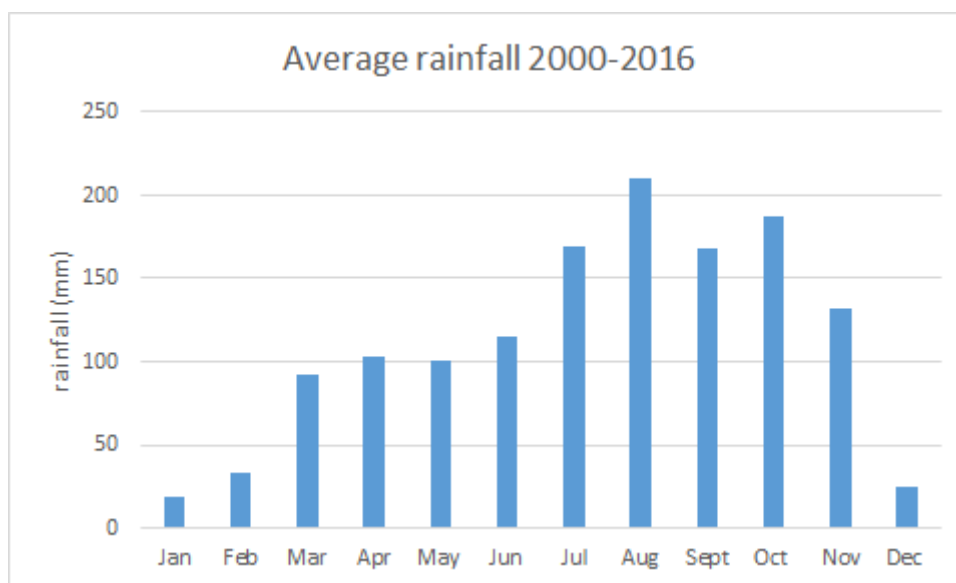
A local meal, with a cow-pea sauce on the left, and a plate of mostly carbohydrates on the right with yams, sweet potato, posho (maize porridge/bread), rice, matooke (plantain, yellow) and some sukuma wiki (green).

Business services

Both agro (crop) input shops and VET shops exist. They are quite abundant in Arua city, less and smaller agro shops are in smaller towns. The agro input shops sell a range of vegetable seeds (brands: EAS, EWS, Syova, BRAC, Royal seed) and only a limited number of pesticides and fertilizers. The few pesticides and (types of) fertilizers on sale is an indication of the low pesticide and fertilizer use in the area. One shop in Arua, Omia Agrobusiness Development Group, provides advice through a farm clinic. The client logbook showed that refugees have not visited this shop.

Environmental drivers

From Arbi Zardi researchers we received 16 years of monthly rainfall data (2000-2016) from the weather station at the experimental station in Arua city. The average annual rainfall is 1352 mm, which was about 200 mm higher than the local researchers initially thought and told us. There is a clear dry period from December to March, when a minor rainy season starts till July. Then, the main rainy season starts for four months. In general, two rainfed crops per year can be grown. For example, farmers grow tobacco in the minor rainy season and groundnut or cereals in the main rainy season.



The landscape in the West Nile region ranges from the highlands (\pm 1500 m) in SW, mid altitude (1200 m) around Arua city to the low altitude (700 m) towards East and North East. Rainfall in the highlands is higher than shown in the figure above, while rainfall decreases towards the East and North-eastern lowlands.

The soil characteristics show a similar spatial pattern, from more clay soils in the highlands, sandy loam soils in the mid altitude to gravelly soils towards a large part of the lowlands. However, along the Nile soils tend to contain more clay again. The soils in the Omugu refugee settlement were extremely gravelly/stony. Soils contained a lateritic layer which reduces rooting depth and soil water holding capacity. Cultivation is difficult where the layer is close to the surface. Refugees had removed stones from home gardens visited in the settlement:



Gravel/stony soil



Heap of stones from a cleaned field



Lateric layer close to the surface

Omugu settlement

1.5 hrs drive on bad roads NE of Arua



Demo plot of NIGI at Omugu settlement.



A homestead at the settlement.



Cooking done over wood fire.



Playground financed by an NGO.

Annex: Outcomes of the workshop mapping food systems Muni University, Arua, Uganda

October 8, 2019

GROUP I: FOOD SYSTEM OUTCOMES

Questions and answers:

a) *What are major constraints in achieving inclusive and sustainable food outcomes?*

- Unpredictable weather conditions (more unpredictable than in the past)
- Small landholdings (especially by refugees); landholding size decreases resulting a.o. in narrow crop rotations
- Poor accessibility of farms
- Crop and animal (FMD) diseases
- Labor availability
- Weak extension services – most extension workers are not trained on soil fertility, so their services are weak on this component. They are not able to detect deficiencies based on the physical appearance of crops.
- Deforestation in refugee areas.
- Mindset farmers is not market-oriented.

b) *What is the level of food security of host and refugee communities (e.g. Kcal intake, number of meals per day)?*

Both host and refugee communities depend on relief aid by WFP, but it also depends on season (host communities). See the report 2017 FSNA PRESENTATION with details on malnutrition and food security of host and refugee communities.

c) *What other income generating activities exist beside agriculture?*

Few, the government is the largest employer. In addition, petty trade, casual labor, Boda boda (motorbike driver) and construction.

d) *What is average household income in host and refugee communities?*

64000 UGX per month for host community (about 160 Euro)

43000 UGX per month for refugees – based on survey data by NGO Palm corps in 2016

e) *What is the major environmental externality of current food systems in Arua: 1) Deforestation 2) GHG emissions, 3) overuse of inputs e.g. veterinary medicines, pesticides, 4) erosion and soil nutrient depletion, 5) biodiversity loss, 6) water contamination, or 6) other?*

1. Deforestation, 2. Erosion and soil nutrient depletion, 3. Overuse of inputs (?), 4. Biodiversity.

f) *Is there information available on current land use and the rate of land use change?*

No information available, maybe government institutions have information.

GROUP II: SOCIO-ECONOMIC DRIVERS

Questions and answers

- a) What are the most important socio-economic drivers and how do they affect food system activities?
- b) Is there up-to-date information on the population (hosts, refugees)?
- c) Is there information on the change in refugee population, i.e. what is fluctuation in refugee population? Which share of refugees is here to stay?
- d) Is there information on how much food is distributed among host and refugee population?
- e) How is the trust / conflict between host and refugee communities? Are there signal that trust between groups decreases?
- f) What is the background of refugees, i.e. non-agriculture, crop farmers, livestock/(semi)nomadic, or mixed farmers?
- g) What policies are relevant for the functioning of the food system in Arua? What regulations/policies are enabling sustainable production and what regulations/policies are hampering sustainable production?
- h) Markets are based on money or barter (differences between host and refugee communities)?
- i) How does food aid affect local food markets? i.e. is there spill-over from refugee communities to other markets? And vice versa, i.e. host communities market products in refugee areas?
- j) How are farmers organized (e.g. cooperatives)?
- k) What is the share of imported (or exported food) in the total food production of Arua?
- l) Where is food being transported from and how?
- m) How is agricultural extension organised? Does it provide advice, credit, inputs for free, etc.

GROUP III: FOOD SYSTEM ACTIVITIES

1. Specific issues:

1a) What are the food preferences of consumers in host and refugee areas? (typical diets) What are the reasons for these preferences?

The most commonly consumed crops are cassava, beans, groundnuts, cow peas, millet, maize, matooke (plantain), sweet potatoes. Both local and improved varieties are produced, but in general people prefer the taste of the local varieties, except for cassava, as the new variety is less bitter requiring less preparation time. Old varieties have a longer shelf life and therefore are more expensive.

1b) what is the average farm size in host communities?

Average land holding is 0.5 – 2.5 acres for local people, and the household size is around 6 persons. Lowland areas along the Nile have larger more land and is less populated. Farms closer to the town of Arua tend to be smaller; People in rural areas have larger pieces of land but do not utilise the land fully due to laziness and a negative mind set. The reasons for this negative mindset are the fact that some people do not see money in agriculture, and the fact that in school they had to plough land as punishment, and as a consequence see agriculture as a punishment.

1c) how much production land do refugees have?

Refugees have 50 or 30m² of land, depending on the settlement. The household size is around 9 people.

1d) In which value chains formal contractual agreements are used? And are they respected?

Little to no contractual agreements are used. There are some farmers who do some contract farming of crops such as simsim, okra, and chilli for larger companies. The seeds are given to the communities by the company and they grow them in large quantities. Companies mentioned are Mukwano Industries and Olam. There are also some informal working agreements between refugees and host communities whereby they have a central garden in which they produce crops in groups.

b) Livestock activities:

1) Is there information available on livestock numbers by species and if possible by breeds (for example local vs exotic, or dairy vs beef)

There is not a lot of livestock production in Arua. The most common livestock in the area are goats, cattle, pigs, sheep, and poultry, but farmers have very few of them. Local varieties are preferred due to their resistance to diseases but sometimes crossbreeding takes place for dairy production. The manure of the cattle is rarely used to fertilize fields, as it is too little to carry. Goats are kept for meat. Meat is eaten probably once a week in the villages and two to three times a week in the cities. Pork and Chicken is the main meat in the villages. No mention is made of available data.

2) What are commonly used livestock feed resources?

Mainly grazing along fields and roads.

3) What are the opportunities for livestock production in the area?

Poultry production is seen as a livestock opportunity. There is a large demand, and more could be produced. Currently poultry is limited by the high cost of the feed. The feed is expensive because it is maize-based, which is not produced a lot in Arua and so it is expensive. There might be opportunities in developing a poultry feed that is based on local products such as cassava residues.

c) Crop activities:

1) what are the major crops in Arua? And what are typical yields?

The main crops are cassava, beans, groundnuts, cow peas, millet, maize, matooke (plantain), sweet potatoes.

Crop	Local variety yields (kg/acre/season)	Improved varieties (kg/acre/season)
Cassava	700-800	14,000
Beans	150-300	1,200
Simsim (sesame)	600-700	3,000

2) *what is the typical growing season of the major crops?*

Not answered.

3) *what is the typical seed source, farm-saved seed, from an agro shop, etc?*

Many farmers use farm-save seed from traditional varieties, new improved varieties are bought from agro-input shop.

4) *External inputs such fertilisers and pesticides are used?*

Overall, few external inputs are used, except for tobacco.

5) *What are the opportunities for crop production in the area?*

There is a market available for food crops, and most crops grow very well. Three fruit crops that are currently being promoted in the region are coffee, citrus, and mangoes. Crops like cassava and simsim are becoming cash crops. There is also interest in coffee from the region, as it is produced without chemicals. Robusta and Arabica both do well in Arua district, although in different counties.

6) *What is the reason for growing a crop (for home consumption, selling price, low risk)?*

Food crops are grown for home consumption and surplus is sold. In the case of tobacco, it is grown as a cash crop. For the food crops, both local and improved varieties are grown. Some reasons why farmers prefer to grow local varieties are:

- They prefer the taste of the local varieties
- The shelf life of local varieties is longer
- With local varieties, the farmers can keep seeds for planting in the next season, while for improved varieties it is necessary to buy the seeds each year
- The price of the local varieties of cassava and groundnuts is higher
- For cassava, the local varieties can remain in to ground for up to 5 years, while the improved varieties start rotting after a year already
- For groundnuts and simsim, local varieties have a higher oil content

Some reasons why farmers prefer growing the improved varieties:

- The new varieties have higher yields
- The new varieties yield more quickly and look better (e.g. sesame and tomato)
- For cassava, the new varieties are less bitter and require less post-harvest treatment
- Improved varieties are more resistant to pests and diseases

d) Post-harvest activities:

1) *What kind of post-harvest practices (e.g. transport in bags, crates) and techniques (e.g. curing, drying, cooling, etc.) are used for which agricultural products?*

Cassava is chipped, dried in the sun and subsequently grounded into flour.

2) *What are the most common reasons for postharvest losses for agricultural products. And how much is lost (both kg's and %)? Are there data sets available? Is this monitored? Possible reasons for loss:*

Reason for loss	Estimate	Clarification
<i>Rodents, birds</i>	± 50%	Rodents are a big source of loss, as there are virtually no good storage facilities and people keep their harvest inside their homes. Storage facilities were used before, but a lot was stolen from them so people resorted to storage in their homes.
<i>Fungal diseases/rot</i>	± 20%	
<i>Wilting/End of shelf life</i>	± 0%	Food is scarce so it is consumed quickly and does not reach the end of its shelf life.
<i>Over ripeness</i>	± 1%	Virtually no food is lost due to over ripeness, except for rice and simsim, which start to germinate if they are harvested too late.
<i>Insects damage</i>	± 2%	There is some damage from fall army worm, and there are very high levels of damage of fruit fly to mango trees.
<i>Loss of weight</i>	Not answered	
<i>Change in structure/flavour</i>	± 0%	Change in structure or flavour are not a reason to discard the food. It is consumed anyways.
<i>Pressure damage</i>	Not answered	
<i>Handling damage</i>	Not answered	
<i>Food surplus waste</i>	Not stated	During harvest periods, meals are sometimes made with more food than necessary. The leftovers are thrown away.

3) *What are the limiting factors in the application of postharvest technologies? Finance & investments? Knowledge/know-how? Lack of qualified staff? Technology is locally not available?*

The main reasons mentioned are (a) the lack of extension officers (currently the ratio is 4,000 farmers to 1 extension officer), (b) the lack of knowledge, and (c) the lack of financial resources.

e) Food processing:

Are there food processing companies in Arua? if so, what agricultural products do they use and what products do they make?

There are very little food processing companies in Arua:

- There is a fruit processing company that is lying idle because of the lack of a reliable power source.
- The company Kawacom buys and processes the local coffee production.
- For simsim there are some small companies who aggregate the production and bring it to Kampala.
- There are some flour milling services for maize and cassava by individual farmers who have a mill.

Extra:

Some of the main challenges in food production mentioned by the group are:

- Land fragmentation: people own very small plots that are far away from each other. Every generation the land of the parents is inherited by the sons and split amongst them.
- Climate change: rainfall is becoming increasingly erratic and farmers are not sure how to deal with this
- Attitude: there is a negative attitude towards being a farmer and the effort it requires
- Land degradation
- Lack of extension officers: the current ratio is 1 officer to 4000 farmers, while the aim is to have a ratio of 1 to 500. There is not enough money at the extension office to employ more people. While some people are retiring, they are not being replaced with new officers.

GROUP IV: ENVIRONMENTAL DRIVERS

General comment: for a food systems analysis it is advised to use a larger area than Arua district of which the administrative borders recently have been adjusted. It is better to analyze the West Nile region (area east of the Nile), or the old Arua zone, which is smaller but still includes the three agro-climatic zones of the West Nile region, i.e. the highlands SE of Arua city, the midlands around Arua city and the lowlands close to the Nile.

Questions and answers:

- a) *What are the most important environmental drivers and how do they affect food system activities? E.g. soil quality (shallow, low in organic matter, etc), climate (rainfall, temperature, etc.), lack of irrigation water, loss of biodiversity*
- Poor soils at low altitudes
 - Unpredictable rainfall
 - Land size
 - Irrigation is not common though there is a potential especially for horticulture. NEMA controls/regulates the use of water for irrigation. Water harvesting is also not common. Some farmers interconnect their farm ridges to hold some moisture for some time, which is slowly used by plants.
- b) *What is the soil fertility of the soil in relation to crop yield? What is the nutrient status? And organic matter?*
- Fertilizer use is low, poor accessibility to fertilizer, relatively good soils in high and mid altitude, compared to low altitude.
- There is a general perception that the soils are good and do not need to be fertilized. In addition, the use of chemical fertilizer is believed to destroy the soil.
- c) *How is the rainfall distribution in relation to crop yield? Is it sufficient or is irrigation necessary?*
- Rainfall patterns are unpredictable. There is need for irrigation, water harvesting is minimal. The need for irrigation would depend on the type of crop cultivated. High value crops (non-staple crops) like vegetables are more likely to require irrigation.
- The low altitudes would require more irrigation because rainfall is less in these areas, and the soils more sandy.
- d) *In what manner agriculture is affected by climate change? (less rainfall, change in rainfall distribution, increased temperature, etc.) and is this monitored by an organisation?*
- Weather is monitored by the department of hydrology at national level. However, the local meteorological station at the airport is poorly equipped and there is no consistent data recording activity.
- e) *What are the available water sources? And how are they used for agriculture? Is there a government body responsible for monitoring agricultural water use and quality?*
- Water is obtained from the rain, streams and ground water. Those closer to the Nile get water for irrigation and graze their livestock along the banks of the river especially during the dry periods. In some areas groundwater is 80 m deep and thus not an opportunity for small farmers.
- f) *What are the major land degrading processes affecting land productivity, i.e. wind and water, erosion, soil nutrient depletion, soil organic matter depletion, soil acidification, compaction, etc.?*
- Deforestation is a major practice that affects land degradation. Erosion is also common. The practice of soil fertilization (both organic and chemical) is uncommon. Crop residues are commonly taken out of the farms either during harvesting or are left for animals to graze on. This leads to continuous nutrient mining on farms which is not yet realized by farmers.
- g) *What is more limiting production land availability or labour availability?*
- Labour is the more limiting factor. Most youths go to work as boda boda (motorbike) drivers or labourers in the neighboring towns. Wages for unskilled labour in Arua ranges from 4000 – 5000 UGX (€ 1 – 1.3) for half a day of work to about 10000 UGX (€ 2.6) for a full day of work.

Land rent is about 45 USD per year. Only host communities have access to communal land. They can rent out their owned land to refugees. Sometimes there is a limitation to land use due to the accessibility of the land.