

Household Livelihood Strategies and Nutritional Vulnerability of Children in a Context of Advanced Deforestation: A Case Study in Isangi Territory (Tshopo Province, Democratic Republic of the Congo)

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Abstract

Background: The Democratic Republic of the Congo (DRC) is home to the world's second-largest tropical rainforest, which plays a vital role in food security and rural livelihoods. In Isangi Territory (Tshopo Province), communities rely substantially on forest resources for food, income, and other household needs. Forest degradation and declining access to forest resources may therefore affect household food availability and child feeding practices. **Methods:** A qualitative study was conducted among 20 mothers of children aged 6 - 59 months in Isangi Territory using semi-structured interviews. Mothers were purposively selected across the health zones of Isangi, Yabaondo, Yahisuli, and Yakusu. The study explored mothers' experiences and perceptions of changes in forest resources, child feeding practices, perceived effects on child health and nutrition, and household coping strategies. **Results:** Mothers reported reduced availability and accessibility of forest-derived foods, including bushmeat, edible caterpillars, mushrooms, and wild fruits. Participants perceived that these changes were accompanied by reduced dietary diversity and, in some households, fewer daily meals for children. Mothers also described perceived health and nutritional problems among children, including participant-reported cases of kwashiorkor. Coping strategies included fishing, vegetable gardening, soybean use, longer travel to remaining forest areas, slash-and-burn agriculture, aquatic farming, and requests for external assistance. **Conclusion:** Mothers in Isangi described declining access to forest foods and perceived

these changes as contributing to poorer dietary diversity and greater nutritional vulnerability among young children. These findings support the need to consider forest conservation, sustainable livelihoods, and nutrition-sensitive interventions together. Because the study relied on participant perceptions and did not include objective measurements of forest cover or child nutritional status, the findings should not be interpreted as establishing a causal effect of deforestation on malnutrition.

Keywords

Deforestation, Forest Degradation, Food Security, Children Aged 6 - 59 Months, House-Hold Coping Strategies, Isangi, Democratic Republic of the Congo, Qualitative Study

1. Introduction

Tropical forests cover nearly one-third of the Earth's land surface and provide essential goods and ecosystem services to millions of people worldwide (Food and Agriculture Organization of the United Nations (FAO), 2020). Approximately 1.6 billion people depend directly or indirectly on forest resources for their food, livelihoods, and health (Powell et al., 2015). Beyond these fundamental benefits, forests play a crucial role in global climate regulation and harbor nearly 80% of the world's terrestrial biodiversity (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019). Nevertheless, deforestation continues at an alarming rate, particularly in tropical regions. According to the Food and Agriculture Organization (FAO), nearly 10 million hectares of forest are lost annually worldwide (Food and Agriculture Organization of the United Nations (FAO), 2020).

In the Democratic Republic of the Congo (DRC), Global Forest Watch estimated that approximately 13 million hectares of forest cover were lost between 2001 and 2022 (Global Forest Watch, 2023). Previous studies by Sunderland et al. (2013) and Ickowitz et al. (2014) demonstrated that household dietary diversity is significantly greater in areas with higher tree cover (Ickowitz et al., 2014; Sunderland et al. (2013)). Similarly, research conducted in the Amazon by Sarti et al. (2015) found that access to forest foods—including bushmeat, wild fruits, and edible caterpillars—substantially improves the intake of iron, zinc, and essential vitamins, which are critical for child growth and development (Sarti et al., 2015). Rasolofson et al. (2018) reported comparable findings in Indonesia, showing that proximity to forests increases the consumption of animal-source foods rich in high-quality protein (Rasolofson et al., 2018).

However, Ickowitz et al. (2014) emphasized that although forest conversion into agricultural land may temporarily improve caloric availability, it ultimately reduces dietary diversity and micronutrient intake, particularly among young children (Ickowitz et al., 2014).

Across sub-Saharan Africa, child malnutrition remains a major public health concern. UNICEF estimates that approximately 30% of children under five years of age suffer from stunting ([United Nations Children's Fund \(UNICEF\), 2022](#)). In the DRC, the Demographic and Health Survey (DHS) reported a chronic malnutrition prevalence of 42% among children under five ([Ministère du Plan et al., 2019](#)).

The Isangi Territory, located in Tshopo Province, is particularly affected by this issue. Local communities rely heavily on non-timber forest products (NTFPs), including bushmeat, edible caterpillars, mushrooms, and wild fruits, to meet their dietary needs ([Tata Ngome et al., 2017](#)). However, the region is increasingly exposed to anthropogenic pressures, including slashandburn agriculture, artisanal and industrial logging, charcoal production, and mining activities. These processes have led to progressive forest degradation and the loss of local ecosystem services.

Despite growing evidence regarding both the nutritional importance of Congo Basin forests and the high burden of child malnutrition in the DRC, few empirical studies have comprehensively examined the relationship between deforestation, food availability, and children's nutritional status in Isangi Territory ([Powell et al., 2015](#)). Most previous research conducted in the DRC has focused primarily on the environmental or economic consequences of deforestation, with limited attention given to household perceptions and coping strategies in response to forest degradation.

The period between 6 and 59 months of age represents a critical stage of child growth and development characterized by particularly high nutritional requirements. The decline in forest resources contributes to reduced household dietary diversity, leading to diets increasingly dominated by starchy staple foods with limited micronutrient content ([Global Forest Watch, 2023](#)). This qualitative study seeks to address this knowledge gap by giving voice to mothers and parents living in Isangi Territory. Specifically, it aims to explore how deforestation influences the diets of children aged 6 - 59 months and to identify the household strategies developed to cope with these challenges.

2. Methodology

2.1. Study Area

The study was conducted in Isangi Territory, located in Tshopo Province, Democratic Republic of the Congo (DRC). It covered the four health zones of Isangi, Yabaondo, Yahisuli, and Yakusu, one of the seven territories that make up Tshopo Province.

2.2. Study Design

This study adopted a descriptive qualitative phenomenological design to explore the lived experiences and subjective perceptions of mothers regarding environmental changes and child nutrition. This approach is well-suited for understanding

the social and ecological dynamics that quantitative data alone cannot fully capture.

2.3. Study Population

The study population consisted exclusively of mothers of children aged 6 - 59 months residing in Isangi Territory. Fathers and other caregivers were not included in the interviews.

2.4. Participants and Sampling

A purposive sampling strategy was used to recruit 20 mothers of children aged 6 - 59 months. Participants were selected to ensure variation in children's age, household size, and marital status. No eligible participant declined to take part in the study.

2.5. Data Collection

Data were collected using a semi-structured interview guide organized around six thematic domains: feeding practices, perceived changes over time, the role of the forest in household nutrition, environmental observations, perceived effects on children, and household coping strategies.

Interviews were conducted in the local languages (Lingala and Kiswahili) with the assistance of a trained interpreter. Each interview lasted approximately 45 minutes, was audio-recorded with participants' consent, transcribed verbatim, and anonymized before analysis.

2.6. Data Analysis

The interview transcripts were analyzed manually using thematic content analysis based on the six predefined themes of the interview guide. The six themes were applied systematically to the transcripts, and representative verbatim quotations were selected to illustrate each subtheme. Data saturation was reached after 16 interviews, after which four additional interviews were conducted to confirm the consistency of the emerging findings.

2.7. Ethical Considerations

Oral informed consent was obtained from all participants prior to data collection. To ensure confidentiality, participants' names were replaced with pseudonyms during transcription and analysis. The study protocol received approval from the local ethics committee before implementation.

3. Results

The findings are presented according to the six thematic domains that emerged from the coding framework.

3.1. Children's Daily Feeding Practices

The interviews revealed substantial heterogeneity in children's feeding practices

across households. While some mothers reported adopting appropriate nutritional practices, such as enriching meals with soybean flour and providing four meals per day, others described far more precarious situations.

“I feed my child four times a day. I add soybean to every meal I prepare for him.” (MM)

In contrast, several mothers reported providing only one meal per day, consisting almost exclusively of **pondu** (cassava leaves) and **chikwangue** (cassava bread), with little or no dietary diversity.

“We only eat pondu and chikwangue—just once a day.” (MA)

An intermediate situation was also reported, with some children eating twice daily. Their diets were mainly based on fish but contained very few vegetables.

“He eats twice a day. He mostly eats fish, but hardly any vegetables.” (MB)

More concerningly, some sick children did not receive any special diet and ate the same meals as the rest of the household, often only once a day.

“He does not have a special diet. He eats the same food as the rest of the family—pondu, chikwangue, rice, and beans. Most of the time, he eats only once a day.” (MML)

3.2. Perceptions of Changes over Time

All respondents agreed that environmental and livelihood conditions had deteriorated compared with the past. However, the perceived nature and magnitude of these changes varied among participants. Some mothers emphasized the growing difficulty in accessing food, contrasting the abundance of previous years with current scarcity.

“In the past, food was easy to find, but today it has become very difficult.” (MAL)

Others attributed these changes to demographic growth and increasing food prices.

“I have seen many changes. The population has increased, obtaining food has become difficult, and food prices are much higher than before.” (MK)

Several respondents used particularly strong expressions to describe forest degradation, referring to the forest as having become **“a desert.”**

“The forest has become a desert. There used to be trees everywhere, but now they are gone.” (MLK1)

“The forest is no longer as our ancestors left it; there are no more trees.” (MM)

Some participants also highlighted seasonal changes, including the increasing scarcity of forest foods and the drying up of vegetation during the dry season.

“Caterpillars and mushrooms have become rare. During the dry season, the plants dry up.” (MB2)

3.3. The Role of the Forest in Household Nutrition

The forest was unanimously recognized as the primary source of household food. Nevertheless, respondents differed in their perceptions of its accessibility and its

current capacity to sustain local livelihoods.

For some mothers, the forest remained indispensable, although reaching it had become increasingly difficult.

“It is because of the forest that we survive. When the forest no longer provides, it becomes difficult to find food.” (ML)

“Mushrooms help us feed our families. We obtain good harvests during the rainy season.” (MY)

Others described the growing inaccessibility of emblematic forest foods such as avocado and **safou** (*Dacryodes edulis*).

“Avocados and safou have become very difficult to obtain because the forest is now so far away.” (AE)

Some respondents reported even more severe conditions, explaining that the forest had virtually disappeared and that obtaining food now required several days of travel.

“To find food, we have to travel for three or four days. The forest has become a desert.” (HS)

One participant reported that the household had completely shifted its livelihood from forestbased activities to river fishing due to the disappearance of cultivable forest land.

“We now depend on the river. There is no longer any forest here for cultivation.” (MAL)

Despite these differences, respondents consistently agreed that the rainy season remains the most productive period for obtaining forest foods.

“Forest foods—caterpillars and mushrooms—are abundant during the rainy season.” (MEB)

3.4. Environmental Observations

Participants reported remarkably consistent observations regarding environmental degradation, although some differences reflected their place of residence and level of exposure to deforestation.

Nearly all respondents described a progressive disappearance of trees and increasing distances to reach the remaining forest.

“There are no more trees nearby; we have to travel far to find them.” (MY)

“The forest has moved farther away because people keep cutting down trees indiscriminately.” (MA)

Some respondents linked deforestation to local climatic disturbances, including stronger winds capable of damaging houses.

“We are facing difficulties because of climate change. Strong winds are destroying our houses.” (ME)

Others again described the current landscape using the metaphor of a desert.

“The forest has become a desert. We have to follow it farther and farther away.” (MP)

Several participants further emphasized that not only had the forest retreated,

but wildlife had almost disappeared and primary forest had largely vanished.

“Wild animals have become extremely difficult to find. The forests are now very far away, and only the forest edges remain.” (MC)

Finally, one respondent perceived that deforestation had altered the seasonal calendar itself.

“Forest exploitation has changed the seasons. We used to eat fish during the dry season, but this year we did not catch any.” (MM)

3.5. Perceived Effects of Deforestation on Children’s Health and Nutrition

Participants described perceived health and nutritional problems among children in their communities, including reported cases of severe acute malnutrition and kwashiorkor. Because the study did not include anthropometric or clinical assessment of children, these accounts are presented as caregiver reported experiences rather than study-confirmed diagnoses.

Some mothers described signs they associated with malnutrition, including changes in hair color and swelling of the feet.

“His hair became discolored, and his feet were swollen.” (ML)

One mother reported that a health professional had told her that her child had kwashiorkor and linked the child’s weight loss to inadequate food intake. This remains a participant reported account of a clinical diagnosis rather than a diagnosis established by the present study.

“The doctors told us that my child had developed kwashiorkor. He lost a lot of weight because he was not eating well.” (MBY)

An interesting contrast emerged between mothers’ efforts to improve their children’s diets—such as providing **Nido® milk** and soybean—and the limited effectiveness of these interventions due to financial constraints and the inability to sustain them.

“I used to give him Nido milk regularly, but he still does not eat well.” (MY2)

Even more concerning, some sick children received no specific nutritional management and continued to eat the same meals as other household members, often only once per day.

“He does not receive a special diet because he is sick. He eats the same food as the rest of us, usually only once a day.” (MM)

One mother summarized the collective concern shared by many participants:

“Our children are suffering from kwashiorkor.” (MS)

Overall, participants perceived that declining forest resources were associated with reduced household dietary diversity and increased nutritional vulnerability among children. These perceptions should be interpreted in light of the qualitative design and the absence of direct anthropometric or clinical assessment.

3.6. Household Coping Strategies

Participants described a wide range of coping strategies in response to declining

forest resources, reflecting remarkable resilience and ingenuity. These strategies varied in terms of their duration (short-term versus long-term), perceived effectiveness, and level of constraint.

Some households adopted spatial adaptation strategies, travelling much longer distances—sometimes requiring three to four days—to access remaining forest resources.

“We always go deep into the forest. It now takes three to four days of travel to find enough food.” (ML)

Others reported that access to some forests had become restricted because they were privately owned.

“Some forests are privately owned, and we need permission to enter them. The others are about three to four kilometers away.” (MM)

Many respondents described dietary substitution strategies, including greater reliance on soybean, fishing, and vegetable gardening.

“I add soybean to every meal I prepare.” (MM)

“We go fishing, and we also maintain a vegetable garden.” (MAL)

A more drastic coping mechanism involved the continued use of slash and burn agriculture, despite widespread awareness of its environmental consequences.

“We burn the forest because we have to. It is the only way for us to survive.” (ME)

One innovative strategy reported by participants was the development of aquatic farming, adopted in response to the disappearance of fertile agricultural land.

“We have started cultivating crops in aquatic environments.” (MML)

Several respondents also sought external support, requesting medicines and fishing equipment from local authorities.

“We ask the authorities to provide medicines and fishing equipment, especially fishing nets.” (MK)

Finally, some participants proposed long-term structural solutions centered on forest restoration.

“We need to plant more trees so that they can restore moisture and help produce food.” (MA)

“We should stop cutting trees indiscriminately and start planting new ones so that our forests can become as they once were.” (MC)

Overall, these findings suggest that although households have developed diverse coping mechanisms to mitigate the effects of deforestation on food security, most of these strategies remain insufficient to ensure sustainable livelihoods without broader environmental conservation and socioeconomic support measures.

4. Discussion

This study sought to explore, through the lived experiences of mothers and parents in Isangi Territory, how deforestation affects the diets of children aged 6 - 59 months and the household strategies developed to cope with these challenges. The

findings reveal a close relationship between forest degradation, declining food resources, and the nutritional vulnerability of young children. They also provide new insights into local perceptions and household adaptation mechanisms.

4.1. Forests as Nutritional Infrastructure: A Shared Perception

One of the most striking findings of this study is the unanimous perception among participants that forests constitute the primary source of household food. As one mother expressed:

Our findings regarding the universal perception of forests as a vital infrastructure echo previous evidence by [Powell et al. \(2015\)](#). This perception is consistent with the findings of Powell, Ickowitz, McMullin, Jamnadass, Pinedo Vasquez, and Sunderland, who emphasized that forests and wild biodiversity provide nutritionally valuable foods including fruits, vegetables, bushmeat, fish, and edible insects that substantially enhance the diversity and nutritional quality of diets among populations living in forested landscapes ([Ickowitz et al., 2014](#)).

The dependence on forests observed in Isangi is not unique. [Rowland et al. \(2017\)](#), in a multicountry study conducted across 24 tropical countries, reported that more than half of rural households collect forest foods for household consumption. Among the most forest dependent households, these foods contributed approximately 14.8% of the recommended intake of fruits and vegetables and the recommended intake of meat and fish, highlighting the fundamental role of forests in supporting food and nutrition security.

4.2. Deforestation and Dietary Diversity: Consistent Evidence

The present study demonstrates a substantial decline in children's dietary diversity, characterized by the progressive disappearance of bushmeat, edible caterpillars, mushrooms, and wild fruits. These findings are consistent with those reported by [Ickowitz et al. \(2014\)](#), who showed that children living in communities surrounded by forests have significantly more diverse diets and consume greater quantities of fruits and vegetables than those living in less forested areas ([Powell et al., 2015](#)).

Their largescale study, involving approximately 93,000 children across 21 African countries, identified a statistically significant association between tree cover and dietary diversity.

Our qualitative findings complement this quantitative evidence by documenting how mothers experience and interpret these environmental changes. When one respondent stated.

"In the past, food was easy to find, but today it has become very difficult,"

she was expressing not only increasing food scarcity but also the disruption of intergenerational food systems and traditional ecological knowledge.

Similarly, [Maseko et al. \(2017\)](#), in rural Malawi, observed that children living in highly deforested areas had substantially less access to wild foods than children residing near intact forests, reinforcing the broader relevance of our findings.

4.3. Interpretation in Relation to Previous Evidence

One of the most important contributions of recent literature has been the establishment of a causal relationship between forest ecosystems and child nutrition. Rasolofoson et al. (2018), in a landmark study published in *Science Advances*, analyzed data from approximately 43,000 households across 27 low and middle income countries and demonstrated that children's exposure to forested environments increased dietary diversity by at least 25% compared with children living in non-forested settings.

The authors concluded that forest conservation may be as effective as certain nutrition sensitive agricultural interventions in improving children's diets in developing countries.

In the present study, mothers perceived declining forest resources as contributing to reduced dietary diversity and greater nutritional vulnerability. However, because dietary diversity scores, anthropometric measurements, biomarkers, and objective forest cover data were not collected, the study cannot determine the magnitude, temporality, or causal pathway of these relationships.

"Our children are suffering from kwashiorkor."

These observations are particularly alarming given the already poor nutritional situation in the Democratic Republic of the Congo. According to the 2023 National Nutrition Survey, 2.6% of children aged 6 - 59 months suffer from severe acute malnutrition (SAM), while 8.2% experience global acute malnutrition (GAM), with considerable regional disparities across provinces.

4.4. Seasonality and Vulnerability: A Double Burden

Our findings also underscore the important role of seasonality in shaping household food security. Several respondents emphasized that the rainy season is the most productive period for obtaining forest foods, whereas the dry season exacerbates food shortages. As one mother explained:

"During the dry season, the plants dry up."

Similarly, one participant stated:

"Forest exploitation has changed the seasons. We used to eat fish during the dry season, but this year we did not catch any."

This quotation should be retained as a participant's perception; it should not be interpreted as an objective demonstration that deforestation changed the seasonal climate. Similar qualitative research has documented perceived links between environmental change and rural livelihoods, although the mechanisms require objective environmental assessment.

4.5. Household Coping Strategies: Ingenuity and Limitations

Participants described a wide range of coping strategies, including travelling longer distances to reach forest resources, dietary substitution through soybean consumption, fishing and vegetable gardening, slash and burn agriculture, aquatic farming, and requests for assistance from public authorities. Although these strat-

egies demonstrate remarkable resilience and ingenuity, respondents generally perceived them as temporary and insufficient to address the long-term consequences of forest degradation.

Rasolofoson et al. (2018) argued that forests contribute most substantially to child nutrition among disadvantaged communities, but that the nutritional benefits of forest ecosystems are maximized when communities also have access to markets, transportation infrastructure, and education. This observation is particularly relevant to Isangi Territory, where access to basic infrastructure remains limited.

The repeated requests made by participants for medicines and fishing equipment illustrate the need for stronger institutional support to enhance local adaptive capacity.

One particularly innovative finding was the emergence of aquatic farming as an adaptive response to the loss of fertile agricultural land.

“We have started cultivating crops in aquatic environments.”

Although this practice reflects considerable local innovation, its long-term sustainability and potential ecological consequences warrant further investigation.

5. Study Limitations

This study has several limitations. First, it was a qualitative investigation and did not include direct anthropometric or clinical measurements of children, dietary diversity scores, nutritional biomarkers, or objective measures of forest cover change. Consequently, reported malnutrition, including kwashiorkor, represents caregiver reported or perceived experience unless a participant reported a diagnosis made by a health professional; such diagnoses were not independently verified by the study team. Second, the study was conducted exclusively in Isangi Territory and was not intended to provide statistically representative findings for Tshopo Province or the DRC. Third, participants' retrospective comparisons between past and present conditions may have been influenced by recall bias and social desirability bias. Fourth, reliance on participants' perceptions means that the study cannot establish temporality or causality between forest degradation, dietary changes, and child nutritional outcomes. Fifth, interpretation and translation between local languages and the language used for analysis may have resulted in loss of nuance or meaning. Sixth, the study included mothers only and therefore does not capture the perspectives of fathers, other caregivers, or other household decision-makers. Finally, the sample comprised 20 interviews, which limits transferability to other populations and settings.

6. Conclusion

This qualitative study explored how mothers in Isangi Territory perceive changes in forest resources and their implications for the diets and nutritional vulnerability of children aged 6 - 59 months. Mothers reported declining access to forest foods—including bushmeat, edible caterpillars, mushrooms, and wild fruits—and

perceived these changes as contributing to poorer dietary diversity and, in some households, reduced meal frequency and greater nutritional vulnerability among children.

Households described a range of coping strategies, including travelling longer distances to access forest resources, fishing, soybean use, vegetable gardening, slash-and-burn agriculture, aquatic farming, and seeking external assistance. These responses demonstrate local adaptation but also highlight the constraints faced by households when forest-derived food resources become less accessible.

The findings support an integrated policy approach that links forest conservation and restoration with nutrition-sensitive livelihood interventions, sustainable food production, and support for locally appropriate coping strategies. However, the study does not establish that deforestation caused reduced dietary diversity or severe acute malnutrition. Future mixed-methods and longitudinal research should combine caregiver perspectives with anthropometric assessment, dietary diversity measurement, and objective geospatial assessment of forest-cover change.

Second, locally developed adaptation strategies, particularly aquatic farming and small-scale livestock production, deserve greater documentation and institutional support through training programmes and appropriate agricultural inputs.

Third, participants' repeated requests for medicines and fishing equipment highlight the need to strengthen both health systems and livelihood support programmes.

Finally, respondents' recommendations regarding reforestation demonstrate a strong local commitment to ecosystem restoration that could be reinforced through participatory agroforestry initiatives.

Further research is needed to build upon these findings. Mixed-methods studies combining anthropometric assessments, dietary diversity measurements, and geospatial analyses of forest cover would provide a more comprehensive understanding of the magnitude of the relationship between deforestation and child nutritional status in Isangi Territory. Longitudinal research would also help assess the long-term sustainability of household coping strategies. Comparative studies conducted in other territories of Tshopo Province and across the Democratic Republic of the Congo would further strengthen the external validity of these findings.

Recognizing forests as a fundamental component of nutritional systems and supporting the adaptive capacities of local communities should therefore be considered priorities for Isangi Territory, Tshopo Province, and the Congo Basin as a whole.

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Author Contributions

Dieudonné Epeleka Mazembe conceptualized the study, developed the methodology, conducted field data collection, performed data analysis, and drafted the first version of the manuscript. Raphael Iseayembe Bosalo contributed to the methodology, data analysis, validation, and critical proofreading of the manuscript. Santos Lobwa participated in the investigation, field coordination, and data management. Alliance Tagoto Tepungipame was involved in the investigation, provided support for transcription, and conducted the literature review. Basile Solomo Elumbu provided resources and was involved in validation and critical revision of the manuscript. Joris Likwela Losimba handled project administration, supervision, methodology validation, and gave final approval for the version to be published. All authors have read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest related to the conduct, preparation, or publication of this study. No financial, material, or institutional support that could have influenced the study findings or their interpretation was received from any organization, company, or individual with an interest in the subject matter. The authors assume full responsibility for the content of this manuscript.

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