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Determinants of nutrient adequacy and dietary intake patterns among rural farming households in Northwestern Nigeria

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ABSTRACT
Food production is expected to provide a sustainable pathway for household nutrition security. Nonetheless, rural farming household in northern Nigeria who are noted for high food production still remain malnourished. Therefore, the study investigated determinants of nutrient adequacy and dietary intake patterns among rural farming households in northwestern Nigeria. Structured interview schedule was used to elicit information from 302 households, which was complimented with Focus Group Discussions (FGD) to gain a better insight into factors influencing dietary intake patterns. Kaduna and Jigawa States were purposively selected in northwestern Nigeria due to socio-cultural conditions of the States. Calories and nutrients intakes were determined using 24-hour dietary recall using total dietary assessment software, while the 30-day food records were used to describe dietary intake pattern. The result revealed that calories and carbohydrate intake exceeded the recommended intake, which were (2480.67KCal) and (246.41g), respectively. Conversely, protein (33.50g), potassium (274.63mg) and iron (17.13mg) were below the recommended intake. Cereals such as rice, millets, maize and wheat were consumed by 96.4% of respondents at least every other day. High cost of food items, cultural preferences and crops cultivated influenced dietary intake pattern. The findings call for renewed attention to encourage cultivation of bio-fortified staple crops in the study area.

Keywords: Calories, Nutrient adequacy, Rural households, Dietary intake

RÈSUMÈ
La production alimentaire devrait fournir une voie durable pour la sécurité nutritionnelle des ménages. Néanmoins, les ménages d'agriculteurs ruraux du nord du Nigéria, connus pour leur production alimentaire élevée, demeurent sous-alimentés. Ainsi, l'étude a examiné les déterminants de l'adéquation des nutriments et des modèles d'apport alimentaire chez les ménages agricoles ruraux du nord-ouest du Nigéria. Le calendrier des entretiens structuré a été utilisé pour obtenir des informations auprès de 302 ménages, qui ont été complétés par des discussions avec le groupe focal (FGD) pour mieux comprendre les facteurs influençant les habitudes alimentaires. Les États de Kaduna et Jigawa ont été choisis de manière objective dans le nord-ouest du Nigéria en raison des conditions socioculturelles des États. Les apports en calories et en nutriments ont été déterminés en utilisant un rappel un rappel alimentaire sur 24 heures à l'aide d'un logiciel d'évaluation de l'alimentation totale, tandis que les

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enregistrements alimentaires sur 30 jours ont été utilisés pour décrire le modèle d'apport alimentaire. Les résultats ont révélé que les calories et l'apport en glucides dépassaient l'apport recommandé, qui étaient respectivement de (2480,67 KCal) et (246,41 g). Inversement, les protéines (33,50 g), le potassium (274,63 mg) et le fer (17,13 mg) étaient inférieurs à l'apport recommandé. Des céréales telles que le riz, le millet, le maïs et le blé étaient consommées par 96,4% des répondants au moins tous les deux jours. Le coût élevé des produits alimentaires, les préférences culturelles et les cultures cultivées ont influencé le régime alimentaire. Les résultats font appellent à une attention renouvelée d'encourager la culture de cultures de base bio-fortifiées dans la zone d'étude.

Mots clés: Calories, Adéquation des nutriments, ménages ruraux, Apport alimentaire

INTRODUCTION

Agriculture remains the backbone of the world's economy. This is evident in its enormous contribution to development and employment of a large percentage of the labour force (Aina, 2013). The impact of agriculture is great in Africa as it employs 65% of her labour force, and contributes over 20% of Gross Domestic Product (GDP) in most African countries (World Bank, 2012; AGRA, 2015). In Nigeria, agriculture has contributed immensely to foreign exchange earnings and GDP, in 2017 it contributed 21.6% (CBN, 2013). Beyond the issues of GDP and employment, agriculture is solely responsible for food which is required for sustenance.

Rural households in Nigeria predominantly engage in agriculture either as a primary or secondary means of livelihood (Oluwatayo, 2008; Amaza *et al*., 2009). It is very common to find households in rural areas with at least a home garden. These rural dwellers are responsible for over half of the world's food production; they produce between 60% and 80% of the food in most developing countries (Technical Centre for Agricultural and Rural Cooperation-CTA, 2009). Although food production is expected to provide a sustainable pathway out of poverty and contribute to national and household food and nutrition security, the rural populace who produce the bulk of these food items remains deprived, poor, malnourished, diseased and marginalized (World Bank, 2008). In Nigeria malnutrition is prevalent among rural households (Ojofeitimi, 2012; FAO 2016) especially in northern Nigeria (Akinyele, 2009). Most of these households experience seasonal chronic food shortages, inadequate diet, irregular supply of food, nutrition low quality of foods, and sometimes a total lack of food.

Food is the most basic human need, it is essential for man's wellbeing and nutrients needed for proper body development. Hence, adequate food consumption, in terms of quantity and quality, is key for a healthy and productive life (Capone *et al*., 2014). Food consumption at the household level is crucial, not only because it is related to poverty and food security, but also because it is highly correlated with nutrition and socioeconomic status of households. The socioeconomic characteristics of households differ significantly across urban to rural areas (Obayelu, 2014). Although, increasing the supply of food rich in carbohydrates such as rice, maize, and tubers may satisfy dietary energy needs, this may not guarantee commensurate improvements in nutrients that will culminate in healthy living. Also, increase in rural farmers' income may not likely lead to a proportionate reduction in malnutrition as reported by Arimond *et al*. (2011). They found that while cash-crop schemes increased farmers' incomes, this did not produce

commensurate impact on their nutritional status. Notably, laudable efforts in form of nutritional interventions has been carried out in the region with the aim of improving agricultural productivity and tackle poor food consumption pattern but surprisingly, the incidence of malnutrition has persisted in the region. It is suggestive that the problem of malnutrition and poor dietary intake in northern Nigeria demands scientific investigation. Hence, this study ascertained determinants of nutrient adequacy and dietary intake patterns among rural farming households in Northwestern Nigeria.

Several nutritional studies often use Body Mass Index (BMI) to predict nutritional status for general estimation without attention to its limitation in assessing individual nutrient adequacy and individual disease risk. This study therefore explores the adequacy of calories and other food nutrient, which are vital in specific nutritional intervention and health risk assessment.

MATERIAL AND METHODS

Study area. Kaduna and Jigawa were purposively selected from the seven States in northwestern Nigeria, based on socio-cultural conditions of the States. Kaduna State was selected due to her socio-cultural heterogeneity, while Jigawa State was selected for its entho-cultural homogeneity (Figure 1). Kaduna State was created in 1967 when Nigeria changed from four (4) Regional system to 19 State structure. There are twenty-three (23) Local Government Areas in the State, and it covers an area of 44,408.3 square kilometres. The population according to 2006 census is 6,066,562, which then put the density at about 137 persons per square kilometre. Kaduna State is a major industrial axis in northern Nigeria and its town has a lot of commercial activities and industries (Bununu *et al.,* 2015). According to Hayab (2015), Kaduna State is populated by about 59 to 63 different ethnic groups.

Jigawa State is in the northwest geopolitical zone of Nigeria. It was created out of the then Kano State in 1991, with Dutse as its capital. The State has 4,348,649 people according to 2006 census, with a size of 23,509.6 square kilometres. Majority of the people live in rural areas and their main occupation is farming. There are twenty-seven (27) Local Government Areas in the State. The socio-cultural situation in Jigawa State could be described as homogeneous; it is mostly populated by the Hausas, Fulanis and the Mangawas, with the Badawas and Ngizimawas being a minority (Jigawa State Government, 2016).

Research approach and sampling. Quantitative and qualitative research approaches were used at different phases of the research. Tools used were household surveys and Focus Group Discussions (FGDs), involving rural households in Kaduna and Jigawa States. Kaduna and Jigawa States have four Agricultural Development Programme (ADP) zones. Two (50%) zones in each State were randomly selected which were: Maigana and Samaru zones from Kaduna State and Birni Kudu and Hadejia zones from Jigawa State. Maigana and Samaru zones have eight and seven blocks, respectively, while Birni-kudu and Hadejia have seven and eight blocks, respectively. Two (25%) of the blocks in each zone were selected using simple random sampling technique. These were Kaya and Danayamaka from Maigana zone; Kachia and Jema'a from Samaru zone; Yan Kunama and Rawuya from Birni-Kudu zone; and Siyari and Cokami from Hadejia zone. An average of eight cells in each block were randomly selected from the selected blocks. From the list of farming households of the selected cell, 20% of farming households were randomly selected, making a sample size of 302 households. In this study a household was considered as a domestic unit of family members living and sharing meals together including non-relatives such as servants (Okali, 2011). At the household level, the eldest females were interviewed.

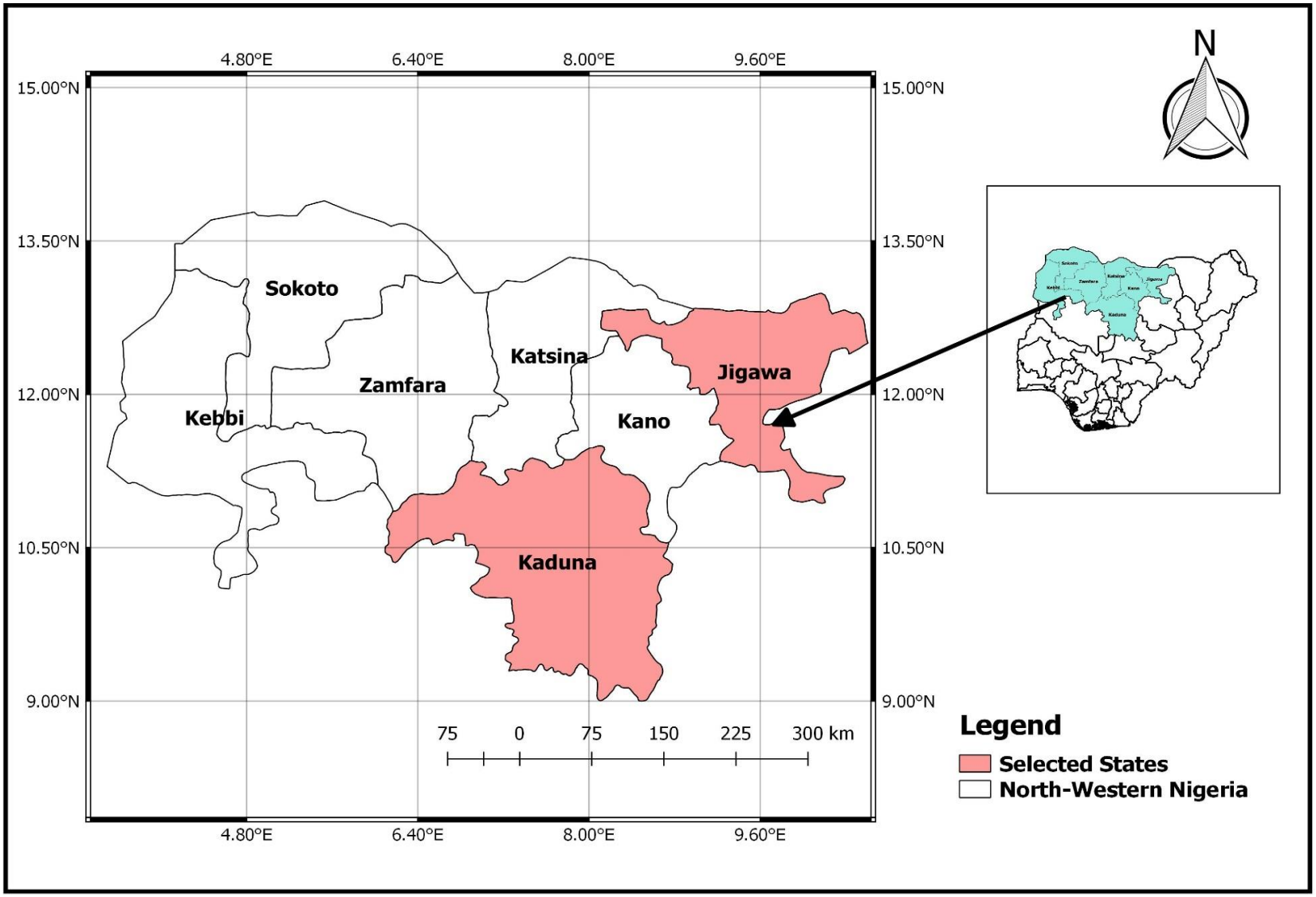

Figure 1. Map of Northwestern Nigeria, showing Kaduna and Jigawa states

Method of data collection. Primary data were collected at individual and community levels using quantitative and qualitative research approaches. Quantitative data were collected through survey by administrating interview schedule to respondents across the selected communities to elicit information on socioeconomic characteristics of households, agricultural enterprise characteristics, factors influencing dietary intake pattern and diet intake pattern of rural farming households. Qualitative data were collected through Focus Group Discussions (FGDs), during the FGD, problem tree analysis was used as a participatory tool to further x-ray factors influencing dietary intake pattern (Figure 2). The problem tree analysis creates a visual output, it breakdowns the problem into effects as well as itSs causes (Dillon, 2018).

Measurement of variables

Factors influencing dietary intake pattern. A list of factors influencing dietary intake pattern was presented to respondents. The response was rated using a three-point rating scale of "High influence (2)", "Low influence (1)" and "Not an influence (0)". The mean score of each factor was computed to rank the factors.

Calories and nutrient intake adequacy assessment. The calories and nutrients intake was determined by 24-hour dietary recall, which was conducted by trained and experienced enumerators. During the 24-hour dietary recall, respondents were asked to recall the exact food intake of the previous day. Detailed descriptions of all foods including recipes and beverages consumed were recorded. Quantities of food consumed were estimated in household measures. One adult individual was selected from the community to assist during the transformation of household measurements and portion size into grams using digital household dietary scale (Omron Electronic kitchen scale, Omron, Tokyo, Japan).

Information from the 24-hour recall data was entered and analysed using Total Dietary Assessment (TDA) software version 3.0 copyright 2001 ESHA research. This determined the actual nutrient intake of each individual based on the age and activity level. The mean intake of respondents for each nutrient was compared with the Recommended Dietary Allowances (RDA). Adequacy of each nutrient intake was determined based on the 2003 Dietary Reference Intake (DRI). The DRIs were based on the Adequate Intake (AI) values for calories and nutrients. The calories and nutrient intake was categorized as follows; adequate within 80–120% of the DRIs, inadequate less than 80% of the DRIs and excess/over-adequate above 120% of the DRIs.

Dietary intake patterns. Dietary data pattern was assessed using the 30 days food records described in (FAO, 2018). It shows the food consumption patterns of the 12 food groups (FAO, 2014) within a 30 days reference period. The response was measured on a 4 point scale of '3'-at least every other day; '2' once or twice in a week; '1' 1-3 days in the month and '0'- not at all.

Determinants of dietary intake. The multiple linear regression model for dietary and nutrient intake, given 302 respondents, is $yi = \beta_0 + \beta_{1xi1} + \beta_{2xi2} + ... \beta_{pxip} + £_i$ for $i = 1,2, ... n$. In the least-squares model, the best-fitting line for the observed data is calculated by minimizing the sum of the squares of the vertical deviations from each data point to the line (if a point lies on the fitted line exactly, then its vertical deviation is 0). The least-squares estimates b_0, b_1, ... b_p were computed using STATA statistical software.

Where $_{Yi}$ = Dietary or nutrient intake (score value), A=constant term

b_1, b_2.....b_n= regression coefficient, e = error, x_1, x_2,..... xn= regression parameters

x_1= High cost of food items, x_2= Inability to afford adequate diet due to low income, x_3= Seasonal availability of certain food items, x_4= Geographical location makes some food unavailable, x_5= The nature of the job of household members, x_6= Farm size (Ha), x_7=

Years of farming experience.

Method of data

The quantitative data collected were entered into Statistical Package for Social Science (SPSS), from which descriptive statistics were obtained were: frequencies, percentage, mean and standard deviation. Qualitative data translated verbatim and transcribed. The transcripts were coded with content analysis used in identifying major themes.

RESULTS

Socio-demographic and agricultural enterprise characteristics of households. Nigeria is highly hetero-ethnic and religious society with Christianity and Islam being the dominant religions (Nneji, 2009). Table 1 reveals that all respondents sampled were either Christians or Muslims. Overall, 63.6% of the respondents were Muslims, while 36.4% were Christians. In Jigawa, majority (97.3%) were Muslims, while in Kaduna, 69.3% and 31.7% were Christians and Muslims, respectively. Almost half (46.7%) of respondents interviewed were Hausas, while 20.9% were Fulanis. Disaggregated result revealed that in Jigawa, 60.4% were Hausas, while in Kaduna 33.3% were Hausas with eleven other ethnic groups sharing the remaining percent. In terms of participation in social groups, majority (70.9%) of the respondents did not belong to any social associations. However, disaggregated result by State revealed that in Kaduna, over half (56.9%) belonged to social associations while in Jigawa 99.3% were non-members of social associations. The almost non-existent of social association membership in Jigawa could be as a result of the prevalent women seclusion, while the relatively high participation in social associations in Kaduna could be as a result of the diverse ethnicity and religions within the State. The common social associations found were cultural, religious and occupational. Over half (51.7%) of the respondents engaged in farming, 35.5% were full-time housewives and 11.9% were involved in trading. Disaggregated result for each State revealed that in Jigawa, 65.1% of respondents were full-time housewives compared to 6.5% in Kaduna, 79.1% were engaged in farming in Kaduna compared to 23.5% in Jigawa while respondents primarily involved in trading constituted 12.4% and 11.4% in Kaduna and Jigawa, respectively. This was confirmed by the FGD findings when some discussants asserted that,

"My husband is still alive, I do not have to do any work, whatever he earns, we use for the family. After all, he promised to take good care of me that is why my parents agreed that I marry him" (Kabomo, Kaduna FGD).

"If I go to work for money, who will take care of the children? There are so many house chores which take a whole day. It is my duty to prepare food for my husband before he leaves for the farm and before he returns" (Sayai, Jigawa FGD).

Agriculture is needed to produce and ensure adequate and diversified food. Therefore, household agricultural production is closely associated with household dietary and nutrient intake adequacy. However, increased food production does not necessarily guarantee dietary and nutrient intake adequacy. Crop and livestock farming are important livelihood activities for the people in northwestern Nigeria. The result on the agricultural enterprise of households in Table 1 reveal that crop production (95.7%) and livestock production (82.5%) were predominant.In Kaduna State, 94.0% and 68.0% were engaged in arable crop and livestock production, respectively; while in Jigawa State, 94.6% and 97.3% were engaged in arable crop and livestock production, respectively. In the study area, goats (56.6%) and sheep (38.1%) were the most reared livestock. Disaggregated results reveal that goat (84.6%), sheep (69.1%) and cow (29.5%) were predominant in Jigawa, while in Kaduna, goat (35.3%) and pig (15.7%) were most predominat. In terms of crops cultivated, maize (87.1%), sorghum (70.5%) and millets (42.4%) were the most cultivated in both States. The mean farm size was 6.51±5.07

ha, over half (61.3%) cultivated less than or equal to five hectares. Disaggregated results revealed that respondents in Kaduna (7.83±5.60 ha) had larger farms than respondents in Jigawa (5.11±4.00 ha). Majority in Jigawa (77.2%) had less than or equal to five hectares as compared to 45.8% in Kaduna.

Results in Table 1 revealed that overall the mean years of farming experience was 15.13±12.42 years. Over half (51.7%) of respondents had between 1-10 years of farming experience. Results for specific States reveal that households in Kaduna (21.21±13.95) had higher years of farming experience than Jigawa (10.26±7.27). Also, a larger per cent (57.9%) used family labour as the main source of farm labour, while 31.2% and 10.9% used hired and animal labour, respectively. In Kaduna, hired labour (56.2%) was mostly used compared to the use of family labour (73.8%) in Jigawa. The use of animal labour observed implied that animals were reared for farm labour and not consumption.

Table 1. Distribution of respondents by demographics and agricultural enterprise characteristics

Variables	Categories	Kaduna (153)%	Jigawa (149)%	Total (302)%
Religion	Christianity	69.3	2.7	36.4
	Islam	30.7	97.3	63.6
Ethnicity of household	Hausa	33.3	60.4	46.7
	Fulani	2.6	39.6	20.9
	Gwari	0.7	0	0.3
	Kadara	22.9	0	11.6
	Jeba	1.3	0	0.7
	Moguwn	6.5	0	3.3
	Fiar	0.7	0	0.3
	Siayawa	2.6	0	1.3
	Idoma	0.7	0	0.3
	Chawai	26.8	0	13.6
	Kataf	1.3	0	0.7
	Piti	0.7	0	0.3
Membership of social association	Yes	56.9	.7	29.1
	No	43.1	99.3	70.9
Primary occupation of respondent	Full time house wife	6.5	65.1	35.4
	Farming	79.1	23.5	51.7
	Teaching	0.7	0	0.3
	Artisan	0.7	0	0.3
	Trading	12.4	11.4	11.9
	Food processing	0.7	0	0.3
Types of enterprise*	Crop	94.0	94.6	95.7
	Livestock	68.0	97.3	82.5
Types of animals reared*	Goat	35.3	84.6	56.6
	Sheep	7.8	69.1	38.1
	Cow	2.0	29.5	15.6
	Poultry	14.4	1.3	7.9
	Pig	15.7	0	7.9
Major crops cultivated*	Maize	86.9	87.2	87.1
	Sorghum	66.0	75.2	70.5
	Millet	26.1	59.1	42.4
	Soybeans	50.3	25.5	38.1

	Rice	12.4	53.7	33.8
	Tomatoes	16.3	40.9	28.5
	Groundnut	34.6	22.1	28.5
	Leafy vegetables	21.6	32.2	26.8
	Pepper	17	36.4	26.5
	Sweet potatoes	28.1	17.4	22.8
	Beans	15.7	15.4	15.6
Farm size (hectares)	Less than equal to 5	45.8	77.2	61.3
	6-10	29.4	10.1	19.9
	11-15	13.1	3.4	8.3
	Above 15	9.1	3.4	6.2
	Mean	7.83±5.60	5.11±4.00	6.51±5.07
Farming experience (years)	Less than 10	35.3	68.5	51.7
	11-20	28.8	26.2	27.5
	21-30	20.3	4.7	12.6
	31-40	8.5	0	4.3
	41-50	4.6	0	2.3
	Above 50	2.6	0.7	1.7
	Mean	21.21±13.95	10.26±7.27	15.13±12.42
Main sources of farm labour	Family labour	42.5	73.8	57.9
	Hired labour	56.2	5.4	31.2
	Animal labour	1.3	20.8	10.9

*Multiple responses

Source: Field survey, 2016

Nutrient adequacy of analysed 24 hour dietary recall. Results of nutrient intake from the 24-hour dietary recall analysed using Total Dietary Assessment as compared with the Recommended Dietary Allowances (RDA) is presented in Table 2. It reveals that respondents' mean intake of calories (2480.67KCal) and carbohydrate (246.41g) exceeded the recommended calories (1800-2000 Kcal) and carbohydrate (130g) intake. However, the mean intake of protein (33.50g), dietary fibre (8.56g), potassium (274.63mg) and iron (17.13mg) were below the recommended intake. Disaggregated result across the States revealed that in Kaduna, the mean intake of calories, carbohydrate and vitamin A exceeded the required intake, while the mean intake of protein, dietary fibre, potassium, zinc and iron was below the required intake. Also, in Jigawa the mean intake of calories, carbohydrate and calcium exceeded the required intake, while the mean intake of protein, dietary fibre, potassium, zinc and iron were below the required intake.

Similarly, Table 3 reveals that majority of the respondents had excess calories intake (100%), carbohydrate (89.6%) and vitamin A (78.8%). Majority also had inadequate intake of protein (87.9%), dietary fibre (73.2%), total fat (87.2%), vitamin C (92.9%), zinc (100%) and iron (90.6%). Disaggregated result across the States revealed that majority in Kaduna had excess intake of calories (100%), carbohydrate (81.0%) and Vitamin A (92.8%). Also, majority had inadequate intake of protein (96.7%), total fat (96.7%), vitamin C (85.2%), calcium (71.5%), zinc (100%) and iron (100%). In Jigawa, respondents had excess intake of calories (100%), and carbohydrate (97.3%) as well as inadequate intake of protein (78.5%), dietary fibre (88.6%), total fat (77.1%), vitamin C (98.7%) and zinc (100%).

Table 2. Nutrient intake of respondents

Nutrients	(*Required Nutrient Intake/Adequate Intake) per day	Mean nutrient intake		
		Kaduna	Jigawa	Total
Calories (KCal)	2200-2403	1144.29	1815.2503	1475.33
Protein (g)	46	34.18	58.6283	46.24
Carbohydrate (g)	130	213.26	275.4905	243.96
Dietary fibre (g)	30	5.24	7.3116	6.26
Fat (g)	20-35	17.88	49.1500	33.31
Vitamin A (mcg)	700	762.77	501.6116	633.92
Vitamin C (mg)	65-75	9.06	4.2060	6.66
Calcium (mg)	1000-1200	94.94	118.3544	106.49
Phosphorus (mg)	800	275.39	262.6793	195.49
Potassium (mg)	4700	275.39	266.4877	271.00
Zinc (mg)	8	6.01	12.7998	9.36
Iron (mg)	18-20	9.60	35.8533	22.55

*RNI/AI was for women between 20 and 70 years and for moderately active lifestyle

Table 3. Nutrient adequacy of analysed 24 hour dietary recall

Nutrient	Adequacy (%)	Kaduna (N=153)%	Jigawa (N=149)%	Total (N=302)%
Calories	Inadequate	81.0	53.1	67.5
	Adequate	17.0	26.8	21.5
	Excess	2.0	20.1	11.0
Protein	Inadequate	65.4	24.2	45.0
	Adequate	21.6	32.2	26.8
	Excess	13.1	43.6	28.1
Carbohydrate	Inadequate	11.8	3.4	7.6
	Adequate	17.6	4.0	10.9
	Excess	70.6	92.6	81.5
Dietary fibre	Inadequate	95.4	94.6	95.0
	Adequate	1.3	3.4	2.3
	Excess	3.3	2.0	2.6
Total fat	Inadequate	64.7	32.9	49.0
	Adequate	17.6	14.8	16.2
	Excess	17.6	52.3	34.8
Vitamin A	Inadequate	56.9	62.4	59.6
	Adequate	11.1	13.4	12.3
	Excess	32.0	24.2	28.1
Vitamin C	Inadequate	93.5	99.3	96.4
	Adequate	0.7	0	0.3
	Excess	5.9	0.7	3.3
Calcium	Inadequate	98.0	100	99.0
	Adequate	2.0	0.0	1.7
	Excess	0.0	0.0	0.0
Phosphorus	Inadequate	142	81.9	87.4
	Adequate	5.0	7.4	5.3
	Excess	6.0	10.7	7.3
Zinc	Inadequate	58.2	27.5	43.1
	Adequate	20.3	25.5	22.8
	Excess	21.6	47.0	34.1
Iron	Inadequate	86.3	55.7	71.2
	Adequate	10.5	10.1	10.3
	Excess	3.3	34.2	18.5

Data analysis, 2017; Inadequate = < 80% RNI, Adequate=80-120 % RNI, Excess= >120% RNI
*RNI/AI was influenced by age and physical activity level

Constraints to dietary intake. Factors influencing dietary intake pattern is presented in Table 4. It reveals that overall, respondents were mostly influenced by high cost of food item which had a mean of 1.81 and was a high factor to 82.5% of the respondents. This was followed by inability to afford adequate diet due to low income which was a high factor to 57.3% of respondents with a mean of 1.52. Ranked third was seasonal availability of certain food items affecting household dietary intake with a severity mean of 1.01, which was a low and high factor to 38.4% and 57.3% of respondents, respectively. Disaggregated result for each State revealed that high cost of food items was the key influencing factor in Kaduna and Jigawa with mean values of 1.83 and 1.81, respectively. Other less influencing factors were personal dislike for certain foods with a mean of 0.60, illness (ulcer, diabetes, hypertension) that prevents the consumption of certain foods and unavailability of essential food items in the market; they had mean values of 0.66 and 0.64, respectively. Furthermore, from the Focus Group Discussion using problem tree as a participatory tool (Figure 2) it was noted that cultural influence, inadequate knowledge on nutrition and unfavourable attitude towards nutrition also constrained and caused inadequate dietary intake. The effects of inadequate dietary intake included proneness to illness, reduction in productivity and malnutrition.

During the FGD discussants lamented about the high cost of food items and low income earned from sales of agricultural produce. Low income is one of the root causes of poor nutrition.

'Food items are so expensive and increasing on a daily basis that money taken to the market can barely buy half of what it used to buy previously' (Cakami, Jigawa FGD)

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'In the rural area, food items are very cheap, especially during the harvest season. 'We make very little profit from the sales of our farm produce, the marketers and transporters are the ones who make bulk of the money' (Dustsenwai, Kaduna, FGD).

Table 4. Distribution of respondents by constraints to consumption of adequate diet

	Kaduna (153)					Jigawa (149)					Total (302)				
	NF (%)	LF (%)	HF (%)	$\bar{x}$	Rank	NF (%)	LF (%)	HF (%)	$\bar{x}$	Rank	NF (%)	LF (%)	HF (%)	$\bar{x}$	Rank
High cost of food items	0.6	15.7	83.7	1.83	1	0.7	18.1	81.2	1.81	1	0.6	16.9	82.5	1.81	1
Inability to afford adequate diet due to low income	6.6	39.2	54.2	1.47	2	2.0	37.6	60.4	1.58	2	4.3	38.4	57.3	1.52	2
Seasonal availability of certain food items affects household food intake	8.5	51.6	39.9	1.31	3	45.6	39.6	14.8	0.69	7	26.8	45.7	27.5	1.01	3
Geographical location makes certain food items unavailable	22.9	50.3	26.8	1.03	4	40.9	44.3	14.8	0.74	4	31.7	47.4	20.9	0.89	4
The nature of the job of household members affects the food intake	23.5	65.4	11.1	0.87	5	34.2	49.7	16.1	0.81	3	28.8	57.6	13.6	0.85	5
None consumption of certain food due to religious inclination and cultural taboo	35.9	48.4	15.7	0.79	8	35.6	55.7	8.7	0.73	5	35.7	52.0	12.3	0.76	6
Inadequate knowledge on food items to consume	32.7	54.2	13.1	0.80	7	49.7	40.9	9.4	0.59	8	41.0	47.7	11.3	0.70	7
Illness (ulcer, diabetes, hypertension) that prevents the consumption of certain foods	41.2	42.5	16.3	0.75	9	51.0	40.9	8.1	0.57	9	46.0	41.7	12.3	0.66	8
Unavailability of essential food items in the market	54.9	33.3	11.8	0.56	10	27.5	72.5	0	0.72	6	41.4	52.6	6.0	0.64	9
Personal dislike for certain foods	33.3	47.7	19.0	0.85	6	65.8	34.2	0	0.34	10	49.3	41.1	9.6	0.60	10

NF: Not a factors, LF: Low factor, HF: High factor

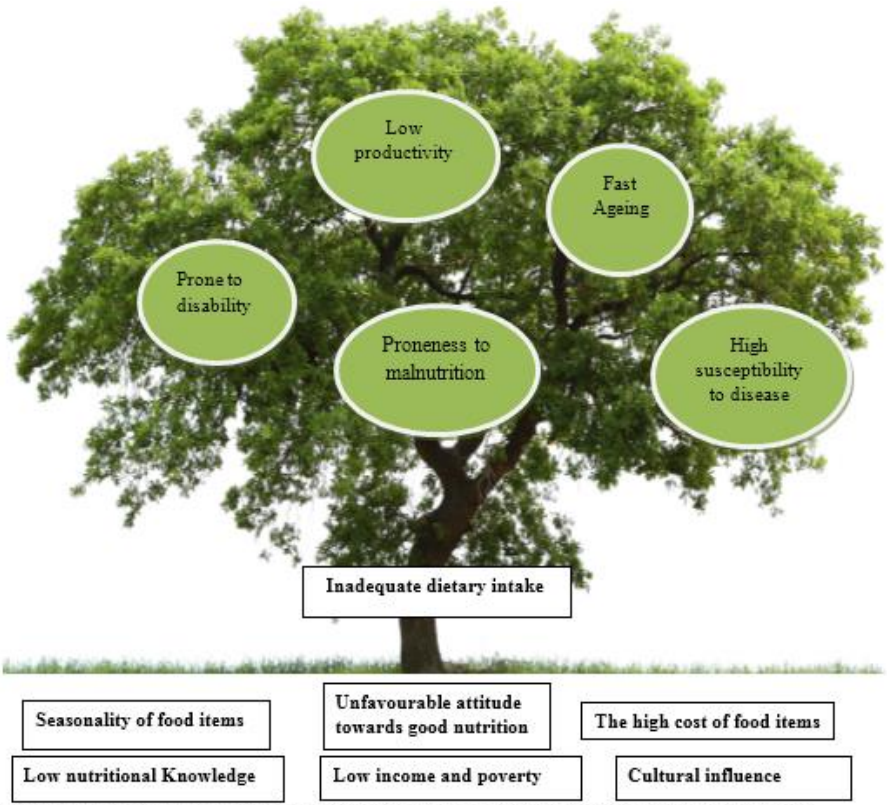

Figure 2. Problen tree analysis of the cause and consquences of inadequate dietary intake among rural farming households in Northern Nigeria

Respondents' dietary intake pattern. Results in Table 5 show the dietary intake pattern by households within 30 days reference period. The results reveal that cereals such as rice, millets, maize and wheat were consumed by majority (96.4%) of respondents at least every other day. Legumes/pulses were consumed at least every other day by 64.2% of the respondents, this was closely followed by food made from oil consumed every other day by 53.0%, while vegetable and fruits were consumed by majority once or twice weekly. Disaggregated results for each State reveal that there was very frequent consumption of cereals in both States, while root and tubers was frequently consumed at least every other day by (63.4%) in Kaduna, while green leafy vegetables were consumed by 88.6% of respondent in Jigawa at least every other day.

Determinants of dietary intake of rural farming households. Table 6 reveals that, overall, the R^2 value was 0.57. This indicates that the regression model explained 57% of the dietary intake of respondents. In Kaduna and Jigawa, the R^2 values were 0.62 and 0.86, respectively. This implies that the independent variables explained 62% and 86% of the dietary intake of respondents in the respective States. It further revealed that overall, high cost of food items (β=0.03), inability to afford adequate diet due to low income (β=0.83), seasonal availability of certain food items (β=-0.09) and geographical location make some food unavailable (β=0.15) items. In Kaduna, high cost of food items (β=-0.10) and inability to afford adequate diet due to low income (β=0.84) while in Jigawa, farm size (β=0.08) and years of farming experience (β=0.28) contributed significantly to food unavailability.

Table 5. Distribution of respondents by dietary intake pattern

Food group	Kaduna (153)				Jigawa (149)				Total (302)			
	EOD (%)	4-6 times a week (%)	1-3 times a week	NA (%)	EOD (%)	4-6 times a week (%)	1-3 times a week	NA (%)	EOD (%)	4-6 times a week (%)	1-3 times a week	NA (%)
Rice, millets, maize, wheat, bread and other cereals	92.8	7.2	-	-	100	-	-	-	96.4	3.6	-	-
Legumes/pulses (beans, g/nut, soybean)	9.8	80.4	7.2	2.6	27.5	60.4	6.7	5.4	64.2	32.1	3.0	0.7
Vegetables/ fruits (carrots, pawpaw, citrus, mango)	6.5	67.3	21.6	4.6	1.3	47.0	51.7	-	18.5	70.5	7.0	4.0
Roots and tubers (yam, cassava, potatoes and their products)	63.4	30.7	4.6	1.3	65.1	33.6	1.3	-	4.0	57.3	36.4	2.3
Green leafy vegetables (pumpkin, spinach, lettuce)	12.4	68.0	16.3	3.3	88.6	6.7	4.7	-	50.0	37.7	10.6	1.7
Meat (beef, chicken, kidney)	3.9	51.6	41.8	2.6	1.3	26.2	67.8	4.7	2.6	39.1	54.6	3.6
Egg	3.9	24.2	60.8	11.1	12.1	48.3	39.6	-	2.0	18.2	54.6	25.2
Seafood (fish and fish products)	5.9	62.7	25.5	5.9	2.7	37.6	57.7	2.0	4.3	50.3	41.4	4.0
Milk and milk products (milk, cheese, yoghurt)	3.9	20.9	65.4	9.8	41.6	36.2	20.8	1.3	22.5	28.5	43.4	5.6
Food made from oil (palm oil, vegetable oil)	22.9	69.3	6.5	1.3	83.9	10.7	3.4	2.0	53.0	40.4	5.0	1.7
Sugar or honey	27.5	52.3	9.2	11.1	65.1	31.5	3.4	-	46.0	42.1	6.3	5.6
Spices, alcoholic and non-alcoholic beverages	29.4	31.4	11.8	27.5	3.4	4.7	29.5	62.4	16.6	18.2	20.5	44.7

EOD: At least every other day, NA: Not at all

Table 6. Determinants of predictors to dietary intake of rural farming households

Predictors	Kaduna			Jigawa			Total		
	Beta	Std. Error	P>|t|	Beta	Std. Error	P>|t|	Beta	Std. Error	P>|t|
High cost of food items	-0.10*	0.46	0.03	-0.25	0.23	0.33	-0.03*	0.03	0.05
Inability to afford adequate diet due to low income	-0.84*	0.09	0.00	-0.31	0.32	0.38	-0.83*	0.09	0.00
Seasonal availability of certain food items	-0.01	0.03	0.69	-0.40	0.23	0.13	-0.09*	0.04	0.04
Geographical location makes some food unavailable	-0.01	0.02	0.50	-0.13	0.08	0.17	-0.15*	0.02	0.39
The nature of the job of household members	0.51	0.37	0.17	0.97	1.08	0.40	0.42	0.34	0.23
Farm size (Ha)	0.04	0.02	0.11	0.08*	0.05	0.02	0.03	0.02	0.22
Years of farming experience	0.01	0.01	0.45	0.28*	0.03	0.04	0.02	0.01	0.11
Prob. > F		0.00	0.12	0.00					
R^2		0.62			0.86			0.57	
Adjusted R		0.56			0.53			0.51	
Mean Standard Error		0.93			0.89			0.96	

*Significant at $p<0.05$

DISCUSSION

The results of this study suggest that dietary intake pattern and socio-economic factor significantly affect effectiveness of local foods in providing adequate nutrition among rural farming households. Based on the estimated nutrient densities of nutrient intakes, the existing dietary practices in the study States may not achieve the recommended intakes of protein, potassium, phosphorus and calcium for women of farming households despite the presence of nutrient-dense foods. This is because majority of households do not take into account the full costs and benefits of a balanced diet. Most of the households rely much on carbohydrate rich foods (cereal products) as the main component in their diets (Table 6). This is probably due to the kind of crops cultivated (Table 1) and traditional reasons. For instance maize, sorghum and millet are often used to make koko, kunu (pap) and different forms of tuwo, which is a highly valued traditional dish in northern Nigeria. The present results are similar to the findings of Afolabi *et al*. (2015) who reported high carbohydrate intake among similar populations, but different ethnic group. Yekeen *et al*. (2013) noted that dishes across Nigeria are dominated by cassava products, cereals and tubers. Furthermore, typical African households are engrossed on abating hunger, hence nutrient adequacy is rarely considered or factored into diets. As a result several households miss opportunities to incorporate other nutrient-rich food stuffs in their diets such as pulses, vegetabless and animal source foods. All these factors affect the nutrition adequacy of households, hence most low income rural farming households are prone to malnutrition and hidden hunger. According to Kotler (2000) if the major meals consumed are bulky, the amount of stable food usually consumed per day does not meet the RNI of calories, protein and other essential nutrients for the body.

Calories and nutrient intakes provide evidence to the quality of dietary practices in the household and community level. Based on the WHO/ FAO/UNU (2004) reference, we noted that the estimated mean calories and carbohydrate intake were in excess of recommended levels. The observed high calories and carbohydrate intakes in both Kaduna and Jigawa is attributed to consumption of high amount of carbohydrates rich diets. This is in agreement with the result of Afolabi (2015) who documented adequate intake of carbohydrate and very low intakes of micronutrients. Our findings indicate that intake of carbohydrate was in excess while protein, dietary fibre, vitamin A and C were inadequate, which implies that adequacy in carbohydrate intake does not imply adequate intakes of micronutrients. Also, the higher intake of calories and protein in Jigawa compared to Kaduna suggest higher nutrient adequacy in the former. Sanusi (2010) posited that portion and serving sizes have been found to be strong predictors of adequate nutrient intakes. However, the quality of protein may be inadequate because large proportion of the protein in the diet was from maize and rice with limited consumption of animal food sources. According to Ghosh (2016), the quality of protein can positively and significantly affect the nutritional status of individuals. Animal source foods help to provide several micronutrients simultaneously, which can be important in diets lacking more than one nutrient. According to Neumann *et al*. (2002), consumption of even small amounts of animal-source foods contributes substantially to ensuring nutrient adequacy, preventing under-nutrition and nutritional deficiencies.

In addition, low consumption of fruits and micronutrient dense foods leads to hidden hunger and micronutrient deficiencies prevalence. According to Brawn (2005) widespread hunger and malnutrition are often experienced, in addition to hidden hunger due to micronutrient deficiencies, is highly prevalent in several low income communities. The inadequacy of micronutrients and vitamins such as zinc, iron, protein and vitamin C suggests that there was limited consumption of fruits, eggs, milk

and fish, which could be traced to low income to purchase food rich in these nutrients and frequent consumption of staple food. This is in line with the position of Arimon *et al*. (2009) that low-quality monotonous diets are the norm in resource-poor environment. The inadequate intake of vitamins, minerals and micronutrients could predispose households to hidden hunger, malnutrition and other severe consequences such as stunted growth and even death, especially in children. This is consistent with the reports by Penny (2003) and UNICEF–WHO–World Bank (2012) that malnutrition is a leading cause of childhood deaths in low and middle-income countries and has permanent consequences for cognitive, physical and metabolic development.

The nutrition adequacy of households is dependent on access to adequate diet by every member of the household, while the dietary intake of households is tied to prevalent economic situation, agricultural production system, cultural issues and other social factors. For examples high cost of food items either resulting from inflation or low purchasing power of households imply that preferred nutritious food are inaccessible to households. The influence of seasonality of food could be as a result of small-scale farming being practised and at the same time high dependence on the same farm produce for their diet. As such, during offseason when produce stored are depleted, the dietary intake is usually poorer in terms of quantity and quality.

The large number of women who were full-time housewives is likely due to high women's seclusion, which is in-line with cultural and predominant religious believe in the two States. Further, the women expect their husbands to take sole responsibility for the family's needs. According to Zakaria (2001), the Hausa society is patriarchal with strong paternalistic tendencies, as men who are the guardians of the family provide both economic and social security to the womenfolk. Practical Islamic taxonomies and Hausa cultural ethics require that men, and not women, should work to feed or provide sustenance for the family. Furthermore, religious and ethnic affiliation highly influence dietary intake in Nigeria, and religion is associated with food taboo and abstinence at certain times. Different religious groups declare certain food items fit and others unfit for human consumption (food taboo) as well as food restriction practices (Benno and Rochow, 2009; Maduforo, 2010; Sholeye *et al*., 2014). The ethnic affiliation could influence dietary intake as certain foods have cultural origin and are peculiar to some ethnic groups. The food preferences and values differ from one ethnic group to another, and this is reflected in their dietary beliefs, attitudes and practices.

CONCLUSION AND RECOMMENDATION

The result revealed that high cost of food items, low income from agricultural activities and seasonal availability determined dietary intake pattern. Also, calories and carbohydrate intake exceeded the recommended intake, while the intake of protein, potassium and iron were below the recommended intake. Cereals such as rice, millets, maize were often used to make the staple foods. The findings call for renewed attention to encourage cultivation of bio-fortified staple crops and design of interventions that will encourage changes in traditional dietary intake pattern in the long term.

Given the scope of this study, findings were based solely on cross-sectional data, which offers only a picture of a single moment in time. In addition, our analysis did not take seasonality into account. Thus, nutrient intakes and food consumption patterns identified refer essentially to the dry season (October to January) in which data were collected. Further studies that extend beyond a single moment in time are therefore, needed to verify the effect of seasonality on food availability and consumption pattern in the study population.

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STATEMENT OF NO CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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