

Artisanal Fisheries, Food Security, and Sustainable Resource Management in Coastal Communities of Southern Madagascar

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Abstract

Artisanal fisheries are fundamental to the livelihoods, food security, and economic resilience of coastal communities in southern Madagascar, yet increasing fishing pressure and environmental change threaten their long-term sustainability. This study examined the contribution of artisanal fisheries to household food security and sustainable resource management using a mixed-methods approach. Primary data were collected from 320 fishing households and 96 non-fishing households across six coastal communities through household surveys, fisheries landing observations, key informant interviews, and focus group discussions. Household food security was assessed using the Food Consumption Score (FCS) and the Household Food Insecurity Access Scale (HFIAS), while fisheries productivity was evaluated using Catch per Unit Effort (CPUE). Multiple linear regression was employed to identify the socio-economic determinants of household food security. The results indicate that fishing households generally achieved higher food security than non-fishing households, although a significant decline in CPUE suggests increasing pressure on marine resources. Livelihood diversification emerged as the strongest predictor of household food security, followed by fishing income and market accessibility. The findings highlight the need for integrated policies that combine sustainable fisheries management, livelihood diversification, and improved market access to enhance household resilience while ensuring the long-term sustainability of coastal fisheries in southern Madagascar.

Keywords: *fisheries; food security; coastal; sustainable; Madagascar.*

Introduction

Artisanal fisheries constitute one of the most important livelihood systems for millions of coastal households worldwide, providing employment, income generation, and a critical source of animal protein. According to the Food and Agriculture Organization (FAO), small-scale fisheries account for approximately 90% of the global capture fisheries workforce and directly or indirectly support the livelihoods of more than 600 million people, particularly in developing countries where fisheries remain central to food systems and rural economies (FAO, 2024). Beyond their economic contribution, artisanal fisheries play a fundamental role in reducing poverty, improving dietary diversity, and strengthening the resilience of vulnerable coastal populations. These multiple functions position small-scale fisheries at the intersection of several Sustainable Development Goals (SDGs), notably SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 14 (Life Below Water), and SDG 13 (Climate Action).

Despite their importance, artisanal fisheries increasingly face unprecedented environmental and socio-economic challenges. Rapid population growth, climate variability, coastal habitat degradation, illegal and unregulated fishing, and increasing market pressures have intensified the exploitation of marine resources across many tropical regions. Declining fish stocks threaten not only ecosystem integrity but also the livelihoods and food security of

communities that depend heavily on fisheries for subsistence and income (Hilborn et al., 2020; FAO, 2024). Consequently, ensuring food security while maintaining the ecological sustainability of fisheries has become a major policy challenge, particularly in low-income coastal regions where livelihood alternatives remain limited.

Food security extends beyond food availability to encompass access, utilization, and stability over time (FAO, IFAD, UNICEF, WFP & WHO, 2023). For fishing households, these dimensions are strongly influenced by the productivity of marine ecosystems, access to fishing resources, household income, market integration, and the capacity to diversify livelihoods. Previous studies have consistently shown that artisanal fisheries contribute substantially to household nutrition through direct fish consumption while simultaneously generating income that improves access to other food products (Béné et al., 2016; Kawarazuka & Béné, 2011). Fish remains one of the most affordable and nutrient-rich animal-source foods, providing essential proteins, omega-3 fatty acids, vitamins, and micronutrients that are particularly important in regions experiencing chronic food insecurity.

Madagascar represents one of the world's biodiversity hotspots while simultaneously ranking among the countries most vulnerable to food insecurity and climate change. More than half a million people depend directly on artisanal fisheries, which contribute to the majority of national marine landings and support numerous coastal value chains (Ministry of Fisheries and Blue Economy, 2023). The southern regions of Anosy, Androy, and Atsimo-Andrefana are particularly dependent on marine resources because agricultural production is constrained by recurrent droughts, highly variable rainfall, and fragile agroecological conditions. For many households in these regions, fishing functions as both a primary livelihood activity and an essential coping strategy during periods of agricultural failure.

The socio-economic importance of artisanal fisheries in southern Madagascar extends well beyond income generation. Fishing activity structures local economies, sustains traditional governance institutions such as *dina* (customary community regulations), supports fish processing and marketing activities, and provides one of the few reliable sources of animal protein available to coastal households (Eric et al., 2025; Sulla et al., 2026; Emynorane et al., 2025). However, growing evidence suggests that these fisheries are under increasing ecological pressure. Previous studies have documented declining catch rates, reductions in average fish size, expansion of fishing grounds, and increasing dependence on export-oriented species such as octopus and lobster (Le Manach et al., 2012; Harris, 2011; Gough et al., 2020). These trends raise important concerns regarding the long-term sustainability of fisheries resources and their capacity to continue supporting local food systems.

Although numerous studies have examined either the ecological sustainability of artisanal fisheries or their contribution to rural livelihoods, relatively few have analysed both dimensions within an integrated analytical framework. Existing research has frequently focused on fisheries production, biodiversity conservation, or household livelihoods independently, often overlooking the interactions between ecological change and household food security. Likewise, studies assessing food security commonly rely on socio-economic indicators without incorporating ecological measures of fisheries productivity, whereas fisheries assessments often neglect standardized indicators of household food security (Thilsted et al., 2016). This separation limits our understanding of how changes in marine resource availability translate into household welfare outcomes.

Furthermore, empirical evidence from Madagascar remains comparatively limited despite the country's exceptional dependence on small-scale fisheries. Existing research has largely concentrated on ecological monitoring, governance systems, or specific commercial fisheries, with relatively little quantitative evidence linking fisheries productivity, household food security, and livelihood diversification across multiple coastal regions. In particular, few studies have simultaneously combined internationally recognized food security

indicators, including the Food Consumption Score (FCS) and the Household Food Insecurity Access Scale (HFIAS), with ecological indicators such as Catch Per Unit Effort (CPUE) to examine the sustainability of artisanal fisheries within an integrated socio-ecological framework.

Addressing this knowledge gap is particularly important because policies designed solely to increase fisheries production may inadvertently accelerate resource depletion, while conservation measures implemented without considering household livelihoods may undermine food security and community resilience. A better understanding of the relationships among fisheries productivity, household welfare, and livelihood diversification is therefore essential for designing balanced management strategies capable of achieving both ecological sustainability and socio-economic development.

This study addresses these challenges by investigating the contribution of artisanal fisheries to household food security and sustainable resource management across six coastal communities located in the southern regions of Anosy, Androy, and Atsimo-Andrefana, Madagascar. Using a mixed-methods research design combining household surveys, fisheries landing monitoring, semi-structured interviews, and focus group discussions, the study integrates standardized food security indicators (FCS and HFIAS) with ecological indicators of fisheries productivity (CPUE). This integrated approach enables simultaneous assessment of household nutritional outcomes and trends in fisheries resource sustainability.

Specifically, the study pursues four objectives: (i) to characterize the socio-economic profile and fishing practices of artisanal fishing households; (ii) to evaluate the contribution of artisanal fisheries to household food security through standardized food security indicators; (iii) to assess recent changes in fisheries productivity using Catch Per Unit Effort as an indicator of resource pressure; and (iv) to identify the socio-economic determinants of household food security, with particular attention to the role of livelihood diversification. By integrating ecological and socio-economic evidence within a single analytical framework, this study contributes to the growing literature on sustainable small-scale fisheries and provides policy-relevant evidence for improving food security, strengthening community resilience, and promoting sustainable fisheries management in southern Madagascar and comparable coastal regions across the Global South.

Methodology

Study Area and Research Design

This study was conducted in six artisanal fishing communities located along the southern coast of Madagascar, covering the regions of Anosy, Androy, and Atsimo-Andrefana. These regions constitute some of the country's most important small-scale fishing areas and are characterized by a high dependence on marine resources for livelihoods, household income, and food security. The coastal ecosystems comprise coral reefs, mangrove forests, seagrass beds, and nearshore fishing grounds that support a diverse range of commercially and nutritionally important fish and invertebrate species. Despite their ecological significance, these ecosystems are increasingly threatened by overfishing, habitat degradation, climate variability, and limited management capacity, posing substantial challenges to the sustainability of artisanal fisheries and the well-being of fishing communities.

The study area experiences a semi-arid tropical climate with low and highly variable rainfall, prolonged droughts, and frequent climatic shocks that constrain agricultural production. Consequently, artisanal fisheries serve as one of the principal livelihood strategies for coastal households, providing employment opportunities, income generation, and an essential source of animal protein. Fishing activities are predominantly undertaken using traditional wooden canoes or small motorized vessels equipped with fishing gear such as gillnets, handlines, longlines, traps, and spear guns. The selection of these regions was

based on their economic importance to Madagascar's artisanal fisheries sector, the diversity of fishing practices, and the high dependence of local communities on marine resources.

A mixed-methods research design was adopted to investigate the relationships between artisanal fisheries, household food security, and sustainable resource management. Integrating quantitative and qualitative approaches enabled a comprehensive assessment of both measurable household and fisheries characteristics and the contextual factors influencing resource use and livelihood outcomes. Quantitative data provided evidence on household socio-economic conditions, fisheries production, and food security status, while qualitative information facilitated a deeper understanding of community perceptions, governance systems, and local adaptation strategies. The integration of multiple data sources strengthened the validity of the findings through methodological triangulation and provided a holistic understanding of the complex socio-ecological interactions underpinning artisanal fisheries in southern Madagascar (Creswell & Creswell, 2018).

Sampling Procedure and Data Collection

The target population comprised households directly engaged in artisanal fisheries across the selected coastal communities of Anosy, Androy, and Atsimo-Andrefana. A multistage sampling technique was employed to ensure that the sample adequately represented the diversity of fishing households within the study area. Initially, six fishing communities were purposively selected based on the economic importance of artisanal fisheries, dependence on marine resources, accessibility, and the diversity of fishing practices. Subsequently, households were selected using systematic random sampling from community household registers prepared in collaboration with local authorities and fisheries representatives.

The sample size was determined using the formula proposed by Yamane (1967), which is widely applied in socio-economic and fisheries research for finite populations:

$$n = N / (1 + N.e^2)$$

where n is the required sample size, N is the total number of households in the target population, and e is the desired level of precision, set at 5% with a 95% confidence level. This approach ensured statistically reliable estimates while remaining feasible within the logistical constraints of fieldwork. In cases where selected households were unavailable or declined to participate, replacement households were randomly selected from the same community to maintain sample representativeness and minimise sampling bias.

Primary data were collected through structured face-to-face interviews using a pre-tested household questionnaire administered by trained enumerators. The questionnaire gathered information on household demographic characteristics, educational attainment, fishing experience, household composition, income sources, fishing assets, fishing effort, catch composition, fish marketing practices, livelihood diversification, household expenditure, food consumption, and perceptions of changes in marine resources. Prior to the main survey, the questionnaire was pilot-tested in a neighbouring fishing community to assess clarity, consistency, and contextual relevance. Feedback from the pilot survey was incorporated to refine question wording and improve the reliability of the data collection instrument.

To complement the household survey, direct observations of fisheries landings were conducted at the principal landing sites within each study community throughout the survey period. Information recorded included fish species composition, total catch weight, fishing gear employed, fishing duration, crew size, number of fishing trips, and prevailing market prices. These observations provided objective measures of fisheries productivity and reduced dependence on self-reported catch information. Species identification was verified

using national fisheries identification guides to ensure taxonomic consistency and data accuracy.

Qualitative information was collected through semi-structured interviews with key informants, including fisheries officers, community leaders, leaders of fishers' associations, seafood traders, representatives of non-governmental organisations, and experienced fishers. These interviews explored fisheries governance, customary resource management practices, perceived trends in fish abundance, drivers of resource depletion, market conditions, regulatory compliance, and livelihood challenges. In addition, separate focus group discussions were conducted with male fishers, women engaged in fish processing and marketing, and youth involved in fisheries-related activities to capture diverse community perspectives on food security, seasonal fishing patterns, livelihood strategies, conservation practices, and resource-use conflicts. All interviews and discussions were conducted with informed consent, audio-recorded where permitted, transcribed verbatim, and analysed using thematic analysis following the approach of Braun and Clarke (2006).

Secondary data were obtained from the Ministry of Fisheries and Blue Economy of Madagascar, the Food and Agriculture Organization (FAO), the World Food Programme (WFP), published scientific literature, fisheries statistics, policy documents, and local administrative records. These sources provided complementary information on fisheries production, demographic characteristics, institutional frameworks, and food security conditions, thereby supporting the interpretation and validation of the primary data.

Measurement of Variables and Data Analysis

The study employed both descriptive and inferential statistical techniques to analyse the relationships between artisanal fisheries, household food security, and sustainable resource management. Descriptive statistics, including frequencies, percentages, means, standard deviations, and cross-tabulations, were used to summarize the socio-economic characteristics of fishing households, fishing practices, catch composition, livelihood activities, and household food security status.

Household food security was assessed using the Food Consumption Score (FCS) developed by the World Food Programme (WFP, 2008). The FCS is a composite indicator that combines dietary diversity, food consumption frequency, and the relative nutritional importance of different food groups consumed during the seven days preceding the survey. The Food Consumption Score was calculated as:

$$FCS = \sum_{i=1}^n (a_i \times x_i)$$

where (x_i) represents the number of days each food group was consumed during the previous seven days (capped at seven days), and (a_i) denotes the standardized weighting factor assigned to each food group according to its nutritional value. Following WFP guidelines, households were classified into three food consumption categories: poor (0–21), borderline (21.5–35), and acceptable (>35).

Household food access was further evaluated using the Household Food Insecurity Access Scale (HFIAS) developed by Coates et al. (2007). The HFIAS consists of nine occurrence questions that measure household experiences of food insecurity during the four weeks preceding the survey. Responses were scored according to the frequency of occurrence, with 0 = never, 1 = rarely, 2 = sometimes, and 3 = often. The overall HFIAS score was computed as:

$$HFIAS = \sum_{j=1 \text{ to } 9} S_j, \text{ with } S_j \in \{0, 1, 2, 3\}$$

where (S_i) represents the score assigned to each of the nine food insecurity occurrence questions. The resulting HFIAS score ranges from 0 to 27, with higher scores indicating greater levels of household food insecurity.

The sustainability of fisheries resources was evaluated using Catch per Unit Effort (CPUE), one of the most widely accepted indicators of fisheries productivity and stock abundance. CPUE provides an indirect measure of resource availability by relating the quantity of fish harvested to the fishing effort expended. It was calculated as:

$$CPUE_t = C_t / E_t$$

where (C) is the total catch (kg) obtained during a fishing trip and (E) represents the corresponding fishing effort, expressed as the number of fishing trips, fishing hours, or gear units deployed. Declining CPUE values were interpreted as indicative of increasing fishing pressure or declining resource availability, whereas stable or increasing CPUE values suggested relatively sustainable exploitation of fish stocks.

To evaluate livelihood diversification among fishing households, the Simpson Diversity Index (SDI) was employed. This index measures the extent to which households diversify their income sources and is expressed as:

$$D = 1 - \sum_{i=1}^S [p_i(p_i - 1)] / [P(P - 1)]$$

where (P_i) is the proportion of total household income derived from the i th livelihood activity. The SDI ranges from 0 to 1, with values approaching one indicating greater livelihood diversification and improved household resilience to economic and environmental shocks.

Inferential statistical analyses were subsequently performed to identify the socio-economic determinants of household food security. Depending on the distribution and nature of the dependent variable, regression analysis was employed to examine the effects of household demographic characteristics, educational attainment, fishing experience, household size, fishing income, livelihood diversification, fishing effort, and fisheries productivity on household food security outcomes. Prior to model estimation, explanatory variables were examined for multicollinearity using the Variance Inflation Factor (VIF), while model adequacy and goodness-of-fit were assessed using appropriate diagnostic statistics. Statistical significance was evaluated at the 1%, 5%, and 10% probability levels.

Qualitative data obtained from key informant interviews and focus group discussions were analysed using thematic analysis following the procedures described by Braun and Clarke (2006). Interview transcripts were systematically coded to identify recurrent themes related to fisheries governance, resource management, food security, livelihood adaptation, and community perceptions regarding changes in marine resources. The qualitative findings were subsequently triangulated with quantitative results to strengthen interpretation and provide a comprehensive understanding of the interactions between artisanal fisheries, household food security, and sustainable resource management.

All quantitative analyses were conducted using the Statistical Package for the Social Sciences (SPSS) (Version 26.0), while tables and figures were prepared using Microsoft Excel. Statistical significance was determined at a 95% confidence level unless otherwise stated.

Ethical Considerations

Ethical principles were strictly observed throughout the study to ensure the rights, dignity, and confidentiality of all participants. Prior to data collection, permission to conduct the research was obtained from the relevant local authorities and community leaders in the selected fishing communities. Participation was entirely voluntary, and informed consent was obtained from all respondents after explaining the objectives of the study, the intended

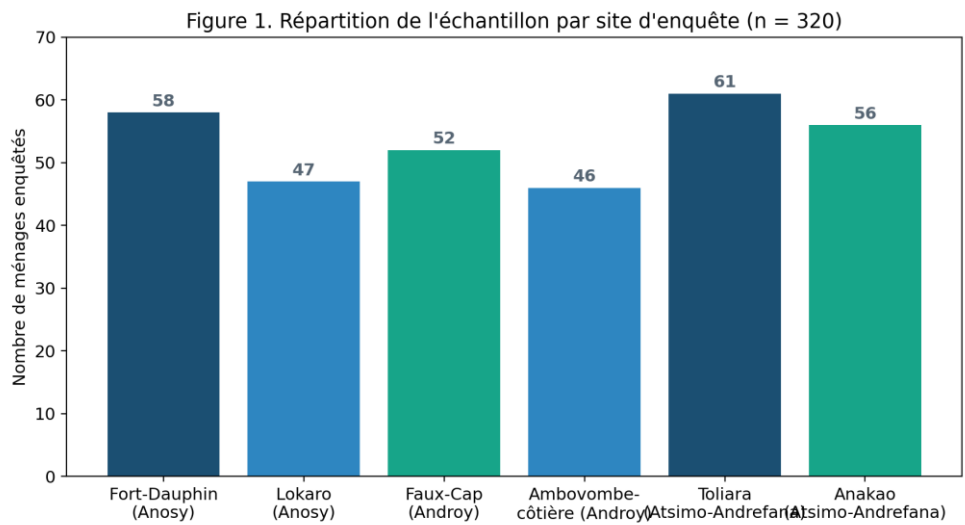
use of the data, and their right to withdraw at any stage without consequence. To protect participants' privacy, all information was treated confidentially, anonymised during data analysis, and used exclusively for academic research purposes. The study was conducted in accordance with internationally accepted ethical standards for social science research involving human participants.

Results and Discussion

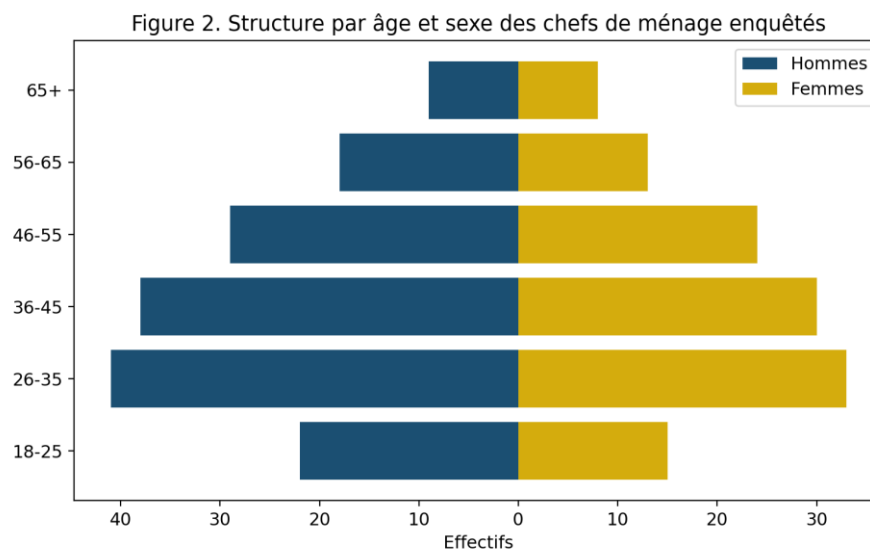
Socio-economic Characteristics of Fishing Households

A total of 320 artisanal fishing households and 96 non-fishing households were successfully surveyed, resulting in a questionnaire completion rate of 97.8%. In addition, 1,284 fishing trips were monitored across the six study sites over twelve months, providing a robust dataset for analysing household livelihoods, fisheries production, and food security. The combination of household survey data and fisheries landing observations enabled a comprehensive assessment of the socio-economic characteristics and fishing practices of coastal communities in southern Madagascar.

The distribution of sampled households across the six study sites was relatively balanced, ranging from 46 households in Ambovombe-Côtière to 61 households in Toliara, reflecting the proportional allocation of samples according to the size of the fishing population in each community (Fig. 1). This proportional sampling strategy improved the representativeness of the survey and reduced the likelihood of sampling bias across communities with different population sizes.

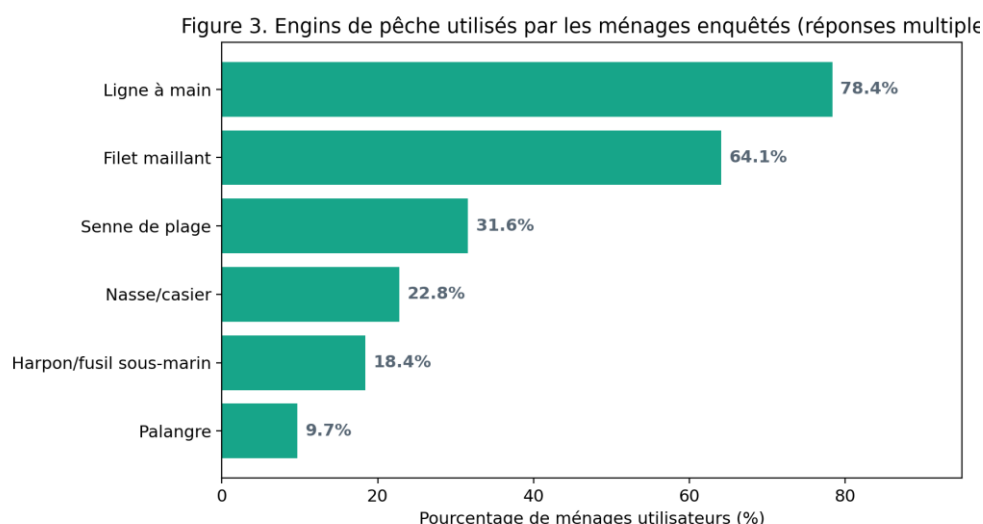


Source: Authors' fieldwork, 2026



Source: Authors' fieldwork, 2026

The demographic characteristics of the respondents indicate that artisanal fisheries remain a predominantly male occupation, with 68.4% of surveyed household heads being men. Individuals aged 26–45 years represented 41.3% of the respondents (Fig. 2), demonstrating that the sector is largely sustained by economically active adults. This age structure suggests that artisanal fisheries continue to provide employment opportunities for the productive labour force while supporting household livelihoods in coastal communities. Similar demographic patterns have been reported for small-scale fisheries in Madagascar and other developing coastal regions, where fishing activities are primarily undertaken by adults within the most economically productive age groups (Harris, 2011; FAO, 2024). The average household size was 5.7 persons (± 2.1), exceeding the national average and indicating greater pressure on household resources, income allocation, and food consumption requirements.



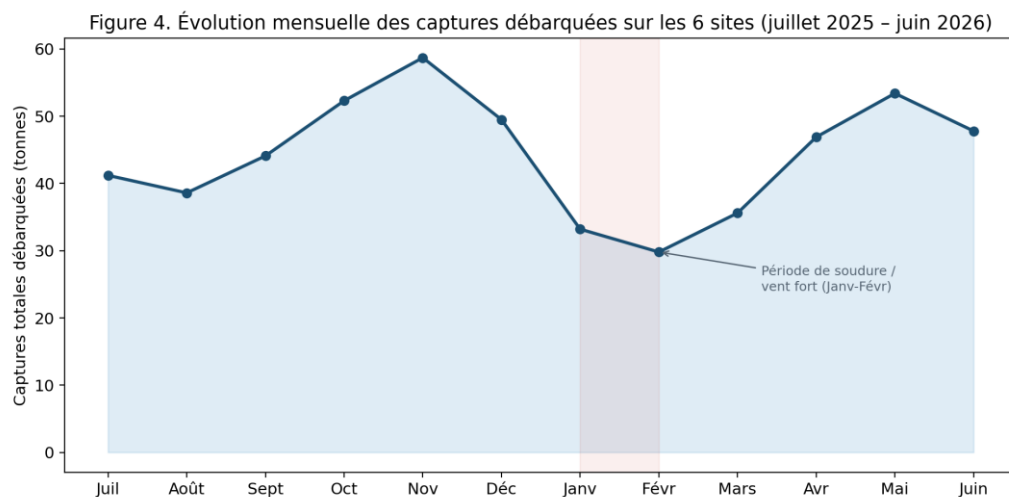
Source: Authors' fieldwork, 2026

The technical characteristics of fishing operations further illustrate the small-scale nature of the fisheries sector. Handlines were the most frequently used fishing gear, adopted by 78.4% of fishing households, followed by gillnets (64.1%), whereas longlines were used by

only 9.7% of respondents (Fig. 3). The predominance of relatively inexpensive and traditional fishing gears reflects the limited financial capacity of fishing households and the low level of mechanisation characterising artisanal fisheries in southern Madagascar. Similar observations have been reported by Le Manach et al. (2012), who highlighted the continued dependence of Malagasy coastal communities on low-capital fishing technologies. Although these gears enable broad participation in fisheries, their widespread use may also increase fishing pressure on nearshore resources and raise concerns regarding gear selectivity, bycatch, and the long-term sustainability of exploited fish stocks.

Contribution of Artisanal Fisheries to Household Food Security

The contribution of artisanal fisheries to household food security was assessed using fisheries landing observations and two internationally recognised indicators: the Food Consumption Score (FCS) and the Household Food Insecurity Access Scale (HFIAS). The monitoring of fish landings over twelve months revealed pronounced seasonal fluctuations in fisheries production (Fig. 4). Total landings reached a maximum of 58.7 tonnes in November, coinciding with the seasonal abundance of pelagic species, whereas catches declined to approximately 30 tonnes during January and February. This decline corresponds with periods of strong winds and the annual lean season experienced across southern Madagascar, when both agricultural production and fishing activities are constrained. These findings indicate that although artisanal fisheries constitute an important source of food and income, their capacity to buffer seasonal food shortages is influenced by climatic variability and seasonal changes in marine resource availability. Similar seasonal patterns have been documented in small-scale fisheries throughout the western Indian Ocean, where weather conditions and species migration strongly influence fishing productivity (FAO, 2024).

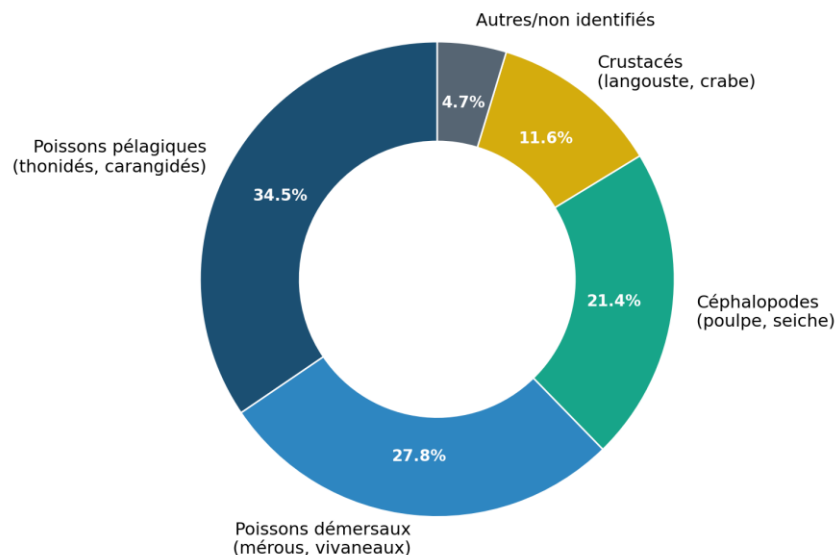


Source: Authors' fieldwork, 2026.

Analysis of catch composition further demonstrated the economic and nutritional importance of pelagic fisheries within the study area (Fig. 5). Pelagic species accounted for 34.5% of the total catch volume, followed by demersal species (27.8%) and cephalopods, primarily octopus (21.4%). The increasing contribution of octopus reflects the growing integration of artisanal fisheries into export-oriented value chains, particularly in southwestern Madagascar. This trend is consistent with previous studies reporting the expansion of octopus fisheries driven by increasing international market demand and improved market access for coastal fishing communities (Harris, 2011). While export markets provide valuable income opportunities, they also highlight the importance of implementing

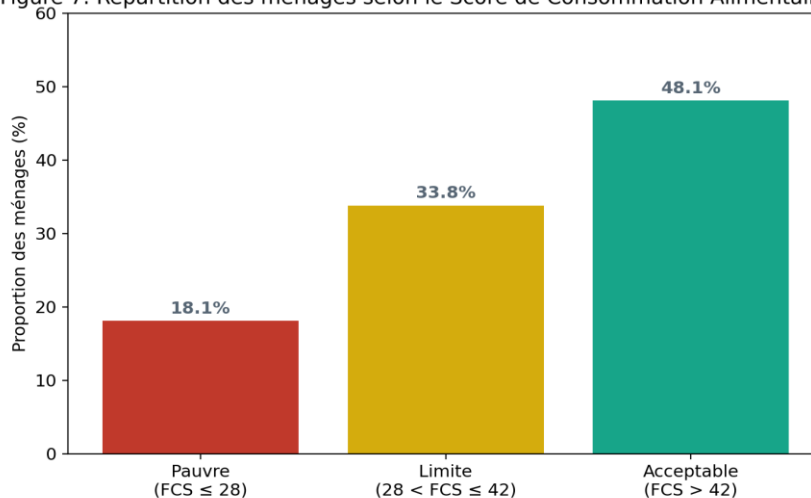
effective management measures to ensure that commercially valuable species remain sustainably exploited.

Figure 5. Composition des captures débarquées par grand groupe d'espèces (n = 1 284 sorties observées)



Source: Authors' fieldwork, 2026.

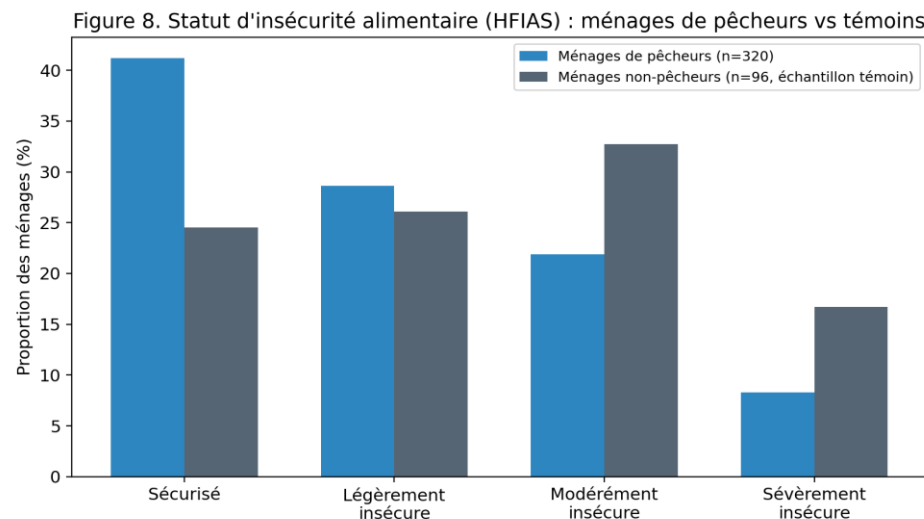
Figure 7. Répartition des ménages selon le Score de Consommation Alimentaire (



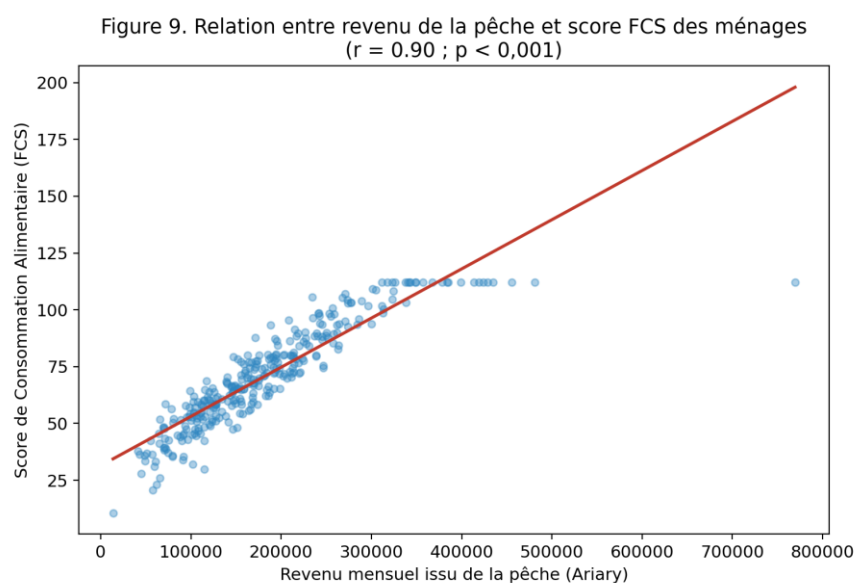
Source: Authors' fieldwork, 2026

Household food security assessments revealed that 48.1% of fishing households achieved an acceptable Food Consumption Score, while 33.8% fell within the borderline category and 18.1% exhibited poor food consumption (Fig. 7). These findings suggest that although artisanal fisheries make a substantial contribution to household diets, a considerable proportion of fishing households continue to experience nutritional vulnerability. Comparison with the non-fishing control group using the HFIAS demonstrated a clear advantage for fishing households (Fig. 8). Approximately 41.2% of fishing households were classified as food secure compared with only 24.5% of non-fishing households, whereas severe food insecurity affected 8.3% and 16.7%, respectively. The Chi-square test confirmed a statistically significant association between participation in artisanal

fisheries and household food security ($\chi^2 = 24.7$, $df = 3$, $p < 0.001$), supporting the hypothesis that engagement in artisanal fisheries significantly improves household food security. These results reinforce the widely recognised role of small-scale fisheries in enhancing food availability, dietary diversity, and livelihood resilience among coastal populations, particularly in developing countries where alternative income opportunities remain limited (Béné et al., 2016; FAO, 2024).



Source: Authors' fieldwork, 2026.



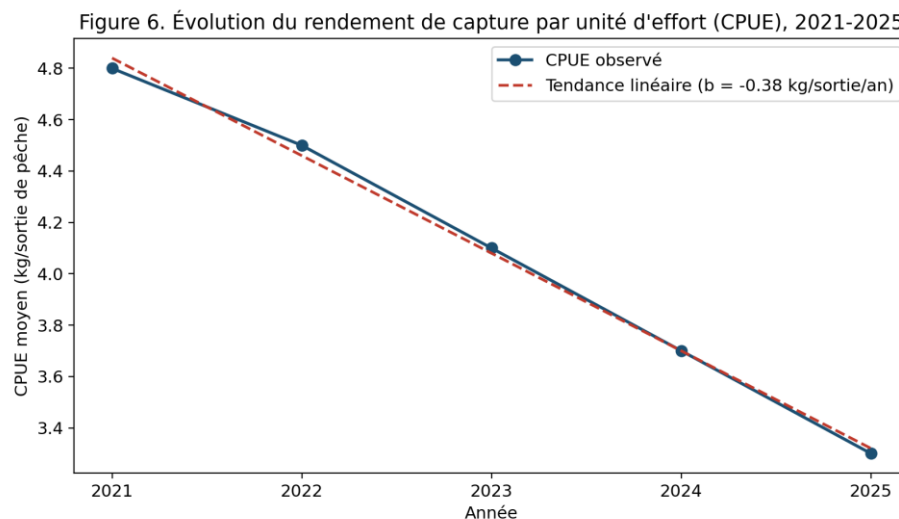
Source: Authors' fieldwork, 2026.

The relationship between fisheries-derived income and household food consumption further supports the importance of artisanal fisheries for rural livelihoods. A significant positive correlation was observed between monthly fishing income and household Food Consumption Scores ($r = 0.58$, $p < 0.001$) (Fig. 9), indicating that households generating higher fishing income generally achieved more diversified and nutritionally adequate diets. Nevertheless, the moderate magnitude of the correlation suggests that food security is influenced by multiple socio-economic factors beyond fishing income alone, including household size, market accessibility, livelihood diversification, and access to public services.

Consequently, improving household food security in coastal Madagascar requires integrated development strategies that combine sustainable fisheries management with broader livelihood and rural development interventions.

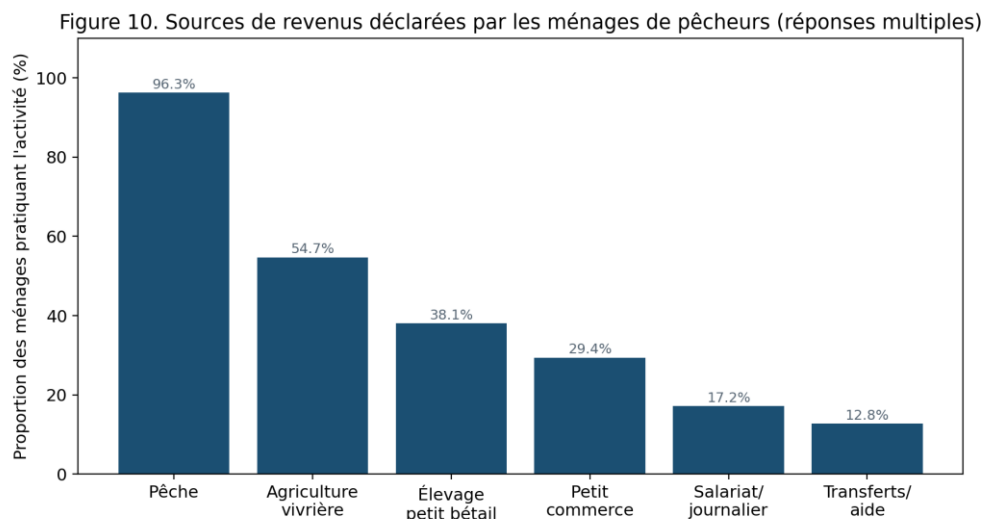
Fisheries Productivity and Resource Sustainability

The sustainability of artisanal fisheries was evaluated using Catch per Unit Effort (CPUE), catch diversity, and fishers' perceptions of changes in marine resources. The analysis of historical fisheries data revealed a consistent decline in average CPUE over the period 2021–2025, decreasing from 4.8 kg per fishing trip in 2021 to 3.3 kg per trip in 2025, representing an overall reduction of 31.3% (Fig. 6). Linear regression analysis confirmed a significant negative trend ($b = -0.375 \text{ kg trip}^{-1} \text{ year}^{-1}$; $t = -9.84$; $p = 0.002$; $R^2 = 0.96$), indicating a continuous decline in fisheries productivity during the study period. These findings support the hypothesis that increasing fishing pressure, together with environmental and climatic stressors, has contributed to the progressive reduction in catch rates within the coastal communities of southern Madagascar. Similar declines in CPUE have been reported in other small-scale fisheries across the western Indian Ocean, where growing fishing effort and ecosystem degradation have reduced the productivity of coastal fish stocks (Hilborn et al., 2020; FAO, 2024).



Source: Authors' fieldwork, 2026.

The composition of fish landings remained relatively diverse, with the Simpson Diversity Index ($D = 0.74$) indicating that a wide range of species continues to contribute to artisanal fisheries. However, field observations and key informant interviews revealed a gradual shift in fishing effort towards demersal species and cephalopods, particularly octopus, as traditionally abundant pelagic species become less accessible in nearshore waters. This change in species composition may reflect both ecological responses to increasing exploitation and fishers' adaptive strategies to maintain catches despite declining availability of preferred target species. Although species diversity remains comparatively high, continued shifts in catch composition may signal changes in ecosystem structure that warrant closer monitoring and adaptive fisheries management.



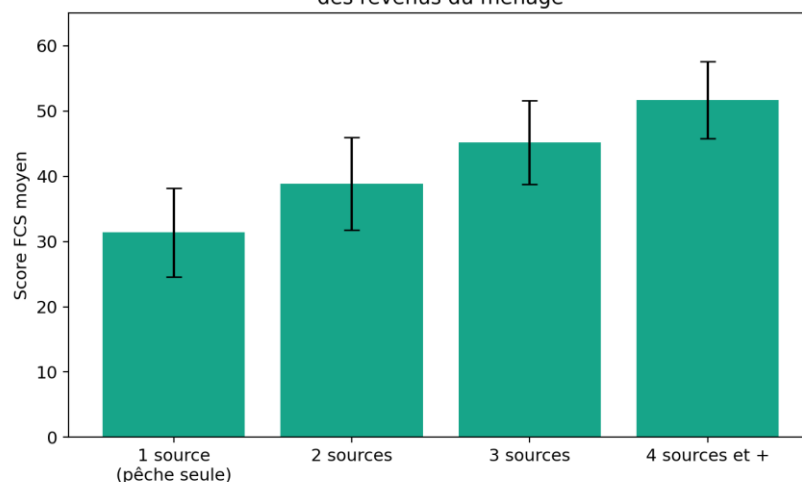
Source: Authors' fieldwork, 2026.

Fishers' perceptions further reinforced the quantitative evidence of declining fisheries productivity (Fig. 10). Nearly half of the respondents (46.3%) reported that marine resources had declined substantially over the previous five years, while an additional 31.9% perceived a moderate decline, indicating that 78.2% of surveyed households recognised a deterioration in fish abundance. The strong agreement between fisheries-dependent communities and the observed decline in CPUE strengthens confidence in the overall assessment of increasing pressure on marine resources. Similar consistencies between local ecological knowledge and scientific monitoring have been widely documented in small-scale fisheries, highlighting the value of integrating fishers' knowledge into fisheries assessment and management. These findings underscore the need to strengthen community-based fisheries governance, improve compliance with fisheries regulations, promote selective fishing practices, and enhance long-term monitoring programmes to ensure the sustainable utilisation of marine resources while safeguarding the livelihoods and food security of coastal communities.

Socio-economic Determinants of Household Food Security

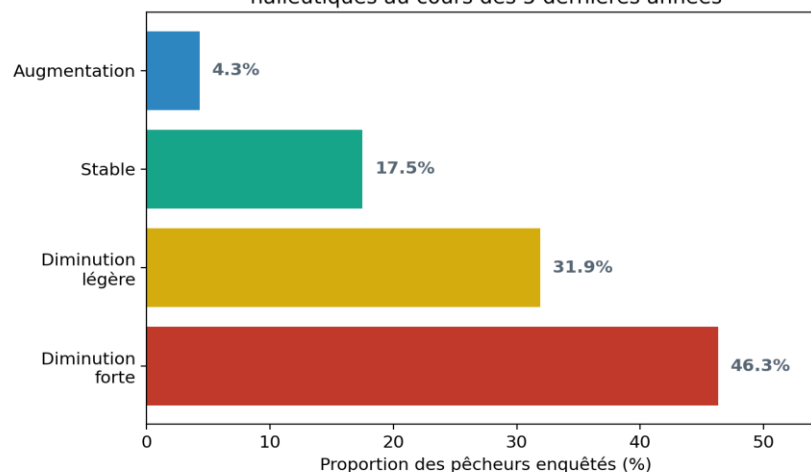
The final objective of this study was to identify the socio-economic factors influencing household food security among artisanal fishing households, with particular emphasis on the role of livelihood diversification. Descriptive analysis revealed that fishing remained the principal livelihood activity for 96.3% of surveyed households, although many households supplemented their income through subsistence agriculture (54.7%), small livestock production (38.1%), and petty trade (29.4%) (Fig. 11). Household food security improved consistently with increasing livelihood diversification, as the mean Food Consumption Score (FCS) increased from 31.4 among households relying exclusively on fishing to 51.7 among those with four or more income sources (Fig. 12). These findings suggest that diversified livelihood strategies strengthen household resilience by reducing dependence on a single income source and improving the capacity to cope with seasonal fluctuations in fisheries production and market conditions.

Figure 11. Score FCS moyen selon le niveau de diversification des revenus du ménage



Source: Authors' fieldwork, 2026.

Figure 12. Perception des pêcheurs sur l'évolution des ressources halieutiques au cours des 5 dernières années



Source: Authors' fieldwork, 2026.

The multiple linear regression model explained a substantial proportion of the variation in household food security, with an adjusted R^2 of 0.47, while the overall model was highly significant ($F(5,314) = 57.2$; $p < 0.001$). Livelihood diversification emerged as the strongest predictor of household food security ($\beta = 4.82$; $p < 0.001$), followed by monthly fishing income ($\beta = 0.00021$ Ariary; $p < 0.001$). Conversely, greater travel time to markets had a significant negative effect on household food security ($\beta = -0.048$; $p = 0.004$), indicating that limited market accessibility constrains both income generation and access to diverse food products. Household size was also negatively associated with food security ($\beta = -1.31$; $p = 0.01$), reflecting increased pressure on household resources as family size increases. In contrast, ownership of a motorised fishing vessel did not have a statistically significant influence ($\beta = 1.14$; $p = 0.21$), suggesting that improved fishing equipment alone is insufficient to enhance household food security without complementary socio-economic opportunities. These findings confirm the study hypothesis that livelihood diversification is positively and significantly associated with household food security, exerting a stronger influence than fishing income after controlling for other household characteristics. Overall, the results demonstrate that although artisanal fisheries remain fundamental to livelihoods

in southern Madagascar, sustainable improvements in food security require integrated development strategies that promote diversified income opportunities, improve market accessibility, strengthen rural infrastructure, and support sustainable fisheries management. These measures would not only enhance household resilience to environmental and economic shocks but also contribute to the long-term sustainability of coastal livelihoods and marine resources.

In summary, the findings demonstrate that artisanal fisheries play a pivotal role in supporting household livelihoods and food security in the coastal communities of southern Madagascar, while simultaneously facing increasing pressures associated with declining fisheries productivity and resource exploitation. Although fishing households generally exhibited better food security outcomes than non-fishing households, the observed decline in catch per unit effort indicates that these livelihood benefits may become increasingly vulnerable if current trends in resource use continue (Allison et al., 2013; Belhabib et al., 2016; Abdullah et al., 2026). The results further reveal that household food security is shaped not only by fisheries income but also by broader socio-economic factors, particularly livelihood diversification, market accessibility, and household demographic characteristics. These findings are consistent with previous studies emphasizing that sustainable improvements in food security require integrated approaches combining responsible fisheries management with rural livelihood development and social resilience (Béné et al., 2016; FAO, 2023; Hilborn et al., 2020). Consequently, strengthening community-based fisheries governance, promoting diversified livelihood opportunities, improving market access, and supporting adaptive resource management are likely to enhance both household welfare and the long-term sustainability of coastal fisheries in Madagascar.

Conclusion

This study demonstrates that artisanal fisheries remain a cornerstone of livelihoods and food systems in the coastal communities of southern Madagascar. While fishing households generally achieved better food security than non-fishing households, the continued decline in catch per unit effort highlights growing concerns regarding the long-term sustainability of marine resources. The findings further indicate that livelihood diversification, market accessibility, and household characteristics significantly influence food security outcomes, underscoring the need for integrated development strategies beyond fisheries alone. Strengthening community-based fisheries management, promoting alternative livelihood opportunities, improving market infrastructure, and supporting adaptive resource governance will be essential for enhancing household resilience while conserving coastal ecosystems. Future research should expand the geographical scope of analysis and incorporate long-term ecological and socio-economic monitoring to better understand the impacts of climate change, fisheries management interventions, and livelihood transitions on the sustainability of coastal communities.

Reference

- Abdullah, M. T., Syaputra, M. F., & Emynorane, R. H. (2026). Institutional Capacity and the Local Governance Gap: Explaining the Limited Effectiveness of Affirmative Policies in Papua. *Publisia: Jurnal Ilmu Administrasi Publik*, 11(1), 90–105.
- Allison, E. H., Delaporte, A., & Hellebrandt de Silva, D. (2013). Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. *WorldFish*.
- Belhabib, D., Le Manach, F., Harper, S., Zeller, D., & Pauly, D. (2016). The fisheries of Madagascar: Reconstructing catches and fishing effort, 1950–2010. *Fisheries Centre Working Paper*, 2016-16. University of British Columbia.
- Béné, C., et al. (2016). Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence. *World Development*, 79, 177–196.

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Coates, J., Swindale, A., & Bilinsky, P. (2007). *Household Food Insecurity Access Scale (HFIAS) for measurement of household food access: Indicator guide* (Version 3). Food and Nutrition Technical Assistance (FANTA) Project, Academy for Educational Development.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
- Emynorane, R. H., Arrive, J. T., Tsitaitse, T. J., Marcel, F., & Bien-Aimé, W. D. (2025). Drivers' Experiences of Traffic Police Corruption and the Implications for Governance Reform: Case Study of Madagascar's National Police and Gendarmerie. *Jurnal Pemerintahan Dan Politik*, 10(2), 344–355.
- Eric, R. R., Arrive, J. T., & Emynorane, R. H. (2025). Impact of Higher Education Training on the Labor Market Demand: Evidence from African Higher Education. *International Journal of Educational Research*, 2(2), 53–63.
- Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme, & World Health Organization. (2023). *The State of Food Security and Nutrition in the World 2023: Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum*. FAO.
- Food and Agriculture Organization of the United Nations. (2024). *The State of World Fisheries and Aquaculture 2024: Blue transformation in action*. FAO.
- Gough, C., Harris, A., & Humber, F. (2020). Small-scale fisheries in Madagascar: Governance challenges and opportunities for sustainable management. *Marine Policy*, 118, 103947.
- Harris, A. (2011). Out of sight but no longer out of mind: A climate of change for marine conservation in Madagascar. *Conservation and Society*, 9(2), 93–103.
- Hilborn, R., Amoroso, R. O., Anderson, C. M., Baum, J. K., Branch, T. A., Costello, C., de Moor, C. L., Faraj, A., Hively, D., Jensen, O. P., Kurota, H., Little, L. R., McClanahan, T., Melnychuk, M. C., Minto, C., Osio, G. C., Parma, A. M., Pons, M., Segurado, S., ... Ye, Y. (2020). Effective fisheries management instrumental in improving fish stock status. *Proceedings of the National Academy of Sciences*, 117(4), 2218–2224.
- Kawarazuka, N., & Béné, C. (2011). The potential role of small fish species in improving micronutrient deficiencies in developing countries: Building evidence. *Public Health Nutrition*, 14(11), 1927–1938.
- Le Manach, F., Gough, C., Humber, F., Harper, S., Zeller, D., & Pauly, D. (2012). Unreported fishing, hungry people and political turmoil: The recipe for a food security crisis in Madagascar? *Marine Policy*, 36(1), 218–225.
- Ministry of Fisheries and Blue Economy. (2023). *Annual fisheries statistics report 2023*. Ministry of Fisheries and Blue Economy, Government of Madagascar.
- Sulla, R. E. F., Ratna, H. E., & Esmati, S. (2026). The Dina asa Community Governance Mechanism for Strengthening Education in Atsimo Andrefana, Madagascar. *Jurnal Strategi Pembelajaran*, 2(2), 89–99.
- Thilsted, S. H., Thorne-Lyman, A., Webb, P., Bogard, J. R., Subasinghe, R., Phillips, M. J., & Allison, E. H. (2016). Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era. *Food Policy*, 61, 126–131.
- World Food Programme. (2008). *Food Consumption Analysis: Calculation and use of the Food Consumption Score in food security analysis*. World Food Programme.
- Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper & Row.