Cultivating Health: The Crucial Role of Rivers in Stunting Eradication and Human Nutrition

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Abstract
This study, conducted in the Komati River watershed in South Africa, investigates the many roles of rivers in addressing stunting and enhancing human nutrition. This study aims to investigate how rivers can help reduce stunting and enhance human nutrition by providing better access to clean water, increasing agricultural productivity, and supporting aquatic biodiversity. The study used a mixed-methods approach involving surveys, health record analysis, interviews, and focus group discussions to highlight the importance of rivers in providing clean water, supporting various agricultural activities, and improving dietary quality by including river fish. The cited contributions underscore the ability of rivers to improve public health and nutrition, stressing the importance of adopting sustainable river management techniques and coordinated policies to maximize their potential on a broader scale.

Keywords
stunting, river, stunting eradication, human nutrition, clean water access, sustainable river management

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Highlights
- Rivers provide crucial clean water access, influencing health and hygiene practices.
- River fish and agriculture enrich diets, improving community nutrition.
- Improved clean water access correlates with lower stunting rates, enhancing nutrition.
- Sustainable river management is vital for maximizing river potential.
- Integrated policies recognize rivers as central to health, nutrition, and global stunting eradication.

Introduction
Stunting, a condition characterized by chronic malnutrition resulting in impaired growth and development in children, remains a global health challenge of significant proportions (de Onis & Branca, 2016). Despite ongoing efforts to address this issue, the multifaceted nature of stunting necessitates a comprehensive approach that encompasses various factors influencing human nutrition and growth. One often underappreciated aspect of this challenge is the role that rivers, as crucial natural resources, play in stunting eradication. This article seeks to shed light on the multifaceted roles of rivers in enhancing human nutrition and addressing stunting.

1 contributed in conceptualization, investigation, methodology, and validation, writing and visualization

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Rivers are lifelines of many communities, providing water for drinking, irrigation, and a host of other uses. Their contributions to clean water accessibility are well documented, with rivers serving as vital sources of potable water for millions worldwide (Meyer, 1990). Ensuring access to clean water is a fundamental element in combating stunting and its associated health risks. Rivers also bolster agricultural productivity by providing consistent water supplies for irrigation, which, in turn, supports diverse food production (Cai et al., 2011). Furthermore, river ecosystems are rich in aquatic biodiversity, making them a potential source of nutrient-rich food, such as fish, which can significantly contribute to improved nutrition (Bunn et al., 2003).

This article delves into the various dimensions of rivers' contributions to stunting eradication and human nutrition, with a focus on their roles in providing clean water, supporting agriculture, and fostering aquatic biodiversity. Moreover, it emphasizes the need for river conservation and sustainable management practices to safeguard these vital natural resources for future generations. In light of the critical roles played by rivers in enhancing human nutrition and addressing stunting, this article raises the following research question: To what extent can harnessing the potential of rivers, through improved access to clean water, enhanced agricultural productivity, and sustainable management of aquatic biodiversity, contribute to the eradication of stunting and the promotion of human nutrition, and what are the associated challenges and policy implications?

Methodology
This extensive research used a mixed-methods approach to investigate the many roles of rivers in reducing stunting and enhancing human nutrition. The study is conducted inside rural communities along the Nkomati River in Mpumalanga, South Africa. The study combines collecting primary data with thoroughly examining relevant literature to enable a full analysis. Data was gathered from 500 families in the Komati River basin area using a structured survey questionnaire. The households were chosen through a random sampling technique to ensure that the dataset is both representative and statistically significant. The survey covers demographic characteristics, availability of drinkable water, eating habits, and the prevalence of stunted growth in children. We analysed health information from local healthcare facilities to assess the prevalence of stunting in the community, focusing on children. During this procedure, great care is taken to ensure the confidence and privacy of all those engaged. Key informant interviews were done with 20 people. This varied group included community leaders, local farmers, and professionals with expertise in water resource management. The interviews offer valuable qualitative insights into the community's opinions and experiences about rivers, water quality, and their impact on nutrition and stunting. We conduct focus group discussions with a group of 50 community members to gain deeper insights into their daily experiences and perspectives on the importance of rivers in their lives, especially in terms of water usage, farming practices, and food choices. A thorough review of academic literature is carried out to enhance the original data, focusing on studies related to the impact of rivers on clean water availability, agricultural practices, and the conservation of aquatic species. This assessment provides important background details and supports our analysis. During our inquiry, we rigorously follow ethical norms to protect persons' privacy and ensure that all participants provide informed consent. The research site selected is the Komati River valley in Mpumalanga, South Africa, which is emblematic of many locations worldwide.
Finding

In the Komati River basin area in Mpumalanga, South Africa, our research revealed a complex interplay between rivers, stunting eradication, and human nutrition. The survey of 500 households highlighted several crucial points. Firstly, access to clean water from the Komati River significantly influences the daily lives of the community members. It was found that 80% of surveyed households relied on the river as their primary source of clean water, and 92% of respondents reported improved overall health and hygiene practices due to this accessibility. The demographic analysis revealed that the majority of respondents were from households with an average family size of 4 to 5 members. The community exhibited diverse age groups, with a significant proportion being children under the age of five. These young children were of particular interest due to their vulnerability to stunting.

In terms of nutrition, dietary habits were diverse. While the majority of families (68%) incorporated fish from the Nkomati River into their diets, the predominant reliance was on staple crops. Nonetheless, families who consumed fish showed a higher intake of essential nutrients, including protein and omega-3 fatty acids. Additionally, 60% of households practicing riverbank agriculture reported a more varied diet, including nutrient-rich fruits and vegetables.

The assessment of health records from local facilities indicated that stunting was prevalent, particularly among children below the age of five. Approximately 35% of children in the community were found to be stunted, emphasizing the pressing need for interventions. Notably, those families that relied more on the Komati River for their daily water needs exhibited a lower prevalence of stunting in their children, suggesting a positive correlation between clean water access and reduced stunting rates.

Qualitative insights from key informant interviews and focus group discussions were equally enlightening. Community leaders and experts highlighted the central role of the river in daily life, emphasizing its importance for agriculture and overall well-being. Local farmers expressed a deep connection between river-dependent farming practices and improved crop yields, offering a diverse range of foods, while the significance of the river as a source of employment and income was underscored.

Access to clean water is a fundamental prerequisite for health and nutrition. Numerous studies have highlighted the role of rivers in providing communities with a reliable source of potable water. UNICEF's report on "Progress on Household Drinking Water, Sanitation, and Hygiene" (UNICEF, 2023) underscores the significance of clean water accessibility. It demonstrates that river-dependent communities often exhibit improved sanitation practices, reduced waterborne diseases, and overall better health, aligning with the findings of this study.

Rivers play a pivotal role in supporting agricultural practices and ensuring food security. Cai et al., (2011) conducted a case study on water scarcity and food import in the Middle East region, emphasizing the critical link between water resources and agricultural productivity. The study indicated that rivers serve as primary sources for irrigation, contributing to enhanced crop yields and a more diversified food production. This aligns with our findings, as river-dependent communities in the Nkomati River basin exhibited more varied dietary patterns due to river-dependent agriculture.

Aquatic biodiversity in river ecosystems is a valuable source of nutrient-rich food. Muringai et al., (2022) conducted a study focusing on indigenous fish species in sub-Saharan Africa. Their research demonstrated the significance of these fish in improving food and nutrition security. Small fish from rivers are rich in essential nutrients, including protein and essential fatty acids. This aligns with our findings, where communities that incorporated fish from the Nkomati River into their diets exhibited improved nutrition.

The literature reviewed here underscores the integral role that rivers play in addressing stunting and improving human nutrition. Clean water accessibility, river-dependent agriculture, and the utilization of aquatic biodiversity are all crucial elements in promoting well-being and reducing malnutrition. The Komati River basin in Mpumalanga, South Africa, serves as a practical case study that reflects these established principles, offering insights for similar regions worldwide grappling with these challenges.
Analysis & Discussion
The findings of this research illuminate the multifaceted roles of rivers in addressing stunting eradication and enhancing human nutrition, in alignment with our research question: "To what extent can harnessing the potential of rivers, through improved access to clean water, enhanced agricultural productivity, and sustainable management of aquatic biodiversity, contribute to the eradication of stunting and the promotion of human nutrition, and what are the associated challenges and policy implications?"

Our research revealed that rivers, such as the Komati River in Mpumalanga, South Africa, are pivotal sources of clean water for local communities. This access to clean water significantly influences health and hygiene practices. The correlation we observed between improved access to clean water from the river and reduced stunting rates echoes similar findings in the literature (UNICEF, 2023). These results underscore the critical importance of clean water sources in promoting health and reducing stunting in communities worldwide.

River-dependent agriculture was found to be a significant factor contributing to diversified food production and improved dietary patterns. Our results align with studies like Cai et al., (2011), highlighting the central role of rivers in supporting agriculture and ensuring food security. This aspect of river influence has broad implications for improving nutrition and addressing stunting, particularly in regions where agriculture is a primary livelihood.

The inclusion of fish from the Komati River in local diets positively impacted nutrition. This finding is consistent with research by Islam et al., (2023), which emphasized the nutritional value of small indigenous fish species. The incorporation of fish into diets in river-dependent communities is an essential step in improving nutrition and countering stunting.

While rivers offer substantial potential in combating stunting and malnutrition, they face various challenges, including pollution, habitat degradation, and overfishing. These challenges necessitate sustainable river management and the development of policies that safeguard these vital resources. The research also highlights the need for integrated policies that address both health and agriculture, considering rivers as central components of public health and well-being.

The Komati River basin in Mpumalanga, South Africa, serves as an illustrative case study, reflecting findings in the existing literature. It underscores the practical significance of rivers in enhancing human nutrition and reducing stunting. These results are of global relevance, offering valuable insights for policymakers, researchers, and communities facing similar challenges. By recognizing the central role of rivers and implementing sustainable practices, we can harness their potential to address stunting and promote human nutrition on a broader scale.

Conclusions
Our study in the Komati River watershed in South Africa highlights the important role of rivers in addressing stunting and enhancing human nutrition. The connection between clean water availability, river-based agriculture, and the consumption of nutrient-rich river fish in local diets demonstrates the various ways in which rivers benefit communities. Rivers have many challenges, but their ability to improve public health and nutrition is important. This study offers additional proof of the important role rivers play in improving human nutrition and combating stunting. It emphasizes the necessity of adopting sustainable river management
practices and integrating river-focused strategies into broader health and agricultural initiatives.

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Conflict of interest
The authors declare that they have no conflicts of interest related to this research study.

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