WOMEN SHELLFISHERS AND FOOD SECURITY PROJECT

Technical Report on Site Based Research in Ghana and The Gambia

Land-seascape Food and Nutrition Profiles

August 2022

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Photo Caption: Mangrove landscape in The Gambia

Photo Credit: World Agroforestry.

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ACRONYMS

DAA	Development Action Association
DOPA	Densu Oyster Picker's Association
FGD	Focus Group Discussions
HoH	Head of Household
ICRAF	World Agroforestry
MAHFP	Months of Adequate Household Food Provisioning
SD	Standard Deviation (s.d.)

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SUMMARY

Diversified food system strategies can improve food composition and income sources for women oyster harvesting communities dependent on seasonal fishery activities. This study focused on women shellfishers in Densu Estuary, Narkwa Lagoon, and Whin Estuary in Ghana and in Tanbi, Bulock, and Allahein estuaries in The Gambia, and to understand the status and opportunities for increasing the use of biodiversity to meet seasonal food and dietary needs.

Research activities included site scoping assessments, 21 focus group discussions in Ghana (5) and The Gambia (16) and 356 random household interviews in Ghana (211) and The Gambia (145). In addition, data validation and feedback discussion meetings were conducted with communities across the six study sites. Overall, assembled data covered household livelihood characteristics, food production, food types, seasonality and expenditure attributes, tree planting, nurseries, species diversity and management, local food portfolios, and oyster and fisheries resource use challenges.

Findings revealed key challenges cited as hindrances to meeting environmental and dietary needs by communities. There are food seasonality challenges, narrow food choice options, and inadequate credit facilities, market infrastructure, knowledge, and local capacity limiting fisheries activities. Data analysis revealed that communities are reliant on starchy staple crops, pulses, vegetables, and fruits for nutrition. Immediate nutrition food portfolios developed together with communities showed tree and crop species and their possible contribution for food and nutritional needs from local production systems. April and July were mapped as peak for food insecurity in Ghana, while in The Gambia peak food insecurity was between June and September. The study therefore recommends establishment of a more diversified food system that includes trees to improve diets and income, and contextualisation of the community needs across the sites based on their locally available biodiversity resources.

1. INTRODUCTION

The Women Shellfishers Food Security Activity engaged with fisheries communities in Ghana and The Gambia to better understand the status and opportunities for increasing the use of biodiversity to meet seasonal food and dietary needs. To develop comprehensive land-seascape food and nutrition profiles, an assessment of the agricultural and wild biodiversity available in the study sites was undertaken. The underlying premise is that if such high value wild food and feed tree species become part of the food systems, then livelihoods and household resilience for local communities will improve, and pressure on mangrove ecosystems will decrease, boosting sustainability of shellfishery economic activities.

A more diversified food system could also improve diets and income sources when oyster harvesting activities are off-season. So far, knowledge on the use of diverse food trees in urban and peri-urban coastal areas with increasing human settlement and food homogenization remains unclear. The study has provided recommendations on important food portfolios from agriculture and forest resources to help communities, development workers and government ministries charged with improving nutrition. To gain an in-depth understanding of specific issues, the study applied several techniques such as scoping assessments, focus group discussions (FGDs) and individual household interviews.

Identified food and nutrition portfolios (or Nutritious Food Portfolios) are context-specific recommendations to guide production and consumption of a greater diversity of nutrient-rich foods. The approach further helps to address seasonal food harvest gaps, and micronutrient gaps in local food composition. Typically, agroforestry food portfolios consist of a variety of indigenous and exotic trees and crops including fruits, vegetables, pulses, and staples. The portfolios are prepared following community inputs and taking into consideration the socio-ecological dynamics of food production, including seasonal availability, food security, and food consumption preferences.

2. MATERIALS AND METHODS

2.1 Study Sites

This study was conducted in Ghana and The Gambia covering three sites per country selected based on a purposive study, "Selection of Locations for Site Based Research" covering coastal sites well known for fisheries and in particular oyster shellfishing activities by women and their associations (Chuku et al., 2020). Site selection, documented in Selection of Locations for Site Based Research (Chuku et al., 2020), involved the collection of secondary and qualitative field information based on set criteria as described in the program design. It included: (1) existing shellfish activity, (2) significant involvement of women shellfishers, (3) existing mangrove systems-based livelihoods, and (4) a range of mangrove health conditions (level of degradation) and changes over time.

We used a purposive rather than random sampling approach for site selection as this approach helped to select sites that have significant variation in key variables of interest such as fisheries and mangrove health, nutrition, anaemia, governance, gender, and women's empowerment dimensions. Further, the characteristics of the entire population of estuaries regionally are not well known. Candidate sites were identified using secondary information, expert opinion, and local knowledge. Once sites were identified, rapid field assessments were undertaken. World Agroforestry (ICRAF) led the field assessment process in The Gambia while the University of Cape Coast led the process in Ghana, with other project partners providing information and expert opinion. Once all the information was compiled, the research team held discussions for each country to arrive at a consensus on the sites for the field research. The key features of the three sites selected in Ghana and three sites selected in The Gambia are provided in Annexes 1 and 2.

2.1.1 Ghana

Study sites in Ghana were the Densu estuary, Narkwa lagoon, and Whin estuary in the Greater Accra, Central and Western regions of Ghana respectively (Figure 1). Scoping assessments and FGDs involved five communities located along estuaries and lagoons on the Atlantic coast of Ghana (i.e., the Gulf of Guinea) in three administrative districts. These are Densu: Tsokomey & Bortainor in Ga South District (Greater Accra Region; 5°32'7.08" N and 0°23'54" W; 341.84km^2); Narkwa in Ekumfi district (Central Region; 0.92°W, 5.37°N and 0.93°W, 5.42°N; 276.65km^2) and Whin: Apremdo & Amanful in Kuma-Effia-Kwesimintsim sub-metro of the Sekondi-Takoradi Metropolis (Western Region; 4°54' 52.2" N and 1°47' 15.36" W; 50.77 km^2).

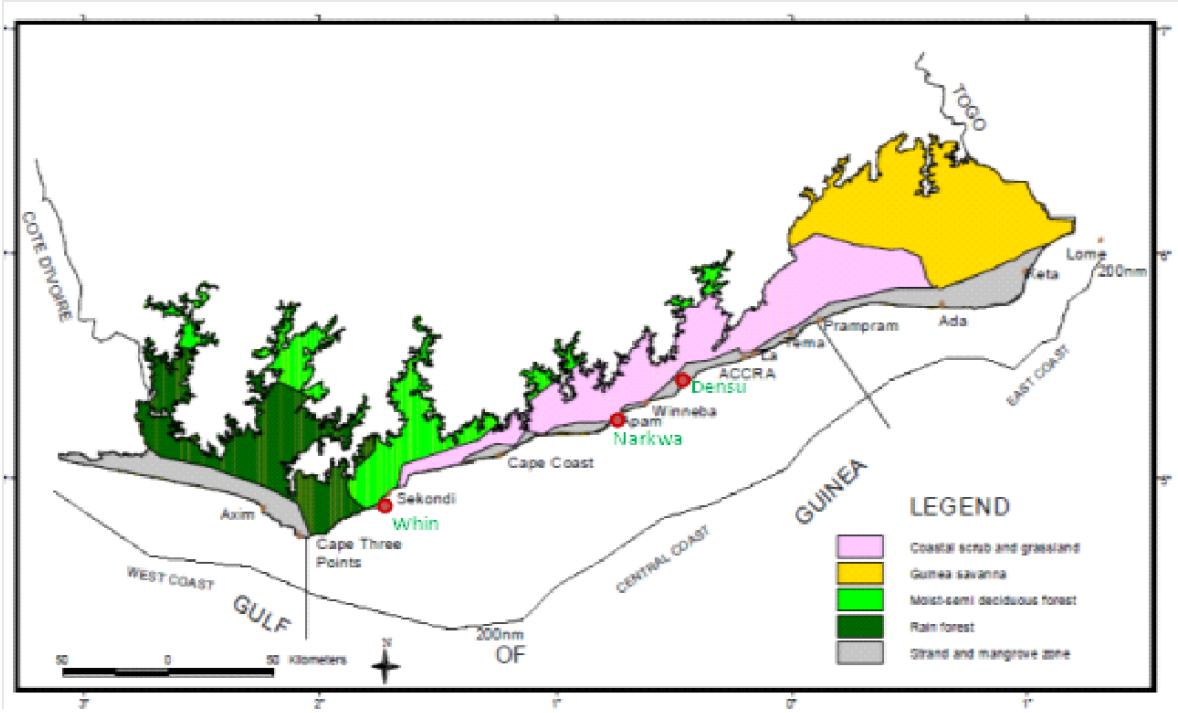

Figure 1: Ghana study sites: Densu, Narkwa, and Whin.

Densu and Whin are typically urban centres while Narkwa is peri-urban to rural. Whin has the least geographical area of about 51 km^2 and is the most populated of the three sites (population density of 6000 persons/km^2). Ethnic settlement consists of Ga (Densu), Fante (Narkwa), and Ahanta and Fante (Whin) people. Most households practice crop agriculture across the sites: Densu (76 percent), Narkwa (93 percent) and Whin (80 percent). Food crops such as cassava, maize, plantain, egg plant, okra, and tree crops such as mango, cashew, palm oil, cashew and avocado are cultivated. Livestock keeping consists of goats, sheep, cattle, poultry, and pigs (GSS, 2014; Obiri et al., 2021). Cash crops are pineapple, citrus, oil palm, and coconuts.

Climate is equatorial with two rainy seasons between April and November ranging from 790 mm in the drier equatorial zone of Densu to over 2000 mm in the moist equatorial zone of Whin. Temperatures vary from 22-34°C. Soils are largely orchrosols and loamy in nature, although they could be saline in some areas. Vegetation types consist of coastal savannah plains in Densu, dense shrubby vegetation in Narkwa, and moist savannah semi-deciduous forests in Whin.

2.1.2 The Gambia

Study sites in The Gambia were the Tanbi, Bulock and Allahein estuaries (Figure 2).

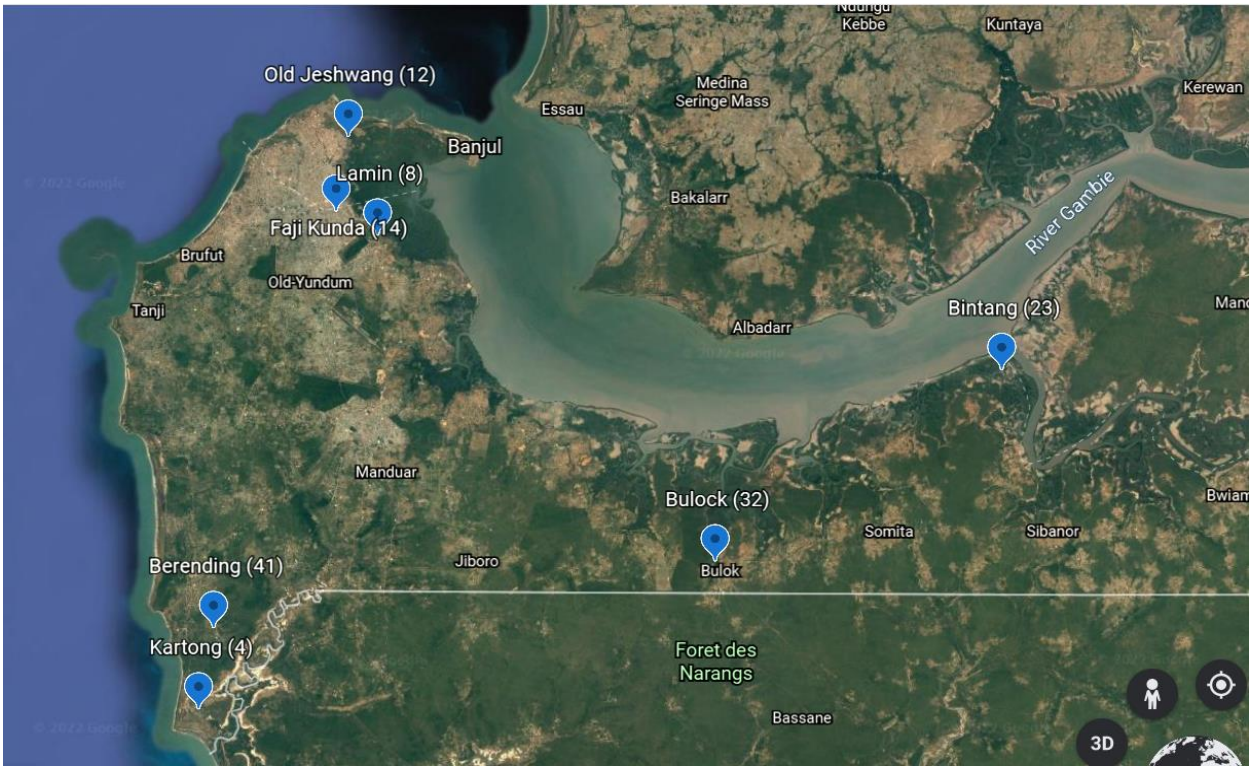

Figure 2: The Gambia study sites: Tanbi, Bulock and Allahein.

Within the Tanbi, selected sites cover the southern area from Abuko, Lamin, Kerewan, Mandinari, and connections to the sea. The northern parts of Tanbi that includes parts of Banjul city have dense settlements. Households in selected parts of Tanbi undertake agricultural activities which provide an opportunity for integrating trees for boosting nutrition and generating benefits. Key economic activities include shellfishing, vegetable gardening, and rice production. During the dry season (December to June), women, who are of the Jola ethnic group, engage in oyster harvesting from the mangroves. Firewood collection from the mangroves is also rampant in the area, used to cook and shuck the oysters, and prepare other meals. There is indiscriminate dumping of trash around the Jeshwang area, causing pollution.

In Bulock, 50 – 70 km from Banjul, communities include Bulock, Sutu Sinjang, Ndemban Chapechum, Besse, and Berefet. There are large areas of mangroves along the Bulock-Berefet stretch, with numerous creeks, locally called "*bolongs*". The landscape selected is approximately 7427 ha with mangroves covering about 3539 ha. Finally, the Allahein River estuary, an area of high ecological importance, supports communities from The Gambia and southern Senegal. Communities of Kartong and Berending villages in The Gambia and others from southern Senegal utilize the oyster and cockle resources for their livelihoods. Shellfishing is an important source of employment and provides food and nutrition security. Overexploitation of the oyster and cockle resources is, however, a major challenge with many people harvesting these resources. In addition, there is uncontrolled misuse of the mangroves.

2.2 Sampling Approach

Twenty-one FGDs, five in Ghana and 16 in The Gambia were conducted with community members between May and June 2021 to capture information on the use of agricultural and wild biodiversity, develop seasonal food harvest calendars, and allow communities to prioritise their preferences for species to meet their food and livelihood needs. A total of 356 households (211 in Ghana, 145 in The Gambia) were interviewed during June and August 2021 to further assess on-farm food production diversity and food security.

Different sampling approaches were used in the two countries based on the extent of prior knowledge of the project sites, organisation, and composition of the existing shellfishing communities. The below sections describe the approach for each country, and for the two data tools used in this activity - the FGD (qualitative) and household survey (quantitative).

2.2.1 Ghana

2.2.1.1 Qualitative Data Collection - Focus Group Discussions

The FDGs were undertaken from May 3-7, 2021, at project sites in Densu estuary, Narkwa lagoon, and Whin estuary in Greater Accra, Central and Western regions of Ghana respectively (Figure 3). The criterion for clustering FGDs was first based on location (i.e., spatial features) of the main

communities involved in shellfishing at the estuaries and lagoon. Within communities, further clustering was done by gender for Densu and Narkwa, where a smaller proportion of men engaged in shellfishing. Development Action Association (DAA) was the main contact at Densu and supported the field team in organizing the Densu Oyster Picker's Association (DOPA) shellfisher group at the Densu estuary into the required clusters for the meeting. However, at Whin Estuary, clustering was based on the scale of oyster collection (i.e., subsistence and commercial). This was due to only women being involved in shellfishing at this site. Once the main communities or groups were identified, community focal contacts were invited to take part in FGDs. A total of 115 shellfishers, including 107 women (93 percent) and eight (7 percent) men participated in the FGDs, this included 43 participants in Densu, 42 in Narkwa and 30 in Whin.

Figure 3: FGDs with shellfishing communities in Tsokomey in the Densu estuary and Apremdo in the Whin estuary. (Photo source: Beatrice Obiri/ Forestry Research Institute of Ghana.

Due to seasonality considerations of oyster harvesting activities, time constraints on the part of respondents were experienced for conducting FGD interview sessions covering two major topics on landscape visioning and agriculture biodiversity assessments. This meant late start (mid-morning) and finish (late afternoons) of the discussions with respondents since early morning was a busy part of the day with shell fisheries collection activities.

2.2.1.2 Quantitative Data Collection - Household surveys

The FGDs were undertaken prior to the household surveys to allow for further scoping and collation of comprehensive lists of individuals involved in shellfishing activities across the project sites. Lists of the communities and groups were obtained through key informants and the local shellfishers cooperatives and groups such as DOPA in Ghana and TRY Oyster Women's Association in The Gambia. For Densu, 155 individuals were listed, for Narkwa, 68 and for Whin, 86. Final survey respondents were randomly sampled from the lists compiled. This resulted in a total of 211 household surveys completed.

2.2.2 The Gambia

2.2.2.1 Qualitative Data Collection - Focus Group Discussions

Sixteen FGDs were conducted covering household clusters in Tanbi, Bulock and Allahein estuaries.

2.2.2.2 Quantitative Data Collection - Household surveys

A total of 144 households were surveyed. The aim was to study an even sample across the three sites covering Tanbi, Bulock and Allahein (Table 1) found across six administrative districts. Random sampling of shellfishers was drawn from records of contacts by TRY Oyster Women's Association, a community-based organization. Due to the high number of people involved in shellfisheries in the Tanbi site, three districts - Busumbala, Jeshwang, Serekunda East, and six villages were covered for the household survey, which is the southern portion of the Tanbi Estuary. The site is also characterised by dense human population settlement. In Bulock, two districts and four villages were covered.

Table 1: Sampling framework for household surveys in The Gambia project sites.

Study site (No. of respondents)	Districts (No. of respondents)	Villages (No. of respondents)
Tanbi (48)	Busumbala (9) Jeshwang (13) Serekunda East (26)	Ebo Town (13); Faji Kunda (10) Jeshwang (6); Kamalo (3) Lamin (11); Old Jeshwang (5)
Bulock (47)	Foni Berefet (31) Foni Bintang Karanai (16)	Bintang (17); Bulock (25) Foni Bintang (1); Sutusinjang (4)
Allahein (49)	Kombo South (49)	Berending (17); Kartong (32)
All sites (144)	All Districts (144)	All Villages (144)

2.3 Data Tools

Participatory research techniques were used to generate quantitative and qualitative information to assess agricultural and forest/wild biodiversity used for food and feed by communities in the project sites. FGD data collection in Ghana used manual data entry forms. Data was later transferred onto the Kobotoolbox platform due to the nature of FGD discussions involving multiple respondents, posing challenges for note takers when working directly on tablets. Given the fewer number of FGDs compared to individual and household interviews and the need to verify data with voice recording tools, this approach was preferred. This process, although time consuming, was valuable for complete data capture. Individual household interviews were conducted on the digital platform using tablets.

2.3.1 Tool 1: Farm and landscape (site) assessment

It is important to know 'for whom' [farming households] and 'where' [farming landscapes] the portfolio(s) are being developed, and how they may benefit socially, nutritionally, ecologically, and

economically. The purpose of the household survey was to generate data on the socio-economic demographics, and on-farm agricultural diversity and use of wild biodiversity, in the selected project sites. The following topics were included in the survey:

- Household socio-demographics (Annex 1).
- Farm production characteristics: general.
- Food tree, crop, livestock production and use: detailed species, varieties (Annex 3).
- Market access: frequency/food expenditure.
- Collection of food and fodder from the wild: type, months of collection.
- Trees on farm: origin, interest to plant more, type (functional use), species, challenges with tree planting/growing.
- Training on tree planting and management: number, type.
- Inputs, nurseries: availability, use, challenges.
- Food availability (seasonality) and Months of Adequate Household Food Provisioning (MAHFP).
- Oyster activities: quantity (kg) harvested (on/off season), use of firewood for oyster activities (source, species, alternative energy).

2.3.2 Tool 2: Focus group discussions – prioritising food and fodder species for food, nutrition, and livelihoods, and developing food harvest calendars

FGDs are a key part in co-developing the portfolios with communities. They were used to capture information on community members preferences and priorities for different food species production and consumption, and to develop seasonal food harvest calendars. The following topics were covered in the FGDs:

- Group demographics (number of participants, gender, age) – See Annex 1.
- Food crops cultivated/used (Annex 3).
- Assessment of livelihood activities across study sites (Annex 4).
- Challenges identified with cultivating/wild collecting/selling of food and fodder products and species (Annex 5, 6, 7).
- On-farm production/wild collection/sale of food and fodder (products).
- Interest in Indigenous/wild food and fodder.
- Trees cultivated/used for food/fodder/medicine/other products/ecosystem services (Annex 8).
- Preferences for food and fodder products and species which are of benefit to shellfishing communities (priority setting and ranking).
- Food and fodder seasonal food harvest calendars (Annex 9).

2.4 Developing Nutritious Food Tree and Crop Portfolios

The availability of micronutrient rich crops like fruits and vegetables is highly season-dependent and as a result, among other reasons, these foods are often lacking in local diets. When consideration is given to the seasonality of production, nutritious food portfolios of cultivated and wild nutritious foods can be promoted for filling seasonal harvest gaps and for delivering key micronutrients in diets[1]. The portfolios are co-developed with local communities based on their preferences for species, priorities for food, income, and other uses and are customized for site-suitability.

An adapted set of tools (described in the above section) are used to determine within an annual calendar the various food, fodder, and other products cultivated or collected from the wild by communities. These data are used to determine, at monthly resolution, periods of food insecurity and to provide recommendations for closing this gap with food that can deliver micronutrients in local food systems. A combination of indigenous (often underutilized) and exotic species are prioritized. Indigenous food species have a key role to play in local systems because they are often more adapted to landscapes and a diversity of species can promote resilience. Due to their differing phenology, these species are sometimes available for harvest when other crops fail due to drought, or pests and disease and during gaps between seasonal crop harvests, also referred to as the "lean season". There is an opportunity for locally adapted species to supply much needed micronutrients in diets and they offer a locally appropriate solution. In addition to addressing the harvest 'gaps', portfolios help to address micronutrient gaps in local diets by mapping proposed species with their nutrient content information. Key micronutrients, vitamins A and C, iron, and folate are prioritized due to their public health concerns, their supportive functions - enhancing vision and boosting immunity against diseases, and (for the former two), their natural high quantity in tree foods.

2.5 Study Validation Meetings

Following field data collection and reports work, feedback sessions were held with the communities to ensure information captured in the reports are representative of the situation on the ground. This also provided an opportunity to correct errors that might have been recorded. Study validation meetings were organised on a site-by-site basis to promote thorough discussions. Validation meetings in Ghana were undertaken with a total of 89 shellfishers covering: Densu estuary (33), Narkwa lagoon (36) and Whin estuary (20). In The Gambia, 134 participants drawn from Tanbi (34), Bulock (55), and Allahein (45) took part. Sites included areas where communities had already been engaged for data collection work. Most of the participants were female - 96 percent and 87 percent respectively in Ghana and The Gambia. DAA supported participants recruitment in Densu from the shellfisher group DOPA. At Narkwa and Whin where shellfishers were not formally organized into groups,

[1] McMullin, S., Njogu, K., Wekesa, B., Gachuiri, A., Ngethe, E., Stadlmayr, B., Jamnadass, R., Kehlenbeck, K. (2019). Developing fruit tree portfolios that link agriculture more effectively with nutrition and health: a new approach for providing year-round micronutrients to smallholder farmers. *Food Security* 11, 1355–1372.

clusters of participants drawn from villages involved in shellfishing activities were used. Figure 4 shows the set-up used to conduct meetings with communities in Ghana and The Gambia.

Figure 4: Study validation meetings in Ghana and The Gambia.

3. RESULTS

3.1 Quantitative Data – Household Survey

Descriptive analysis on the survey data is presented here. More detailed and triangulated analysis will be available for additional outputs such as the multivariate data analysis combining several data elements or for more formal publications. The descriptive data below nonetheless covers key findings and is presented on a per country basis.

3.1.1 Ghana

3.1.1.1 Household demographics

Household surveys were completed across three sites: Densu, Narkwa and Whin. A summary of household demographics is presented (Table 2). Ninety four percent of respondents were female, with 54 percent of respondents identifying as Head of Household (HoH). The average age of respondents was 50 years old (SD – 14). There was a statistically significant difference in age between the Densu and Whin sites ($F(2,208) = 18.584$, $p < 0.0001$).

On average, there were four adults and three children in households. There was a statistically significant difference in the number of adults between sites ($F(2,208) = 4.06$, $p = 0.0184$). The average number of adults per household was significantly different between Whin and Narkwa, Whin and Densu, and Densu and Narkwa.

The average farm size was one acre, with respondents indicating an average of five years farming. The average farm size differed significantly between Densu and Whin, with average farms sizes of 0.1 acres in Densu, and 2.3 acres in Whin ($F(2,208) = 38.377$, $p < 0.0001$). The average number of years farmed was significantly different between Whin and Densu and between Narkwa and Whin and Densu but not between Narkwa and Densu ($F(2,208) = 20.428$, $p < 0.0001$).

Table 2: Summary of basic characteristics in Ghana by project site.

Study Sites	No. of respondents (percent)		Household head mean age (s.d.)	Farm size (acres) (s.d.)	Mean no. of years on land (s.d.)	Mean no. of adults/HH	No. of children/ HH
	Female	Male					
Densu Ga south District	66 (90.4)	7 (9.6)	43.2 (10.5)	0.1 (0.4)	0.5 (2.5)	3.1 (2.3)	3.3 (3.8)
Narkwa Ekumfi District	66 (95.7)	3 (4.3)	52.1 (15.1)	0.6 (0.9)	3.2 (7.9)	3.7 (2.3)	3.6 (2.5)
Whin Secondi - Takoradi Metro	66 (95.7)	3 (4.3)	56.3 (13.7)	2.3 (2.6)	12.5 (18.7)	4.3 (3.2)	2.9 (2.1)
All sites	198 (93.8)	13 (6.2)	50.4 (14.3)	1.0 (1.9)	5.3 (12.7)	3.7 (2.7)	3.3 (2.9)

3.1.1.2 Oyster harvesting

On average, oyster harvesting quantities reported from Densu and Whin sites were only about 11 Kg while the peak season amount was about 12 Kg, and only 6 Kg in low season. Narkwa recorded high average peak season amounts of around 12.3 Kg compared to Densu (4 Kg). There was high variability in the amount harvested overall between sites. The average daily harvest per person during the peak season was similar to the annual average harvest, even though on average, about half of the harvest is obtained during the low and high harvesting seasons (Table 3).

Table 3: Average Oyster harvesting during on/off season in Ghana project site (in kg).

Oyster Harvest (in kg)	Densu	Narkwa	Whin	All sites
All season Oyster harvest	2.0	11.1	-	10.9 (12.0)
Per person per day (kg) (all)	0.4	1.8		1.8 (2.3)
Oyster peak season	4.0	12.3	-	12.2 (16.5)
Per person per day (kg) (peak)	0.8	1.9		1.9 (2.5)
Oyster off season	1.0	6.1	-	6.0 (9.3)
Per person per day (kg) (off-season	0.2	0.9		0.9 (1.5)

*Value in bracket is the standard deviation for average for all sites; *(-): no interviews conducted in Whin*

3.1.1.3 Household food production

In terms of the types of food produced on-farm (Figure 1), in Densu, 34 percent of households kept livestock, 12 percent produced fruits, eight percent staple crops, seven percent vegetables, and four percent pulse crops and fodder. In Narkwa, 35 percent produced vegetables, 35 percent kept livestock, 44 percent produced staple crops, 20 percent fruits, nine percent pulse crops and six percent fodder. In Whin, 75 percent produced staple crops, 70 percent produced vegetables, 32 percent produced fruits, 26 percent kept livestock, seven percent produced fodder, three percent produced pulse crops and one percent produced honey (Figure 5).

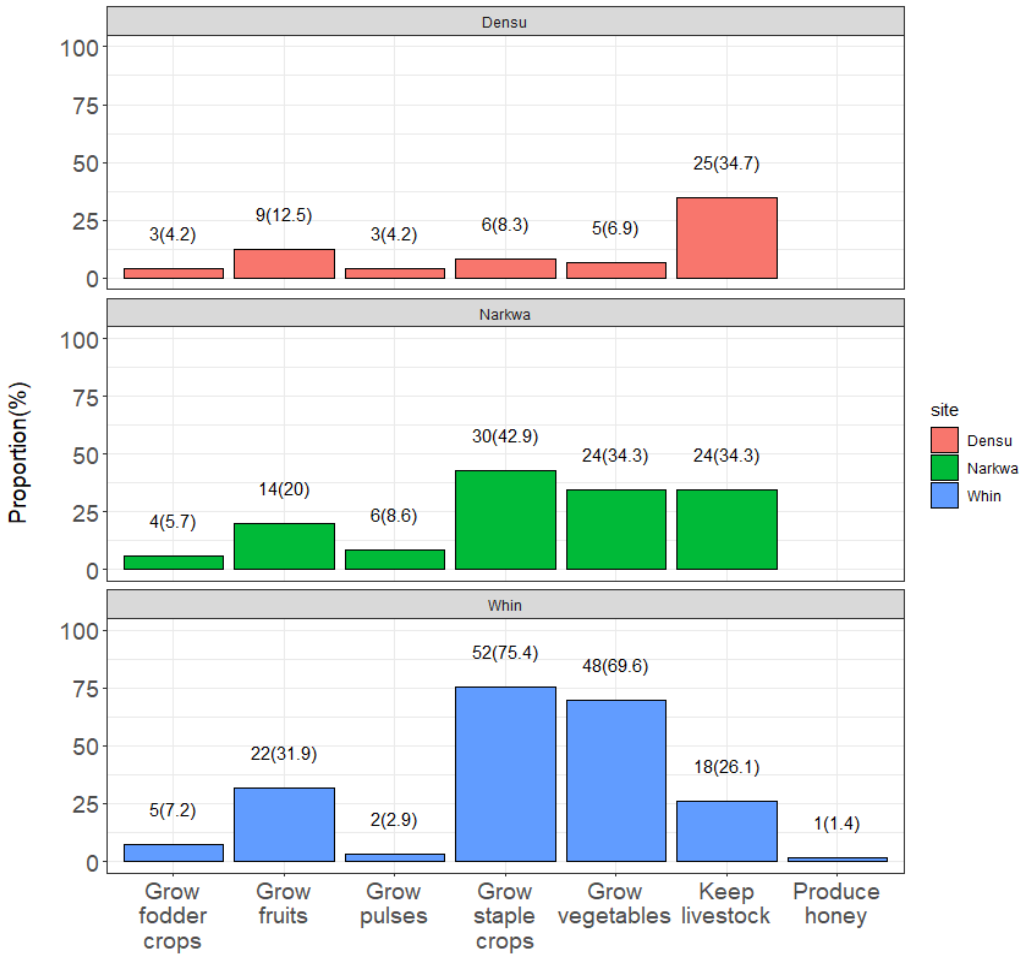

Figure 5: Types of food production activities undertaken by respondents in the Densu, Narkwa, and Whin project sites.

Results show that a proportion (30 percent) of households kept livestock. This suggests the importance of these food sources even for densely populated areas such as Densu. Growing of staple crops, vegetables, and fruits were reported by over 20 percent of households in Whin and Narkwa. Respondents in Whin and Narkwa have the highest proportions of households growing staples, 75

percent, and 43 percent respectively, and growing vegetables, 70 percent, and 34 percent, respectively. These options were mentioned as important by less than 10 percent of households in the Densu site due to limited farm sizes. Growing fruits was nonetheless important for at least 12 percent of households in the Densu site. Growing of fodder crops was reported by less than 10 percent of the households even though most mentioned livestock as an important food source since most livestock are fed on food waste.

3.1.1.4 Common food types produced

Major food source groups were recorded as staples, vegetables, and fruits by households' respondents across survey sites (Table 4). Specific crops used as staples by most respondents were cassava, maize, and plantain; vegetables included pepper, garden eggs, tomato, and okra; fruits included pawpaw, coconut, pineapple, banana, mango, guava, and others; while pulses included beans, cow peas, moringa, and groundnuts.

Table 4: Major food groups and specific crop types produced at surveyed sites.

Food Group	Specific Crop Type (Respondents count %)
Fruits	Pawpaw -18 (9%), Coconut-18 (9%), Pineapple 16 (8%), Banana -14 (7%), Mangoes -11 (5%), Guava - 7 (3%), Pears - 6 (3%), Oranges - 4 (2%), Nonni - 1 (<1%), Watermelon - 1 (<1%)
Pulses	Beans – 6 (3%), Cowpeas – 3 (1%), Moringa – 3 (1%), Groundnuts-1 (<1%)
Staples	Cassava - 81 (38%), Maize – 70 (33%), Plantain - 48 (23%), Cocoyam - 7 (3%), Potatoes - 3 (1%), Yam - 2 (1%)
Grow vegetables	Pepper - 67 (32%) Garden eggs - 62 (29%), Tomato - 55 (26%), Okra - 27 (13%), Onions - 2 (1%), Amaranth - 1 (<1%), Cabbage - 1 (<1%), Cowpea leaves - 1 (<1%).

3.1.1.5 Market visits

Most households produce certain types and amounts of food crops but also use markets to trade and fulfil their food needs. Respondents were asked about their frequency of visits to markets. Thirty-two percent of all respondents across all sites visit local food markets once a week, while 29 percent make daily visits. Only 13 percent said they do not visit the market (Table 6). Results show that Densu had the highest number of respondents (36) who visit food markets once a week compared to those in Narkwa (14) and Whin (18). Although, Densu had the highest number of respondents (22) reporting no visits to food markets compared to Narkwa (6) and Whin (0). Daily food market visits were reported by most respondents in Narkwa (37) and Whin (24), compared to very few in Densu (2). Findings suggest more visits to the markets by the peri-urban sites of Narkwa and Whin for food trade compared to Densu which is more urban (Table 5).

Table 5: Food market visits frequency in Densu, Narkwa and Whin, Ghana raw count (%).

Frequency of market visit	Densu (n = 72)	Narkwa (n = 70)	Whin (n = 69)	Total (n = 211)
Once a week	36 (50%)	14 (20%)	18 (26.1%)	68 (32.23%)
Twice	6 (8.3%)	6 (8.6%)	11 (15.9%	23 (10.9%)
Three times	2 (2.8%)	3 (4.3%)	10 (14.5%)	15 (7.11%)
Four times	0	0	3 (4.3%)	3 (1.42%)
Five times	0	4 (5.7%)	1 (1.5%)	5 (2.37%)
Six times	0	0	1 (1.5%	1(0.47%)
Daily	2 (2.8%)	37 (52.8%)	24 (34.8%)	63 (29.86%)
Did not visit the market	22 (30.6%)	6 (8.6%)	0	28 (13.27%)
Do not know	4 (5.5%)	0	1 (1.4%)	5 (2.37%)

3.1.1.6 Household food expenditure

Household expenditures on buying food showed that 78 percent of respondents in Densu, 76 percent in Narkwa and 71 percent in Whin knew the amount spent on household food purchases. Data analysis on expenditures incurred per week showed that 50 percent of the households across sites had a similar expenditure (200 Ghana Cedis) even though households in Narkwa spent higher amounts (250 Cedis). For the 25 percent of households who spent the highest amount, that amount was similar (300 Cedis), except for Narkwa (Figure 6). Overall, results show that as expected, weekly household food expenditures across sites were significantly different ($F=2.847$; $p<0.003$).

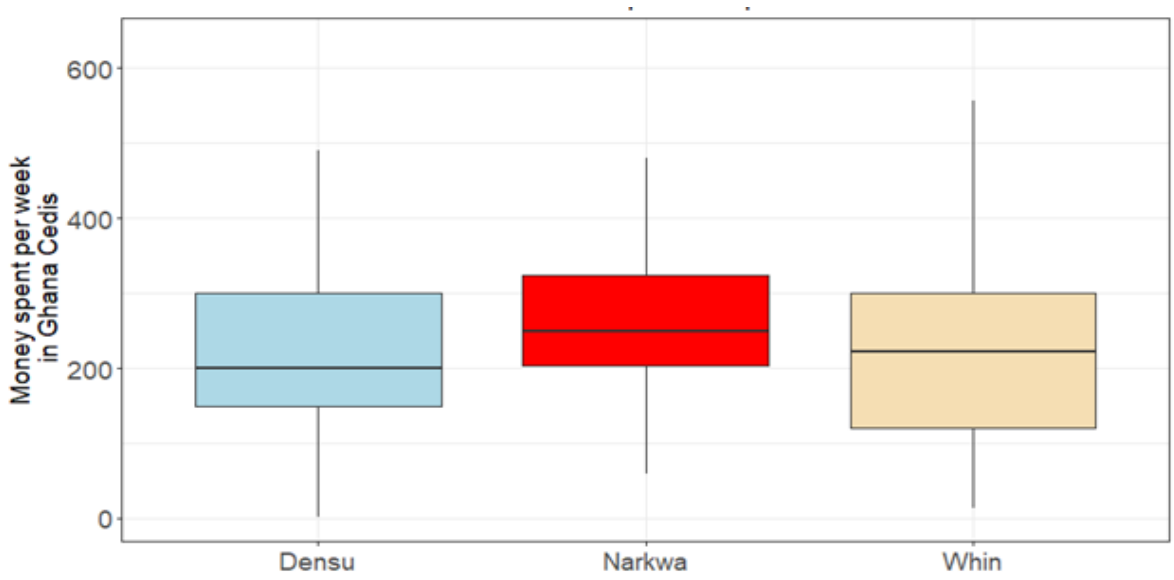

Figure 6: Households weekly food expenditure in Densu, Narkwa, and Whin, Ghana.

Further analysis of expenditures on nine food types sourced from local markets shows that on average, households' weekly expenditure in Cedis were highest for starch (63; s.d. 48.5), meat (59; s.d. -50.5) and vegetables (27; s.d. 23.1). Households in Densu show high spending variability on starch (Figure 7). Overall, median weekly food expenditures on all food types were below 25 Cedis except for meat and starch (Figure 7).

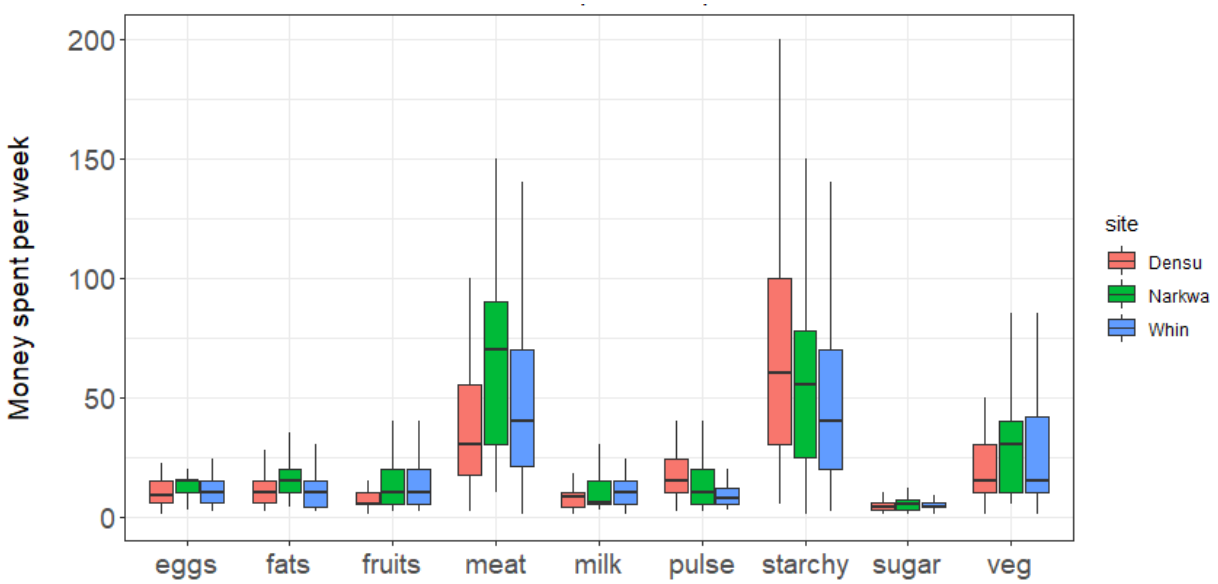

Figure 7: Weekly spending (Ghanian Cedis) on different types of food groups in Densu, Narkwa and Whin.

3.1.1.7 Household weekly food purchase characteristics in Densu, Narkwa, and Whin

In Narkwa, there is greater frequency of buying different food groups, particularly for more perishable foods like eggs, milk, fruits, vegetables, and pulses throughout the week (Figure 8). However, data shows most households in Densu purchase almost all food types once a week (Figure 7). Household food frequency purchases for the Whin site were similar to the patterns for the Densu.

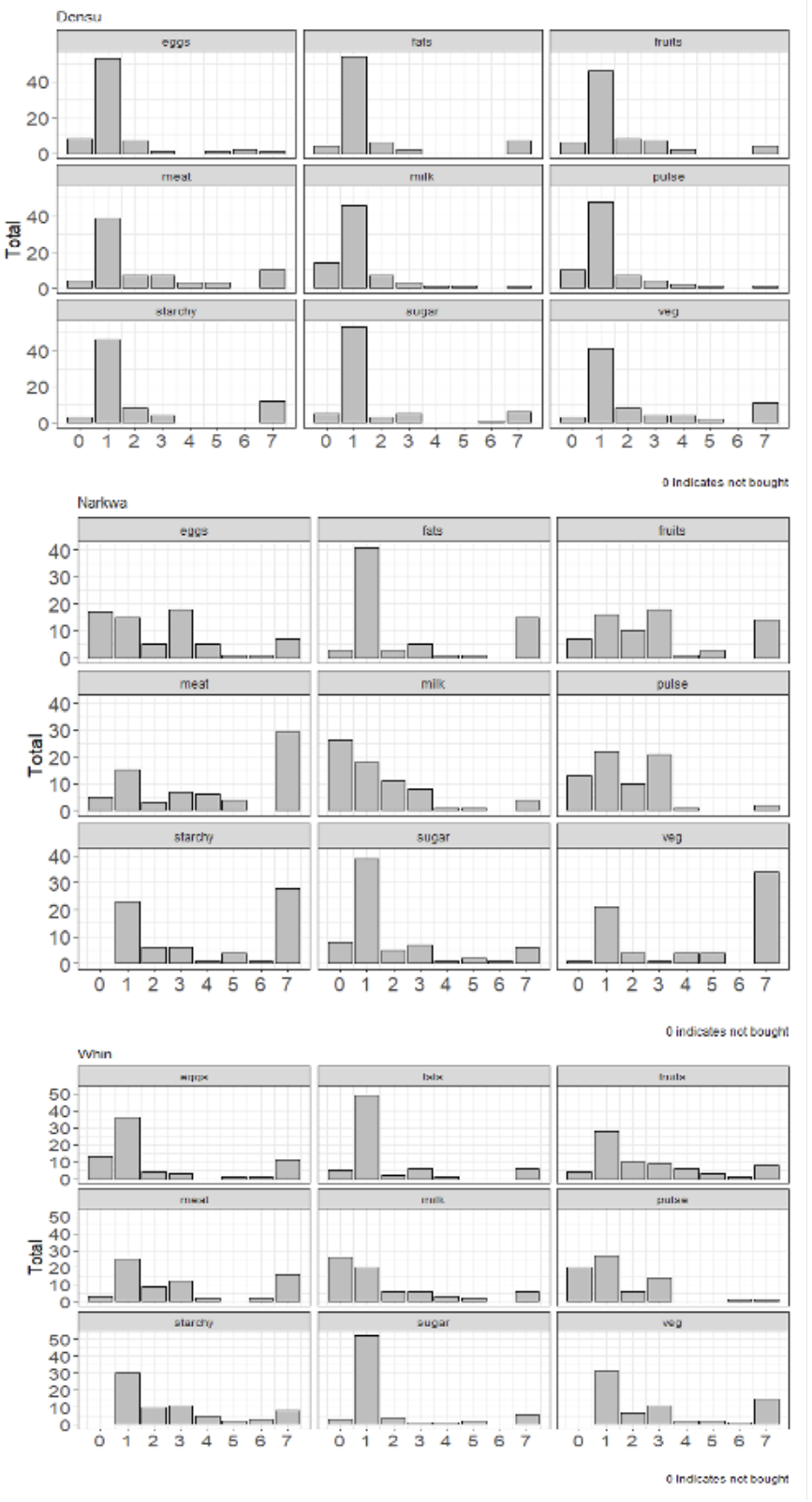

Figure 8: Frequency of weekly purchase of different food groups in project sites Densu, Narkwa, and Whin.

3.1.1.8 Collection of food and fodder from the forest/wild areas

In addition to on-farm food and fodder production, and the use of markets for meeting weekly food needs, the survey assessed food and fodder collection from forests or wild areas. In Densu and Whin, no respondents indicated collecting food from the wild, while in Narkwa, only nine percent of respondents said they did. Vegetables and fish were the types of foods that respondents collected from the wild. The main months when food is collected from the wild are June and July, with some respondents saying year-round. For the collection of fodder from the wild, seven percent of respondents in Narkwa did, while in Densu this was only one percent, and none in Whin. April, May, June, and July are the months when fodder is collected from the wild. Few households indicated year-round fodder collection.

More information from validation meetings recorded that animals are also fed with left over products from corn mills and maize chaff. Goats and sheep are fed on moringa leaves, tomato leaves, ornamentals, cassava, and maize. In Narkwa, poultry are fed with cereals and grains such as rice, and participants in Whin reported buying poultry feeds. At Densu, it was clarified that Tsokomey and Bortianor communities do not rear goats, but the Tetegu community does.

3.1.1.9 Tree planting and management

Data analysis covering household status of the number of trees on farm, training on tree planting received, problems with access to fodder trees, and plans to plant more trees show variation between project sites. More households in Densu have received training on tree planting, have problems with fodder trees, and plan to plant more trees compared to all other sites. They nonetheless have the least number of trees on farm. Households in Whin have received very few trainings on tree planting while no households in Narkwa reported to have received tree planting training. Households in Whin, however, have the highest number of trees on-farm (Figure 9).

3.1.1.10 Tree origin, preferences, and growing challenges

Tree origin from a total of 58 households surveyed in Whin (21), Narkwa (10) and Densu (1) was mainly from natural regeneration. Eight households each in Densu and Whin, and seven households in Narkwa, reported to have planted the trees. Assessment of most preferred tree functional use such as environmental services (shade, windbreaks, soil fertility improvements), firewood, fodder, fruit, medicinal, timber, and others revealed that preference (Table 6) was greatest for fruit trees (32 out of 40 respondents). Densu (16) had the highest number of households with high preference for fruit tress followed by Narkwa (10) and Whin (6).

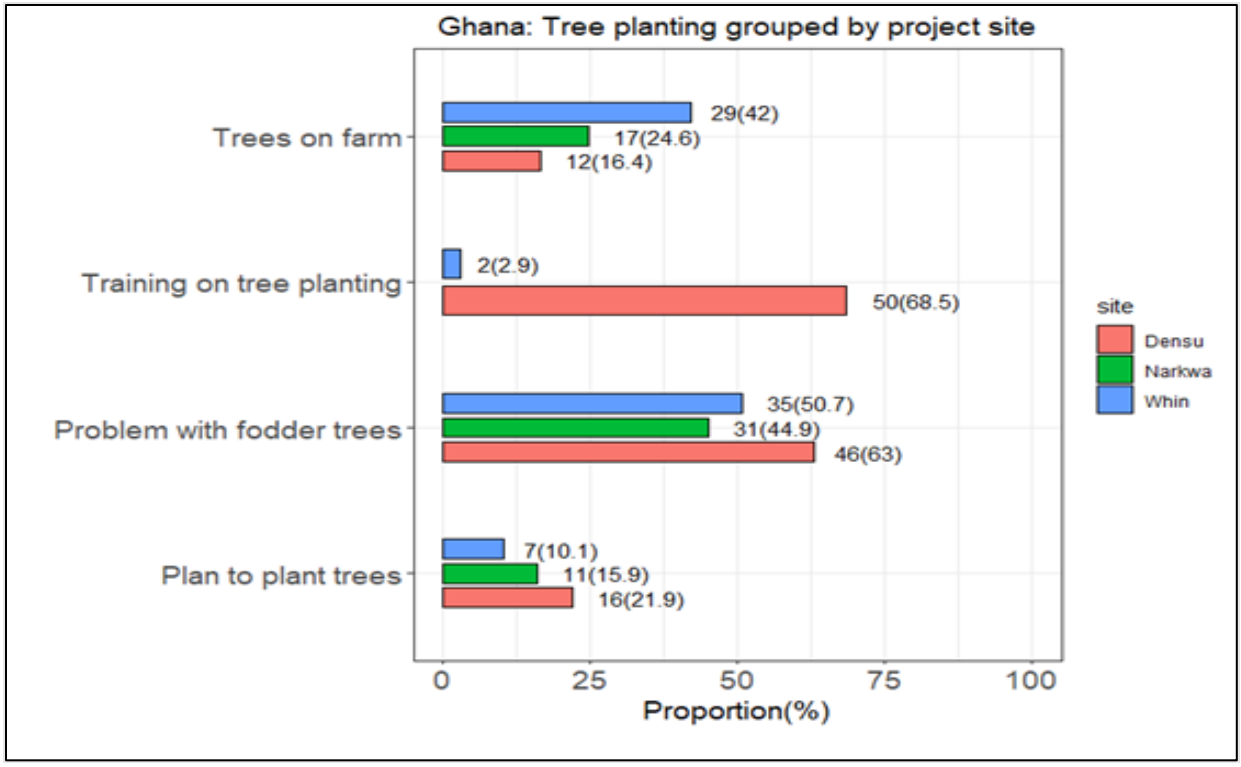

Figure 9: Presence of trees on farms, training received, challenges with planting and managing trees, and interest to plant more trees.

Table 6: Respondent preferences for type of trees (functional use – food, income, ecosystem, etc.).

Tree use	Respondents count (%)			
	Densu (73)	Narkwa (69)	Whin (69)	All sites (211)
Environmental services	1 (1%)	1(1%)	0	2 (1%)
Firewood	1 (1%)	0	0	1 (<1%)
Fodder	1(1%)	0	0	1(<1%)
Fruit/Food	16 (22%)	10 (14%)	6 (9%)	32 (15%)
Medicinal	3 (4%)	0	0	3 (1%)
Timber	0	0	1 (1%)	1 (,1%)
Other	0	0	0	0

During finding validations, tree species such as the noni tree (*Morinda citrifolia*) and oil palm (*Elaeis guineensis*) were identified as important for the Densu area. Coconut (*Cocos nucifera*), mangrove (*Rhiziphora spp.*) pawpaw (*Carica papaya*), moringa (*Moringa oleifera*), mango (*Mangifera indica*), and guava (*Psidium guajava*) were examples of other trees valued for food and income. In Narkwa, important medicinals were identified such as Aposue used by pregnant women; Sempedua (*Cassia*

alata): used for treatment of ringworm and skin diseases, and Nunum (*Ocimum gratissimum*): used as a nasal drop. Nyanya (*Momordica charantia*): used as an herb and for spiritual purposes. At Whin, pawpaw was used in soup preparations. Other medicinals recorded were Gbotsi plant (bitter leaf) (*Vernonia amygdalina*): used for malaria treatment. Amatse: is also used to treat malaria and fever in Densu. In Whin, medicinal plants mentioned were Kanto (*Zanthoxyllum xanthoxyloides*), Odwen (*Baphia nitida*) and Ogyama (*Alchornea cordifolia*).

Survey responses on the challenges experienced growing trees identified land size (44), land tenure (18); access to planting materials (17), and other land related issues (51) as most frequent factors (Table 7). Meanwhile analysis on the number of households that received training found that tree nursery management training was most important and was received mainly in Densu (46) compared to only one in Whin and none in Narkwa (Table 8). Overall, only households in Densu reported to have received training on mangrove establishment, tree planting, vegetative propagation, pruning, and direct planting even though they own smaller farm sizes than those in Narkwa and Whin (Table 8).

Table 7: Types of challenges with growing trees.

Problem	Respondents Count (%)
Other land related	51 (**24%**)
Land size	44 (**21%**)
Land tenure/lease/not owned	18 (**9%**)
Access to planting material (high quality)	17 (**8%**)
Infertile/salty land	6 (**3%**)
Destroyed by livestock/people	5 (**2%**)
Water	2 (**1%**)
Technical knowledge and training	1 (<**1%**)

Table 8: Training received on tree planting and management.

Type of training	Respondents count (%)			
	Densu (73)	Narkwa (69)	Whin (69)	All sites (211)
Fruit production orchard set up	0	-	1 (1%)	1 (<1 %)
Timber harvesting	0	-	0 (0%)	0 (0%)
Tree nursery establishment	45 (62%)	-	1 (1%)	46 (22%)
Tree pruning	7 (10%)	-	0 (0%)	7 (3%)
Vegetative propagation e.g., grafting	11 (15%)	-	0 (0%)	11 (5%)
Direct planting	5 (7%)	-	0 (0%)	5 (2%)
Mangrove establishment	20 9 (27%)	-	0 (0%)	20 (9%)
Transplanting	12 (16%)	-	0 (0%)	12 (6%)

Note (-): no interviews conducted

Considering firewood and mangrove associated use values, validation meetings at Densu reported firewood trees such as Neem (*Azadirachta indica)* and Mango (*Mangifera indica*); at Whin, Bamboo (*Bambusa vulgaris*), Ebire and Asopro tree (Black mangrove/*Avicennia germinans*) were reported as sources of firewood and charcoal. At Narkwa, mangrove (esudue), even though found in a small part of the lagoon, is used as a source of firewood.

3.1.1.11 Local tree nursery operations

Survey assessment on whether there were tree nurseries or seedling purchase points nearby, revealed only two respondents in Densu who said that there was a tree seedling nursery close by. Findings on challenges faced by local nurseries which respondents would like improved included lack of information on variety management (14), lack of enough seedling quantities (24), and affordability/cost (10) as the most important (Table 9).

Table 9: Challenges experienced when sourcing trees from local nurseries.

Challenge	Respondents count (%)			
	Densu (73)	Narkwa (69)	Whin (69)	All sites (211
Lack of diversity of types of seedlings for fruits	0 (0%)	0(%)	0(%)	0(%)
Lack of information provided by nursery staff on species varieties management	1(1%)	12 (17%)	1 (1%)	14 (7%)
Lack of knowledge by nursery staff on species varieties management	0(%)	0 (0%)	0 (%)	0 (0%)
Lack of seedlings in quantities	23(32%)	0 (0%)	1 (1%)	24 (11%)
Lack of varieties for one species e.g., Mango	0(%)	0 (0%)	0(%)	0 (0%)
Low quality of seedlings: they are tired looking	0(%)	0 (0%)	1 (1%)	1 (<1%)
Too expensive	10 (14%)	0 (0%)	0 (0%)	10 (5%)
Other	51 (70%)	57 (83%)	68 (99%)	176 (83%)

3.1.1.12 Seasonal food availability

Ninety percent of respondents in Densu, 68 percent in Whin, and 48 percent in Narkwa said that they had experienced periods in the previous 12 months when their families did not have enough food to meet their needs. April to June were identified as the most food insecure in the project sites (Figure 10; also, see Annex 12). In Densu, the main food insecure months were May (45 percent), June (53 percent) and July (38 percent). In Narkwa, it was April (49 percent), May (66 percent), June (55 percent), and July (51 percent), while in Whin, it was March (36 percent), April (42 percent), May (27 percent), and June (39 percent). The months of insufficient food group availability corresponded with the months identified as being most food insecure, starting in January and spanning across months until July (Figure 11).

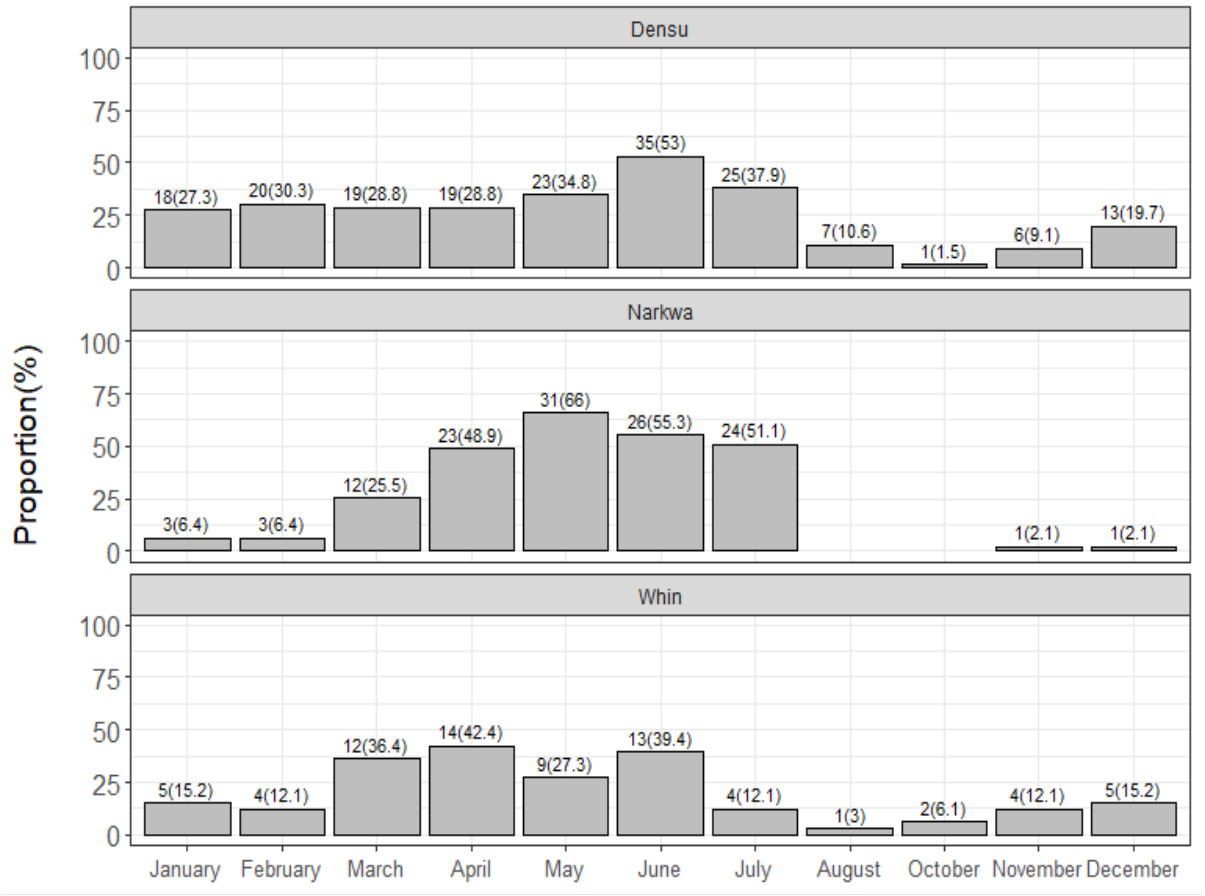

Figure 10: Months of food insecurity identified by respondents across the three project sites of Densu, Narkwa, and Whin.

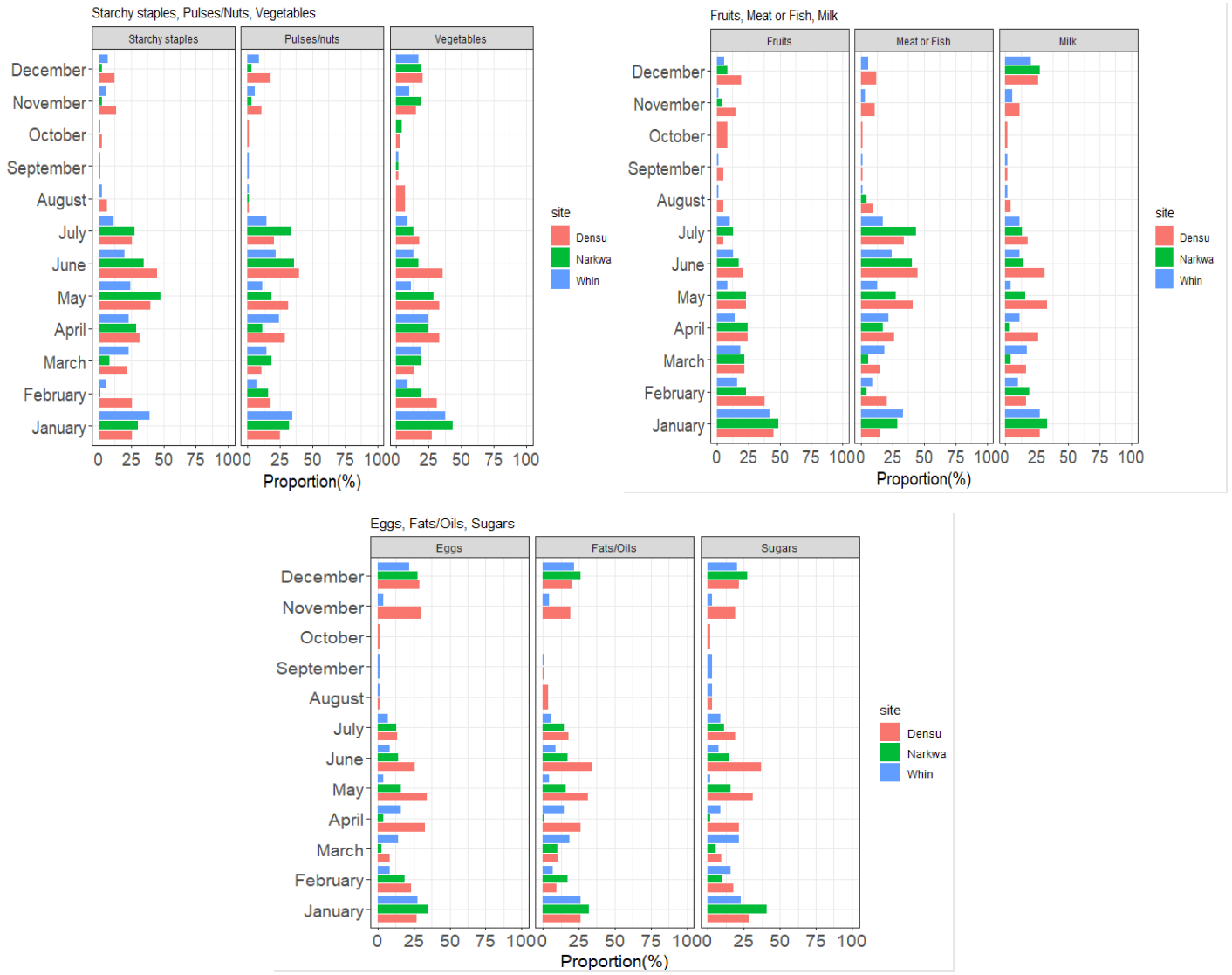

Figure 11: Months of insufficient food, by food group, identified by respondents across the three project sites of Densu, Narkwa, and Whin.

3.1.2 The Gambia

3.1.2.1 Household demographics

Study sites covered 144 random households in Tanbi (48), Bulock (47) and Allahein (49) areas. A summary of household demographics is presented in Table 10. Ninety two percent of respondents were female, with 53 percent of respondents identifying as Head of Household (HoH), and 43 percent as spouse of the HoH. The average age of respondents was 57 years old (SD – 15). On average, there were six adults and six children in households. The average farm size was two acres, with respondents reporting an average of 11 years farming their land. Significant differences in farm size across the sites was found ($F(2,141) = 5.87$, $p = 0.00355$). Significant differences in the number of years farmed was also found ($F(2,141) = 8.9222$, $p = 0.0002$) between Bulock and Allahein, and Allahein and Tanbi but not between Tanbi and Bulock.

Findings identified livelihood strategies such as vegetable gardening, rice cultivation, poultry, pig rearing, petty trading, fish smoking, firewood collection, carpentry, masonry, and painting as important livelihood strategies for men and youth. In Bulock, salt mining is an important alternative livelihood strategy for Bintang women. Livelihood activities in Allahein in addition to fisheries include petty trading, daily paid labor, firewood collection, and boat rental services. See Annex 2 for similar examples from Ghana.

Table 10: Basic characteristics of households surveyed in Tanbi, Bulock and Allahein in The Gambia.

Site	Respondent's gender		Mean Respondents age (s.d.)	Mean No. of adults/ HH (s.d.)	Mean No of children per HH (s.d.)	Mean farm size (acres) (s.d.)	Mean No of farming years (s.d.)
	Female	Male					
Tanbi	48 (100.0)		58.9 (13.9)	5.8 (4.9)	4.7 (2.7)	1.1 (1.3)	7.9 (9.9)
Bulock	43 (91.5)	4 (8.5)	58.4 (17.8)	6.5 (3.3)	7.1 (8.9)	2.5 (2.9)	8.6 (9.0)
Allahein	41 (83.7)	8 (16.3)	52.3 (13.1)	6.9 (3.6)	5.4 (3.3)	2.0 (1.8)	16.3 (13.3)
All sites	132 (91.7)	12 (8.3)	56.5 (15.2)	6.4 (4.0)	5.7 (5.7)	1.9 (2.2)	11.0 (11.5)

3.1.2.2 Oyster harvesting

Average daily oyster harvesting quantities per person reported in the Tanbi and Allahein sites were approximately 2 kgs while the peak season amount was about 2.9 kgs and none during the low season. Respondents from the Allahein site recorded the highest mean daily harvests of 4 kgs per respondent.

Findings from discussions with communities in Tanbi revealed that shellfisheries (oyster, cockles, crab, tilapia, seashell, and shrimp) dominate economic activities as the primary source of food and revenue

for most households. Oyster culture was said to have a large potential to improve livelihoods and household income throughout the year. Several important challenges were identified. In Lamin, women shellfishers experience tingling, burning or itchy skin in the water, possible due to water infestation or acidity, often causing allergic reactions. Oil pollution from machinery oil depot causes pollution of the aquatic ecosystems of Tanbi Wetland Complex and the problem is even noticeable in the oysters. Dumping of solid waste around the mangrove areas was noted to be increasing. In Faji Kunda, salt intrusion is affecting crop production and buildings. In Bulock and Bintang, rice production is constrained by salt intrusion.

Despite the fisheries potential in Tanbi, Bulock, and Allahein, the actors are faced with a host of environmental, technical, economic, and social constraints such as:

- Lack of canoes and safety gear (live jackets, booths, gloves, etc.).
- Lack of cold storage facilities (including ice and cold storage).
- Lack of proper artisanal landing infrastructure.
- Poor market infrastructure and marketing system.
- Lack of proper knowledge and training on processing and packaging of shellfishery products.
- Inadequate credit facilities, including access to funds, and the lack of mobility.
- In Bulock, women shellfishers pay an annual fee of 1,000 Gambian Dalasi to the Village Development Committee, which is a huge burden on them.
- In Allahein, lack of training on financial management, lack of adequate waiting sheds, and lack of toilet facilities, were also noted.

3.1.2.3 Household food production

The types of food produced on-farm in the Tanbi wetland showed that 65 percent of respondents produced staple crops, 25 percent kept livestock, and six percent each produced fruit, fodder, and staple crops. In Bulock, 81 percent of respondents produced vegetables, 72 percent kept livestock, 70 percent produced staple crops, 55 percent fruits, 36 percent pulse crops and 11 percent fodder crops (Figure 12). In Allahein, 80 percent produced vegetables, 59 percent produced staple crops, 49 percent kept livestock, 47 percent produced fruit, 37 percent produced vegetables, 29 percent pulse crops and 10 percent fodder crops.

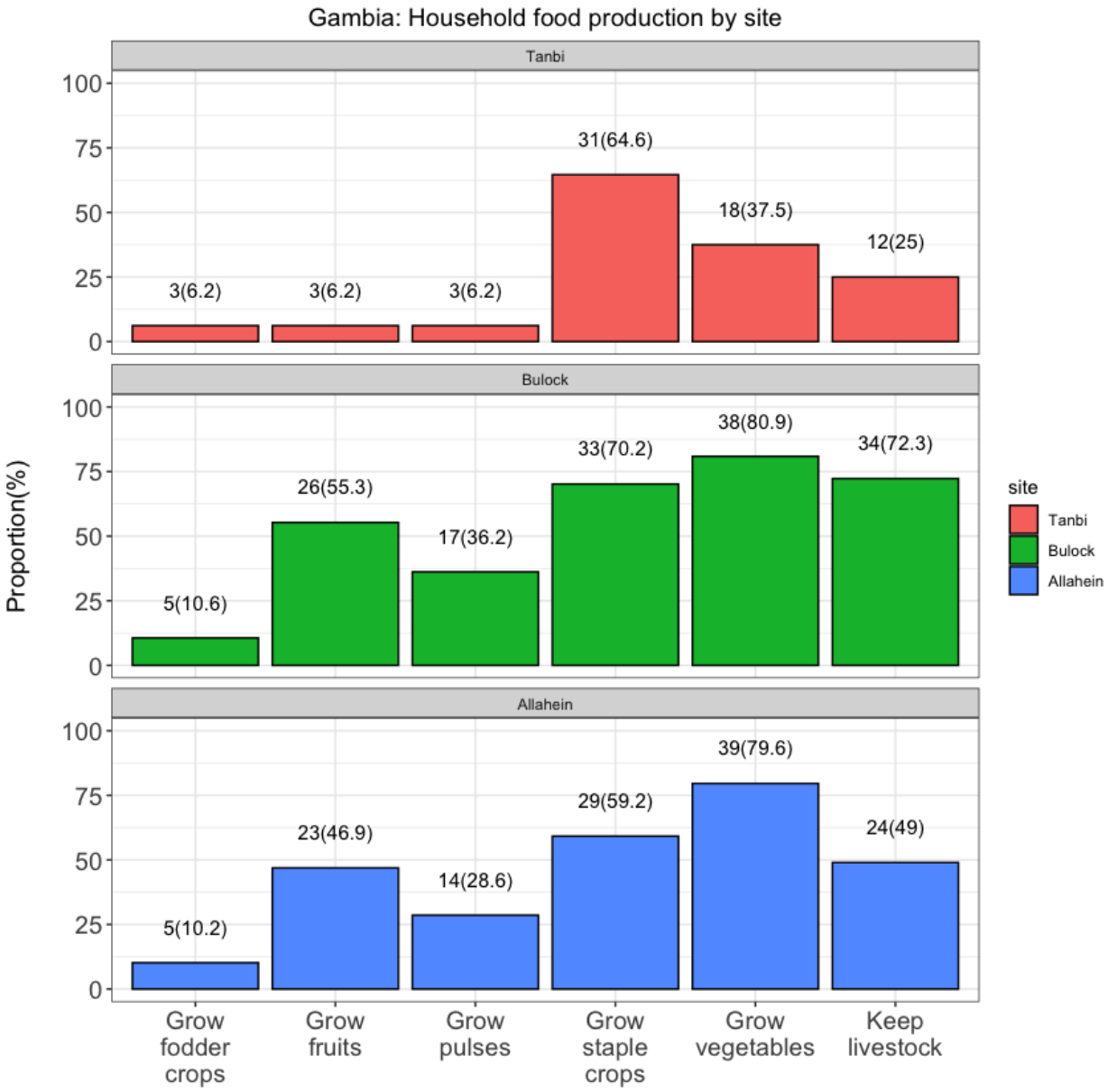

Figure 12: Type of food production activities undertaken by respondents in Tanbi, Bulock and Allahein.

3.1.2.4 Common food types produced:

Major food groups were recorded as staples, pulses, vegetables, and fruits. Important staple crops used were rice, maize, cassava, potatoes, and millet, while vegetable crops included tomato, okra, onion, bitter tomato, pepper, cabbages, and garden egg. Pulses included beans, ground nuts, and cowpeas, while fruits included oranges, mango, banana, pawpaw, lemon, and cashew (Table 11).

Table 11: Food groups and specific crop type used as food sources across surveyed sites.

Food Group	Specific Crop Type (response count %)
Fruits	Oranges -32 (22%), Mangoes - 30 (21%), Banana -18 (13%), Pawpaw -17 (12%), lemon -13 (9%), Cashew - 12 (8%), Watermelon -2 (1%), Pineapple - 1 (<1%), Baobab - 1 (<1%), Guava - 2 (1%)
Pulses	Beans – 33 (23%), Cowpeas – 1 (<1%), Groundnuts - 5 (3%)
Staples	Rice - 72 (50%), Maize – 38 (26%), Cassava - 33 (23%), Potatoes – 28 (19%), Millet -17 (12%), Sorghum – 2 (1%)
Vegetables	Tomato -55 (38%), Okra – 51 (35%), Onion – 50 (35%), Bitter tomato – 46 (32%), pepper – 38 (26%), Cabbage – 33 (23%), Garden egg - 20 (14%), Egg plant – 9 (6%), Ethiopian kale – 1 (<1%), Hibiscus-1 (<1%).

3.1.2.5 Market visits

Households produce certain types and amounts of food crops but also use markets to purchase to fulfil their food needs. Respondents were asked about their frequency of visits to markets and 74 percent of respondents across all sites indicated visiting markets daily, while 10 percent indicated three times a week and 6 percent twice a week (Figure 13). A larger proportion of households from Tanbi (75 percent) visited the markets once a week compared to those in Bulock (25 percent) and Allahein (0 percent). Daily market visits are approximately 27 percent of households in Tanbi, and over 30 percent of households in Bulock and Allahein.

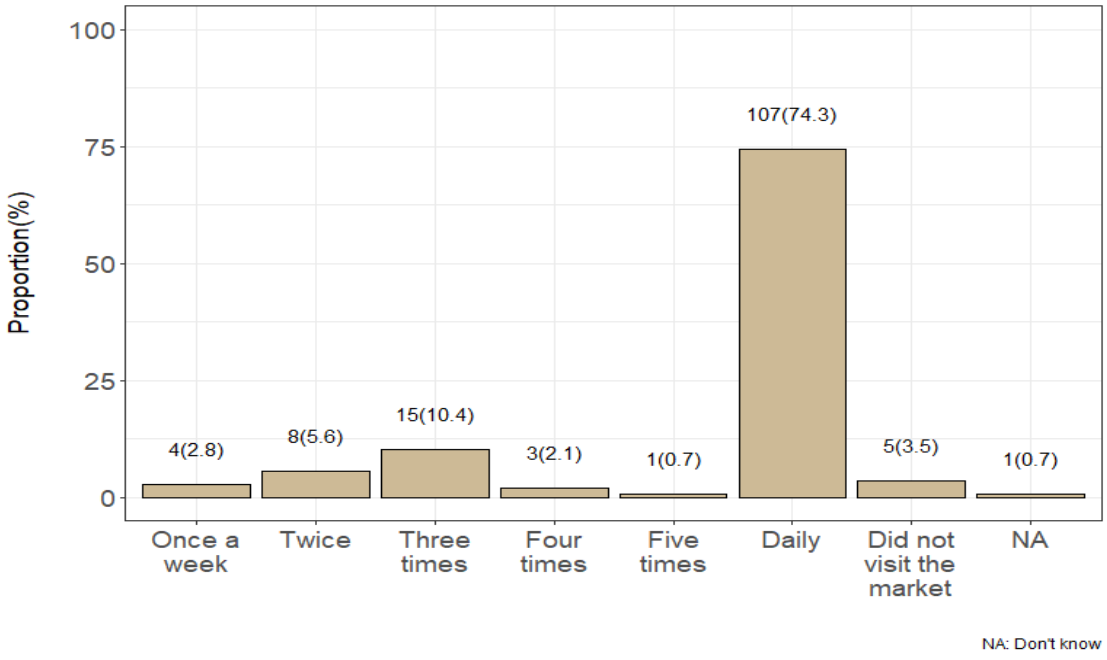

Figure 13: Frequency of market visits by respondents across three sites in The Gambia.

3.1.2.6 Household food expenditure

Most households knew their expenditures on food for their families. Findings showed that the proportion keeping track of expenditure varied as follows: Tanbi (69 percent), Bulock (81 percent) and Allahein (75 percent). In addition, 50 percent of the respondents surveyed in Tanbi spent about 1800 Gambian Dalasi per week on food compared to 1000 Dalasi each in Bulock and Allahein. Twenty-five percent of the households in Tanbi reported expenditures of over 2000 Dalasi per week, while at least 25 percent of households surveyed in Bulock and Allahein spent less than 1000 Dalasi per week (Figure 14). One way ANOVA showed significant differences in overall weekly food expenditures between at least two sites ($F(2.344)=9.60$, $p=0.0004$).

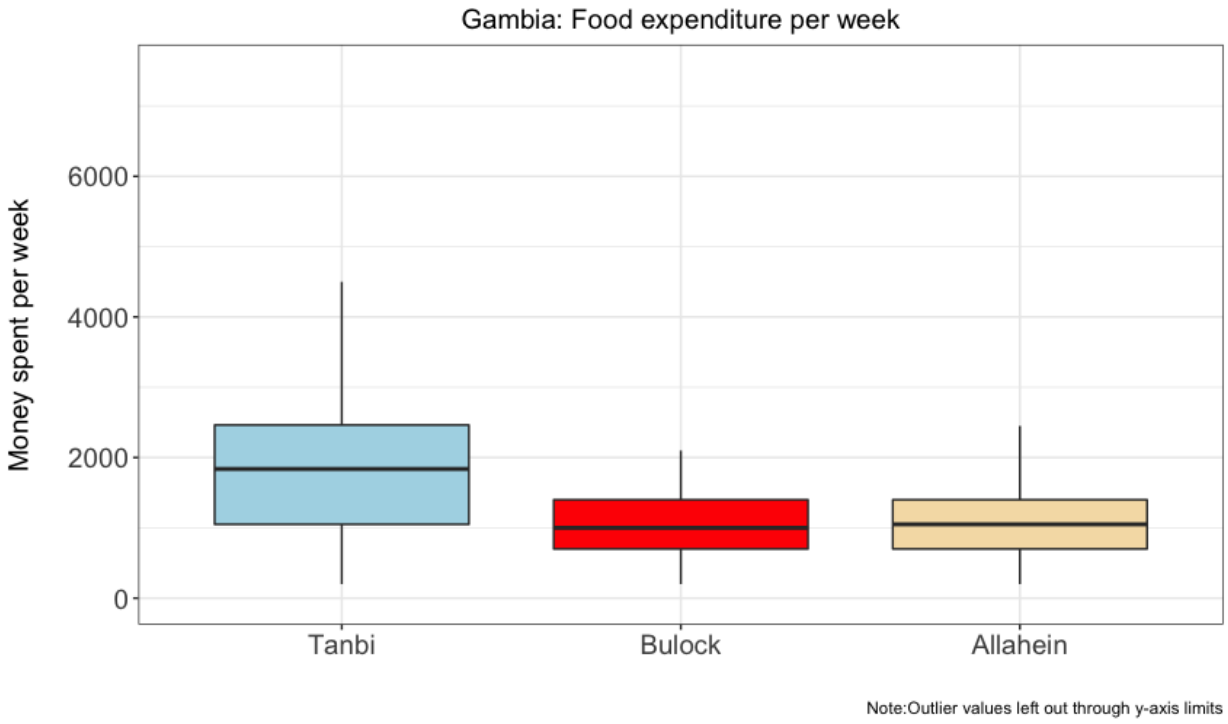

Figure 14: Households weekly food expenditure in Tanbi, Bulock and Allahein.

In addition, data analysis on how much money was spent weekly on purchasing different food groups (Figure 15), revealed on average, the highest amount of money (Dalasi) is spent on: starch (647; s.d.-1563), meat (473; s.d.- 413), fats (340, s.d.-443), vegetables (307, s.d. 220), sugar (195, s.d.- 163), and fruits (190, s.d. -149). Overall highest food expenses were on meat, starch, and fats.

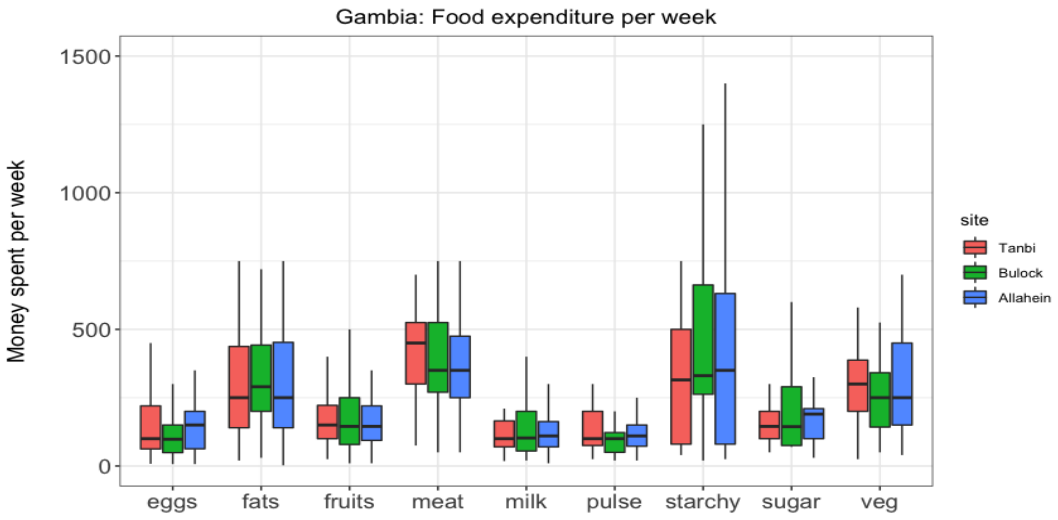

Figure 15: Weekly spending (Gambian Dalasi) on different food groups in Tanbi, Bulock and Allahein.

The sites recorded similar household purchase patterns for sugar, vegetables, meat, fats, milk, starch, and pulses (Figures 16, 17, 18). Tanbi had fewer respondents compared to Bulock and Allahein, where sugar, vegetables, and meat were bought by the largest number of respondents seven times a week, while starch and pulses were purchased mostly only once a week. Several households recorded no purchases of fruits and eggs.

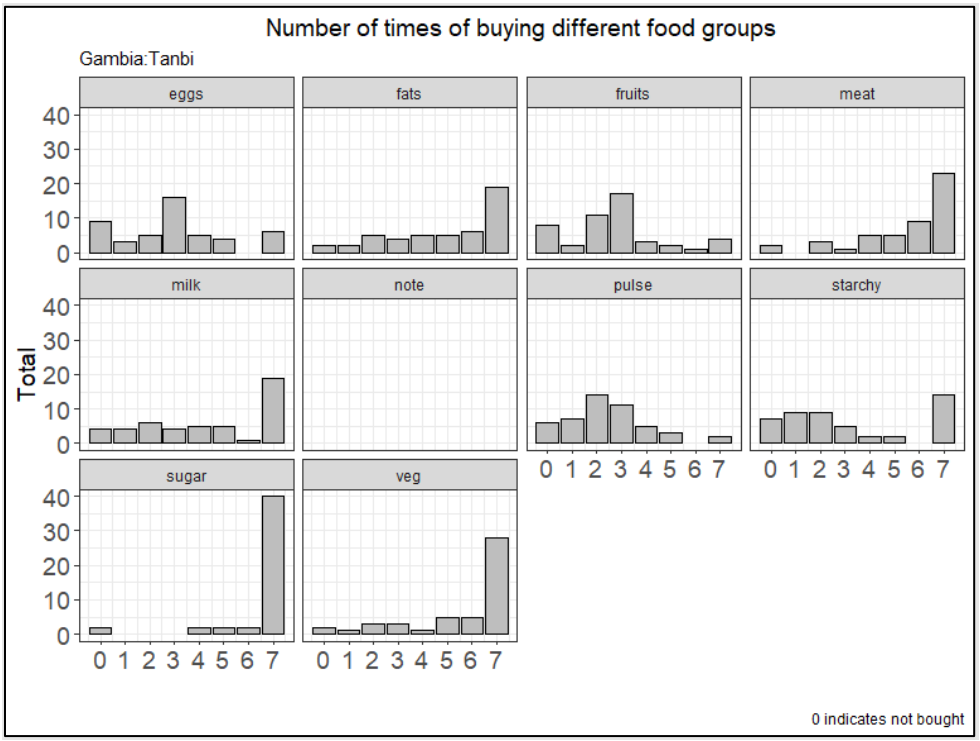

Figure 16: Frequency of weekly purchase of different food groups in Tanbi, The Gambia.

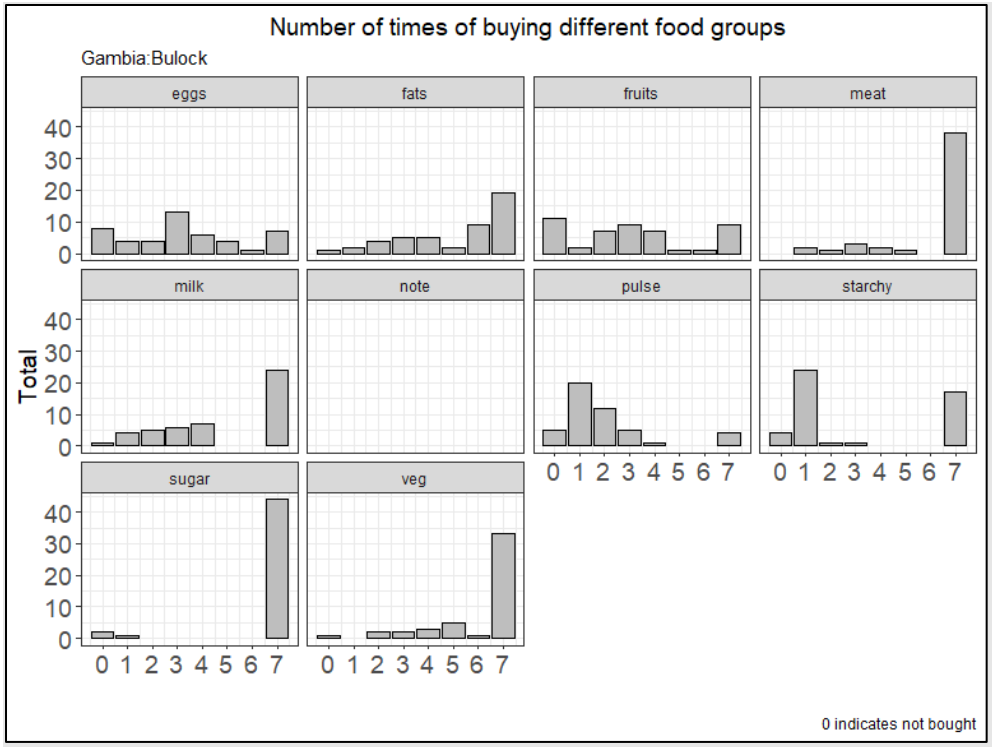

Figure 17: Frequency of weekly purchase of different food groups in Bulock, The Gambia.

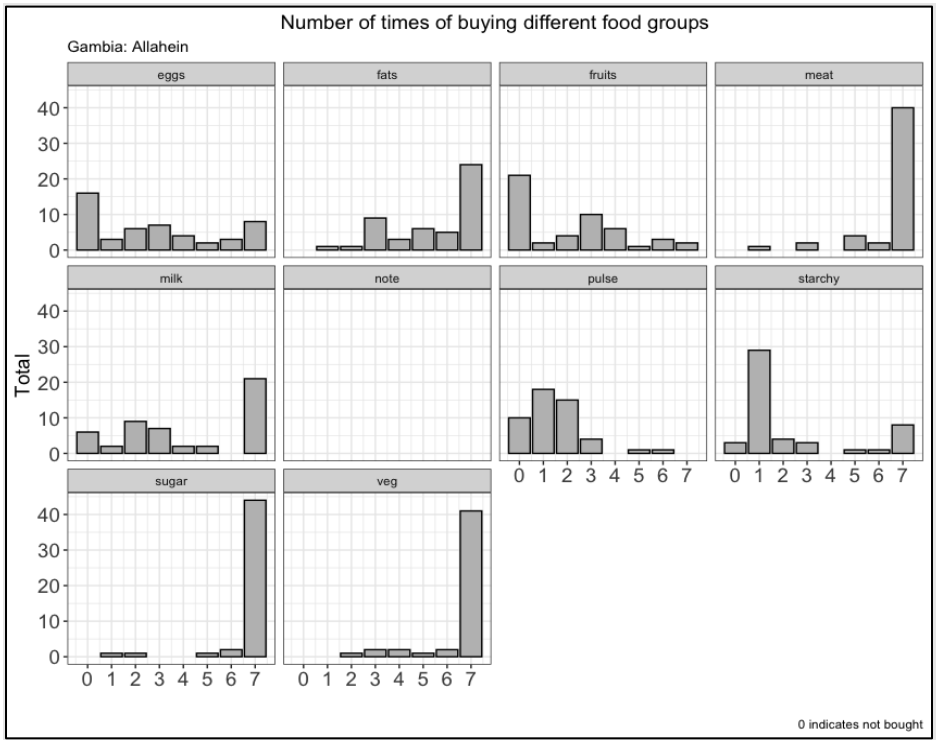

Figure 18: Frequency of weekly purchase of different food groups in Allahein, The Gambia.

3.1.2.7 Collection of food and fodder from the forest/wild areas

In addition to on-farm food production and use of markets to meet weekly food needs, we assessed the contribution of wild food resources to households. Wild food collection was undertaken by five (10 percent), 19 (40 percent) and 18 (37 percent) of respondents in Tanbi, Bulock and Allahein, respectively. Fruits, nuts and seeds, roots and tubers, and fish are the foods most collected from the forest/wild areas. May, June, July, and August are the main months when food is collected. This coincides with the main months of food insecurity across the sites (Figure 20, Section 3.1.2.11). Wild fodder collection was undertaken by respondents in Bulock (15 percent) but not by respondents in Tanbi and Allahein. Fodder is collected throughout the year, with December through March being the most common time for collection.

3.1.2.8 Tree planting and management

Data showed that 17 percent, 53 percent, and 45 percent of respondents in Tanbi, Bulock and Allahein, respectively, had trees on farms (Figure 19). While only 21 percent, 23 percent, and 8 percent of respondents in Tanbi, Bulock and Allahein respectively, had received training on tree planting previously; 87 percent, 63 percent, and 96 percent of respondents in Tanbi, Bulock and Allahein respectively, were planning to plant more trees in the future.

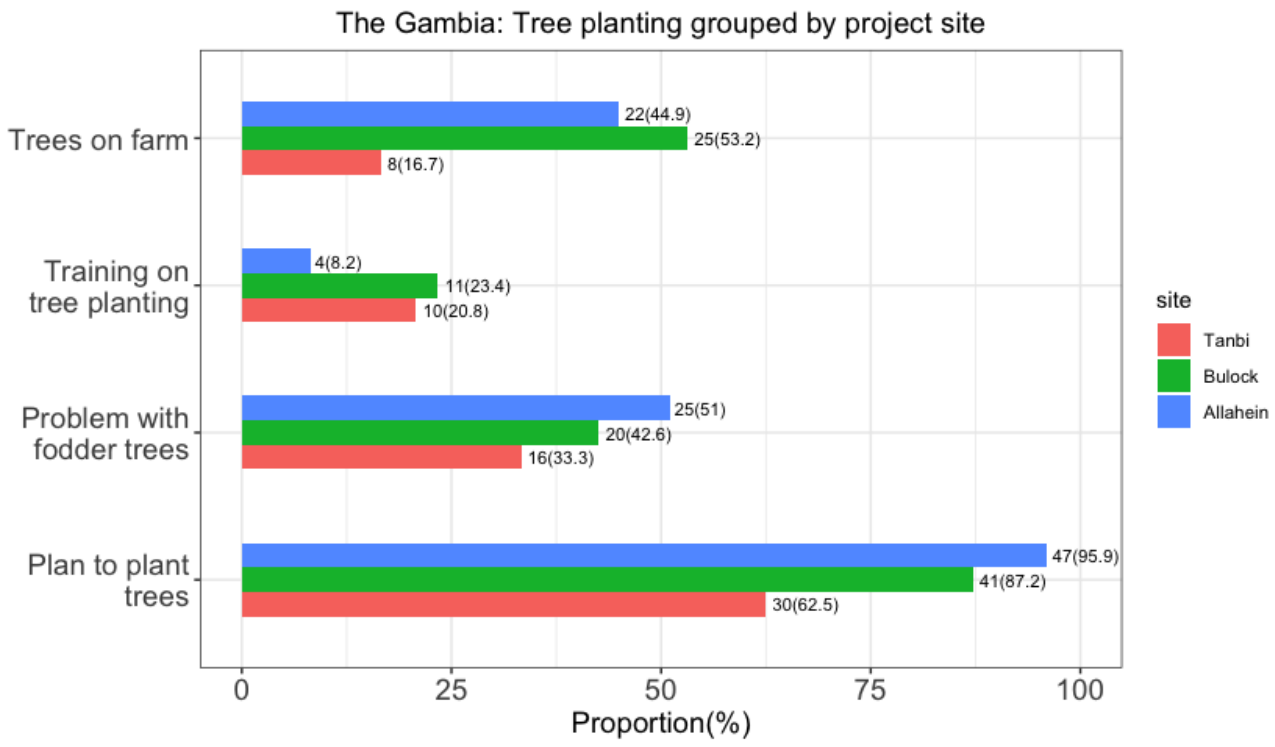

Figure 19: Presence of trees on farms, training received, challenges with planting and managing trees, and interest to plant more trees.

3.1.2.9 Tree origin, preferences, and growing challenges

Assessment of trees existing on-farm showed the number of respondents with planted trees were: Tanbi (6), Bulock (17) and Allahein (16). Two, seven and five households in Tanbi, Bulock, and Allahein respectively had trees on-farm that were established by natural regeneration. Data analysis on preferred tree based on functional uses such as food, environmental services, firewood, timber, and medicinal values shows a high preference for fruit or food trees (117), medicinal (35), environmental services e.g., shade, windbreaks, soil fertility improvements (34), firewood (27) and timber (20) (Table 12).

Table 12: Preference for type of trees (functional use – food, income, soil fertility shade).

Tree types	Respondent count (%)			
	Tanbi (48)	Bulock (47)	Allahein (49)	All sites (144)
Environmental services	12 (25%)	8 (17%)	14 (29%)	34 (24%)
Firewood	10 (21%)	3 (6%)	14 (29%)	27 (19%)
Fodder	5 (10%)	5(11%)	5 (10%)	15 (10%)
Fruit/Food	30 (63%)	40 (85%)	47 (96%)	117 (81%)
Medicinal	14 (29%)	7 (15%)	14 (29%)	35 (24%)
Timber	6 (13%)	3 (6%)	11 (22%)	20 (14%)
Other	0	1 (2%)	0	1(<1%)

Challenges experienced by households to grow trees (Table 13) showed the following responses: access to planting materials (46), land size (38), water (37) and technical knowledge (18).

Table 13: Types of challenges growing trees.

Problem	Respondents Count (%)
Access to planting material (high quality)	46 (32%)
Land size	38 (26%)
Technical knowledge and training	18 (13%)
Water	37 (26%)
Other land related	2 (1%)
Infertile/salty land	2 (1%)
Destroyed by livestock/people	11 (8%)

Analysis of training received on tree planting showed that a total of 16 respondents had received training on mangrove establishment and that five, and four other people had received training on vegetative propagation and tree nursery establishment respectively (Table 14).

Table 14: Training received on tree planting and management.

Type of training	Respondents count (%)			
	Tanbi (48)	Bulock (47)	Allahein(49)	All Sites (144)
Fruit production orchard set up	0	1 (2%)	1 (2%)	2 (1%)
Tree nursery establishment	0	1 (2%)	3 (6%)	4 (3%)
Tree pruning	1 (2%)	0	2 (4%)	3 (2%)
Vegetative propagation e.g., grafting	2 (4%)	2 (4%)	1 (2%)	5 (3%)
Mangrove establishment	7 (15%)	8 (17%)	1 (2%)	16 (11%)

3.1.2.10 Local tree nursery operations

Assessment of whether there were tree nurseries or seedling purchase points nearby (to where respondents lived), showed that four, six and nineteen respondents in Tanbi, Bulock and Allahein reported nearby tree nurseries. Respondents indicated challenges faced by local nurseries which they would like improved. Lack of information on variety management (14), lack of enough seedling quantities (43), affordability/cost (28), inferior quality seedlings (19), and lack of varieties such as mango (18) were listed as the most important (Table 15).

Table 15: Challenges experienced when sourcing trees from local tree nurseries.

Challenge	Respondents count (%)			
	Tanbi (48)	Bulock (47)	Allahein (49)	All sites (144)
Lack of diverse of types of seedlings for (e.g., fruits)	9 (19%)	0	9 (18%)	18 (13%)
Lack of information on species varieties management	2 (4%)	0	3 (6%)	5 (3%)
Lack of knowledge by nursery staff on species varieties management	7 (15%)	0	7 (14%)	14 (10%)
Lack of seedlings in quantities	16 (33%)	12 (26%)	15 (31%)	43 (30%)
Lack of varieties for one species (e.g., mango)	9 (19%)	2 (4%)	7 (14%)	18 (13%)
Low quality of seedlings: they are tired looking	9 (19%)	0	10 (20%)	19 (13%)
Too expensive	16 (33%)	4 (9%)	8 (16%)	28 (19%)
Other	23 (48%)	33 (70%)	23 (47%)	79 (55%)

3.1.2.11 Seasonal food availability

Thirty-nine (81 percent), 39 (83 percent) and 46 (93 percent) of respondents in Tanbi, Bulock and Allahein respectively, said they had experienced periods in the previous 12 months when their families did not have enough food to meet their needs. The main months of food insecurity in the project sites were from June to September. In Tanbi, it was June (49 percent), July (59 percent), August (74 percent), and September (39 percent). In Bulock, the main food insecure months were July (39

percent), August (49 percent), and September (51 percent) while In Allahein it was June (35 percent), July (43 percent), August (52 percent), and September (61 percent). The food group availability calendars corresponded with the main months named by respondents as being the most food insecure (Figure 20).

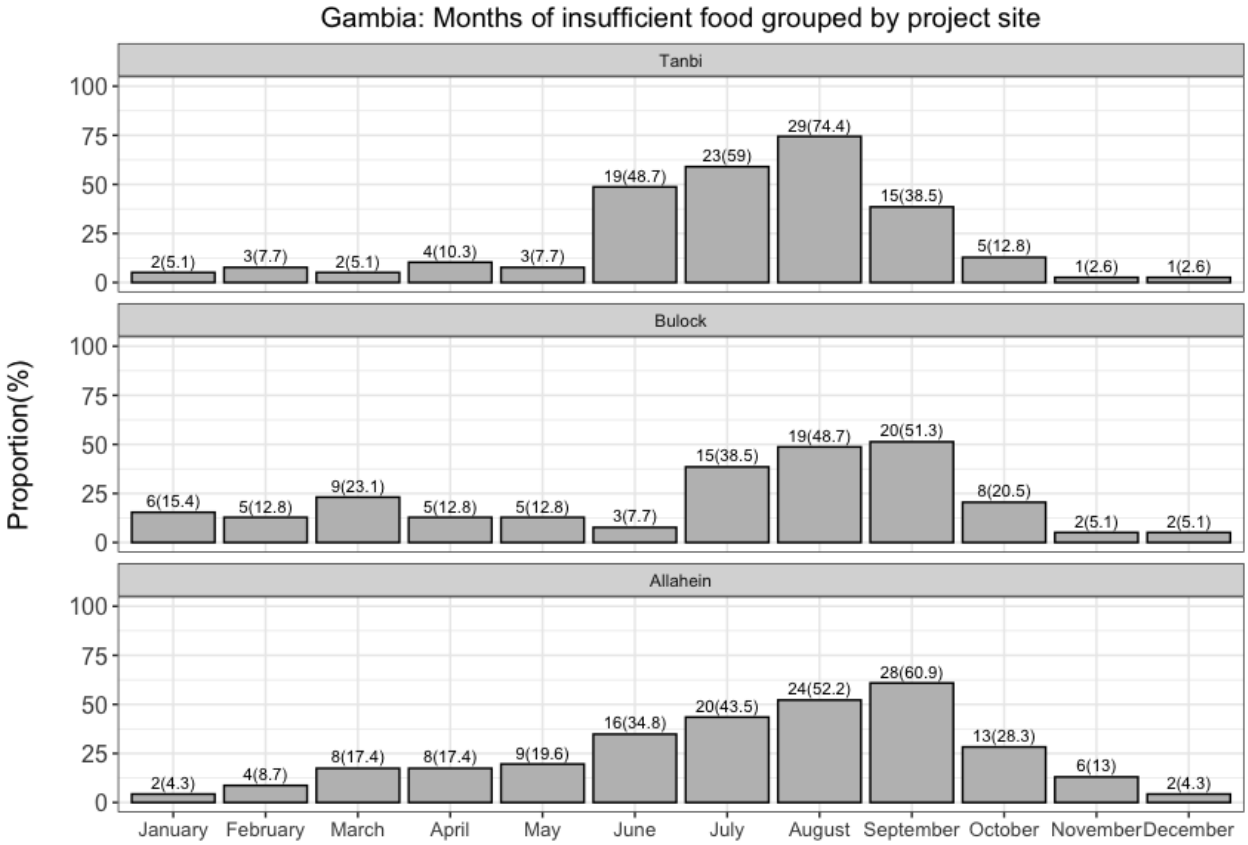

Figure 20: Months of food insecurity identified by respondents across the three project sites of Tanbi, Bulock and Allahein.

3.1.2.12 Food shortage periods

Respondents in The Gambia reported June to October as the period where food shortages are most experienced for staples, pulses, and vegetables. This coincided with the main months named by respondents as being most food insecure – June, July, August, and September (Figure 20). Respondents in Tanbi indicated August as the month with the highest food shortage for the staples, pulses, vegetables, fruits, meat or fish, and milk food groups. There is a shortage of eggs, fats, and sugars in August in Bulock according to respondents' (Figures 21, 22, 23), while overall, results show that more respondents in Allahein experienced shortages compared to all the other sites.

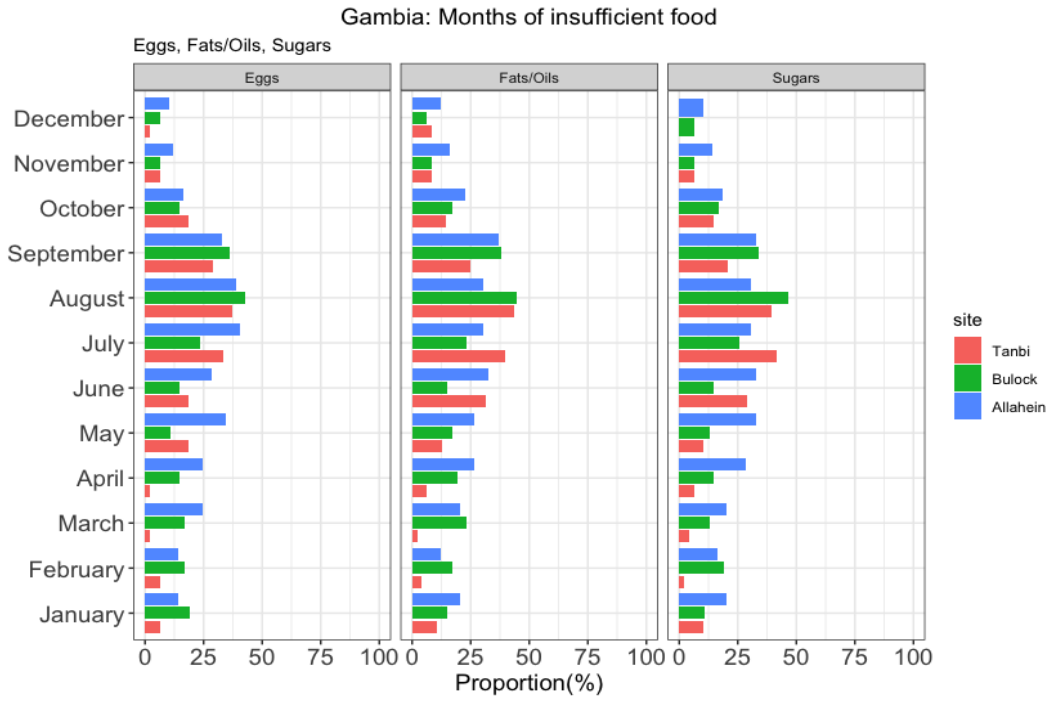

Figure 21: Months of insufficient food per food group (eggs, fats, sugars) as identified by respondents surveyed in The Gambia.

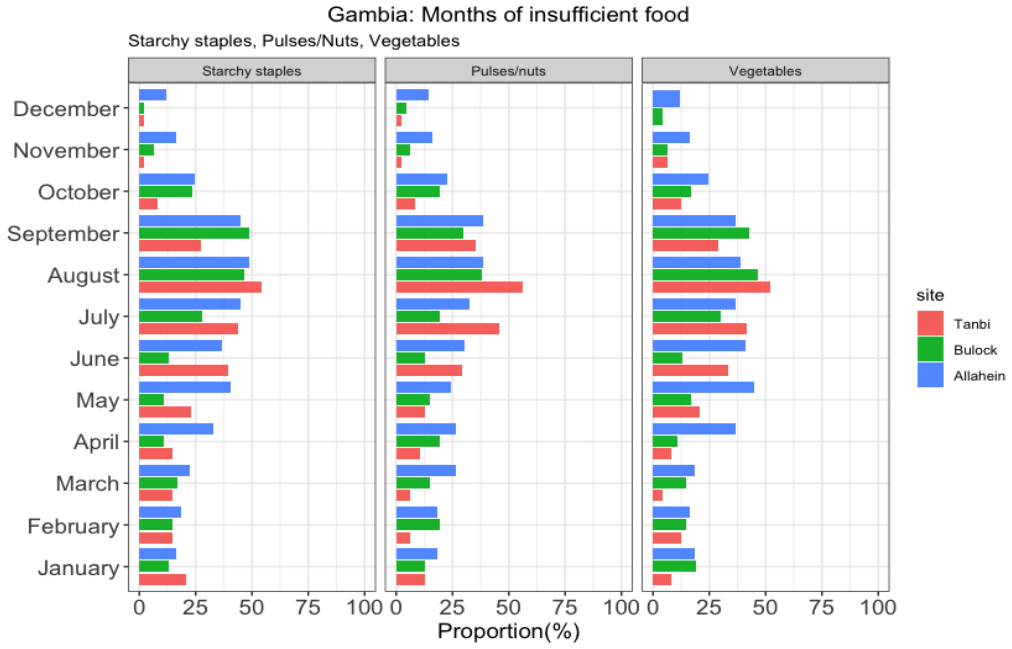

Figure 22: Months of insufficient food per food group (staples, nuts, vegetables) as identified by respondents surveyed in The Gambia.

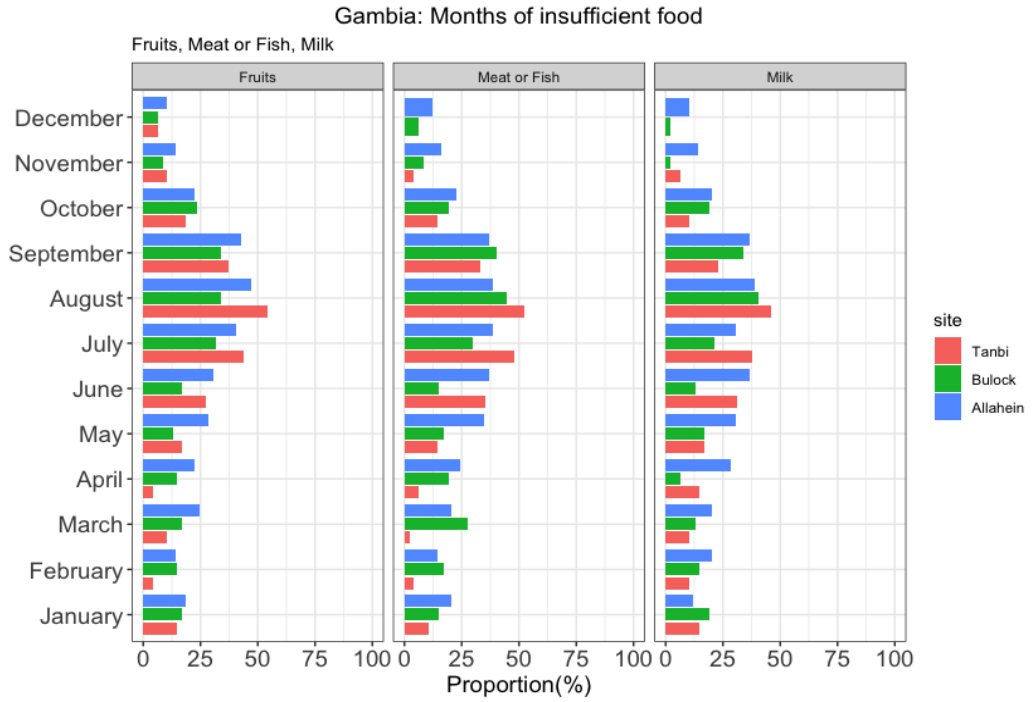

Figure 23: Months of insufficient food per food group (fruits, meat, fish, milk) as identified by respondents surveyed in The Gambia.

3.2 Nutritious Food Portfolios for Food Security and Healthier Diets

Smallholder food production is often dominated by starchy staple crops. The availability of micronutrient- rich crops like fruits and vegetables is highly season-dependent, which is one reason, amongst others, for low consumption. The food and nutrition portfolios (or Nutritious Food Portfolios) are context-specific recommendations for producing and consuming a greater diversity of nutrient-rich foods to address seasonal food harvest gaps, and micronutrient gaps in local diets (McMullin et al., 2019). They consist of a variety of indigenous and exotic trees and crops including fruits, vegetables, pulses, and staples. The portfolios were co-developed with communities taking into consideration socio-ecological dynamics of food production including seasonal availability, food security, and food consumption. They were further informed and validated with communities based on their needs and priorities for producing food for home consumption and income generation. A participatory screening of agricultural and wild biodiversity, including food and feed, was conducted in each field site. For each of the prioritized species, their contribution to food and nutrition security at the landscape level was assessed based on existing production potential, including land availability for planting, and the respective nutritional value for key micronutrients vitamins A and C, iron, and folate. These micronutrients, vitamins A and C, iron and folate are prioritized due to their public health relevance, based on their supportive functions for general good health and because tree foods (fruits)

are often a naturally high source of the vitamins mentioned. To simplify nutrition information, a scoring system goes with the customized portfolios to support species selection. However, this data is limited regarding underutilized species—a knowledge gap due to inadequate investment and hence research is hampering a full contribution of these species in local food systems. The portfolios matter in our research because they are an approach to ensuring that agricultural and wild biodiversity are prioritized as part of a solution for promoting greater diversity of nutritious foods in local production systems and diets.

3.2.1 Challenges in local food systems

Study assessments on functioning of local food supply across sites has shown important learnings to help in future improvement efforts. These include:

- Periods of seasonal food insecurity worsens lack of availability and access to a diversity of food.
- There has been a narrow focus on a few crops that are nutritionally limited. This undermines human health and degrades ecosystems.
- Availability of micronutrient-rich crops like fruits and vegetables are often lacking and highly season-dependent.

In Ghana, peak periods of food insecurity were shown to be between the months of April and July (inclusive) across all sites, with an average of 55 percent of respondents in Narkwa indicating these months as most affected, followed by 39 percent in Densu, and 30 percent in Whin (Figure 24).

Across the six sites, there were varying degrees of food production and livestock keeping. In the Ghana sites, Whin had the highest number of respondents indicating food production – staple crops (75 percent), vegetables (70 percent), fruits (32 percent), and livestock (26 percent). This was followed by Narkwa staple crops (44 percent), vegetables (35 percent), fruits (20 percent), and livestock (35 percent), and Densu - staple crops (8 percent), vegetables (7 percent), fruits (12 percent), and livestock (34 percent).

Respondents in Whin, who engaged more in food production and livestock keeping, as compared to those in Narkwa and Densu, stated lower rates of food insecurity during the peak months between April and July.

In The Gambia, peak periods of food insecurity were between the months of June and September (inclusive), with an average of 55 percent of respondents in Tanbi indicating these months, 37 percent in Bulock, and 48 percent in Allahein and (Figure 25). In the sites in The Gambia, respondents indicated different percentages of own food production, with Tanbi indicating staple crops (65 percent), vegetables (38 percent), fruits (6 percent) and livestock (25 percent), Bulock indicating staple crops (70 percent), vegetables (81 percent), fruits (55 percent) and livestock (72 percent), while Allahein indicating staple crops (59 percent), vegetables (80 percent), fruits (47 percent) and livestock (49

percent). Respondents in Bulock, who engaged more in food production and livestock keeping, as compared to those in Allahein and Tanbi, indicated lower rates of food insecurity during the peak months of June to September.

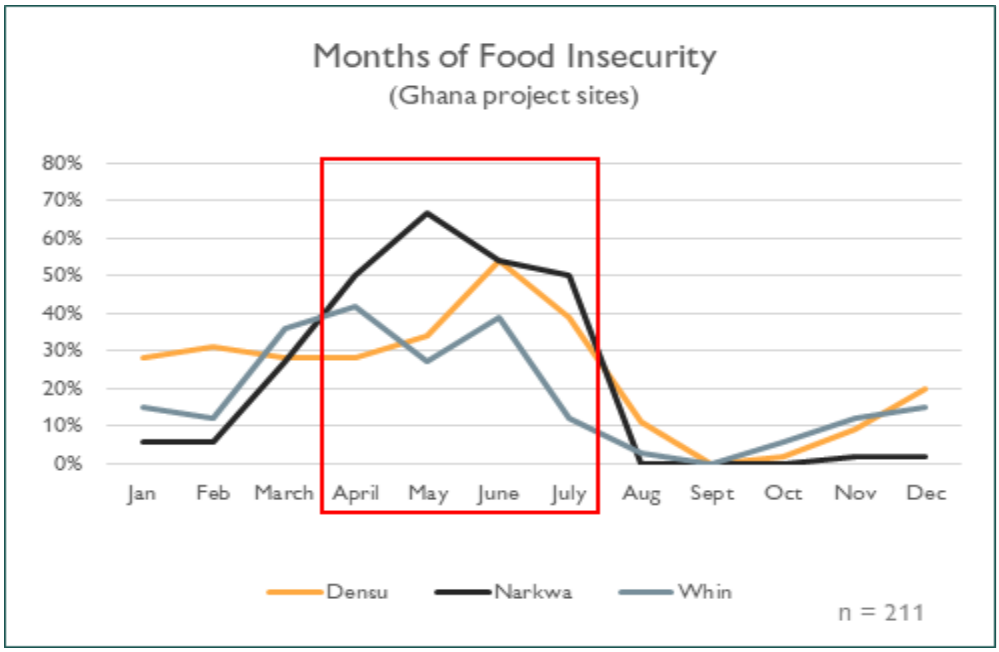

Figure 24: Months of food insecurity indicated by communities in the Densu, Narkwa, and Whin sites in Ghana.

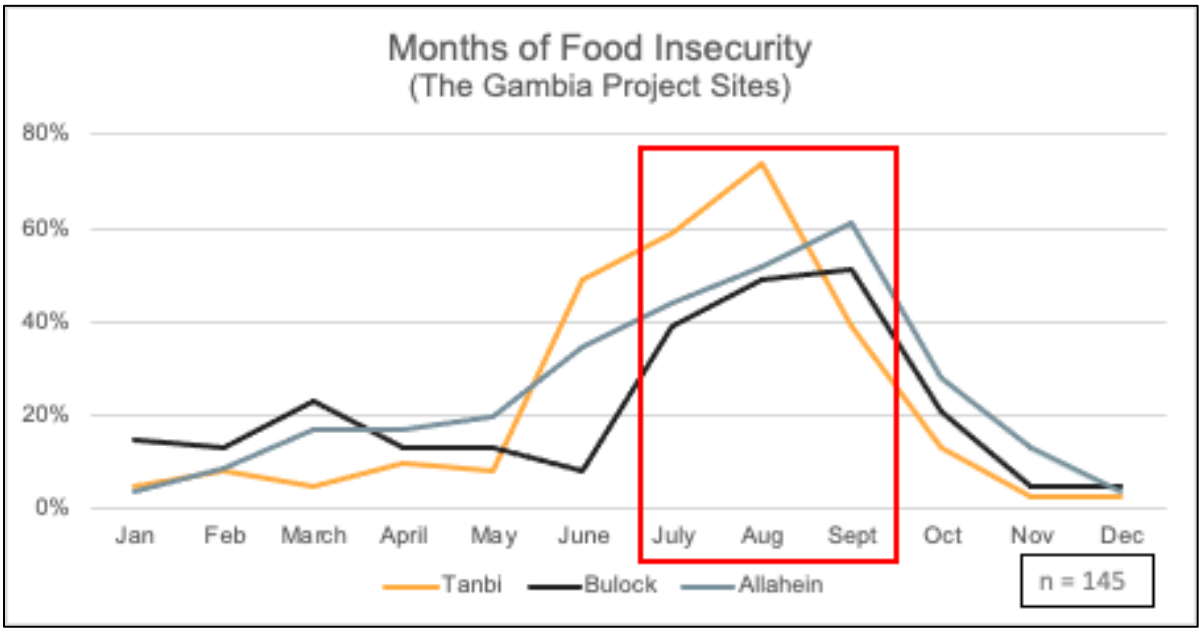

Figure 25: Months of food insecurity indicated by communities in the Tanbi, Bulock and Allahein sites in The Gambia.

3.2.2 Solutions for local food systems

Assessment of local food supply systems has provided key learnings for consideration in future improvements of local diets. These are:

- Local food systems need to change towards delivering healthy diets. This is increasingly recognized in international frameworks and reports.
- Local, contextually relevant solutions, such as the nutritious food portfolios are suitable and are part of the solution for transforming local food systems to deliver greater diversity of nutritious foods.
- A more diversified food system could improve diets and income sources when oyster fishery activities are off - season.

Across the six sites, there were varying degrees of food production and livestock keeping, and agricultural and wild biodiversity use by the communities. This requires site-specific recommendations to be contextualised for the sites to respond to the interests and priorities of communities. Six site specific nutritious food portfolios have been devised (Annex 16) with an average of food tree species, three vegetable, and three staple crops, two legumes, and four fodder types in Ghana, and four food tree species, three vegetable, four staple crops, and one legume in The Gambia, which are mapped for months of seasonal availability, against the peak months of site-specific food insecurity and key micronutrients vitamins A and C, iron, and folate (Annex 16).

To support the community's livestock keeping, fodder species were also included in the nutritious food portfolios (in Ghana) to address better animal feed which can indirectly improve nutrition of families via the production - consumption pathway of increased, more consistent produce yields, and through the production – income pathway, for buying food from markets. Feed options mentioned by communities were the waste produce of food crops, such as cassava peels and leaves, and peels of plantain. This highlights the local circular economy of utilizing waste from human food crops for animal feed. Cultivating and managing fodder crops would offer a complementary source of feed for livestock at various times of the year.

The portfolios are not exhaustive but supply a suitable diversity for households to be able to select different foods and species which could be cultivated or managed to meet their food, and income needs based on their own priorities, and the physical dimensions (land size, access to water, etc.) which may enable or inhibit agricultural diversification.

As part of the site-specific portfolio recommendations, secondary data sources were also reviewed to further select, specifically, food tree species, of native origin or naturalised (species that were introduced but now adapted). Often such species are referred to as “neglected or underutilized” because they may not play a prominent role in local systems but are usually more adapted to their ecological conditions, and due to deep and extensive root structures, they are more resilient in

extreme weather events (droughts, floods, etc.). This is most important for considering the impacts of anthropogenic climate change.

For the sites in Ghana, additional species suggested included: *Artocarpus altilis* (Breadfruit); *Spondias mombin* (Yellow mombia); *Annona squamosa* (Sugar apple); *Borassus aethiopum* (Borassus palm); *Dacroydes klaineanan* (African cherry); *Terminalia catappa* (Indian almond); *Dialium indum* (Tamarind plum). For the sites in The Gambia, additional species are recommended which supply food and fodder but also have additional functions such as medicinal uses, and ecosystem services such as nitrogen fixing for healthy soil: *Anacardium occidentalis* (Cashew – food); *Cordyla pinnata* (Bush mango – food); *Ceiba pentandra* (Kapok – fodder); and *Pterocarpus erinaceus* (fodder and nitrogen fixing).

4. SUMMARY AND RECOMMENDATIONS

4.1 Summary

Most shellfishers engage in more than one livelihood activity as recorded across sites in Ghana and The Gambia. In Ghana, collection of periwinkle, cockle, and other shellfish are undertaken by women. Sea fish sale, trading, and farming are other major additional income earning activities (Annex 3). In the Gambia, results further show vegetable gardening, rice cultivation, rearing local chicken, pig rearing, petty trading, fish smoking, firewood collection, and salt mining as important supplementary livelihood strategies.

Findings validation with communities in Ghana concurred that change trajectories on fisheries seen across study areas were realistic. Communities, however, perceive that trap fishing (cutting of leafy tree branches for deposition in the estuary water to capture fish) does not affect or deplete fish resources in the sea and lagoon but rather improves them. On application of study findings towards improving food security and dietary diversity, participants had consensus on the need to improve tree planting activities with coconut trees along the coast. This was seen to provide benefits such as shade and fruits, as well as income from sale of fruits. Since land is a major shortcoming to upscale tree planting and farming activities, improving small ruminant production was recognised as an added strategy to help improve household incomes and food especially during seasonal stress periods. Possibilities to venture into vegetable production was recognised as another opportunity.

Findings validation in The Gambia on the other hand, noted that to improve shellfisheries, food security, and dietary diversity, for example in the Tanbi area, there is a need to focus capacity development in the areas of oyster processing and financial management. The need to restore landscapes within and around the residential areas, farmlands, and forests will supply ecosystem goods and services such as food, shade, erosion protection, and trees of medicinal value for communities. Restoration efforts should include planting of indigenous tree species, and mangroves were highlighted. In Bulock, provision of starting capital and support on the establishment of aquaculture farms was identified. In Allahein, participants identified support areas such as construction of waiting sheds for

women, provision of revolving loan schemes, establishment of a cooperative credit union for TRY Oyster Women's Association, and innovations on alternative livelihoods such as vegetable gardening, fruit processing, trading, and training on natural resource management.

4.2 Overall recommendations

- This study contributes knowledge on use of diverse food trees in urban and peri-urban coastal areas with increasing human settlement and where aspects of food homogenization remain unclear.
- Communities engage in multiple subsistence, consumption and income generating activities which highlights the relevance of providing recommendations which can support their various consumption and income needs, especially at different times of the year to respond to seasonal changes in food production, accessibility in markets, and availability of income.
- Findings allow recommendations to be made on important food portfolios from agriculture and forest resources for consideration by communities, development workers, and government ministries charged with nutrition improvement.
- Across the six sites, there are varying degrees of agricultural and wild biodiversity use by the communities. This requires site-specific recommendations to be contextualized for each site in order to respond to the interests and priorities of each community.
- Six site specific nutritious food portfolios have been devised with an average of four food tree species, three vegetable, and three staple crops in Ghana, and five food tree species, six vegetable and four staple crops in The Gambia. These are mapped for months of seasonal availability, and key micronutrients vitamins A and C, iron, and folate (Annex 16).
- To support the community's livestock keeping, fodder species have also been included in the nutritious food portfolio to address better animal feed which can indirectly improve nutrition of families via the production - consumption pathway of increased, more consistent produce yields, and through the production – income pathway, for buying foods from markets.
- A more diversified food system could improve diets and income sources when oyster fishery activities are off season.
- Greater information and sensitization on the importance of diversity to meet multiple livelihood and well-being needs should be supported through community engagement and awareness campaigns.
- Detailed capacity needs assessments on technical knowledge and application of tree planting and management, alternative on-farm agricultural activities, business and entrepreneurial skills etc. should be explored, with training modules devised and deployed to community members.

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ANNEXES

Annex 1. Summary attributes of the sites selected for Ghana.

Site	Shellfishing activity	Number of women shellfishers for the site	Est. littoral mangrove & water body area	Livelihood connectivity with mangroves	Mangrove condition	Key factors affecting mangroves	Governance aspects	Nutrition Information
Densu Estuary	Oyster	~150	~206 ha	Brush parks - culture-based fishing; Firewood collection; Salt mining	Highly degraded	Harvesting, settlements expansion (Land reclamation	Ramsar protected site with weak enforcement. Co-management policy for oyster harvesting active – yet to be legislated*	Coastwide increase in fishing dependent households of moderate and severe hunger during the artisanal and inshore fishing closure period. Increase in low dietary diversity during artisanal and inshore fishing closure period. Consumption of six food groups ("other vitamin A rich fruits and vegetables", "other fruits and vegetables", organ meat, meat and fish, legumes and nuts, and milk and milk products) in the period during the artisanal and inshore fishing closure low.
Narkwa Lagoon	Oyster Cockle Shrimp	Unknown [60% of 60 people interview-ed involved in oyster harvesting and trading (Asare et al., 2019)]	~110 ha	Crop farming (maize, cassava, plantain); Salt mining	Moderate (low density of naturally occurring mangrove)	Harvesting, settlements expansion (Land reclamation), die back, pollution	Open access fishing; Customary law – no-fishing Tuesday (low compliance)	Central region was ranked as a food insecure region in the country. Dietary diversity among children 6-59 months of age is low. Only about 11% of children consumed vitamin A rich foods and 47% of children met the minimum dietary requirements

Site	Shellfishing activity	Number of women shellfishers for the site	Est. littoral mangrove & water body area	Livelihood connectivity with mangroves	Mangrove condition	Key factors affecting mangroves	Governance aspects	Nutrition Information
Whin Estuary	Oyster Shrimp Periwinkle	~80	~178 ha	Firewood collection; Bivalve shell trade	Less degraded	Harvesting, settlements expansion and tourism, pollution from sewage	Open access fishing; Customary law – no-fishing Tuesday (low compliance)	Coastwide increase in fishing dependent households of moderate and severe hunger during the artisanal and inshore fishing closure period. Increase in low dietary diversity during artisanal and inshore fishing closure period. Consumption of six food groups ("other vitamin A rich fruits and vegetables", "other fruits and vegetables", organ meat, meat and fish, legumes and nuts, and milk and milk products) in the period during the artisanal and inshore fishing closure low.

*Note: As of the writing of this progress report, the Ghana Co-Management Policy for the Fisheries Sector, and the Densu Delta Community-Based Fisheries Management Plan delegating exclusive use rights to the oyster fisheries resources to the Densu Oyster Pickers Association, were approved in December 2020.

Annex 2. Summary attributes of the sites selected for The Gambia.

Site	Shellfishing activity	Average number of women shellfishers per village	Estimated mangrove area in the site	Livelihood connectivity with mangroves	Mangrove condition	Key factors affecting mangroves	Governance aspects
Tanbi Wetland complex	Oyster Crab Cockle	43	2550 ha	Rice farming, vegetable gardening, Firewood collection	Moderate (location specific)	Harvesting, settlements expansion (Land reclamation), die back, pollution	National Park and Ramsar site, hence, enjoys some degree of management though weak. Women are given exclusive use rights.
Bulock area	Oyster Crab Cockles	19	3539 ha	Rice farming, vegetable gardening, Firewood collection	Less degraded	Harvesting, settlements expansion (Land reclamation), die back, pollution	Local regulations of harvesting shellfish are present.
Allahein Estuary	Oyster, Crab	~100	424 ha	Vegetable gardening, Firewood collection	Highly degraded	Harvesting, settlements expansion (Land reclamation), die back	Shellfishing groups exist but no properly functioning governance structure is in place.

Annex 3. Socio-demographic profile of FGD participants at the Ghana sites.

Parameter	Site		
	Densu (n=42)	Narkwa (n=43)	Whin (n=30)
Gender (percent)			
Men	19	7	0
Women	81	93	100
Age (years)			
Mean	43	47	51
Range	25-77	18-73	21-81
Education (percent)			
None	18	73	60
Primary	47	12	17
Junior high/middle	26	10	10
Senior high (secondary)	9	5	13
Tertiary	0	0	0
Number of years lived in community			
Mean	32	47	50
Range	9-71	18-73	21-81
Livelihood activities (percent)			
Shellfish (oyster) collection, processing & sale	64	31	34
Shellfish (periwinkle) collection and sale	-	-	11
Crab collection and sale	-	-	12
Sea fishing	2	2	
Sea fish processing (frying, smoking, etc.)	9	-	-
Sea fish sale	1	24	2.5
Lagoon/estuary (freshwater fishing)	4	1	
Shrimp sale	2	-	-
Farming	0	15	16
Firewood collection/sale	1	-	5
Trading including petty trade, etc.	5	17	8.5
Trades (including dress making, hair dressing, masonry, carpentry)	6	1	-
Cooked food sale	2	-	-
Miscellaneous jobs (proprietor, pantry woman, lotto agent, etc.)	3	-	-
No other livelihood aside shellfishing	1	9	11

Annex 4. Distribution of livelihoods activities generally undertaken across project sites.

Livelihood Activity	Densu		Narkwa	Whin	
	Bortianor	Tsokomey & Tetegu	Narkwa	Apremdo	Amanful
Fishery					
Shellfishing (Oyster fishing)	×	×	×	×	×
River/lagoon/basket fishing/trap fishing	×	×	×	-	-
Sea fishing	×	×	×	-	×
Shellfish processing	×	×	×	×	×
Shellfish sale	×	×	×	×	×
Sea fish carrying/porter	×	×	×	-	×
Sea fish processing (frying & smoking)	×	×	×	-	×
Sea fish sale	×	×	×	-	×
Crop and livestock					
Livestock rearing: chicken, goats, dogs, sheep, ducks, pigs	×	×	×	×	×
Crop farming (vegetables, staples, etc.)	×	-	×	×	×
Tree based production					
Firewood collection	-	-	×	×	×
Firewood sales	×	×	×	×	×
Charcoal burning	-	-	×	-	-
Herbal medicine collection and sale	×	×	×	×	×
Fruits: Coconut, mango, pawpaw, avocado, etc.	×	×	×	×	×
Trade & artisanship					
Masonry	×	×	×	-	-
Boat building	×	×	×	-	×
Carpentry	-	-	×	-	-
Thatch roofing	-	×	-	-	-
Other jobs					
Driving	-	×	-	-	-
Mariners in ship		×	-	-	-
Petty trading- water, provisions	×	×	×	×	×
Plastics collection for sale (recycling)	×	-	-	-	-
Food sales	×	×	×	×	×
Lottery agent	-	×	-	-	-

Annex 5. Agricultural crops produced and/or consumed across sites.

Site	Common name of crop	Local name	Botanical name
Densu (Tsokomey & Tetegu)	Corn/Maize	Bli	*Zea mays*
	Cassava	Gbeli	*Manihot esculenta*
	Okro	Fetri	*Abelmoschus esculentus*
	Tomato	Tomato	*Lycopersicon esculentum*
	Garden egg	Agbitsa	*Solanum aethiopicum*
	Pepper	Atadi	*Capsicum fructescens*
	Jute leaves	Ademe	*Corchorus olitorius*
Densu (Bortianor)	Corn/Maize	Abele	*Zea mays*
	Cassava	Duade	*Manihot esculenta*
	Okro	Engmomi	*Abelmoschus esculentus*
	Tomato	Tomato	*Lycopersicon esculentum*
	Garden egg	S3b3	*Solanum aethiopicum*
	Carrots	Carrots	*Daucus carota*
Narkwa	Corn/Maize	Aburo	*Zea mays*
	Cassava	Bankye	*Manihot esculenta*
	Plantain	Brodze	*Musa sapientum*
	Okro	Nkruma	*Abelmoschus esculentus*
	Tomato	Tomato	*Lycopersicon esculentum*
	Garden egg	Ntroba	*Solanum aethiopicum*
	Pepper	Moko	*Capsicum fructescens*
	Pineapple	Abrobe	*Ananas comosus*
	Banana	Mpuoa	*Musa paradisiaca*
	Orange	Akutu	*Citrus sinensis*
	Lime	Ankama	*Citrus aurantifolia*
Whin (Apremdo)	Corn/Maize	Aburo	*Zea mays*
	Cassava	Bankye	*Manihot esculenta*
	Plantain	Brodze	*Musa sapientum*
	Banana	Mpuoa	*Musa paradisiaca*
	Cocoyam	Makani	*Xanthosoma mafaffa*
	Tomato	Tomato	*Lycopersicon esculentum*
	Pepper	Moko	*Capsicum fructescens*
	Onion	Anwew	*Allium cepa*
	Garden eggs	Ntroba	*Solanum aethiopicum*
	Turkey berries	Samantroba/kwahu nsusua	*Solanum torvum*
	Okro	Nkruma	*Abelmoschus esculentus*
	Cocoyam (taro) leaves	Nkontomire	*Xanthosoma mafaffa*
	Tiger nut	Atadwe	*Cyperus esculentus*
	Groundnut	Nkatse	*Arachis hypogaea*
Whin (Amanful)	Corn/Maize	Aburo	*Zea mays*
	Cassava	Bankye	*Manihot esculenta*
	Plantain	Brodze	*Musa sapientum*
	Cocoyam	Makani	*Xanthosoma mafaffa*
	Sweet potato	Santum	*Ipomoea batatas*
	Colocasia	Ntwibo	*Colocasia esculenta*
	Tomato	Tomato	*Lycopersicon esculentum*
	Pepper	Moko	*Capsicum fructescens*

Site	Common name of crop	Local name	Botanical name
	Green bell pepper	Green pepper	*Capsicum annum*
	Onion	Anwew	*Allium cepa*
	French onion	Spring onion	*Allium fistulosum*
	Turkey berries	Samantroba/kwahu nsusua	*Solanum torvum*
	Garden eggs	Ntroba	*Solanum aethiopicum*
	Okro	Nkruma	*Abelmoschus esculentus*
	Carrot	Carrot	*Daucus carota*
	Cucumber	Cucumber	*Cucumis sativus*
	Cocoyam /taro leaves	Nkontomire	*Xanthosoma mafaffa*
	Jute leaves	Ayoyo	*Corchorus olitorius*
	Groundnut	Nkatse	*Arachis hypogaea*
	Tiger nut	Atadwe	*Cyperus esculentus*
	Beans	Adua	*Vigna unguiculata*
	Egusie/Agushie	Akatoa/Aketsewa	*Citrullus lanatus/ Cucumeropsis mannii*

Annex 6. Indigenous fruit tree species identified for use in Narkwa and Whin.

Adesema (Tree & Fruits)-Narkwa

Atamba (Tree & Fruits)-Whin

Annex 7. Cultivated and wild products, species and uses across the sites of Densu, Narkwa, and Whin.

Cultivated & wild vegetation products & use	Densu Estuary		Narkwa Lagoon	Whin Estuary		Production source
	Bortianor	Tsokomey & Tetegu	Narkwa	Apremdo	Amanful	
Energy species						
Wood fuel						
Firewood: Coconut frond/branches	×	×	-	-	-	Beaches & home compounds
Firewood: Mangrove (dead wood)	-	×	-	-	-	Mangrove swamp
Firewood: Other spp.	-	-	×	×	×	Wild vegetation on farmlands including. fallows
Charcoal	-	-	×	-	-	Wild vegetation on farmlands including. fallows
Medicine species						
Trees & shrubs						
Moringa leaves	×	×	-	-	-	Cultivated in home compound/ fences/boundaries
Kakapenpen -Hernia, typhoid fever, skin diseases, insomnia/sleeplessness, etc.	-	-	-	×	×	Wild vegetation on farmlands including. fallows
Mahogany bark (fever, pains, blood tonic, etc.)	-	-	-	×	×	Wild vegetation on farmlands including. fallows
Neem leaves (fever)	×	×	-	-	×	Community vegetation
Pawpaw leaves (fever)	×	×	-	-	-	Cultivated in home compound/ fences/boundaries
Pawpaw seeds (de-wormer)	×	×	-	-	-	Cultivated in home compound/ fences/boundaries
Mangrove leaves (first aid to stop bleeding)	-	×	-	-	-	Mangrove swamp
Amatse (blood tonic)	-	×	-	-	-	Cultivated in home compound/ fences/boundaries
Aburadua (fever)	-	-	×	-	-	Wild vegetation on farmlands including fallows
Aposue	-	-	×	-		Wild vegetation on farmlands including fallows
Bowin (fever, malaria, diabetes, de-wormer, asthma, etc.)	-	-	×	-	-	Wild vegetation on farmlands including fallows
Nsepedua	-	-	×	-	-	Wild vegetation on farmlands including fallows
Nunum	-	-	×	×	×	Wild vegetation on farmlands including fallows
Ene – spiritual	-	-	×	-	-	Wild vegetation on farmlands including fallows
Sinduro	-	-	-	-	×	Wild vegetation on farmlands including fallows
Simpe	-	-	-	-	×	Wild vegetation on farmlands including fallows
Abode (fever)	-	-	-	-	×	Wild vegetation on farmlands including fallows
Egyansa	-	-	-	-	×	Wild vegetation on farmlands including fallows

Cultivated & wild vegetation products & use	Densu Estuary		Narkwa Lagoon	Whin Estuary		Production source
	Bortianor	Tsokomey & Tetegu	Narkwa	Apremdo	Amanful	
Herbs	-					
Nyanya (*Momordica foetida*)-spiritual	-	-	×	×	×	Wild vegetation on farmlands including fallows
Dandelion	×	-	-	-	-	Home compounds
Fruits						
Coconut	×	×	×	×	×	Cultivated; Wild vegetation on farmlands including fallows
Mango	×	×	×	×	×	Farmlands including fallow vegetation
Avocado pear			×	×	×	Wild vegetation on farmlands including fallows
Pawpaw	×	×	×	×	×	Wild vegetation on farmlands including fallows
Pineapple			×			Cultivated
Guava	×	-	×	×	×	Cultivated at home compounds Bortianor (Densu), but collected from Wild vegetation on farmlands including fallows at Narkwa and Whin
Oil palm	-	-	×	×	×	Cultivated, Wild vegetation on farmlands including fallows
Orange	-	-	×	×	×	Cultivated
Tangerine	-	-		×	×	Cultivated
Lemon	-	-	×	-	-	Cultivated
Sour sop	-	-	×	-	-	Cultivated
Banana	-	-	×	×	×	Cultivated, Wild vegetation on farmlands including fallows
Atamba (Velvet tamarind/African black berries)						Wild vegetation on farmlands including fallows
Ekyeresoaba- palm	-	-	×	-	-	Wild vegetation on farmlands including fallows
Adesema (African star fruit)			×	-	-	Wild vegetation on farmlands including fallows
Vegetables						
Moringa leaves & seeds	×	×	-	-	-	Cultivated on home compound/ fences/boundaries
Bitter leaf	×	×	-	-	-	Cultivated on home compound

Annex 8. Important tree species, challenges in production and marketing – Densu.

Community	Priority Tree species	Rank	Input challenge	Input challenge rank	Collection/harvesting challenge	Collection challenge rank	Sale challenge	Sale challenge rank
Tsokomey & Tetegu	Coconut	1	Livestock browsing during establishment phase	1	Climbing to harvest fruits is laborious	1	Pricing of fruit. Buyers often offer low farm gate prices	1
			Soil infertility during establishment phase due to sandy nature of soils	2	Climbing is risky as trees often grow very tall	4	Sometimes demand for fruits is low	3
			Moisture stress after planting as soils are sandy with low moisture retention capacity. Watering must be done to prevent seedlings from dying	2	Snake bites	3	Demand is low at times. Sometimes must search for buyers	4
	Mangrove	2	Unavailability of planting material	1	Production site is far from community, hence labor intensive and expensive to harvest and transport for use or sale in community	1	Wood not often sold as firewood so low demand; branches rather used as fish trap	1
			Marshy land requiring protective clothing against snake bites, etc.	2	Risks of snake bites and injuries	1	Theft of mature trees if it to be harvested for sale	2
			Production or planting site is far from community requiring transportation fare and poor monitoring of stand	2	Poor monitoring could lead to over harvesting	3	Conflicts over matured mangrove if to be harvested for sale	4
	Moringa	3	Labor to maintain or manage stands especially in fences	1	Labor intensive when stands grow tall	2	Poor pricing for seeds and leaves by buyers usually outsiders	1
	Pawpaw	4	Lack of land and improved planting material	1	Trees can grow very tall making harvesting of fruits tedious	2	Poor market demand now because currently harvested mainly for home consumption although has market value in urban areas	3

Community	Priority Tree species	Rank	Input challenge	Input challenge rank	Collection/harvesting challenge	Collection challenge rank	Sale challenge	Sale challenge rank
	Neem	5	Stand management as can grow profusely	1	Risks of snake bite and injury	1	No market demand now	1
			Land scarcity for cultivation	1		1	Poor pricing. Buyers decide their own prices	2
Bortianor	Coconut	1	Theft	2	Theft Risks in climbing to harvest fruit	3	Poor prices offered by buyers	2
			Scarcity of land and no improved planting material for planting	1	Snake bites	1	Poor pricing	2
	Moringa	2	Scarcity of land for planting on large scale so limited to home boundary fences	1	Risk of injury during cutting and labor as tree can grow tall	1	Poor pricing. Inability to process for sale so must wait for buyers to come round to purchase fresh leafy products at low prices	2
	Mangrove	3	Labor demanding and expensive (distant location)	1	No harvesting plan resulting in theft and potential over harvesting of planted areas	2	Low demand for mangrove as firewood because of the ban on harvesting	1
	Pawpaw	4	Limited space available for planting	1	Labor for harvesting as trees can grow very tall	1	Poor pricing	2
	Mango	5	Changing weather pattern and insufficient rain for growth	1	Risks from insect and snake bites in harvesting from bushes i.e., fallows and secondary forests	1	Highly perishable	1

Annex 9. Important tree species, challenges in production and marketing – Narkwa.

Community	Priority tree	Rank	Input challenge	Input challenge rank	Collection/ harvesting challenge	Collection challenge rank	Sale challenge	Sale challenge rank
Narkwa	Coconut	1	Improved seed; Moisture availability after planting; Renders the land infertile because of the extensive rooting system. Often cannot integrate with other crops	1	Harvesting is risky due to tall tree stem	1	Low price offered by buyers	2
	Pawpaw	2	Improved planting material and moisture availability to support plant growth, Wind throw during periods of high winds	1	Sometimes trees grow very tall, risk of fruit breaking	2	Low price offered by buyers	1
	Mango	3	Improved planting material; Reduced moisture availability due to intense sunshine	1	Risks of insect and snake bites from harvesting wild stocks in bushes	1	Low price by buyers	2
			In the wild, not managed, excessive drought will reduce growth	3	Risk of insect and snake bites from harvesting from forests/bushes	1	No market demand at village level as used mainly at household level for food	4
	Orange	4	Labor intensive-high cost of labor-finance required for weeding, pest control, etc.; limited rain	2	Labor intensive	2	Low farm gate price	1
	Lime	5	Unstable weather pattern and insufficient rain affect fruiting	2	Labor intensive	2	Low farm gate price	1

Annex 10. Important tree species, challenges in production and marketing – Whin.

Community	Priority tree	Rank	Input challenge	Input challenge rank	Collection/harvesting challenge	Collection challenge rank	Sale challenge	Sale challenge rank
Apremdo	Mango	1	Unstable weather sometimes affects fruiting	1	Increasing sale of farmlands to developers leading to loss of trees in fallows and forests	1	Highly perishable	2
	Avocado pear	2	Changing weather pattern and insufficient rain reduces fruit yield	1	Risks of harvesting from bushes	2	Poor price	1
	Pawpaw	3	Unstable weather sometimes affects fruiting	3	Vegetation is being cleared for development threat to availability in the future	3	Marketing not a problem	5
	Guava	4	Planting material not easily available	2	Risks of harvesting from wild bush	2	Poor price	2
	Oil palm	5	unstable weather pattern and insufficient rain affect fruiting	2	Labor intensive	1	Poor price although ready market	2
Amanful	Orange/ guava	1	Lack of planting material, moisture unavailability to support growth	1	Limited stocks, not easily available in the wild	1	Marketing not a problem	4
	Coconut/ Avocado pear	2	Land scarcity for cultivation, labor, limited rainfall	2	Vegetation is being cleared for development threat to availability in the future	1	Marketing not a problem	5
	Pawpaw	3	Livestock browsing during establishment phase	2	Vegetation is being cleared for development threat to availability in the future	1	Marketing not a problem	5
	Oil palm	4	Land scarcity for cultivation, labor, limited rainfall	2	Vegetation is being cleared for development threat to availability in the future	1	Marketing not a problem	5
	Mango	5	Land scarcity for cultivation, labor, limited rainfall	2	Vegetation is being cleared for development threat to availability in the future	1	Marketing not a problem but highly perishable	5

Annex 11. Fodder and feed produced for livestock and sources.

Fodder & feed	Site/Community					Production source
	Densu Estuary		Narkwa Lagoon	Whin Estuary		
	Bortianor	Tsokomey & Tetegu	Narkwa	Apremdo	Amanful	
Ficus for sheep	-	-	×	-	-	Wild vegetation on farmlands including fallow vegetation
Cassava leaves for goats	-	-	×	×	×	Farmlands including croplands and fallow vegetation
Pawpaw leaves for goats	×	×	×	×	×	Home compounds and farms
Cassava peels for goats	×	×	×	×	×	Household & cooked food producers
Plantain peels for goats	×	×	×	×	×	Household & cooked food producers/ restaurants
Household food leftovers for chickens, ducks & pigs	×	×	-	-	-	Household
Mangrove leaves/branches (fish trapping)-fish feed	×	×	-	-	-	Mangrove swamp
Elephant grass (*Pennisetum spp.*)-goat & sheep	×	-	-	-	-	Community wild vegetation on land yet to be built
Sonli grass	-	×	-	-	-	Estuary shore

Annex 12. Priority agricultural crops, inputs, and sale challenges across sites.

Site (Community)	Priority Crop	Rank	Input challenge	Challenge rank	Sale Challenge	Sale challenge rank
Densu (Tsokomey & Tetegu)	Cassava	1	Scarcity of land for cultivation Improved cassava stems or planting material	2	Poor pricing of tubers after harvest by intermediaries	2
	Corn/ maize	2	Scarcity of land for cultivation	1	Low pricing of produce by intermediaries	1
	Tomato	3	Scarcity of land for cultivation	1	Poor pricing by intermediaries	1
	Okro	4	Scarcity of land for cultivation	1	Highly perishable	1
	Garden eggs	5	Scarcity of land for cultivation Inadequate finance to pay for high cost of labor if it is to be cultivated	1	Poor pricing especially during periods of bumper harvest	1
Densu (Bortianor)	Corn/maize	1	Land scarcity for cultivation	1	Poor pricing especially by intermediaries	2
	Cassava	2	Scarcity of land for cultivation Inadequate finance to pay for high cost of labor if it is to be cultivated	3	Perishable. Needs to be protected from drying up, hence requires timely transfer to market	4
	Tomato	3	Scarcity of land for cultivation	1	Poor pricing offered by intermediaries	2
	Garden eggs	4	Inadequate money to buy inputs i.e., land, labor, agrochemicals, seeds	1	Poor pricing at farm gate	1
	Okro	5	Inadequate money to buy land elsewhere for cultivation due to scarcity of land in community	1	Poor farm gate price	2
Narkwa lagoon (Narkwa)	Cassava	1	Inadequate money to engage labor to weed	1	Low price	2
	Corn/maize	2	Maize cultivated by women. main issue is lack of finance for weeding	1	Poor price at farm gate	1
	Plantain	3	Lack of finance for engaging labor especially for weeding	1	Low price	2
	Garden eggs	4	Inputs are available but lack of finance to engage labor for watering and pest control	1	Low farm gate price	1
	Pineapple	5	Labor demanding but inadequate funds for engaging labor weeding	1	Poor price at farm gate	1

Site (Community)	Priority Crop	Rank	Input challenge	Challenge rank	Sale Challenge	Sale challenge rank
Whin (Apremdo)	Corn/maize	1	Inadequate money to buy inputs i.e., land, labor, agrochemicals, seeds	1	Poor pricing at farm gate and perishability	1
	Cassava	2	Inadequate money to buy inputs i.e., land, labor, agrochemicals, seeds	1	Poor farm gate price	1
	Plantain	3	Inadequate money to buy inputs i.e., land, labor, agrochemicals, seeds	1	Poor farmgate pricing	1
	Cocoyam	4	Inadequate money	1	Poor pricing	1
	Tomato	5	inadequate money to engage labor to weed	1	Poor price	1
Whin (Amanful)	Cassava	1	inadequate money to engage labor to weed	1	None, easy to sell	5
	Plantain	2	inadequate money to engage labor to weed	1	None, easy to sell	5
	Sweet potato	3	inadequate money to engage labor to weed	1	None, easy to sell	5
	Maize	4	inadequate money to engage labor to weed	1	None, easy to sell	5
	Tomato	5	inadequate money to engage labor to weed, water and control pest	1	None, easy to sell	5

Annex 13. Priority tree products and measures for up-scaling production.

Site (Community)	Priority Tree	Rank	Group or community main remedial measure/coping strategy to challenge	External support needed	Community group already collecting/ adding value	Priority action going forward
Densu estuary *(Tsokomey & Tetegu)*	Coconut	1	Fencing and watering when planted	Improved planting material-shorter varieties to ease harvesting; knowledge on improving soil fertility	Yes	Improved planting material
	Mangrove	2	Harvesting of stumps to produce planting material; intensive monitoring of both planted and wild areas to prevent theft and over harvesting; instituting management plans to regulate harvesting and ensuring enforcement	Knowledge and capacity to produce sufficient planting material and establishment techniques, preparation of management plans, conflict management techniques, transport , planting tools and protective clothing	Yes	Knowledge for planting material production, establishment and management, planting tools, transport, and management plans
	Moringa	3	Regular trimming (pruning) of the branches not to over grow	Planting material production, improve knowledge/capacity for establishment on limited land area and stand management to improve productivity for fruit/seed and leaves production	Yes	Planting material production, establishment and stand management techniques for production of quality seeds and leaves; improve market linkages as usually must wait till outsiders come round by which time pods and leaves might have fallen
	Pawpaw	4	None	Improved planting material for shorter varieties; integration into limited land spaces available and stand management; improve market linkage because market demand is currently low, as largely consumed at the household level	Yes	Planting material of improved high yielding and low statured marketable varieties, innovative systems for production on limited land areas and if possible, with vegetables

Site (Community)	Priority Tree	Rank	Group or community main remedial measure/coping strategy to challenge	External support needed	Community group already collecting/ adding value	Priority action going forward
	Neem	5	No coping strategy. Knowledge and capacity need to be built for establishment and management	Planting material, establishment, and management with other crops, especially vegetables.	Yes	Planting material, establishment, and management in limited land areas available with other crops
Densu estuary (Bortianor)	Coconut	1	None	Improved planting material to overcome harvesting problems from tall trees; knowledge for establishment and management on limited land	Yes (men and women)	Improved planting material, capacity building for cultivation in limited spaces
	Moringa	2	None	Improve capacity to manage stands and process for sale	Yes (men and women)	Improve capacity to establishment and management of stands in small spaces and processing for sale
	Mangrove	3	None	Establishment and management plan to avoid over harvesting for trap fishing	Yes (Men)	Planting, management plan to regulate harvesting
	Pawpaw	4	None	Improved and short statured variety to reduce harvesting labor	Yes (men and women) but not big scale. Limited to home consumption mainly although has potential for sale on urban market	Improved planting material, integration in home gardens due to limited space
	Mango	5	None	Improved and short statured variety to that be grown in home gardens to address problem scarcity of land and snake bites	Yes (women collection from the wild mainly for home consumption with limited sales)	Improved planting material, integration in home gardens due to limited space
Narkwa lagoon (Narkwa)	Coconut	1	Plant improved varieties; watering	Improved varieties, capacity building for establishment	Yes	Seeds of short stature varieties to plant

Site (Community)	Priority Tree	Rank	Group or community main remedial measure/coping strategy to challenge	External support needed	Community group already collecting/ adding value	Priority action going forward
	Pawpaw	2	Plant improved variety	Improved planting material, capacity building for establishment and management of pawpaw plantations	Yes	Establishment of pawpaw farms or plantations with improved seeds
	Mango	3	Plant in plantations to reduce insect and snake bites	Improved seeds and knowledge for establishment and management in plantations	yes	Build capacity for cultivating mango plantations for the market
	Orange	4	Plant	improved planting material, moisture availability techniques	Yes	Supply improved planting material; build capacity for watering to establishment period
	Lime	5	Establish in plantations or orchard	Improved planting material, irrigation, or moisture retention measure during establishment	Yes	Supply improved planting material, build capacity to plant and manage including moisture retention measures
Apremdo	Mango	1	Plant i.e., domestication	Improved planting material and knowledge	yes	Planting material and capacity building
	Avocado pear	2	Plant	Planting material and knowledge	Yes	Planting material
	Pawpaw	4	Plant	Improved planting material	Yes	Planting material and capacity building
	Guava	4	Plant	Planting material	Yes, but not readily available	Improved planting material and capacity building in establishment
	Oil palm	5	Plant	High yielding variety	Yes	Improved planting material and moisture retention techniques
Whin estuary Amanful	Orange/guava	1	Establish or plant in plantations or orchard	Planting material irrigation or moisture retention measure during establishment	Yes, individuals collect and sell	Planting material, watering methods, protection from livestock browsing
	Coconut/pear	2	Establish or plant in plantations or orchard	Planting material irrigation or moisture retention measure during establishment	Yes, individuals collect and sell	Planting material, water methods, protection from livestock browsing

Site (Community)	Priority Tree	Rank	Group or community main remedial measure/coping strategy to challenge	External support needed	Community group already collecting/ adding value	Priority action going forward
	Pawpaw	3	Establish or plant in plantations or orchard	Planting material irrigation or moisture retention measure during establishment	Yes, individuals collect and sell	Planting material, watering methods, protection from livestock browsing
	Oil palm	4	Establish or plant in plantations or orchard	Planting material irrigation or moisture retention measure during establishment	Yes, individuals collect and sell	Planting material, watering methods, protection from livestock browsing
	Mango	5	Establish or plant in plantations or orchard	Planting material irrigation or moisture retention measure during establishment	Yes, individuals collect and sell	Planting material, watering methods, protection from livestock browsing

Annex 14. Seasonal availability of main food types throughout the year.

Site	Community	Crop	Crop type	Seasonal availability (months)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Densu estuary	*Tsokomey & Tetegu*	Cassava	Staple												
		Corn/Maize	Staple												
		Tomato	vegetable												
	Bortianor	Corn/Maize	Staple												
		Cassava	Staple												
		Garden egg	Vegetable												
		Okra	Vegetable												
		Coconut	Fruit												
		Moringa	Vegetable												
		Mango	Fruit												
Narkwa lagoon	Narkwa	Corn/Maize	Staple												
		Cassava	Staple												
		Plantain	Staple												
		Okra	Vegetable												
		Tomato	Vegetable												
		Garden egg	Vegetable												
		Pepper	Vegetable												
		Orange	Fruit												
		Mango	Fruit												
		Lime	Fruit												
		Pawpaw	Fruit												
		Avocado pear	Fruit												
		Coconut	Fruit												
		Adesema	Fruit /Wild food												
		Oil palm	Fruit												
Whin estuary	Apremdo	Corn/Maize	Staple												
		Cassava	Staple												
		Plantain	Staple												
		Cocoyam	Staple												

Site	Community	Crop	Crop type	Seasonal availability (months)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Tomato	Vegetable												
		Garden egg	Vegetable												
		Mango	Fruit												
		Coconut	Fruit												
		Pawpaw	Fruit												
		Groundnuts	Pulses												
		Oil palm	Fruit												
	Amanful	Corn/Maize	Staple												
		Cassava	Staple												
		Plantain	Staple												
		Cocoyam	Staple												
		Sweet potato	Staple												
		Tomato	Vegetable												
		Garden egg	Vegetable												
		Okra	Vegetable												
		Onion	Vegetable												
		Pepper	Vegetable												
		Ayoyo	Vegetable												
		Groundnuts	Pulses												
		Beans (Cowpea)	Pulses												
		Tiger nut	Nut												
		Mango	Fruit												
		Pawpaw	Fruit												
		Oil palm	Fruit												
		Coconut	Fruit												

*Color code: Staples Vegetables: Fruits Pulses Nut

Annex 15. Seasonal availability of fodder and feed types for livestock throughout the year.

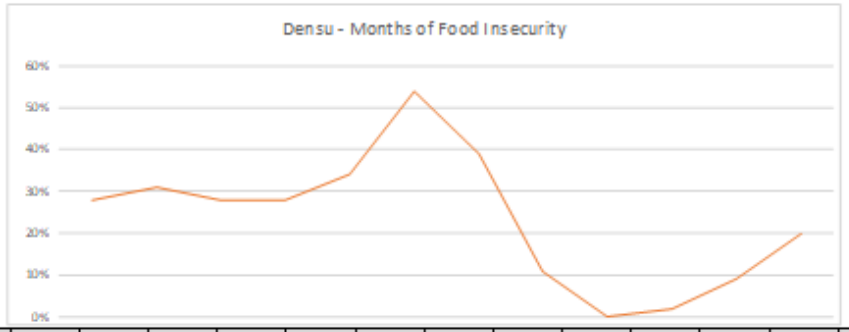
Site/ Community	Fodder & feed	Seasonal availability (months)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Densu *Bortianor*	Cassava peels for goats												
	Plantain peels for goats												
	Household food leftovers for chickens, ducks & pigs												
	Pawpaw leaves for goats												
	Elephant grass (*Pennisetum* spp.) for goat & sheep												
Densu *Tsokomey & Tetegu*	Cassava peels for goats												
	Plantain peels for goats												
	Pawpaw leaves for goats												
	Household food leftovers for chickens, ducks & pigs												
	Sonli grass at the shore & upland of estuary for goats												
Narkwa Lagoon *Narkwa*	*Ficus spp*. for sheep												
	Cassava peels for goats												
	Plantain peels for goats												
	Cassava leaves for goats												
	Pawpaw leaves & fruits for goats												
Whin Estuary Apremdo	Cassava peels for goats												
	Plantain peels for goats												
	Cassava leaves for goats												
Whin Estuary Amanfo	Cassava peels for goats												
	Plantain peels for goats												
	Cassava leaves for goats												

*Color code:

Staples	Vegetables:	Fruits	Pulses	Nut

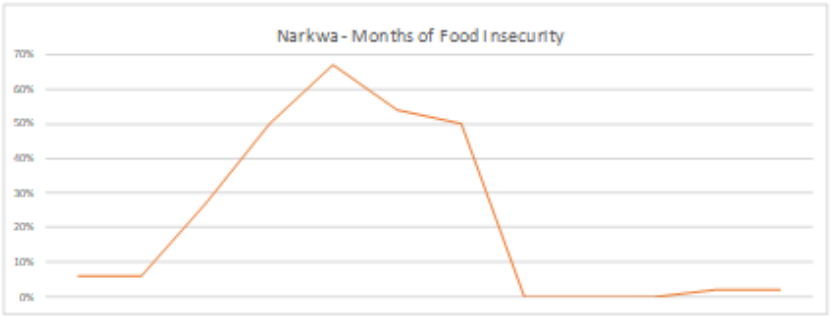
Annex 16. Nutritious food portfolios.

Ghana Nutritious Food Portfolios



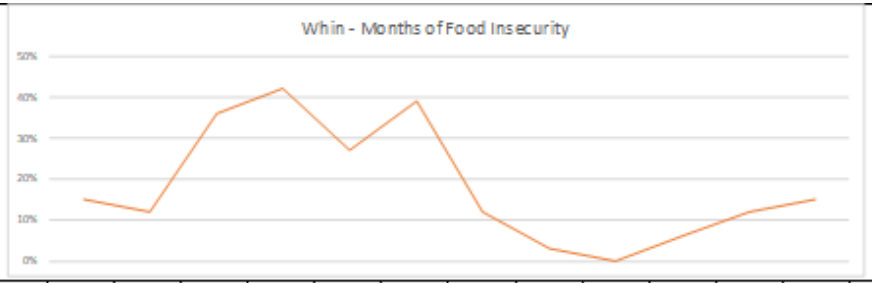
site	Crop	Food Crop	Botanical name	Part/ preparation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Vitamin A	Vitamin C	Iron	Folate
Densu	Food Trees	Coconut	*Cocos nucifera L.*	Flesh, raw															++	~
		Mango	*Mangifera indica*	Pulp, raw													+++	++	~	~
		Papaya (pawpaw)	*Carica papaya*	Pulp, raw													++	+++	~	~
		Moringa	*Moringa oleifera*	Leaves, raw													+++	+++	+++	~
				Leaves, boiled													+++	++	++	~
				Pods, raw														+++		~
				Pods, boiled														+++		~
		Neem	*Azadirachta indica*	Leaves																
	Vegetables	Tomato	*Solanum lycopersicum*																	
		Aubergine	*Solanum melongena*																	
		Okra	*Abelmoschus esculentus*																	
	Staples / Starchy roots and	Maize (Tsokomey)	*Zea mays*	Sweet, yellow, boiled													~		~	
		Maize (Bortianor)	*Zea mays*	Sweet, yellow, boiled													~		~	
		Cassava (Tsokomey)	*Manihot esculenta*	Tuber, boiled														~	~	
		Cassava (Bortianor)	*Manihot esculenta*	Tuber, boiled														~	~	
	Fodder	Elephant grass	*Cenchrus clandestinus*	Grass																
		Cassava	*Manihot esculenta*	Peels, leaves																
		Plaintain	*Musa paradisiaca*	Peels																
		Papaya	*Carica papaya*	Leaves																

	Months of harvest
+++	High source
++	Source
~	Present but low source
	Not a source
	Data compilation on-going



site	Crop Type	Food Crop	Botanical Name	Part/ preparation	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Vitamin A	Vitamin C	Iron	Folate
Narkwa	Food Trees	Lime	*Citrus latifolia*	Raw	■	■	■	■	■	■	■	■	■	■	■	■		++		
		Papaya (pawpaw)	*Carica papaya*	Pulp, raw	■	■	■	■	■	■	■	■	■	■	■	■	++	+++	~	~
		Mango	*Mangifera indica*	Pulp, raw	■	■	■	■							■	■	+++	++	~	~
		Coconut	*Cocos nucifera*	Flesh, raw	■	■	■	■	■	■	■	■	■	■	■	■			++	~
		Adesema*	*Adesema*		■	■	■									■				
		Oil Palm	*Elaeis guineensis*		■	■	■									■				
		Avocado	*Persea americana*	Pulp, raw				■	■	■	■							~	~	~
		Orange	*Citrus sinensis*	Raw						■	■	■	■	■	■			+++		~
	Vegetables	Capsicum	*Capsicum annuum*		■					■	■	■	■	■	■	■				
		Aubergine	*Solanum melongena*							■	■	■	■	■	■					
		Okra	*Abelmoschus esculentus*						■	■	■	■								
		Tomato	*Solanum lycopersicum*							■	■	■								
	Staples/ Starchy roots & tubers	Maize	*Zea mays*	Sweet, yellow, boiled					■	■	■						~		~	
		Cassava	*Manihot esculenta*	Tuber, boiled	■	■	■	■	■	■	■	■	■	■	■	■		~	~	
		Plantain	*Musa paradisiaca*	Yellow and green, raw	■						■	■	■	■	■	■	++	++		~
				Green, boiled	■						■	■	■	■	■	■		~		~
				Yellow, boiled	■						■	■	■	■	■	■		~		++
	Fodder	Ficus spp	*Ficus spp.*	Leaves																
		Cassava	*Manihot esculenta*	Peels, leaves	■	■	■	■	■	■	■	■	■	■	■	■				
		Plaintain	*Musa paradisiaca*	Leaves	■						■	■	■	■	■	■				
		Papaya	*Carica papaya*	Leaves, fruits	■	■	■	■	■	■	■	■	■	■	■	■				

■	Months of harvest
+++	High source
++	Source
~	Present but low source
	Not a source
	Data compilation on-going



site	Crop Type	Food Crop	Botanical Name	Part/Preparation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Vitamin A	Vitamin C	Iron	Folate
Whin	Food Trees	Papaya (pawpaw)	*Carica papaya*	Pulp, raw													++	+++	~	~
		Mango	*Mangifera indica*	Pulp, raw													++	~	~	
		Avocado	*Persea americana*	Pulp, raw														~	~	~
		Guava	*Psidium guajava*	Pulp, raw													~	+++	~	~
		Orange	*Citrus X sinensis*	Pulp, raw														+++		~
	Vegetables	Tomato	*Solanum lycopersicum*	Raw																
		Aubergine	*Solanum melongena*	Raw																
		Cowpeas	*Vigna unguiculata*	Leaves, boiled													+++	++	++	++
	Legumes	Cowpeas	*Vigna unguiculata*	Mature, water-soaked, boiled															~	++
		Peanut	*Arachis hypogea*	Raw															+++	+++
	Staples/ starchy roots and tubers	Maize	*Zea mays*	Sweet, yellow, boiled													~		~	
		Cassava	*Manihot esculenta*	Tuber, boiled														~	~	
		Cocoyam/Taro	*Colocasia esculenta*																	
		Plantain	*Musa paradisiaca*	Yellow and green, raw													++	++		~
				Green, boiled														~		~
				Yellow, boiled														~		++
	Fodder	Cassava	*Manihot esculenta*	Peels, leaves																
		Plantain	*Musa paradisiaca*	Peels																

	Months of harvest
+++	High source
++	Source
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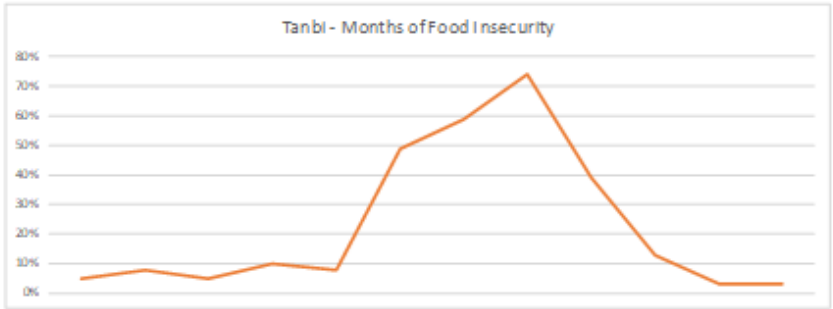
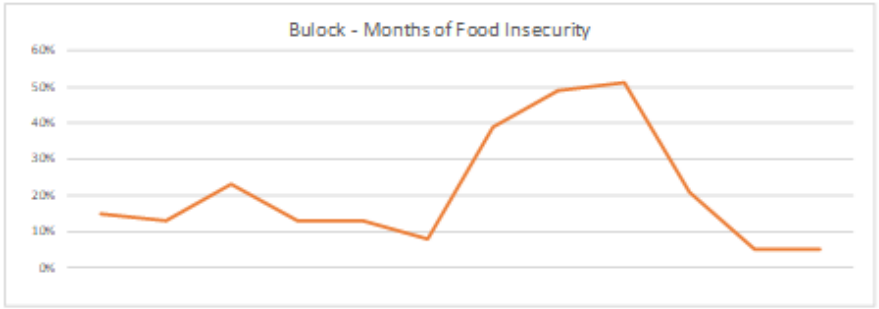
	Not a source
	Data compilation on-going

The Gambia Nutritious Food Portfolios



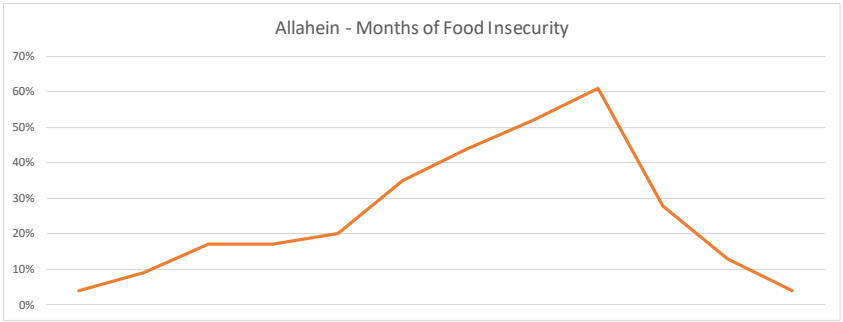
site	Crop	Food Crop	Botanical name	Part/Preparation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Vitamin A	Vitamin C	Iron	Folate
Tanbi	Food Trees	Baobab	*Adansonia digitata*	Fruit, pulp, raw														+++	+++	~
		Cocoa	*Theobroma cacao*																	
		Oil palm	*Elaeis guineensis*																	
	Vegetables	Tomato	*Solanum lycopersicum*																	
		Aubergine	*Solanum melongena*																	
		Cucumber	*Cucumis sativus*																	
		Cassava	*Manihot esculenta*	Leaves, boiled													+++	~	+++	++
		Cabbage	*Brassica oleracea var. capitata*	Boiled														++		~
		Okra	*Abelmoschus esculentus*																	
	Legumes	Soybean	*Glycine max*																	
		Groundnuts/peanuts	*Arachis hypogea*	Raw															+++	+++
	Staples / Starchy roots and	Yam (Purple yam)	*Dioscorea alata*	Tuber, boiled														~	~	
		Cassava	*Manihot esculenta*	Tuber, boiled														~	~	
		Rice	*Oryza sativa*	White, polished, boiled																
		Maize	*Zea mays*	Sweet, yellow, boiled													~		~	

	Months of harvest
+++	High source
++	Source
~	Present but low source
	Not a source
	Data compilation on-going



site	Crop Type	Food Crop	Botanical Name	Part/Preparation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Vitamin	Vitamin	Iron	Folate
	Food Trees	Papaya(pawpaw)	*Carica papaya*	Pulp, raw													++	+++	~	~
		Kaba	*Saba senegalensis*	Pulp, raw																
		Velvet tamarind	*Dialium guineense*	Pulp, raw																
	Vegetable	Okra	*Abelmaschus esculentus*																	
	Legume	Groundnuts/	*Arachis hypogea*	Raw															+++	+++
	Staples / Starchy roots and tuber	Cassava	*Manihot esculenta*	Tuber, boiled														~	~	
		Millet (finger)	*Eleusine coracana*	Boiled															~	
		Millet (Pearl)	*Pennisetum*	Whole grain, boiled															++	
		Sorghum	*Sorghum bicolor*	Whole grain, boiled															++	
		Rice	*Oryza sativa*	White, polished, boiled																
Bulock		Maize	*Zea mays*	Sweet, yellow, boiled													~		~	

	Months of harvest
+++	High source
++	Source
~	Present but low source
	Not a source
	Data compilation on-going



site	Crop Type	Food Crop	Botanical Name	Part/Preparation	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec	Vitamin A	Vitamin C	Iron	Folate
Allahein	Food Trees	Velvet Tamarind/ Kosito	*Dialium guineense*																	
		Talo ("Tallo" "Tallow")	*Detarium senegalense*																	
		Kaba	*Saba senegalensis*																	
		Foleh																		
		Ficus	*Ficus gnaphalocarpa*																	
	Vegetables	Onion	*Allium cepa*																	
		Capsicum	*Capsicum annum*																	
		Tomato	*Solanum lycopersicum*																	
	Staples / Starchy roots and tubers	Cassava	*Manihot esculenta*	Tuber, boiled														~	~	
		Maize	*Zea mays*	Sweet, yellow, boiled													~		~	
		Rice	*Oryza sativa*	White, polished, boiled																

+++	High source
++	Source
~	Present but low source
	Not a source
	Data compilation on-going