

HOUSEHOLD FOOD CONSUMPTION IN THE RURAL COMMUNE AMBATOMANGA-MADAGASCAR

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ABSTRACT

The study objective is to find out the dietary diversity and caloric needs of the two areas. Almost all households have a diet composed of at least four types of food during the period of abundance. A comparative food consumption survey of 932 households was carried out in the five Fokontany of the Rural Commune of Ambatomanga, District of Manjakandrina between the periods of abundance and lean season in 2018. More precisely, our study site was formed by Area A including the Fokontany Ambatomanga Chef -lieu of the Commune and Area B composed of the four other peripheral Fokontany. The frequency survey and 24-hour recall were used to analyse food consumption. The Student's t-test was used to determine whether there was a statistically significant difference between the average Food Consumption Scores (FCS) of the two localities. respectively 63.26% for Area A and 79.05% for Area B, compared to 33.85% and 39.39% during the lean period. Thus, household food consumption in Area B is more diversified than in Area A. Household food consumption in both Areas is unsatisfactory during the lean season, with an average score of 2.75 indicating that their diet is acceptable, including 2.64 in Area A and 2.89 in Area B. During the lean season, the average household food consumption scores reflect a very poor diet: 1.82 in Area A and 0.97 in Area B. Caloric needs are deficient during the same period in both localities: -13.52% and -10.71%. Thus, food consumption is precarious and unbalanced and not very diversified in our sites. Poor food habits, low agricultural production, unstable sources of income, the occupation of mothers and the lack of nutritional education are the causes identified by our surveys. This poor state of food consumption in our study areas is one of the problems hindering sustainable development in the locality by making the population less active. Thus, it is recommended to diversify the diet of each household and eventually promote sustainable development projects related to agriculture and livestock, to develop the practice of market gardening in the two study sites to improve their dietary habits and to strengthen nutrition education within the Commune.

Keywords: *Food consumption, undernutrition, caloric needs, food security, Ambatomanga, Manjakandriana*

1. INTRODUCTION

The interest and concern of the international community regarding nutrition and food are growing. Indeed, since the human right to food was recognized in the Universal Declaration of Human Rights in 1948, it has been confirmed at every world summit [1]. One of the major public health problems and factors of malnutrition is "undernutrition", which is defined as: "the result of insufficient food consumption, both quantitatively and qualitatively, associated with illness and inadequate child care practices" [2]. "While we produce enough food for the entire world's population, undernutrition causes the deaths of 3.1 million children under the age of 5 each year, accounting for nearly half (45%) of all causes of death, the vast majority of which are in countries with low or medium Gross Domestic Product (GDP)" [3].

Madagascar has enormous plant resources but remains hungry. "Malnutrition and food insecurity remain an unsustainable burden. According to estimates from the 2001 Census of Communes (RC), more than half of the Malagasy population is chronically or temporarily food insecure [4]. The majority of food insecure people are found in the provinces of Toliara, Fianarantsoa, Antananarivo and Toamasina. [5].

This is why we have focused on the food consumption of households in the Ambatomanga Rural Commune (CR), as a good diet is a determining factor in maintaining good health and allowing the harmonious development of the body.

In total, CR Ambatomanga has five Fokontany (Fkt) and in the present study two different areas were chosen. The first, Area A, is a sample of the population of Fkt Ambatomanga, the capital of RC Ambatomanga. The second, Area B, is a sample of the population of the four other Fokontany: the Fkt of Ambohitsimeloka, Ambohibary, Soavina, and Ambohimbory, which are peripheral and enclave of the Commune.

The choice of environment is based on the fact that both Areas belong to the Analamanga region, which is one of the regions most affected by food insecurity. In addition, living conditions are different in the main town of the Commune and in the enclave. Activities are mixed, and civil servants, merchants, and underemployed day laborers are in the majority in Area A, whereas in Area B, ninety-nine percent of the population are farmers. In other words, this work is positioned around the general problem of food consumption in rural households: how to improve and eradicate undernutrition among small farmers in Antananarivo?

The following hypotheses are put forward: H1: "Household food consumption is precarious in the RC of Ambatomanga". H2: "Household food consumption in the chief town of the Commune is satisfactory compared to that of the enclaved Area. To test these hypotheses, the overall objective of this paper is to provide an overall picture of household food consumption in the two Areas. Specifically, it is about:-to know the food diversity of the two Areas in the RC of Ambatomanga;-determine the caloric needs of rural households living in two very different areas;-check their relative food consumption.

This study continues as follows: the principles used to determine dietary diversity, caloric needs coverage and household consumption score in our two study areas. The results are presented third followed by the discussion. The last section is devoted to the conclusion.

2. METHODS

2.1 Study site

The survey took place in the five Fokontany of the RC of Ambatomanga belonging to the district of Manjakandriana, Analamanga region [6] presented in Fig-1.

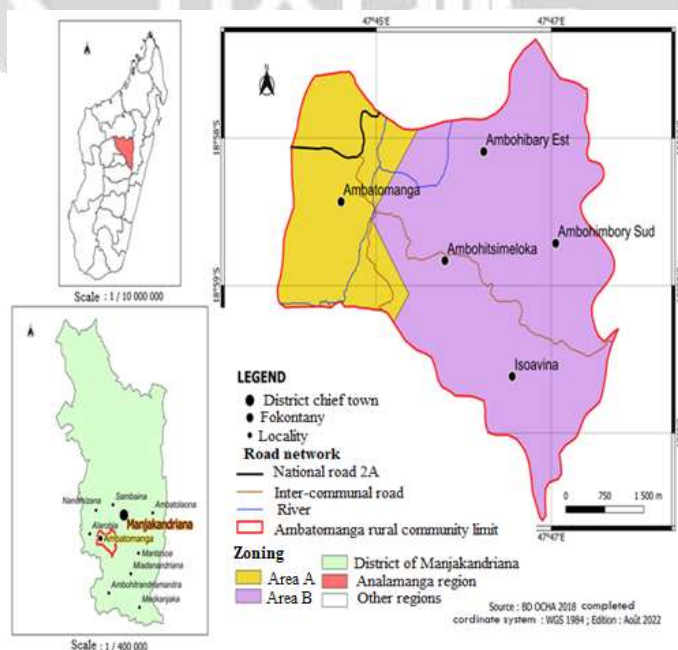


Fig -1: Location of the rural commune of Ambatomanga in the Analamanga region

2.2 Characteristics of the study

2.2.1 Type and period of study

This is a retrospective, longitudinal, analytical field study conducted in two different periods in Area A and Area B. The first one which took place from June 15, 2018 until July 21, 2018 which corresponds to the Period of abundance (PA). The second from November 08 until December 21, 2018 corresponds to the Hunger Season (HS) during which the previous year's crop is exhausted while the next crop has not yet entered.

2.2.2. Study population

The study population is composed of all households in Ambatomanga RC. All households residing in the Commune for more than one year are included

2.2.3. Sampling mode

To obtain representative data, the study uses a two-stage random sampling design with the villages as the primary unit and each household as the secondary unit:-First, a random selection of 6 villages from the 24 villages in the two Areas studied in the Ambatomanga RC.-Second, randomly select households in each selected village from the list of households prepared by the Fkt after household enumeration.

2.3. Data collection method [7]

Determining food consumption through dietary surveys:-evaluation of the food consumption and intake of an individual or group-We will discuss the main methods of retrospective data collection in more detail,-exploitation by specific tools,-Follow-up protocol depending on the objectives set beforehand.

2.3.1 24-hour recall survey

The retrospective method in which the subject is asked to recall all his food intake, as well as the quantities (drinks, snacks, addition of sugar or fat...) during the previous 24 hours has been exploited.

2.1.2 .Food Frequency Questionnaire

The method is retrospective. The frequency questionnaires used to assess average consumption habits consist of filling in a table containing a list of foods and a marker to find out the weekly consumption frequency that best corresponds to one's habits for each food

2.4 Use of the data

After the consistency check, the data collected from the households were coded and entered into EXCEL Version 2010 and Epi info Version 3.4.3, 2007 using a specially designed input mask effect. After the data. The data have been cleared, the processing and exploitation are carried out on Epi info, and SPSS version 20. The information collected during the interviews and discussions is transcribed and analysed before analysis. The data collected from the dietary surveys are exploited using two different approaches:

2.4.1 Approach based on food composition tables [8].

According to this approach, the processing of the collected data leads to numerical intake values by means of the food composition database. These values estimating the quality of consumption in terms of nutrients will then be exploited according to the objective and the context. First, the quantities listed are transformed into raw food weights. The composition tables provide information on the energy and nutrient content per 100g edible portion of the listed foods. The selection of foods and portions consumed is recorded and the column-by-column sum of the nutrient values determines the nutrient intakes. Food consumption tables are consulted to calculate the nutritional value per food for each meal.

2.4.2 Dietary profile approach [8].

This second approach considers that the consumption of a food cannot be dissociated from the rest of a person's food intake. It leads to the study of the overall dietary pattern and thus a typology of dietary behavior through nutritional history and frequency questionnaires. In nutritional epidemiology, this approach uses scores (of variety, diversity...) or statistical techniques to determine dietary profiles. The Food Consumption Score (FCS) is a composite indicator calculated to reflect dietary diversity, frequency of consumption, and the relative nutritional intake of products and food groups consumed by a household. The choice of score construction is that standardized by Action Contre la Faim (ACF). The score indicates adequate energy and protein intake. The household FCS is calculated using the following formula [8];

$$\text{Food Consumption Score} = -2.056 + 0.306 * \text{Cereals} + 0.325 * \text{Meatfish} + 0.0801 * \text{EggsMilk} + 0.133 * \text{LegFruit} + 0.0921 * \text{Tuberc} + 0.129 * \text{Légmse} + 0.03 * \text{Nb_total.effect.}$$

or:

Cereals: number of days of cereal consumption (all species)

Meatfish: number of days of meat or fish consumption

EggsMilk: number of days of consumption of eggs or milk.

Legfruit: number of days of consumption of vegetables or fruits.

T uberc: number of days of consumption of tubers

Legmse: number of days of legume consumption.

Nb_total: total number of food items consumed in the last 7 days (out of 14)

The reference adopted is the following:

- if $FCS \leq 1.5$: Very poor diet or food consumption: household with very poorly diversified and largely inadequate diet with two types of food.

-if $1.5 < FCS \leq 2.5$: Diet or borderline food consumption: households with slightly more diverse diets with three types of food.

- if $2.5 < FCS \leq 3.5$: Acceptable diet or acceptable food consumption: four-food households.

- if $SCA > 3.5$: Good diet or food consumption: households to a much more diverse and balanced diet with more than four foods.

2.5 Statistical analysis-Student's t test [10]

Comparisons of means in the two Areas are made using analysis of variance (Student's t-test) to see if there is a statistically significant difference between the means of the Food Consumption Scores (FCS) in the two Areas. The H_0 assumes that there is no significant difference between the means of the FCS of samples 1 and 2.

-If $p \leq 0.05$: H_0 rejected

-If $p > 0.05$: H_0 accepted

3. RESULTS AND DISCUSSIONS

3.1. Household Food Consumption

The profile of household food consumption is measured through the FCS. The number of food groups consumed reflects dietary diversity at the household level.

3.1.1 Food Consumption Score (FCS)

This type of measurement captures the number of different types or groups of foods that subjects consume and the frequency of consumption of those foods.

The result is a score significantly correlated with calorie consumption per person and representing diversity of food intake, but not necessarily quantity [11].

Table 1 shows the distribution of the food consumption score (FCS) across the two sites.

Table-1: Distribution of the food consumption score (FCS) at the two sites

Periods	Periods of abundance			Hunger season		
	Area A N= 264	Area B N= 210	Two Areas combined N=474	Area A N= 260	Area B N= 198	Two Areas combined N=458
Number of households	n	n	n	n	n	n
Percentage	%	%	%	%	%	%
FCS $\leq 1,5$ Very poor diet	06 02,27	0 0	06 01,26	33 14,49	22 11,11	55 12,00
$1,5 < FCS \leq 2,5$ Marginal or borderline diet	09 03,41	44 20,95	53 11,18	101 38,85	128 64,64	229 50
$2,5 < FCS \leq 3,5$ Acceptable diet	144 54,54	120 57,14	264 55,69	105 40,38	54 27,27	159 34,72
FCS $> 3,5$ Good diet	23 08,71	46 21,90	69 14,56	21 08,07	04 02,02	25 05,45

N: Total number of staff

During the harvest period, more than half of the households have an acceptable diet composed of at least four types of food (rice, tubers, vegetables, legumes and/or fruits). Household diets in both Areas are therefore very diversified. Rice, a staple food, oils and sugar are consumed daily. Legumes provide an adequate supply of essential amino acids. Vegetables are also consumed 3 to 4 days a week. At least two animal products are consumed 3 to 4 days a week or milk almost every day. Households in Area B have a more diversified diet than those in Area A, with 79.04% and 63.25 % respectively for the acceptable and good diet.

During the period when access to food is very limited, more than half of households in both locations consume at least three types of food (rice, vegetables or leaves, and seasonal fruits). In addition to the staple food, there is less diversification with the consumption of breeds, fruits, beans, oil and sugar, and sometimes fish or meat. It should be noted that households in the Commune's chief town have a better diet than those in the outlying Fkt during the HS, respectively 48.45% compared to 29.29% for the acceptable and good diet.

During the first period, the diet is more diversified in Area B than in Area A. The reasons why diversification is more satisfactory in Area B than in Area A are as follows:

- because households in peripheral Fkt are all agricultural producers, they tend to be self-producing. The diversity of local foods available (cereals, tubers, fruits and vegetables, fish...) during this period improves their diet.

- In the main town of the Commune, the households are a minority of farmers. Despite their access to a more diversified diet, their consumption is limited by their low purchasing power. This reflects the lower FCS compared to the enclave area. During the WP, the situation in Area B deteriorates. The low dietary diversity score there is due to:

- the conditions of isolation are a determining factor for access to local consumption products, but also for the sale of production and access to inputs [12]. Households experience difficulties in accessing food at this time and have access to an inadequate diet [13].

- to the poor situation of the local production, the poor management of the harvest of the standard of living of the inhabitants, the prices of the food products and the food habits [14]

- mothers who are too busy with housework and small economic activities in the chief town of the Commune are no longer able to take care of the food for their households.

Comparing the dietary diversity of the city of Antananarivo with the results of our study, we note that; those of our two sites are not improved and have even decreased because in the city of Antananarivo only 1% of households had a "poor" dietary profile and 34% with a "borderline" dietary profile, in 2005 [15]. In addition, other determinants of consumer decisions, such as tradition, habits or advertising, probably have impacts on demand in general and on the demand for dietary diversity in particular [13]; this explains the low score of dietary diversity in the two localities because in any case, the majority of people in the two Areas live in poverty. According to Razafindravonona, 2003, over 77% of rural households in Madagascar live below the poverty line [16].

From a food profile perspective, households in Area B have acceptable food consumption profiles. These households live mainly from agriculture and livestock, and their food habits depend mainly on the local availability of seasonal foods that can satisfy their needs from their own resources. Therefore, the variation in the harvest throughout the year improves their food consumption.

In Area A, where the state of food consumption is very worrying, the majority of the inhabitants are wage earners, day laborers and small traders. Consumption depends mainly on their purchasing power because the majority of households are unable to cultivate because of land problems and lack of time due to their work.

Their eating habits depend mainly on their purchasing power, and the possibilities of increasing their income are limited. Thus, they mainly consume cereals and tubers with a few days a week of fruits and vegetables, sugar and oil. They hardly or rarely consume dairy products, fish and legumes and almost never meat. Therefore, the diet is cereal type in which, it is traditionally the basis of the diet [17]. This result is in line with the study carried out by Andriamialison showing that the food ration of the Mananasy population of the Itasy region remains monotonous and little diversified [18].

3.1.2 Comparison of the Average Food Consumption Scores (AFCS) of the two Areas

Table 2 shows the comparison of the AFCS of Area A and Area B.

Table-2: Comparison of the Average Food Consumption Scores (AFCS) of the two Areas

Locations	Area A		Area B		Two Areas combined		Two Areas combined
Periods	Period of abundance	Hunger season	Period of abundance	Hunger season	Period of abundance	Hunger season	Two periods combined
Score Average of Food Consumption	2,64	1,88	2,89	0,977	2,75	1,43	2,08
Standard deviation	± 0,66	±1,06	± 0,67	±0,71	±0,51	± 0,42	±1,09
P	0,01		0,025		0,000		
Test t	+		+		+		

The AFCS for both Areas during the period of abundance indicate acceptable food consumption, with a score of 2.64 in Area A and 2.89 in Area B. For HS, the AFCS is less than 1.5 in Area B showing a very poor diet while in Area A, household food consumption is limited.

The AFCS for both areas combined is 2.02 ± 1.09 ($\pm ES$, $n=932$) reflecting that households in these two locations have a very poor diet. According to the t-test, the differences in AFCS between the two Areas during the two periods are all statistically significant.

The AFCS in both locations is very low and classifies households as having a very poor diet during the HS and an acceptable diet during the harvest period. In general, Malagasy people have a poorly varied diet. This is mainly related to the high number of mouths to feed in the family, unstable sources of income, the existence of taboo foods for some family members and the lack of information on the dietary needs of different age groups. However, in many rural areas, households often face food shortages because crop production is seasonal and sometimes insufficient [19]. On the other hand, our result is better compared to what is confirmed by the 2013 National Survey on Monitoring the Millennium Goals (ENSOMD) which had estimated that 76% of households have a poor diet in quantity and 84% have a poor diet in quality [19]

3.2 Coverage of calorie needs

The aim is to determine the calorie intake per person per day and the rate of calorie coverage in the two locations. The requirements are covered by the food intake if the histograms are above the x-axis, otherwise they are not met by the food. In addition, it is interesting to see how evenly the average calorie and protein ratios are distributed in each community.

Table-3 shows the Household Calorie Coverage Rates in both Areas

Table-3: Household Calorie Coverage Rates in both Areas

Locations		Area A		Area B	
Periods		Period of abundance	Hunger season	Period of abundance	Hunger season
Calories	ER (Kcal)	2642,41	2037	3191,05	1817,47
	TR (Kcal)	2203,45	2201,27	2274,59	2254,9
	RC (%)	21,27	-13,52	45,16	-10,71

ER: Coverage R: Effective Ration, TR: Theoretical Ration, RC: Coverage Rate

In both Areas, during the PA, the calorie requirements are covered and there are excesses. The effective ration per ration day in Area A reaches 2642,41 Kcal while the theoretical ration is 2203,45 Kcal. For Area B, the caloric intake is 3191,05 Kcal exceeding the requirement which is 2274,59 Kcal. (Table-3)

As for the HS, households do not manage to cover their calorie needs with a deficit of 13,52% in Area A and 10,71% in Area B. Caloric consumption provides only 2037 Kcal while the theoretical requirement is 2201,27 Kcal in Area A. As for Area B, the theoretical ration is 2254,90 Kcal while the effective ration provides only 1817,47 Kcal. The differences in the effective caloric in two Areas are statically significant in both periods according to the T-test with $p=0,000$ for both Areas. (Table-3)

During PA, caloric intake per person per day is satisfactory in our two study sites but the situation is reversed during HS (see Table II). Energy intakes below the reference average of 2100 Kcal per person define undernourishment. [21]. Thus, according to our results, the households surveyed in the two localities are not yet classified as undernourished despite their difficulties in obtaining food during the HS. Compared to the national average, our result seems to be better during the harvest period. However, caloric intake is below the threshold. According to the EPM (Household Survey) in 2010, the food threshold corresponding to a minimum food basket is set at 2133 Kcal for all of Madagascar [21]. The low caloric deficit during the SP is relatively due to a very low consumption of energy foods such as rice, tubers and legumes. Rice is the primary source of calories and is the staple food, but almost all households do not have sufficient stocks for the entire year. Rice production is low because it is grown in the traditional way. This means that there is no self-sufficiency in grain. Most farmers are tenants or sharecroppers. The low yield is also linked to the absence of irrigation dams, climate change and the lack of techniques and inputs to improve production [22]. Thus, they need to buy their rice ration to satisfy their needs; at least 6 to 10 months out of 12 with very limited purchasing power. Thus, seasonal price variation and food availability result in a significant reduction in the level of food and caloric consumption among poor households in Madagascar during the HS [23]. This poor state of food consumption in our study areas is one of the problems hindering sustainable development in the locality by making the population less active.

3.3 Causal analysis of inadequate food consumption in Ambatomanga RC

Figure-3 shows the causal analysis of food consumption in Ambatomanga RC

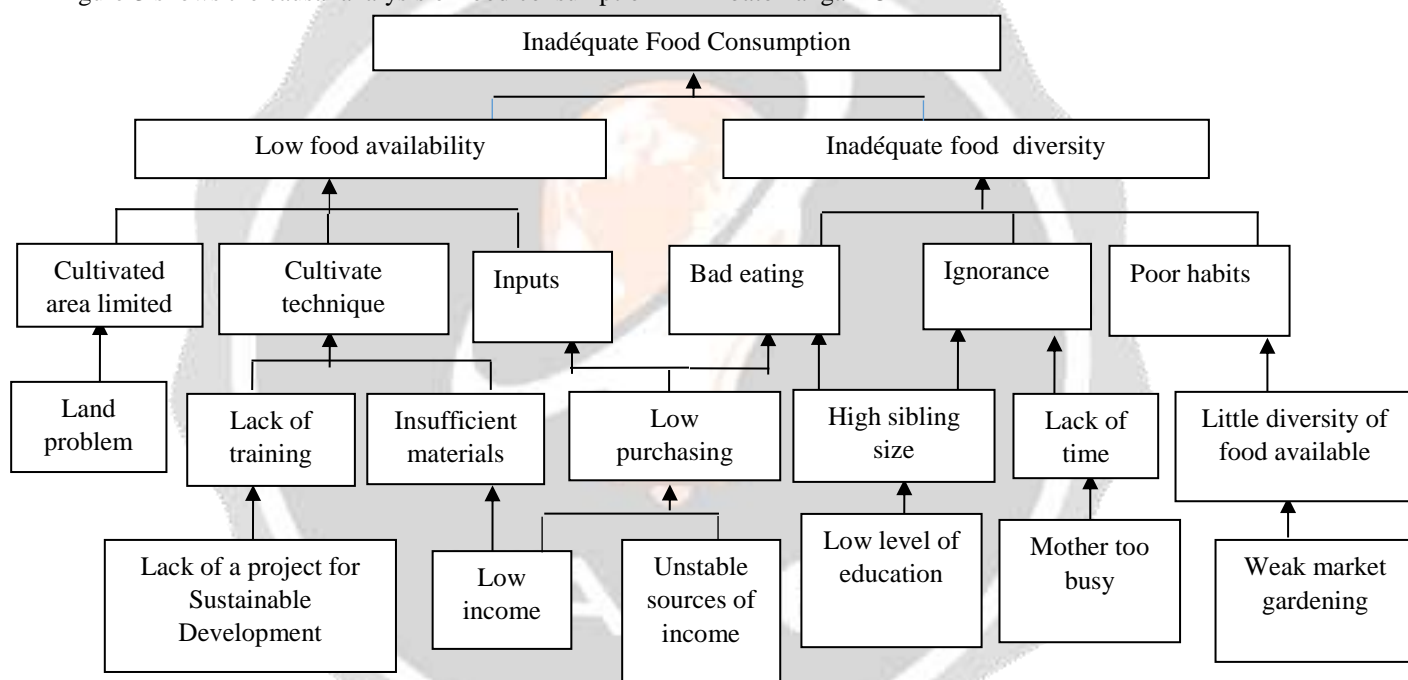


Fig - 2: Analyse causale de la consommation alimentaire dans la RC Ambatomanga

4. CONCLUSION

The study of food consumption in the two Areas reveals that:

- Household diets in both study communities are moderately diversified in general. During the harvest period, households in Area B have a more diverse diet than those in Area A. The diversity of local foods available in Area B is satisfactory during this period, which improves the diet of households. However, the situation deteriorates during the HS in this Area, because by this time households have exhausted their reserves, while their purchasing power is very limited. In Area A, the diet is not very diversified thanks to other non-agricultural household resources.

- As for calorie intake, it is generally covered in both Areas during the PA, with some excess. During HS, households are unable to cover their calorie needs because there is no cereal self-sufficiency. The statistical test shows a significant difference in the FCS averages between the two localities.

Thus, the first hypothesis is accepted; announcing that "the food consumption situation is precarious"; on the other hand, the second hypothesis is rejected because it is the households living in the isolated Area that have a better food situation than those in the chief town of the Commune. In any case, poverty and lack of nutritional

education are the main causes of undernutrition in these study areas. This poor state of food consumption in our study areas is one of the problems hindering sustainable development in the locality by making the population less active. Thus, it is recommended to diversify the diet of each household and possibly promote sustainable development projects related to agriculture and livestock, to develop the practice of market gardening in the two study sites to improve their dietary habits and to strengthen nutritional education within the Commune. The study was qualitatively limited in terms of household diets in the two Areas. It provides an overall view of food consumption in rural households. It is interesting to go deeper into the quantity of food and analyze again its impact on the socio-economic life of the population in the commune.

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6. NOTES AND BIBLIOGRAPHIC REFERENCES

- [1]. FAO, 2014. Manuel pratique sur le droit à l'alimentation. L'évaluation du droit à l'alimentation. Rome:52p.
- [2]. ACF, 2014. International. Document de cadrage. Politique sécurité nutritionnelle. Action contre la faim. 15-21.
- [3]. PAM, 2009. Manuel d'évaluation de la sécurité alimentaire en situation d'urgence. 2e édition. 43p.
- [4]. FAO, 2005. Profil nutritionnel de Madagascar : division de l'alimentation et de la nutrition. 9-14.
- [5]. IAWG & FIVIMS, 2004. Inter-Agency Working Group on Food. Insecurity and Vulnerability Information and Mapping Systems. Vol. http://www.fivims.net/upload/recentletters/404/FN_V6N3_July2004.doc.
- [6]. Monographie de la RC Ambatomanga, 2016.12p.
- [7]. ACF, 2009. Evaluation de la Sécurité Alimentaire et des Moyens d'Existence Guide pratique pour le terrain. ACF International. 227p.
- [8]. ACF, 2009. Evaluation de la Sécurité Alimentaire et des Moyens d'Existence Guide pratique pour le terrain. ACF International. 227p.
- [9]. FAO, 2013. Guide pour mesurer la diversité alimentaire au niveau du ménage.12-16.
- [10]. Lamottea, 1971. Olivia G., 1970.in Labrousse C., 1977. Statistiques. Tome 1. Dunod, édit. Paris: 232p.
- [11]. Maxwell D., Caldwell R., (2008). The Coping Strategies Index: Field Methods Manual, second edition, CARE. <ftp://ftp.fao.org/doRCep/fao/meeting/009/ae513e.pdf>.
- [12]. PAM. 2007. Evaluation Rapide de la Sécurité Alimentaire: Madagascar.71p.
- [13]. TGH, 2016. Evaluation Sécurité alimentaire Qauka.15p.S
- [14]. OMS, 1997. Aspect sanitaire et nutritionnel des oligoéléments et des éléments de base, Genève: 13-18.
- [15]. Moritz, 1993; Kooreman et Wunderink, 1997 in Andriamparany,J., 2011. Sécurité alimentaire dans deux Fkt de la RC de Fiaferana district d'Antananarivo-Avaradrano. Mémoire de DEA en Sciences de la Terre et de l'Evolution. Faculté des Sciences. Université d'Antananarivo.55p. .
- [16]. PAM, Juillet 2005. Strengthening Emergency Needs Assessment Capacity (SENAC). Analyse de la sécurité alimentaire et de la vulnérabilité (CFSVA) Madagascar.97p.
- [17]. PAM, 2015. Analyse de la Vulnérabilité Urbaine Madagascar. Etude de cas des villes d'Antananarivo-Toamasina Toliara, 67p.
- [18]. Andriamialison, H. 2000. Caractéristiques anthropométriques et état nutritionnel de la population de Mananasy du Fivondronana de Soavinandriana Itasy. Réposes biologiques chez les sujets de la naissance à 50 ans et plus. Thèse de doctorat de 3^{ème} cycle en Anthropologie Biologique. Faculté des Sciences Université d'Antananarivo, Madagascar. 193p.
- [19]. Dos et col, 1987. in ACF. 2014. Politique sécurité nutritionnelle. p10.
- [20]. François, P., 1962. Budget et alimentation des ménages ruraux à Madagascar. Paris : Tome II, 287p.
- [21]. FAO/PAM, 2014.Mission d'évaluation de la sécurité alimentaire à Madagascar. 42 p.
- [22]. FAO, 2005 Madagascar : Plan d'Action National pour la sécurité alimentaire (PANSA). 49p.
- [23]. INSTAT, 2010. Enquête périodique auprès des ménages (EPM) 2010.184-187.