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Impacts of climate change on forest-harvested food and the nutrition of children and families in Lao PDR

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ABSTRACT

Background: Forests are an important source of food, medicine, and income for rural families in Laos, especially ethnic communities. Non-timber forest Products (NTFPs) contribute significantly to food security and income through consumption and sales. However, the impact of climate changes on agricultural productivity leads to increasing land demand for cash crops has caused significant changes in forestland and resource use, posing threats to food security and livelihoods.

Objectives: This study aimed to investigate how climate change affects the availability of forest-harvested food and its subsequent impact on children's nutrition in communities near forests, utilizing descriptive and regression analysis to understand the influencing factors.

Methods: A cross-sectional mixed-method study included a desk review, 259 household surveys, 8 Focus Group Discussions (FGDs), and 4 case studies in six different villages of three provinces (north, central, and southern) of Laos.

Results: The study found 90% of households have observed a reduction in forest-harvested food in the last few years because of overexploitation of forests (75%) and changes in weather patterns (25%). 84% of children consumed forest foods regularly. Logistics regression analysis showed that children (6-59 months) who consume forest products more than twice a week are about 2.13 times more likely to have the outcome of not being underweight compared to those who do not, holding other factors constant.

Conclusion: Climate change has reduced the availability of forest-harvested food, adversely affecting children's nutrition. In response, communities have adopted alternative coping strategies. To mitigate the impact of climate change, it is recommended to implement climate monitoring, promote sustainable land use, and empower communities to enhance resilience and food security.

Keywords: Children, Climate change, Forest-harvested foods, Nutrition

1. Introduction

Laos, a landlocked country with total land area of 23.68 million hectares, had the highest forest cover in Southeast [1], with 40% of its land area covered by forests. The total area of forest has decreased dramatically, from 70% of land area in 1940, to 49% in 1982, to 40% in 2010 [2]. There have been significant changes in forestland and resource use over the past two decades, driven mainly by the demand for land from neighbouring countries for growing cash crops [3].

Forests are an important source of food, medicine, and income for rural families in Laos, in particular ethnic communities and is a key source of protein for some rural [4]. NTFPs contribute to rural households' food security through consumption and income and are particularly important during the lean months just before harvest and during drought years [3]. Forests also serve as a source of feed for large livestock raised by households living near them [5].

Laos is one of the most vulnerable countries to the impact of climate change which has negatively affected poorer and more marginalized communities [6]. Laos has already experienced an increase in extreme weather events and is projected to face more in the future. This will exacerbate weather-related disasters, weaken household and community resilience, and place significant pressure on crops and other livelihoods [7]. Climate change has led to alter CO2 levels, precipitation, and temperatures, causing severe droughts that threaten food security. Declining agricultural productivity has driven farmers to clear forests for cash crop cultivation, resulting in significant forest loss, fragmentation, and decreased crop yields [8]. Key drivers of deforestation include wildfires, unsustainable wood extraction, slash-and-burn agriculture, agricultural expansion and industrial development [9]. This forest loss is particularly concerning, as households living adjacent to these forests rely heavily on them for their income and food sources.

2. Methods

2.1 Study Area

This study was carried out on the six villages in 3 provinces in Laos. Study site was selected purposively to represent three major agro-ecological regions of the country, namely, the Northern Highlands (Luang Prabang), the Mekong Corridor (Khammouane) and the Central and Southern Highland Areas (Saravane).

2.2 Study Design

This study used a cross-sectional mixed-method design to understand the impact of climate change on the forest-harvested food and malnutrition. Quantitative information on the impact of the impact change was collected through desk review, HHs survey, and anthropometric measurement. Qualitative data was collected through FGDs and case studies.

2.3 Sample size and sampling

A Cochrane sample size calculator was used to calculate the sample size, which was further adjusted by design effect to bring effective sample size. HHs were selected from 6 cluster villages with total of 43 HHs per village (30 HHs with under five children and 13 with Under 18 children). A total of 259 households with children under 18 years were randomly selected using cluster sampling method. HHs with under 18 years children permanently living on the selected village near to the forest were included on the study. HHs without children were excluded from the study. 80 parents and caregivers were purposively selected for FGDs, ensuring equal representation of men and women. Half of the FGD participants had children under five, while the rest had children under 18. Four case studies focused on families regularly consuming forest foods.

2.4 Data Collection

A literature review of existing research on the topic was conducted. This included grey literature [6, 10, 11], research conducted by development partners [12] and project reports [13], on the topic of deforestation, climate change and malnutrition in Laos. Literature review was conducted in a systematic way (define research topic, search databases, review and synthesize the information) to have an overview of the current understanding of the impact of climate change in the nutrition of communities that rely on forests for their nutrition in Laos. This rapid literature review informed the development of the data collection tools.

The household survey tool was used to collect quantitative data at the household level. The survey form was developed in consultation with technical experts from World Vision International Laos and World Wildlife Fund (WWF) and implemented using the KOBO toolbox. The tool underwent significant review and adaptation to ensure accuracy and appropriateness in the Lao language and context. Enumerators used tablets for data input, with field supervisors

ensuring data quality through close supervision and monitoring. Supervisors randomly attended 10% of the interviews, providing on-site support. Anthropometric measurements were conducted using WHO-recommended equipment (Seca Scale), with health and nutrition experts closely monitoring the process. Measurements for children under five were taken twice, with photos of the measurements and equipment for record-keeping. Children measured below -2SD were considered as undernourished children. FGDs and case studies were conducted to gather qualitative information on the impact of climate change on forest-harvested food and nutrition. Trained enumerators, under close supervision, conducted FGDs, while in-depth interviews were used to collect human-interest case stories.

2.5 Data Analysis

Collected data underwent thorough review before analysis. A 30% back-check of randomly selected questions was conducted to address inconsistencies. The final database was checked for logic, consistency, outliers, frequencies, and interview length. Open-ended responses were scrutinized for unusual answers, with the quality assurance team seeking clarification when needed.

SPSS software was used for descriptive and inferential analysis of quantitative data. Anthropometric data was analysed using WHO Anthro Software. Data collected from FGDs, and in-depth interview were summarized and grouped in the themes to identify the pattern. Thematic analysis was carried out to explain the impact of climate change. All data was stored safely in servers with several layers of protection.

2.6 Ethical Clearance

Ethical approval (Ref No: 238/RASO) was received from Research and Academic Service Office (RASO), Research ethics Committees of the National University of Laos. Proper consent was received on written form from the participants and option was provided to the participants to withdraw from the interview or group discussion at any point of time during the data collection process.

3. Results

Demographic characteristics of the Respondents

Study respondents were from three different provinces, Laungprabang, Khammouane and Salavan. HHs with at least one child under 18 years of age were selected as respondent. Ethnicity of respondents varies by province, with large portion of Phoutai (27%) followed

by Khmu (26.6%), Pako (16.2%), Katang (11.6%), Hmong (7.75), Toey, Lao, Tai, Prai and Ouy. More than a quarter of respondents (29%) did not have formal education, with a further fifth (21%) did not complete their primary school education. Almost a quarter of respondents (24%) had completed primary education, with the rest of respondents (26%) having higher levels of education.

Consumption of forest-harvested foods

Overall, 83% of surveyed households consumed products from the forest, from a low of 74% of surveyed households in Saravan to a high 92% of households in Khammouane. The most common forest products consumed during the year were bamboo shoots (92%), crab (64%), edible fern (48.6%), white fish (48.6%), and squirrel (46%). The proportion of children aged 5-18 years old that consumed forest products were more than two times per week in the surveyed households is 92% overall, with some small variations between communities in different provinces. The main products consumed by children in these communities were bamboo shoots (56%), white fish (35%), squirrel (31%), crab (29%) and edible fern (19%).

The vast majority of children aged six months to 5 years (84%) were also fed forest products. The main products consumed by children of this age were white fish (39%), bamboo shoots (38%), squirrel (34%), crab (26%) and snakehead murrel fish (24%), with variations between children from different provinces.

Table 1: Consumption of forest food by children aged 6 months-5 years old, by province

Forest Food	Luang Prabang (%)	Khammouane (%)	Saravan (%)	Overall (%)
White fish	27.4	68.3	17.0	39.5
Bamboo shoots	29.0	42.9	44.7	38.4
Squirrel	75.8	11.1	10.6	34.3
Crab	29.0	23.8	25.5	26.2
Snakehead murrel fish	1.6	52.4	14.9	23.8

Situation and trend of the forest-harvested foods

Ninety percent of surveyed households had seen a reduction in the availability of forest foods, with Luang Prabang province having the highest reported reduction at 99% of surveyed households. The forest foods that had decreased the most according to surveyed households were squirrel (49%), muntjac (46%), boar (42%), deer (32%) and bamboo shoots (24%), with variations in decrease in availability of forest foods between provinces.

Factors affecting the forest harvested foods

The main reason surveyed households attribute the decrease in availability of forest foods was overexploitation of forests (75%), with less than a quarter (23%) claiming that changes in weather were among the main reasons for the decrease in availability of forest foods. Among these, the most significant change in weather reported by respondents was droughts (80%), followed by floods (39%).

Table 2: Factors affecting the forest harvested foods, by province, n (%)

	Luang Prabang (%)	Khammouane (%)	Saravan (%)	Overall (%)
Total, n	85	66	81	232
Overexploitation	81.2	51.5	86.4	74.6
Changes in weather	25.9	30.3	14.8	23.3
Less rain, droughts	86.4	85.0	58.3	79.6
Too much rain, floods	40.9	30.0	50.0	38.9
Weather is unpredictable	13.6	5.0	0.0	7.4
Other, explain	0.0	5.0	8.3	3.7
Don't know	0.0	1.5	0.0	0.4

Households coping mechanism on decreased forest harvested foods

Coping mechanisms included cultivating some NTFPs at home or in their fields (74%), buying the products from the market or traders (28%), and did not consume them anymore (19%), with some variations between communities in different provinces to the ways they are coping. Most respondents (82%) had not been able to find the same amount of forest foods through other sources. Families were mainly compensating for the reduction in forest foods with other foods, such as chicken, cabbage, pumpkin, pork, duck, beef and others. For most households with children between the ages of 5 and 18, they consumed other products to compensate for the loss of forest foods. Overall, three quarters (75%) of surveyed households said that children aged 6 months to 5 years of age are eating other foods to compensate for the reduction in availability of forest foods. The foods that are given to infants included chicken (66%), pork (48%), duck (41%), pumpkin (37%) and cabbage (35%) among others.

Child nutrition

Overall, underweight, or low weight for age was at 24% among measured children aged 0-24 months, but this increased to 32% among measured children in Luang Prabang and decreased to 19% in Saravan. However, among children aged 0-59.9 months, 27%

were underweight, increasing to 35% of children measured in Luang Prabang and decreasing to 23% in Khammouane and to 22% in Saravan. This compared to an overall rate of 21.1% at the national level, 25% in Luang Prabang, 23.3% in Khammouane and 28.6% in Saravan, according to LSIS 2017 [14].

Overall, 35% of measured children 0-24 months of age were stunted. The rates of stunting were highest in communities visited in Saravan (37%) and lowest in those visited in Luang Prabang (32%). Wasting levels among measured children aged 0-24 months were low to moderate, with an overall prevalence of 5%.

Table 3: Weight for age (Underweight), Height/length for age(stunting), and weight for length/height(wasting) of children under five 5 years of age, by province

Nutrition Status	Age	Luang Prabang (%)	Khammouane	Saravan (%)	Overall (%)
Underweight	0-59 months	35.5	23.3	21.7	26.9
Stunting	0-59.9 months	47.5	30.0	40.0	39.2
Wasting	0-59.9 months	8.2	3.3	1.7	4.4

Relationship between forest food consumption and malnutrition

To investigate the potential relationship between forest food consumption and children's malnutrition, a comparison of nutrition indicators was made between children who regularly consume forest products and those who do not. It showed that a lower proportion of children aged 0-24 months who regularly consume forest foods were underweight. For children aged 24-60 months, the proportion of underweight children was similar regardless of forest food consumption. However, a lower proportion of children aged 0-60 months who did not regularly consume forest foods were underweight.

Table 4: Weight for children under five 5 years of age, by those who regularly consume forest foods and those who do not regularly consume forest foods

Weight/Age	Yes (%)	No (%)
0-23.9 months	23.2	38.9
24-59.9 months	70.7	71.4
0-59.9 months	73.0	64.0

The next table indicated that a higher proportion of children aged 0-24 months who did not regularly consume forest foods were stunted compared to those who did.

Conversely, a higher proportion of children aged 24-60 months who regularly consume forest foods were stunted compared to those who did not. Overall, a slightly higher proportion of children aged 0-59 months who did not regularly consume forest foods were stunted compared to those who did.

Table 5: Height for age (Stunting) of children under five 5 years of age, by those who regularly consume forest foods and those who do not regularly consume forest foods

Height/Age	Yes (%)	No (%)
0-23.9 months	35.0	50.0
24-59.9 months	44.0	28.6
0-59.9 months	40.8	44.0

Although these findings were not conclusive due to the small sample sizes and the diverse characteristics of the sample (small groups of children from different ethnic groups in various locations), the data suggested that a higher proportion of children under five years of age who did not consume forest foods suffer from underweight, and stunting compared to those who did. However, further research with a larger and more representative sample of children under five living in communities near forests was needed to validate these insights.

The logistic regression analysis of forest food consumption more than twice a week and underweight of the children identified statistically significant (P value 0.029) relationship. The odds ratio (Exp(B)) of 2.126 showed that children who consumed forest products more than twice a week were about 2.13 times more likely to have the outcome of not being underweight compared to those who did not, holding other factors constant.

Community perception on the impact of climate change on forest-harvested food

Eight Focus Group Discussions across three provinces revealed significant impacts of climate change on access to forest foods. In Xaybouathong district, Khammouane province, extreme weather events from 2017-2018 and a dry spell in 2022-2023 reduced crop yields, affecting forest food availability. High temperatures have led to issues such as stunted rice growth, emaciated cows, dying bamboo shoots, increased forest fires, and fewer crabs, fish, frogs, and wild animals. Participants noted declines in bamboo shoots, squirrels, red junglefowl, Bengal monitors, wild boars, wild birds, lesser mousedeer, and wild vegetables, mainly due to deforestation and forest clearance. Families adapted by

purchasing market foods, migrating for work, and changing diets.

In TaOy district, Saravan province, drought and deforestation severely limited forest food availability, forcing families to forage, grow food at home, and borrow money. Unusually cold winters killed pets and livestock, while heavy rains in late 2022 caused landslides that destroyed crops. Extreme heat in 2023 further affected maize and potatoes. Some household members worked in banana plantations or sold foraged foods to Vietnamese traders, often borrowing money at high interest rates.

In Phonexay district, Luang Prabang province, deforestation was blamed for weather changes. Hot, dry weather and late rains from 2019-2020 reduced crop yields and forest food availability, increasing market dependence. New road infrastructure facilitated market access but led to unhealthy dietary changes. Overall, FGDs highlighted that climate change and environmental degradation challenge communities in maintaining traditional diets.

4. Discussion

This study analysed the consumption of forest-harvested food and its impact on child nutrition in three provinces in Laos. It revealed that 83% of households rely heavily on forest products, consistent with previous research [15] highlighting their importance in rural diets [16]. 90% of these households report a decline in availability, raising sustainability concerns of forest harvested foods as forest cover has declined over past decades [17]. The study found that change in weather patterns (heavy rain causing flood, longer droughts and extreme weather events) and over exploitation; and a lack of awareness or resources to adapt the climate change are found to be major contributor on reduction of forest harvested food, similar to other studies [18].

High rates of child stunting (39%) and underweight (27%) were observed, especially in Luang Prabang, suggesting a clear link between reduced forest resources and nutritional deficiencies as found in similar studies [19], which recommended forest conservation for better nutrition [20]. Statistical analysis showed the statistically significant(P=0.029) relationship between forest-harvested food consumption and nutrition as identified on other research [21].

The study underscored the importance of forest foods in rural diets, particularly in marginalized communities, where a decline in resources could worsen undernutrition.

The study's implications are significant for public health and environmental policy. Addressing forest resource overexploitation is crucial for biodiversity preservation and rural nutritional health. Policies promoting sustainable harvesting and enhanced agricultural productivity could mitigate negative impacts. Despite challenges, many families maintain child health through market purchases and nutrition education initiatives.

5. Conclusion

In conclusion, the study highlighted the significant decline in forest-harvested foods primarily due to overexploitation and climate-related factors. Households are adopting coping mechanisms like cultivating NTFPs and purchasing alternatives, yet many struggles to replace the nutritional value of forest foods, especially for children. High rates of underweight, stunting, and wasting among children reflect the broader implications of decreased access to forest resources on child health. These findings underscore the urgent need for sustainable forest management and targeted nutritional interventions to mitigate adverse effects on vulnerable populations. However, the study's cross-sectional design limits causal conclusions, and self-reported data could introduce bias. Future research should explore the long-term effects of climate change on forest-harvested foods and child nutrition.

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References

[1] Khamhung A. Land and Water Investment in the Lao PDR: Food and Agriculture Organization (FAO); [cited 2024 Sep 3]. Available from: https://www.fao.org/4/ac623e/ac623e0h.htm.
[2] Fiches IC. Forest / Lao People's Democratic Republic [cited 2024 Sep 3]. Available from: https://dicf.unepgrid.ch/lao-peoples-democratic-republic/forest.

[3] Food, Agriculture O, European U, Cirad. Food Systems Profile - The Lao People's Democratic Republic. Rome, Italy ; Brussels, Belgium ; Montpellier, France 2022.
[4] Bartlett A. Dynamics of Food Security in the Uplands of Laos: a summary of 10 years of research. n.p.; 2012.
[5] Village Focus I. Comprehensive Food Security and Vulnerability Analysis (CFSVA) n.p.: Strengthening Emergency Needs Assessment Capacity (SENAC); 2017 [cited 2024 Aug 11]. Available from: https://data.laos.opendevelopmentmekong.net/library_record/comprehensive-food-security-and-vulnerability-analysis-cfsva.
[6] Climate Risk Country Profile - Lao PDR. Washington, DC; 2021.
[7] Climate Change Knowledge Portal: World Bank; n.d. [cited 2024 Aug 11]. Available from: https://climateknowledgeportal.worldbank.org/.
[8] Kumar L, Chhogyel N, Gopalakrishnan T, Hasan MK, Jayasinghe SL, Kariyawasam CS, et al. Chapter 4 - Climate change and future of agri-food production. In: Bhat R, editor. Future Foods: Academic Press; 2022. p. 49-79.
[9] Kornexl WL, Danyo S. Lao PDR Forest Note: Toward Sustainable Forest Landscapes for Green Growth, Jobs, and Resilience (English). Washington, D.C.: World Bank Group; 2020. Report No.: 150496.
[10] Thongmanivong S, Phanvilay K, Vongvisouk T. How Laos is moving forward with REDD+ schemes. International Journal of Regional, Rural and Remote Law and Policy. 2013(1):1-4.
[11] World Bank G. Lao PDR - Vulnerability n.d. [cited 2024 Aug 13]. Available from: https://climateknowledgeportal.worldbank.org/country/lao-pdr/vulnerability.
[12] Lao People's Democratic Republic: Country Partnership Strategy (2024–2028). n.p.; 2024 2024-02-29.
[13] Recoftc. RECOFTC. [cited 2024 Aug 13]: RECOFTC. https://www.recoftc.org/publications/browse
[14] Bureau LS. Lao Social Indicator Survey II 2017, Surve Findings Report. Vietiane, Lao PDR; 2018.
[15] Rasolofoson RA, Hanauer MM, Pappinen A, Fisher B, Ricketts TH. Impacts of Forests on Children's Diet in Rural Areas across 27 Developing Countries. Science Advances. 2018;4(8):eaat2853.
[16] Tong PS. Lao People's Democratic Republic Forestry Outlook Study. Bangkok; 2009. Contract No.: APFSOS II/WP/2009/17
[17] World Resources I. Top 10 Lists | World Resources Institute Research. [cited 2024 Nov 16]: World Resources Institute. https://gfr.wri.org/top-ten-lists
[18] Meyer J. How do Forests Contribute to Food Security Following a Weather Shock? Evidence from Malawi. World Development. 2023;169:106307.
[19] Hall CM, Rasmussen LV, Powell B, Dyngeland C, Jung S, Olesen RS. Deforestation reduces fruit and vegetable consumption in rural Tanzania. Proc Natl Acad Sci U S A. 2022;119(10):e2112063119.
[20] Johnson KB, Jacob A, Brown ME. Forest Cover Associated with Improved Child Health and Nutrition: Evidence from the Malawi Demographic and Health Survey and Satellite Data. Global Health: Science and Practice. 2013;1(2):237.
[21] Ickowitz A, Powell B, Salim MA, Sunderland TCH. Dietary Quality and Tree Cover in Africa. Global Environmental Change. 2014;24:287-94.