

Assessing the links between women's empowerment and household food security in rural areas of the Itasy Region, Madagascar, using the Women's Empowerment in Agriculture Index (WEAI) and nutritional indicators

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Abstract

This study assesses the interactions between women's empowerment, measured by the Women's Empowerment in Agriculture Index–5 Domains of Empowerment (WEAI-5DE), and household food and nutrition security in rural areas of the Itasy Region, Madagascar. This region has strong agricultural potential but is known for its high prevalence of stunting (52% among children under five). A mixed-methods approach was adopted, combining a household survey involving 385 households (including 264 women eligible for the WEAI), focus group discussions, and semi-structured interviews.

The results indicate high adequacy levels in production, access to resources, and control over income. However, significant deficits were observed in leadership (38.9%) and time allocation (37.6%), which are strongly associated with the overall empowerment score.

Regarding food security, households generally exhibit acceptable dietary consumption, while minimum dietary diversity for women (MDD-W) remains low, with only 24.18% achieving adequate dietary diversity, highlighting intra-household disparities. Correlations between overall empowerment and food-related indicators are positive but weak ($\rho = 0.174$ with the Household Dietary Diversity Score (HDDS); $\rho = 0.155$ with the Food Consumption Score (FCS); and $\rho = 0.165$ with MDD-W), suggesting that empowerment acts as an enabling factor whose effects are conditioned by conversion mechanisms such as economic resources, intra-household distribution norms, workload, and access to food.

These findings highlight the need for integrated interventions combining agricultural diversification, nutrition education, practical nutrition training, reduction of time poverty, and increased male involvement. Such combined interventions aim to strengthen the impact of women's empowerment on household nutritional status.

Index Terms- women's empowerment, dietary diversity, food security, Itasy, Madagascar

I. INTRODUCTION

The Itasy Region, located in the central highlands of Madagascar, is traditionally considered a major agricultural area, known for its substantial food crop production (rice, maize, cassava). It is also known for the presence of diverse ecosystems, including the Itasy Lake, wetlands, and forested areas, which provide fisheries resources and wild edible resources. However, these resources are not reflected in the nutritional status of the population. Indeed, the Itasy Region is among the areas affected by stunting, with a prevalence reaching 52% among children under five years of age (INSTAT, 2021). Furthermore, the region also reports an anemia rate and an iron deficiency rate, both estimated at 32% among children aged 6 to 59 months. Among women of reproductive age (15–49 years), the

anemia rate reaches 27%, while the prevalence of iron deficiency stands at 22% in the Itasy region (Ministère de la Santé Publique de Madagascar *et al.*, 2025).

This situation occurs in a context of widespread economic vulnerability. According to the results of the Third General Population and Housing Census in 2018, the Itasy Region recorded a material poverty rate of approximately 79.6%, accompanied by a poverty gap of 39% and a severity index of 22.5%, indicating deep structural poverty within households. Globally, 1.6 billion school-aged children and women of reproductive age suffer from deficiencies in one or more micronutrients, corresponding to one in two children and two in three women (BEAL, 2026).

In this context, gender inequalities are a key determinant of food and nutrition security trajectories. In Madagascar, women assure a substantial share of agricultural and food-related activities, while having more limited access than men to education, productive resources, income, and decision-making. They are less likely to participate in the labor force (71.3% compared to 82.4%) and less likely to hold paid employment (24% compared to 35%), which restricts their capacity to generate independent income (World Bank, 2024). These disadvantages have direct implications for food choices and investments in health and nutrition at the household level. Assessing the link between women's empowerment and nutritional outcomes is therefore essential to better understand the underlying mechanisms behind the paradox observed in an agricultural region such as Itasy.

In this perspective, the present study aims to assess the relationships between the different domains of women's empowerment, as defined by the Women's Empowerment in Agriculture Index (WEAI), and household food and nutrition security indicators in the Itasy Region. It aims to document how women's empowerment levels are translated into actual food practices and outcomes, and to identify the domains most closely associated with improved nutritional conditions. This work thus aims to contribute to a better understanding of priority entry points for strengthening, in an integrated manner, gender equality and sustainable improvements in nutrition in rural settings.

II- MATERIALS AND METHODS

2.1. Study area

The study was conducted in the Itasy Region, located in the central-western part of Madagascar's central highlands. The region has three districts (Arivonimamo, Miarinarivo, and Soavinandriana), covering an area of approximately 6,900 km² with an estimated population of nearly 900,000 inhabitants (INSTAT, 2021).

The population is mostly rural and mainly depends on smallholder agriculture as a primary source of livelihood. This area was selected due to its importance within the highland agricultural systems and the availability of prior data documenting both its productive potential and persistent challenges related to living conditions and nutrition. These characteristics make it a relevant setting for assessing the link between women's empowerment, food security, and nutrition.

2.2. Study design and period

This research adopts a mixed-methods approach, combining quantitative and qualitative methods within a data triangulation framework. The quantitative component is based on the analysis of data collected from a survey of rural women, allowing the assessment of the link between women's empowerment domains and food security indicators. The qualitative component draws on semi-structured individual interviews ($n = 11$) and focus group discussions (FGDs, $n = 7$), aimed at deepening the understanding of the underlying mechanisms behind the observed associations and contextualizing the quantitative findings. These data sources are complemented by a targeted review of scientific and institutional literature.

Data collection was conducted from December 4 to December 12, 2024, in the districts of Arivonimamo, Miarinarivo, and Soavinandriana. Fieldwork involved two teams, totaling fourteen members.

2.3. Sampling

Sampling

The study population consists of smallholder farming households in the three districts of the Itasy Region, where adult women constitute the target population for the analysis of empowerment. Households represent the unit of observation for food and nutrition security indicators, while the surveyed women are the unit of analysis for variables related to the Women's Empowerment in Agriculture Index (WEAI).

The minimum sample size for the quantitative survey was estimated using the standard formula for proportions:

$$n = (t^2 \times p \times (1-p)) / e^2,$$

where n represents the minimum sample size, t the score associated with a 95% confidence level (1.96), p the expected proportion (0.5), and e the margin of error (0.05). This approach yielded a theoretical sample size of 384 households, rounded to 385 households surveyed.

A stratified random sampling design was adopted. Stratification was performed at the district level, proportionally to the regional population, resulting in approximately 41% of the surveys in Arivonimamo, 35% in Miarinarivo, and 24% in Soavinandriana. About 30% of the communes in each district were then selected, followed by the selection of fokontany within these communes. At the community level, households were randomly selected from available lists, with the support of local authorities.

For analyses related to women's empowerment, only respondents with complete data on the five domains of the WEAI were retained. Thus, out of the 385 surveyed households, 264 women met the eligibility criteria and constitute the analytical sub-sample. For analytical consistency and to enable correlation analyses between empowerment and food security, food and nutrition security indicators were also computed exclusively for these 264 women and their respective households.

Furthermore, the calculation of the Minimum Dietary Diversity for Women (MDD-W) was restricted to women aged 15 to 49 years, in line with international methodological guidelines. Among the 264 women eligible for the WEAI, 182 fell within this age range and constitute the sub-sample used for analyses involving MDD-W.

2.4. Data Collection Tools and Variables

2.4.1. Women's Empowerment

Women's empowerment was assessed using the Women's Empowerment in Agriculture Index (WEAI), developed by the International Food Policy Research Institute (IFPRI) and widely used to assess women's role, power, and decision-making capacities within agricultural systems (Alkire *et al.*, 2013; IFPRI, 2025). The WEAI considers five complementary domains of empowerment: (i) production decisions, (ii) access to and control over productive resources, (iii) control over income use, (iv) leadership, and (v) community participation, as well as time allocation and workload (Alkire *et al.*, 2013).

In the present study, the analysis focused on the Five Domains of Empowerment (5DE) index. The Gender Parity Index (GPI) was not computed, as the objective was to document women's empowerment levels per se and to assess their relationship with household food and nutrition security outcomes, without intra-household comparison between women and men.

A structured questionnaire adapted from the WEAI was administered to the surveyed women. Ten indicators, distributed across the five domains, were constructed in accordance with WEAI methodological guidelines (Alkire *et al.*, 2013). For each indicator, a value of 1 is assigned when the adequacy criterion is met, and 0 otherwise. The domains are equally weighted (0.2), and the indicators within each domain follow the standard weights proposed by the tool. It should be noted that the "control over income use" domain relies on a single indicator within the 5DE. In accordance with the WEAI methodology, this indicator is binary (adequate/inadequate) and carries the full weight of the domain (0.20). As a result, this domain can only take values of 0 (inadequate) or 0.20 (adequate), unlike other domains composed of multiple indicators. This feature may limit the observed variability for this domain and influence the magnitude of correlations with continuous variables.

For each woman, an inadequacy score was computed as the weighted sum of indicators in which adequacy criteria were not met. A threshold of $k = 0.2$ was applied: women with a score less than or equal to this threshold are considered empowered, while those with a score above the threshold are considered not empowered. The 5DE index is then derived from the proportion of women who are not empowered and their average inadequacy score, following the Alkire-Foster methodology (2011), which is commonly used for constructing multidimensional composite indices.

Both domain-specific scores and the overall 5DE score were used as explanatory variables in the analyses exploring their associations with food and nutrition security indicators.

2.4.2. Indicators of Food and Nutrition Security

Household food and nutrition security was assessed using a set of complementary indicators designed to capture the overall quality of household diets, their diversity, and specific dimensions related to women's nutrition. Three widely recognized indicators were employed: the Food Consumption Score (FCS), the Household Dietary Diversity Score (HDDS), and the Minimum Dietary Diversity for Women (MDD-W).

The Food Consumption Score (FCS) was calculated following the joint FAO/WFP methodology, based on the frequency of consumption of major food groups over the previous seven days at the household level, weighted by their nutritional density (FAO & WFP, 2008; FAO, 2014). This indicator provides a composite measure of the overall nutritional quality of household diets. Adjusted thresholds recommended for contexts with high consumption of sugar and oil were applied: $FCS < 28$ (poor consumption), $28.5-42$ (borderline), and > 42 (acceptable).

The Household Dietary Diversity Score (HDDS) was used to measure the number of different food groups consumed over the previous 24 hours. This indicator reflects dietary variety and is a widely recognized proxy for the micronutrient adequacy of household diets (Arimond & Ruel, 2004; FAO, 2011).

Furthermore, to better document the nutritional status of women, the Minimum Dietary Diversity for Women (MDD-W) was estimated in accordance with FAO and FHI 360 recommendations (2016) among women aged 15–49 years, i.e., of reproductive age. A woman is considered to have achieved minimum dietary diversity if she consumed at least five out of the ten defined food groups in the previous 24 hours, a threshold associated with a higher probability of micronutrient adequacy.

The FCS and HDDS indicators were calculated for the full analytical subsample, while the MDD-W was estimated only for women meeting the age criterion. For consistency with the WEAI framework, cross-analyses were conducted on the subsample of eligible women.

2.4.3. *Data process and analysis*

Data collected using the KoboCollect application were exported and subjected to a rigorous quality control process. This step involved checking the internal consistency of responses, identifying missing values, duplicates, and potential data entry errors. Data cleaning and organization were performed using Microsoft Excel prior to importing the datasets into R software (RStudio, version 2025.09.1+401) for statistical analysis.

Quantitative analyses initially relied on descriptive statistics to characterize the study sample, including sociodemographic profiles, agricultural characteristics, empowerment scores, and food and nutrition security indicators. The scores for the various indicators (WEAI 5DE, FCS, HDDS, and MDD-W) were computed in accordance with the methodological procedures described in the previous sections.

Analyses related to women's empowerment (WEAI) and household food security indicators (FCS, HDDS) were conducted on a subsample of 264 women with complete data. In contrast, analyses pertaining to Minimum Dietary Diversity for Women (MDD-W) were performed exclusively on the 182 women aged 15–49 years, in line with the methodological guidelines of the indicator.

To examine the link between women's empowerment and food and nutrition security indicators, correlation analyses were conducted. Spearman's rank correlation coefficient (ρ) was used, given the ordinal nature of certain variables and the non-normal distribution of the scores. This coefficient allows the assessment of the existence and strength of monotonic relationships between variables without assuming strict linearity.

Three levels of analysis were carried out: (i) relationships between each of the five domains of empowerment and the overall 5DE score; (ii) relationships between the overall empowerment score (WEAI-5DE) and household food security indicators (FCS, HDDS) as well as the individual nutrition indicator (MDD-W); and (iii) relationships between domains of empowerment and each of the food and nutrition indicators.

The interpretation of correlation strength was based on commonly accepted thresholds: weak correlation for $|\rho| < 0.30$, moderate for $0.30 \leq |\rho| < 0.60$, and strong for $|\rho| \geq 0.60$. Additionally, coefficients of determination (R^2) were calculated as a complementary measure to estimate the proportion of shared variance between selected pairs of variables.

Qualitative data from semi-structured interviews and focus group discussions were analysed using thematic content analysis. Verbatim transcripts were reviewed iteratively and manually coded into emerging categories related to WEAI domains, dietary practices, social norms, gender roles, and daily constraints. This qualitative analysis aimed to complement and contextualize the quantitative findings by shedding light on the social mechanisms and lived experiences underlying the observed statistical associations.

Overall, these analytical procedures were grounded in a mixed-methods triangulation approach, combining multiple data sources to enhance the validity and interpretative depth of the results

III- RESULTS

3.1. *Women's Empowerment Profile According to the WEAI*

The figure 1 below illustrates the average proportion of women who have achieved the minimum empowerment threshold defined by the WEAI methodology across the five domains of empowerment. These indicators reflect the share of women who possess a level of decision-making power or control considered sufficient within the five domains under study. Each percentage represents an average derived from individual women's scores in each district, which are then aggregated at the regional level based on sample size.

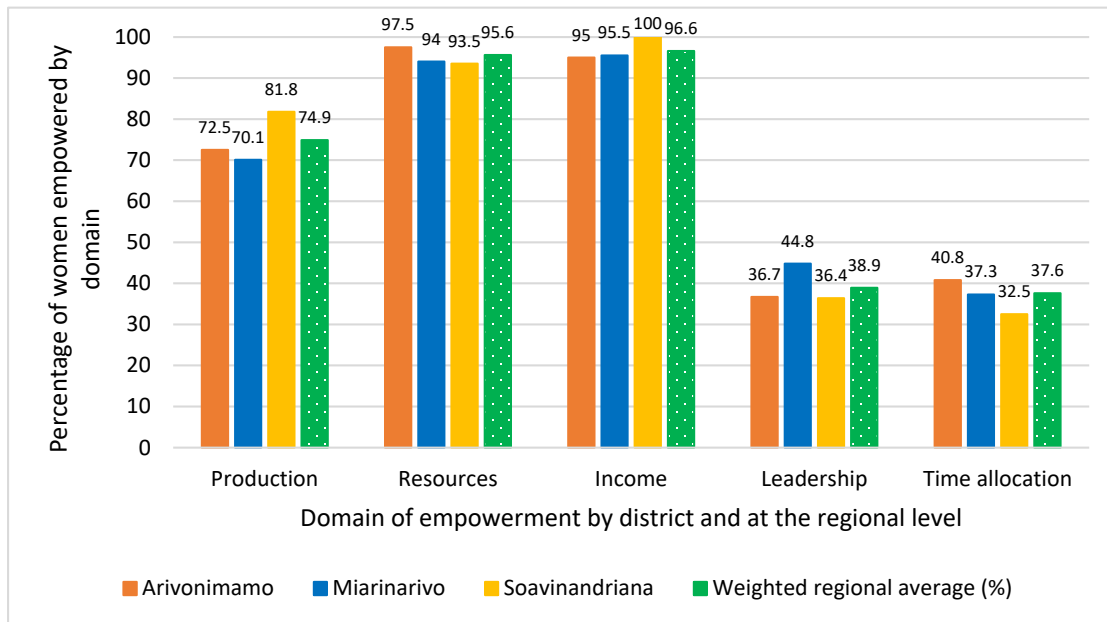


Figure 1 : Proportion of Women’s Empowerment by Domain, by District, and at the Regional Level

Level of Women’s Empowerment Across the five domains of empowerment

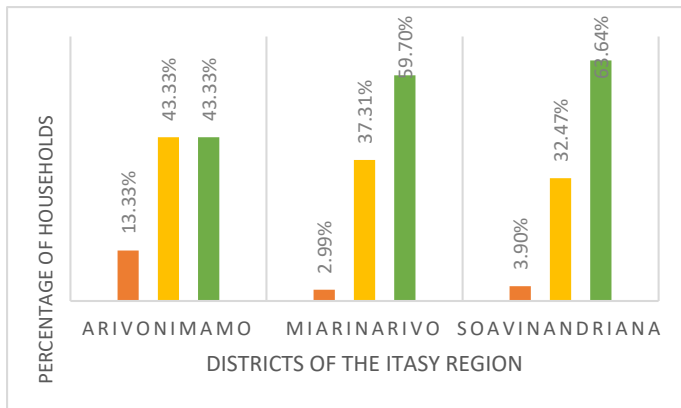
Approximately three-quarters of women (74.9%) adequately participate in agricultural production decisions at the regional level, with variations between Soavinandriana (81.8%) and Miarinarivo (70.1%). These differences suggest disparities in women’s integration into farm management across districts. The resources domain exhibits a substantially high level of adequacy (95.6%), indicating that nearly all women have sufficient access to and control over productive resources (land, assets, credit, and inputs). Similarly, the income control domain records the highest regional score (96.6%), demonstrating that a large majority of women have significant decision-making power over household budgeting and major expenditures.

With a regional average of only 38.9%, the leadership domain shows the lowest value after time allocation, indicating that barely one in three women exerts recognized social influence within their community. Focus group discussions primarily identified women’s involvement in collective agricultural groups (e.g., chili cultivation and poultry farming).

At 37.6%, the time allocation domain records the lowest score, reflecting persistent gender inequalities in the division of labor. The results show that 37.1% of women work more than 10.5 hours per day to fulfill both productive and reproductive work, and 51.1% report dissatisfaction with the time available for leisure and rest.

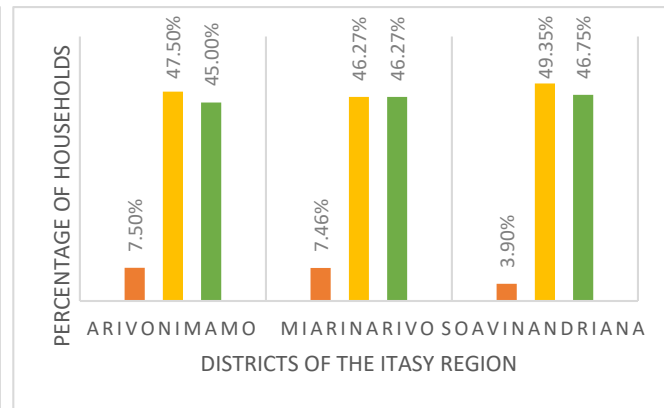
3.2. Household Food and Nutrition Security Situation

The food and nutrition security situation of households in the Itasy region was assessed using the Food Consumption Score (FCS), the Household Dietary Diversity Score (HDDS), and the Minimum Dietary Diversity for Women (MDD-W). Spatial variations in the FCS and HDDS are presented by district in Figures 2 and 3.



■ Poor consumption ; ■ borderline; ■ acceptable

Figure 2 : Distribution of households by Food Consumption Score (FCS) categories by district in the Itasy region



■ Low dietary diversity ; ■ medium dietary diversity; ■ high dietary diversity

Figure 3 : Distribution of households by levels of dietary diversity by district in the Itasy region

The figure 2 highlights inter-district disparities in the overall quality of household food consumption. At the regional level, the average FCS (45.39) corresponds to generally acceptable food consumption. However, the Arivonimamo district exhibits a more vulnerable situation, with an average FCS classified as “borderline” (41.96) and a higher proportion of households in the poor (13.33%) and borderline (43.33%) consumption categories. In contrast, the districts of Miarinarivo and Soavinandriana show more favorable profiles, with average FCS values of 47.77 and 48.68, respectively, and a majority of households classified under acceptable consumption (approximately 60% and 63.64%). Poor consumption remains marginal in these districts, indicating better overall dietary quality.

Figure 3 shows a generally homogeneous level of dietary diversity across districts. The regional average HDDS (5.49) indicates a medium level of dietary diversity, close to the values observed in Arivonimamo, Miarinarivo, and Soavinandriana. Approximately half of the households exhibit medium dietary diversity, while 45–47% achieve high dietary diversity. Nevertheless, a non-negligible proportion of households remains in a situation of low dietary diversity, particularly in Arivonimamo (7.50%) and Miarinarivo (7.46%), suggesting persistent constraints in access to sufficiently diverse diets.

Figure 4 presents the proportion of women aged 15–49 years achieving the minimum dietary diversity threshold ($MDD-W \geq 5$) across districts in the Itasy region. At the regional level, only 24.18% of women meet this threshold, indicating a high nutritional risk for the majority of the women surveyed. Inter-district disparities are observed, with a higher proportion in Miarinarivo (34.15%) and particularly low levels in Arivonimamo (23.26%) and Soavinandriana (18.18%). These results highlight a generally unfavorable nutritional situation for women, even in districts with better household food security levels. This low dietary diversity among women underscores the importance of examining the gender-related determinants of diet, which are addressed in the following sections.

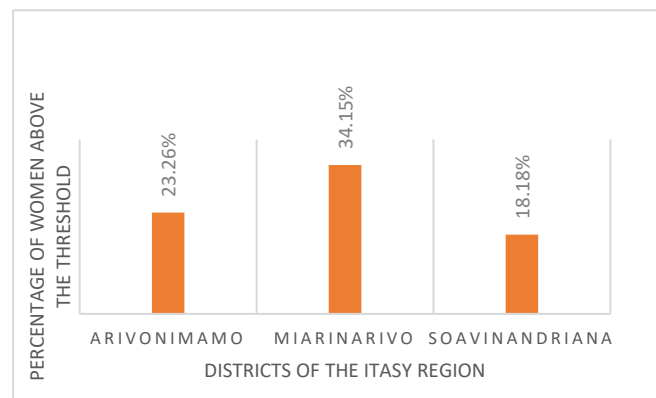


Figure 4 : Proportion of Women Aged 15–49 Years Achieving Minimum Dietary Diversity ($MDD-W \geq 5$) by District in the Itasy Region

3.3. *Links Between Women’s Empowerment and Household Food Security and Dietary Diversity (HDDS and FCS)*

The relationships between women’s empowerment and household food security were examined using Spearman correlation analyses between the five WEAI domains, the overall empowerment score (5DE), the Household Dietary Diversity Score (HDDS), and the Food Consumption Score (FCS).

Table 1 : Spearman Correlation Matrix Between WEAI Domains, the Overall Empowerment Score, HDDS, and FCS

| Variables | PRODUC-TION | RESOUR-CES | INCOME | LEADER-SHIP | TIME ALLOCATION | Overall WEAI | HDDS | FCS |
|------------------------|-------------|------------|----------|-------------|-----------------|--------------|----------|----------|
| PRODUCTION | 1 | 0.259 | 0.180 | 0.122 | -0.030 | 0.463 | 0.191 | 0.099 |
| RESOURCES | 0.259 | 1 | 0.228 | 0.122 | 0.043 | 0.439 | 0.103 | 0.063 |
| INCOME | 0.180 | 0.228 | 1 | 0.057 | 0.032 | 0.296 | 0.089 | 0.140 |
| LEADERSHIP | 0.122 | 0.122 | 0.057 | 1 | 0.074 | 0.601 | 0.104 | 0.090 |
| TIME ALLOCATION | -0.030 | 0.043 | 0.032 | 0.074 | 1 | 0.625 | 0.034 | 0.073 |
| Overall WEAI | 0.463 | 0.439 | 0.296 | 0.601 | 0.625 | 1 | 0.174 | 0.155 |
| HDDS | 0.191 | 0.103 | 0.089 | 0.104 | 0.034 | 0.174 | 1 | 0.410 |
| FCS | 0.099 | 0.063 | 0.140 | 0.090 | 0.073 | 0.155 | 0.410 | 1 |

Note: The coefficients presented correspond to Spearman’s correlation coefficients (ρ). Values close to 1 indicate a strong positive association, whereas values close to 0 indicate a weak association. HDDS: Household Dietary Diversity Score; FCS: Food Consumption Score; WEAI: Women’s Empowerment in Agriculture Index.

Overall, the results show that the overall women’s empowerment score is positively, albeit weakly, correlated with both household food security indicators, with coefficients of $\rho = 0.174$ for HDDS and $\rho = 0.155$ for FCS. These values indicate that higher levels of empowerment are associated with a slight improvement in household dietary diversity and food quality, although without reflecting a strong or direct relationship.

The examination of the WEAI domains individually confirms this general trend. The domains related to agricultural production and access to and control over resources show positive but weak correlations with HDDS ($\rho = 0.191$ and $\rho = 0.103$, respectively) as well as with FCS ($\rho = 0.099$ and $\rho = 0.063$). These findings suggest that women’s participation in production decisions or their access to productive resources does not automatically translate into a diversification or substantial improvement in household diets.

The income control domain also shows weak correlations with the food indicators ($\rho = 0.089$ with HDDS and $\rho = 0.140$ with FCS). In other words, even when women report some control over income use, this advantage is only marginally reflected in household dietary diversity or diet quality.

The more social dimensions of empowerment, namely time allocation and leadership, although strongly associated with the overall WEAI score, also exhibit very weak correlations with the two household food security indicators (ρ ranging from 0.034 to 0.104). This suggests that women’s ability to express themselves in public, to participate in groups, or to have greater control over their workload is not directly associated with better household food outcomes.

However, it is important to note that, despite this weak association with food indicators, the time allocation domain shows a strong relationship with the overall women’s empowerment score ($\rho = 0.625$). Similarly, leadership is strongly correlated with the overall WEAI score ($\rho = 0.601$). These results confirm that control over working time, rest, and leisure, as well as the ability to influence collective decisions, are key pillars of women’s empowerment in Itasy. The absence of a direct correlation between these dimensions and food indicators suggests that their effect operates primarily through the broader construction of women’s agency, without necessarily translating into an immediate improvement in household dietary diversity or food quality.

Furthermore, a moderate correlation is observed between HDDS and FCS ($\rho = 0.410$), indicating that these two indicators share part of their variance while measuring distinct dimensions of food security. HDDS primarily reflects the diversity of food groups consumed, whereas FCS also incorporates consumption frequency and the nutritional density of foods.

Taken together, these results indicate that women’s empowerment is a favorable but insufficient condition for improving household food security in Itasy. Even when women have a certain degree of agency in productive, economic, or social domains, their ability to

translate this into concrete improvements in dietary practices remains strongly constrained by other structural factors, such as monetary poverty, limited access to food, material constraints, and social norms governing decision-making within households. These findings highlight the need to integrate women’s empowerment interventions with actions simultaneously aimed at improving economic access to food, diversifying production, and transforming social norms.

3.4. Links between Women’s Empowerment and Minimum Dietary Diversity for Women (MDD-W)

The relationships between women’s empowerment and their own nutritional status were examined using Spearman correlation analyses between the five WEAI domains, the overall empowerment score (5DE), and Minimum Dietary Diversity for Women (MDD-W). The results are presented in Table 2.

Table 2 : Spearman Correlation Matrix Between WEAI Domains, the Overall Women’s Empowerment Score, and Minimum Dietary Diversity for Women (MDD-W)

| Variables | PRODUC-TION | RESOUR-CES | INCOME | LEADER-SHIP | TIME ALLOCATION | Overall WEAI | MDD-W |
|------------------------|-------------|------------|----------|-------------|-----------------|--------------|----------|
| PRODUCTION | 1 | 0.285 | 0.208 | 0.080 | -0.065 | 0.449 | 0.099 |
| RESOURCES | 0.285 | 1 | 0.257 | 0.155 | 0.001 | 0.477 | 0.046 |
| INCOME | 0.208 | 0.257 | 1 | 0.066 | -0.008 | 0.314 | 0.049 |
| LEADERSHIP | 0.080 | 0.155 | 0.066 | 1 | 0.096 | 0.596 | 0.176 |
| TIME ALLOCATION | -0.065 | 0.001 | -0.008 | 0.096 | 1 | 0.602 | 0.004 |
| Overall WEAI | 0.449 | 0.477 | 0.314 | 0.596 | 0.602 | 1 | 0.165 |
| MDD-W | 0.099 | 0.046 | 0.049 | 0.176 | 0.004 | 0.165 | 1 |

Note: The coefficients presented correspond to Spearman’s correlation coefficients (ρ). Values close to 1 indicate a strong positive association, whereas values close to 0 indicate a weak association. MDD-W: Minimum Dietary Diversity for Women; WEAI: Women’s Empowerment in Agriculture Index.

Overall, the overall women’s empowerment score shows a positive but weak correlation with MDD-W ($\rho = 0.165$). This result indicates that higher levels of empowerment are associated with a slight improvement in women’s individual dietary diversity, without reflecting a strong or systematic relationship.

An examination of the WEAI domains shows that leadership is the dimension most strongly associated with MDD-W, although the relationship remains weak ($\rho = 0.176$). This association suggests that women who are more engaged in group participation or feel more confident speaking in public tend, to a limited extent, to be more likely to achieve minimum dietary diversity. In other words, certain social dimensions of empowerment may marginally contribute to better individual dietary practices.

The domains related to agricultural production, access to resources, and control over income show very weak correlations with MDD-W (ρ ranging from 0.046 to 0.099). These findings indicate that, in the context of Itasy, women’s participation in production decisions, their access to resources, or their control over income do not directly translate into a meaningful diversification of their own diets.

Notably, the time allocation domain shows virtually no relationship with MDD-W ($\rho = 0.004$), despite being one of the key pillars of overall women’s empowerment. This contrast suggests that, although workload and time control are central to the lived experience of empowerment, they are not sufficient, on their own, to explain variations in individual dietary diversity.

Furthermore, the correlations between the WEAI domains and the overall empowerment score confirm the previously observed patterns: time allocation ($\rho = 0.602$) and leadership ($\rho = 0.596$) emerge as the two main determinants of the overall WEAI score, followed by access to resources ($\rho = 0.477$) and production ($\rho = 0.449$), while control over income shows the weakest contribution ($\rho = 0.314$).

Taken together, these results highlight a gap between empowerment and individual nutrition. Women’s empowerment, although important, translates is only weakly linked with improvements in dietary diversity. This suggests that other factors, such as food availability, cultural preferences, economic constraints, and intra-household norms governing food distribution, play a decisive role in shaping women’s diets.

These findings reinforce the idea that interventions aimed at improving women's nutrition should go beyond empowerment alone and simultaneously incorporate actions targeting economic access to food, nutrition education, and social norms related to food consumption.

IV- DISCUSSION

4.1. Women's Empowerment and Household Food Security: Situating the Findings from Itasy considering international Evidence

The results issued from the study in the Itasy region show that women's empowerment, as measured by the overall WEAI-5DE score, is positively associated with household dietary diversity (HDDS) and the Food Consumption Score (FCS), albeit with a weak magnitude. These findings are broadly consistent with international studies using the WEAI, which report statistically significant yet often modest associations between women's empowerment and household food security.

In several contexts, including Bangladesh, Nepal, Ghana, and Burkina Faso, women's empowerment has been found to be associated with improvements in food security and dietary diversity, without constituting a sole or dominant determinant of these outcomes (Sraboni *et al.*, 2014; Malapit *et al.*, 2015; Malapit & Quisumbing, 2015; Cissé & Quisumbing, 2014). As observed in Itasy, these studies highlight that empowerment primarily acts as an enabling factor, strengthening households' ability to make better food choices when minimal resources are available, rather than as a lever capable of offsetting severe economic constraints on its own (Herforth & Harris, 2014; Moore *et al.*, 2023).

A first important point of convergence concerns the magnitude of the associations. The weak correlations observed in Itasy ($\rho = 0.174$ with HDDS; $\rho = 0.155$ with FCS) are comparable to the moderate effects reported in many studies, where coefficients, although positive, reflect partial and context-specific relationships. This similarity suggests that the Itasy context is not an exception but rather part of a widely documented pattern: women's empowerment improves enabling conditions for better diets, without necessarily guaranteeing substantial improvements in dietary outcomes (Herforth & Harris, 2014; FAO, 2022).

A second point of comparison concerns the WEAI domains associated with food indicators. In the literature, some studies highlight the role of control over income and economic decision-making in improving food security. In Itasy, however, these dimensions exhibit weak correlations with HDDS and FCS. This discrepancy may partly be explained by contextual specificities: in a setting characterized by high monetary and structural poverty and strong reliance on self-consumption, controlling limited financial resources does not necessarily translate into meaningful dietary diversification. It may also be related to methodological aspects, as the "control over income" domain relies on a single binary indicator in the 5DE, which reduces variability and may attenuate the strength of observed associations (Alkire *et al.*, 2013; Malapit *et al.*, 2017).

This interpretation is consistent with analyses conducted in Madagascar, which show that women often have relative autonomy over small daily expenditures (staple foods, condiments, minor household purchases), while strategic economic decisions (productive investments, equipment, land, marketing) remain largely controlled by men, particularly in cases of disagreement (FERT & FIFATA, 2020). In this context, partial control over income by women does not guarantee sufficient capacity to direct resources toward sustainable dietary diversification at the household level.

Conversely, time allocation and leadership domains appear to be key components of women's overall empowerment in Itasy, yet their relationship with food indicators remains very weak. Although less emphasized in some studies, this pattern is consistent with evidence suggesting that social dimensions of empowerment primarily enhance agency, self-esteem, and collective participation, without necessarily producing immediate nutritional outcomes. In Itasy, this may reflect a context in which women are gradually gaining voice and social recognition, while remaining constrained by heavy workloads, limited income, and norms governing intra-household food allocation (FAO, 2024; World Bank, 2024).

Finally, a distinctive feature of the Itasy case lies in its productive paradox: a highly agricultural region characterized by high levels of poverty and chronic malnutrition. In such a context, even improvements in empowerment may be difficult to translate into measurable dietary gains if production systems remain insufficiently diversified, market access is limited, or households prioritize the sale of agricultural products over own consumption.

Overall, the comparison between Itasy and international evidence leads to a convergent conclusion: women's empowerment is a necessary but insufficient condition for improving household food security. The findings from Itasy thus support the need for integrated approaches that combine empowerment interventions with support for agricultural diversification, improved economic access to food, and actions addressing social norms, in order to create an enabling environment for translating women's agency into tangible nutritional gains (Herforth & Harris, 2014; FAO, 2022; Moore *et al.*, 2023).

4.2. *Women's Empowerment and Minimum Dietary Diversity for Women: A Gap Between Empowerment and Individual Nutrition (MDD-W)*

The results obtained in Itasy show that the overall women's empowerment score (WEAI-5DE) is positively, albeit weakly, associated with the Minimum Dietary Diversity for Women (MDD-W) ($\rho = 0.165$). This level of association suggests that an increase in women's agency is accompanied by a slight improvement in their dietary diversity, without reflecting a strong or systematic relationship. This finding is consistent with several studies indicating that empowerment acts more as an indirect determinant of individual dietary practices rather than as a factor ensuring direct and immediate control over food consumption (Sraboni *et al.*, 2014; Malapit *et al.*, 2015; Malapit & Quisumbing, 2015; Moore *et al.*, 2023).

Although the relationship between women's empowerment and dietary diversity observed in this study is weak, other studies conducted in Madagascar have shown that poor nutritional conditions can indirectly affect women's empowerment. Indeed, a World Bank study demonstrated that undernourished children arrive at school hungry, experience difficulties focusing, and may feel ashamed. Furthermore, school fee payments become increasingly difficult for low-income households and single mothers, especially as these costs rise with higher levels of education. In addition to this, beyond the direct costs of schooling, participants in studies conducted in the three regions (Analamanga, Sofia, and Vangaindrano) consistently identified food insecurity as a major factor contributing to early school dropout. These constraints frequently lead to permanent early school dropout, particularly among girls from poor households (World Bank, 2023). Beyond that, a study conducted in Afghanistan highlights the importance of increasing access to education, as it can enhance women's participation in household decision-making processes (Rashidi, 2023).

Moreover, gender equality yields significant benefits for households and society, as it is associated with economic growth, improved labor productivity, poverty reduction, decreased food insecurity, and more favorable outcomes for future generations (Aguirre *et al.*, 2012; Allendorf, 2007; Andrabi *et al.*, 2011; Dumas & Lambert, 2011; Mulugeta, 2021). As Madagascar is experiencing significant demographic growth in its working-age population by 2050, directing investments toward the health, education, and empowerment of adolescent girls represents a key strategic priority, with the potential to generate long-term gains in economic growth and sustainable development. However, Madagascar continues to face substantial gender inequalities manifested in early marriage, a high domestic workload for women, limited access to health services, insufficient knowledge of contraceptive methods, as well as deeply rooted patriarchal and social norms (World Bank, 2023).

Among the WEAI domains, leadership exhibits the strongest relationship with MDD-W in Itasy ($\rho = 0.176$), although this association remains weak. This suggests that women who are more engaged in group activities, who feel confident speaking in public, or who hold positions of social recognition may marginally benefit from improved access to information, support networks, or resources that could positively influence their dietary practices. Analyses conducted in other contexts similarly indicate that certain social dimensions of empowerment are associated with more favorable nutritional behaviors; however, these effects remain highly conditioned by economic and contextual constraints (Malapit *et al.*, 2015; Moore *et al.*, 2023). Other studies, notably in Bangladesh, have shown that women's empowerment and food security are positively influenced by women's participation in various socio-economic organizations and cooperative structures (Holland & Rammohan, 2019).

However, as observed in Itasy, several studies demonstrate that women's economic or social empowerment does not necessarily translate into substantial improvements in their own dietary diversity when household resources are limited. A qualitative study in Nigeria highlights that even when women have greater economic autonomy, their food choices remain constrained by income levels, the cost of diversified foods, and social norms governing food allocation within the household (Onah *et al.*, 2022). These findings are further supported by a mixed-methods study conducted in Senegal, which identifies food prices, physical availability of food, as well as family dynamics and socially constructed gender roles within households as key factors influencing food-related decisions (Sylla & Diagne, 2024).

This observation is consistent with studies conducted in Madagascar, which show that women often have autonomy over certain daily expenditures related to food and household needs; however, this autonomy operates within a constrained budgetary space, while strategic economic decisions remain largely controlled by men (FERT & FIFATA, 2020). In such a context, even when women manage resources, these are primarily allocated to meet household and children's needs, without necessarily ensuring an improvement in their own dietary diversity.

One of the central mechanisms explaining this gap between empowerment and individual nutrition lies in intra-household allocation norms and practices. A systematic review conducted in South Asia shows that food distribution among adults is influenced by gender, social status, age, perceived economic contribution, and cultural norms, regardless of the overall level of empowerment (Harris-Fry *et al.*, 2017). In many contexts, women tend to prioritize the food consumption of children, as is often the case in Madagascar, and sometimes even that of their spouses, before their own, particularly for foods considered more nutritious or more expensive. Focus group discussions conducted in Itasy clearly illustrate these intra-household bargaining mechanisms, with several participants stating: "*When there is little food, we first give it to the children. As women, we eat afterwards, sometimes only what remains*" (FGD, Soavinandriana).

This “protective” allocation logic may result in potential benefits from empowerment accruing more to other household members than to women themselves.

Another explanatory factor is that the WEAI primarily captures capabilities and opportunities (decision-making power, control, participation), whereas the MDD-W reflects a highly immediate outcome that is sensitive to food prices, availability, and seasonality. Thus, a woman may have greater agency while still operating in an environment with limited dietary diversity and insufficient economic resources to regularly achieve the consumption of at least five food groups.

Overall, the results from Itasy suggest that women’s empowerment constitutes an important foundation for improving their nutritional status, but that it is not sufficient on its own to ensure adequate dietary diversity. This finding reinforces the need for strategies aimed at improving women’s nutrition to combine empowerment-focused interventions with actions that directly enhance economic access to diverse foods, increase the local availability of nutritious products, and transform social norms governing food allocation and value within households.

4.3. Constraints on Women’s Empowerment: Structural Barriers and Complementary Determinants

The results from Itasy confirm that women’s empowerment, although important, is not sufficient on its own to sustainably transform food and nutrition security in a context of structural rural poverty. The literature is convergent: empowerment primarily acts as an enabling factor, whose effects depend on actual access to economic resources, productive assets, and human capital (Sraboni *et al.*, 2014; Malapit *et al.*, 2015; Malapit & Quisumbing, 2015; Moore *et al.*, 2023). In Itasy, the margin for action remains limited: more than 69% of the population is poor, and 37.2% lives in extreme poverty (MID & UNDP, 2024). Despite considerable agricultural potential, the level of human development remains low (regional HDI of 0.501 in 2021, compared to 0.533 at the national level), reflecting persistent constraints in infrastructure, services, and opportunities (MID & UNDP, 2024). In this context, even when decision-making power increases, it faces very concrete constraints in terms of access to resources and the ability to ensure household food security.

A key insight concerns the structuring role of education in translating empowerment into tangible well-being, particularly in nutrition. In the sample, 26.9% of women are uneducated, 32.2% have only completed primary education, and only 11.3% have reached secondary or higher education, with no women having attained university-level education in Miarinarivo. This limited educational capital is embedded in multidimensional poverty, where educational deprivation strongly contributes to vulnerability (World Bank & INSTAT, 2024). Education also fosters collective engagement: each additional level of schooling increases the likelihood of participating in group-based structures by approximately 42%. Beyond formal qualifications, it enhances confidence, voice, and access to information. In the field, many women report “knowing” the importance of dietary diversity, while not always having the practical means to achieve it in their daily lives—highlighting a recurrent gap between knowledge and practice.

Within this context, group formations play a leveraging role, including for less educated women: they provide spaces for informal learning, exposure to positive role models, exchange, and socialization, progressively supporting self-confidence and decision-making capacities (Kwapong, 2005; Bonnassieux, 2014). However, this transformative function remains constrained by the low representation of women in leadership positions: within organizations affiliated with FIFATA, women account for only 23% of members of the boards of directors of farmers’ organizations (OPR) and 14% at the level of producer organizations (OPF), and approximately 25% of farmer facilitators (FERT & FIFATA, 2020). In Itasy, this suggests that group structures can serve as a bridge between individual and social empowerment, provided that, beyond production, they integrate functional literacy, nutrition, and leadership components.

Two other dimensions stand out clearly. First, male involvement: focus group discussions indicate that, even when women manage certain incomes or participate in decision-making, strategic decisions (sales, investments, production orientation) are often negotiated—and sometimes dominated—within the household. Without shifts in gender norms (such as the sharing of responsibilities and recognition of women’s economic roles), gains in women’s autonomy are unlikely to translate into improvements in diets and well-being. Second, time poverty: women simultaneously manage agricultural production, income-generating activities, domestic chores, water and firewood collection, childcare, and meal preparation. This heavy workload leaves little room for training, experimentation, or sustained participation in collective activities. These findings are consistent with studies in Africa showing that rural development is strongly linked to improvements in women’s conditions. However, women bear the burden of unpaid work, spending up to six times more time than men on unpaid domestic and care work. This ratio varies across African countries; in Mali, for instance, the gap is particularly pronounced (Fall & Jacquemot, 2023).

During focus group discussions, women described daily lives marked by the accumulation of productive and domestic responsibilities: “We work from morning to evening: in the fields, at home, for the children. Even if we want to learn or try something else, we do not have the time.” (FGD, Arivonimamo). Time thus emerges as a concrete constraining mechanism: the issue is not only “not knowing,” but often “not being able,” despite willingness.

Finally, limited access to productive resources remains a major constraint. Participation in decision-making does not necessarily imply control over assets: land, inputs, and credit remain less accessible to women. In Madagascar, several studies show that women are less

likely to receive land through inheritance or donation and have fewer means to acquire land, often relying more on rental arrangements. Without secure access to assets, decision-making empowerment remains partial and is difficult to translate into sustained nutritional gains.

4.4. Proposed framework: linking women's empowerment and nutritional outcomes

The combined analysis of quantitative and qualitative results highlights a key finding: women's empowerment constitutes an important lever for improving food and nutrition security, yet its effects remain partial, indirect, and highly dependent on the socioeconomic context. The observed weak but positive correlations between the overall WEAI score and food-related indicators, both at the household level (HDDS, FCS) and the individual level (MDD-W), suggest that empowerment acts more as an enabling factor that creates opportunities, rather than as a direct driver ensuring sustained changes in dietary practices.

Based on these results, a conceptual framework is proposed to represent the main pathways through which women's empowerment can influence nutritional outcomes in the Itasy region.

This conceptual framework is grounded in the assumption that the five domains of the WEAI do not exert uniform effects. Domains related to resources, production, and income control primarily contribute to the availability and economic access to food. In parallel, the domains of leadership and time allocation mainly strengthen women's social and organizational capabilities, including self-confidence, ability to express themselves, participation in collective activities, and negotiation within the household. Together, these dimensions feed into intermediate mechanisms that act as conversion pathways between empowerment and nutritional outcomes.

These intermediate mechanisms include: (i) economic and physical access to food, (ii) dietary practices (diversification, processing, preparation, and preservation), (iii) household budgetary allocation decisions, (iv) intra-household food distribution, and (v) access to information and social and institutional networks.

Nutritional indicators (HDDS, FCS, and MDD-W) thus appear as the final outcomes of a cumulative, complex, and non-linear process resulting from the interaction of these different levels.

However, these relationships are constrained by powerful structural and normative factors, such as monetary poverty, agricultural seasonality, limited market access, low levels of education, high workload, as well as gender norms and intra-household power relations. These constraints help explain why, despite progress observed in certain dimensions of empowerment, nutritional improvements remain overall limited.

The proposed framework therefore highlights:

- the multidimensional nature of women's empowerment;
- the diversity of pathways linking empowerment to nutritional outcomes;
- the central role of intermediate mechanisms;
- and the moderating effect of the socioeconomic and institutional context.

This analytical framework provides a basis for interpreting the observed correlations and for guiding the design of integrated interventions, combining women’s empowerment, economic strengthening, diversified food production, nutrition education, and transformation of social norms.

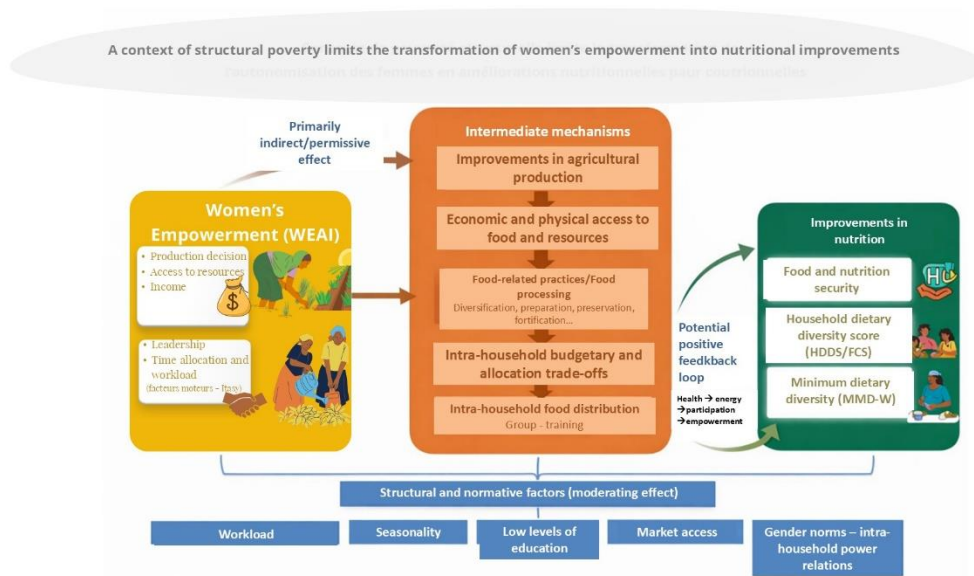


Figure 5 : Conceptual framework of the pathways linking women’s empowerment to household and women’s nutritional outcomes in the Itasy region

4.5. Recommendations

The findings of this study indicate that women’s empowerment constitutes a key lever for improving food and nutrition security in Itasy; however, its effects remain limited when it is not accompanied by structural interventions addressing living conditions, access to resources, and the broader social environment. These results therefore call for integrated interventions that combine empowerment, productive diversification, education, transformation of gender norms, and improved economic access to food.

First, agricultural projects would benefit from explicitly strengthening the nutrition orientation of their interventions by supporting the diversification of production toward nutrient-dense crops and livestock systems, while better linking production, household consumption, and dietary practices. The integration of simple, practical modules on nutrition, food processing, and preservation within agricultural activities appears to be a relevant entry point.

The results also highlight the structuring role of farmer groups as spaces for learning and the development of agency. Strengthening farmer organizations and women’s groups is recommended, as these can serve as platforms combining economic support, functional literacy, leadership development, and nutrition-related knowledge, while also promoting women’s access to leadership positions in order to address their underrepresentation in decision-making bodies.

Women’s heavy workload constitutes a major barrier to the sustained adoption of new practices. Projects should therefore incorporate solutions aimed at reducing time poverty (such as time-saving technologies, improved access to water, and post-harvest equipment) and promote a more equitable sharing of domestic responsibilities within households. Furthermore, the involvement of men is essential. Interventions would benefit from including community-based awareness activities on gender roles, joint decision-making, and the value of investing in women’s nutrition, in order to foster sustainable changes in social norms.

Women’s access to productive resources, particularly land, inputs, and credit, remains a cross-cutting priority. Without effective control over assets, decision-making empowerment is unlikely to translate into sustained nutritional improvements.

Finally, these findings confirm the need for multisectoral approaches, in alignment with the National Multisectoral Nutrition Action Plan (PNAMN) coordinated by Madagascar’s National Nutrition Office. Gender integration should be considered a cross-cutting principle throughout the entire project cycle, rather than a standalone component.

Overall, sustainable improvements in nutrition in Itasy depend on the coherent combination of economic, social, and institutional interventions, in which women’s empowerment constitutes a central pillar, yet one that must be articulated with other key determinants.

4.6. Study limitations

As with any field-based study, this work provides, above all, a snapshot of the situation. The analysis is based on 264 women with complete WEAI data (and 182 for MDD-W), which allows for the identification of general trends but limits a more detailed examination of certain local variations. Moreover, data were collected at a single point in time; however, in Itasy, food consumption and resource availability vary considerably across seasons, prices, and agricultural cycles—dynamics that this survey could not capture over a full year. These variations were nonetheless addressed during the focus group discussions (FGDs).

Finally, as this is a cross-sectional study, the correlations observed indicate associations without allowing causal inferences. The focus on the 5DE (without calculating the GPI) and the nature of some indicators (particularly income control, which is more “binary” in nature) may also reduce the observed variability. Despite these limitations, the triangulation with interviews and FGDs contributes to contextualizing the findings and grounding the results in the lived experiences of the women surveyed.

V-CONCLUSION

This study conducted in Itasy highlights a reality that is both encouraging and concerning. It is encouraging because the women interviewed are widely involved in production-related decision-making and, for many of them, report access to resources and a certain degree of control over income. It is concerning, however, because despite this apparent agency, the food and nutritional situation remain fragile, and, more importantly, women’s dietary diversity remains very low: only a minority achieves the minimum dietary diversity. In other words, even when the household is “coping,” women’s own dietary intake does not always follow.

The analyses show that empowerment (WEAI-5DE) is indeed associated with improved food security (FCS, HDDS) and slightly better dietary diversity among women; however, these relationships remain weak. This underscores a simple yet important point: while empowerment expands opportunities, it cannot, on its own, offset poverty, seasonality, food price inflation, and prevailing social norms. In Itasy, leadership and time emerge as central pillars of women’s agency; however, heavy workloads, unequal access to assets, and intra-household bargaining dynamics continue to constrain the translation of this agency into tangible nutritional gains.

These findings call for moving beyond siloed approaches. For empowerment to become a genuine lever for improving nutrition, it must be accompanied by simultaneous actions aimed at diversifying production, improving economic access to nutritious foods, providing practical nutrition education, reducing time poverty, and engaging men in transforming social norms. More broadly, this study emphasizes that empowerment is not only reflected in decision-making power, but also in the very concrete ability to eat better, rest, and take care of oneself. Strengthening this capacity at both household and community levels is crucial for sustainably reducing nutritional vulnerability in Itasy.

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