

Beyond Capacity: Ecosystem management in the Kyaka II Refugee Settlement, Uganda

Reuben Twinomujuni¹, Hannah
Muzee², Fredrick Kisekka-Ntale³

¹reubentwins@gmail.com, ²muzhann2002@gmail.com, ³fkisekka2018@gmail.com
^{1,2,3}Kyambogo University, Uganda

ABSTRACT

Refugee-hosting communities often struggle to balance basic human survival needs with environmental protection. Uganda hosts over two million refugees and asylum seekers, exemplifying this tension and offering a critical case study for understanding these dynamics. Rich in biodiversity, Uganda is under pressure to manage its ecosystems effectively to ensure human survival. This study aims to appraise ecosystem management in the Kyaka II refugee settlement and examine its relationship with indigene well-being using ecosystem services theory. Using a sequential explanatory

mixed-methods design, the study involved 399 indigene respondents, focus groups, in-depth interviews, and input from district officials, Office of the Prime Minister staff, and NGOs. The study analysed quantitative data using SPSS and SmartPLS, and qualitative data using thematic analysis. Quantitative results showed that provisioning services, which encompass access to food, water, and forest resources, accounted for 20.020% of the total variance. Regulating services contributed 15.921%, highlighting vital ecosystem processes such as water regulation and air purification. Cultural services showed the strongest correlation, explaining 11.676% of the variance and emphasising their importance in delivering cultural and social benefits. Qualitatively, provisioning services were considered accessible, though concerns about quality and sustainability arose. The study concluded that ecosystem management in Kyaka II faces significant constraints, including unpredictable weather, population growth, poverty, and weak policy enforcement. Recommendations include adopting climate-smart agriculture, strengthening water conservation, enforcing environmental policies, and fostering accountability. These measures aim to strengthen ecosystem resilience while addressing the competing needs of refugees and host communities.

Keywords: Ecosystem, Well-being, Indigenes, Kyaka II, Refugees

1.0 INTRODUCTION

Communities that host refugees have long grappled with challenges stemming from competition for resources, especially water, food, firewood, land, and housing, among others, between refugees and host communities that hinder effective ecosystem management (Ahimbisibwe, 2018; Ministry of Water and Environment, 2016; NEMA, 2019; UNHCR, 2005). Hosting refugees remains a precursor to

ecological degradation and biodiversity decline, yet these are necessary for human survival, societal harmony and sustainable development (Wu et al., 2022). The world relies on four primary interconnected ecosystems for its life support: the atmosphere (air), the hydrosphere (water), the geosphere (soil, rocks, and remnants), and the biosphere (living organisms) (Miller & Spoolman, 2012). Yet refugee settlement negatively affects all four ecosystems. The growing human population has led to alarming depletion of natural resources, with habitats devastated, wildlife corridors obstructed, illegal resource extraction, and frequent wildfires (Kideghesho, 2021). These activities threaten the rich biodiversity of ecosystems that harbour a wide array of plant and animal species. These ecosystems are ecologically and economically significant and steeped in socio-cultural importance (Kideghesho et al., 2013). Uganda is one of Africa's wealthiest countries in biodiversity, with 1,742 terrestrial vertebrate species, at least 3,662 plant species, and over half of Africa's bird population. Uganda

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is home to diverse ecosystems, including forests, wetlands, rangelands, lakes, and rivers, making it a vital country for global biodiversity conservation (NEMA, 2019).

Unfortunately, despite this reputation for biodiversity, the country's forest cover is on the verge of extinction, having lost 3.1 million hectares over 25 years, an average of 122,000 hectares per year. Refugees near settlements put widespread pressure on forests by cutting down trees for various purposes (Ministry of Water and Environment, 2016). Refugees rely heavily on firewood and other forest materials for cooking and shelter. This reliance has degraded forests neighbouring refugee settlements. For instance, forests in Kyangwali, Rwamwanja, Oruchinga and Bidibidi have suffered from deforestation (NEMA, 2019). Similarly, refugee settlements have affected wetlands. For example, the Lake Albert basin experienced a 32% reduction in wetland area and lost over 903 km² of wetlands between 1994 and 2015. This loss is attributed to the basin's growing population, including refugees who have encroached on wetlands for agriculture and settlement (NEMA, 2019). Moreover, in 2020, Uganda had 2.1 million hectares of

natural forest, covering about 9% of its land area. By 2024, the country had lost 27,000 hectares of natural forest, resulting in 13 million tonnes of carbon dioxide emissions (Global Forest Watch, nd). From 2001 to 2024, 85% of tree cover loss occurred in areas where the main drivers of deforestation were present. As of 2000, 32% of Uganda's land cover was tree cover with over 30% canopy density (Global Forest Watch, nd). Refugees have consistently been recognised as key contributors to the degradation and deforestation of Uganda's forests (Ministry of Water and Environment, 2016). The nature of refugee settlements leads to the accumulation of waste materials. These include plastics, paper packaging, kitchen remains, plant residues, medical waste, ash, and faecal waste. To mitigate this, households use open waste pits; some burn waste, while others scatter it across open fields, including through open defecation, creating breeding sites for mosquitoes and flies. This poses public health risks, including waterborne diseases and other infections (NEMA, 2019).

NEMA (2019) reports that approximately 149.65 kg of waste is produced per person annually, resulting in a total of 188,069,494 tonnes of waste generated by refugees. In Bukere, Kyaka II, the disposal site is near a valley water body, while Rhino and Omugo have no designated final disposal area. Landfilling and open dumping create many difficulties, mainly because wind disperses waste, leading to further littering.

Since the refugee population in the Kyaka II refugee settlement increased tenfold from 17,000 in 2017 (OPM, 2024) to 139,142 (UNHCR, 2026), the area has experienced land-use changes, leading to ecosystem decline, atmospheric changes, and altered rainfall patterns. These changes result from refugees' unsustainable use of forests and wetlands and the biodiversity and ecosystems they harbour. Established in 1983/84, Kyaka II refugee settlement was intended to host Rwandan refugees. When refugees returned, it was closed and reopened in 1995 to host Rwandan refugees. In 2005/6, Congolese refugees bolstered its population. Until December 2017, Kyaka II had a population of around 27,000-30,00 refugees. Since then, refugees from Congo, Rwanda, and Burundi have been the settlement's primary residents (Danish Refugee Council, 2018). As at 30 June 2026, the Kyaka II refugee settlement has been home to 139,142 refugees (UNHCR, 2026).

The western part of Uganda hosts a reasonable number of refugees, mainly attributable to its proximity to the Democratic Republic of Congo, a country that has faced unending wars. Kyegegwa District, which hosts the Kyaka II refugee settlement, neighbours other districts, including Kibaale, Mubende, Kiruhura, Kamwenge and Kyenjojo. These

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districts are also affected by the influx of refugees, mainly from the Democratic Republic of Congo. This underscores the difficulties of hosting and integrating refugees, given the effects of refugee settlement.

1.1 Problem Statement

Uganda has hosted refugees since the 1920s and ranks first in Africa and third globally for refugee hosting. This has contributed to population growth and increased pressure on ecosystems, as

the combined numbers of refugees and locals exceed carrying capacity. Studies indicate that refugee influxes lead to deforestation, water contamination, soil degradation, and biodiversity loss. Uganda loses an average of 122,000 hectares of forest annually, largely due to unsustainable resource use by refugees. This long-term environmental strain has significantly altered land cover and reduced rainfall around the Kyaka II Refugee Settlement, negatively affecting ecosystem services such as water purification and food availability. Degraded ecosystems can spread infectious diseases and increase local living costs. This study assesses ecosystem management at the Kyaka II Refugee Settlement.

1.2. Research Objectives

To appraise ecosystem management at the Kyaka II Refugee Settlement and examine its relationship to the well-being of indigenes.

II. LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Ecosystem Services Theory

Ecosystem Services Theory draws on several notable scholars, particularly Paul and Anne Ehrlich (1981) and Gretchen C. Daily (1997). The Ehrlichs emphasised the essential role of ecological functions in supporting human and biological survival, while Daily bridged ecology and economics. In 1997, Costanza et al. estimated the global economic value of ecosystem services, underscoring their significance amid environmental degradation. MEA (2005) further categorised these services and documented their global impacts, strengthening the theory's foundations.

The theory holds that biodiversity is integral to ecosystem functioning, which in turn produces services that bolster human well-being (Daily, 1997; Díaz et al., 2018; Harmáčková et al., 2024; MEA, 2005). Healthy, diverse ecosystems maintain essential ecological processes while ecosystem degradation undermines the delivery of these vital services. Thus, sustainable management practices are essential to preserve ecosystem integrity and safeguard biodiversity.

Scholars, such as De Groot et al. (2002), confirm that the theory effectively integrates biodiversity conservation into ecosystem management. Polasky et al. (2015) note that it helps assess environmental trade-offs and encourages sustainable land-use decisions. The MEA (2005) concludes that safeguarding ecosystem services maintains ecosystem integrity and biodiversity.

However, Gómez-Baggethun and Ruiz-Pérez (2011) contend that viewing ecological systems solely through a market lens risks commodifying nature. Büscher and Fletcher (2020) affirm that a market-based approach to ecosystem management may fail to address governance and environmental justice. Sullivan (2017) argues that neglecting the ethical, cultural, and political aspects of environmental management tends to promote neoliberal conservation strategies. Norgaard (2010) criticises the theory for simplifying complex ecological interactions into discrete service categories, arguing that ecosystems are dynamic and often unpredictable.

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But by integrating environmental science, environmental policy, conservation biology, ecology, economics, geography, and sociology, the theory enables a comprehensive understanding of ecosystem dynamics (Costanza et al., 1997; Daily, 1997). The theory outlines strategies for ecosystem restoration, biodiversity conservation, environmental impact assessment, and sustainable land-use planning (MEA, 2005). The theory enables easy evaluation of trade-offs between environmental conservation and resource utilisation, helping decision-makers and implementers assess how different land-use practices affect ecosystem functions and ecological sustainability (Hernández-Blanco et al., 2022).

2.2. Empirical Review

Ecosystem management in refugee settlements is associated with deforestation, soil erosion, wetland degradation, and waste management issues that affect ecological services and economically affect refugees and indigenes (Bose, 2024; Dutta, 2023; Ruesink & Gronau, 2025). Studies, such as Dutta (2024), Kideghesho et al. (2013), and Rubangangeyo and Apecu (2026), also highlight that refugee settlements are a threat to ecological stability in that they lead to increased deforestation, habitat degradation, resource depletion and environmental conflict, and endanger biodiversity and the resilience of host communities. Consequently, several studies Duguma et al. (2020), Gianvenuti et al. (2022), and The World Bank and FAO (2020)) confirm that refugee settlements are driving significant forest loss in Uganda. Refugees rely heavily on wood for cooking and shelter. Refugees and hosts rely on wood and charcoal, driving widespread deforestation and biodiversity loss.

However, other factors, such as political and economic conditions, traditional practices, and donors' actions or inaction, also contribute to ecological degradation beyond refugee settlements (Van Blerk et al., 2026). They argue that population growth affects ecosystems when governance systems fail to regulate resource use effectively, exacerbating ecosystem degradation. Ecosystem management is closely linked to indigene well-being, because they provide the material resources, environmental regulation, and ecological resilience upon which human societies depend. Provisioning ecosystem services, including food, freshwater, fuelwood, timber, and medicinal resources, directly support livelihoods, food security, and household income. Regulating ecosystem services such as flood regulation, water purification, disease

control, climate regulation, and erosion prevention reduce environmental risks and protect communities from ecological shocks. These services matter most in vulnerable landscapes, including refugee-hosting areas, where communities depend heavily on natural resources for survival and resilience (Bethwell et al., 2021; Hernández-Blanco et al., 2022; Liu & Wu, 2021; Zhou et al., 2025).

Furthermore, Duku et al. (2022) report that communities with greater satisfaction with provisioning, regulating, and cultural services generally reported higher well-being. When ecosystems are well managed, communities can have improved well-being, while ecosystem degradation can undermine material and non-material foundations of well-being. Although provisioning services are particularly important, the literature cautions against reducing ecosystem management to food, income and material resources. Nyathi et al. (2022) found that both provisioning and cultural ecosystem services contribute to well-being through life satisfaction, happiness, living standards, safety, security and good health. Importantly, respondents perceived ecosystem services as degrading, with climate change, poverty, and policies identified

as drivers of ecosystem change. Kosanic and Petzold (2020) also show that cultural ecosystem services contribute to both the physical and mental dimensions of well-being.

While scholars, such as (Danish Refugee Council, 2018; Hassan et al., 2023; Ministry of Water and Environment, 2016; NEMA, 2019; Wu et al., 2022), document the pressure on ecosystems resulting from refugee settlement, a gap remains in research on the lived experiences of indigenes. The indigenes rely on ecosystems to survive. They also make refugee settlement possible by feeding refugees. More research is needed to understand how refugee-hosting communities manage ecosystems and how this management is associated with indigene well-being.

III. METHODOLOGY

3.1 Research Design

This study used an explanatory sequential mixed-methods design comprising two phases. The first phase gathered quantitative data via a questionnaire, analysed the results, and used them to inform the second phase. In the second phase, the study gathered qualitative data through interviews and focus group discussions to explain the questionnaire responses in depth.

3.2 Study Area

The study was conducted in twenty-four villages across the three sub-counties of Nkanja, Ruyonza and Kyegegwa. These sub-counties surround the Kyaka II Refugee Settlement. The settlement is under ecological strain, with deforestation, wetland encroachment and soil erosion driven by population growth and humanitarian demands.

3.3 Target Population

The study targeted indigenes residing in Kyegegwa, Nkanja and Ruyonza sub-counties. These communities were selected because they interact daily with refugees and depend on degraded resources. As a result, indigenes' perspectives are crucial to a comprehensive understanding of the forces shaping ecosystem management.

3.4 Sampling and sample size

The study used linear extrapolation of the 2014 population census data from the Uganda Bureau of Statistics (UBOS) to estimate populations for the three sub-counties. Linear extrapolation based on assumptions. The first assumption was proportional growth, with the growth rates across these sub-counties aligned with the district-level population growth. Second, it assumed consistent growth, with population growth remaining steady

and linear from 2014 to 2024. After this process, the population totalled 151,462 distributed across the sub-counties. The distribution was 67,866 for Nkanja, 50,183 for Ruyonza and 333,413 for Kyegegwa. From that process, the study applied Yamane's formula, assuming a 5% margin of error, to determine the required sample size for future analysis.

$$n = \frac{N}{1 + Ne^2}$$

Where: n = sample size

N = population size (151462)

e = margin of error, where e = 0.05

Thus, $n = 151462 / 1 + (151462 \times (0.05)^2)$

n = 399 indigenous respondents

The study targeted 399 potential respondents and received 387 valid responses, yielding a 97.0% response rate. Therefore, 387 respondents participated. The study sampled 20 respondents from each of the 24 villages. This was intended to ensure equitable representation across the study area. The Chairpersons of Local Council I in each village helped carry out the selection process. In Uganda, local councils (LCs) are established under the Local Governments Act (Cap. 243). These councils are

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grassroots structures that centralise political, administrative, and service-delivery functions, improving access to governance and public services at the community level. They also foster greater civic engagement and accountability. In this data collection process, the chairpersons identified thirty participants from their respective villages. They followed the guideline that each family should have only one respondent. Another guideline was to select respondents from across the entire village, not from the same neighbourhood. The team selected respondents based on age, ability to understand the questions, and time spent in the area. These ensured inclusivity and objectivity. The team selected 20 of the 30 respondents and invited them to meet the research team to complete the questionnaire.

3.5 Data Collection Instruments and Procedures

The team collected data using a previously published, globally applicable structured questionnaire designed to evaluate ecosystem management. It employed a five-point Likert scale, from 1 (Strongly Disagree) to 5 (Strongly Agree). The ecosystem measurement scale presented statements about ecosystem services, including regulating, provisioning, and cultural services. Respondents indicated whether they agreed or disagreed with these statements. After this process, the data were analysed, and the findings informed the qualitative phase.

Quantitative data were collected through focus group discussions, in-depth interviews, and key informant interviews; Tables 1, 2, and 3 present these findings.

Table 1

Focus Group Discussions

Number	Village	Sub-County	Gender	Age Category
1	Katete	Nkanja	Women Only	18-35
2	Katete	Nkanja	Men Only	18-35
3	Karokarungi	Kyegegwa	Men Only	36-55
4	Karokarungi	Kyegegwa	Women Only	36-55
5	Ndama	Ruyonza	Women Only	55 and above
6	Ndama	Ruyonza	Men Only	55 and above

Source: Field data (2024)

As shown in Table 1, each village held two discussion sessions for men and women, totalling 36 participants across the three villages. This approach was adopted to capture gender-specific and community-specific insights.

Table 2

In-Depth Interviews

No	Gender
1	Male
2	Female
3	Male
4	Female
5	Male
6	Female
7	Female
8	Male
9	Male
10	Male
11	Female
12	Female
13	Male
14	Male

Table 2 Participants

15	Male
16	Female
17	Female
18	Male

Source: Field data (2024)

As presented in Table 2, 18 participants took part in the in-depth interviews across the three villages. This approach explored community dynamics and provided a richer comprehension of the



relationships and interactions within the community.

Table 3

Key Informant Interviews

No	Position	Institution	Ethical Considerations
1	A representative from the office of the Settlement Commandant	Office of the Settlement Commandant	The researcher followed ethical guidelines
2	A representative from the office of the Commandant - security	Office of the Commandant - security	for the research involving human
3	A representative from the Environment Office	Kyegwa District	participants and obtained approval
4	A representative from the District Health Office	Kyegwa District	from the appropriate ethics committee
5	A representative from the District Planning Office	Kyegwa District	and the District Local Council
6	A representative from the District Production Office	Kyegwa District	Participants received comprehensive information
7	A representative from the District Probation Office	Kyegwa District	about the study and provided informed
8	A representative from the Programme Office	Medical Teams International (MTI)	part.
9	A representative from the Projects Management Office	ADRA	Participation was entirely voluntary,
10	A representative from the Projects Management Office	Nsamenang	and participants could withdraw at any
11	A representative from the Projects Management Office	UNHCR	time without negative consequences.
12	Chairperson LC 1	Katete Village	The village researcher maintained
13	Chairperson LC 1	Karokan Village	confidentiality and anonymity by using

Source: Field data (2024)

The researcher engaged participants in strategic positions across institutions, including local leaders, district officials relevant to this study, and non-governmental organisations such as UNHCR.

3.6 Data Analysis

The researcher analysed quantitative data using the Statistical Package for the Social Sciences (SPSS) and SmartPLS software. The analysis followed a systematic procedure involving data screening, descriptive analysis, exploratory factor analysis, assessment of parametric test assumptions, measurement model evaluation, and structural model assessment. The qualitative data were analysed using thematic analysis. This method provided a systematic approach to identifying patterns of meaning within participants’

IV. FINDINGS AND DISCUSSIONS

4.1. Findings

To appraise the ecosystem management of the Kyaka II refugee settlement, the study used Factor Analysis.

accounts. It also supported the development of explanations that strengthened the quantitative findings, following several connected stages.

The researcher followed ethical guidelines for the research involving human participants and obtained approval from the appropriate ethics committee and the District Local Council. Participants received comprehensive information about the study and provided informed consent before participating. Participation was entirely voluntary, and participants could withdraw at any time without negative consequences. The village researcher maintained confidentiality and anonymity by using codes instead of names and prioritised privacy during data collection, particularly on sensitive subjects. The researcher used the information strictly for academic purposes, stored it securely, and reported findings with integrity, upholding participants' dignity and rights throughout the research process.

The study used Exploratory Factor Analysis to examine the structure of the study variables and help identify dimensions/measures consistent with the literature in the Kyaka II context.

Table 4

Kaiser-Meyer-Olkin Test and Bartlett's Test of Sphericity

	<i>KMO Measure - Sampling Adequacy.</i>	<i>Bartlett's Test of Sphericity</i>		
		Approx. Chi-Square	df	Sig.
Eco-System Services	.784	14112.390	3655	.000
Indigene Wellbeing	.899	4395.488	630	.000

The Kaiser Meyer Olkin (KMO) test was used to assess sampling adequacy for Exploratory Factor Analysis (EFA); values should not fall below 0.700. The EFA also generated Bartlett's Test of Sphericity to test whether the dimensions are related. The test should be significant (sig<.05) when the measures are related to each other.

Table 5

Ecosystem Services

	<i>Provisioning Services</i>	<i>Regulating Services</i>	<i>Cultural Services</i>	<i>Supporting Services</i>	<i>Access to resources</i>
PROV1	.813				
PROV2	.814				
PROV5	.626				
PROV6	.842				
PROV7	.716				
PROV9	.515				
PROV10	.675				
PROV11	.737				
PROV12	.748				
PROV15	.722				
REGS4		.700			
REGS5		.726			
REGS6		.741			
REGS8		.849			
REGS9		.779			
REGS10		.870			

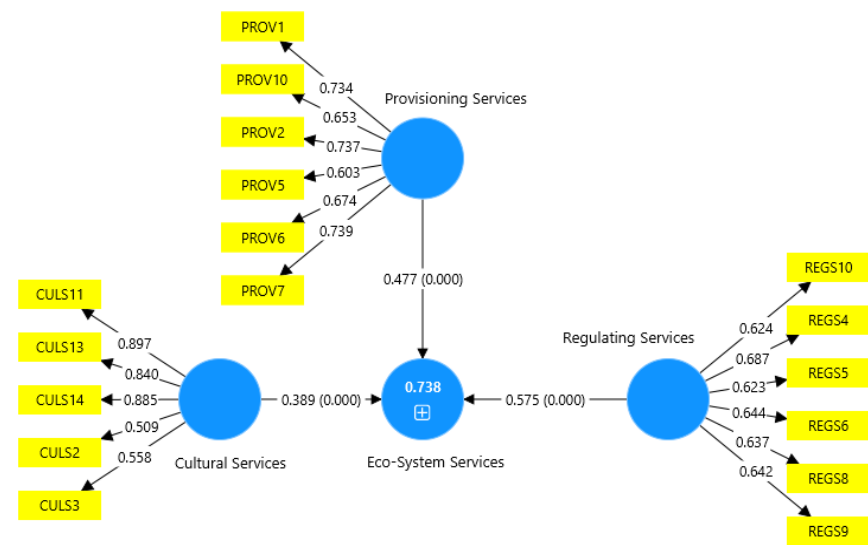
REGS18		.550			
CULS2			.807		
CULS3			.813		
CULS11			.896		
CULS12			.902		
CULS13			.885		
CULS14			.881		
SPSV1				.915	
SPSV3				.676	
SPSV4				.705	
SPSV6				.683	
SPSV8				.716	
ACCS2					.702
ACCS3					.841
ACCS4					.605
Eigen Value	15.538	14.112	10.462	9.211	8.452
Variance %	20.020	15.921	11.676	10.222	9.339
Cumulative %	20.020	35.941	47.618	57.840	67.179

The information provided consists of a factor analysis of ecosystem services, which is divided into five main categories: Provisioning services had factor loadings between 0.515 and 0.842, reflecting their varying contributions to the provisioning services factor. This indicates that provisioning services constitute a significant component of the ecosystem services being analysed. Regulating services exhibited factor loadings ranging from 0.550 to 0.870. This shows that regulating services play a vital role within the ecosystem services framework and contribute significantly to overall variance. Cultural services exhibited high factor loadings between 0.807 and 0.902. This factor loading indicate that cultural services are well represented and a significant component of ecosystem services. Supporting services featured factor loadings ranging from 0.676 to 0.915. This highlights the importance of supporting services within ecosystem services and their essential role in the overall structure. Access to resources exhibited factor loadings between 0.605 and 0.841. This indicates that while access to resources is significant, it contributes less to the overall variance than the other categories. This underscores the multifaceted nature of ecosystem services and their varying impacts on the overall ecosystem framework.

Figure 1

Measurement Model for Ecosystem Services

The measurement model refined the ecosystem scale examined earlier using factor analysis, and the results show that the three dimensions were retained.



These are Cultural Services, Provisioning Services and Regulating Services, each with at least five items. The dimension of Access to Resources and Supporting Services were dropped since they rendered the model less reliable and had Cronbach Alpha values that were less than 0.700. Regulating services had the highest contribution towards the global variable ($\beta = .575$, $p < .05$). The dimension had loadings ranging from 0.623 – 0.687.

Table 6
Effect Size and Prediction Estimates for Eco-System Services

The contribution of the measures was further examined using the *f-square* values, which should have a minimum value of 0.02.

	<i>f-Square</i>	R-Square	R-Square Adjusted
Cultural Services	.524	.738	.736
Provisioning Services	.798		
Regulating Services	1.242		

Further, the highest contribution was from the Regulating Services (*f-square* = 1.242), and the dimensions can account for 73.8% of the global variable.

The results in the measurement model were further indicated using the Bootstrapped estimates below.

Table 7
Bootstrapped Measurement Model Estimates

	β	Std. Error	T statistics	p values
Cultural Services ➡ Eco-System Services	.389	.032	12.051	.000
Provisioning Services ➡ Eco-System Services	.477	.029	16.465	.000
Regulating Services ➡ Eco-System Services	.575	.032	17.939	.000

To examine the relationship between the Ecosystem management of Kyaka II refugee settlement and the well-being of indigenes, the structural model in this section was generated

Structural Model Estimates

This section's structural model was developed to test the relationship between ecosystem services and indigene well-being. The model also included control variables (Gender and the highest level of education to rule out any other interactions that could affect the relationship between the dependent and the independent variables.

Figure 2

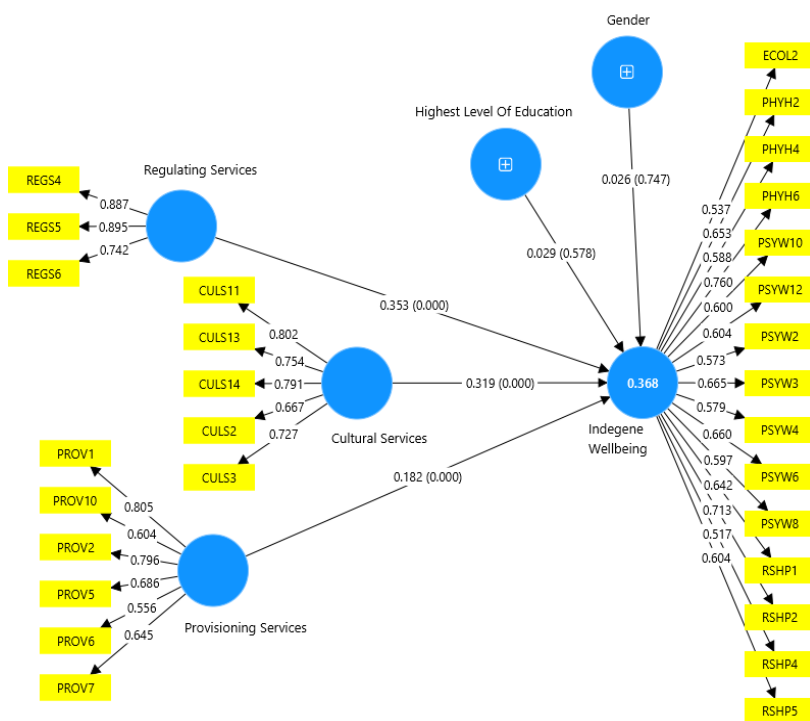


Table 8
Structural Model Estimates

	β	Std. Error	T Statistics	p values	95% BCCI
Gender $\rightarrow$ Indigene Wellbeing	.026	.082	.323	.747	-0.137,0.185
Highest Level Of Education $\rightarrow$ Indigene Wellbeing	.029	.051	.557	.578	-0.135,0.069
Cultural Services $\rightarrow$ Indigene Wellbeing	.319	.043	7.372	.000	0.231,0.401
Provisioning Services $\rightarrow$ Indigene Wellbeing	.182	.042	4.328	.000	0.093,0.258
Regulating Services $\rightarrow$ Indigene Wellbeing	.353	.037	9.630	.000	0.423,0.278

The control variables, gender and highest level of education showed no significant relationship with the criterion variable, Indigene well-being ($p > .05$).

However, Cultural services were observed to have a significant and positive effect on Indigene well-being ($\beta = .319, p < .05$). The same was observed for Provisioning services, which have a significant positive effect on Indigene well-being ($\beta = .182, p < .05$). and Regulating Services ($\beta = .353, p < .05$). It's clear that regulating services have the most significant capacity to improve indigene well-being; in other words, regulation and control of disasters like floods, diseases and waste, and water quality should take priority in efforts to achieve indigene well-being in the community.

These findings were robust, but they lacked the lived experiences of host community members who benefit from, or are affected by, these ecosystem services. As a result, focus group discussions, in-depth interviews, and key informant interviews were conducted to understand the indigenes' lived experiences. This methodological approach yielded key themes. For regulating services, which have the most significant capacity to improve indigene well-being through the regulation and control of disasters like floods, diseases, waste, and water quality, the interviews focused on what indigenes' experiences are, the perceptions they have developed over time, and what ought to be done to achieve indigene well-being in the community.

Floods

Furthermore, participant R11 emphasised the importance of managing the environment: "If we maintain nature and the environment, we won't have issues with disasters like floods and strong winds. [...]" (R11, 10th, 03, 2025). In agreement with R11 above and to better manage the ecosystem and reduce floods and their harmful effects, a representative from the District Environment Office advised the people not to encroach on wetlands. "If you want to avoid floods, don't encroach on a wetland. Don't construct in a wetland. Don't practice your agricultural activities in a wetland area." (KII, 15th, 03, 2025).

Waste management

A representative from the District Community Development Office reported that there's more that needs to be done to better manage waste. "I have not seen a robust system whereby waste is managed well. If you pass via Bukere market, you see the buveras (polythene), we are soon stopping seeing land, but seeing buveras throughout. [...] So waste management is still an issue, but also pollution is still an issue; dust and noise are still issues" (KII, 15th, 03, 2025).

Water quality

Water access in Kyaka II is not the only water-related problem. After struggling to access it, participants reported another challenge: its quality, as participant R14 stated: "We drink very dirty water. We get dirty water from the swamps..." (R14, 10th, 03, 2025). R15 added that, "We go through challenges because we don't have clean water. We drink water from ebiziba (open wells)" (R15, 10th, 03, 2025). R16 agreed, "We drink the same water as cows. We don't have clean water. (R16, 10th, 03, 2025)"

The disease burden

As a result of this massive water contamination and the resultant use of this contaminated water, participants reported suffering from a plethora of diseases. Participants, including R3, reported that "The water we use gives us diseases, coughs and fevers" (R3, 10th, 03, 2025). R34 reported more diseases: "For sickness, we are mostly affected by malaria, diarrhoea, which is all caused by dirty water" (R34, 13th, 03, 2025). This aligns with R36's report, "For sickness, we are really attacked by many because we suffer from malaria frequently, our children suffer from typhoid [...] caused by dirty water" (R36, 13th, 03, 2025). For participant R49, "The dam water that we get has worms; you can't just drink it" (R49, 13th, 03, 2025).

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Climate change

Climate change has become a critical issue in Kyaka II; for example, a representative from the Planning Office stressed the importance of adopting climate-smart agriculture to mitigate climate risks: “For example, we need to plant drought-resistant crops. You need to plant agroforestry. You need to continue supporting micro-scale irrigation schemes” (KII, 15th, 03, 2025).

Regarding provisioning services and their effect on well-being, indigenes identified:

Food shortages

The study found food shortages, mainly due to prolonged drought and the presence of refugees. For instance, R48, through an in-depth interview in Ndama village, emphasised that *“The food is not enough because the weather changed in a way that we haven’t even commenced crop planting due to excess sunshine; we currently don’t have food and water because without rain, there is no crop you may grow that yields”* (R48, 13th, 03, 2025).

Equally so, R7, in a focus group discussion in Katete, attributed food shortages to the presence of refugees.

“The problems that have resulted from food shortages are these: there are many people who come around to get food. We produce a lot of food, but its consumers are too many. That’s why we have food shortages. For instance, we have refugees neighbouring us. They get food for work from us” (R7, 10th, 03, 2025).

In contrast, some participants said they don’t face food shortages. Despite this acknowledgement, they also admitted that they sometimes experience food shortages due to population growth, drought, poor soil quality, and other overwhelming household needs. In this regard, R21 noted that “Food access in this area has continuously reduced as the population increased, and due to increased soil exhaustion and low harvests. All this has led to reduced food access [...]” (R21, 12th, 03, 2025). This confirms that the area experiences food shortages, although harvests are sometimes plentiful.

A large number of participants (62%) reported experiencing food shortages, while only 28% said they didn’t. Remarkably, 90% of participants recognised that food is accessible, but this accessibility is inconsistent when other needs are considered. These findings show a relationship between environmental stability, social responsibilities, and food security in Kyaka II.

Famine occurrences

The study found that Kyaka II experiences famine outbreaks, with participants identifying a range of other situations that confirm this. For instance, participant R24 said, “The food we produce would be enough, but because our soils are exhausted, we harvest little and later run short of food and experience famine” (R24, 12th, 03, 2025). Similarly, participant R45 confirmed that Kyaka II experiences famine outbreaks mainly due to unpredictable weather patterns: “We are currently in times of drought, and this hinders the growth of our crops, hence leading to famine” (R45, 13th, 03, 2025). For participant R28, it is the big family that catalyses famine outbreaks: “[...] The third problem is the famine we experience. Food is not enough because we are looking after children whose mothers left them in our care” (R24, 12th, 03, 2025). Other participants, such as R26, attributed famine outbreaks to a lack of support: “What do they give us? We’ve seen nothing. We are hit by famine, suffer, and get no support. We need justice. Now that we are hit by famine, we should

also receive rice, posho, and money [...]” (R26, 12th, 03, 2025). Other participants, including R36, R37, and R40, also acknowledged famine outbreaks.

However, the follow-up interviews revealed that some participants don’t experience famine outbreaks in Kyaka II. One such participant is R7, who confirmed that “[...] We rarely face famine because our land is not too exhausted to produce food” (R7, 10th, 03, 2025).

Similarly, R21 appreciated Kyaka's fertile soils, which support crop growth.

Compared to where I came from where we experienced famine almost all the time, Kyaka is different. We do not experience that bad famine. We get what to eat. While other places may be suffering with famine, here in Kyaka we rarely face it. Our soil is good in that food crops mature fast (R21, 12th, 03, 2025).

Water scarcity

Kyaka II faces water scarcity, forcing residents to resort to available water sources as revealed by R8: “We mainly use water from open wells. We don’t have any protected well. We use our own dug open wells, and sometimes we get water from swamps” (R8, 10th, 03, 2025).

Water shortages in Kyaka are fuelled by a range of factors, such as infrastructure failures, and accessing dirty water has had its effects on the people, as reported by R37.

[...] water is scarce because we had a borehole which also got spoilt, meaning that we have to fetch water from the wells, which at times get dry, where we share with all kinds of animals too. We have heard of organisations connecting water in the neighbouring villages, but we haven’t gotten a chance to be connected. We sometimes get malaria due to dirty water [...]” (R37, 13th, 03, 2025).

Furthermore, participants described water as dirty, contaminated with worms, and often shared with livestock, posing health risks. According to R9, “This is because we drink the same water that cows drink. Eventually, people get worms from this water. For us, water is a very big challenge” (R9, 10th, 03, 2025).

Open defecation was identified as a major source of contamination, along with practices such as washing clothes in wells and improper disposal of animal waste. “We also have a problem of animal grazers who defecate openly anywhere in the bushes. This leads to water contamination and diseases when we drink this water”, said R8 (R8, 10th, 03, 2025).

Despite widespread contamination, some participants reported access to relatively clean water through practices such as fencing off wells, separating water sources for animals and humans, and reducing congestion at shared wells, as R8 reported.

We, as natives, try to dig open wells, put a simple fence around them, and have fairly clean water. Secondly, in the past, the whole village would have one well, but today you find that only 3-4 households are sharing a well. So there’s no congestion, and the owners try to keep them clean [...]. Thirdly, some people now have separate wells for the animals so that the wells for domestic use are not contaminated with animal waste (R8, 10th, 03, 2025).

Others mentioned clean water sourced from wetlands or purification pots distributed by organisations, which helped ensure safer drinking water, as reported by R35, “The water is good, and it got better when we received the pots from some organisation where we used our national IDs to acquire; each pot carries around 10 litres, and they help us make the water clean and safe for drinking” (R35, 13th, 03, 2025).

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These findings show that 54% of participants find it difficult to access water. 24% reported having easy access to water. This means 78% of participants reported varying experiences with water access, highlighting the difficulty in accessing water, which threatens their livelihoods, physical health, social stability and general well-being.

Firewood shortages

The study found that the Kyaka II community faces significant firewood shortages, constraining daily cooking, as reported by R26.

We don't have anything to cook with. [...]. When we uproot cassava, we dry the stems, which we later use as cooking firewood. So we lack firewood (R26, 12th, 03, 2025).

The scarcity of firewood has reached annoying levels, with people getting imprisoned, their pieces of land taken from them, as reported by R32: "My biggest problem, which annoys me here, is the lack of firewood. If someone finds you in their forest looking for firewood, they send you to prison and usually demand a piece of your land" (R32, 13th, 03, 2025).

Indeed, firewood scarcity is at a crisis level, as some participants reported failing to cook because of firewood, as reported by R43: "We even at times fail to have food ready due to firewood, and we would appreciate any efforts on how we would have our food ready" (R43, 13th, 03, 2025).

This scarcity was attributed to a number of problems, including the high population and refugees, as reported by R42: "The increased number causes scarcity of a lot of other things, i.e. firewood, because the more people, the less the land per person, and so it becomes challenging for some people to plant trees where they will get firewood" (R42, 13th, 03, 2025). R26 added: "Refugees are the leading cutters of our trees. Every day, they pass by carrying firewood; they would rather go with fresh wood than return home with nothing" (R26, 12th, 03, 2025).

Despite this firewood scarcity crisis, some participants reported that they access firewood. One such participant is R34, who reported that

For firewood, we have farms that are owned by people from home; you seek permission and then go ahead to fetch firewood. For instance, when people like Arthur, our chairman, have cut down trees on their farms, that's when we access trees (R34, 13th, 03, 2025).

Culture and the environment

The study confirmed that cultural practices and values depend on the environment. R11 stated, "Yes, in this community, we have certain species of trees that are used for cultural practices. Some cultural practitioners pray from those trees and put some items underneath them" (R11, 10th, 03, 2025). R33 added: "We have traditional healers and fortune tellers [who] worship stones and trees in the assumption that they receive blessings" (R33, 13th, 03, 2025). Similarly, interviewee R39 says the community has traditional healers who hunt and kill wild animals for their parts. "For the traditional healers, [...] I hear that traditionalists sometimes [...] they go hunting for some wild animals where you find them with tails of some animals" R39, 13th, 03, 2025).

Several other participants, such as R35, R38, R36, and R39, agreed that the community has traditionalists and fortune tellers who worship trees and stones for blessings and medicine.

However, R49 reported that "we don't have traditionalists here for the time I have been here, though I have a feeling there could be some, but it's not as intensive as it is in Buganda" (R49, 13th, 03, 2025).

Access to green spaces

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The study found that communal spaces provide venues for relaxation, conversation, and social bonding, as R41 reported.

For places of hanging out, such things can never miss in people's day-to-day lives, even when they aren't as rich, but when you get a visitor or when evening time reaches, one can leave his home and head to the town centre and have a drink [...] you buy for yourself or even sometimes for a friend because when men meet, [they] converse, which is like a norm (R41, 13th, 03, 2025).

Having examined how the Kyaka II ecosystem is managed, the next step is to examine the relationship between ecosystem management and indigenes' well-being in the Kyaka II Refugee Settlement and a correlation was carried out.

Table 9

Pearson Correlation for study variables

	<i>Mean</i>	<i>SD</i>	1	2	3	4	5	6	7
Provisioning Services-1	2.918	.934	1.000						
Regulating Services-2	2.085	.507	.171**	1.000					
Cultural Services-3	3.673	.842	.256**	.348**	1.000				
Ecosystem Services-4	3.314	.483	.422**	.464**	.656**	.525**	.231**	1.000	
Indigene Well-being-5	3.511	.614	.492**	.243**	.256**	.390**	.179**	.471**	1.000

** . Correlation is significant at the 0.01 level (2-tailed).

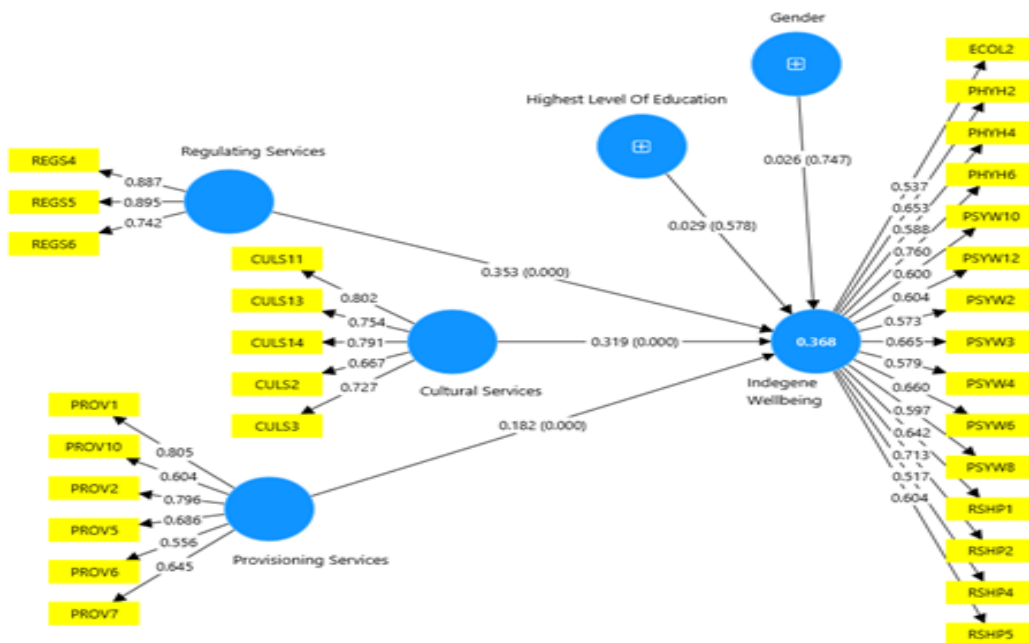
The results show that Ecosystem services were significantly and positively related to Indigene well-being ($r = .471^{**}$, $p < .05$). The results indicate that improvements in ecosystem services will be positively associated with Indigene well-being.

All aspects of ecosystem services were significantly and positively related to Indigene well-being, with Provisioning services showing the strongest association with the dependent variable ($r = .492^{**}$, $p < .05$).

To further test the nature of the relationship between ecosystem services and indigene well-being, a structural model was generated. The model also included control variables (Gender and the highest level of education) to rule out any other interactions that could affect the relationship between the dependent and independent variables.

Figure 3.

Structural Model Estimates



From Table 4.10, the control variables (gender and highest level of education) showed no significant relationship with the criterion variable, Indigene well-being ($p > .05$).

Cultural services have a significant and positive effect on Indigene well-being ($\beta = .319, p < .05$). The same was observed for Provisioning services, which have a significant positive effect on indigene well-being ($\beta = .182, p < .05$). and regulating services ($\beta = .353, p < .05$). It's clear that regulating services have the most significant capacity to improve indigene well-being. In other words, regulation and control of disasters like floods, diseases, waste, and water quality should take priority in efforts to achieve indigene well-being in Kyaka II.

Table 10

Structural model estimates for predictors of indigene well-being

	β	Std. Error	T Statistics	p values	95% BCCI
Gender $\rightarrow$ Indigene Wellbeing	.026	.082	.323	.747	-0.137,0.185
Highest Level Of Education $\rightarrow$ Indigene Wellbeing	.029	.051	.557	.578	-0.135,0.069
Cultural Services $\rightarrow$ Indigene Wellbeing	.319	.043	7.372	.000	0.231,0.401
Provisioning Services $\rightarrow$ Indigene Wellbeing	.182	.042	4.328	.000	0.093,0.258
Regulating Services $\rightarrow$ Indigene Wellbeing	.353	.037	9.630	.000	0.423,0.278

4.2. Discussion

Regulating services have the greatest capacity to improve indigene well-being; in other words, regulating and controlling disasters like floods, diseases, and waste, and maintaining water quality should take priority in efforts to achieve indigene well-being in the community. This finding aligns with broader scholarship that places regulating services at the centre of ecosystem management. For example, Mengist et al. (2020) identify climate regulation, water purification, flood protection, disease control, waste treatment, air quality management, and erosion control as crucial for reducing environmental and health threats.

Other investigations into flood regulation, such as Vári et al. (2022), show that natural ecosystems can reduce flood severity and frequency, and that high flooding can reduce losses in water management, water quality, disease control, and climate regulation services. This matters for Kyaka II because environmental pressures on regulating services may relate to refugee settlement, host-community activities, climatic variability, poverty, and poor environmental management.

From an ecological epidemiology perspective, evidence links ecosystem degradation to disease transmission. Water contamination, poor sanitation, and sharing resources with animals create conditions that facilitate the transmission of diseases such as diarrhoea, malaria, and other parasitic infections (Bwanbale, 2026; Pinto Jimenez et al., 2023; WHO, 2025; Wolf et al., 2023). Experiences from Kyaka II point to cases of worms, typhoid and malaria due to dirty water shared with animals. This aligns with Levins and Lopez (1999) concept of the "ecological production of disease." This concept highlights how interactions between human activities and environmental conditions shape epidemiological outcomes. Kyaka II is grappling with disturbing nutritional deficiency statistics, with stunting among refugee children at 45.5%, compared with 8% among the children of the local population. This points to food insecurity and underscores gaps in dietary diversity. This calls for interventions, such as training in modern farming methods, with a focus on the nutritional needs of the communities. This means that food interventions should focus on both quality and quantity (Guli et al., 2023; Khuri et al., 2022).

Refugee settlements produce large amounts of waste and often have poor waste management, creating conditions conducive to disease. Some of these diseases are respiratory and vector-borne. For example, refugee settlements produce 188 million tonnes of waste annually. Much of this is mismanaged, resulting in pollution and related

health risks (NEMA, 2019). Poor practices, such as open dumping and inadequate landfill management, harm the environment and cause ill health (Shackelford et al., 2026).

In Kyaka II, ecosystem management is reactive, uneven and based on access to water rather than regulation. This survival-oriented approach to community management is vulnerable to disease and relies on disjointed household coping strategies and external technical support. The findings show that governing services are overstretched and poorly maintained, revealing governance gaps and the need for a policy-driven approach to strengthen services. In this context, water purification and disease control are not only secondary but essential to sustainable health and require institutional commitment and strong enforcement.

Provisioning services (Food, access to water, firewood) have a significant positive effect on Indigene well-being. The findings show that provisioning services- food, water, and firewood- are a lifeline and necessary for human survival in refugee-hosting communities, especially in Kyaka II, the focus area for this study. However, refugees consume nearly two million

tonnes of firewood annually, and yet deforestation harms habitats, biodiversity, and other ecological processes (Garai, 2024; Negret et al., 2021; Ngeve et al., 2026; Perrin et al., 2025). Deforestation also undermines host communities' ecological resilience (Arthington, 2025; Ban et al., 2025; Dyck et al., 2008; Tonkin et al., 2026). Biodiversity loss is driving a looming global crisis. This crisis is exemplified by human-induced ecological strain, including climate change, habitat loss and unsustainable resource extraction, which are accelerating the extinction of critical species (Habibullah et al., 2022; Rogers, 2025). Given this, Pimm (2009) warns of an irreversible tipping point at which extinct species are irretrievable, even if the conditions that led to their extinction improve.

Cultural

services have a significant and positive effect on Indigene well-being. The study highlights the importance of cultural services to ecosystem functioning within the broader framework of environmental studies, linking environmental conditions to the intrinsic values of cultural practices. Participants reported cultural practices such as hunting wild fauna for cultural purposes and using non-destructive herbal medicine. They also reported contemporary religious practice and tourism potential arising from the presence of caves and cultural sites. Scholarship, such as Gladkikha et al. (2019) and Pearson et al. (2021), noted a shift by refugee-hosting communities toward these resources and a subsequent reduction in reliance on cultural sites. This tourism potential attests to the influence of cultural services on overall ecosystem management frameworks. Cultural services alleviate the psychological stress common in refugee-hosting communities, nurture a sense of belonging, and strengthen community ties. Gladkikha et al. (2019) corroborate this perspective. This interconnectedness among culture, the environment, and socio-economic factors points to the lack of a comprehensive strategy that integrates cultural heritage into environmental sustainability and community development initiatives.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The study concluded that ecosystem management in Kyaka II is severely constrained by unpredictable weather, rapid population growth, poverty, corruption, political interference, and weak policy enforcement, leaving provisioning services such as food, water, and forests fragile and unevenly distributed. Although NGOs and district offices can help address some system-wide challenges, they cannot resolve systemic shortages and governance failures. The study further concluded that regulating services are poorly

managed and that environmental degradation persists when localised interventions are not implemented. Furthermore, cultural services, such as herbal medicine and heritage sites, support resilience but are also vulnerable to deforestation, religious change, and ecological degradation. These conclusions indicate that ecosystem management in Kyaka II is multidimensional and shaped by structural, political, and socio-economic factors that undermine sustainability and community health.

5.2 Recommendations

The recommendations for the Kyaka II Refugee Settlement emphasise the need to foster collaboration among the Office of the Prime Minister, UNHCR, NGOs, and government agencies to ensure equitable access to resources and to address environmentally damaging practices. Key actions include strengthening inter-institutional coordination, enforcing environmental regulations, promoting climate-smart agriculture, improving waste management and public health, integrating cultural heritage into ecosystem management, and reinforcing accountability and participatory governance. This aims to restore ecosystems, preserve cultural heritage, strengthen livelihoods, and

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ultimately enhance the well-being of refugees and host communities.

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