

Participatory Mapping of Ecosystem Services and Degradation Hotspots in the Nyadire Sub-Catchment, Zimbabwe: Implications for Multifunctional Landscape Design

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CGIAR Multifunctional Landscapes Program

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Executive Summary

Agricultural landscapes in Zimbabwe are under increasing pressure from land degradation, water scarcity, and declining ecological infrastructure, threatening both ecosystem integrity and rural livelihoods. These challenges are particularly pronounced in the Nyadire sub-catchment, a predominantly smallholder farming system in Mashonaland East Province that encompasses parts of Murehwa District, where livelihoods depend heavily on water, soil, forest, wetland, and grazing ecosystem services. In this context, this technical report presents findings from a participatory ecosystem services mapping exercise conducted under the CGIAR Multifunctional Landscapes (MFL) Science Program, with the aim of identifying ecosystem service hotspots, perceived threats, and locally grounded priorities to inform landscape-scale planning and governance.

Participatory mapping and ranking exercises were undertaken with community members (women, men, and youth), traditional leaders, and government stakeholders in Ward 4 and Ward 27 of Murehwa District, selected to represent contrasting upper- and lower-catchment contexts within the Nyadire sub-catchment. Five ecosystem services namely water regulation, soil fertility and erosion control, forests and woodlands, wetlands, and grazing land were prioritised through a co-design process based primarily on local livelihood dependence, ecological function, and vulnerability to degradation. The results reveal spatially explicit ecosystem service hotspots alongside widespread perceptions of holistic landscape degradation, understood not only as biophysical decline but also as the erosion of interconnected social, cultural, and ecological systems.

Clear social differentiation emerged in how ecosystem services were valued and prioritised. Women consistently emphasised water availability, wetlands, and home-based nutrition gardens, reflecting their responsibilities for domestic water provision and household food security. Men prioritised soil erosion control, forests, and grazing land, linked to land preparation, livestock management, and fuelwood use. Older participants highlighted sacred sites and culturally significant areas, underscoring their custodial role in intergenerational knowledge transmission. Government stakeholders placed greater emphasis on soil conservation and watershed protection, reflecting institutional mandates and longer-term planning perspectives.

These differentiated perspectives highlight the need for inclusive, socially differentiated, and spatially targeted landscape interventions. Overall, the findings demonstrate that effective multifunctional landscape management in the Nyadire sub-catchment, particularly in its Murehwa portion, must integrate water-centred restoration, soil and forest management, gender-responsive governance, and participatory decision-making. The report concludes by illustrating how participatory ecosystem services mapping can be used as a practical design and learning tool to support MFL - aligned interventions in landscape restoration, natural resource governance, and capacity building, offering a scalable model for people-centred landscape planning in Zimbabwe and comparable highland catchment systems.

“Without water, even our soil becomes useless.”

— Farmer, Ward 4, Murehwa district.

1 Introduction

Agricultural landscapes in Zimbabwe are undergoing rapid transformation as a result of land-use change, climate variability, population pressure, and competing demands for natural resources (Chimonyo et al., 2023). These dynamics have intensified land degradation, reduced ecosystem service provision, and increased vulnerability of smallholder livelihoods. Addressing such interconnected challenges requires approaches that move beyond farm-level interventions to embrace landscape-scale, socially inclusive, and ecologically grounded planning frameworks (Garibaldi et al., 2023; Jeanneret et al., 2021).

The Consultative Group on International Agricultural Research (CGIAR) Multifunctional Landscapes (MFL) Science Program responds to this need by promoting integrated approaches that balance agricultural production, ecosystem service stewardship, and livelihood resilience across landscapes. Central to this approach is the recognition that landscapes are not only biophysical systems, but also social and institutional spaces where different actors hold distinct knowledge, priorities, and power (Chirwa et al., 2024; Garibaldi et al., 2023). Participatory methods are therefore critical for revealing how ecosystem services are perceived, accessed, and managed by different social groups, and for ensuring that landscape interventions are locally legitimate and socially differentiated.

This report presents findings from a participatory ecosystem services mapping exercise conducted in the Nyadire Sub-Catchment Agroecological Landscape (Murehwa Highveld), Zimbabwe (World Bank, 2024). The Nyadire sub-catchment forms part of the Mazowe Catchment within the Zambezi River Basin and covers approximately 5,960 km², spanning portions of Murehwa, Mutoko, Uzumba – Maramba - Pfungwe, and Mudzi districts. The landscape is predominantly communal and supports dense rural populations whose livelihoods depend directly on ecosystem services derived from rivers, wetlands, forests, rangelands, and soils. Like many highland agroecological systems in southern Africa, the Nyadire Sub-catchment landscape is experiencing holistic landscape degradation. This degradation is not limited to biophysical decline such as soil erosion, wetland degradation, deforestation, and declining water quality but also encompasses social and institutional dimensions, including weakened customary governance, land-use conflicts, and inequitable access to resources. Understanding degradation as a coupled social–ecological process is essential for designing interventions that are both effective and locally legitimate (Lescourret et al., 2015; Leslie et al., 2015).

Participatory ecosystem services mapping has emerged globally as a key approach for addressing such complexity in multifunctional landscapes (Chevalier & Buckles, 2019; García-Díez et al., 2020). Participatory GIS (PGIS) and ecosystem service mapping methods have been widely applied to integrate local knowledge into landscape planning (Mekuria et al., 2024), improve the visibility of socially differentiated values (García-Díez et al., 2020), and support negotiated decision-making in contexts characterised by competing land uses (World Bank, 2024). Studies from Latin America, Asia, and sub-Saharan Africa demonstrate that participatory mapping can enhance stakeholder learning, strengthen local ownership of interventions, and improve the design of landscape restoration and climate-resilient land-use strategies (e.g. Baumeister et al., 2020; Clarkson et al., 2022; Kim et al., 2021; World Bank, 2024).

In Africa, participatory mapping has been applied to support watershed management, rangeland governance, forest co-management (Djenontin et al., 2020), and climate adaptation planning, particularly where conventional top-down planning has failed to account for local priorities and power asymmetries. Evidence suggests that when participatory mapping is embedded within broader governance processes, it can contribute to more resilient social–ecological systems by facilitating dialogue across scales, surfacing trade-offs, and enabling more inclusive landscape design (Braslow et al., 2016; Lescourret et al., 2015). In Zimbabwe, while participatory approaches have been used in natural resource management and community-based planning, their systematic application to

ecosystem service mapping at landscape scale remains limited, particularly within the context of agroecology and multifunctional landscapes. The Nyadire sub-catchment has recently been identified by the Government of Zimbabwe, the Environmental Management Agency (EMA), and the World Bank as a pilot landscape for participatory land-use planning and sustainable production landscapes, providing a timely institutional entry point for such approaches (World Bank, 2024).

Within the Nyadire Sub-catchment, participatory mapping was undertaken in Ward 4 and Ward 27 of Murehwa District, selected to represent contrasting upper and lower catchment contexts. These wards exhibit different land-use pressures, hydrological positions, and livelihood strategies, making them suitable sites for exploring how ecosystem service priorities vary spatially and socially within a single landscape. Therefore, the objectives of this study were to (i) identify and spatially map ecosystem service hotspots within the Nyadire Sub-catchment, (ii) examine perceived threats to key ecosystem services across different stakeholder groups; and (iii) generate insights to inform the design of MFL-aligned interventions that integrate agroecology, ecosystem governance, and socially differentiated livelihood needs.

The results of the participatory mapping exercise presented in this report are intended to inform multiple user groups and decision-making processes. At community level, the maps provide a platform for reflection, learning, and negotiation around ecosystem service use and degradation. For traditional leadership and local government structures, the outputs support more context-specific and socially informed resource governance. At district and national levels, the findings contribute evidence to ongoing participatory land-use planning processes, ecosystem restoration initiatives, and the design of MFL interventions aligned with agroecology, water management, and livelihood resilience. More broadly, the results provide a spatially explicit knowledge base to support the CGIAR MFL Science Program in co-designing interventions that are ecologically grounded, socially differentiated, and scalable. The remainder of the report is structured as follows: the next section describes the participatory mapping methodology; subsequent sections present and interpret the results; and the final section discusses implications for the CGIAR MFL Areas of Work, landscape governance, and future research and practice.

2 Methodology

2.1 Study Area

The study was conducted in the Nyadire sub-catchment, located in Mashonaland East Province, Zimbabwe. The Nyadire sub-catchment forms part of the Mazowe Catchment within the Zambezi River Basin and covers approximately 5,960 km², spanning parts of Murehwa, Mutoko, Uzumba–Maramba–Pfungwe, and Mudzi districts. It is predominantly communal land and supports dense rural populations whose livelihoods depend directly on ecosystem services derived from water, soils, forests, wetlands, and rangelands (World Bank, 2024).

Agriculture is the dominant land use in the sub-catchment and is largely smallholder-based. Farming systems are characterised by rainfed maize production, groundnuts, horticulture, and mixed crop–livestock systems, complemented by small-scale irrigation along rivers and wetlands. Other important land uses include forested areas, communal grazing lands, human settlements, and both formal and artisanal mining (notably gold and black granite) (Chimonyo et al., 2023). Key ecosystem service features include rivers and tributaries draining into the Nyadire River, wetlands used for dry-season cultivation, forest patches providing fuelwood and grazing, and water infrastructure such as Nyadire Dam, which supplies domestic and irrigation water to surrounding communities and institutions.

Previous assessments in the Mazowe Catchment and Nyadire sub-catchment have identified widespread land degradation, including streambank and wetland cultivation, soil erosion and gully formation on sodic soils, deforestation driven by fuelwood demand, invasive alien species (e.g. *Lantana camara* and water hyacinth), and pollution associated with mining activities (Mandizha et al., 2024; Matsa et al., 2020). These pressures have resulted in declining water quality, siltation of water bodies, reduced soil fertility, and increasing competition over natural resources, making the sub-catchment a priority area for participatory land-use planning and sustainable production landscape interventions.

Within the Nyadire sub-catchment, the study focused on Ward 4 and Ward 27 of Murehwa District (Figure 1). In Zimbabwe, a *ward* is the lowest formal administrative unit for local governance and planning, typically comprising several villages and serving populations ranging from several thousand to over ten thousand people, depending on settlement density. Wards are commonly used as entry points for development planning, extension services, and natural resource governance.

Ward 4 and Ward 27 were purposively selected to represent contrasting socio-ecological and hydrological contexts within the sub-catchment. Ward 4 represents an upper catchment setting, characterised by steeper slopes, higher erosion risk, and concentrated horticultural production along rivers and wetlands. Ward 27 represents a lower catchment setting, with higher population density, extensive streambank cultivation, wetland conversion, gum tree plantations, and greater pressure on forests and grazing land. The contrast between these wards enabled examination of how ecosystem service priorities and perceived threats vary across different positions within the same sub-catchment system.

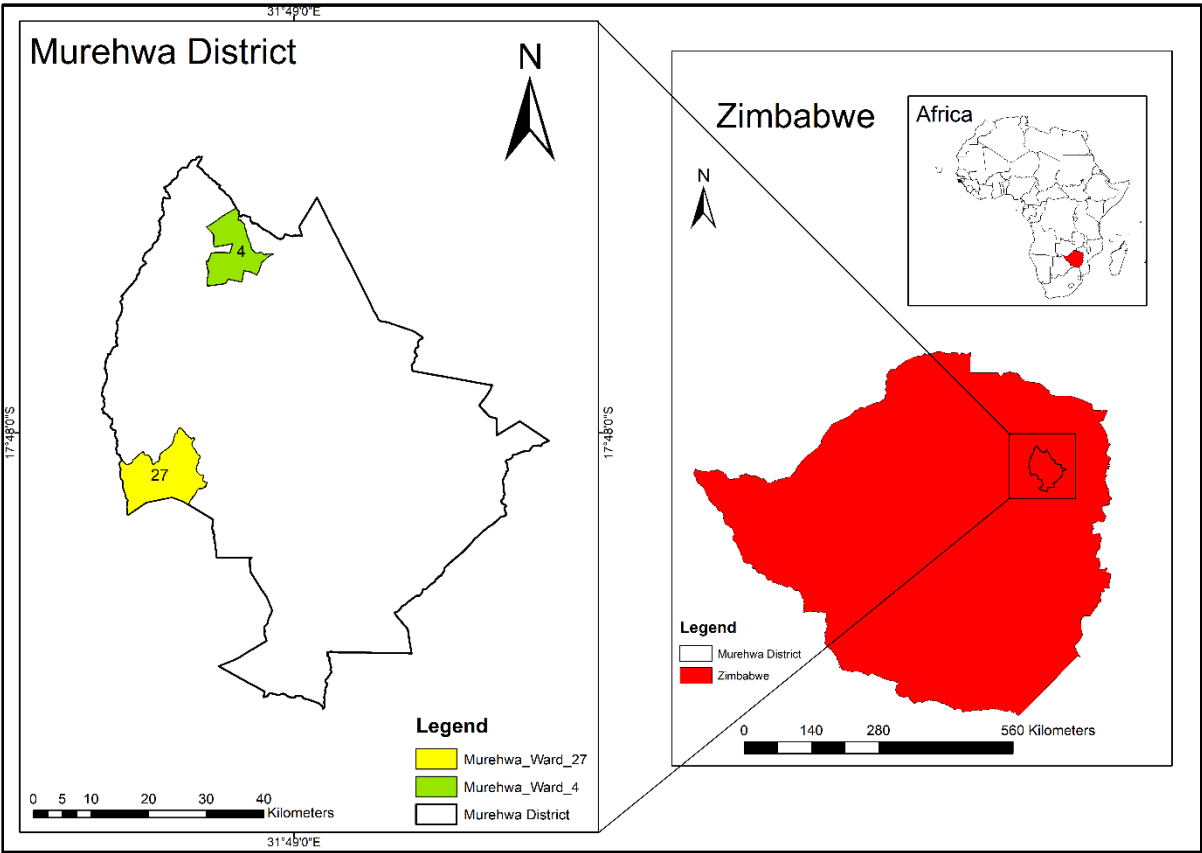


Figure 1. Map of Murehwa District in Zimbabwe showing Wards 4 and 27. (Source: Dennis J. Choruma)

2.2 Participatory Ecosystem Services Mapping Approach and Data Collection

The study adopted a participatory ecosystem services mapping approach that integrates Participatory Geographic Information Systems (PGIS) with ecosystem service ranking and threat assessment. The approach was informed by established participatory mapping protocols for multi-use agricultural landscapes (e.g. Braslow et al., 2016) and adapted to the socio-ecological context of the Nyadire sub-catchment.

Selection of ecosystem services

Five ecosystem services were selected for evaluation at the outset of the study: (i) water resource management, (ii) soil health and erosion control, (iii) forest and rangeland management, (iv) livelihood diversification and climate resilience, and (v) biodiversity conservation. These services were prioritised primarily based on local environmental challenges and livelihood dependencies, rather than abstract programmatic priorities.

Preliminary engagement with extension officers and local stakeholders indicated that water scarcity, soil erosion, deforestation, and declining livelihood options were the most pressing concerns in the sub-catchment. These ecosystem services were therefore selected because they directly reflect the dominant drivers of land degradation, the ecosystem functions underpinning smallholder livelihoods, and the locally perceived entry points for landscape restoration. Alignment with broader MFL thematic areas was considered secondary and confirmatory, rather than the primary justification for selection.

Stakeholder workshop

A stakeholder workshop was conducted with representatives from key government institutions, including Agricultural Technical and Extension Services (AGRITEX), the Environmental Management Agency (EMA), the Forestry Commission, the Rural District Council, and the Department of Irrigation. Participants individually ranked the five ecosystem services according to their perceived importance and assessed threat levels (High, Medium, Low) for key ecosystem goods.

A structured questionnaire was designed in KoboToolbox, pre-tested with IWMI and AGRITEX staff, and administered in paper format during the workshop to minimise group influence. Completed questionnaires were later digitised into Kobo for data cleaning and descriptive analysis. The stakeholder workshop served two purposes: first, to capture institutional perspectives on ecosystem service priorities and threats; and second, to inform and contextualise subsequent community-level participatory mapping.



Stakeholder workshop conducted at Chibhanguza Hotel, Murehwa, on 2 September 2025. (photo: Walter Mupangwa).

Community PGIS and participatory mapping

Separate PGIS workshops were conducted in Ward 4 and Ward 27, each involving 40 participants (20 women and 20 men). Participants were further disaggregated into four focus groups: younger women, older women, younger men, and older men, using 50 years as the locally recognised threshold between younger and older participants. This structure was designed to capture gendered and generational differences in ecosystem service use, knowledge, and valuation.

Each group worked with A1-sized satellite imagery covering a 3–5 km radius around their villages. Using coloured stickers and markers, participants identified and mapped key landscape features, including rivers, wetlands, springs, gardens, crop fields, forests, grazing areas, soil erosion hotspots, and sacred or culturally significant sites. Colours were standardised to distinguish water-related features, natural vegetation and cultural sites, and built or cultivated areas. Facilitators documented group discussions on perceived changes, drivers of degradation, and interconnections between ecosystem services.

Following the mapping exercise, each group ranked the five selected ecosystem services from 1 (least important) to 5 (most important) and assessed perceived threat levels for each service, providing qualitative explanations for their rankings. This ensured direct comparability between stakeholder and community assessments.



Photographs of participants in the different groups during the participatory mapping, organised by gender and age. Top right – younger men, Top right – younger women, Bottom left – older women and Bottom right – older men (photo: Walter Mupangwa).

Data analysis and integration

Quantitative data from ecosystem service rankings and threat assessments were analysed using descriptive statistics to summarise priorities and perceived threat levels across stakeholder groups, wards, gender, and age categories. Qualitative data from PGIS discussions and mapped outputs were analysed thematically to identify recurring narratives related to water scarcity, soil degradation, deforestation, wetland loss, and cultural ecosystem services.

The integration of ranking data and participatory mapping enabled triangulation of spatial patterns and social perceptions. Graphical outputs, including bar charts, radar charts, and selected participatory maps, were produced to visualise differences in ecosystem service priorities, threat perceptions, and gender-differentiated mapping patterns. This integrated approach provided a holistic understanding of ecosystem service dynamics within the Nyadire sub-catchment and their implications for landscape-scale planning and intervention design.

3 Results

3.1 Stakeholder Prioritization and Threat Assessment

Stakeholders ranked water resource management as the highest priority (60%), followed by livelihood diversification, soil health and soil erosion control (55%), and forest and rangeland management (46%). Biodiversity conservation was lowest with 27%. Figure 1 shows the ranking of ecosystem priorities by the government stakeholders who participated in the workshop. Water supply was rated as under high threat due to deforestation, streambank cultivation, and poor catchment management. Stakeholders stressed that water connects all ecosystem services and recommended targeting wetland restoration, catchment protection, and enforcement of environmental by-laws.

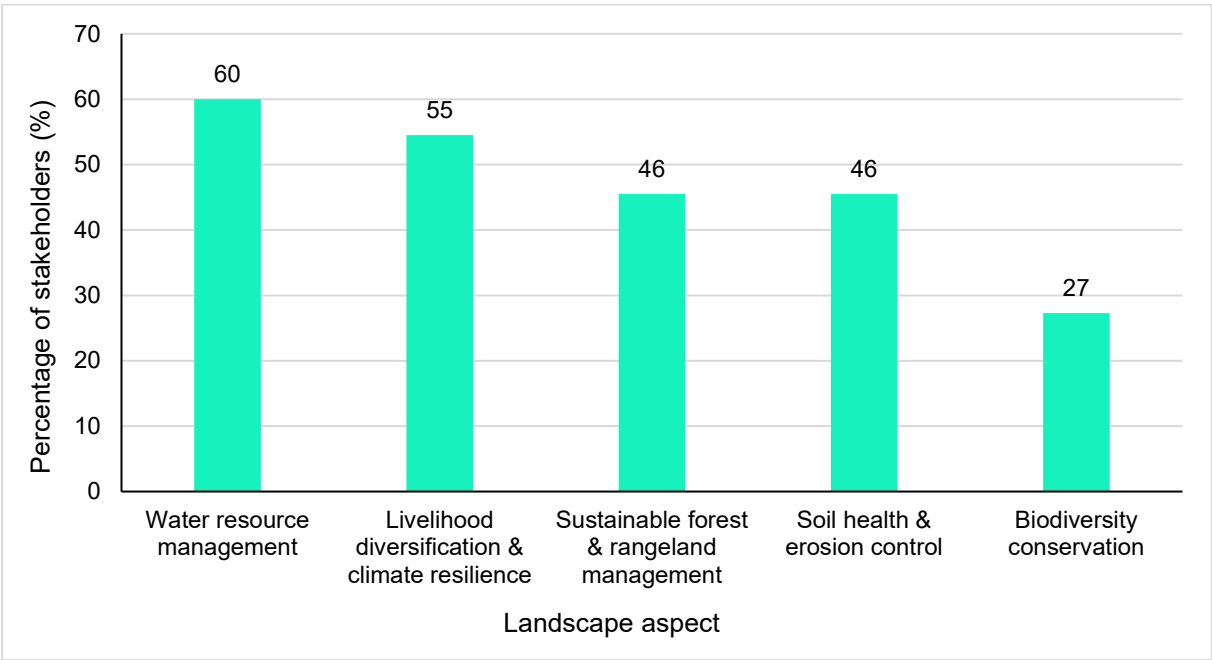


Figure 2. Stakeholders ranking of landscape aspects (1=least priority, 5 = highest priority).

Government stakeholders prioritised water resource management most highly (60%), reflecting their institutional mandates and direct experience with declining water availability, river siltation, and increasing competition over water access in the Nyadire sub-catchment. Livelihood diversification and climate resilience together with soil health and erosion control were also strongly emphasised, indicating recognition that land degradation is directly undermining irrigated horticulture, livestock production, and dry-season gardening, and therefore household income security. Biodiversity conservation received the lowest ranking (27%), likely due to its indirect visibility within routine ward-level monitoring rather than a lack of perceived importance.

3.2 Stakeholder Threat Assessment

Stakeholders from AGRITEX, EMA, the Forestry Commission, and the RDC agreed that water quality regulation, wetlands, and water supply (quantity) are under high threat due to streambank cultivation, siltation, and reduced rainfall (Table 1). Soil quality and soil erosion were also reported as under high threat, mainly from maize monoculture on smallholder farms, deforestation, and poor contouring for soil and water conservation within and around smallholder farms in the district. Fuel and building materials were ranked as under medium threat, while habitats and biodiversity, pollination, and recreation were generally under low to medium threat, reflecting limited monitoring rather than actual stability of these ecosystem services on the multifunctional landscapes in Murehwa. Stakeholders emphasized that declining water quantities and quality, and soil health have cascading effects across the multifunctional landscapes. One AGRITEX officer summarized:

“When water is lost, everything else collapses.”

Stakeholders identified water supply, water quality regulation, wetlands, and soil fertility as being under high threat due to deforestation, streambank cultivation, and poor catchment management, demonstrating an understanding of cascading landscape effects whereby upland degradation translates into downstream water scarcity and wetland loss. Overall, the results position water as a central system connector and a strategic entry point for multifunctional landscape interventions that integrate ecological restoration with livelihood diversification.

3.3 Ward 4 - Community Prioritization and Mapping

In Ward 4, all four farmer groups ranked water resource management as most important (5), followed by soil health and erosion control (4), forest and rangeland management (3), and livelihood diversification (2). Biodiversity conservation was least prioritized (1). Figure 2 shows how the different farmer groups in Ward 4 prioritised landscape aspects. Ward 4 represents an upper catchment setting where steep slopes, shallow soils, and concentrated horticultural activity amplify erosion risks. The prioritization of water and soil reflects farmers' lived experience of declining stream flows, drying wells, and loss of fertile topsoil that directly threaten crop productivity. The close spatial overlap between gardens, erosion features, and watercourses on participatory maps illustrates how livelihood strategies particularly riverbank gardening are simultaneously adaptive responses to water scarcity and drivers of further degradation.

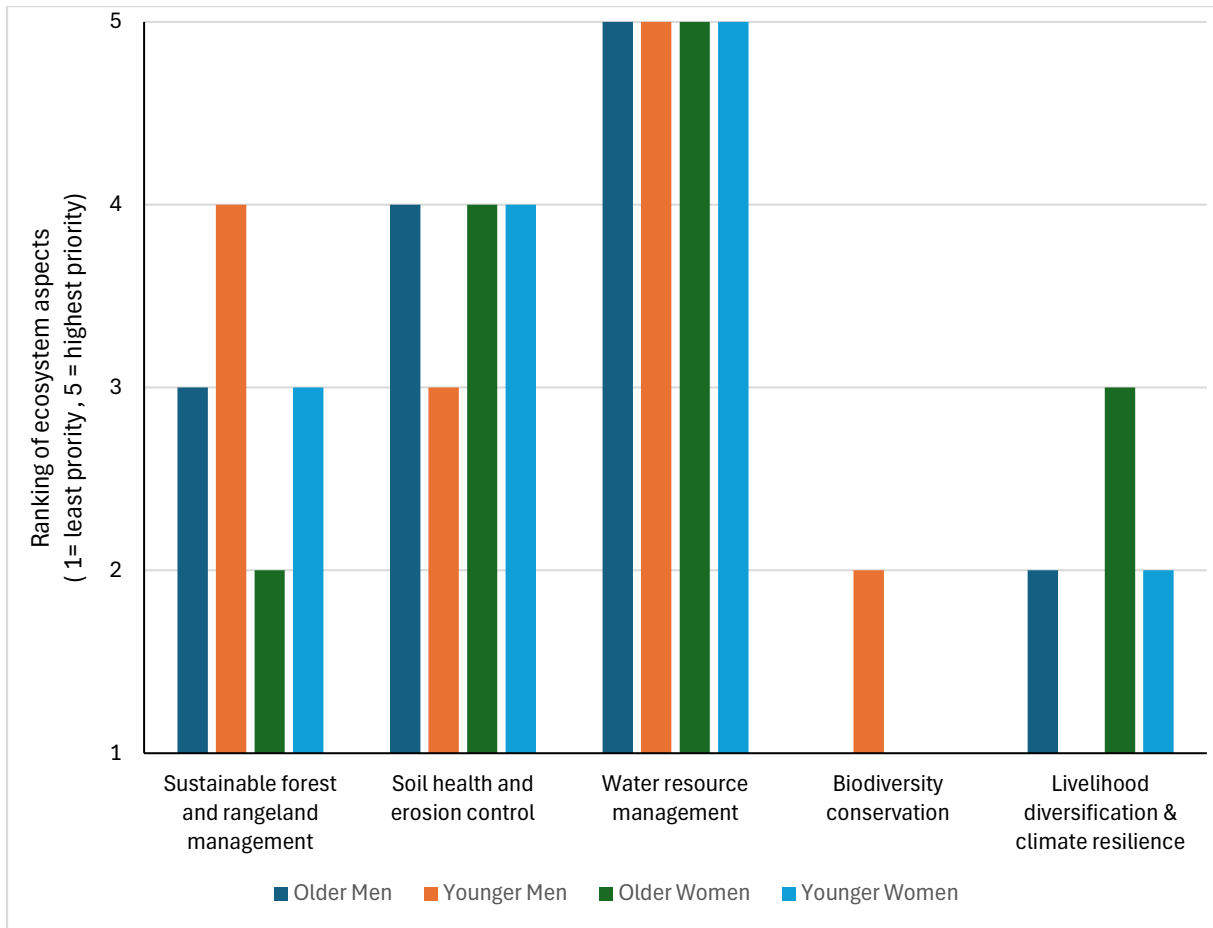


Figure 3. Ward 4: Ecosystem service rankings by gender and age group (1 = least priority; 5 = highest priority).

Mapped features included vegetable gardens and crop fields along rivers, soil erosion hotspots on steep slopes, and shrinking forest patches near settlements. Sacred caves (*ninga*) and water springs were identified as cultural sites under threat from religious encroachment. Participants estimated gully expansion by about 25% in five years. Thematic consensus showed that soil loss, water scarcity, and deforestation are closely linked processes within the same hydrological system. Figure 3 shows an example participatory mapping done by younger men (50 and below) in Murehwa ward 4. The maps for the other groups can be found in Appendix A.

“When the wetlands dry, even our wells follow. The land no longer keeps water.” — Older woman, Ward 4.

Table 1. Example of the threat assessment results (Older Women, Ward 4). Additional tables for all groups are included in Appendix A.

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation		x		Less water sources river are silted
Wetlands	x			Wetlands are drying up
Water supply (quantity)	x			There is a decrease in water sources especially rivers, few boreholes
Soil fertility/quality	x			Dongas gullies are in the area, veld fires
Soil erosion	x			Too much erosion and poor soils within the area
Food production (gardens, wild fruits, crops)	x			High competition for wild fruits
Fuel and building materials (firewood, timber)	x			Forests now sparse
Habitat and biodiversity (forests, grasslands, wildlife)	x			Grazing land decreasing with poor grass and tree species
Pollination (bees, insects supporting crops)	x			Decrease of pollination vectors and tree species
Cultural values (sacred forests, traditional sites)	x			The springs and sacred places are getting less and drying up
Recreation and inspiration (beautiful, calming spaces)	x			Our forests are destroyed by people trying to get firewood and personal interest
Climate regulation (shade, trees, cool breezes)	x			No trees in most areas

The Ward 4 results suggest that interventions must address water–soil interactions at plot and hillslope level, combining soil conservation, regulated riverbank cultivation, and improved water management for gardens. Gender-sensitive approaches are essential: supporting women’s water access and garden productivity while engaging men in erosion control and forest restoration.

3.4 Ward 27 - Community prioritization and mapping

In Ward 27, participants similarly ranked water resource management highest (5), followed by soil health and erosion control (4) and forest and rangeland management (3). Forest management ranked slightly higher than in

Ward 4 due to visible deforestation and loss of grazing land. Notably, younger men ranked forest and rangeland management above water, unlike other groups (Figure 3).

Participatory maps revealed widespread wetland conversion, streambank cultivation, forest remnants confined to hilltops, and sacred sites located near rivers. Boreholes were reported as more numerous than in Ward 4 but often dried up by late winter.

Ward 27 is a lower catchment area with higher population density, more extensive settlement expansion, and greater pressure on wetlands. The stronger emphasis on forest and rangeland management reflects both ecological conditions and livelihood strategies. Younger men’s prioritization of forests is closely linked to their dependence on forest products, grazing lands, and firewood-based income sources, including brick moulding and livestock-related activities. This contrasts with women’s focus on water scarcity for gardens and domestic use, highlighting differentiated exposure to landscape change.

The perception that biodiversity conservation is less important across groups likely reflects limited visibility of wildlife and the dominance of immediate livelihood concerns. However, discussions revealed implicit recognition that forest loss undermines water regulation and grazing availability, suggesting biodiversity values are indirectly acknowledged through other ecosystem services.

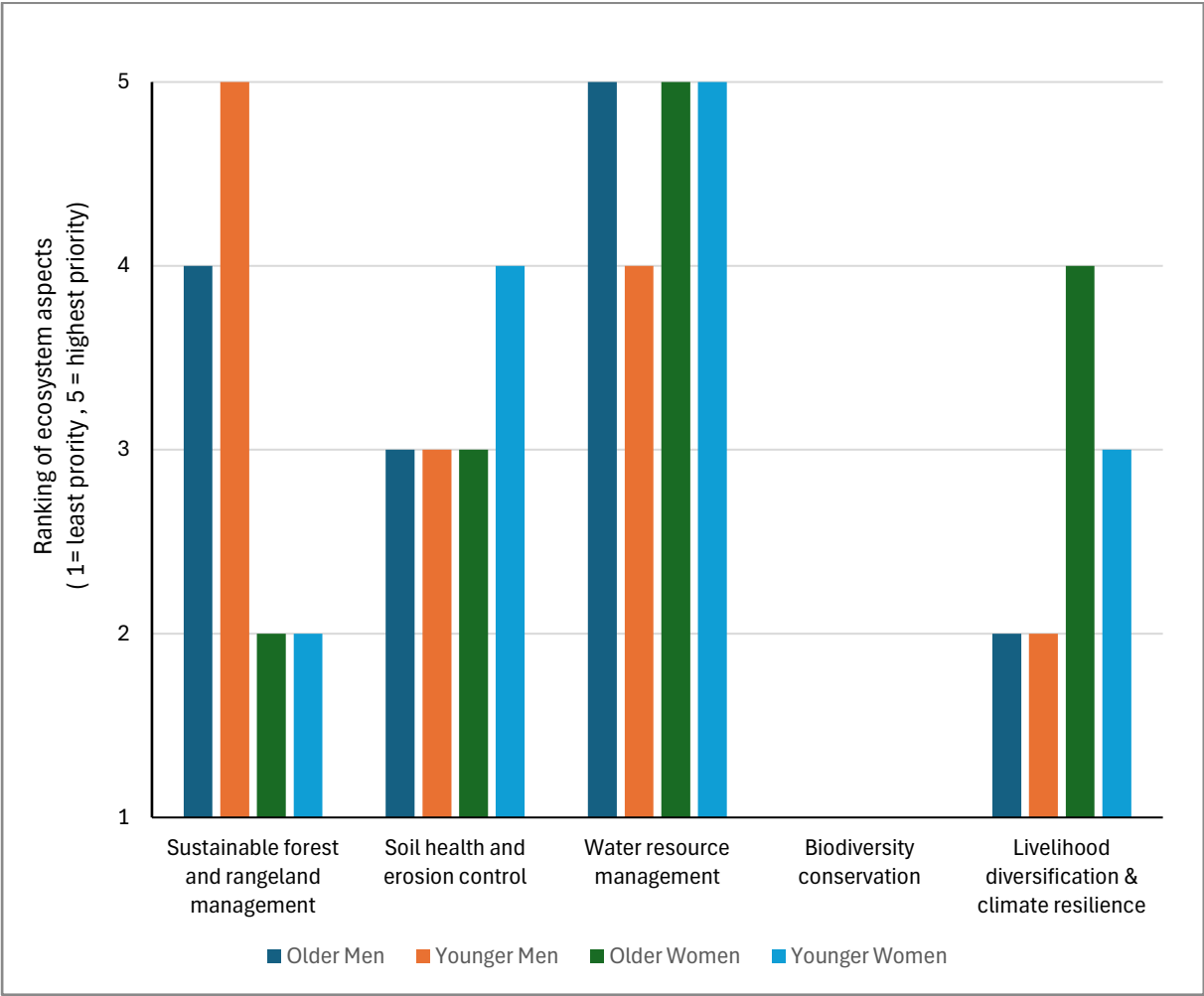


Figure 5. Ward 27: Ecosystem service rankings by gender and age group (1 = least priority; 5 = highest priority). All groups prioritized water management, though greater importance was placed on forest and rangeland management compared to Ward 4.

Regarding mapping, women's groups focused on water scarcity for gardens, while men emphasized soil erosion and streambank cultivation. The younger groups linked deforestation to loss of income from firewood and grazing. Cultural sites were reported as encroached by churches. Figure 4 shows the participatory mapping done by older women in Murehwa ward 27. The maps for the other groups from Ward 27 are shown in Appendix A.

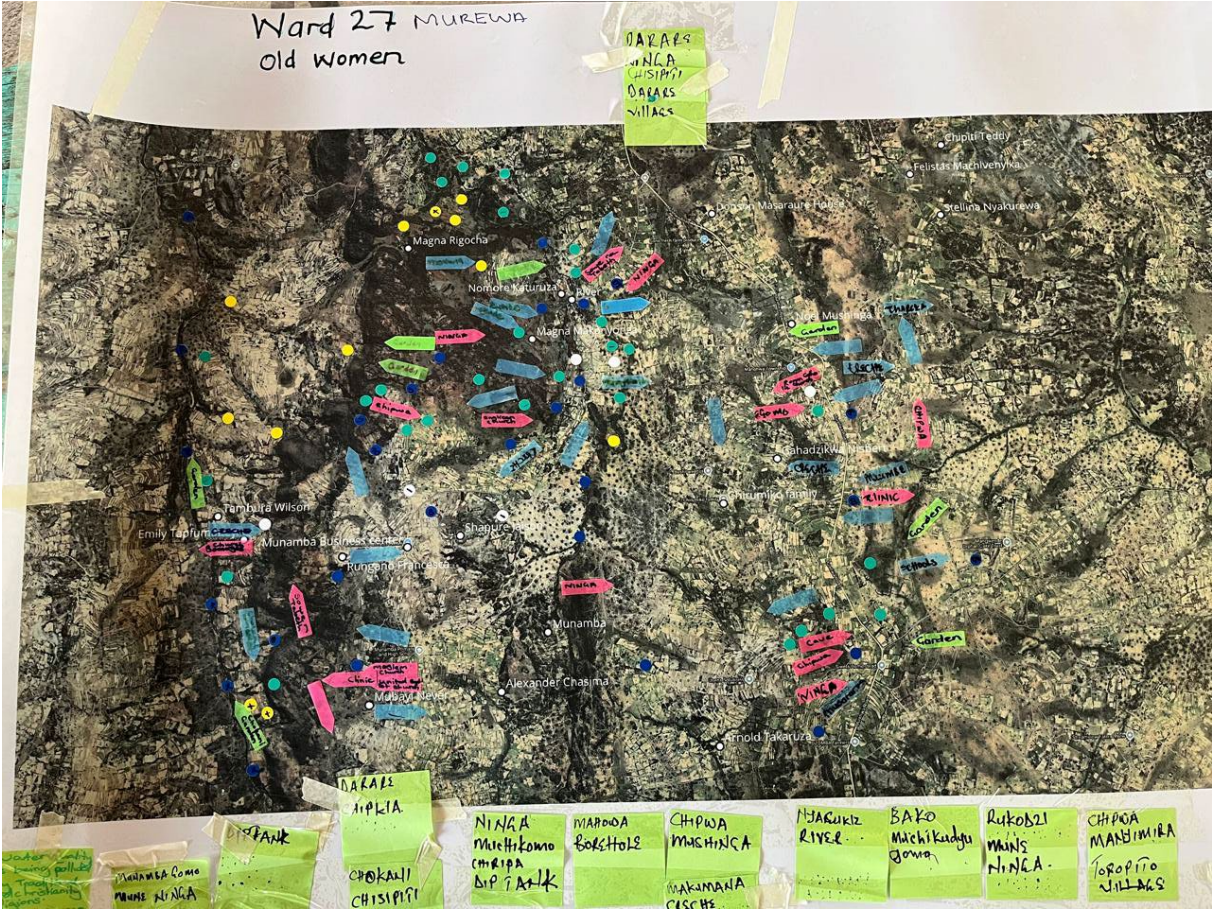


Figure 6. Ward 27 Participatory Map showing ecosystem service assets and perceived degradation hotspots. The map illustrates widespread wetland conversion and streambank cultivation (green arrows), with forests (green) concentrated on hilltops and sacred sites (pink) near rivers.

Ward 27 participants reported even greater land degradation on the landscape. Water quality regulation, wetlands, and water supply were described as under high threat, caused by encroachment, sand abstraction, and pollution from nearby settlements (Table 2). Soil resource was ranked as under high threat due to increased soil erosion and declining soil quality/fertility driven by deforestation, monoculture and the lack of soil and water conservation measures on the landscape. Fuel, building materials and food production were rated under medium threat, while cultural values were also under medium threat due to loss of sacred forests and springs on the landscape. Habitats and biodiversity, pollination, and recreation were generally ranked at low to medium threat yet recognized as indirectly affected by forest loss. Farmers concluded that upstream deforestation has reduced water and wetland functions downstream.

“We used to fear the sacred spring; now people wash and farm there.” — Young woman, Ward 27.

Table 2. Example of the threat assessment results (Older Women, Ward 27). Additional tables for all groups in Ward 27 are included in Appendix A.

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation	x			Religious conflicts, traditional dumping
Wetlands	x			Resettlements in wetlands
Water supply (quantity)	x			Climate change lessening supply
Soil fertility/quality	x			Soil erosion, monocropping
Soil erosion	x			Lack of ridges
Food production (gardens, wild fruits, crops)	x			Gardens lack water, wild fruits, deforestation
Fuel and building materials (firewood, timber)	x			Deforestation
Habitat and biodiversity (forests, grasslands, wildlife)	x			No forestry
Pollination (bees, insects supporting crops)	x			No forestry
Cultural values (sacred forests, traditional sites)	x			Churches now a problem
Recreation and inspiration (beautiful, calming spaces)	x			No forestry
Climate regulation (shade, trees, cool breezes)	x			No forestry

Ward 27 findings point to the need for wetland protection, regulated settlement expansion, and forest restoration, particularly in upland areas feeding downstream water systems. Youth-focused livelihood alternatives linked to sustainable forest management could help address the drivers of deforestation identified by younger men.

3.5 Cross-Ward Comparison and Emerging Themes

Across both wards, water, soil, and forests emerged as tightly interconnected priorities. Ward 4 participants emphasized soil erosion and groundwater recharge, reflecting steeper terrain and erosion-prone soils, while Ward 27 participants stressed wetland loss and deforestation, consistent with downstream pressures and higher settlement density. Religious conflicts over sacred sites were reported more frequently in Ward 27, indicating greater erosion of traditional ecological governance mechanisms. The convergence around water as the central concern highlights water's role as the entry point for multifunctional landscape interventions. Differences between wards highlight the importance of tailoring interventions to local biophysical and social contexts, even within the same sub-catchment.

3.6 Gender and Generational Insights

A distinct pattern emerged in what different groups mapped and prioritized. Young women mapped the most water points, reflecting their daily responsibility for domestic water collection and garden irrigation. Studies in Zimbabwe and Kenya similarly show that women are more attuned to water resource changes due to gendered labour divisions (Bukachi et al., 2021; Chigusiwa et al., 2023; Collins et al., 2019). Their emphasis suggests that water insecurity is felt most acutely at the household level, making women crucial actors in water-related interventions.

Older men and women mapped more sacred and prayer sites, linked to their roles as custodians of traditional practices. This mirrors findings from Malawi and Ghana where elders associate cultural landscapes with moral order and ecological stewardship (Asante, 2024; Lerski & Mwale, 2025; Mweta et al., 2022). In Murehwa, older participants lamented the erosion of cultural respect, noting that "*churches enter caves without permission.*"

Young men emphasized illegal land allocation and streambank cultivation, pointing to generational awareness of governance failures and land-use conflicts. Their participation revealed a nuanced understanding of landscape transformation processes.

The results demonstrate that inclusive landscape planning must explicitly incorporate gendered and generational perspectives. Women's knowledge is critical for water-related interventions, elders' insights are central to cultural governance, and youth engagement is essential for addressing land-use conflicts and sustaining long-term stewardship. Also, these patterns demonstrate how knowledge, memory, and responsibility shape what people notice and value. Integrating these differentiated insights into MFL design and long term management ensures that interventions respond not only to ecological needs but also to gendered realities.

3.7 Summary

Across wards and demographic groups, water resource management consistently ranked as the top priority, except among younger men in Ward 27 who prioritized forests and rangelands. The triad of water, soil, and forests forms the ecological foundation of multifunctionality in the Nyadire sub-catchment. Variations in ranking reflect local conditions, livelihood strategies, and social roles rather than disagreement over the importance of ecosystem services.

Overall, the results show that communities perceive landscape degradation holistically, linking environmental decline with livelihood insecurity and cultural disruption. Water emerges as the unifying element connecting

ecological processes and social well-being, making it the most strategic entry point for designing integrated and inclusive MFL interventions.

4 Discussion

Empirical evidence on how different stakeholder groups perceive and prioritise ecosystem services at landscape scale remains limited in sub-Saharan Africa, particularly in Zimbabwe, where assessments often rely on biophysical indicators or expert-driven approaches. Such methods frequently overlook spatially explicit local knowledge and socially differentiated ecosystem service values (Breyne et al., 2021; Meli et al., 2023). This study addresses this gap by applying participatory ecosystem services mapping within the Nyadire sub-catchment, integrating ecological processes, livelihoods, and governance perspectives at landscape scale.

Across stakeholder and community groups, water, soil, and forest ecosystem services emerged as the foundation of landscape functionality. Water resource management was consistently ranked highest, reflecting widespread concern over declining water availability, wetland degradation, and deteriorating water quality. Similar findings have been reported in other African catchments, where water scarcity links agricultural productivity, ecosystem integrity, and human wellbeing (Falkenmark, 2013; Rosegrant et al., 2009). Soil health and erosion control and forest and rangeland management were also prioritised, underscoring recognition that land degradation directly undermines crop production, livestock systems, and household incomes (Rashid et al., 2025; Venkatachalam et al., 2024). Although biodiversity conservation ranked lower, discussions indicated that biodiversity values were implicitly embedded within concerns about water regulation and soil stability.

Spatial differences between wards reflected well-documented upstream–downstream dynamics. In the upper catchment (Ward 4), participants emphasised soil erosion, declining fertility, and reduced groundwater recharge, while downstream communities (Ward 27) prioritised wetland loss, deforestation, and streambank cultivation. Such patterns are consistent with landscape studies showing how upland land-use practices generate downstream impacts on water availability and ecosystem services (Giri et al., 2018; Hirko et al., 2025), reinforcing the need for catchment-scale rather than site-specific interventions.

Gendered and generational differences further illustrate the social differentiation of ecosystem service values. Women prioritised water availability, wetlands, and garden productivity, reflecting their roles in domestic water provision and small-scale horticulture, while men emphasised soil erosion, forests, and grazing land, aligned with land preparation, livestock management, and fuelwood collection. Older participants highlighted sacred sites and cultural landscapes, whereas younger men focused on forests and governance challenges related to land use. Similar patterns have been documented across eastern and southern Africa, where labour divisions and authority structures shape environmental knowledge and priorities (Sithole et al., 2021).

Several limitations should be acknowledged. The focus on two wards limits generalisation across the full sub-catchment, and participatory mapping captures perceptions rather than direct biophysical measurements. However, these limitations are well recognised in PGIS research and were mitigated through social disaggregation, triangulation with stakeholder rankings, and integration of spatial and qualitative data (Braslow et al., 2016). Rather than replacing biophysical assessments, participatory mapping complements them by revealing governance and livelihood dimensions often overlooked in conventional analyses.

The findings point to several directions for future research. Longitudinal application of participatory mapping could help track changes in ecosystem service priorities and perceptions over time, particularly in response to climate variability or landscape interventions. Integrating participatory outputs with remote sensing, hydrological modelling,

and ecosystem service quantification would further strengthen landscape diagnostics and support scenario analysis, as recommended in recent multifunctional landscape research (Gao et al., 2025). Future studies could also examine how participatory mapping outcomes influence decision-making and governance processes, helping to assess the long-term impact of PGIS as a learning and design tool within multifunctional landscape programs.

5 Conclusion and Recommendations


This study demonstrates that participatory ecosystem services mapping provides a robust and context-sensitive approach for understanding landscape functionality in the Nyadire sub-catchment. By revealing socially and spatially differentiated ecosystem service priorities, the findings highlight water, soil, and forests as interconnected foundations of multifunctionality, with water emerging as a strategic entry point for integrated landscape interventions. The results highlight the importance of inclusive, catchment-scale approaches to multifunctional landscape design and governance, offering insights that are directly relevant for developing resilient, socially legitimate, and ecologically grounded interventions in Zimbabwe and similar contexts.

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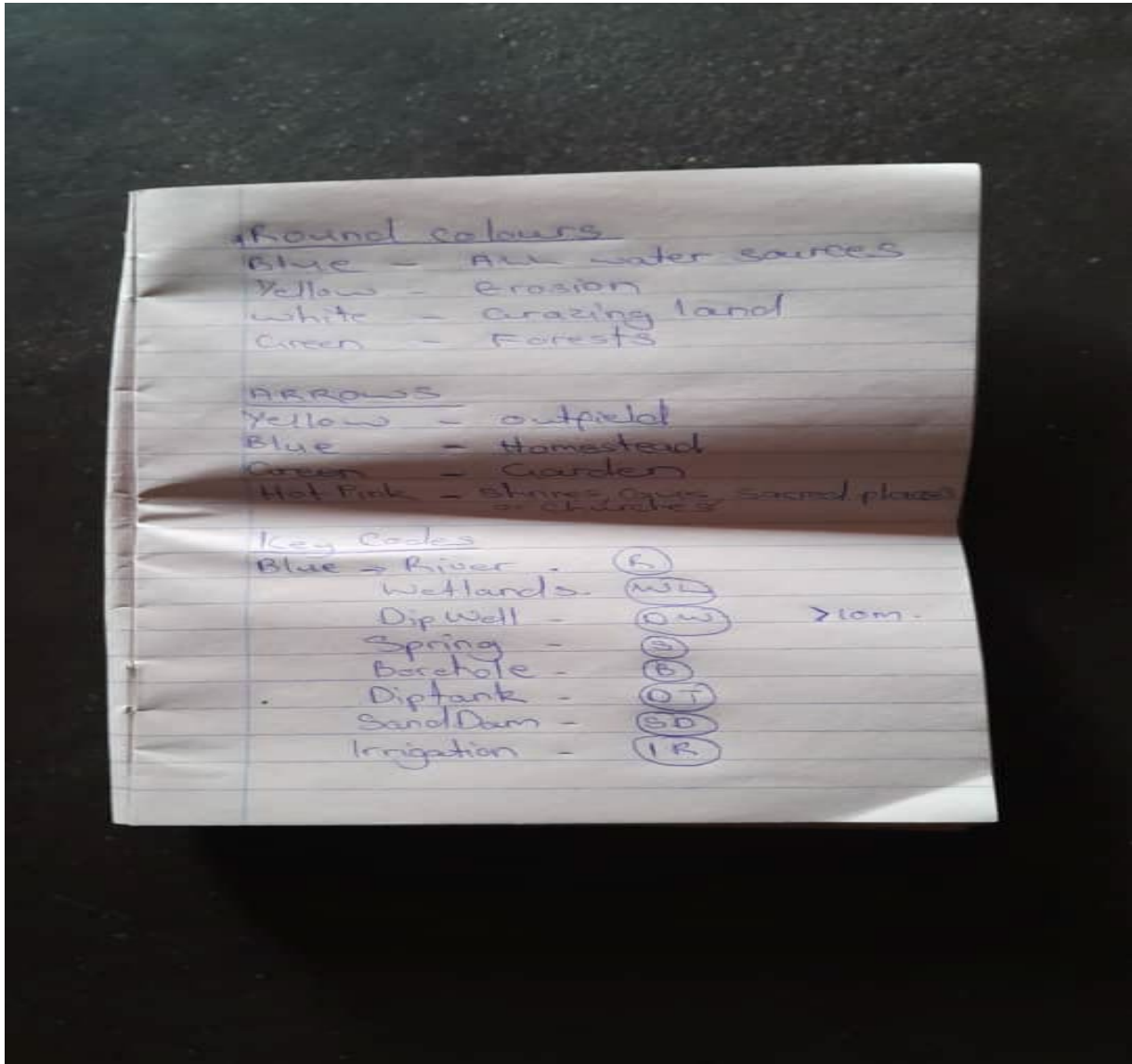
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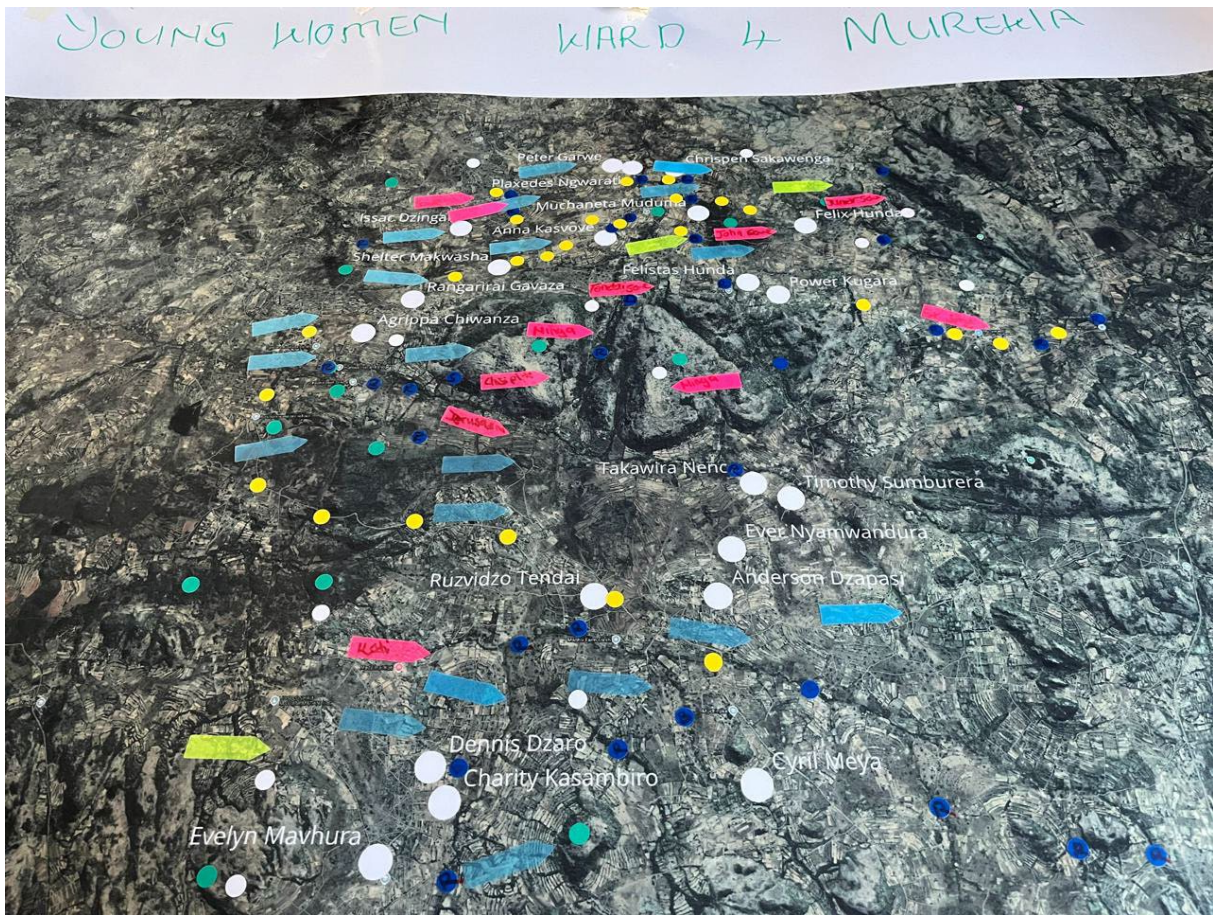
7 Appendix A.

7.1 Maps

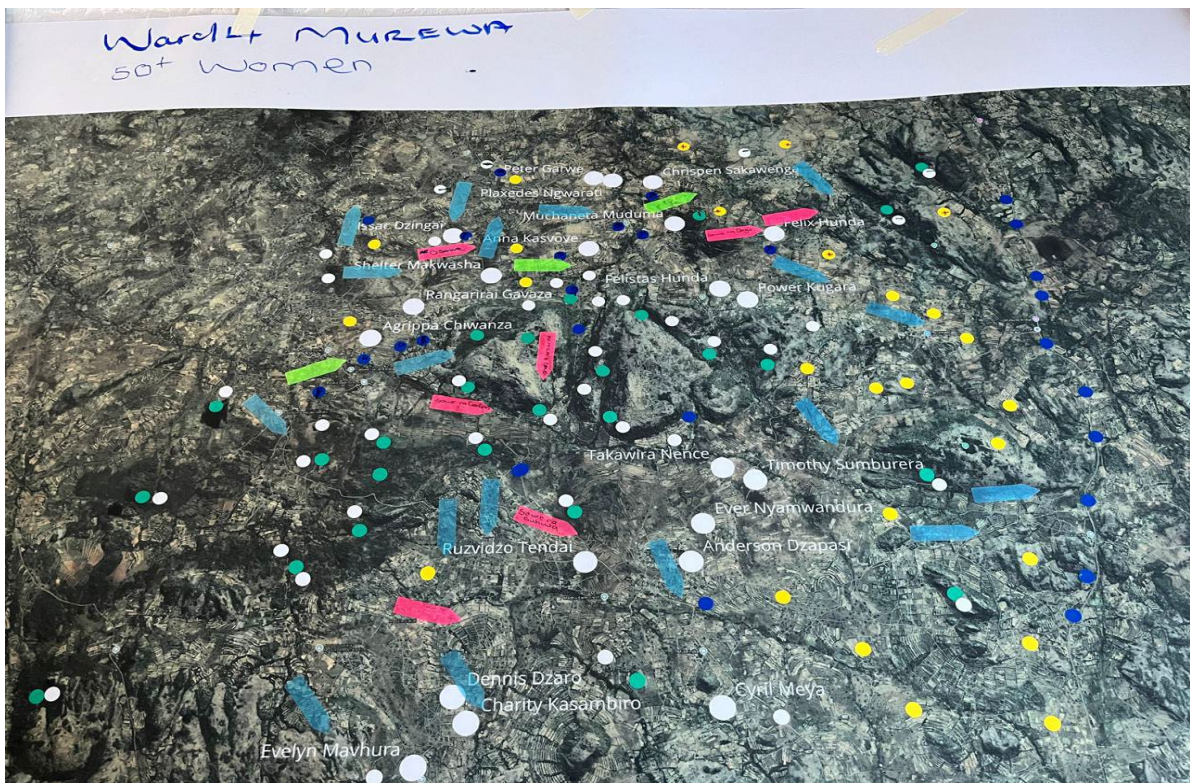
Key to colors and shapes



Younger women – Ward 4



Older women – Ward 4



7.2 Perceived Threat Levels

Farmers conducted a threat assessment for key ecosystem goods. Overall results show that most natural resources were perceived as under high threat, especially water supply, soil fertility, and cultural values.

Ward 4

Older women rated high threats to soil fertility, cultural values, and forest-based recreation, noting that “our forests are being destroyed by people collecting firewood.”

Table A.1. Threat assessment of key ecosystem services and reasons – Older women, Ward 4

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation		x		Less water sources river are silted
Wetlands	x			Wetlands are drying up
Water supply (quantity)	x			There is a decrease in water sources especially rivers, few boreholes
Soil fertility/quality	x			Dongas gullies are in the area, veld fires
Soil erosion	x			Too much erosion and poor soils within the area
Food production (gardens, wild fruits, crops)	x			High competition for wild fruits
Fuel and building materials (firewood, timber)	x			Forests now sparse
Habitat and biodiversity (forests, grasslands, wildlife)	x			Grazing land decreasing with poor grass and tree species
Pollination (bees, insects supporting crops)	x			Decrease of pollination vectors and tree species
Cultural values (sacred forests, traditional sites)	x			The springs and sacred places are getting less and drying up
Recreation and inspiration (beautiful, calming spaces)	x			Our forests are destroyed by people trying to get firewood and personal interest
Climate regulation (shade, trees, cool breezes)	x			No trees in most areas

Older men emphasized soil erosion, water scarcity, and cultural erosion due to religious encroachment.

Table A.2. Threat assessment of key ecosystem services and reasons – Older men, Ward 4

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation			x	
Wetlands	x			

Water supply (quantity)	x			Receding water table , no boreholes
Soil fertility/quality	x			
Soil erosion	x			Stream bank cultivation
Food production (gardens, wild fruits, crops)	x			Deforestation climate change
Fuel and building materials (firewood, timber)	x			Deforestation
Habitat and biodiversity (forests, grasslands, wildlife)			x	
Pollination (bees, insects supporting crops)			x	
Cultural values (sacred forests, traditional sites)	x			Religions destroying
Recreation and inspiration (beautiful, calming spaces)				
Climate regulation (shade, trees, cool breezes)	x			

Young men viewed fuelwood, cultural values, and biodiversity as highly threatened due to brick making and deforestation.

Table A.3. Threat assessment of key ecosystem services and reasons – Younger men, Ward 4

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation			x	No harmful chemical in our water
Wetlands		x		Increasing farming in wetlands
Water supply (quantity)	x			Low rainfall competition between human and domestic needs
Soil fertility/quality	x			Weak soils veld fires
Soil erosion	x			Streambank cultivation, ploughing down lope
Food production (gardens, wild fruits, crops)			x	Water scarcity in gardens

Fuel and building materials (firewood, timber)	x			Destruction of natural forests for firewood, bricks cooking sticks
Habitat and biodiversity (forests, grasslands, wildlife)		x		Veld fires
Pollination (bees, insects supporting crops)			x	Fruitfly a problem
Cultural values (sacred forests, traditional sites)		x		Traditional religious conflicts , chritianity does not respect traditional laws
Recreation and inspiration (beautiful, calming spaces)			x	
Climate regulation (shade, trees, cool breezes)	x			Firewood for brick making, tobacco curing, cutting down of indigenous trees

Young women reported high threats across nearly all categories, particularly wetlands, habitat loss, and climate regulation, linking veld fires and drying rivers to changing weather patterns.

Table A.4. Threat assessment of key ecosystem services and reasons – Younger women, Ward 4

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation	x			Water is life and health
Wetlands	x			Very few, people now live there
Water supply (quantity)	x			Limited rains and siltation
Soil fertility/quality	x			Most of the soil is now sandy and tired, no longer productive
Soil erosion	x			A lot of soil lost through erosion
Food production (gardens, wild fruits, crops)		x		Farmers are planting fruit trees
Fuel and building materials (firewood, timber)	x			

Habitat and biodiversity (forests, grasslands, wildlife)	x			A lot of animals were killed
Pollination (bees, insects supporting crops)		x		
Cultural values (sacred forests, traditional sites)	x			Christianity has killed traditional religion
Recreation and inspiration (beautiful, calming spaces)	x			No one takes care f these places anymore
Climate regulation (shade, trees, cool breezes)	x			A lot of veld fires destroying

Ward 27 findings

Older men stressed wetland degradation and poor soils.

Table A.6. Threat assessment of key ecosystem services and reasons – Older men, Ward 27

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation		x		Some rivers are still clean
Wetlands	x			People farming in wetlands
Water supply (quantity)	x			Erratic rainfall
Soil fertility/quality	x			
Soil erosion		x		
Food production (gardens, wild fruits, crops)		x		
Fuel and building materials (firewood, timber)		x		
Habitat and biodiversity (forests, grasslands, wildlife)	x			
Pollination (bees, insects supporting crops)			x	

Cultural values (sacred forests, traditional sites)		x		
Recreation and inspiration (beautiful, calming spaces)		x		
Climate regulation (shade, trees, cool breezes)			x	

Young men identified high threats across almost all ecosystem goods, especially deforestation, hunting, and illegal land allocations.

Table A.7. Threat assessment of key ecosystem services and reasons – Younger men, Ward 27

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation	x			Traditional and religious beliefs a lot of dumping of religious and spiritual items
Wetlands	x			Settlements, plantations, gardens
Water supply (quantity)	x			Siltation drought, overpopulation, fewer potable water sources
Soil fertility/quality		x		Conventional tillage reduces effects, veld fires
Soil erosion	x			Poor maintenance of contour drains, veld fires, deforestation
Food production (gardens, wild fruits, crops)		x		Limited water supply, deforestation, veld fires
Fuel and building materials (firewood, timber)	x			Deforestation, settlements
Habitat and biodiversity (forests, grasslands, wildlife)	x			Hunting, deforestation veld fires
Pollination (bees, insects supporting crops)	x			Agrochemical use killing pollinators, veld fires
Cultural values (sacred forests, traditional sites)	x			Christianity, different cultural beliefs
Recreation and inspiration (beautiful, calming spaces)	x			Settlements deforestation

Climate regulation (shade, trees, cool breezes)	x			Deforestation, veld fires, settlements
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Young women prioritized wetlands, water supply, and cultural values as the most endangered.

Table A.8. Threat assessment of key ecosystem services and reasons – Younger women, Ward 27

Natural resource/ecosystem	Threat			Reason
	High	Medium	Low	
Water quality regulation	x			
Wetlands	x			
Water supply (quantity)	x			Settlements, gumtree plantations
Soil fertility/quality		x		We are practising conservation agriculture
Soil erosion	x			
Food production (gardens, wild fruits, crops)		x		
Fuel and building materials (firewood, timber)	x			No forests
Habitat and biodiversity (forests, grasslands, wildlife)	x			
Pollination (bees, insects supporting crops)		x		
Cultural values (sacred forests, traditional sites)		x		Depends with religious beliefs
Recreation and inspiration (beautiful, calming spaces)		x		No one really taking care of the places
Climate regulation (shade, trees, cool breezes)	x			

The convergence of perceptions indicates a landscape-wide crisis of water, soil, and forest decline. The cultural ecosystem services (sacred sites, spiritual spaces, aesthetic areas) also emerged as highly threatened, a pattern often underrepresented in formal landscape assessments (Fagerholm et al., 2016).



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