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Food Diversity and Adaptation Strategies of Rural Households in the Face of Food Insecurity in the District of Ambatoboeny, Madagascar

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Abstract: *Food insecurity remains a structural problem in Madagascar, particularly in rural areas where dependence on subsistence farming makes households vulnerable to seasonal fluctuations. This study aims to assess the level of food insecurity and dietary diversity among rural households in the Ambato Boeny district, as well as to identify the coping strategies employed during the lean season. A cross-sectional survey was conducted with 300 households across four communes (Anjiajia, Andranofasika, Ankijabe, and Ambato Ambarimay). Data were collected using a structured questionnaire and semi-structured interviews, and then analyzed using a descriptive approach. The Food Consumption Score was calculated according to the methodology of the World Food Programme (WFP). The results show that 97.49% of households are food insecure. In terms of dietary diversity, 56.25% of households have a low score, 32.45% a medium score, and 11.25% a high score. The diet is mainly composed of cereals and tubers, while the consumption of animal protein, legumes, fruits, and vegetables remains limited. During the lean season (January–April), the frequency of meals decreases, and households adopt various coping strategies: harvesting wild plants (e.g., Nymphaea lotus, Dioscorea spp.), reducing the number of meals, selling livestock, and resorting to borrowing. These observations corroborate results reported in other Sahelian and sub-Saharan African countries (e.g., Burkina Faso, Niger, Kenya), where seasonal food vulnerability remains high. The study's limitations lie primarily in its cross-sectional design, which prevents the assessment of intra-annual variations. It is recommended to promote crop diversification and the development of local food resources, and to conduct longitudinal and nutritional studies to better understand the seasonal dynamics of food insecurity.*

Keywords: *Food insecurity, food diversity, lean season, adaptation strategies, rural households.*

I. INTRODUCTION

Vulnerability to food insecurity is a problem that primarily affects agricultural households in poor rural areas (FAO, 2010). Periodic food crises, particularly during the lean season, remain a cyclical phenomenon that impacts farmers and leads to malnutrition in Madagascar. Malnutrition can be defined as either an excess or insufficient intake of one or more nutrients (BAUDIN, 2014). A person is in a state of food insecurity when they do not have regular access to sufficient healthy and nutritious food for normal growth, development, and an active, healthy life. This may be due to a lack of food availability and/or a lack of resources to purchase food ([https://ccfd-terresolidaire.org/tag/insecurite-alimentaire] (https://ccfd-terresolidaire.org/tag/insecurite-alimentaire)).

Food insecurity among households in Madagascar results from a complex system of "vulnerability factors," mainly due to a lack of purchasing power and, in the face of crises, the low resilience of households. Madagascar is one of the countries most affected by food insecurity, with 26% of Malagasy households in a state of severe food insecurity (having gone a full day without eating) (INSTAT, 2020). Ambatobeony, one of the districts, is marked by periodic food crises, especially during the lean season and natural disasters such as droughts and floods. On one hand, with a population composed of various ethnic groups and a large capacity for arable land, subsistence farming and underperforming livestock farming are unable to meet the food needs of the population. This study was conducted to assess the food insecurity scale of households in the Ambato Boeny district. The procedure involves understanding the fight against malnutrition in rural areas and searching for alternatives to remedy it, hence the purpose of this study to determine the role of factors associated with chronic malnutrition in the absence of food insecurity in the Ambato Boeny district. The overall objective is to study food practices associated with the lean season in the Ambato Boeny district.

Research Question:

Will these food practices meet the nutritional needs during the lean season?

Research Hypotheses:

Do the available resources meet the criteria of sufficiency and appropriate nutritional quality of the foods?

Study Aim: To assess the state of food insecurity and contribute to the characterization of food diversity among farmers in the Ambato Boeny district.

Main Objective of the Survey:

- To study the food practices associated with the lean season in the Ambato Boeny district.
- Specific Objectives of the Survey:
- To analyze the socio-professional characteristics of the surveyed farmers.

- To evaluate the habits, diversity, and frequency of food consumption throughout the year.
- To calculate the food diversity score of the farmers.
- To identify the lean season periods for the surveyed farmers.
- To study the associated food practices.
- To examine food adaptation strategies.

II. Study Site

The survey was conducted in the Ambato-Boeny district of the Boeny Region, specifically in the following communes: Anjiajia, Andranofasika, Ankijabe, and Ambato Ambarimay, located in the northwest of Madagascar.

III. Materials and Methods

III.1 Study Type and Period

III.1.1. Study Type:

This research consisted of a descriptive cross-sectional study, conducted to characterize the food habits, nutritional diversity, and food adaptation strategies of rural households facing food insecurity in the Ambato Boeny district. This study design was chosen to obtain a representative snapshot of the food situation over a given period.

III.1.2. Study Period:

The study was carried out from March 21 to June 21, 2022, a period corresponding to the end of the harvest and the beginning of the lean season, which allowed for capturing seasonal variations in food behaviors and the availability of foodstuffs.

III.1.3. Study Population:

The target population consisted of all households residing in the four communes studied (Anjiajia, Andranofasika, Ankijabe, and Ambato Ambarimay) in the Ambato Boeny district. The majority of the population engages in agricultural, livestock, or artisanal fishing activities, complemented by small-scale subsistence or commercial activities.

III.2. Descriptive Food Survey

A descriptive food survey was conducted among selected households using simple random sampling. The main data collection tool was a structured questionnaire, developed based on the standard model of the Food and Agriculture Organization (FAO, 2010) and the Food and Nutrition Technical Assistance Project (FANTA, 2008). This questionnaire included both closed-ended questions (with "yes" or "no" answers) and open-ended questions that allowed participants to freely express their perceptions and food practices.

Data was collected directly from household heads or those responsible for meal preparation. The enumerators filled out the forms on-site based on responses gathered during individual interviews.

III.2.1. Calculation of the Food Consumption Score (FCS) and the Household Dietary Diversity Score (HDDS)

The Food Consumption Score (FCS) was calculated using the method recommended by the World Food Programme (WFP, 2008). The calculation is based on the weighting of food groups by their frequency of consumption during the seven days prior to the survey.

The Household Dietary Diversity Score (HDDS) was determined from the 12 food groups defined by FANTA (2008), using the following formula:

Low HDDS: ≤ 3 food groups consumed
Medium HDDS: 4 or 5 food groups consumed
High HDDS: ≥ 6 food groups consumed

The overall dietary diversity score corresponds to the sum of the number of food groups consumed during the reference period. This approach allows for an assessment of the quality of the diet and the level of food security of households.

III.2.2. Data Processing and Analysis

Completed questionnaires were manually processed before being entered into a computer system. Quantitative data were processed using IBM SPSS Statistics software (version 25) for descriptive analysis and frequency calculations. Principal Component Analysis (PCA) was also performed to identify the most determining variables in the variability of food practices. The results were presented in the form of tables, graphs, and figures, created with Microsoft Excel (version 2016). The entire report was written following the scientific presentation standards in force.

IV. Results

IV.1. Socioprofessional Characteristics of the Surveyed Farmers

Table 01 presents the socioprofessional characteristics of the surveyed farmers. These characteristics are essential for understanding the socio-economic and cultural variables that can influence food practices and vulnerability to food insecurity. These include age group, sex, marital status, and the professional sector of the surveyed households.

Variable	n(300) Percentages (%)
Age	
≤45] 45-65] >65	35 45,75 19,25
Sex	
Male Female	41.85 58.15
Level of Education	
Never Educated Educated	5.22 94.78
Marital Status	
Single Widowed	9.40 90.60
Secteur professionnel	
Livestock Artisanal Fishing Commercial Activities | Others (Supplements)	75.35 24.75
Food Insecurity Scale	
Having Food Insecurity No Food Insecurity	97.49 2.51

Analysis of the data shows that the majority of respondents are in the middle age group (45 to 65 years), representing 45.75% of respondents, while 35% are under 45 years old and 19.25% are over 65 years old. The study population has a female majority (58.15%), reflecting the essential role of

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women in agricultural and domestic activities within rural communities.

Regarding education level, a large proportion of respondents (94.78%) have received some schooling, though generally at the elementary level, while 5.22% have never attended school. This situation illustrates recent efforts to increase education in rural areas, though access to higher education remains limited.

In terms of marital status, 90.60% of the farmers live in common-law unions, while 9.40% are single, reflecting a traditional social structure and predominant family stability. Professionally, 75.35% of respondents work in primary sectors such as agriculture, livestock, and fishing, which are the economic pillars of the studied communes. The remaining 24.75% work in secondary and tertiary sectors (small trade, crafts, rural transport, etc.).

It is also important to note that 97.49% of the surveyed households face food insecurity, highlighting significant vulnerability to seasonal fluctuations in agricultural production and income.

IV.2. Eating Habits, Food Diversity, and Frequency According to Seasonal Periods

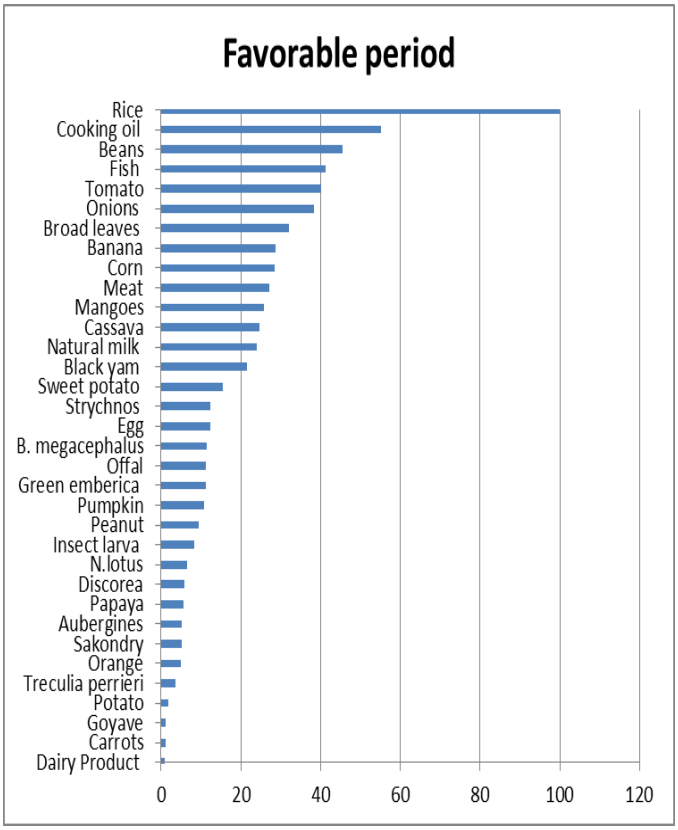

Figure 1. Characterization of Foodstuffs and Frequency of Food Consumption of Surveyed Farmers During the Favorable Period

IV.3. Household Dietary Diversity Score of Farmers throughout the Year

IV.3.1. Household Dietary Diversity Score of Farmers during the Normal Period

IV.3.2. Household Dietary Diversity Score of Farmers During the Lean Season

The dietary diversity scores of the surveyed farmers are presented in Figure 04 below.

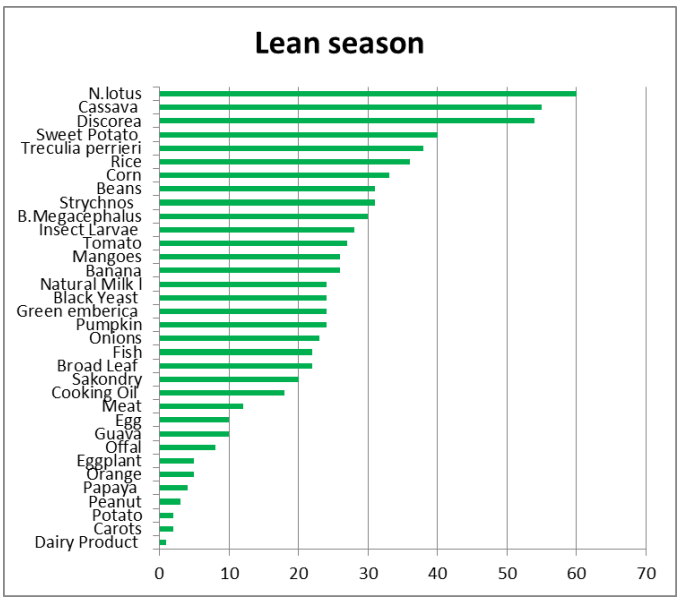

Figure 2. Characterization of Foodstuffs and Frequency of Food Consumption of Surveyed Farmers during the Favorable Period

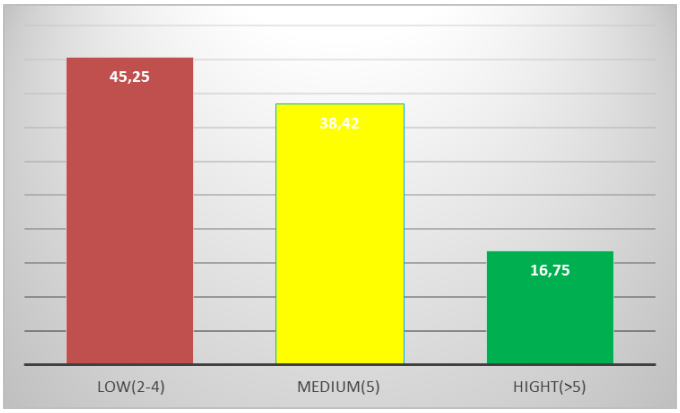

Figure 03. Household Dietary Diversity Score of Farmers During the Favorable Period

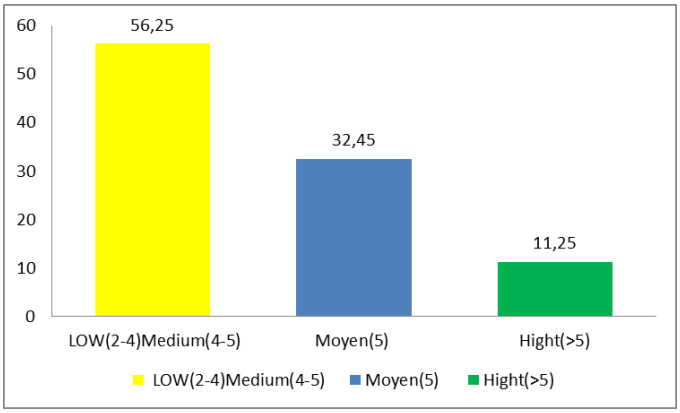

Figure 4. Household Dietary Diversity Score of Farmers during the Lean Season

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The score reflects only one week's consumption and does not measure the "deficit" in food availability. According to Figure 4, the majority of farmers, 56.25%, have low dietary diversity. It also shows that 32.45% of farmers have acceptable dietary diversity, while only 11.25% have high dietary diversity.

IV.3.3. Lean Seasons for the Surveyed Farmers

According to the surveyed farmers, the average duration of the lean season varies from 2 to 4 months. It occurs between the months of January and April, affecting nearly 62% of the farmers. The following Figure 03 represents the percentages of different responses given by the surveyed farmers.

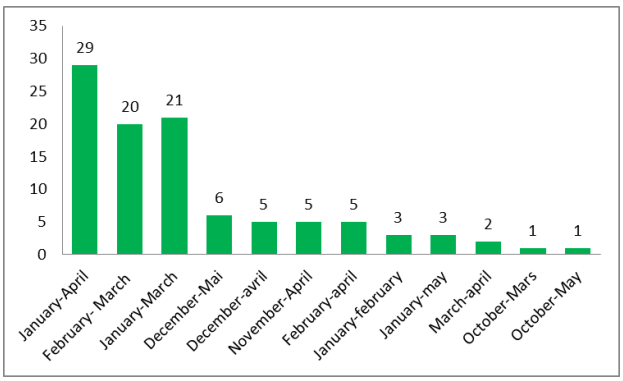

Figure 5. Lean Season for the Surveyed Farmers

IV.4. Food Adaptation Strategies

On average, 56.25% of farmers reported having difficulties in feeding themselves or obtaining money for their food needs during our survey. The surveyed farmers adopted the following food strategies in response to the lack of food or insufficient funds to purchase food: borrowing, reducing the number of meals, selling livestock, foraging for wild food, and consuming less preferred foods.

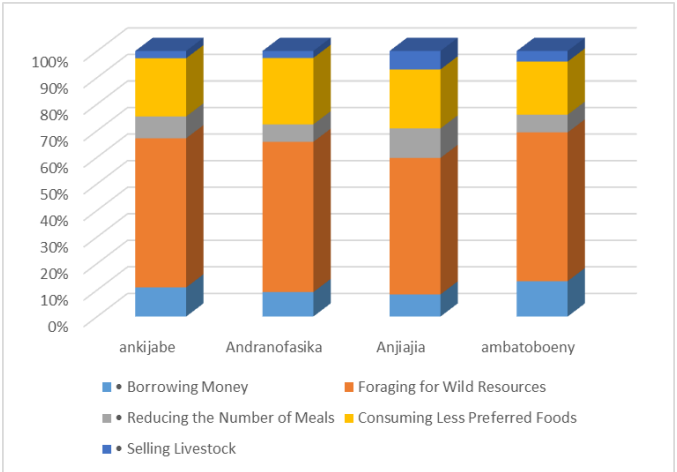

Figure 6. Distribution of Food Adaptation Strategies by District

IV.5. Food Consumption Profile of Farmers

The analysis of the data reveals several important trends in the eating habits of farmers:

Most Consumed Foods: Cereals and tubers dominate consumption (e.g., N. lotus, cassava, Dioscorea, sweet potatoes, rice, corn). These foods are rich in carbohydrates, making them essential for energy intake, but they are often poor in protein and micronutrients.

Animal Proteins and Legumes: The consumption of meat, fish, eggs, and natural milk remains low. Some foods, such as insects (e.g., B. megacephalus, insect larvae, Sakondry), appear as alternative sources of protein. Legumes (e.g., beans) are consumed moderately.

Fruits and Vegetables: There is a low consumption of fruits and vegetables rich in vitamins and minerals (e.g., oranges, guavas, papayas, eggplants, carrots, onions, brèdes). This deficit may lead to nutritional deficiencies, particularly in vitamins A and C, iron, and calcium.

Processed Foods and Oils: Cooking oil is consumed by 18% of farmers, but other processed products remain rare.

Surveyed farmers have adopted the following food strategies to obtain food or money to buy food during the lean season: foraging for wild food, consuming less preferred foods, borrowing, reducing the number of meals, and selling livestock. This analysis revealed significant differences in the adoption of strategies between districts. The strategy of "foraging for wild food" is the most commonly used, while "selling livestock" is the least common. Correlations between certain strategies suggest common behaviors among farmers in response to food insecurity. These results can guide future interventions to improve food resilience.

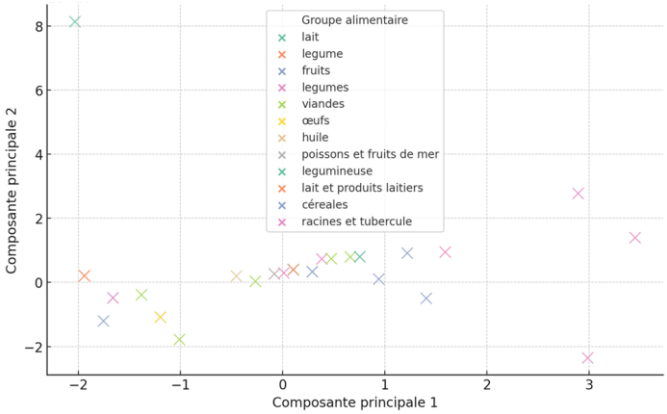

Figure7. Food Consumption Profile of Farmers

VI. Discussion

The objective of this study was to assess the scale and determinants of food insecurity among rural households in the Ambato Boeny district, a predominantly agricultural area in northwestern Madagascar. Analysis of data from 300 households reveals an alarmingly high prevalence of food insecurity, affecting 97.49% of respondents. These results confirm the severity of the food security issue in rural Madagascar, as previously highlighted in other studies conducted in different regions of the country (RAZAFIMAMONJY, 1988; FAO, 2022).

The results show that the majority of respondents are between 45 and 65 years old (45.75%), followed by those under 45 years old (35%). The significant proportion of adults in the productive age group in our sample can be explained by their central role in agricultural activities and household management. The female majority (58.15%) reflects the

increased involvement of women in food production and household management, a situation similar to that observed in rural areas of southern Madagascar (RASOLOFO, 2017) and in several sub-Saharan African countries (Hoddinott & Yohannes, 2002; FAO, 2020).

Regarding education levels, 94.78% of respondents are literate, while 5.22% have never attended school. This low proportion of illiteracy reflects progress in rural education, although the relationship between education and food security remains complex. Studies conducted in Malawi and Niger have shown that formal education significantly improves dietary diversity by enhancing households' ability to adopt better livelihood strategies (Smith et al., 2016; Leroy et al., 2020). Agriculture, livestock, and fishing are the primary economic activities for 75.35% of households, compared to 24.75% in other sectors. This finding aligns with studies conducted in the Boeny region (FAO, 2019) and other Malagasy regions, showing that households dependent on subsistence agriculture are more vulnerable to climate variations and fluctuations in food prices. Similar trends have been observed in Burkina Faso and Ethiopia, where rural populations dependent on seasonal production face chronic food insecurity (Somé et al., 2011; Tadesse et al., 2021).

Rice remains the staple food of Madagascar and is consumed almost daily. Analysis of dietary diversity highlights that cereals (rice) (100%) are the most consumed food during the favorable period. In total, 55.13% of farmers consume cooking oil, often accompanied by a high consumption of fish and vegetables (green leaves), at 41.35% and 32.26%, respectively, followed by the consumption of roots and tubers at 24.7%. Edible insects (Brachytrupes megacephalus larvae) are consumed by only 11.43% of farmers, while bananas (28.75%) and mangoes (25.46%) are the most commonly consumed fruits. Generally, milk is consumed naturally by 45%, while its derivatives are rarely consumed.

During the favorable period, rice is the dominant food. The diet is relatively balanced in terms of carbohydrates, fats, and proteins. However, during the lean season, rice drops to fifth place, overtaken by tubers, resulting in an imbalanced diet with a protein deficit.

During the lean season, the farmers surveyed rely heavily on wild roots and tubers (40% to 60%) (e.g., N. lotus, cassava, Dioscorea), followed by cereal consumption (maize, rice) among 33% of the population. This finding aligns with the work of RAZAFIMAMONJY (1988), which showed that household food consumption in Madagascar heavily depends on roots and tubers. Regarding legumes, beans (31%) are the most consumed compared to other varieties. The consumption of vegetables, fish (22%), and meat (12%) is generally lower than during the favorable period, but the primary source of animal protein is replaced by edible insects (30%) (Brachytrupes megacephalus larvae), with consumption rising during the lean season. This situation may also be explained by the availability of these edible insects in rural communities during this period (Somé et al., 2011).

Instead of conventional fruits, farmers consume Treculia perrieri seeds (38%) and Strychnos fruits (31%), which are the most commonly consumed fruits, especially by farmers in the communes of Ankijabe and Ambato Boeny.

All the farmers surveyed have a low food security score. In fact, as shown in Figure 2, 56.25% of households have a low food security score, 32.45% have a medium food security score, and 11.25% have a high food security score. According to the survey results, food availability varies significantly throughout the year. There is a favorable period when food is sufficient and a lean season when food availability is scarce. Similar studies have confirmed that low dietary diversity is often linked to low purchasing power and low incomes. Certain food groups were not consumed due to economic difficulties or limited means (Jones et al., 2014; Lourme-Ruiz et al., 2016).

According to the farmers interviewed, the months from January to April are the most difficult for households to obtain food, followed by November and December, with a gradual return to normal. This difficulty occurs during the rainy season and coincides with the cyclone period in Madagascar. Additionally, the rising prices of food products in almost all rural areas exacerbate the problem. During these months, the majority of food consumed by farmers comes from foraging, indicating that these months are marked by food insecurity for farmers. These findings align with the results observed by RAZAFIMAMONJY (1988) in all regions of Madagascar.

Adaptation Strategies

To cope with food shortages, farmers adopt various adaptation strategies: the collection of wild resources (56%), reducing the number of meals (7%), selling livestock (4%), borrowing money (11%), and consuming less preferred foods (22%). These behaviors are comparable to those observed in rural areas of sub-Saharan Africa, where households combine food security and economic strategies to survive during the lean season (Dercon & Krishnan, 2000; Hoddinott, 2006).

In Madagascar, the works of Rakotoarisoa (2015) and Randrianarisoa (2019) show that these adaptation mechanisms have become structural in rural areas: the collection of insects, wild fruits (Treculia perrieri, Strychnos spp.), and the substitution of rice with tubers are common practices. However, these strategies remain short-term and do not guarantee long-term nutritional security.

Regional Trends

The results of this study align with regional trends observed in several East and Southern African countries, where food security is highly dependent on seasonality and climate-related shocks (FAO, 2023; WFP, 2022). For example, in Ethiopia, 64% of farming households experience an average lean season lasting three months (Tadesse et al., 2021), similar to the lean period in Ambato Boeny. These regional similarities highlight the need to integrate crop diversification, strengthen economic resilience, and promote locally available edible products (insects, wild fruits) in Malagasy agricultural and nutrition policies.

VII. CONCLUSION

One of the main objectives of this study is to assess the food practices of farmers during the lean season and characterize their professional and socio-economic profiles.

The aim of this work is to evaluate the state of food insecurity and contribute to the characterization of dietary diversity among farmers in the Ambato Boeni District. A survey was conducted among farmers to gather the results associated with this study. Indeed, during this difficult period, individuals find survival strategies to adapt. A total of 300 farmers were surveyed across four different communes (Anjiajia, Andranofasika, Ankijabe, and Ambato Ambarimay). Our results show that farmers are divided into three age groups: 35% are under 45 years old; 45.75% are between 45 and 65 years old; and 19.25% are over 65 years old. 41.85% of the respondents are male, and 58.15% are female. Furthermore, 97.49% report having food security. However, the majority of farmers, 56.25% of households, have a low food security score. This survey revealed that the diet of eligible farmers is very little diversified and particularly poor in micronutrient-rich foods. Moreover, the low dietary diversity among pregnant or breastfeeding women leads to the birth of underweight children with very fragile health. An acceptable dietary diversity score is equal to or greater than four. However, the survey showed that farmers had a low dietary diversity score. This study can serve as a guide for the development of a food guide for Madagascar, which would inform the public on the types and quantities of food to consume to meet their nutritional needs and prevent diseases.

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