TOWARDS A NUTRITION SENSITIVE AGRICULTURE IN THE WEST NILE REGION

Assessing Nutritional Knowledge, Attitudes and Practices of the West Nile Region

Research
REPORT

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TOWARDS A NUTRITION SENSITIVE AGRICULTURE IN THE WEST NILE REGION

Assessing Nutritional Knowledge, Attitudes and Practices of the West Nile Region

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EXECUTIVE SUMMARY

Agriculture and nutrition are closely related with Agriculture as a source of dietary nutrients and nutrition as a nutrient sink. The link by which agricultural production is driven by nutritional knowledge and practice is called Nutritional Sensitive Agriculture (NSA). NSA is an approach towards food and nutritional security, whose success results in increased productivity, reduced morbidity and enhanced socio-economic status.

This study set out to establish the levels of nutritional knowledge, attitudes and practices (KAPs) among communities of the West Nile Region districts of Nebbi, Zombo and Yumbe.

The study used a qualitative research approach and the descriptive cross-sectional survey research design was used to derive learning for KAPs. Focus groups discussions were also employed to establish the gender perspectives of nutritional practices. Triangulation of nutritional practices was done through a three month ethnographic study and drivers towards NSA done through literature review.

Nutritional knowledge levels were in a range of 37%- 60% ±SD. Nutritional attitude ranges of 35% - 60% ±SD of the study population. Nutritional practices were characterized by 2.7 meals per person per day, inadequate serving portions (37.58%) and low nutritional diversity (60.37%). Pearson's correlation revealed a weak negative relationship between gender and nutritional practices like number of meals per day ($r = -0.21917$), adequacy of serving portions ($r = -0.1989$), adequacy of food diversity ($r = -0.1403$) and sufficiency of food supply throughout the year ($r = -0.1079$) at a P value < 0.05.

The study established the region's preferred traditional crops to diet as cassava, sorghum, millet, beans, groundnuts and sweet potatoes. Home preparation and processing practices of some of these foodstuffs were found deficient at unlocking nutrients, especially from foods containing anti-nutritional factors like sorghum, millet and cassava.

The study predicted that offering nutrition education among the communities and its linkage to agricultural production might modify nutritional habits, behaviors and attitudes which then might result in desired nutritional and agricultural practices including a Nutritional Sensitive Agriculture.

This study set out to establish the levels of nutritional knowledge, attitudes and practices (KAPs) among communities of the West Nile Region districts of Nebbi, Zombo and Yumbe.

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LIST OF ABBREVIATIONS

AFARD	The Agency For Accelerated Regional Development
BMI	Body Mass Index
CLTS	Community Led Total Sanitation
COVID	Corona Virus Disease
DES	Dietary Energy Supply
FAO	Food and Agricultural Organization
FDA	Food and Drug Authority
FLI	Food Loss Index
FBS	Food Balance Sheet
FSA	Food System Approach
HCN	Hydrogen Cyanide
IDA	Iron Deficiency Anaemia
IDR	Import Dependency Ratio
JIT	Just-In-Time manufacturing
KAPs	Knowledge, Attitudes and Practices
NSA	Nutritional- Sensitive Agriculture
PoU	Prevalence of Undernourishment
PPD	Post-harvest Physiological Deterioration
SSR	Self- Sufficiency-Ratio
UDHS	Uganda Demographic and Health Survey
WENAGIC	The West Nile Agriculture Improvement and Conservation Project
WHO	World Health Organisation
WNR	West Nile Region

1.0 BACKGROUND

Early 2020, The Agency for Accelerated Regional Development (AFARD) launched a new AFARD Strategy 2020-2025 to guide its contribution to the socio-economic transformation of the West Nile region. One critical pillar of intervention is "nutrition-sensitive agriculture" (NSA). This intervention was planned under the West Nile Agriculture Improvement and Conservation Project (WENAGIC Project) of AFARD.

The West Nile Agriculture Improvement and Conservation Project (WENAGIC Project), a 6-year project (2016-2022) sought to contribute to the Sustainable Development Goal 1 (end poverty) and Goal 2 (zero hunger) with a goal, "to support a sustainable and equitable food and income security of 450 smallholder farmer households (with 3,150 people) in Yumbe district, Uganda."

The specific objectives included; (i) To increase smallholder farmers' agricultural production and productivity by 85%; (ii) To improve the dietary intake of locally available foods in a gender sensitive manner; (iii) To support smallholder farmers to diversify their livelihood activities; and (iv) To build the capacity of smallholder farmer groups into viable village development groups able to meet their member's needs.

The WENAGIC project registered successes include; i) Diversified food being available and shared equally among men and women, ii) All households having vegetable gardens and fruit trees, iii) Borders of gardens planted with firewood or timber trees, iv) At least 200 households use improved energy saving stoves; v) Savings culture has been adopted; vi) Women own productive assets with improved social space and self-esteem from their family economic contributions.

This study explored the WENAGIC path to a "Nutrition-Sensitive Agriculture" (NSA).

Nutrition is a branch of science that deals with the way food is consumed, digested into soluble components that the body can absorb. Absorbed components by the body are assimilated such that it derives energy, materials for its development, growth and health. Nutrition is commonly viewed under two perspectives; Individual nutrition and Community level nutrition. Cumulative improved Individual nutrition results in improved community nutrition.

The nutritional status of any community is an indicator of that community's food security (Shaw (2007). The World Food summit of 1996 defined food security as a stable combination of food availability, food access and food utilization. Food availability involves food production, distribution and exchange. Food access involves food affordability, allocation and preferences. Food utilization entails the nutritional value derived after consumption of food which includes; social value and safety value of the food product. Food security is achieved when the above three variables are realized for a community in stability over a long time. Agricultural production is the main contributor to food availability Fresco (1997).

Nutrition-sensitive agriculture (NSA) is a food-based approach to agricultural production that puts nutritionally rich foods and dietary diversity at the heart of overcoming under-nutrition, over-nutrition and micronutrient deficiencies. The NSA concept aims to narrowing the gap between available and accessible food and the food needed for a healthy and balanced diet for all people.

To support the NSA critical pillar, in the year 2021, AFARD conducted a study titled ***"Assessing Nutritional Composition, Anti nutritional factors and Shelf stability of selected traditional foodstuffs of West Nile Region."*** The study focused on the traditional foods of the West Nile Region. The study results summarized the nutritional compositions of key plant foodstuffs under different categories, their nutritional stabilities and the common anti-nutritional factors associated with some of these foods. The study pointed at the important traditional crops, their nutritional potentials and their limitations as nutritional sources and potential food security tools.

The current study ***"Assessing Nutritional Knowledge, Attitudes and Practices of the West Nile Region"*** focused on aspects of individual and community nutrition.

The study was guided by theoretical models including the food systems approach model by Van Berkum, Dengerink, and Ruben (2018) and Entry point into Nutrition Sensitive Agriculture by Jaenicke and Virchow (2013).

The indicators of community food security were extrapolated from those of National Food Security provided by the National Food Balance sheet 2013-2018 summarized in UBOS (2020).

AFARD arrived at this part of the strategy towards a nutrition sensitive agriculture after observing that the statistics of levels of food and nutritional insecurity in the West Nile region were averagely higher than the National averages. By 2019, the region had relatively large and young native population of 3.1 million people and 58.5% of the total refugee population in Uganda, equivalent to 704,902 people majorly from South Sudan and the Democratic

Republic of Congo (AFARD strategic plan 2020-2025) *https://www.afard.net/publications/policy-documents/172-afard-strategy-2020-25/file*

Problem Statement

During their preparatory work, The AFARD strategic planning group identified three major impediments to the socio-economic transformation of the West Nile Region. These were; food and nutritional insecurity, Income insecurity and political marginalization of all or certain categories of the people of West Nile.

Food and nutrition insecurity was attributed to; low food production characterized by subsistence farming, limited income with which to buy food from the market, limited awareness of nutrition and poor sanitization and hygiene practices and high population growth rates.

The food and nutrition insecurity was reported to be responsible for 56% of Iron Deficiency Anaemia and 34% stuntedness among the under fives in this region. Six in every 10 households eat two non-nutritious meals a day. 48% of children in the region are deprived of food; 16% of children in refugee hosting districts eat less than two meals daily. Also Mandre & Kogi-Makam, 2021 reported West Nile region to be suffering acute malnutrition at a rate of 3.9% among under fives, with refugee communities suffering slightly less (3.6%) as compared to the host communities (4.1%).Earlier studies have shown the food system in Arua district to be under performing and thus incapable of addressing rapid changes within the region including refugee influx, rapid urbanization and population growth Rozemeijer and Roefs (2021).

To address the effects of the high food and nutrition insecurity, AFARD proposed to employ climate smart and nutrition-sensitive agriculture practices and community led total sanitation (CLTS) approaches.

This study assessed the knowledge, attitudes and practices regarding nutrition among community members with the view of identifying training gaps, and drafting approaches towards a nutrition sensitive agriculture within the communities of West Nile. The ultimate objective of the study is to increased production and consumption of diversified foods in hygienic homes

Study Purpose

The study aimed at assessing the nutritional knowledge, attitudes and practices among selected Districts of West Nile region (Nebbi, Yumbe, and Zombo). The study was done to inform approaches to food production, planning, preparation & processing and preservation that ensure that the valuable macro and micronutrients are optimized. The intended outcome after rolling out activities guided by this study is food and nutrition security for the West Nile Region.

Overall objective

The overall objective was to assess the nutritional knowledge, attitudes and practices of among selected Districts in the West Nile region.

Specific objectives

The study;

I. Profiled the current nutritional knowledge, attitudes and practices among selected Districts in the West Nile Region.
II. Scoped the gender perspectives of nutritional practices of the West Nile Region
III. Explored the value chains for the common traditional foodstuffs from selected Districts in the West Nile Region.
IV. Assessed the drivers towards NSA in West Nile Conceptual FW & Hypothesis (consider FG Discussions among men (bars))

Significance of the study

This study intended to propose the critical path in the food system of the West Nile Region aiming at food and nutritional security and its linkage to agriculture an intervention that is now called Nutritional Sensitive Agriculture. While the food systems activities are clearly known and the possible paths are numerous, the critical path to a resilient and sustainable system is unclear. The conceptual framework below was used to predict this critical path.

Justification of the study

Food and nutritional security is very essential for any community, if this community is going to realize socio-economic gains with time. Food plays its roles in a sequential manner in order of improved food security from curbing food shortage mortality, to reducing nutrition linked morbidity and finally to increase human productivity. As such, the primary role of nutrition is maintenance of the body's physiological needs and the secondary is provision of raw materials for body's production which includes growth and work. A badly fed community has a higher morbidity cost and low production output.

Food consumption scores for the West Nile and Northern region by UBOS 2020 per household were reported to be 78% "Acceptable", 17% "borderline" and 5% "poor". Six in every 10 households eat two non-nutritious meals a day. 48% of children in the region are deprived of food; 16% of children in refugee hosting districts eat less than two meals daily.

Morbidity statistics for the West Nile Region were at; 56% of Iron Deficiency Anaemia and 34% stuntedness among the under fives. Also Mandre & Kogi-Makam, 2021 reported West Nile region to be suffering acute malnutrition at a rate of 3.9% among under fives, with refugee communities suffering slightly less (3.6%) as compared to the host communities (4.1%). 9.7% of women between 15-49 years were under weight, with more women undernourished (BMI<18.5) in rural areas than the urban. The Dietary Energy Supply (DES) which indicates total energy consumption per person and also predicts energy available for work was reported to be 2,083 Kilo Calories per person. For the same period, Swaziland, China and Canada DES were 2,360, 2,940 and 3,590 respectively. These figures predicted low work output among working age persons in Uganda as compared to these countries.

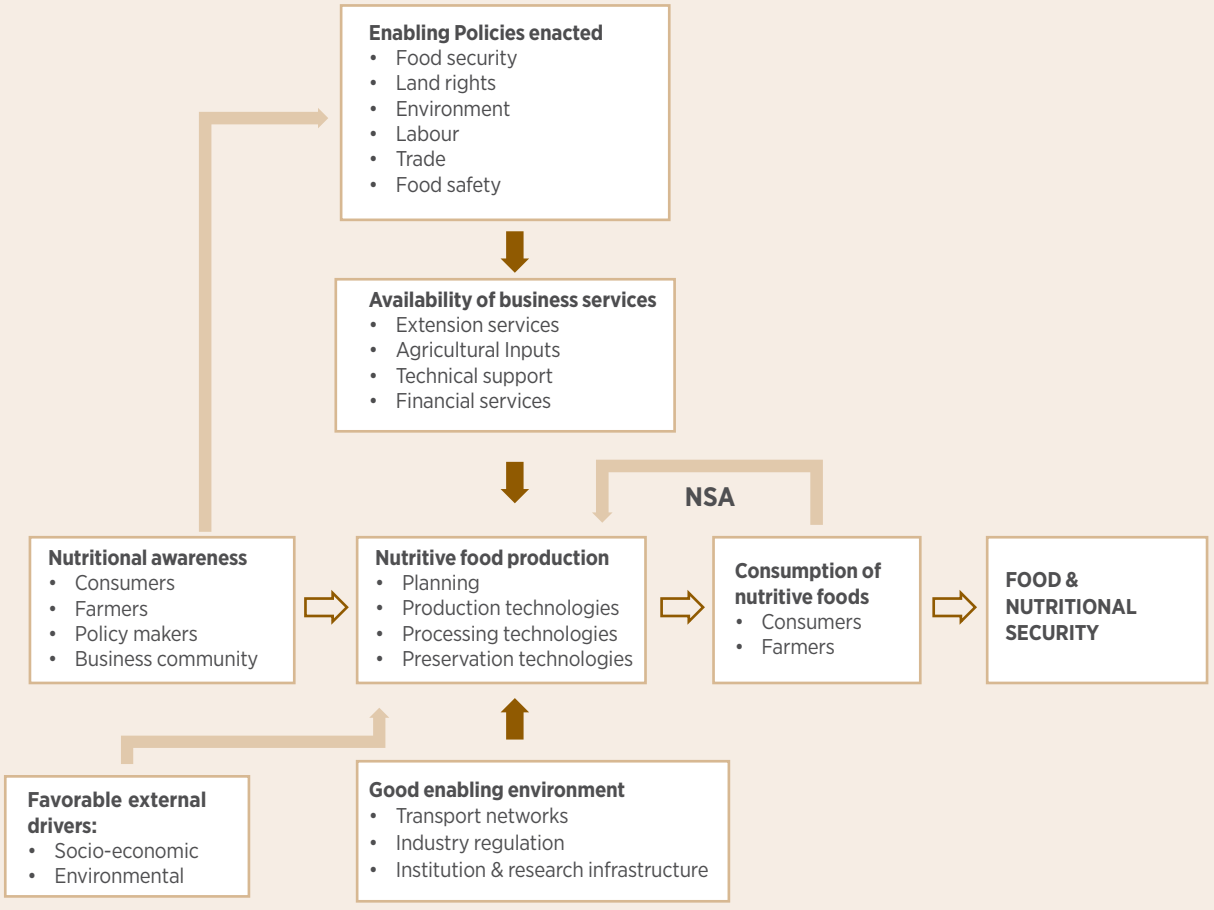
Interventions through this study towards food security in the West Nile are expected to address the above issues of food consumption, morbidity and productivity among the residing communities.

Scope of the study

The scope of this study was to propose approaches towards NSA for the West Nile Region basing on information collected from the two highlighted studies conducted in Nebbi, Zombo, and Yumbe districts.

Figure. 1 : Conceptual Framework

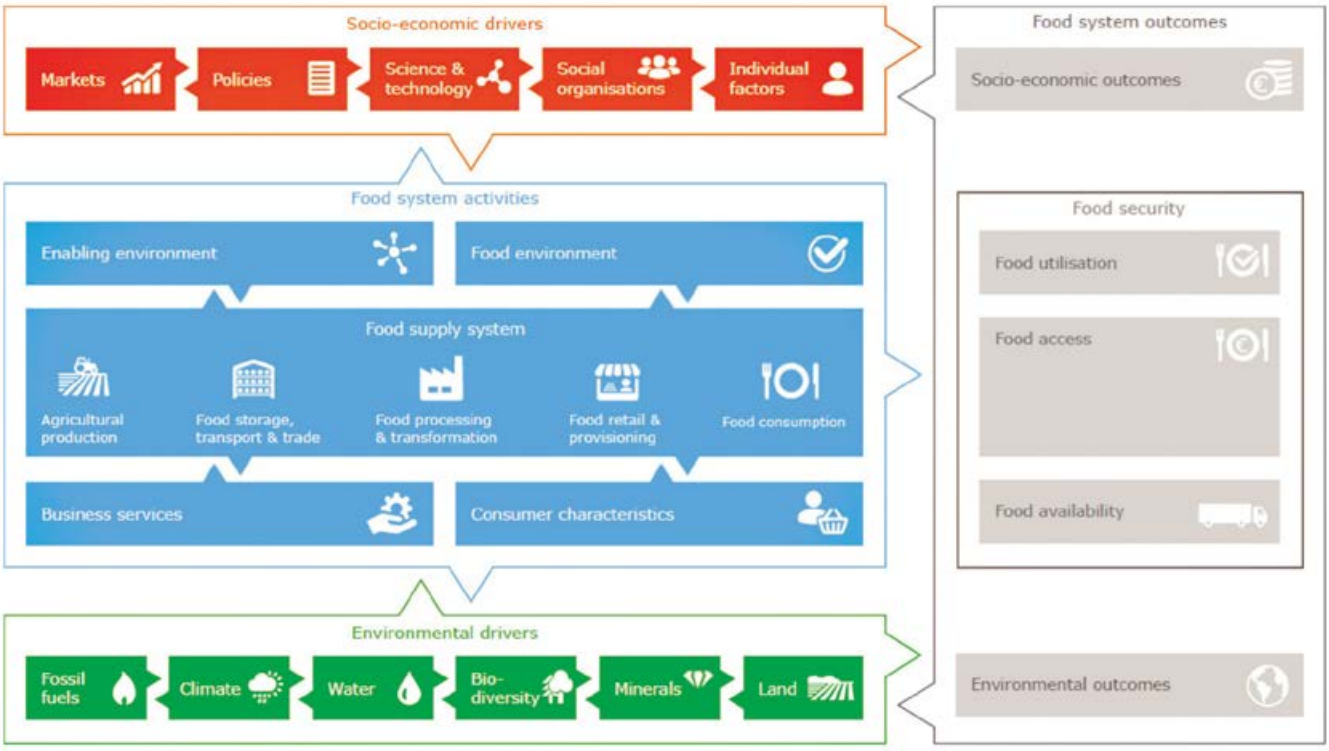
Diagrammatic conceptual framework for the implementation of NSA in the WNR



2.0 BRIEF LITERATURE REVIEW

In order to broadly guide the study towards NSA planning and rollout for AFARD, systems thinking approaches, ones described by the Food Systems Approach (FSA) were sought Van Berkum et al. (2018). These are shown in Fig. 1 below. Earlier approaches to NSA were also visited and their details are shown in Fig. 2 below Jaenicke and Virchow (2013)

Figure. 2: A way of mapping the relationships of the Food System to its drivers (Van Berkum et al., 2018)



The model above presents a food system as a complex of inter-dependent activities and the trigger of food demand automatically trigger the running of all the inter-dependent activities. The model comprises of four major chunks; the food supply chain, its environmental drivers, its socio-economic drivers and the food system outcome. The food supply chain chunk is supported by activities and enablers.

The Food System Approach (FSA) analyses the relationships between the different parts of the food system and the outcomes of activities within the system in food security, socio-economic and environmental terms. Feedback loops are a distinguishing factor in systems thinking: they occur between parts of the food chain (production, processing, distribution and consumption) and from the socio-economic and environmental outcomes of food production and consumption (such as food security and soil depletion) back to that production and consumption. The approach emphasizes the non-linear processes in the food system, and the possible trade-offs between policy objectives. The food systems approach highlights the interdependent nature of the agricultural sector. It shows how production systems, consumer behaviour, food security, climate change, natural conditions (i.e. the available natural resources) and socio-economic trends interact with one another. It prevents people from becoming mired in silo thinking, whereby possibilities for enhancing food security are sought within a single subsystem without taking into account the effects of an intervention in other parts of the system, thereby overlooking possible trade-offs. Systems thinking also broadens the perspective when seeking solutions for the root causes of problems such as poverty, malnutrition and climate change (Van Berkum et al., 2018).

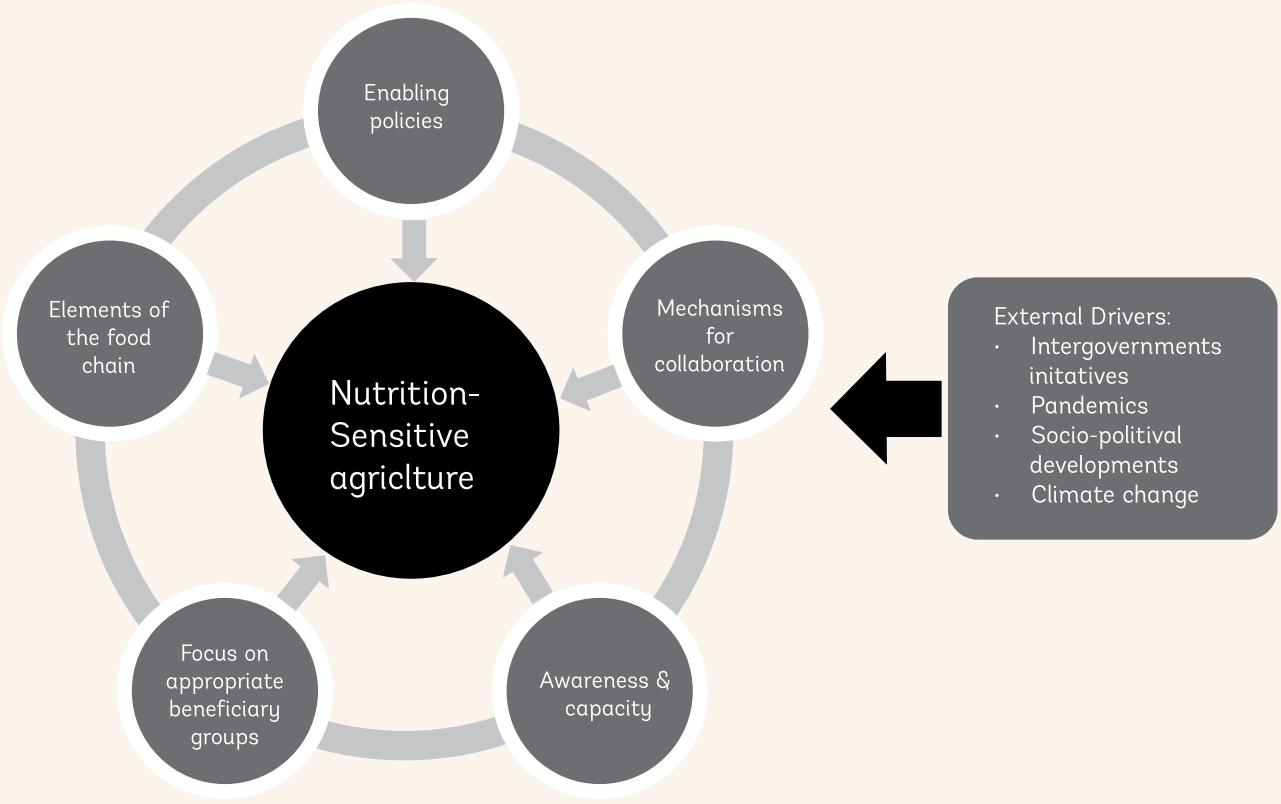
The approach offers at least three benefits. First, it provides a checklist of topics that should at the very least be addressed when it comes to improving food security, certainly in relation to other policy objectives. Second, FSA helps to map the

impact of environmental and other changes on food security by pointing to the various vulnerabilities of the food system. In that sense the approach can contribute to the search for possibilities for strengthening the system's resilience to climate changes or other shocks. Third, it helps to determine the most limiting factors for achieving food security, and hence identify effective interventions aimed at improving food security (Van Berkum et al., 2018).

While the FSA offers a helpful structure for analysis of the food system in the WNR, it falls short on the following:

1. The research process steps for giving an action perspective to the analysis in order to remove bottlenecks that contribute to the current food insecurity in WNR and improve the performance of the food system;
2. Embedding the analysis in a trans-disciplinary research framework that engages local stakeholders in the understanding as well as improvement of the WNR food system. Such embedding is necessary to develop and implement knowledge and research tools with stakeholders as the main change actors.

Fig. 3. Entry points for fostering nutrition-sensitive agriculture (Jaenicke & Virchow, 2013)



This model by (Jaenicke & Virchow, 2013) has complementary elements to the food system approach at the operationalization level. It introduces two internal drivers; awareness capacity and mechanisms for collaboration. These two drivers point to the need for shared knowledge among food system participants and to the need for a convenient and reliable information exchange system within the food supply.

Use of the two guides above aided this study by broadening the scope of investigation, pointing to the imperatives, their drivers and the outcomes. The imperatives included the activities along the agricultural value chain. The drivers included the socioeconomic and the environmental drivers. The outcomes included food security, socio-economic and environmental outcomes. The drivers of a food system

according to Berkum 2018 are identified as socio-economic drivers and environmental drivers. The socio-economic drivers include markets, policies, science & technology, socio organization and individual factors. The environmental factors include minerals, climate, water, biodiversity, fossil fuels, and land & soils.

With this broadened view of study into NSA roll out strategies and policies, long term sustainability and resilience are factored in.

The National Food Balance Sheet by UBOS 2020, pointed to the probable metrics in measuring food security success. It pointed to a need of establishing baseline information before intervention roll-out. A community is said to be food secure when it has adequate Dietary Energy Supply (DES) of its individuals to support physiological activity and to do work. The community's food supply must also be majorly dependent on production from within that community, rather than importation from other communities ((Self-Sufficiency-Ratio (SSR) Vs Import Dependency Ratio (IDR)). Apart from the above three, other two indicators of food security are Food Loss Index (FLI) which measures proportion of food produced that is lost after harvest. The last indicator is Prevalence of Undernourishment (PoU) which uses anthropometric data from health centers. In order to track food security within the West Nile Region (WNR) before and after implementation of NSA, the above five indicators need to progressively be monitored.

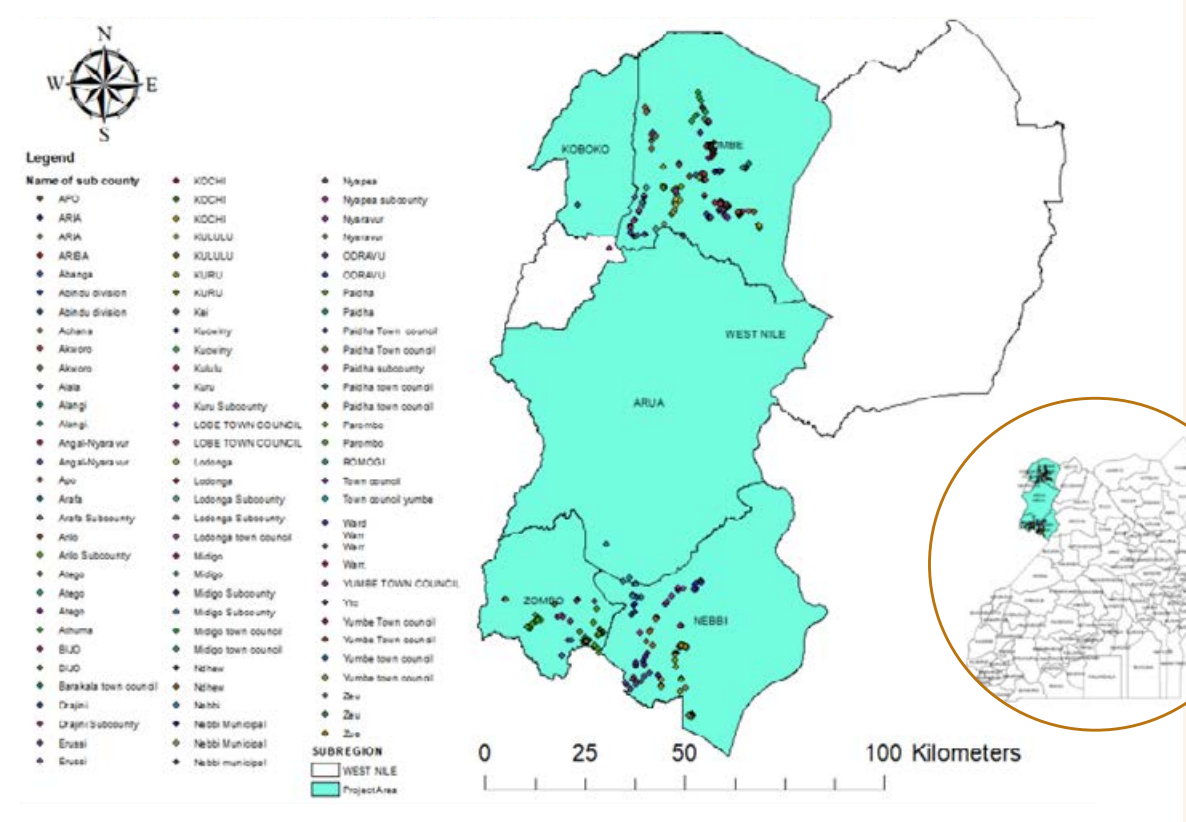
Nutrition Sensitive Agriculture (NSA) is an approach to Food Security. NSA is analogous to the contemporary PULL system of Just-In-Time (JIT) manufacturing. In JIT supply chain, demand prompts manufacturing as opposed to the PUSH system where items are manufacture to stock and availed to the market for probable demand. NSA is expected to operate by the consumers demanding what they need nutritionally and this will be interpreted in what is produced on farms.

3.0 METHODOLOGY

Geographical area of study

The study was conducted in the West Nile Districts of Nebbi, Yumbe and Zombo targeting household heads or persons in charge with ages of 20 years and above.

Figure 4: Map of Uganda highlighting The West Nile Region



Research approaches, Design, Sampling and Data collection methods

The study had four objectives and the research approaches were different for the different objectives.

Objective 1: This objective profiled the current nutritional knowledge, attitudes and practices of the major traditional foods in the West Nile Region. This Objective was studied using a qualitative research approach and the descriptive cross-sectional survey research design was used. Method of data collection used was by individual survey interviews. The survey was triangulated with a three months ethnographic study to capture nutritional practice. Three ethnographic data collectors, one for every district were involved in the data collection.

Objective II: This objective scoped the gender perspectives of nutritional practices of the West Nile Region. Like objective I, this Objective was studied using a qualitative research approach and the descriptive cross-sectional survey research design was used. Method of data collection used was by individual interviews, triangulated by focus group discussions. Six focus group discussions (FGD) were conducted in total, with two FGDs per district, one with men and one with women.

Objective III: This objective explored the value chains for the common traditional foods of the West Nile Region. This objective was studied using a qualitative research approach through six (6) key informant interviews two per target district. The target key informants were local agro processors.

Objective IV: This objective assessed the drivers towards NSA in West Nile. This objective was studied through review of literature. Journal papers from 2010 to date were considered for the review. Key words for the search among indexed journals were; "Nutritional Sensitive Agriculture", "Nutrition Sensitive Agriculture Drivers", Food Systems Approach", "Food System Drivers".

Survey interviews

Sampling of respondents was done using stratified random sampling, with the sub counties forming the sampling strata.

The data collection team received a four day team preparation, during which they were introduced to the study, its objectives, approaches and tools. The team was given a copy of the letter, permitting the research to be conducted. The team went through a session of preliminary data collection to acquaint themselves with the interview guide and the data obtained was subjected to preliminary analysis. This activity aided the survey tool fine tuning. The Data collection tool used for the study was ODK Collect Software version 2022.3.6.

Data was collected using pre- approved and fine tuned survey interview guides. The interview guides were uploaded onto the data collection software and permission accorded to each member on the data collection team. While in the field, consent to participate in the study was sought from the respective participants. Participants received a description of the study and the study objectives prior to their signing the consent forms. Data was then collected electronically through individual interviews. The data collectors were able to edit their entries before final submission after which, editing rights were denied.

Data quality control was done in two ways. The reliability of the data was ensured through senior peer review of the data collection tools to ensure that the question were relevant and exhaustive of the subject. The validity of the data was ensured through number of responses collected which was a total of 936 and the geographical coordinate to cater for convenience sampling and coverage.

Electronic data received was cleaned to remove test data sets and outliers. Necessary corrections were made in consultation with the respective field staff. After these corrections, finalized databases were stored. From the databases, data files organized by research objective were created and subjected to descriptive statistical analysis using Statistical Package for Social Scientists software (version 16). Interpretations of the data by objective are given in the next chapter.

Ethnographic studies

Three suitably selected and trained data collectors, one per district were located within the communities for a period of three months. The data collectors were equipped with electronic log books and physical note books. The electronic log books were supported by ODK Collect Software version 2022.3.6. data collected was coded and processed in a similar way like survey interview data.

Key Informant interviews

Six (6) key informant interviews, two per target district were conducted. The target key informants were local agro processors. Information collected was transcribed cleaned and coded and analyzed using excel.

Focus Group Discussions

Six focus group discussions (FGD) were conducted in total, with two FGDs per district, one with men and one with women. A pre –approved FGD tool was used for data collection. Two data collectors, one leading the discussion and the other recording were involved. The community discussants were maintained at 12 persons per discussion. Each discussion took a maximum of two hours. The discussions were maintained as monologues to ease free information sharing. Information collected was transcribed cleaned and coded and analyzed using excel.

Review of Literature on drivers towards NSA

Drivers towards NSA were sought through a literature search. The research terms were selected; inclusion and exclusion criteria were then defined. Search for relevant papers were done.

Ethical Consideration

Ethical approval for this study was through the National Research Information Management System (NRIMS) and obtained from its certified member; Busitema University higher degrees, research and ethics committee. A letter of permission to conduct the research was also obtained and this was used in the field to ease data collection.

Informed consent was sought from each of the probable research participants after briefing them on the study purpose, objective and benefit of the research. Participants were free to withdraw their participation at any time in the study. Participants' anonymity and confidentiality was pledged.

4.0 RESULTS

4.1 Demographic data

The nutrition KAPs study survey 936 respondents with 52.03% being female and 47.97% male. The highest percentage of respondents, 38.95% were in the age bracket (31 – 40) and the lowest 11.21%, were above 51 years.

Majority of the respondents, 87.19% were married, and the highest percentage of respondents 47.1% mentioned being a housewife/husband as their nature of personal work, 15.47% mentioned Business/Trade whereas 4.70% mentioned skilled based work.

Majority of the respondents 59.61% reported that they were educated up to Primary level, 26.82% up to Secondary level and 13.57% up to tertiary level. Also 34.29% of the respondents reported that they had received training in nutrition/home economics before, whereas 65.71% reported not to have had that prior training.

All respondents reported to have some land, with the majority sampled population 51.51% owning between 2 -5 acres, 27.78% owning more than 5 acres, and 20.63 owning less than 2 acres.

4.2 Nutritional Knowledge, Attitudes and Practices among selected districts of the West Nile Region

4.2.1 Nutritional Knowledge among selected districts of The West Nile Region

Nutritional knowledge of respondents was assessed by subjecting them to 9 general nutritional statements that were scored on a 5 level likert scale. The scale had levels as strongly disagree scoring 1 and strongly agree scoring 5. The respondents' scores were used to predict their knowledge. These statements are summarized in Table 1.below.

Table1. Knowledge of respondents and their corresponding scores

No.	Statement	Correct Statement	Percentage Correct
1	Good feeding is associated with eating more animal foods than plant foods	SD	40.28
2	Good feeding is associated with eating large quantities of food per meal.	SD	44.23
3	Different food have different food values	SA	53.85
4	Crop based foods have less energy than animal based foods	SD	37.18
5	The largest portion of human daily diet should come from cereals, roots and tubers	SA	54.27
6	Traditional crops have sufficient energy to support human growth and development	SA	56.62
7	Adding groundnut paste to sauce improves the food value of that sauce	SA	60.58
8	Pregnant mothers, children under 5 and the sick require preferential feeding	SA	44.23
9	Recalled at least one disease related to bad feeding		90

SA: Strongly agree / A: Agree / NAD: Neither Agree nor Disagree / D: Disagree / SD: Strongly Disagree

Knowledge of the respondents about nutritional diversity, frequency and serving portions of meals, nutrition quality, food diversification/supplementation, perception, vulnerable groups and agricultural practices was reported as below.

40.28% strongly disagreed the statement that "Good feeding is eating more animal foods than plant foods" and 44.23% strongly reported that good feeding is not about eating large quantities of food per meal.

The highest percentage of respondents 53.85% agreed that different foods have different food values and 37.18% of the respondents consented that eating crop-based foods gives more energy than animal foods. 54.27% strongly agreed that the largest portion of food should come from cereals and roots & tubers.

Above 56.62 % of the respondents acknowledged that traditional food crops have enough food values to allow good growth and production that the largest portion of foods eaten by a person per day should be from cereals.

The respondents showed knowledge about food supplementation as the majority 60.58% strongly agreed that

adding groundnut paste to sauce improves the food value. Moreover, 97% of the respondents showed knowledge about the vulnerable groups of people in the communities that require different food from the rest of the family members.

44.23% of the respondents strongly agreed to the need for preferential feeding of pregnant mothers, children under 5, and the sick as compared to other family members.

90% of the respondents were able to recall at least one of the common diseases associated with under nutrition and they mostly reported marasmus, kwashiorkor, and anaemia. However, a few of the respondents mentioned some diseases associated with over nutrition such as obesity and high blood pressure.

4.2.2 Nutritional Attitudes among respondents

Nutritional attitudes of respondents were assessed by subjecting them to 7 general attitudinal statements that were scored on a 5 level likert scale. The scale had levels as strongly disagree scoring 1 and strongly agree scoring 5. The respondents' scores were used to predict their nutritional attitudes. These statements are summarized in Table 2 below.

Table2. Nutritional attitudes among respondents and their corresponding scores

No.	Statement	Correct Statement	Percentage Correct
1	Crop derived foods are for the poor (inferior) while animal derived foods are for the rich (superior)	SD	56.94
2	When our household income grows, we will have to drop crop foods from diet and eat mainly from animal foods.	SD	54.38
3	Imported food crops have higher food values as compared to our local traditional food crops.	SD	62.71
4	Trainings aimed at good feeding are a waste of time.	SD	50.43
5	Farming is an activity for the less educated or the uneducated.	SD	52.24
6	Choice of crops to be grown should be based mainly on the food value of the crop.	SA	35.15
7	Consumption of traditional foods is being affected by cultural erosion and globalization trends	A	56.20

SA: Strongly agree / A: Agree / NAD: Neither Agree nor Disagree / D: Disagree / SD: Strongly Disagree

56.94% of respondents believe that crop derived foods are not inferior to animal derived foods. This belief was sustained with the positive response (54.38%) that when household incomes grow, crop based foods would not be damped in favor of animal derived foods.

The responses also showed a strong belief (62.71%) in perceived nutritive value of the traditional food crops against the imported food crops.

The respondents exhibited an urge 50.43% for training in good feeding and positive attitude towards farming (52.24%).

The respondents however exhibited low agreement (35.15%) with crop choice being driven by food values of the crops.

The respondents were however in agreement (56.20%) that consumption of traditional foods is going to be affected by cultural erosion and globalization trends.

4.2.3 Nutritional Practices of among selected districts of the West Nile Region

Nutritional practices among respondents were assessed by subjecting them to 6 general nutritional practice questions. These were;

1. How many meals do you have on average per day?
2. Are meal serving portions adequate for all?
3. Do your meals at home have a diverse range of foods?
4. Do you do farming at home?
5. Is domestic food production sufficient to supply your home needs all year?
6. Do all family members eat the same food or do boys and men eat different food from girls and women?

The highest proportion of responses was 62.09% and this was reported for an average of three meals per day; breakfast, lunch and super. 25.70% reported to be having two meals per day and the meal mix varied between breakfast & super and lunch & super. 9.61% reported to be having a forth meal and this was either evening tea or break tea. 2.49% however reported to be having one meal a day.

On the adequacy of serving portions, 60.69% reported to always having adequate serving portions of food at home on average. 37.58% reported that the adequacy of the serving portions is occasional. 1.73% reported their households to never receiving adequate serving portions.

On the adequacy of dietary diversity as an issue of nutritional practice, 60.37% of the respondents reported to be receiving diversified meals always. On the contrary, 38.44% and 1.19% of the respondents reported their household nutritional diversity to be occasional and inadequate respectively.

All respondents reported their households to be engaged in some form of home farming. 74.08% reported constancy in their household farming, while 25.92% reported their home farming to be occasional. Generally, respondents reported that cassava, maize, beans, and vegetables are typical of their domestic food production

Although all respondents reported their households to be engaged in some sort of food production, only 40.06% reported their food production to always sufficiently meet the food demand for the year. 38.66% reported food production to occasionally meet annual demand. 21.27% confessed to the perpetual insufficiency of their food production in meeting annual food demand.

Respondents reported 96.11% of households sharing the same meals between men and women. Only 3.88% reported men to be having different meals from women.

4.3 Gender perspectives to nutritional practices

The gender perspectives to nutritional practices of respondents were assessed by subjecting them to 13 nutritional practice questions. These were;

1. Do you do farming at home?
2. Do all family members eat the same food or do boys/ men eat different food from girls/ women?
3. Domestic food production is sufficient to supply our home food needs all year.
4. Who decides the foods to plant?
5. Who participates in the planting?
6. Who participates in the harvesting?
7. Who decides what is sold/ what is taken home?
8. Who manages the income from what is sold?
9. Who decides what to cook in the home?
10. Do different households share food?
11. Who teaches mothers how to feed their children or their family members?
12. Should men cook?
13. Does your home have a good nutrition?

Adequacy on household participation in farming was assessed using a scale of; Never, Occasionally, and Always. The study found that all respondents' household were engaged in some form of farming with proportionate scores of 74.08% and 25.92% for Always and Occasionally, respectively.

Men and women were generally reported to be having the same meals at home 96.11% except for 3.88% who reported that men have different meals from women because of cultural factors.

While households of 96.11% of the respondents were engaged in some form of farming, it was also reported that only 40.06% of the households had sufficient food production for their household needs all year. 38.66% reported occasional self sufficiency while 21.27% reported all year production insufficiency.

On the question of who decides what to plant, the study learnt that 86.07%, this decision is an all inclusive decision. Only 12.09% tagged it to men only and 1.84% tagged it to women only.

Participation in planting was also reported as generally all inclusive (96.76%). Minority reports were of 1.3%, 1.3% and

Adequacy on household participation in farming was assessed using a scale of; Never, Occasionally, and Always. The study found that all respondents' household were engaged in some form of farming with proportionate scores of **74.08%** and **25.92%** for Always and Occasionally, respectively.

0.65% planting labor being "all family members excluding men", "hired labor" and women only respectively. Focus group discussions on gender roles reported that planting is an activity for the family but boys and girls participation is mandatory as long as it does not interfere with their academics.

On harvesting labor, the study learnt that the activity is generally 65.12% all inclusive, 25.38% "family except men", 8.21% "women only" and 1.30% "hired labor". Focus group discussions on individual participation in harvesting however reported that this activity is majorly for women. Only 15.3% men supported that men participate in harvesting.

The decision on what is sold and what is taken home for consumption was found to be 85.1% "all inclusive", 9.61% "man only", and 5.30% "woman only" decision.

The income from produce sales was reported to be 71.49% "all inclusively managed", 18.68% "man only" and 9.83% "woman only" managed.

Household menus were reported to be 49.89% an "all inclusive" decision and 49.46% a "woman only" decision. Men alone were reported to contribute only 0.65% to this decision.

85.27% of the respondents reported the practice of households sharing food while 14.73% declined that practice.

On the mothers' source of knowledge of feeding their families and their family members, health workers were reported to be a key source (50.76%). Other sources of nutritional knowledge were reported as relatives, peers, elders and self intuition with respective scores of 38.56%, 4.43%, 4.10% and 2.16%.

It was reported shameful for men to do cooking with 82.72% of respondents against it and only 17.28% in its support. Those in support of the practice reported it as an act of family love, while those against it reported it as an encroachment on the gender role of a woman.

The respondents also answered an opinion question on whether their households had good nutrition or not. 52.54% had the negative opinion, while 47.46% considered their households as having good nutrition.

Pearson's correlation on Gender perspectives

Pearson's correlation showed existing relationships between data collected and gender. The scale for strength of relationship is given below:

Table 3 Pearson's correlation scale descriptors

Descriptor	Correlation coeficient (r) range
No relationship	0 to 0.1
Weak relationship	0.1 to 0.39
Moderate relationship	0.4 to 0.69
Strong relationship	0.7 to 1

The observed relationships at P< 0.05 are summarized below:

Table 4: Observed relationships between Gender and Nutritional Knowledge

Nutritional knowledge parameter	Correlation coeficient (r)
Good feeding is eating large food quantities	0.11390
Different foods have different energy values	0.10393
Recall of an under nutrition related disease	0.1115

Gender affected knowledge responses for parameters including; good feeding as eating large food quantities, different foods having different energy levels, and on recall of an under nutrition disease. All these relationships were positive.

Table 5: Observed relationships between Gender and Nutritional Attitudes

Nutritional attitude parameter	Correlation coeficient (r)
Crop derived foods are inferior	0.10575
Farming is an activity for the less educated	0.13899

Gender also affected nutritional attitude responses for parameters including; crop derived foods being inferior than animal derived foods and for farming being an activity for the less educated. All these relationships were positive.

Table 6: Observed relationships between Gender and Nutritional Practices

Nutritional practice parameter	Correlation coeficient (r)
Number of meals per day	-0.21917
Adequacy of serving portions	-0.1989
Adequacy in food diversity	-0.14031
Sufficiency of domestic food supply	-0.1079

Gender also affected nutritional practice responses for parameters including; number of meals consumed per day, adequacy of serving portions per meal, adequacy in food diversity of meals and on sufficiency of domestic food supply. All these relationships were negative.

4.4 Exploration of the value chains for common traditional foodstuffs

Foodstuffs traditional to selected districts of the West Nile were explored for preference; harvesting practices; storage stability, storage practices and losses; home preparation practices and existing processing opportunities. Tendency to deselect a foodstuff implies its nutrients are going to be less important to food and nutritional security. Table 7 below summarizes the nutritive values of traditional foodstuffs collected among four districts of the West Nile; Arua, Nebbi, Yumbe and Zombo.

Table 7: Proximate Composition of some traditional foodstuffs under their categories

CATEGORY	FOODSTUFF	DM %	CP %	EE %	CF %	ASH%	Ca (mg/100g)	P (mg/100g)
CEREALS	Finger Millet (Anya)	88	10.80	4.07	3.30	3.10	50.00	24.00
	Sorghum (Ondu-Godo)	89	11.80	3.20	7.20	1.80	40.00	30.00
	Red maize	88	9.70	2.30	6.50	1.47	8.00	16.00
	Yellow maize (Maga)	87	8.90	2.10	6.20	1.60	4.00	18.00
	Purple-white maize (Gusi)	88	9.40	1.80	5.70	1.79	3.00	19.00
	Sorghum (Ondu-Goma)	88	10.80	3.00	6.80	1.60		
	Sorghum (Ondu- Dura)	87	11.20	3.30	5.10	1.20		
	Sorghum (White)	88	12.6	3.40	4.50	1.30		
LEGUMES & PULSES	Cow Peas (Osunyirikia)	89	23.10	1.00	7.20	3.44	20.00	55.00
	Nyarawora beans	88	22.00	1.33	5.00	4.62	17.00	63.00
	Pigeon Peas	86	20.30	1.20	11.80	4.20	120.00	170.00
	Soy beans (green)	87	26.00	4.50	8.00	5.60	28.00	66.00
	Green gram	88	21.60	1.50	0.63	3.90	75.00	320.00
	Sepeya beans	88	18.82	2.20	4.40	4.10		
	Nyamusoole beans	88	22.40	2.60	4.70	3.80		
	Black Beans	87	21.32	2.30	4.90	3.77		
	Nylon beans	88	18.82	2.10	1.82	3.58		
	Lau-lau beans	87	19.80	2.40	3.30	4.30		
	Red ground nuts (Funo Ika)	86	27	43	5.87	5.20		
	Pink ground nuts (Funo Inve)	87	28.2	32.70	4.32	4.56		
	Bambara nuts-Purple (Sungu)	88	21.20	7.50	1.90	4.50		
	Bambara nuts-White (Sungu)	88	17.80	8.00	1.80	5.00		
	Cashew nuts	88	24.40	41.20	5.80	3.10		

Table 3.2 Proximate composition of foodstuffs under their categories (CONTINUED)

CATEGORY	FOODSTUFF	DM %	CP %	EE %	CF %	ASH%	Ca (mg/100g)	P (mg/100g)
ROOTS & TUBERS	Cassava chips (Banda)	86	2.36	0.62	1.40	0.75		
	Sweet potato chips (Mukeke)	88	6.20	0.68	6.40	1.02		
	Air potato	86	6.50	3.02	7.80	2.39		
	Yam (Mayuni)	86	10.36	3.15	8.98	3.65		
OTHER FOODS	Simsim –Small (Muniga)	90	22.60	51.0	6.29	5.62		
	Simsim –large (Anyu)	90	24.40	50.2	6.19	6.09		
	Amaranth seeds	85	5.42	2.63	4.81	7.30		
	Desert date kernel	93	5.20	46.6	3.80	6.64		

DM%- Dry matter percentage; CP –Crude protein; EE- Ether extract; CF – Crude Fiber; Ca – Calcium and P- Phosphorus

The study observed that of the traditional cereals of the region, millet and sorghum are highly preferred and they play key roles in flour production. The flours from these cereals are consumed directly or as composites for porridge or bread dough. Maize though not as highly preferred as the other two is very important as food and in production of fermentation yeast for local beer fermentation.

Of the legumes and pulses, beans and groundnuts were reported to be the most preferred. Beans were reported as the most popular sauce among households providing the staple sauce. Groundnuts through their paste were reported as the most popular foodstuff in enrichment of other sauces.

Pigeon peas were reported to be important as an ingredient for ceremonial sauce during cultural and memorial events.

Of the roots and tubers, cassava was found to be the most important since its flour is key in blending other cereal flours during bread making. Cassava is also starch substrate for beer fermentation. Sweet potatoes were reported as important tubers for fresh food and dried chips.

Simsim was also reported to be a blend to groundnuts during paste making.

Table 8 below summarizes the traditional food preferences among three broad ethnicities of the West Nile.

Table 8. Traditional foodstuff preferences by ethnic community of the West Nile

CATEGORY	FOODSTUFF	Preferences by Ethnicity			MAIN PURPOSE IN COMMUNITY
		ALUR	LUGBARA	MADI	
CEREALS	Millet	✓	✓	✓	Porridge flour, Alcohol yeast
	Sorghum	✓	✓	✓	Dough flour, Alcohol yeast
	Maize				For sale , Dough flour, Alcohol yeast
LEGUMES & PULSES	Pigeon Peas	✓			Cultural (Ojogo)
	Soy beans				Majorly for sale, not for food
	Kidney Beans	✓	✓	✓	Main Sauce
	Ground nuts	✓	✓	✓	Oddi
ROOTS & TUBERS	Cassava	✓	✓	✓	Dough flour
	Sweet potato	✓	✓	✓	Dry chips
OTHER FOODS	Simsim	✓	✓	✓	Blending Oddi

Note: Lugbara represents ethnicities of the Ayivu, Vura, Aringa, Maracha and Terego

4.4.1 The preferred traditional cereals of selected West Nile districts

4.4.1.1 MILLET

Reasons for preference of millet

Millet was reported to be accepted by communities as a nutritious foodstuff. Porridge from millet flour was reported to be recommended for the sick and child nutrition by the medical practitioners. Millet was also reported as one of the important cereals used in yeast production. Yeast is used in making alcohol. The millet-cassava composite flour is important for dough making, which dough is mingled into bread.

Millet harvesting practices

Mature millet is harvested by cutting the stem at a reasonable length and packed in a sack for transportation. Millet is spread on a carpet at the farm and allowed to dry completely while on the stem in the farm. Millet is separated from the stem by hitting it using a small size stick to avoid the seeds from breaking. The seeds are separated from the pods by winnowing

Millet storage stability, storage, and probable losses

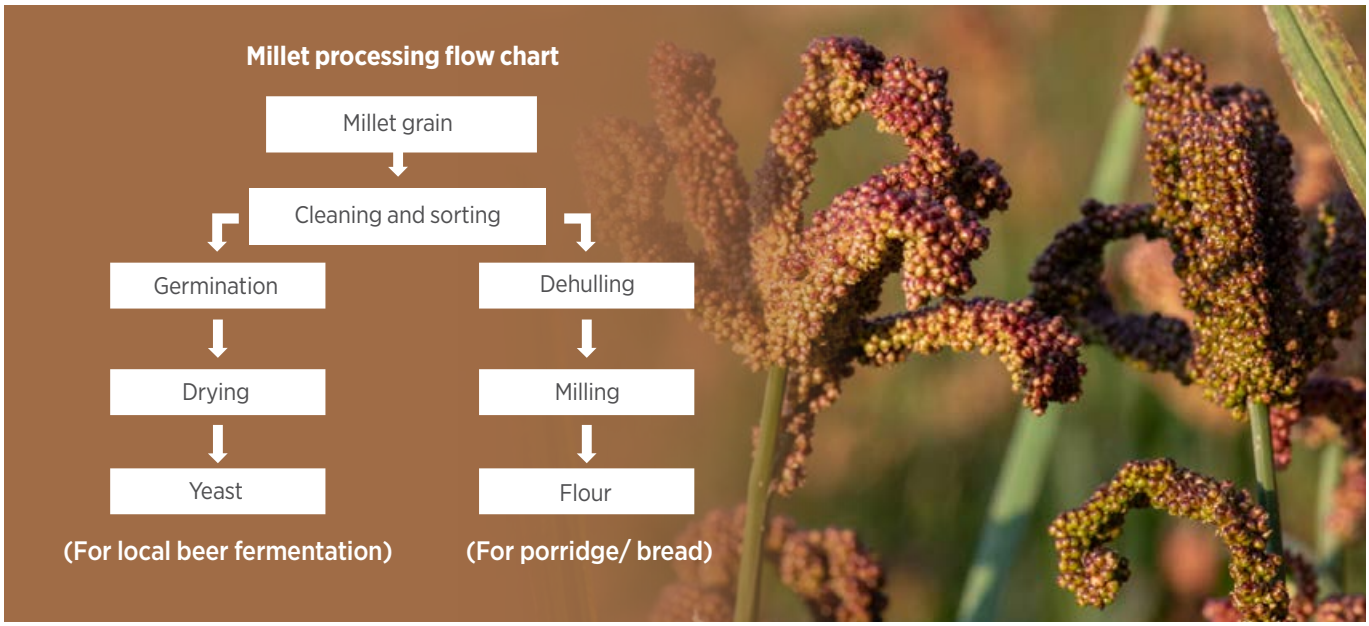
Millet was reported to be stable under storage, as long as it is adequately dried prior to storage. Millet was reported to be stored mainly in woven poly ethylene sacks, off the ground and stacked so as to allow adequate ventilation. The grain was ideally stored under shelter and maintained under damp proof conditions.

Probable qualitative and quantitative losses were linked moisture re-absorption that would lead to mould growth. Other causes included insect and vermin attacks.

Home preparation of millet:

Home preparation starts with de-coating the millet grain. This is done by short time roasting of the grain to loosen the coat, followed by slight pounding in a motor with a pestle. The loosened coat is removed by winnowing and the winnowed grain is milled to produce flour. In homes, milling is accomplished by grinding on a grinding stone. Motorized milling services were also sought from mobile mills on market days. The flour is used for porridge or making bread dough.

In case of porridge, un-blended millet flour is boiled in water until a smooth consistent paste is obtained. For bread, millet flour is blended with cassava flour to produce a composite flour for dough.



4.4.1.2 SORGHUM

Reasons for preference of sorghum

Sorghum was reported to be a key cereal for bread making. Sorghum flour is blended with cassava flour to make composite flour for bread dough. This bread is the traditional stapple food. Pre-germinated sorghum was also used in local beer (Kwete) production as the yeast. Sorghum can also be used for making Porridge.

Sorghum harvesting practices

Sorghum is harvested using a knife by cutting or sickle bar headers. Raise the header high enough to harvest only the grain heads with a minimum of leaves and stalks. Pre drying is practiced while the crop is in the field, cut by knives but not detached from the stalk. Line harvesting is done to ensure no heads are left in the field. Sorghum heads are sun dried or hang in properly ventilated rooms such as kitchens or cribs for optimum drying. Optimum drying minimizes harvest losses.

With adequate sunshine, proper drying takes 1 to 2 weeks

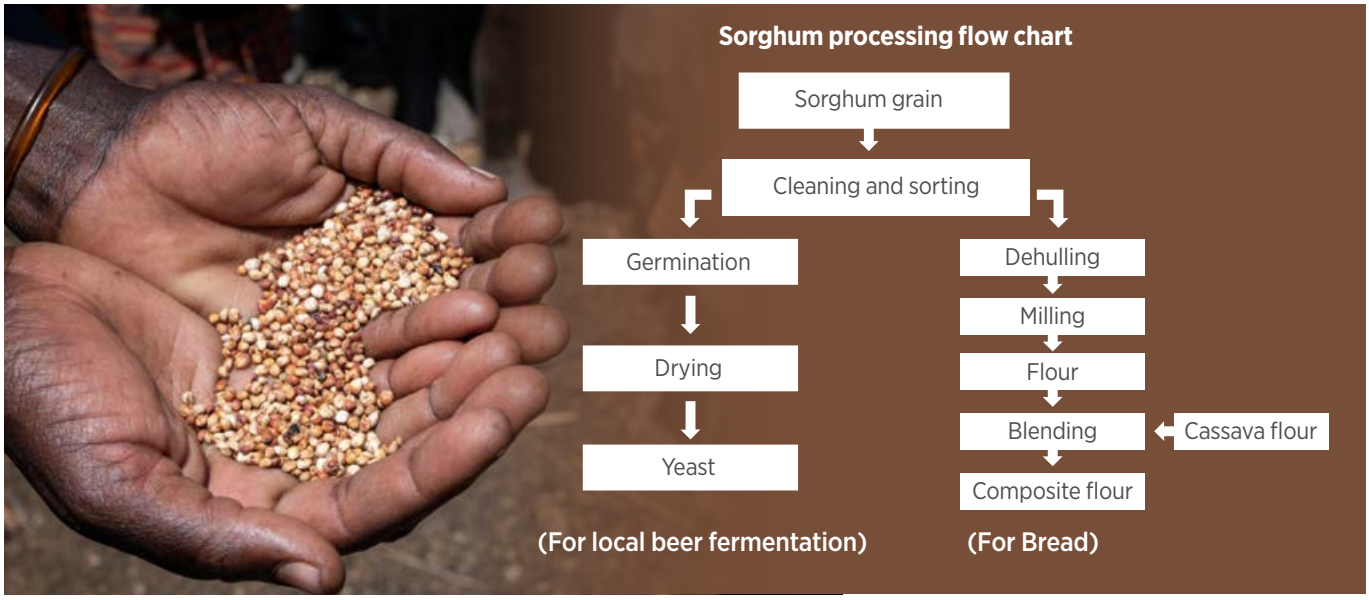
Separation of the seed from the head is by beating heads with the sticks while on a tarpaulin. Grains are separated from the chuff by winnowing with the help of wind.

Sorghum storage stability, storage, and probable losses
Sorghum was reported to be stable under storage, as long as it is adequately dried prior storage.

Field drying is difficult and leads to excessive field losses from birds, wildlife. Sorghum should be harvested early and dried in confined locations to maintain quality and minimize harvest losses.

Home preparation of sorghum:
Sorghum threshing is done by short time roasting to loosen the coat, followed by slight pounding in a mortar with a pestle. The loosened coat is removed by winnowing and the winnowed grain is milled to produce flour. The flour is used in ratios with cassava flour and millet to produce a composite flour for dough. Pre-germinated sorghum was reported to provide fermentation yeast during local beer production.

Sorghum processing
Sorghum processing is focused at improving palatability and lowering its tannin content. Tannins bind minerals and proteins in cooked sorghum, making them unavailable during absorption in the GIT. The tannin content of Ondu- goma of triplicate sample analysis was found to be 326 ±24 mg/100g dry weight. Ebadi et al. (2005), categorized sorghum into three, basing on their tannin content. Low tannin sorghum has up to 9mg/100g dry weight, medium tannin sorghum has up to 190mg/ 100g dry weight and high tannin sorghum has up to 370mg/100g dry weight.



4.4.1.3 MAIZE

Reasons for preference of maize
Maize was reported to yield highest per acreage as compared to other cereals planted. As a food it was reported to derive sufficient high energy to a consumer after eating. The eating forms of maize included fresh roasted or fresh boiled maize, which sufficiently serve as snacks. The flour derived from maize milling can be used for making porridge, or mingled into dough to make a high energy meal. Growing maize as a cash crop was also reported to bring seasonal income. The maize stalk can be used as fodder.

Maize harvesting practices
Maize cobs are harvested by plucking the ears from the standing plants and they are spread for drying in the sun. Ears can be dried in sun for 4 to 5 days.

Maize storage stability, storage, and probable losses
Maize was reported to be stable under storage on condition that it was adequately dried. Maize was stored on cobs hang in open room such as kitchen and cribs or as shelled grain in air-porous containers. Commonly, storage of maize was reported to be in polythene sacks. The storage conditions need to be maintained dry, off the ground and the store well ventilated.

Probable losses during maize storage can result from moisture gains while in the store due to damp storage condition, resulting in qualitative losses. Quantitative losses can be due to insect and vermin attacks.

Home preparation:
Home preparation of maize flour dough is by boiling water and introducing flour to the boiling water gradually with mingling until firm dough is obtained. The dough can be served with sauce for a meal.

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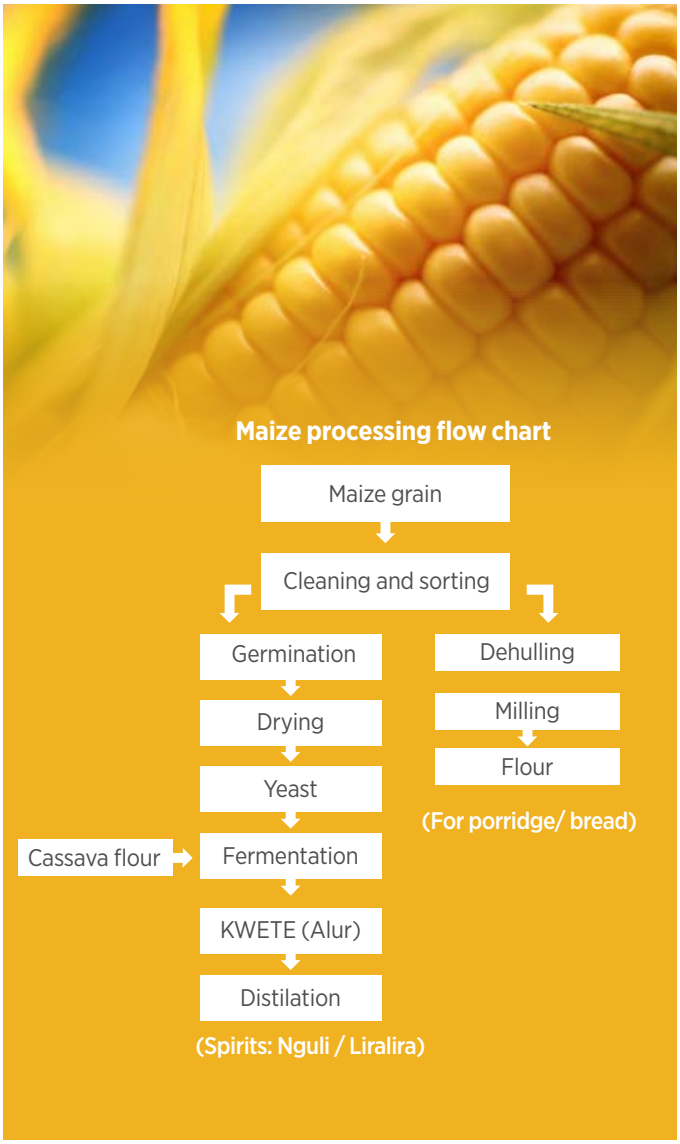

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4.4.2 The preferred traditional legumes of selected West Nile districts

4.4.2.1 BEANS

Beans were reported a preference among the communities because, next to vegetables, they are the cheapest sauce, blending well with a variety of foods. They are cheap to produce on the farm. Beans are a staple sauce, encouraged by medical personnel for offering cheap protein.

In times of hardship, beans can be cooked with Maize (anyoya) and served.

Beans harvesting practices

Beans are harvested when already dry in the field by uprooting the plant. Beans can also be harvested fresh from the field and immediately prepared for sauce. Prior to cooking, the seeds are manually removed from the pods in case of fresh harvest. For dry harvest, the harvest is further dried to loosen the haulms and using a clab, the haulms are then beaten to let loose of the beans. The seeds are spread on mats, and then dried under direct sunshine for 2-5 days before storage.

Beans storage stability, storage, and probable losses

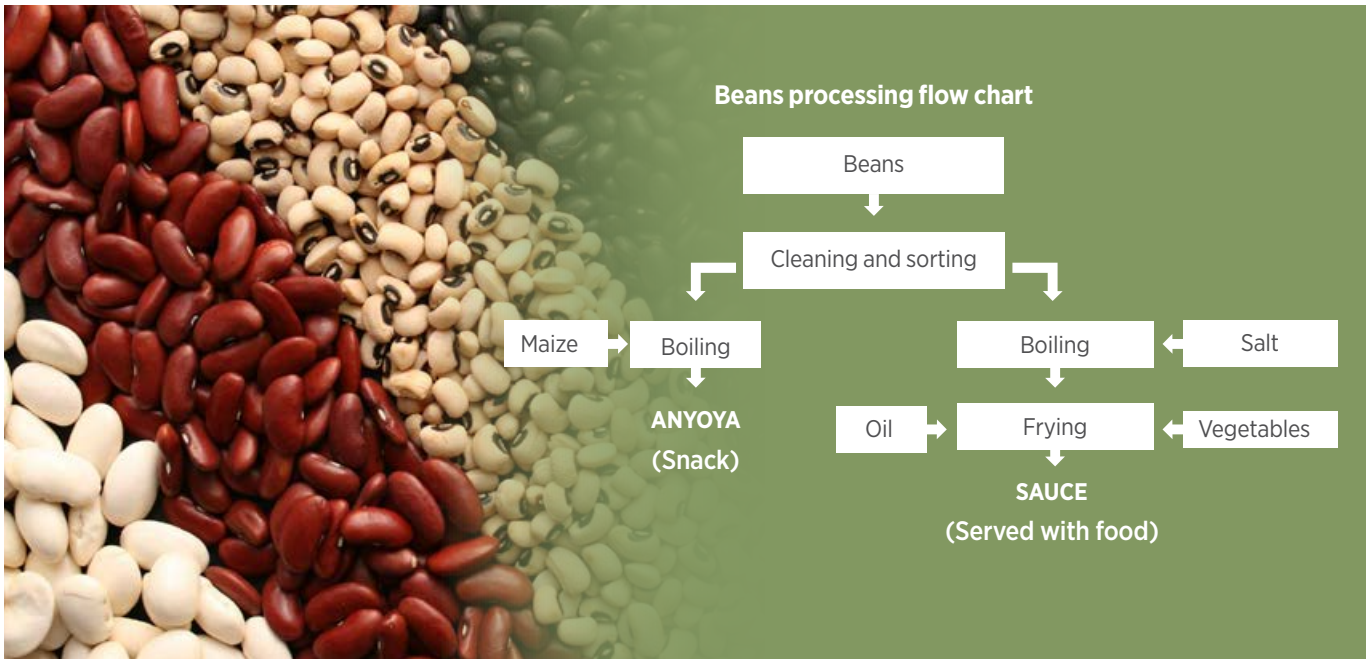
Properly dried beans were reported to be quite stable during storage. They however suffer weevil attack and the attacks increase with increase in storage moisture content.

Dried beans were reported to be commonly stored in woven polythene sacks. After packing in a sack it is kept in a dry place, off the ground to avoid dampening. Care needs to be taken to avoid vermin attack, which can trigger mould attack.

The highest probable losses reported for beans were attributed to weevil attacks. These lower the market value of beans since they present the beans with holes and moving insects (weevils). Physical loss is presumed to contribute to a nutritional loss as well.

Home preparation practices

Beans are prepared at home by sorting, washing, boiling with salt and followed by frying with vegetables. The sauce is then served with different foods. In other cases beans can be cooked together with Maize for breakfast



4.4.2.2 GROUNDNUTS

Reasons for preference of groundnut:

Groundnuts were reported to be desired among communities due to their high oil content. When roasted and pressed, groundnuts produce a delicious oily paste which can be eaten direct, but is majorly mixed with different sauces, improving their taste and texture. Groundnut seeds are also eaten raw (not roasted), boiled, and fried. The groundnut seeds were also reported to be a reliable cash crop.

Groundnut harvesting practices

Groundnuts harvesting stage was reported to be a key determinant of pulse quality. When harvested too early, the seeds tend to shrink during drying, which lowers the yield, oil content and quality of the seed. Delays in harvesting were reported to result in reduced yields due to pods remaining in the ground, germination of non-dormant grain and poor quality seed due to mould infections.

Harvesting was reported to be done by hand pulling, especially when the soils are loose and well drained such as in sandy and loam soils. For soil that is wet and heavy or very dry, pulling pods by hand was reported to result in high pod losses. In such circumstances, pulling pods was reported to be assisted by use of hand hoes or garden folks, and these loosened the soil. It is important to shake the plant after lifting to remove excess soil from the pods, particularly when the soil is wet to avoid fungal growth. Groundnuts are dried in the field using windrows, where plants are laid in rows to catch the wind. The drying of pods in windrows for 3–5 days should produce the required level of moisture before the pods are picked or stripped. The hand removal of pods from the plants (plucking) was reported to be labour intensive. Stripped pods are then laid out in a thin layer in the sun on dry ground, matting or other dry surfaces for a further 2–5 days which would normally dry the pods to the required moisture content for storing.

In case pods are picked immediately after lifting from the soil, they should be dried in the sun for 6–8 days. Ideally pods should be dried with plenty of air circulation.

Groundnut storage stability, storage, and probable losses

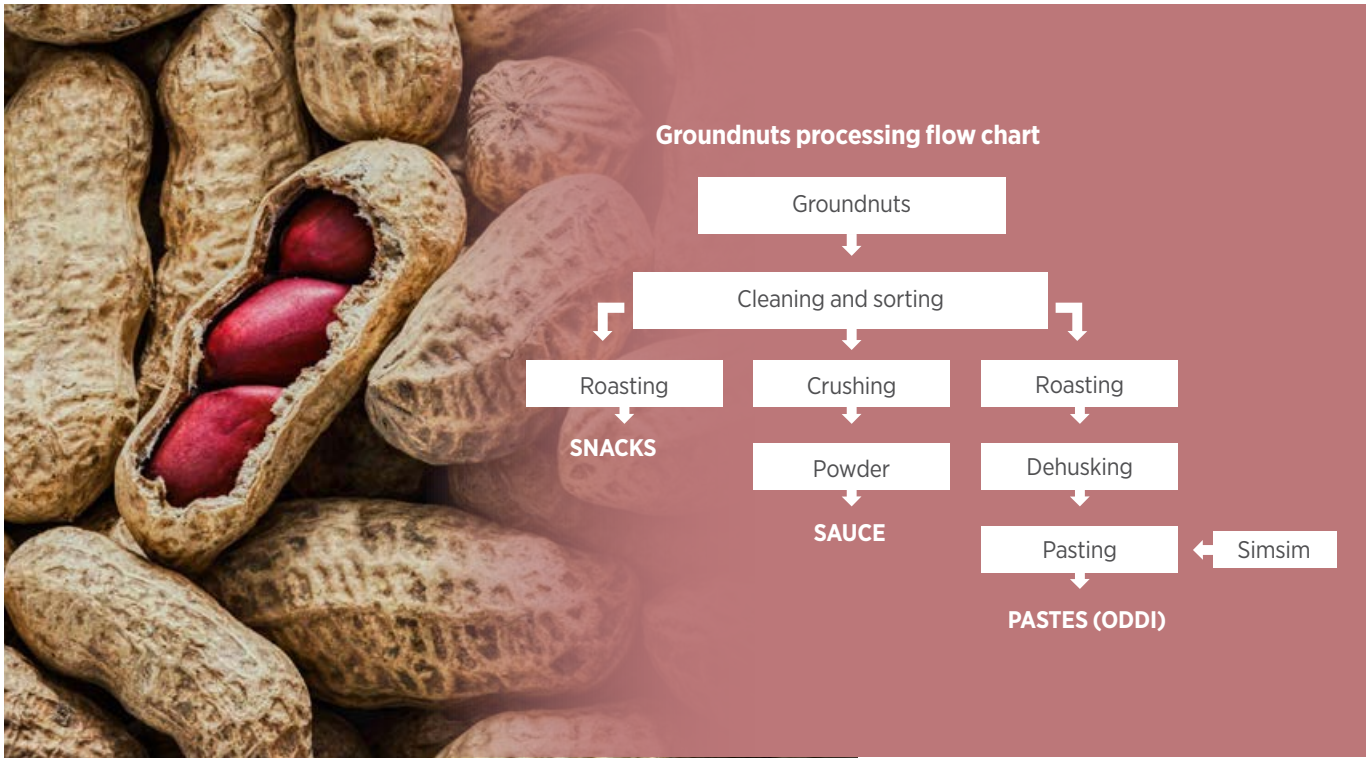
Proper drying was reported as a requirement for groundnut storage stability. Groundnuts store best in their shell, although this requires larger storage space.

Bags, baskets and granaries are the common storage vessels. Whatever the storage container, it is important to ensure that the store is dry and that there is good ventilation.

Probable losses during storage may arise due to moisture build-up due to poor ventilation or water seepage. This would encourage fungal growth and seed quality deterioration. Insect and rodent attacks also result in quantitative losses and subsequent quality loss.

Home preparation practices

Groundnut preparation for home consumption can be by boiling podded pulses. Shelled seeds can also be roasted for consumption as snacks. Pasting of roasted groundnuts produces the oily delicacy, Oddi that is used in improving sauces.



4.4.2.3 SOY

Reasons for preference of soy
Soy is only grown for sale. Limited quantities of soy are roasted and eaten as snacks.

Soy processing
Soy processing is aimed at unlocking the full content of the soy proteins and minerals. While heat treatment has been applied for long, its efficiency in unlocking nutrient is poor. Excessive heat treatment also results into nutrient denaturation. The Trypsin inhibitor activity of green soybeans after various treatments is summarized below:

Table 3.3: Trypsin Inhibitor Units / g of soy powder after different sample treatments

Sample Treatment		TIU/g of sample
Sample1	No thermal Deactivation	44,840
Sample 2	Oven dry heated at 800C for 1 hour	39,902
Sample 3	Oven dry heated at 1000C for 1 hour	29,980
Sample 2	Oven dry heated at 1000C for 2.5 hour	25,500

The trypsin inhibitor activity values obtained are comparable to those of Coscueta et al. (2017), who reported TIU values per gram of 43,420 for raw sample, 39,874 at 800Cfor 1 hr, 30,310 at 1000C for 1 hr and 25,340 at 1000C for 2.5hr. The values indicated that higher temperatures and/or longer process times are needed to adequately lower the trypsin inhibitor activity of soy, otherwise its use as a foodstuff would reduce the digestion and absorption of other protein containing foodstuffs.

4.4.3 The preferred traditional roots & tubers of selected West Nile districts

4.4.3.1 CASSAVA

Reasons for preference of cassava
Cassava is a key food security crop. The tubers are consumed both as fresh root and as flour. The tender leaves are consumed as sauce. The market value of cassava leaves in areas where they are consumed is often higher than that of the roots, indicating that their sale contributes significantly to farm household incomes. Cassava is also a key raw material for local beer production.

Cassava harvesting practices
Cassava harvesting usually takes place at about 8 to 10 months from planting. This however is dependent on the variety and the intended use of the roots.

Cassava roots are generally harvested by cutting off the stems to about 20 cm above ground, then lifting the whole root system out of the ground by pulling on the stump. If the soil is too hard or the roots are too deep, it may be necessary to dig around the roots with a hoe, spade or pick to remove the soil, avoiding damage to the roots in the process.

Cassava storage stability, storage, and probable losses
After harvest, cassava roots deteriorate rapidly and must be processed within a few days of harvesting. This type of perishability is higher if the tubers are damaged or stored in warm conditions.

One of the reported common ways of storing cassava roots is by delaying harvest. This allows the family to harvest only what they can consume or process. This approach however denies the family from utilization of the farm land and results into increased woodiness and starch degradation within the tubers in case the harvest is over delayed.

After harvest, cassava was reported to be stored best as dried chips in cribs, granaries or woven bags with proper ventilation.

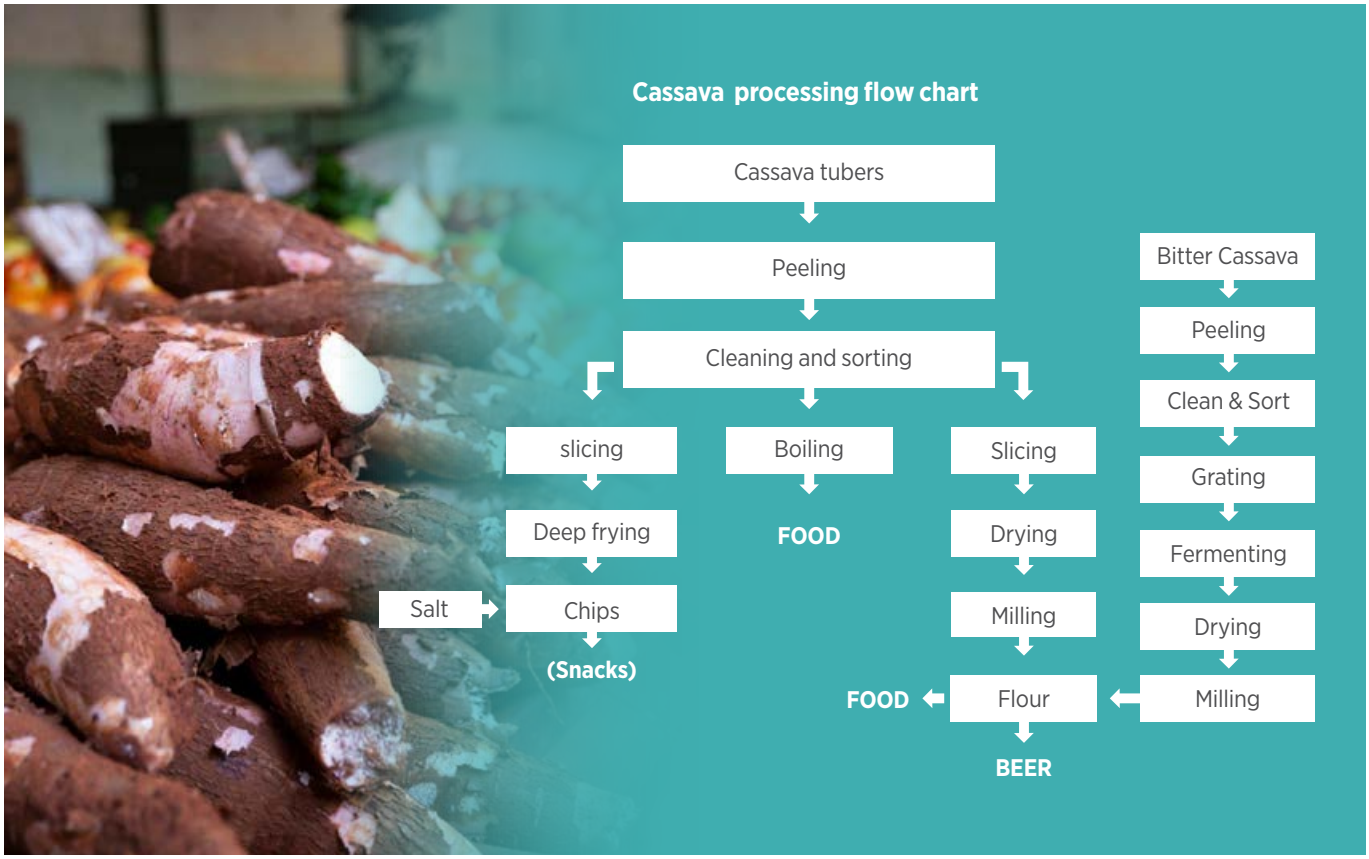
Fresh cassava deteriorates quickly in quality; by streaking and in quantity by rotting. Dried cassava is storage stable as long as moisture and vermins are kept out of the storage area.

Home preparation:
Cassava Leaves
Cassava leaves are prepared by removing the hard petioles, then pounding the blades and young petioles with a pestle and mortar, and boiling the resulting pulp for about 30 to 60 minutes. That process eliminates cyanogens and makes the leaves safe to eat.

Cassava Roots
After harvest, the roots are peeled, washed and cut into chips or grated. The chips are sun dried on polythene sheets or mats with regular turning to reduce their moisture content. This also helps in reducing the bitter components in bitter cassava varieties. The dried chips are transported to commercial millers for milling into flour. This flour is a key component in the bread dough composite flour with a mixing ratio of cassava: sorghum flour of 4:1 or basing on the taste of the consumers.

Cassava processing
Cassava processing is aimed at removing the two types of cyanogenic glucosides; linamarin as a major one and small amount of lotaustralin, both of which are catalytically hydrolysed to release toxic hydrogen cyanide (HCN). Cyanogenic glucosides have been associated to the bitterness in cassava. Sundaresan et.al. 1987, categorised cassava by its level of bitterness into three

categories basing on their cyanogenic glucoside content. Non bitter varieties have low cyanogenic glucoside content (27.5- 77.5 mg/Kg Fresh Weight). Bitter varieties contain 100- 180 mg/Kg Fresh Weight cyanogenic glucoside and very bitter varieties, 320 -1100 mg/Kg Fresh Weight. The fresh root samples analyzed fell between the bitter and very bitter categories. The processed root quality also was below safe limits for human consumption as guided by FAO/WHO Joint, Additives, and Organization (1992).



4.4.3.2 SWEET POTATO

Reasons for preference of sweet potato

Sweet potatoes, when cooked, develop a sweet taste. They can be used for breakfast when boiled or deep fried. They can be steamed and eaten as food with sauce. They were reported to be a generally an affordable food among consuming communities.

Sweet potato harvesting practices

Sweet potato is normally harvested by carefully digging them out of the heaps on which vines were planted at planting time. Care must be taken to avoid cutting the tubers.

Sweet potato storage stability, storage, and probable losses

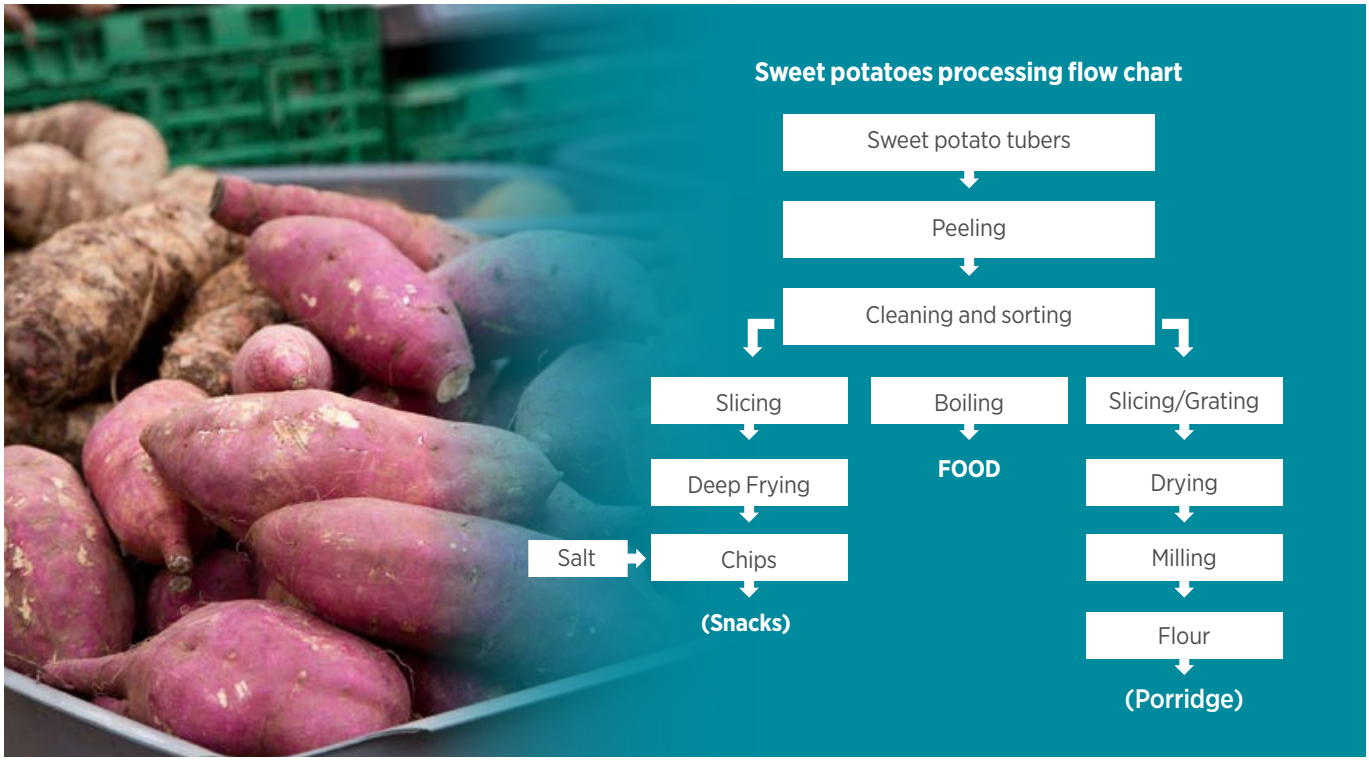
Like cassava, sweet potatoes were also reported to have a low storage stability. They keep for less than a month on shelf. This tends to influence farmer to harvest only what they are going to consume, or to process the harvest into dry chips which are more stable to storage. Sweet potatoes are normally stored at home after pealing, slicing and drying. The chips are dried in the sun for 3 to 5 days and then packed in a sack and stored for a number of days and then consumed for breakfast after reconstituting. The dried chips can also be eaten.

Quantitative losses are incurred when digging out Sweet potatoes from the mounds. They can be cut with the hoe especially if harvesting is done when the ground is hard. At such moments tubers can also be left in the ground. If left in the farm after harvest, can be destroyed by animals like cows, goats and sheep or even get rotten after long exposure.

Stored chips face loses as a result of vermin attack or seepage of moisture.

Home preparation

Sweet potatoes are prepared by pealing after harvest, followed boiling or steaming. Dried sweet potatoes chips can be cooked with paste for breakfast. Sweet potatoes can likewise be cooked and mashed, then blended with lemon for Porridge



4.5 Assessing the drivers towards Nutrition Sensitive Agriculture in West Nile

The study characterized the study area against the food systems drivers (FSDs)frame work by (Van Berkum et al., 2018). This was to predict holistically the success and resilience of NSA activity when rolled out in the region. The FSDs analyzed were social economic drivers and environmental drivers.

4.5.1 Socioeconomic drivers to support NSA

According to the framework, socioeconomic drivers include markets, policies, science & technology, social organization and individual factors.

The market in the study area may be characterized as a small and subsistent with great growth potential. With proper trade relations subsistent production can change to commercial scale and improve incomes.

Some policies of the areas are friendly to favor inward looking NSA success, while others need some adjustment and strengthening. Trade policies existing encourage production and sell of produce and this is a good start. The environmental policies need to address the issue of charcoal production as an economic activity, whose effect has a negative implication to the environment. The land rights policies also need to harmonize land use rights to women who are major contributors to agricultural production. Policies on food safety need to be translated such that food safety guidelines are known and ultimately practiced. The labour policies need to scope labor supply such that families can use household labor effectively, though not at the expense of children's education.

Science and technology is available to support NSA in the study area and already efforts to extend technologies exist. The region can access research & innovation from within or employ technical support in areas that are not familiar.

Social organization in the study areas; right from household to community, public administration and socio movements are existing and these are adequate to strengthen the position of farmers in case NSA is implemented.

The individual factors like lifestyle, norms, attitudes & culture within the study area have not yet negatively been influenced by modern trends and there seems to be general acceptance of traditional stapple foods as important to diet.

4.5.2 Environmental drivers to support NSA

The environmental drivers include minerals, climate, water, biodiversity, fossil fuels , land and soils.

The study observed that climate change effects exist in the study areas. These included unpredictable rains, long dry spells especially in Yumbe District. Yumbe district also suffered loss of tree cover to charcoal production. These observed environmental factors are likely to affect NSA success by lowering crop productivity.

4.5.3 The food Supply chain Characteristics in the selected study districts

The supply chain to support the NSA in West Nile was characterized under; production, storage, processing, food retail, enabling environment, business services, the food environment and consumer characteristics.

The observed production was categorized as subsistent, with communities producing food majorly for consumption and the surplus sold. Production volumes were found to be higher among communities that produced under organized groups such as the AFARD facilitated groups. As produce volumes were subsistent, the storage capacities too were generally small and technologies employed included outdoor granaries, baskets and woven bags kept inside houses.

Processing characteristics observed can be majorly classified as artisanal and a few small scale sized ones. The artisanal processors generally operated in mobile markets which move from trading center to trading center on different days of the week. The most common ones included grain miller and groundnut paste machines. The miller capacities were an approximate maximum of 300kg per mill per day. The stationed small scale mills had capacities of 2000 to 5000kg per day. Other type of processors included local beer producers, though their characteristics were not established.

Food retail existed especially in trading centers.
The enabling environment which consists of transport networks, regulation and institutional infrastructure can be characterized as generally good.

The business services including training services, agricultural input supply, technical and financial support can also be characterized as generally good. It has however to be noted that seasonal failures that may be caused by climate change were reported to greatly affect the credit score of farmers since they bear all the effects. No insurance services exist to share liability in agricultural activities.

The study area lacks food environment promotional practices. There is no food labeling, extent of advertisement low even for seemingly productive group production and no quality seals differentiate produce from different farmer groups.

The consumption can be characterized as subsistent. Consumer preferences were highly inclined to traditional staples and their cultural inclinations towards diet are strong.

5.0 DISCUSSION

5.1 Profiling nutritional knowledge, attitudes and practices

The findings of this study indicate knowledge levels to be within ranges of 37% to 61% on the subject of nutrition among the population. Could this be a mirror image of a community with 59.61% of its population having attained their maximum education level as primary level? This may be true, comparing this case with a case in Bangladesh where at an illiteracy level of 61% and primary level at 32%, farmers nutritional knowledge was reported at 11% Afrin Sultana, Afrad, Hoque, and Bhattacharjee (2016). Nutritional knowledge in the study area is higher than this case, probably due to a reported 34.29% of nutritional training. This proportional range is however on a low average for a farming community who are interested in accelerated growth of agriculture under NSA that AFARD is planning to roll out.

The reported nutrition attitude levels within a range 35% to 57% positivity among the population. Nutritional knowledge has been reported to match nutritional attitude and comparing with that in this study with a range of 37% to 61% this might hold true. Activities towards empowering persons with more nutritional knowledge have likewise positively influenced nutritional attitudes, nutritional habits and nutritional behaviors Kang and Kim (2004).

Nutritional practice results were answered with six questions. Analysis of study population and number of meals per day reported the average number of meals per person per day (total number of meals consumed per day/ number of respondents) as equal to 2.79 meals. This figure, though comparable, is slightly higher than the 2.5 reported for Uganda before COVID pandemic Trotter et al. (2020). The average number of meals per person per day has been reported to be affected by seasonality, with harvest receiving a rise and droughts receiving a drop Masheb, Grilo, and White (2011). Probably this was the case.

Serving portions are indicative of food availability. Food serving sizes also serve as tools for use in controlling portion sizes as part of a weight loss and weight management programme, and as useful tools for dieticians to better manage diet- related chronic diseases Sanusi and Olurin (2012). These portions differ with difference in nutrient densities of the different foods. Variability in domestic serving portions to levels of consumer inadequacy is an indicator of food insecurity. UBOS (2020) shows Uganda to have poor food security with a low Dietary Energy Supply (DES) 2,083 Kilo Calories per person.

Dietary diversity is a predictor of nutrient security. Where as a community might have adequate supply of macro-nutrients, supply of micronutrients may become a limiting factor to full growth and development Warren, Hawkesworth, and Knai (2015). The reported 38.44% occasional and 1.19% absence of nutritional diversity may be linked to micronutrient deficiencies. Morbidity statistics for the West Nile Region were reported at; 56% of Iron Deficiency Anaemia and 34% stuntedness among the under fives ALI (2018).

The reported permanency of food production at 74% and its occasionality in the other 26% is an indicator that an intervention in agriculture is a concern to all West Nile community members. Such interventions will go far in reducing the reported production insufficiency of 38.66%.

Family members eating the same food (96.11) indicates nutritional equity. Reported nutritional inequality reported among 3.88% was explained as a result of cultural practices which exclude women from consumption of some highly proteineous foods like chicken and eggs Annan (2011). Such inequalities can be addressed through training for attitudinal change.

Anchoring agriculture on nutrition as its key driver, points to a direction that the future of over and under nutrition among populations can be pre-determined and managed. Under and over nutrition have been shown to have negative production and health effects to humans. Of particular importance to Uganda are the long lasting effects of under nutrition Martins et al. (2011).

5.2 Gender perspectives to nutritional practices

Correlation studies summarized the gender perspectives of nutrition at a P-Value < 0.05.

For knowledge, the factors that were reported to have relationships with gender were knowledge on feeding quantities, the recall capacity for one under nutrition disease and knowledge that different foods had different energy values. The nature of the relationships of these three factors was weak in strength and for the energy values, it was negative.

On nutritional attitudes, the factors that showed relationship were the positive attitudes towards inferiority of crop derived foods as compared to animal derived foods. The other positively correlated attitude with gender was the attitude that farming is an activity for the poor and the less educated.

Gender produced negative relationships in relation to nutritional practice. They can be interpreted as:

I. One is more likely to have 21.9% less meals per day if they were women as compared to if they were men
II. One is more likely to have 19.8% inadequate serving portion per day if they were women as compared to if they were men
III. One is more likely to have 14.0% inadequacy in food diversity if they were women as compared to if they were men
IV. One is more likely to experience 10.7% insufficiency in supply if they were women as compared to if they were men

Although these relationships are categorized as weak, their direction of negativity for such a large dataset makes them important considering the level of participation of women in nutrition and in agriculture. The negativity of less serving portions and number of meals per day between men and women may probably be explained by physiological factors. Men have a generally higher metabolism and muscle mass for enhanced work, leading to a relatively higher energy demand than women Wismann and Willoughby (2006).

The inadequacy in dietary diversity among women could be explained by cultural practices of selfless care displayed majorly by women. They may probably serve their households richly first at their own expense Wood (1994).

5.3 Exploration of the value chains for common traditional foodstuffs

5.3.1 Preferred traditional foods

The primary target for any nutritional intervention is to ensure that macronutrients are in adequate supply in diet. The macro nutrients are energy; supplied majorly by carbohydrate rich foods, and proteins. After meeting the primary needs, then micro nutrients can be incorporated. It must be however noted that even with this classification, the balanced consumption of macro and micro nutrients basing on requirements achieves the highest productivity since nutrition is governed by the principle of limiting factors Bell (2004). The nutrient in the shortest supply is the one that governs productivity in the long run.

The energy rich foods

The preferred traditional foodstuffs under cereals were millet, sorghum and maize. From the category of roots and tubers, cassava and sweet potatoes were preferred. These two categories nutritionally are categorized as energy rich foods. Energy rich foods are recommended to be the base food in human diet. For people involved in highly productive activities, reduction in energy giving food consumption in diet has been reported to lower their work productivity and prolonged short intakes may lead to morbidity Mkupete (2022).

The protein rich foods

The preferred traditional foodstuffs under protein rich foodstuffs were beans and groundnuts. These two are legumes. Nutrition defines protein quality by amino acid composition of the foodstuff. From a nutritional perspective, beans have been reported to be low in sulphur containing amino acids; methionine and cysteine Sotelo, Sousa, and Sanchez (1995). Groundnuts have also been reported to be low in methionine Essien (2011). The combination of groundnuts and bean in diet however improves the amino acid composition for diet. The study might need to consider the inclusion of soy and pigeon peas as a legume in diet due to not only its fair content of methionine and cysteine proportion but also its essential fatty acids and minerals. Erbersdobler, Barth, and Jahreis (2017)

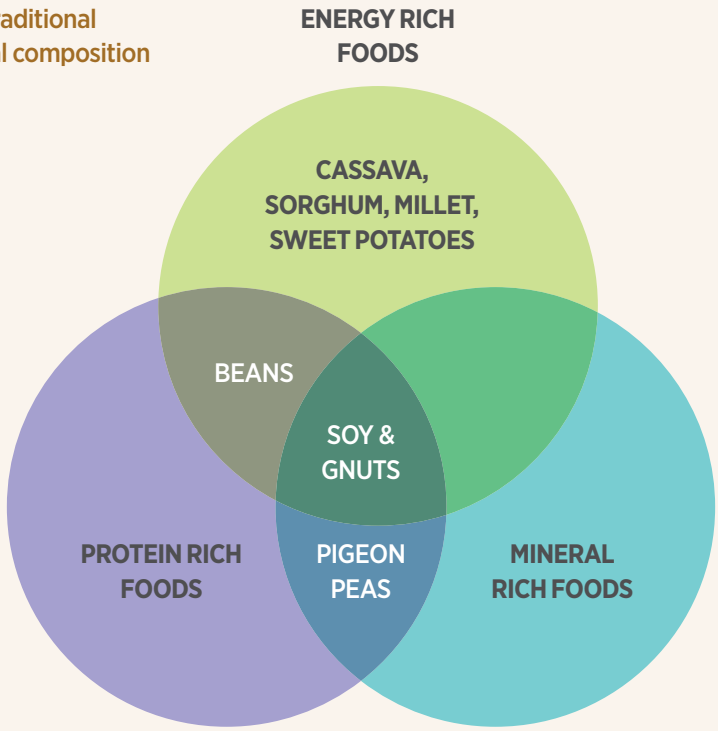
The micronutrients in diet

Micronutrients of nutritional importance include minerals and vitamins. Vitamins are generally supplied from fruits and vegetables. The major of importance include sodium, chlorine, calcium, phosphorus, potassium, sulphur and magnesium. Minor minerals include iron, Iodine, zinc, copper, cobalt, selenium and others.

Iron deficiency is the most common mineral deficiency, and is common among under fives and women of child bearing age. Its absorption from foods of plant origin is less than animal foodstuff. The absorption is affected by tannins and catechins in tea, coffee and cocoa, so communities must be advised against practices of taking tea with meals. Iron is commonly available in supplementary form from pharmacies and its absorption is enhanced by accompanying supplements with vitamin C rich fruits. Eating iodised salt supplies three of the needed minerals; sodium, chlorine and iodine. Calcium can be obtained from cereals and dark green leafy vegetables, fermented cereals and dairy product if they are available Phillips (2005); Sandra Cristina Gomes Silva João Pedro Pinho Cátia Borges Cristina Teixeira Santos Alejandro Santos Pedro Graça (2015).

The inadequacy in dietary diversity among women could be explained by cultural practices of selfless care displayed majorly by women. They may probably serve their households richly first at their own expense *Wood (1994)*.

Figure 5: Summary of traditional foodstuffs by nutritional composition



5.3.2 Harvesting and Storage practices adequacy among traditional foods

The harvesting practices observed among farmers were generally adequate among cereals and legumes. Roots and tubers had irregular harvesting practices governed by their high perishability after harvest. Post harvest, cassava particularly suffers Postharvest Physiological Deterioration (PPD) due to its high water content. Because of this, farmers tend to harvest only what they can market, or process and consume in a little time Rickard (1985).

To control PPD, care has to be taken during harvest in order to minimize root damage which exposes cells to oxidation and enzyme activity. Damaged tuber should be processed into chips and flour immediately, otherwise it undergoes deterioration. Mechanical control practices like waxing have been devised although these also increase shelf stability from 4 days to about 60days Beeching et al. (2002); Zainuddin et al. (2018).

After harvest, sweet potatoes can be exposed to a single days sun shine, then cooled and stored in fiber layered underground pits. This increases the shelf life of potatoes to 180 days postharvest Mpagalile, Silayo, Laswai, Ballegu, and Kikuu (2007);Dandago and Gungula (2011).

The storage of cereals and legumes in granaries, baskets and woven bags, as long as these grains are appropriately dried protects them safely and results in no qualitative and quantitative losses.

5.3.3 Preparation and processing adequacy for traditional foods

Plants by nature have phytochemicals that are meant to protect them from being eaten by animals. These can be perceived as bitter agents, soapy or pungent flavors as found in cassava (cyanide), soy (saponins and trypsin inhibitors) and sorghum (tannins) respectively Belitz, Grosch, and Schieberle (2009). Preparation and processing should focus on making food more palatable and unlock the nutrients contained in them. Some of the enzymes in the human digestive system may however be unable to unlock nutrients from foods of plant origin or even free them from the anti-nutritional factors.

Cassava

Preparation of sweet cassava varieties by steaming and eating were adequate to derive the desired cassava safety and digestibility. For bitter cassava varieties however, skipping the fermentation stage, and only drying the tubers gives a residual cyanide content way above the safe limit. It is advisable that for all bitter varieties, processing adopts a 24 hour fermentation stage of grated cassava in a yoghurt inoculated broth followed by drying and milling. The resultant product will be safe Nwokoro and Anya (2011).

Table 9: Cyanide content at different processing stages of bitter cassava varieties

Safe limit	Fresh Root	Dry chips	Steamed Fresh root	(FAO/WHO, 1991)
Concentration (mg HCN/ kg)	268.79 (20)	65.49 (8)	122.34 (5)	10

Figures in brackets stand for standard deviation of 3 samples

Sorghum and millet

Tannin located in the testa of cereals such as sorghum and millet are removed by decortication of the cereals. The domestic preparation process involving roasting, motor hulling and winnowing is capable for removing approximately 17% of the tannins. Soaking and boiling reduce tannins to approximately 73% Mendoza, Barroga, Rodriguez, Revilleza, and Laurena (1988). 95% detannification of millet and sorghurm can be achieved by soaking grains in a 0.1M solution of sodium bi carbonate (0.1M NaHCO3) for 20 minutes at room temperature Makkar and Singh (1992). This is equivalent to 8.4 grams (approximately 2 tea spoonfuls) of sodium bi carbonate in a liter of water for soaking the grains. Detannification improves both protein and mineral uptake from cereals. Processors and households should adopt this procedure. Sodium bicarbonate is already on the market.

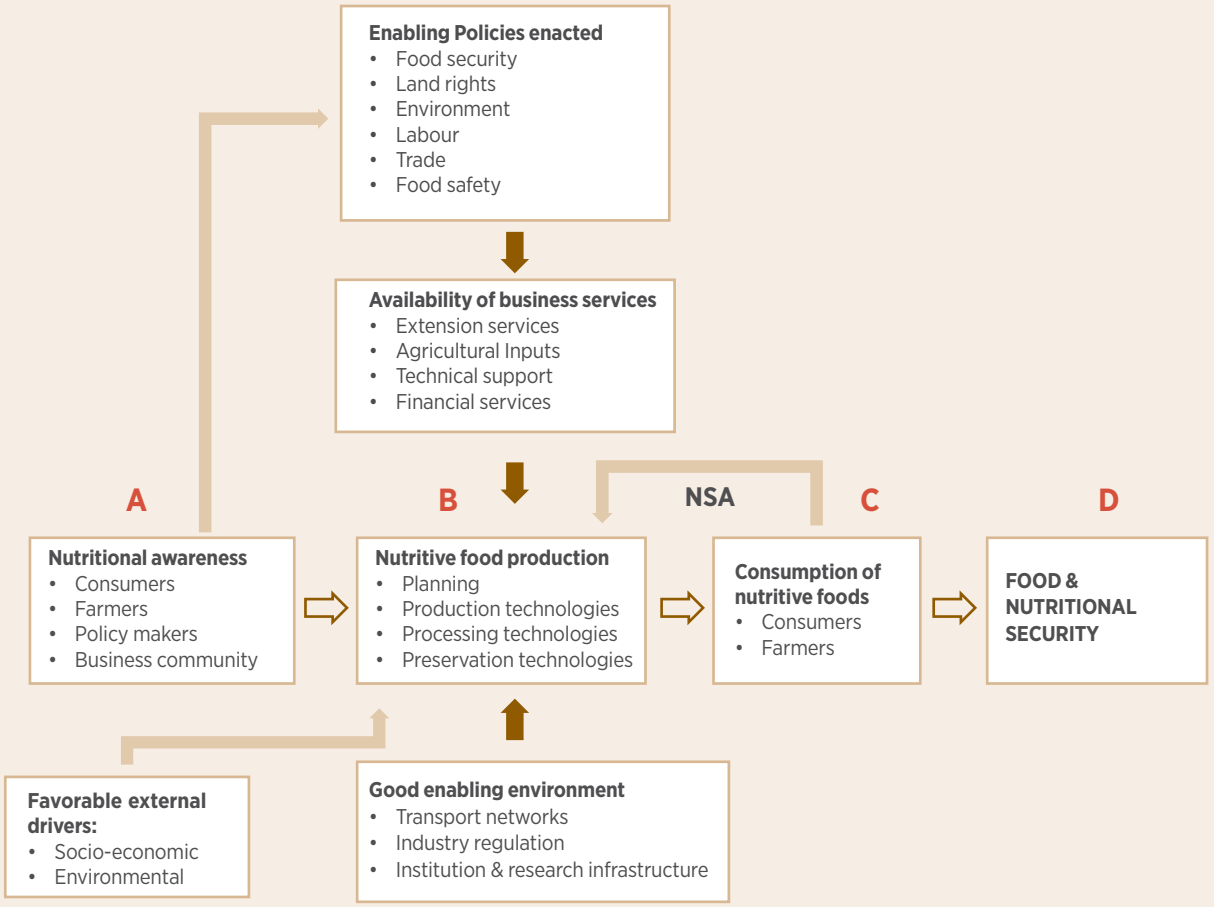
Soy

Although soy has the highest protein content among the legumes, soy is characterized with trypsin inhibitors, which lower soy protein digestion and absorption. Boiling soy in a 10% solution of lime (10% Ca(OH)2) for 1 hour removes 100% of the trypsin inhibitors. The calcium improves the calcium content of the soy Belitz et al. (2009). Calcium hydroxide is an FDA accepted food ingredient with an E number of E526.

5.4 Towards a Nutrition Sensitive Agriculture.

Nutrition sensitive agriculture is a practice that starts with attitudinal change. To change attitudes, new knowledge must be disseminated. NSA is expected to result into positive and negative output to the environment. Resilience demands a systems approach.

Anticipated framework for the implementation of NSA in the WNR



6.0 CONCLUSIONS RECOMMENDATIONS

The study observed average levels of nutritional knowledge among respondents. This matched with the observed nutritional attitudes which were also average. Nutritional practices were representative of national statistical levels, characterized by average serving frequencies per day (2.5) and relatively inadequate serving portions and limited in nutritional diversity.

Nutritional practices were slightly in favor of the men than the women. The women were found to score lower than men in number of meals per person per day, in serving portions and adequacy in nutritional diversity.

Traditional foodstuffs were found to have high preference over contemporary foods, with millet, sorghum, beans, groundnuts, cassava and sweet potatoes ranking highly of the preference list. Pigeon peas, soy and simsim need to be promoted. Due to the nutrient compositions these crops, they are potential contributors to nutritional security. The new food processing technologies highlighted once adopted, have the potential of unlocking nutrients from the traditional foodstuffs.

Resilience of NSA over time is hinged to environmental protection practices such as boosting of soil fertility climate change resilience through flora restoration.

Recommendations

Soy, pigeon peas, and simsim though considered minor on the overall traditional crop preferences, need to be promoted for their nutritional importance.

Preparation and processing technologies of traditional foodstuffs need to be blended with improved approaches to improve their nutritiousness and safety.

Reforms on land and labor policies need to be done to promote gender equity as an effort towards a sustainable NSA.

Boosting nutritional and agricultural knowledge through education and training is expected to form the foundation for NSA. Knowledge will influence attitudes, attitudes will create habits and habits will become behaviour. It is a process.

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Annexes

A.1 Pictures of some traditional foodstuffs under their categories

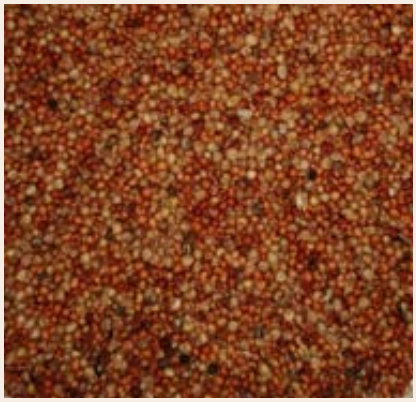
CATEGORY: ROOTS & TUBERS

CASSAVA CHIPS / BANDA

SWEET POTATO CHIPS / MUTERE

CATEGORY: CEREALS

FINGER MILLET



AMARANTH SEEDS

TALL SORGHUM / ONDU-GODO

SHORT SORGHUM / ONDU-PURA

GOMA / SHORT SORGHUM

WHITE SORGHUM

GUSI

MAGA / YELLOW MAIZE

MAIZE (RED VARIETY)

CATEGORY: LEGUMES & PULSES

GREEN SOY BEANS

MUNIGA GREEN BEANS

LAULAU BEANS

NYLON BEANS

PIGEON PEAS

NYIRIKIA / OSUNYIRIKIA

TRADITIONAL GNUTS / SUNGU (B)

GROUND NUTS (A) SUNGU

RED GNUTS / FUNYO IKA

PINK GNUTS / FUNYO / IMVE

GREEN GRAM

SEPEYA BEANS

BLACK BEANS

NYARAWULA BEANS

NYAMUSOOLE BEANS

CASHEW NUTS

ANYU / SIMSIM

SMALL SIMSIM (MUNIGA)