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Original Research Article

Analysis of the Dietary Diversification of Sedentary and Pastoral Households in Niger

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Abstract: Food is made up of complex and multidimensional elements whose implementation requires significant measurement tools. The overall objective of this work is to assess food consumption within sedentary and pastoral households. This is a cross-sectional study. The methodology used is a food survey of 845 households. The result of this study is that the food groups most stocked by both urban and rural households are cereals (urban 95.7%, rural 79% and pastoral 94.4%) followed by spices/condiments (urban 74.3%, rural 67.5% and 74.4%). The least stocked food groups in urban areas are fruits and vegetables, while the availability of meats in stored speculation is almost non-existent in rural and pastoral areas. The average household food consumption score is 68.10±21.04; 43.29±13.27 and 44.96±13.77 respectively in urban, rural and pastoral areas. We also note a lack of diversity in the diet of rural and pastoral households. Indeed, the average household dietary diversity score is 6.84±1.91; 5.53±1.49 and 5.13±1.29 respectively in urban, rural and pastoral areas. Dietary diversity as well as the average consumption score are associated with household living conditions. In short, the assessment of consumption is an important element in characterizing the household diet.

Keyword: Dietary diversity score; Food consumption score, Households, sedentary environment, pastoral environment.

INTRODUCTION

Man consumes food to meet the body's multiple needs (Hamadou, 2010). Over the generations, human beings have modified their eating behavior and the current generation is made up of consumers wishing to eat better (Gallier, 2020). Indeed, over the last decades, the daily supply of food predominates in households and food availability per capita has increased globally (MINADER and CSSRA, 2008).

In Niger, gross production per capita during the 2021 agricultural campaign (160 kg/capita) is the lowest in more than 20 years (OCHA, 2022). This low production capacity and the insufficient income of many households limit their access to food.

(HNO, 2014) the agricultural sector, the basis of the country's economy, is highly dependent on difficult climatic conditions, including recurring periods of drought (FAO, 2009). This heavy dependence on rainfed agriculture predisposes the country to great food vulnerability (INS, 2011). The latter finds its origins in the structural poverty of certain social groups, in the cereal and fodder deficits recorded regularly for several decades. Even in a "good year" of agricultural production, between 3 and 4 million people are in such a vulnerable situation that they require humanitarian assistance (HNO, 2014). Added to this, the diet of Nigeriens in terms of consumption of macronutrients (carbohydrates, proteins and lipids) and micronutrients (vitamins and mineral salts) is unbalanced for the entire country. In Niger, the food and nutritional situation remains worrying, despite the mitigation measures put in place by the government and its technical and financial partners (HNO, 2014).

Thus, the study of food consumption in households represents an important issue to promote the

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establishment of data relating to food consumption patterns in order to better understand what the population eats. This with the aim of designing diets through the eating habits of households in different residential environments (urban, rural and pastoral).

MATERIAL AND METHODS
Study Material
Data collection tool
The study material consists of a questionnaire relating to the food consumption situation at the household level and covering information on variables such as: Dietary diversity and frequency of consumption.

Study methods
Study location
The study was carried out in four of Niger's eight regions, namely Agadez, Maradi, Zinder and Niamey. The choice of these regions is based on the absence of insecurity and the presence of the three target zones (urban, rural and pastoral) in a given region.

Type and period of study
This is a cross-sectional, mixed (quantitative, qualitative) and descriptive study covering the period from March to the end of April 2023.

Study population
The statistical unit of interest is the household. The individual surveyed is the person responsible for household food management (women responsible for cooking were interviewed and/or heads of households).

Sampling:
The 2-stage cluster probability sampling method was used for the selection of localities and households. Thus, for this study, twenty (20) households per locality (village and/or neighborhood) were surveyed. The number of clusters was calculated according to the ratio between the size of the sample and the number of households to be surveyed. A total of 42 clusters were obtained (Table I).

The sampling frame used for the choice of localities by region is made up of files from the last general census of the population of Niger (RGP/H, 2012) created by INS (INS, 2014)**.** Households were selected by systematic random sampling using a sampling step (P).

Table I: Different localities surveyed

Region	Department	Municipality	Cluster	ZD	Locality
AGADEZ	Dannet	Fachat	109	27	Fachat
AGADEZ	Gougaran	Awidarari	068	2	Awidarari
AGADEZ	Tchirozerine	Abaro	005	7	Abaro
AGADEZ	Fachi	Fachi	006	13	Fachi
AGADEZ	Gougaran	Irza	018	43	Irza
AGADEZ	Aderbissinat	Tarissai	204	83	Tarissai
AGADEZ	Aderbissinat	Abalama	055	54	Abalama
AGADEZ	Aderbissinat	Issatafen	213	57	Issatafen
AGADEZ	Ingall	Mizilli	105	80	Mizilli
AGADEZ	Ingall	Izouzal	087	36	Izouzal
MARADI	Mayahi	Mayah i	070	73	The room
MARADI	Tessaoua	Maijirgui	053	51	N'walla is awake
MARADI	Mayahi	Kanan-bakache	057	108	Kanambakache
MARADI	Aguie	Tchadoua	022	74	Dan yacouba
MARADI	Mayahi	Issawane	032	22	Mazaouda
MARADI	Guidan-roumdji	Chadakori	030	46	There is no harm in the room
MARADI	Bermo	Gadabedji	028	4	Go baba ahmed
MARADI	Berm	Berm	109	27	Pourel
MARADI	Berm	Gadabedji	068	2	Tiguitout
MARADI	Berm	Berm	005	7	Amat doutchi
MARADI	Berm	Berm	006	13	Aminata i
ZINDER	Kantche	Matamey	018	43	Gado haoussa
ZINDER	Dungass	Malawa	204	83	Tchiromari
ZINDER	Mirriah	Dogo	055	54	Gada garin gjadi
ZINDER	Goure	Boune	213	57	Tchantchari yamma
ZINDER	Tanout	Tenhya	105	80	Agagara
ZINDER	Tanout	Tenhya	087	36	Chiguefane
ZINDER	Tesker	Founitane	042	102	Fountain
ZINDER	Tester	Baboulwa	028	99	Baboulwa

Region	Department	Municipality	Cluster	ZD	Locality
ZINDER	Tanout	Tenhya	367	222	Taboak
ZINDER	Tanout	Tenhya	114	19	Dole tzam
NIAMEY	City of Niamey	District 1	016	44	Bobiel
NIAMEY	City of Niamey	District 5	033	19	Lamorde
NIAMEY	City of Niamey	District 4	016	125	Airport
NIAMEY	City of Niamey	District 3	023	216	Banifandou
NIAMEY	City of Niamey	District 2	006	43	Boukoki iii
NIAMEY	City of Niamey	District 2	007	221	Quote from deputy
NIAMEY	City of Niamey	Arrondissement 4	046	153	Cite faycal
NIAMEY	Ville de Niamey	Arrondissement 5	045	49	Kirkissoye
NIAMEY	Ville de Niamey	Arrondissement 1	021	188	Nouveau marche
NIAMEY	Ville de Niamey	Arrondissement 1	013	268	Koubia nord
NIAMEY	Ville de Niamey	Arrondissement 2	022	213	Nord lazaret

The sample size was determined according to the SMART formula (Daniel SCHWARTZ formula) recommended by the National Institute of Statistics (INS); with a confidence level of 95%, an estimated prevalence of risk factors of 50%, a margin of error of 5% and a cluster effect of 2.

$$ n = Z^2 \frac{P(1-P)}{d^2} \; Eff $$

The resulting size of 768.32 households plus the 10% to increase gives a total of: 845,152≈845 households to survey.

Data processing
Assessment of household food consumption indicators

For the assessment of food consumption according to the area of residence, the household food consumption score (FCS) was determined. A descriptive analysis allowed its distribution.

The FCS is a basic indicator of food consumption (both quantity and quality) used by WFP (2009). Thus, a period of the last seven (7) days preceding the survey was taken as a reference. Taking into account the type of food and the frequency of consumption which are then weighted according to the nutritional value relating to each food group consumed. The FCS is calculated according to the following formula:

$$ (FCS = \sum_{i=1}^{9} x_i.p_i) $$

With:
- ✓ $x_i \in$ {Frequency of consumption of each food group i}
$f_t \in$ {Weight of food groups}.

The thresholds adjusted for countries with consumption on a daily basis (7) of oil and sugar following FCS were used for the classification of households according to their profile (PAM, 2009): acceptable (>35), limit (21-35), and low (<21)

Assessment of household dietary diversity indicators

For the assessment of dietary diversity according to the environment of residence, the household dietary diversity score (HDDS) was determined. A descriptive analysis allowed its distribution.

Dietary diversity refers to foods and food groups consumed in a given reference period (Sanou *et al.*, 2018; Ruel, 2002).

For this study, a period of 24 hours preceding the survey was used as a reference. Thus the HDDS was determined following the FAO methodology and the FANTA project (in 2010) (EU and FAO, 2013). The values of the dietary diversity variable are calculated by adding all the food groups consumed by at least one member of the household in the 24 hours preceding the survey. The HDDS is calculated according to the following formula:

$$ (HDDS = \sum_{i=1}^{12} x_i) $$

With: $x_i \in$ {0: Food i not consumed, 1: Food i consumed}

The values of the scores thus calculated for each household were reported on a scale ranging from 0 to 12 points. After determining the HDDS, households were grouped according to the level of HDDS in accordance with the FAO and FANTA classification (Kennedy *et al.*, 2010).

Thus, three groups of households were recorded:
- The group that consumes at most three (3) food groups (low HDDS);
- The group consuming between 4 and 5 food groups (average HDDS);
- The group that consumes at least six (6) food groups (high HDDS).

Data analysis

Data entry and analysis were done using SPSS.23 software. The results were presented in the form of tables and figures using Microsoft office 2019. The Chi-square test was used to analyze the link between the different food groups consumed and the food

consumption thresholds because all cross-tabulations contained at least minus a theoretical number less than 5. For a p>0.05 the difference is statistically insignificant while for a p<0.05 the difference is statistically significant.

RESULTS
Availability of food stock at household level
Availability of food groups at household level.

Table II presents stocks of household food products,

Table II: Distribution of households according to food stock management

Food groups	Place of residence					
	Urban		Rural		Pastoral	
	Workforce	%	Workforce	%	Workforce	%
Cereals	201	95.7	241	79	302	94.4
Root/Tuber	37	17.6	27	8.9	11	3.4
Legumes	67	31.9	149	48.9	158	49.4
Vegetables and fruits	12	5.7	106	34.8	181	56.6
OPV	28	13.3	0	0	1	0.3
Oils	84	40	82	26.9	64	20
Milk/Dairy products	63	30	15	4.9	98	30.6
Sugars/Sweet products	97	46.2	71	23.3	182	56.9
Spices/condiments	156	74.3	206	67.5	238	74.4

Of these stocks of household food groups, cereals are the most stored in the different areas of residence (urban 95.7%, rural 79% and pastoral 94.4%) in Niger, to those produced are added Spices /condiment (urban 74.3%, rural 67.5% and 74.4%). The food groups least cited by households as stored products are vegetables and fruits for urban areas (5.7%) and meat/fish/eggs for rural (0%) and pastoral areas (0.3%).

Availability of food products at household level

Figure 1 shows the different types of foods and food groups stored by households. Thus, of all stored cereals, in urban areas rice with 70.5% is more represented then comes pasta with 48.1%, in rural and pastoral areas millet is the most cited product with respectively 76 .7% and 93.1% followed by rice with

44.6% and 78.4% respectively. The least stored cereal products are sorghum in urban areas and maize in rural and pastoral areas. The most stored legume is cowpea with 30% in urban areas, 49.4% in rural and pastoral areas, for vegetables/fruits in rural and pastoral areas green leaves are the most widespread with 36.4% and 56% respectively. .9%. Thus, industrialized milk appears much more in urban areas with 28.1% and fresh milk in pastoral areas 19.7%. White sugar is stored by everyone but it is more widespread in pastoral areas 56.6%, from the condiments/drinks group salt is the one stored, followed by spices in urban areas with 55.2% and tea with 35.1%. and 47.8% respectively in rural and pastoral areas. Root/tuber and meat products are the least stored in Niger.
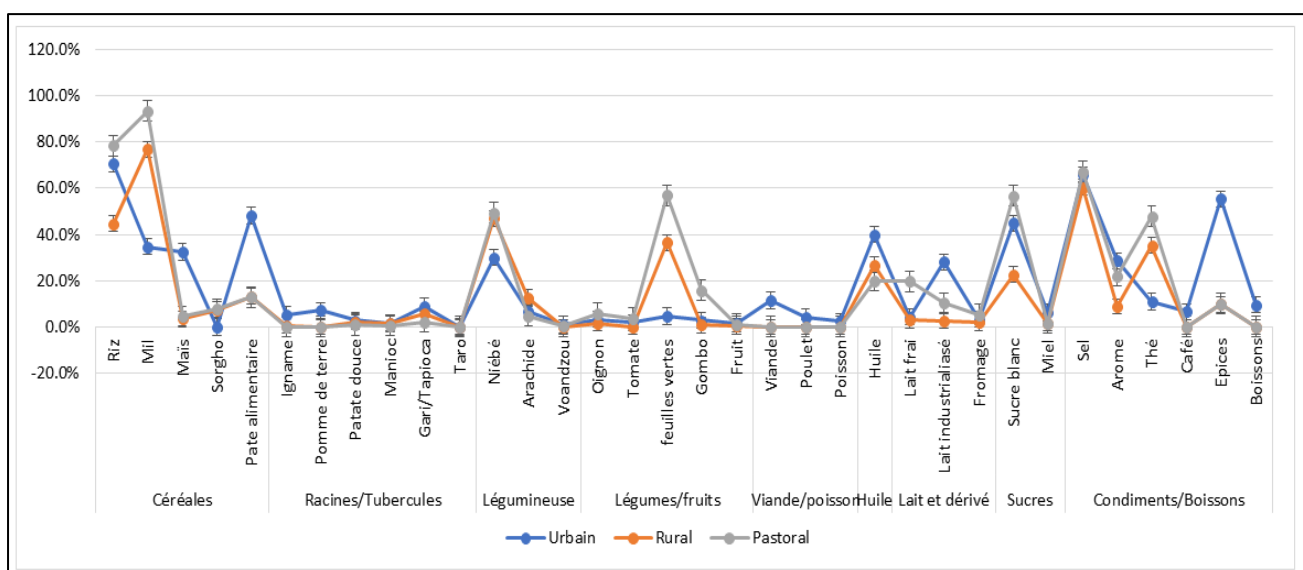

Figure 1: Type of food stored by households

Household food consumption
Household food consumption score according to area of residence

Analysis of the information in Figure 39 indicates that household food consumption has a very highly significant link with the areas of residence. Indeed, the food consumption score is much more acceptable in urban areas and concerns 85.7% of this population. While the acceptable score only concerns 51.8% and 58.1% respectively of the population in rural and pastoral areas. Also, the results revealed a poor and limited score with 13.4%; 13.1% and 1.4% of households respectively in pastoral, rural and urban areas.
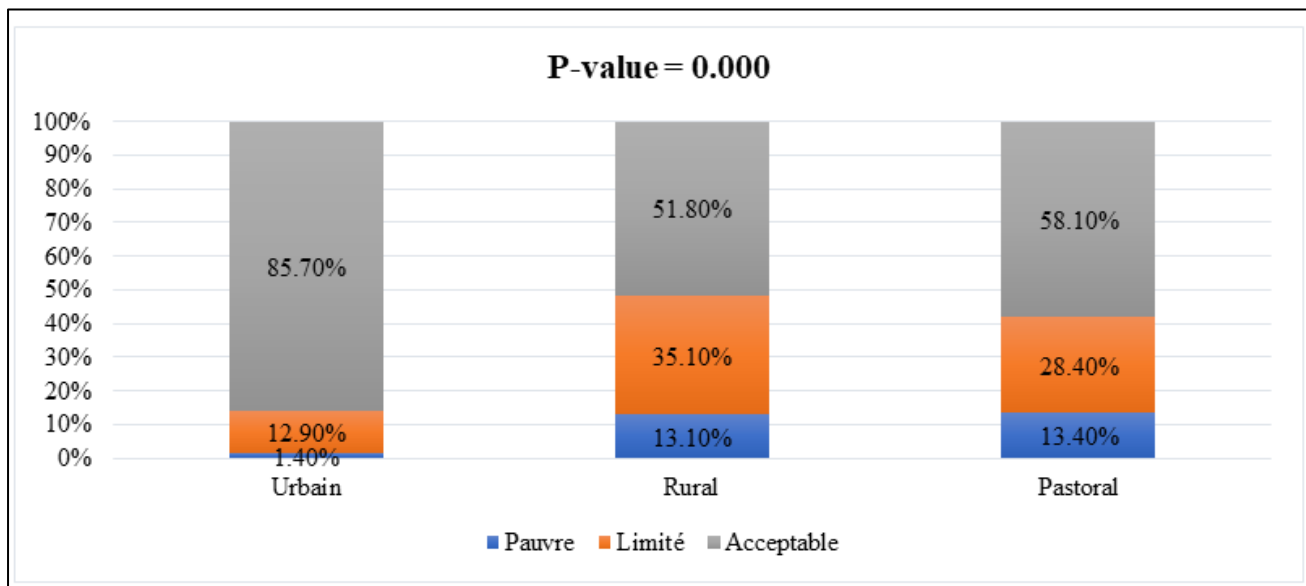

Figure 2: Distribution of households according to Food Consumption Score

Historical profile of consumption of food groups according to area of residence

Dietary pattern can influence FCS from one area to another. Table III covers household food consumption over a seven (7) day period.

Table III: Frequency of consumption of food groups over a period of 7 days

	Urban (Mean and standard deviation)	Rural (Mean and standard deviation)	Pastoral (Mean and standard deviation)
Cereals	6.82 [2 - 7] ±0.761	6.29 [1 - 7] ±1.396	6.80 [3 - 7] ±0.667
Legumes and oilseeds	1.40 [0 - 7] ±1.313	2.99 [0 - 7] ±1.876	2.28 [0 - 7] ±2.259
Vegetables	6.39 [0 - 7] ±1.460	5.57[0 - 7] ±1.657	6.76 [0 - 7] ±1.534
Fruits	2.59 [0 - 7] ±3.736	0.34 [0 - 4] ±0.875	0.08 [0 - 3] ±0.383
OPV	5.22 [0 - 7] ±2.161	0.37 [0 - 4] ±0.705	0.34 [0 - 4] ±0.742
Sugar	4.28 [0 - 7] ±3.109	4.08 [0 - 7] ±2.650	4.83 [0 - 7] ±2.570
Milk and Dairy Products	3.43 [0 - 7] ±3.031	2.43 [0 - 7] ±2.189	3.20 [0 - 7] ±2.534
Oil and Grease	6.91 [2 - 7] ±0.541	5.89 [0 - 7] ±2.505	3.95 [0 - 7] ±2.428

VPO: Meat Fish Egg

According to the analysis of Table III above, the average frequency of consumption of food groups during the last seven (7) days shows that depending on the area of residence, cereals, vegetables, oils and sugars are the most consumed. In urban areas, OPV is consumed on average 5.22 times in the last 7 days. The least consumed food groups among the food frequencies are legumes with 1.4 times on average/week in urban areas and fruits and OPV with (0.34 and 0.08 on average/week) and (0.37 and 0.34 on average/week) in rural and pastoral areas respectively.

Household food consumption profile

Food consumption varies considerably depending on the household's environment. Table IV presents the relationship between major food groups and food consumption scores. Consumption frequencies are observed among households.

Table IV: Household food consumption profile according to area of residence

Food group	Urban FCS			P-value	FCS Rural			P-value	FCS Pastoral			P-value
	P	L	A		P	L	A		P	L	A	
Cereals and tubers	7	7	7	0.921	6	6	7	0.001	7	7	7	0.195
Legumes/Oilseeds	0	1	1	0.101	1	3	4	0.000	1	2	3	0.000
Vegetables	1	6	7	0.000	5	5	6	0.000	4	6	6	0.000
Fruits	1	1	3	0.007	0	0	0	0.685	0	0	0	0.739
OPV	1	3	6	0.000	0	0	1	0.000	0	0	1	0.000
Milks/dairy products	0	0	4	0.000	0	1	4	0.000	0	1	5	0.000
Oils and fats	4	7	7	0.000	2	4	6	0.000	3	3	5	0.000
Sugars/sweet products	2	3	4	0.000	3	3	5	0.000	3	4	6	0.000

FCS: Food Consumption Score; P: Poor; L: Limit; A: Acceptable; VPO: Meat Fish Egg

In urban areas, the average frequency of cereal consumption is 7 days a week by different categories of households, the difference is much more observed in the level of consumption of vegetables and milk/dairy products. Households with acceptable and limited food consumption have a frequency of vegetable consumption of 7 days a week and 6 days a week respectively, on the other hand, households with poor food consumption consume vegetables on average 1 day a week. Milk/dairy products are consumed on average 4 days during the last seven days in households with acceptable food consumption and this consumption of milk/dairy products is almost non-existent in households with poor and limited food consumption. Almost all food groups contribute positively to the determination of the food consumption score, apart from cereals which are consumed every day, and legumes which households practically do not consume. In rural areas, cereals are consumed 7 days a week in households with acceptable food consumption, but this cereal consumption is 6 days a week on average in households with poor and limited food consumption. As with vegetables, households with acceptable food consumption consume vegetables 6 days a week and those with poor and limited food consumption only consume them 5 days a week on average. Fruits and OPV are the least consumed with respectively no consumption and consumption of 1 day/7 on average in households with acceptable food consumption.

Milk/dairy products are only consumed in households with acceptable food consumption (4 days/7 on average). Only the fruit food group (no consumption on average) is not significantly linked with the evaluation of food consumption in rural areas.

In pastoral environments, cereals are consumed on average every day 7 days a week followed by the group of vegetables with consumption almost every day 6 days a week on average in households with acceptable and limited food consumption, then 4 days /7 in households with poor food consumption. Milk/dairy products, oils and sugars are high consumption products in pastoral environments in households which have an acceptable food consumption above all, with respectively an average consumption of 5 days, 5 days and 6 days over the last 7 days. All food groups contribute positively to the determination of the food consumption score, apart from cereals which are consumed every day, and fruits which households practically do not consume.

Food consumption score according to area of residence

Table V presents the results of the descriptive analysis of the household food consumption score according to the area of residence.

Table V: Food consumption score

FCS	Urban	Rural	Pastoral	Together
Average (CI, 95%)	68.10 (65.35-71.09	43.29 (41.88-44.73)	44.96 (43.45-46.48)	50.17 (48.97-51.53)
Median	69	43	46.25	48
Standard deviation	21.04	13.27734	13.77289	18.88
Variance	442,569	176,288	189,693	356,457
Minimum	15.5	11	16	11
Maximum	106	85	87	106

SCA: Food consumption score

The average food consumption score is acceptable and ranges from 68.10±21.04; 43.29±13.27 and 44.96±13.77 out of 112, respectively in urban, rural and pastoral areas.

Household dietary diversity
Household dietary diversity profile according to area of residence

Table VI illustrates the dietary diversity score levels based on dietary profiles.

Table VI: Dietary diversity score based on dietary profiles

Place of residence	Score Levels	%	Food groups
Urban	HDDS Low	1.4	Cereals, Oils and fats, Spices and condiments
	HDDS Medium	29	Cereals, Vegetables, Meat, Oils and fats, Spices and condiments
	HDDS High	69.5	Cereals, Vegetables, Fruits, Meat, Milk/dairy products, Oils and fats, Sugar/sweet products, Spices and condiments
Rural	HDDS Low	8.9	Cereals, Vegetables, Spices and condiments
	HDDS Medium	41.6	Cereals, Legumes, Vegetables, Oils and fats, Spices and condiments
	HDDS High	49.4	Cereals, Legumes, Vegetables, Milk/dairy products, Oils and fats, Sugar/sweet products, Spices and condiments
Pastoral	HDDS Low	10.3	Cereals, Vegetables, Spices and condiments
	HDDS Medium	53.8	Cereals, Vegetables, Sugar/sweet products, Spices and condiments
	HDDS High	35.9	Cereals, Legumes, Vegetables, Milk/dairy products, Oils and fats, Sugar/sweet products, Spices and condiments

HDDS: Household dietary diversity score

The analysis of Table VI shows that dietary profiles differ from one area of residence to another and even within household dietary diversity thresholds. Low diversity households consume on average three (3) food groups. Thus, dietary profiles vary within households with low dietary diversity. This dietary profile is based on cereals, oils/fats and spices and condiments in urban areas. While in rural and pastoral areas, the dietary profile remains essentially the same: cereals, vegetables and spices/condiments. Those with medium diversity also consume vegetables and meat in urban areas, legumes and oils/fats in rural areas and sugars/sweet products in pastoral areas. For high-diversity households

in urban areas, they additionally consume fruits, milk/dairy products and sugars/sweet products. While in rural and pastoral areas the dietary profile remains the same for high diversity households, they consume seven (7) of twelve (12) food groups, Cereals, Legumes, Vegetables, Milk/dairy products, Oils/ fats, Sugar/sweet products and Spices and condiments.

Food groups consumed in household dietary diversity according to area of residence

Table VII presents the food groups consumed in the twenty-four hours (24 hours) preceding the survey.

Table VII: Proportion of consumption of food groups by households according to area of residence

Food groups	Urban N(%)	Rural N(%)	Pastoral N(%)	P-value
Cereals	209 (99.5)	299 (98)	317 (99.1)	0.268
Root/tuber	33 (15.7)	29 (9.5)	22 (6.9)	0.004
Legumes	65 (31)	189 (62)	132 (41.3)	0.000
Vegetables	204 (97.1)	281 (92.1)	302 (94.4)	0.056
Fruits	87 (41.4)	17 (5.6)	11 (3.4)	0.000
Meat	161 (76.7)	17 (5.6)	15 (4.7)	0.000
Fish	55 (26.2)	1 (0.3)	1 (0.3)	0.000
Eggs	42 (20)	8 (2.6)	3 (0.9)	0.000
Milk/products	103 (49)	130 (42.6)	151 (47.2)	0.306
Oils	203 (96.7)	228 (74.8)	167 (52.2)	0.000
Sugars/products	118 (56.2)	184 (60.3)	218 (68.1)	0.015
Spices	206 (98.1)	302 (99)	308 (96.3)	0.062

Analysis of the data in Table VII above shows that depending on the area of residence, cereals, spices/condiments and vegetables are the food groups most cited in the food consumption of the households surveyed. Added to these groups are oils/fatty products (96.7%), meats (76.7%) and sugars/sweet products (56.2%) in urban areas; oils/fatty products (74.8%), legumes (62.3%) and sugars/sweet products (60.3%) in rural areas and finally in pastoral areas sugars/sweet products (68.1%). The least mentioned groups in rural and pastoral households are fish, eggs, fruits and roots/tubers. The latter remains the least mentioned

group of dietary diversity in urban areas with 15.70%. Thus, eight groups out of twelve (8/12) are statistically significant at the 5% threshold with the different areas of residence. These include groups such as roots/tubers, legumes, fruits, meat, fish, eggs, oils and sugar/sweet products. The other groups (cereals, vegetables, milk/dairy products and spices) have a similar proportion of consumption depending on the area of residence.

Household dietary diversity score according to area of residence

Table VIII presents the results on the household dietary diversity score according to the area of residence.

Table VIII: Household dietary diversity score

HDDS	Urban	Rural	Pastoral	Together
Average (CI, 95%)	6.84 (6.56-7.08)	5.53 (5.37-5.69)	5.13 (4.99-5.27)	5.71 (5.59-5.82)
Median	7	5	5	5
Standard deviation	1,919	1,498	1,294	1,687
Variance	3,683	2,243	1,676	2,845
Minimum	2	2	0	0
Maximum	11	10	8	11

HDDS: Dietary diversity score

It appears from Table VIII that household dietary diversity varies from 6.84±1.91; 5.53±1.49 and 5.13±1.68 out of 12, respectively in urban, rural and pastoral areas.

DISCUSSION

Availability of food stocks

The presence of a stock of food in the household makes it possible to relatively assess its level of food security (Tingu and Mathunabo, 2019). The study showed that the majority of households purchase their consumer products in bulk to store and guarantee their availability. Of these stocks of household food groups, cereals are the most available regardless of the area of residence (urban 95.7%, rural 79% and pastoral 94.4%), followed by spices/condiments (urban 74 .3%, rural 67.5% and pastoral 74.4%). This practice can be explained by the fact that cereals are the staple foods in Niger and that condiments/spices are used in all kinds of preparations in households. This result is different from that found in the DRC where 52.1% of households had a stock of food (Tingu and Mathunabo, 2019). The availability of products such as sugars (urban 46.2%, rural 23.3% and pastoral 56.9%), oils (urban 40%, rural 26.9% and pastoral 20%), legumes (urban 31 .9%, rural 48.9% and pastoral 49.4%), and milk/Products (urban 30%, rural 4.9% and pastoral 30.6%) should not be neglected. However, only 5.7% of households in urban areas store fruits and vegetables, which are perishable foods that require relatively significant resources to store. Whereas, the availability of meat/fish/eggs is almost zero for rural (0%) and pastoral (0.3%) households. This proportion could be explained by the non-existence of electricity in the study areas with regard to rural and pastoral environments. In fact, the majority of products belonging to the meat/fish/egg group are products that require a maximum temperature of 4°C for their conservation.

The increase in the number of meals eaten at home and purchasing volumes has led households to store more more or less perishable products at home (Margot *et al.,* 2020). Among the different types of products stored by households, in urban areas rice is most represented, followed by pasta, in rural and pastoral areas millet is the most cited product followed by rice. The least stored cereal products are sorghum in urban areas and maize in rural and pastoral areas. This result could be explained in two ways, on the one hand households

ensure that there is no shortage of the basic food in their stored speculations and on the other hand, the inaccessibility due to the The rise in market prices forces households to have stocks.

The most widely stored legume is cowpea; for fruit vegetables in rural and pastoral areas, green leaves are the most widespread. In fact, legumes are the second food group after cereals that are part of the daily consumption of Nigeriens. Cowpea is used much more in the diversification of the diet and is also for seasoning sauces. Thus, the latter are generally made in rural and pastoral areas using dried green leaves. At the same time, industrialized milk appears much more in urban areas and fresh milk in pastoral areas. White sugar is stored by everyone but it is more widespread in pastoral areas due to their excessive consumption of green tea.

Household food consumption score

It was noted after the analysis of food availability that food consumption is generally acceptable at the level of the households surveyed. Indeed, in urban areas it is recorded in 85.7% of households and a little more than half of households in rural areas 51.8% and pastoral areas 58.1%. This result between different areas of residence could be explained by the availability and accessibility to certain consumer products by target households in certain localities of the study area. Thus, in urban areas, market supplies are much easier and food products are available almost all year round. Overall, the result is close to those obtained in 2019 in the DRC (61%) and in 2018 in Mopti (67%) (Tingu and Mathunabo, 2019; Ouologuem *et al.*, 2018) and in Niger (62.2%) (DNPGCA *et al.*, 2018). But different from those reported in Sikasso and Mopti in Mali (88.4%) (Diarra., 2018), in Bamako (78.8%) (Dramé *et al.*, 2019), in Timbuktu (78.1%) (Goïta et *al.,* 2018), in Kibumba (50.7%) in the DRC (Michée *et al.*, 2020) and in Kayes (49.6%) (Sogoba *et al.*, 2019). This difference can be interpreted on the one hand, by the dietary model which could influence food consumption from one area to another through food choice. On the other hand, the period and the study area may have an impact on household food consumption. However, the daily diet of households was essentially composed of cereals (with an average weekly frequency of at least 6 days a week), vegetable vegetables (on average consumption of 6 days a week), oils and sugars with a minimum of consumption on average 4 days/7. In urban areas, animal proteins are consumed on average 5 days a

week. Indeed, among urban consumers like to eat well and accompanying food with meat or fish is most often part of a daily dietary practice, which is not the case in rural and pastoral areas. The frequency of fruit consumption is low in urban areas and almost zero in rural and pastoral areas during the last seven (7) days. However, low consumption of fruits and vegetables is one of the five most important risk factors for poor health (Aprifel and IFAVA, 2015). Thus, insufficient consumption of products from this group is detrimental to the functioning of the digestive tract and can promote cardiovascular diseases and certain cancers. Raw fruits and/or vegetables are essential for a sufficient daily intake of certain vitamins, particularly vitamin C (GEM-RCN., 2015).

Household dietary diversity score

The average household dietary diversity score ranges from 6.84; 5.53 and 5.13 out of 12, respectively in urban, rural and pastoral areas. These average scores were similar to those (5.7) found in Burkina Faso (Sita *et al.,* 2018). Diversity is influenced by food groups such as roots/tubers, legumes, fruits, meat, fish, eggs, oils and sugars/sweet products which have a very varied proportion of consumption on both sides of residence. Thus, greater dietary diversity does not guarantee the satisfaction of micronutrient needs, if the intake of these foods is very low compared to dietary recommendations (FAO and FHI360, 2016). But low dietary diversity can exacerbate the double burden of malnutrition, which can negatively impact health (Cooper *et al.,* 2012; Fung *et al.,* 2016). However, the average household dietary diversity score is high, with consumption of at least 6 food groups in urban and rural areas, while this diversity is average composed of groups such as cereals, vegetables, oils, sugars and spices among pastoralists. Thus, the 6 food groups that constitute dietary diversity in urban and rural areas are composed respectively of (cereals, vegetables, meat, oils, sugars and spices) and (cereals, legumes, vegetables, oils, sugars and spices). However, it should be noted that these 6 groups constitute the bulk of the foods in the urban and rural dietary pattern each. In addition, each of these 6 groups plays an important role in the dietary diversification of these households. Cereals constitute the basic food; vegetables (especially leafy vegetables and other vegetables) represent a source of vitamins and minerals; meats and oils remain respectively a source of proteins and lipids and finally spices, which are essentially foods used to season meals. Thus, this dietary diversity during the 24 hours preceding the survey shows that 69.5 % of households surveyed in urban areas and almost half (49.5%) of households in rural areas have high dietary diversity. that is to say having consumed at least six (6) food groups. So, more than half of pastoral households (53.8%) consumed between four (4) and five (5) food groups and a significant proportion of 10.3% of these households have low dietary diversity. consumed between one (1) to three (3) food groups. In other words, the level of dietary diversity is relatively low, that is to

say that the conditions of households' economic access to food are not good. These results are different from those found by Ouologuem *et al.*, in 2018 in Mopti, Diarra in 2018 in Sikasso and Mopti, Dramé *et al.*, in 2019 in Bamako, Goïta *et al.,* in 2018 in Timbuktu and Sogoba *et al.,* in 2019 in Kayes with respectively a high dietary diversity score (DDS) of 95.9%, 86.86%, 77.8%, 75.1% and 39.3%. The latter noted that the poor are much more exposed to an inadequate diet than the rich, however the poor are more likely to have a diversified diet than the rich (Sogoba *et al.*, *in* 2019). This difference could be explained by the fact that the survey took place between May and April, a period close to the rainy season. During this so-called pre-war period, food insecurity is felt across almost the entire national territory, because most of the food consumed by households comes from sources other than their own farms. Thus, the dietary profiles belonging to households with different levels of dietary diversity vary depending on the environment they belong to. Low-diversity households have a dietary profile based on cereals, oils/fat and spices/condiments in urban areas. Whereas in rural and pastoral areas, the dietary profile remains the same based on cereals, vegetables and spices/condiments. Indeed, among households with low diversity, physical and economic access to food remains relatively very low. So, they will not have a high-quality diet and the intake of essential nutrients will be insufficient.

CONCLUSION

The analysis of household food consumption according to the livelihood zones (urban, rural and pastoral) of Niger, resulted in demonstrating that the households surveyed buy and store their consumer products (cereals, spices/condiments, sugars, oils, legumes, and milks/dairy products). Indeed, depending on the area of residence, rice, millet and pasta are the products most recorded in the household food reserve. Also, the diet at the level of these households is moderately diversified (Avg = 5.71 and CI = 5.59-5.82) and mainly composed of cereals, vegetables and spices/condiments. This results in the consumption of oils/fatty products, meats and sugars/sweet products in urban areas; oils/fatty products, legumes and sugars/sweet products in rural areas and finally sugars/sweet products in pastoral areas. This means that food consumption is generally acceptable at the level of the households surveyed (Avg= 50.17 and CI=48.97-51.53). Indeed, the food consumption profile is acceptable to 85.7% of households in urban areas, and more than half of rural (51.8%) and pastoral (58.1%) households are not at risk of food insecurity. The dietary profile over the last seven days is essentially composed of cereals, plant vegetables, oils and sugars with an average consumption of at least 4 days out of 7.

REFERENCES

- Aprifel., & IFAVA. (2015). Food consumption trends. *Equationutrition.* Nuffield Department of Primary Care Health Sciences, University of Oxford, United Kingdom. 6p. *Equationutrition.* No. 154. 6p.
- Cooper, A. J., Sharp, S. J., Lentjes, M. A., Luben, R. N., Khaw, K. T., Wareham, N. J., & Forouhi, N. G. (2012). A prospective study of the association between quantity and variety of fruit and vegetable intake and incident type 2 diabetes. *Diabetes care*, *35*(6), 1293-1300. doi: 10.2337/DC11-2388. EPUB 2012 Apr 3.
- Diarra, M. F. (2018). Evaluation of factors associated with low consumption and dietary diversity scores in households in the Sikasso and Mopti region in July 2017. Doctoral degree in Medicine and odontostomatology at BAMAKO N°: ...199. 110p.
- DNPGCA, CC/SAP/PC, INS. (2018). Joint survey on vulnerability to household food insecurity in Niger (October-November 2018). *Final report.* 162p.
- Dramé, M., Diarra, S., Sangho, O., Diawara, F., Sangho, F., Coulibaly, D., Coulibaly, C. A., Sangho, A., & Iknane, A. (2019). Sociodemographic characteristics associated with household food consumption in Bamako. *Mali Public Health, 9*(1), 33-37.
- FAO. (2016). FHI360: Minimum Dietary Diversity for Women: A Guide for Measurement. Rome: FAO. 2016.
- FAO. (2009). Profil Nutritionnel de pays- Division de la nutrition et de la protection des consommateurs. 72p. Accessible sur https://www.fao.org/3/bc638f/bc638f.pdf .
- Fung, T. T., Pan, A., Hou, T., Mozaffarian, D., Rexrode, K. M., Willett, W. C., & Hu, F. B. (2016). Food quality score and the risk of coronary artery disease: a prospective analysis in 3 cohorts. *Am J Clin Nutr*, 104, 65-72.
- GEM-RCN. (2015). Nutrition recommendation study group for collective catering and nutrition markets. Version 2.0-JULY 2015. Recommendation relating to nutrition n°J-5-07 of May 4, 2007. 123p. Accessible at: https://www.economie.gouv.fr/files/files/directions_services/daj/marches_publics/oeap/gem/nutrition/nutrition.pdf .
- Gallier, M. (2020). Between fashion phenomena and new consumer trends: what impacts for catering in Geneva? Geneva High School of Management (HEG-GE) Business Economics sector. Bachelor's degree HES, Business Economics sector. 120p
- Goïta A, Ag Iknane A, Coulibaly D, Dramé M, Traoré S, Koïta D, Kassogué K, Sogoba A, Bagayoko K, Bouaré A. (2018). Factors influencing household food consumption in the Timbuktu Region in February 2018. *Mali Santé Publique*, *9*(2), 5p. DOI: https://doi.org/10.53318/msp.v9i02.1501 .
- Hamadou, M. (2010). Importance of cereals, in this case millet, in eating habits in rural areas: case of the rural commune of Donudibi/Boboye. Higher technician diploma, Specialty: Public Health. 62p.
- HNO-Niger. (2014). Overview of humanitarian needs. Main humanitarian problems. Niger, November 2014. *Evaluation register. niger.humanitarianresponse.info*. p.26.
- INS. (2011). National survey on household living conditions and agriculture. Profile and determinants of poverty in NIGER. *Report.* Document 69p.
- INS. (2014). National Directory of Localities (RENALOC) of the Fourth (4th) General Population and Housing Census (RGP/H) of 2012. 733p.
- INS-Niger. (2014). National Directory of Localities (ReNaLoc) of the Fourth (4th) General Population and Housing Census (RGP/H) of 2012. 733p
- Kennedy, G., Berardo, A., Papavero, C., Horjus, P., Ballard, T., Dop, M. C., Delbaere, J., & Brouwer, I. D. (2010). Proxy measures of household food consumption for food security assessment and surveillance: comparison of the household dietary diversity and food consumption scores. *Public Health Nutrition, 13*(12), 2010–2018. Must: 10.1017/S136898001000145X.
- Margot, D., Guillaume, L. B., & Lucie, S. (2020). How confinement can permanently transform our eating practices. HAL Id: hal-02908786 https://hal.inrae.fr/hal-02908786 4p.
- Micah, M. O., Muhumutsa, N., & Enock, M. (2020). Household budget and food consumption score in Kibumba (North Kivu, DRC). Hal-02537143. 24p.
- MINADER D, CSSRA. (2008). Food Balance Sheets of Cameroon. *Report* . Cameroon. 67p.
- OCHA. (2022). Food crisis in Niger: urgently mobilize substantial resources to save lives. Emergency response; https://reports.unocha.org/fr/country/niger/card/6Dd4SnoNW0/ 2p.
- Ouologuem, T., Iknane, A. G., Diarra, S., Drame, M., Diarra, Y., Coulibaly, D., Tounkara, S., & Drame, A. (2018). Household food consumption profile in the Mopti region in February 2016. *Mali Sante Publique, 8*(1), 13-17.
- PAM. (2009). Emergency Food Security Assessment Manual. 2.ed. Rome (Italy): ISSB: WFPWFP242F. 358p.
- Ruel, M. T. (2002). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. Food Consumption and Nutrition Division, *International Food Policy Research Institute (IFPRI),* 140(202), 862-5600.
- Sanou, S., Havingund, A., & Nianogo, A. J. (2018). Household food consumption and determinants of dietary diversity: case of four municipalities in the Northern region, Burkina Faso. *International*

journal of biological and chemical science, 12(4), 1784-1801.

- Sita, S., Augustine, A., & Nianogo, A. J. (2018). Household food consumption and determinants of dietary diversity: case of four municipalities in the Northern region, Burkina Faso. *Int J Biol Chem Sci,* 12(4), 1784-1801. 18p.
- Sogoba, A. K., Iknane, A. A., Dramé, M., & Ouologuèm, T. (2019). Dietary profile of

households in the Kayes region in February 2018. *Mali Sante Publique, 10*(1), 53-56.

- Tingu, C., & Mathunabo, A. (2019). Analysis of the socio-economic and food situation of households in the North and South Ubangi provinces in the DRC. *Rev Mar Sci Agron Vet,* 7(1), 203-211.
- EU, FAO. (2013). Guide to measuring dietary diversity at the household and individual level. ISBN 978-92-5-206749-8. 56p. https://www.fao.org/3/i1983f/i1983f.pdf .