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VIEWPOINT

Farming fragile ecosystems: Rethinking agriculture in the Congolese marshlands for sustainable management and secure livelihoods

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Introduction

Wetlands are among the most critical and productive ecosystems, providing a wide range of ecosystem services that support ecological stability and the livelihoods of many communities (Chuma et al., 2024; Johnes et al., 2020). Recent research by Chuma et al. (2024) has developed a typology of wetlands in the Democratic Republic of Congo (DRC), differentiating between peatlands, swamps, inland valleys, and marshes. In this viewpoint, I focus on marshes—fragile ecosystems characterized by water-saturated soils and dominated by herbaceous plants such as grasses and reeds—which are cleared and drained annually to establish crop fields in eastern DRC. Marshlands contain rich alluvial soils with high organic matter and nutrient content, enriched by runoff from nearby hills, making them lands of economic and agronomic interest for rural communities (Johnes et al., 2020; Verhoeven & Setter, 2010). But what drives the use of marshland areas in South Kivu Province, DRC, despite their status as fragile ecosystems intended to be preserved?

In South Kivu, marshes have historically been used for agricultural production, including crops such as beans, maize, and sorghum. In recent years, however, farmers have intensified vegetable and sugarcane cultivation. The demand for land in Bukavu has increased due to a large-scale rural exodus, driven by armed conflicts and growing insecurity in the region. Fierce competition for land between residential expansion and farming has prompted many households to cultivate nearby marshland areas (Figure 1).

Another key factor driving marshland cultivation is the decline in upland agricultural productiv-

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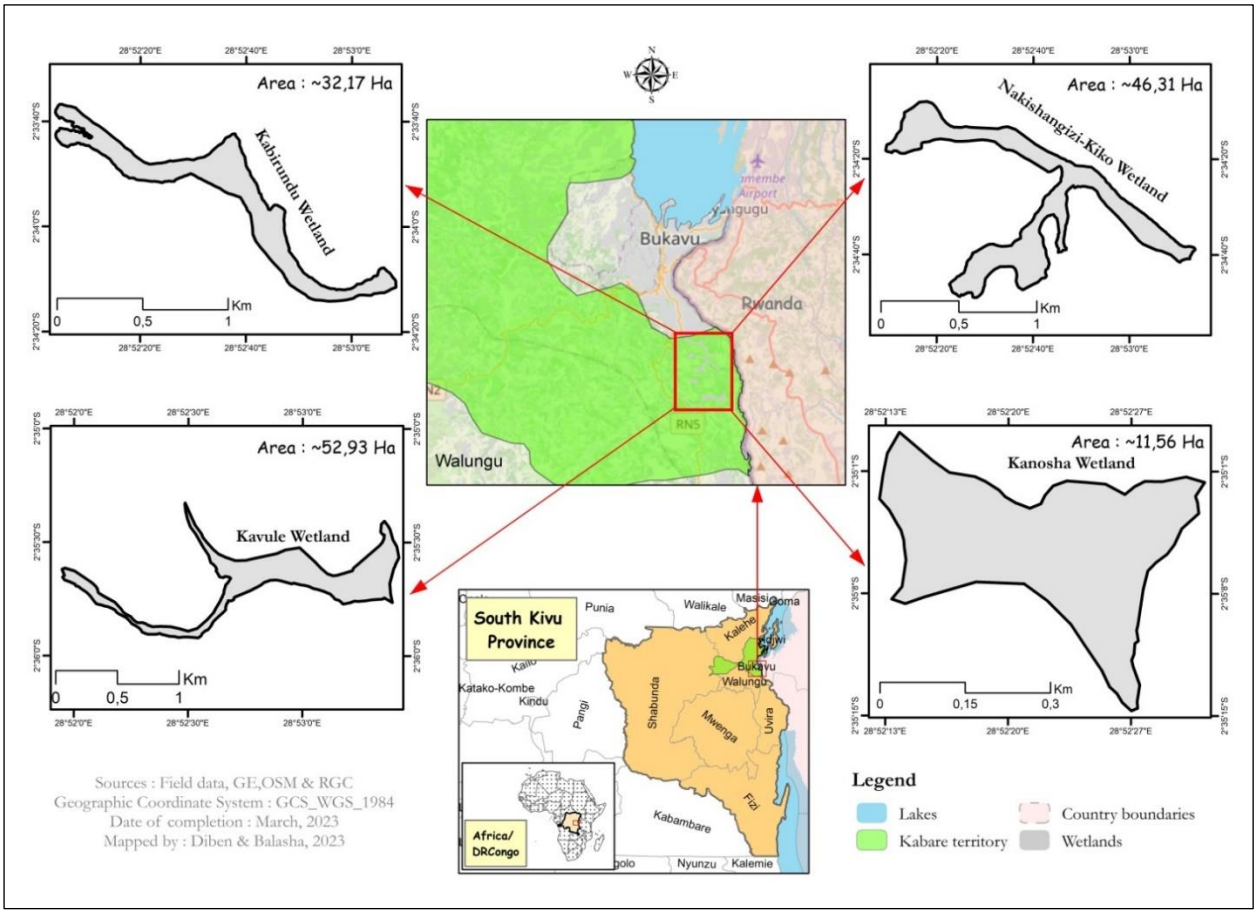
ity due to soil fertility loss, which has prompted farmers to intensify vegetable and sugarcane cultivation in marshlands and gradually develop fish farming as well (Balasha et al., 2023b; Chuma et al., 2021). The marshlands offer opportunities for off-season farming and support the cultivation of water-intensive crops such as sugarcane and diverse vegetables, including cabbage, squash, and eggplant (Balasha et al., 2023a; Chuma et al., 2021). Despite the crucial ecosystem services that marshes provide to communities and their vulnerability, discussions on how to reconcile agricultural production with wetland conservation remain limited. Here, I examine livelihood security through crop diversification in marshlands and the economic empowerment of women farmers, and explore how farming practices in these ecologically sensitive areas can be adapted to minimize their environmental impact.

Securing Livelihood through Crop Diversification in Congolese Marshlands

One of the primary benefits of marshland agriculture is its role in supporting household food production and income diversification. Due to year-round water availability and fertile soils, marshlands allow for continuous crop production even during the dry season. This is particularly important in eastern DRC, where rainfed upland farming is increasingly affected by climate variability (Azine et al., 2025; Balasha et al., 2023a). In the marshlands around Bukavu, crop diversification is a common practice among farmers. It is widely regarded as one of the most ecologically feasible, cost-effective, and rational strategies for reducing uncertainty in agriculture, particularly among small-scale farmers. This approach involves cultivating multiple crop varieties—either of the same or different species—through prac-

Figure 1. Map of the Marshlands around the City of Bukavu, Eastern Democratic Republic of Congo (DRC)



tices such as crop rotation and intercropping (Makate et al., 2016).

Compared to monoculture, crop diversification enhances biodiversity on farms, strengthens resilience to environmental stresses such as pest outbreaks, and improves the ability of agro-ecosystems to recover and maintain productivity (Jensen et al., 2020). Marshland farmers report that crop diversification reduces their reliance on chemical pesticides and fertilizers and enhances soil fertility through complementary crop interactions. Reducing the use of chemical pesticides and fertilizers protects fragile wetland ecosystems from pollution, maintaining the ecological balance and essential functions of marshes.

Economic Empowerment of Women Farmers through Marshland Agriculture

Marshland agriculture plays a crucial role in the economic empowerment of women farmers by providing opportunities for income generation and food security. Previous research indicates that 79% of women adopt crop diversification as a strategy to adapt to climate change and reduce food shortages, with 65% farming on marshlands to achieve financial independence (Balasha et al., 2021, 2023a). In marshlands, women and men farmers use crop diversification to reduce the risks of crop failure caused by pest outbreaks and climate change pressures; in a sentiment shared by many farmers, "if one crop fails due to environmental hazards, another can survive and help us." In Kabare marshlands, one of the key factors influencing crop diversification and farmers' crop choices is the nature of land tenure. Secure land tenure through inheritance or land purchase (ownership) provides farmers with the security and incentives to diversify crops, cultivate long-cycle crops such as sugarcane, taro, and cassava, and invest in fish farming. Women often cultivate plots obtained through informal or rental arrangements, growing vegetables such as amaranth, cabbage, and squash for sale in local markets. These fast-growing crops generate quick income, which supports women's financial independence, household food security, and decision-making power. This is illustrated by a woman farmer who said, "Unlike the income from sugarcane, which my husband manages as he pleases, the money I earn from vegetables gives me financial autonomy because I control it myself." On many farms, women are solely responsible for agricultural work, as their husbands and young male adults have migrated to artisanal mining sites in Misisi and Fizi, leaving women to bear the full burden of farming and household responsibilities. This was illustrated by one woman farmer, who said,

> Heavy tasks like drainage and field clearing used to be done by men. All the work now falls on me because my husband, who used to help in the fields, has left to seek income in the gold mine at Missi. The vegetables I grow feed my family, and the surplus I sell allows me to clothe [my children] and pay for my children's school fees.

Marshland Agriculture and Environmental Trade-offs

In addition to agricultural food production, marshlands provide building materials and regulatory functions such as water filtration, carbon storage, and support for community cultural identity (Chuma et al., 2024). However, these services are increasingly threatened by unsustainable farming practices due to a lack of technical support, information, and environmental safeguards. One of the major issues is the systematic drainage of marshes to make them suitable for agriculture, which threatens plant and animal species adapted to highly flooded environments. In addition, the exploitation of marshes for brick production further exacerbates their degradation. Moreover, many farmers rely on highly hazardous pesticides (such as dichlorvos, mancozeb, profenofos, and chlorpyrifos) to control pests.

Masumbuko et al. (2024) and Balasha et al. (2023b) argue that without proper guidance, pesticide use can contaminate water sources, harm aquatic life, and pose serious health risks to both farmers and the environment. At the same time, chemical fertilizers are increasingly being introduced (Lambrecht et al., 2014). However, farmers' limited knowledge of chemical fertilizers and weak regulatory oversight make their use a

potential threat to the long-term sustainability of marshland ecosystems.

While promoting organic inputs such as manure would be ideal, repeated conflicts and disease outbreaks have drastically reduced livestock populations in South Kivu, limiting the availability of organic matter. This was illustrated by one farmer, who said,

> Before, I used to collect manure from my rabbits, guinea pigs, and goats to fertilize my cropland. However, I no longer have any, because diseases killed almost all of them, and the few that remained were stolen. This has negatively affected the yield of my fields and my livelihood.

Pathways to Sustainable Marshland Agriculture

Promoting sustainable marshland conservation practices is essential to continue benefiting from the vital ecosystem services they provide. Effective marshland conservation requires a collaborative approach involving community participation, researchers, clear wetland management policies, and relevant public authorities operating within well-defined regulatory frameworks (Chuma et al., 2024). In the marshlands around Bukavu, several promising agroecological initiatives are already underway, such that farmers are planting anti-erosion hedges, using organic matter, applying mulch, and practicing crop diversification. These techniques help reduce dependency on synthetic inputs and enhance soil health; they should be scaled up in similar agroecosystems. Promoting flood-tolerant crops well suited to marshlands would help to minimize crop failures during flooding periods. I have observed that many farmers are beginning to consider fish farming as an alternative to food crops. There is hope that farmers will adopt new practices in the future if they receive critical technical support and information, as one farmer shared, "I've learned about integrated rice and fish farming in flooded environments. I plan to give it a try." The stakeholders mentioned above are encouraged to promote a marshland zoning strategy that clearly defines areas designated for cultivation, conservation, water retention, and ecological buffer zones. This process must be participatory, engaging farmers—particularly women farmers—who are key users of these shared and fragile landscapes. Properly implemented, marshland zoning can reconcile agricultural use with biodiversity conservation in wetlands (Zeng et al., 2012).

Conclusion

Marshlands offer various ecosystem services that support community livelihoods and development. However, sustainable marshland use is threatened by systematic drainage, the widespread application of highly hazardous pesticides, and a critical lack of agricultural information, including land-use management plans. Yet, this trajectory is not inevitable. I argue that scaling up agroecological practices, implementing land zoning, and ensuring farmers' access to information and their participation in the development of wetland management policies can simultaneously secure livelihoods and conserve the ecological functions of marshes. I also look forward to seeing meaningful actions, such as incentivizing the adoption of the best management practices among farmers, to support successful wetland conservation in the DRC.

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