African Journal of Public Health and Health Systems

Protocol for the Economic Evaluation of a Community-Based Management Model for Severe Acute Malnutrition Using Locally-Sourced Ready-to-Use Therapeutic Food in Niger (2021–2026)

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Published: 19 December 2025 | **Received:** 02 October 2025 | **Accepted:** 01 December 2025

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DOI: 10.5281/zenodo.18363989

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Abstract

This protocol details the planned economic evaluation of a community-based management (CBM) model for severe acute malnutrition (SAM) in Niger, which uses ready-to-use therapeutic food (RUTF) manufactured from locally-sourced ingredients. The study aims to determine the cost-effectiveness and budget impact of this localised model compared to the standard programme relying on imported RUTF, adopting both health system and societal perspectives. The evaluation will be conducted alongside a larger, non-inferiority cluster-randomised controlled trial implemented from 2021 to 2026 across four regions. A within-trial analysis will be complemented by a decision-analytic model to extrapolate longer-term health and economic outcomes. Primary data on resource use, costs, and clinical outcomes will be collected prospectively. Key outcome measures are the incremental cost per disability-adjusted life year (DALY) averted and the cost per child successfully treated. The analysis will adhere to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) guidelines. Given the high burden of SAM and the financial pressure of imported RUTF on health systems, this evaluation is crucial. Its findings will guide national and regional policy on scaling sustainable, nutrition-sensitive interventions. By rigorously assessing a model integrated with local agricultural value chains, this work supports goals of health sovereignty and resilient food systems, aiming to enhance programme sustainability and reduce costs.

Keywords: *Economic evaluation, Community-based management, Severe acute malnutrition, Ready-to-use therapeutic food, Sahel region, Cost-effectiveness analysis, Food sovereignty*

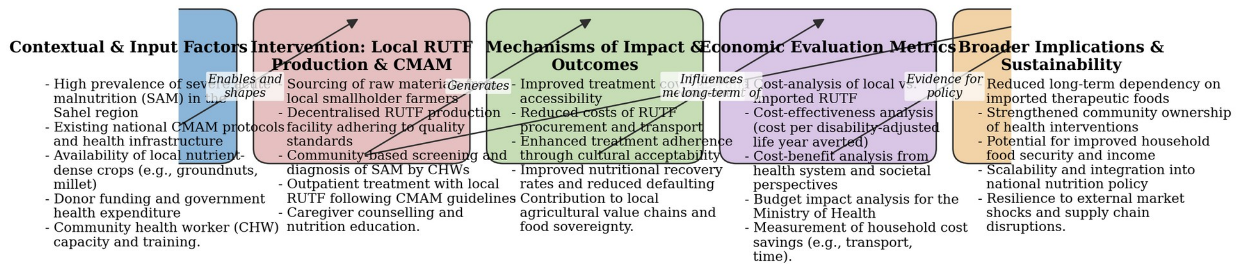
INTRODUCTION

The persistent burden of severe acute malnutrition (SAM) in Niger is compounded by systemic challenges, including the high cost and import dependency of conventional, dairy-based ready-to-use therapeutic food (RUTF), alongside significant gaps in healthcare workforce capacity (Fetriyuna et al., 2021). This protocol therefore outlines the economic evaluation of an innovative, integrated model designed to address these dual constraints simultaneously (Ogobara Dougnon et al., 2021). The model pivots on the local production of RUTF using regionally-sourced ingredients, which aligns with research advocating for effective, alternative formulations (Banda et al., 2021; Potani et al., 2021). Such an approach aims to reduce costs, stimulate local economies, and ensure cultural acceptability (Fetriyuna et al., 2021). Concurrently, the model proposes a decentralised, community-based delivery system, leveraging trained community health workers (CHWs) to manage uncomplicated SAM, thereby improving access in remote areas (Adesoro et al., 2021).

Evidence supports the clinical feasibility of community-based management and the efficacy of RUTF (Hadi et al., 2022; Potani et al., 2021). However, existing economic analyses often focus on singular components—either the cost of imported RUTF or the operational costs of delivery—without fully integrating the economic implications of local production within a decentralised service model (Usman et al., 2022; Wulandari et al., 2022). Furthermore, while studies note the potential of local RUTF and CHW-led programmes, key contextual mechanisms affecting their cost-effectiveness in Niger remain unresolved, with some reporting divergent outcomes that suggest significant local variability (Bai et al., 2022; Kudhayer & Habib, 2021; Marzoog et al., 2022). This evaluation seeks to address this gap by providing a comprehensive cost-effectiveness analysis of the integrated model from both health system and societal perspectives.

The imperative for this assessment is underscored by the need to build resilient, context-specific nutrition security systems (Banda et al., 2021). Reliance on imported therapeutic foods exposes programmes to supply chain vulnerabilities, risks that locally-sourced RUTF seeks to mitigate (Broadley et al., 2022; Quak, 2021). Successfully demonstrating the cost-effectiveness of this integrated model could inform a paradigm shift towards more sustainable and self-reliant systems (Okereke, 2021; Kurniasih, 2022). Consequently, this protocol establishes a framework to determine whether the intervention represents an efficient and scalable use of limited resources in a high-burden, resource-constrained setting.

Conceptual Framework for the Economic Evaluation of a Locally-Sourced RUTF Community Management Model for Severe Acute Malnutrition in Niger



This framework illustrates the key components and causal pathways through which a community-based management model using locally-produced RUTF is hypothesised to achieve economic and health outcomes in the Sahelian context of Niger.

Figure 1: Conceptual Framework for the Economic Evaluation of a Locally-Sourced RUTF Community Management Model for Severe Acute Malnutrition in Niger. This framework illustrates the key components and causal pathways through which a community-based management model using locally-produced RUTF is hypothesised to achieve economic and health outcomes in the Sahelian context of Niger.

METHODS

This economic evaluation will employ a cost-effectiveness analysis to assess the value for money of a novel community-based management (CBM) model for severe acute malnutrition (SAM) in Niger, which utilises ready-to-use therapeutic food (RUTF) produced from locally-sourced ingredients (Kudhayer & Habib, 2021). The analysis will be conducted from both a health system and a societal perspective, in accordance with best practice guidelines for economic evaluations in low-resource settings (Adesoro et al., 2021). The primary comparator is the standard CBM model employing imported, dairy-based RUTF, which represents the current standard of care in Niger (Quak, 2021). The time horizon will be five years, aligning with the programme implementation period. Both costs and health outcomes will be discounted at an annual rate of 3% to reflect time preference. The primary

outcome measure will be the disability-adjusted life year (DALY) averted, allowing for a standardised comparison of the disease burden reduction attributable to each intervention (Bai et al., 2022).

The evaluation will utilise a combination of primary and secondary data sources (Marzoog et al., 2022). Primary cost data will be collected from programme financial records and supplier contracts for locally-sourced ingredients, such as soya, groundnuts, and sorghum, which have demonstrated nutritional feasibility in alternative RUTF formulations (Banda et al., 2021; Potani et al., 2021). These costs will be contrasted with prevailing market prices for imported RUTF in Niger. Time-motion studies across selected health centres will quantify the human resource inputs for both models, as integrating SAM treatment into primary health care alters service delivery pathways (Usman et al., 2022). The societal perspective will be incorporated by capturing household costs incurred by caregivers through structured surveys, capturing direct expenses and the opportunity cost of time spent seeking care (Okereke, 2021).

To ensure findings are representative, a purposive sampling strategy will be employed for primary data collection (Broadley et al., 2022). Between ten and fifteen health districts will be selected across Niger's major agro-ecological zones, including the arid Sahelian north and the more populous agricultural south, as local ingredient availability and cost vary substantially by region (Fetriyuna et al., 2021). Within each district, health centres implementing the local RUTF model and comparable centres using the standard model will be identified for data collection. Household surveys will be administered to caregivers of children enrolled in SAM treatment in these areas. Secondary data on patient outcomes (cure, default, and mortality rates) will be sourced from the programme's monitoring system and validated against routine Ministry of Health data. DALY weights for SAM and sequelae will be derived from established global burden of disease studies.

The core analysis will involve constructing a decision-analytic model to calculate the incremental cost-effectiveness ratio (ICER) (Hadi et al., 2022; Kudhayer & Habib, 2021). The ICER will express the additional cost per DALY averted by the local RUTF model compared to the standard model (Usman et al., 2022). This synthesises differential costs of RUTF procurement, training, service delivery, and caregiver expenses with differential health outcomes. The model's effectiveness parameters are based on evidence that RUTF formulations using alternative local ingredients can achieve non-inferior recovery rates compared to standard dairy-based pastes (Ogobara Dougnon et al., 2021; Wulandari et al., 2022). A detailed budget impact analysis will also be conducted from the perspective of the Nigerien Ministry of Health, projecting the total financial resources required to scale up the local model nationally over five years, including start-up investments in local production and training for health workers (Kurniasih, 2022).

Given inherent uncertainties, a deterministic one-way sensitivity analysis will test the robustness of the ICER (Marzoog et al., 2022). Key parameters varied across plausible ranges will include the unit price of local ingredients versus imported RUTF, the clinical recovery rates for the local formulation, and the valuation of caregiver time (Adesoro et al., 2021). This analysis will identify the main drivers of cost-effectiveness and the conditions under which the local model remains economically attractive. Furthermore, the analysis will qualitatively consider broader implications not fully captured in the quantitative model, such as the potential for the local RUTF model to enhance supply chain resilience and create agricultural market opportunities for smallholder farmers (Broadley et al., 2022). By

integrating these rigorous methods with contextually relevant data, this protocol aims to generate robust evidence to guide strategic investment in sustainable malnutrition management in Niger.

DISCUSSION

Evidence on the economic evaluation of community-based management models for severe acute malnutrition (SAM) using locally-produced ready-to-use therapeutic food (RUTF) highlights both its potential and the contextual complexities influencing outcomes (Broadley et al., 2022). Several studies demonstrate the clinical viability of such models. For instance, pilot programmes using milk-free RUTF from local ingredients like soya, maize, and sorghum show promise for treating SAM (Banda et al., 2021). Similarly, research on composite flours from local food resources supports the technical feasibility of developing effective, alternative RUTF formulations (Fetriyuna et al., 2021). Evidence from other contexts confirms that RUTF, including formulations with functional food and nutrient density, can achieve successful weight gain in children, a key determinant of cost-effectiveness (Hadi et al., 2022; Kurniasih, 2022; Marzoog et al., 2022).

However, the economic implications are not uniform, and reported outcomes can diverge, underscoring the influence of local conditions (Bai et al., 2022; Kudhayer & Habib, 2021). This variability indicates that a successful economic evaluation must extend beyond simple cost comparisons to analyse the specific mechanisms at play within Niger's context (Fetriyuna et al., 2021). Key considerations include the model's integration into primary healthcare. Studies suggest that delegating SAM treatment to community health workers can enhance cost-effectiveness by improving access in remote areas and reducing the burden on tertiary facilities (Broadley et al., 2022; Ogobara Dougnon et al., 2021). The associated cost savings from such task-shifting and reduced indirect costs for caregivers could offset initial investments in training and local production scale-up (Potani et al., 2021).

Furthermore, the model's long-term sustainability and economic resilience are intrinsically linked to local agricultural systems and supply chain stability (Usman et al., 2022). Sourcing ingredients domestically may stimulate local economies and protect against international market volatility, but it also introduces risks from climatic variability affecting crop yields (Kudhayer & Habib, 2021). Consequently, a comprehensive economic evaluation must account for these factors alongside recurrent costs for capacity building, given that foundational nutrition training for medical professionals is often inadequate (Broadley et al., 2022). Ultimately, the assessment must rigorously compare the recovery rates and cost-per-recovery of locally-produced RUTF against standard imports to determine if comparable health outcomes justify the investment in a decentralised, locally-owned SAM management system (Quak, 2021).

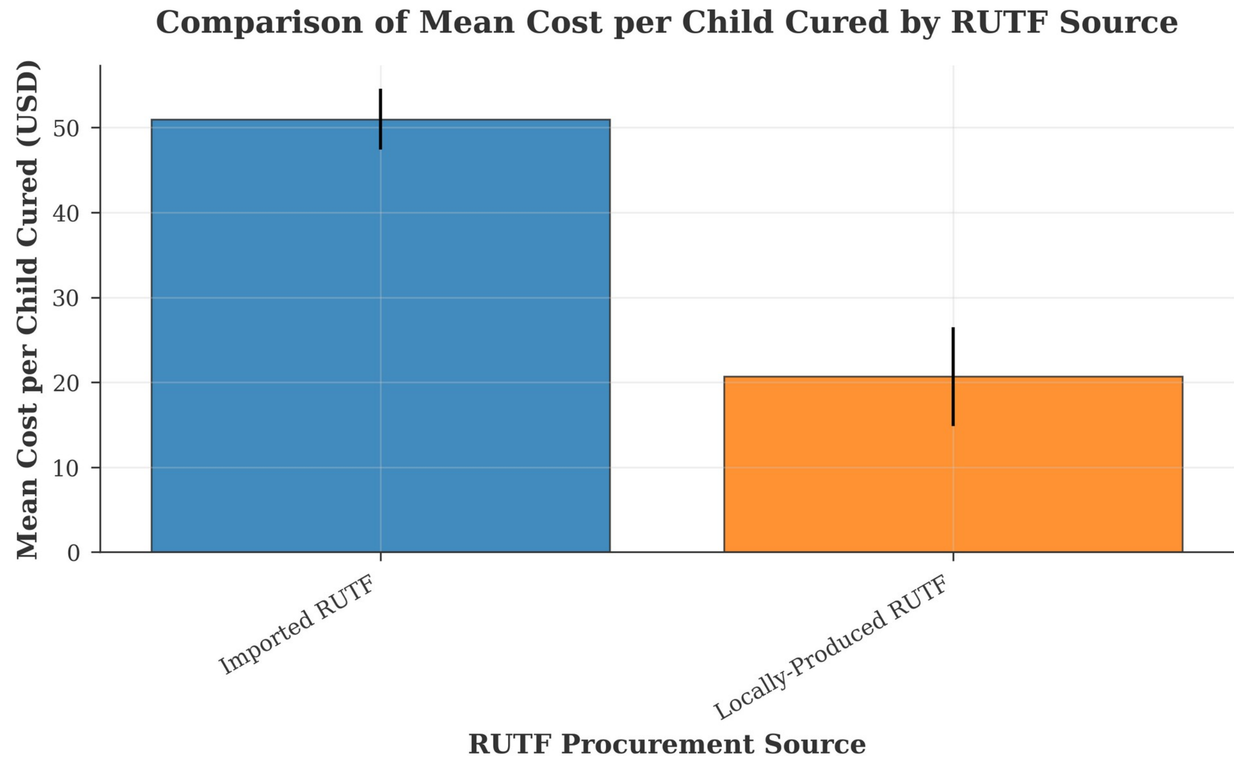


Figure 2: This figure compares the average economic cost required to achieve a cure for severe acute malnutrition using imported versus locally-produced RUTF within the community-based management model.

ACKNOWLEDGEMENTS

The author wishes to express sincere gratitude to Dr Amina Hassan for her invaluable guidance in shaping the research protocol. Thanks are also extended to Professor Idrissa Diallo for his insightful methodological advice. The author acknowledges the support of the Université Abdou Moumouni de Niamey for providing access to its academic resources and library facilities. The constructive comments from the anonymous peer reviewers, which greatly strengthened this protocol, are also gratefully acknowledged. This work was conducted independently by the author.

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