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Multi-Criteria Evaluation of Indigenous Crops and Fish Species for Value Chain Integration and Added-Value Commercialization in Cotabato Province

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Abstract

Localized resource management is critical to ecological and economic sustainability. This study utilizes quantitative multi-criteria assessment data to examine how riparian communities along the Pulangi River in Mindanao, Philippines, value and preference indigenous crops and fish species. While economic incentives and income enhancement primarily drive agricultural and fisheries preferences, prioritization varies sharply across specific species. Among the analyzed varieties, residents prioritized cassava (*Manihot esculenta*) and giant mottled eel (*Anguilla marmorata*) for cultivation and value-added product development. These results offer actionable, empirical insights for stakeholders designing targeted biodiversity conservation policies and regional food security frameworks along the Pulangi River.

Keywords: Indigenous, crops, fish, Pulangi, Mindanao

Introduction

The Pulangi River basin in Mindanao, Philippines, serves as a critical ecological and economic lifeline that sustains diverse riparian agricultural and fishing communities. Within this basin, indigenous crops and native fish species form the bedrock of local food systems, public health, and cultural heritage. However, contemporary pressures from agricultural modernization, climate fluctuations, and shifting market dynamics pose severe challenges to traditional agrobiodiversity. In the Philippines, agricultural land degradation across steeply sloping upland areas has been recognized as a critical environmental issue for decades, generating severe on-site and off-site ecological impacts (Cramb, 1998). To mitigate these threats, conservation farming frameworks such as contour hedgerows utilizing shrub legumes have been widely promoted (Cramb, 2000; Cramb et al., 2000). These sustainable systems enable smallholder farmers to expand cultivation areas efficiently, thereby fostering increased food production and household income.

Beyond structural field modifications, smallholders navigate complex daily agricultural operations and practical knowledge systems. Everyday activities including land preparation, planting, fertilizing, chemical application, weeding, harvesting, transport, cooking, and consumption interlock to reflect localized ideology-making, establishing farming as a deeply embedded, distinctive human process (Bhandari, 1993). Parallel to these terrestrial agricultural dynamics, the aquatic ecosystem of the Pulangi River features distinct hydrological parameters, deep pools, and variable currents that sustain a diverse array of inland fisheries. High-value indigenous species, such as the giant mottled eel (*Anguilla marmorata*), locally known as kasili or igat, and the river mullet (*Cestraeus plicatilis*), locally termed banak, anchor the river's native trophic food web (Corpuz et al., 2025). These resident and migratory species rely heavily on uninterrupted riverine connectivity to complete their biological life cycles, while concurrently providing crucial micronutrients and baseline income for riverside communities (Morillo, 2025).

To design effective, targeted rural development and biodiversity conservation strategies, researchers must identify which indigenous resources local residents prioritize and dissect the underlying mechanisms driving these preferences. Consequently, this study analyzes structured, multi-criteria evaluation data to examine the

socio-economic and ecological drivers influencing the preferences of indigenous crops and fish species among communities along the Pulangi River.

Methodology

Primary data were gathered utilizing a structured multi-criteria evaluation matrix administered to residents and key stakeholders within the Pulangi River basin. Using this framework, respondents systematically evaluated three native crop varieties and three indigenous fish species against a suite of fourteen distinct development indicators. This multi-criteria approach captured localized socio-economic, market, cultural, and environmental valuation priorities.

Research Design

This study employed a descriptive-quantitative, multi-criteria decision-making (MCDM) research design. This framework was selected to systematically capture and quantify localized ecological knowledge regarding the preferences of native crop and fish species for cultivation, resource management, and value-added product development. Primary field data collection targeted key multi-stakeholder cohorts, specifically smallholder farmers, artisanal fishers (mangingisda), and barangay environmental officers. Respondents evaluated six focal target species using a structured MCDM matrix. Within this instrument, participants assigned proportional weight percentages across fourteen distinct developmental indicators, providing a quantifiable metric for socioeconomic and environmental viability.

Respondents of the Study

The target population consisted of localized agricultural and fisheries operators within the Pulangi River basin. A sample size of ($N = 250$) was established, stratifying respondents into equal subsets of ($n = 50$) farmers and fisherfolk per target barangay. The administrative distribution of the sample across the five field sites included two barangays in the municipality of President Roxas, one barangay in Matalam, and two barangays in Carmen. This selection strategy gathered robust, community-level data from primary resource users.

Location of the Study

As illustrated in Figure 1, field data collection was strategically partitioned into three distinct river segments within Cotabato Province to capture geographical variances across the Pulangi River basin. The upstream zone was anchored in the municipality of President Roxas at Sitio Kaminuangan, Barangay Kisupaan ($7^{\circ}22'52.97''$ N, $125^{\circ}0'9.09''$ E). The midstream segment spanned three distinct locations: Barangay Arakan in Matalam ($7^{\circ}21'29.81''$ N, $124^{\circ}55'52.39''$ E), Sitio Lebpas within Barangay Tual, President Roxas ($7^{\circ}21'9.63''$ N, $124^{\circ}55'18.58''$ E), and Barangay Manili in Carmen ($7^{\circ}8'33.44''$ N, $124^{\circ}53'35.16''$ E). Lastly, the downstream zone was established at Sitio Lumayong, Barangay Ugalingan in the municipality of Carmen ($7^{\circ}17'26.49''$ N, $124^{\circ}51'15.11''$ E).

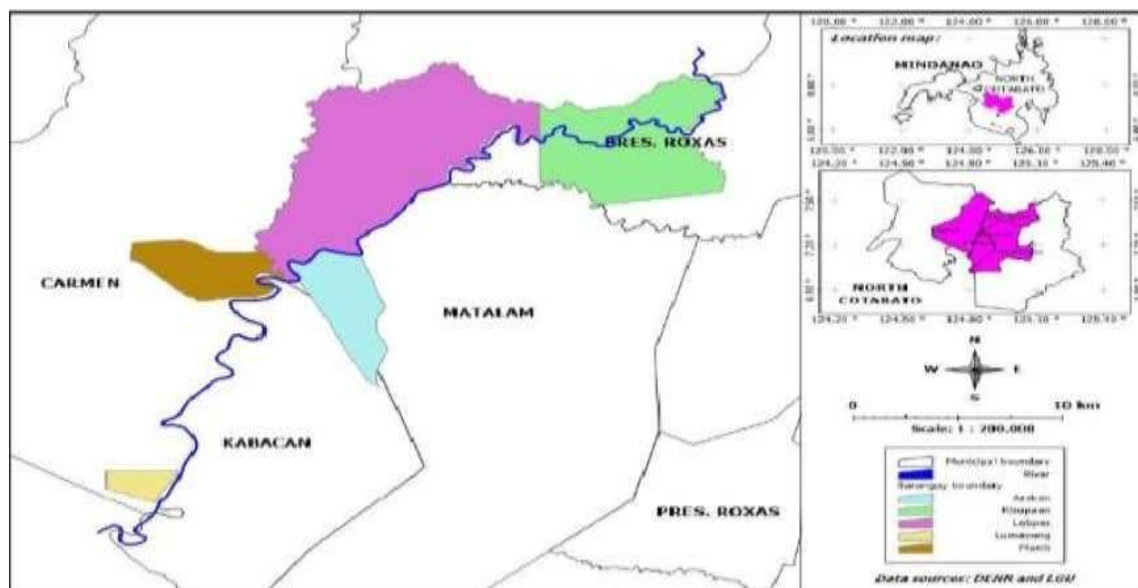


Fig. 1. Map showing the study site

Evaluated Species

Indigenous Crops: Kayos (Wild Yam), Kamoting Kahoy (Cassava variety), and Mangga Wani (Local Mangifera/Mango relative).

Indigenous Fish Species: Kasili (Freshwater Eel), Buted or beya/ (Glossogobius giuris), and Baanak (Mullet variety).

Core Assessment Metrics

The evaluation utilized fourteen standardized metrics grouped into five primary thematic areas:

1. **Economic & Market Impact (A1–A3):** Potential to increase income, potential for increasing market share, and potential for increasing production.
2. **Governance & Collective Action (B1–B4):** Collective action capabilities, private sector engagement, government priority/engagement, and infrastructure availability.
3. **Social Inclusion & Value Chains (C1–C4):** Smallholder involvement, youth and women engagement, value chain collaboration potential, and scaling potential.
4. **Environmental Sustainability (D1):** Low negative impact on the environment.
5. **Research & Development (E1):** Researchability and technical feasibility.

Results and Discussion

Indigenous Crop Preferences and Agroecological

Context

The evaluation of the indigenous crop dataset reveals a pronounced preference for specific indigenous crops, deeply contingent upon the developmental metrics applied (Figure 2). Economically, kamoting kahoy (cassava) demonstrates clear dominance across market-driven indicators, securing a high score of 70.98% for income increase potential (A1). This robust valuation underscores a highly functional local market ecosystem and resilient consumer demand. Furthermore, kamoting kahoy leads alternative cultivars in market expansion potential (29.20%) and production scalability (26.67%), establishing it as the primary vehicle for rural agricultural commercialization along the basin.

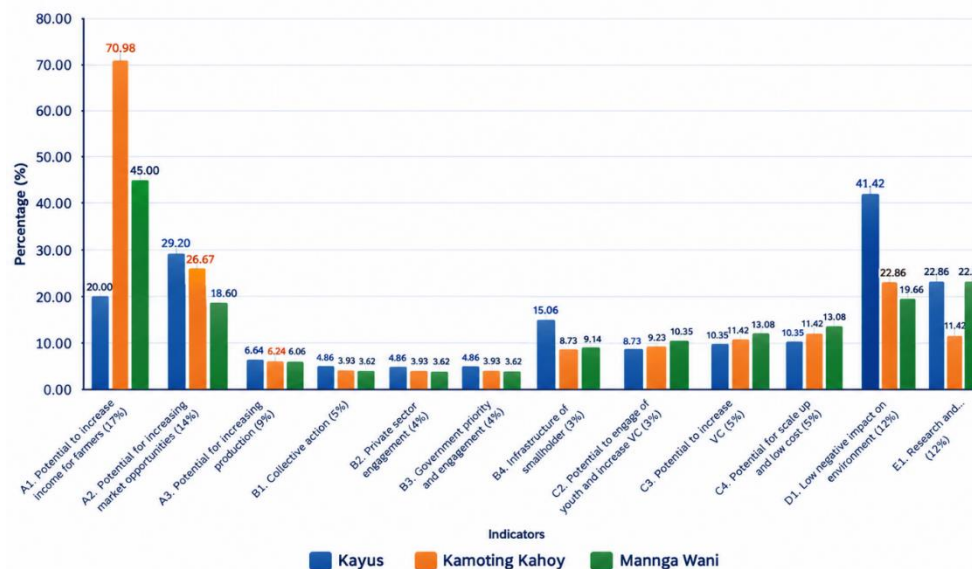


Fig. 2. Indigenous Crop Preferences of the Communities and Agroecological Context

In contrast, traditional wild varieties demonstrate significant value regarding ecological resilience rather than immediate cash yields. While kayos (wild yam) and mangga wani (native forest mango) yield lower short-term commercial returns, they perform strongly under environmental sustainability parameters. Kamoting kahoy maintains the leading environmental safety score at 41.42%, but it is closely followed by kayos at 31.00% and mangga wani at 22.86%. These metrics emphasize the exceptionally low ecological footprint inherent to cultivating traditional wild yams and perennial tree crops. Conversely, critical institutional and social bottlenecks emerge uniformly across all evaluated cultivars. Every crop scored below the 10.00% threshold for institutional indicators, specifically collective action (B1), government prioritization (B3), and infrastructure availability (B4). This uniform deficit highlights a severe lack of formal policy frameworks, organized agrarian

cooperatives, and dedicated agricultural extension services tailored to indigenous crops within the Pulangi basin.

Fisheries Preferences and Ecological Dynamics

The multi-criteria assessment of the fisheries sector reveals distinct preferences dynamics, characterized by an elevated economic demand for specific high-value native fish species among riparian residents (Figure 3). Among the evaluated aquatic resources, kasili (giant mottled eel, *Anguilla marmorata*) emerges as the definitive top-priority species, scoring 55.76% in immediate income-generating potential. This prominent valuation directly reflects its premium market value and consistent integration into local and regional trade networks. Additionally, kasili leads all other evaluated fish varieties in perceived potential for production scalability, securing a score of 17.99%. Managed wild-capture systems or localized aquaculture initiatives for this species are also viewed favorably by riverside residents, as evidenced by kasili leading the environmental sustainability category at 32.99%. This indicates a strong community consensus that structured eel production remains ecologically viable along the corridor.

In contrast, secondary fisheries display more stable, moderate development profiles across the basin. Buted (flathead gudgeon/gobies) shows a balanced performance, maintaining a reliable income potential of 26.00% and a solid environmental compatibility score of 27.00%. Meanwhile, baanak (river mullet, *Cestraeus plicatilis*) exhibits lower scores across immediate production scalability metrics (5.78%), yet it retains vital cultural and food security value within riverside communities due to its baseline climate adaptability. Notably, across the entire dataset, these native fish species demonstrate a significantly higher capacity for value chain integration (C3) and structural scalability (C4) than the agricultural crop species. This comparative advantage indicates that localized aquatic resource processing possesses fewer institutional friction points and higher commercial viability for smallholders than traditional agrobiodiversity.

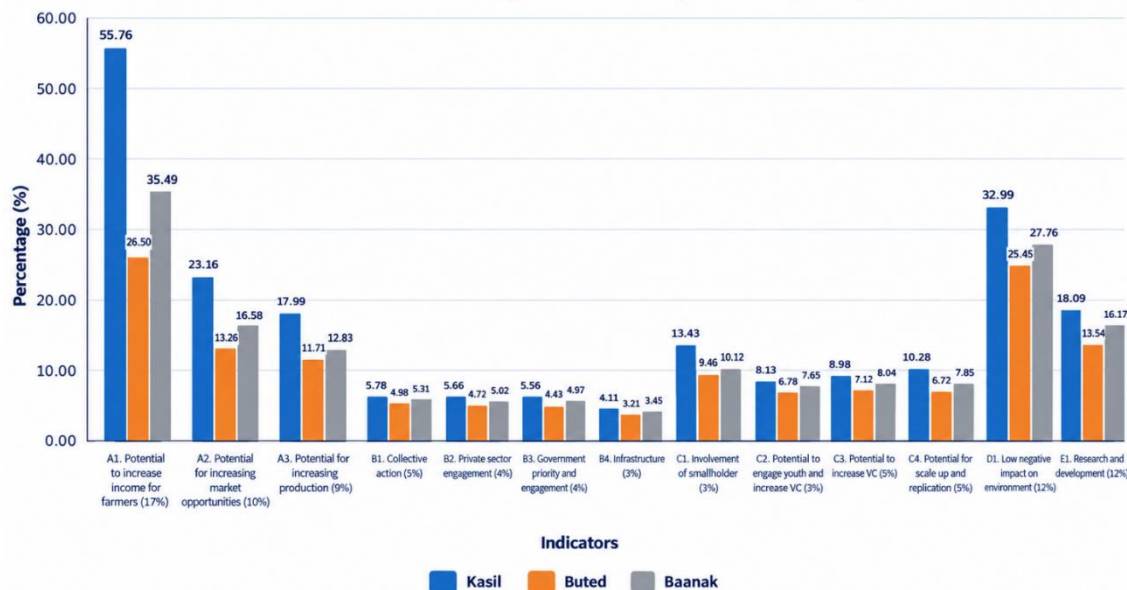


Fig. 3. Community Fishery Preferences and Ecological Dynamics

Conclusion

The multi-criteria analysis confirms that economic viability and income-generating potential are the primary drivers influencing how Pulangi residents' preferences indigenous species. Kamoting kahoy emerges as the premier agricultural preference, while kasili functions as the central anchor for riverine fisheries. Critically, the uniformly low scores recorded for institutional indicators, governance, and infrastructure underscore a significant gap between community reliance on these native resources and formal government backing. Addressing these bottlenecks requires targeted regional policies that transition these highly valued species from subsistence-level harvesting into formalized, value-added value chains backed by dedicated agricultural extension services and local ecological frameworks.

Policy Recommendations

Based on the multi-criteria evaluation and agroecological findings, three strategic policy interventions are

recommended to foster sustainable rural development and resource conservation along the Pulangi River basin. First, provincial and municipal governments must prioritize Targeted Infrastructure Investment by funding localized processing facilities and cold-storage networks directly adjacent to key riparian hubs. These interventions are critical to reducing post-harvest losses, enhancing supply chain efficiency, and maximizing the commercial value-added potential of high-priority commodities such as kasili (giant mottled eel) and kamoting kahoy (cassava). Second, the Department of Agriculture, alongside municipal and provincial agricultural offices, should execute the Formal Integration of Native Species into Local Extension Services. This requires establishing explicit conservation, cultivation, and marketing frameworks tailored specifically to underrepresented but ecologically resilient crops like kayos (wild yam) and mangga wani (native forest mango), thereby preserving regional agro-biodiversity against the pressures of monocultural agricultural modernization.

Finally, regional stakeholders must provide robust legislative and financial Support for Community-Led Resource Management. Establishing community-managed freshwater sanctuaries and implementing sustainable, data-driven fishing quotas along the Pulangi River will create a vital ecological safeguard. These localized governance frameworks will protect highly prioritized native aquatic species from overexploitation by invasive food fish and unmanaged wild-capture practices, ultimately securing long-term baseline incomes and food security networks for the region's indigenous cultural communities.

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