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Developing an Environmental Conservation Framework for Sustainable Land Use Planning a Case of Kanakapanta Resettlement Scheme

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Abstract

Land use planning plays an important role in advancing sustainable development by integrating environmental, social, and economic dimensions to optimize land utilization and bolster climate resilience. The adoption of efficient practices contributes to the mitigation of land degradation, while strategically planned agricultural systems enhance food security and promote ecological balance. This study focused on the development of an environmental conservation framework for sustainable land use planning in Zambia. Employing a mixed-methods research design, data were collected from a sample of 150 respondents. Quantitative data were analysed using descriptive and inferential statistics, including regression analysis, while qualitative data were subjected to thematic analysis. The research identified key conflicts between agriculture and environmental conservation, including unsustainable farming practices (30.8%), resource competition (24.2%), and deforestation (23.3%). Approximately 40.3% of respondents reported occasional conflicts, while 33% experienced them often. Major barriers to sustainable land development included inadequate financial support (35%) and lack of knowledge (30%). Awareness of sustainable agricultural practices varied, with 38% of respondents indicating high awareness and 35.8% reporting low awareness. Conventional agriculture (35.8%), crop rotation (30%), and conservation agriculture (11.7%) were the most common practices, with crop rotation being the easiest to implement (42.2%), and climate-smart agriculture being the most challenging (37.8%). A chi-square analysis revealed no significant association between awareness levels and perceived barrier impacts ($p=0.327$). Regression analysis indicated that age negatively correlated with the type of conflict ($\beta=-0.0283$, $p<0.001$), while location influenced conflict experiences, with certain areas, such as Section D ($\beta=1.3799$, $p<0.001$) and Section G ($\beta=1.6554$, $p<0.001$), reporting more frequent conflicts. Additionally, sex had a positive but marginally significant effect ($\beta=0.2640$, $p=0.062$). Qualitative findings highlighted the tension between agricultural production and environmental conservation, with economic pressures driving environmental degradation, such as deforestation and water pollution. Participants also pointed to limited knowledge, training, and financial barriers, including high costs and restricted access to credit, as key obstacles. The study proposed an environmental conservation framework to address these conflicts, integrating sustainable agricultural practices with effective land use planning. The framework advocates a multi-stakeholder approach involving policymakers, farmers, and environmental experts to promote balanced sustainable land use. The findings enhance the body of knowledge by providing empirical evidence on the conflicts between agriculture and environmental conservation in land use planning, highlighting key socio-economic and spatial factors influencing sustainability challenges. The proposed environmental conservation framework offers a practical guide for policymakers and stakeholders to integrate sustainable agricultural practices into land use planning.

Keywords: sustainable agriculture; land use planning; environmental conservation; climate-smart agriculture; land degradation

1. Introduction

Land use planning is a fundamental process that systematically assesses land and water resources while accounting for economic, social, and environmental considerations to identify the most efficient and sustainable land-use strategies (Huang et al., 2023). It plays a pivotal role in shaping patterns of land utilization and urban development, guided by public policy, regulatory frameworks, and collaborative stakeholder engagement (Naik & Gurumurthy, 2022). Effective land use planning promotes balanced community development by optimizing the use of landscape systems, embedding principles of sustainability, and fostering environmental resilience (Bubyr, 2019).

Agriculture remains integral to sustainable development through its contributions to food security, environmental sustainability, and social inclusion. Despite its importance, incorporating agriculture into land use planning poses significant challenges, such as conflicts with environmental conservation goals, inefficient resource utilization, and gaps in regulatory frameworks (Lee et al., 2023). Nonetheless, agriculture underpins national food systems and supports ecological stewardship, particularly in urban and peri-urban contexts, by addressing local food needs, enabling large-scale food production, and preserving agricultural heritage (Loos & von Wehrden, 2018).

Achieving effective and sustainable land use planning necessitates active stakeholder involvement including policymakers, urban planners, environmental advocates, and farmers to ensure that agricultural practices align with broader development objectives (Paganin et al., 2023). Public education and capacity-building initiatives are also crucial in promoting the adoption of sustainable agricultural practices and strengthening the resilience of urban food systems and infrastructure (Bulut & Gökalp, 2022).

When strategically integrated, sustainable agriculture and land use planning can cultivate regenerative environments that support economic viability, ecological integrity, and social well-being (Nowysz et al., 2022; Specht et al., 2021). This study contributes to the growing discourse on sustainable development by examining the interconnections among sustainable agriculture, environmental conservation, and land use planning.

2. Literature Review

2.1. Theoretical Framework

This study integrates multiple theories to develop an environmental conservation framework for sustainable urban agricultural land use planning in Zambia. The theories included are the Theory of Sustainable Development, Institutional Theory, Biophilic Urbanism Theory, and Ecological Urbanism Theory.

2.1.1. The Theory of Sustainable Development

Sustainable land use planning considers the interconnectedness of land, water, and socio-ecological systems to promote food security and environmental sustainability (Wang et al., 2023). The Theory of Sustainable Development emphasizes the efficient and rational use of land resources to ensure long-term viability, addressing challenges like land degradation and pollution. It focuses on improving agricultural land use efficiency while protecting fertile land from non-agricultural activities (Nhamo et al., 2022). This approach aligns with the sustainable development goals (SDGs) by integrating transformative models and circular approaches to boost rural economic development and promote long-term agricultural sustainability.

2.1.2. The Institutional Theory

Institutional Theory examines how external pressures shape organizations and influence their structures and behaviours to conform to societal norms (Capponi et al., 2023; Ikbal et al., 2020; Tretiak et al., 2021). In the context of developing an environmental conservation framework for sustainable land use planning, this theory highlights how regulations, standards, and practices are shaped by societal expectations and environmental concerns. Institutional Theory ensures that the developed framework aligns with sustainability goals, addresses stakeholder needs, and contributes to environmental preservation within the agricultural sector.

2.1.3. The Biophilic Urbanism Theory

Biophilic Urbanism Theory focuses on integrating nature and green infrastructure into urban areas to enhance human well-being, environmental sustainability, and economic aspects (Cacique and Ou, 2022; Monteiro et al., 2023). By incorporating natural elements and biodiversity, urban areas can promote healthier environments, improve quality of life, and create a strong sense of place identity. This theory contributes to sustainable urban agriculture by addressing challenges such as urbanization and pollution, fostering resilient and sustainable cities through effective land use planning and urban agriculture practices.

2.1.4. The Ecological Urbanism Theory

Ecological Urbanism Theory promotes resilience, sustainability, and socio-environmental diversity within urban areas, opposing globalized urbanization patterns. It advocates for nature-based farming approaches and integrated land-use strategies that contribute to sustainable development goals (Kalfas et al., 2023. This theory highlights the importance of structural changes and societal shifts to preserve natural resources for future generations while addressing environmental challenges such as urban heat islands. Ecological Urbanism plays a critical role in shaping green urban development trends through green infrastructure, resilience, and low-carbon economies.

These integrated theories provide a comprehensive foundation for developing a framework that balances agricultural productivity with environmental conservation in Zambia's urban agricultural land use planning.

2.2. Empirical Review

Environmental conservation plays a crucial role in protecting natural resources, biodiversity, and ecosystems, ensuring sustainability for current and future generations. Key efforts in conservation include reforestation, waste reduction, pollution control, and sustainable resource management (Almulhim et al., 2022; Feby et al., 2022). The significance of conservation extends beyond preserving wildlife and ecosystems it also supports freshwater sources, climate stability, and human health (Dwaita Hazra, 2014; Mohd Asharuddin et al., 2018). These efforts highlight the need for continuous participation in conservation activities to maintain environmental balance.

In sustainable agriculture, environmental conservation addresses challenges such as land degradation, biodiversity loss, and pollution. Conservation agriculture (CA), which includes reduced tillage, cover cropping, and residue retention, has proven effective in promoting soil health and reducing production costs (Saikanth et al., 2023; Kertész & Madarász, 2014). The increasing adoption of CA reflects a growing awareness of environmental sustainability. By fostering collaboration and enhancing public awareness, conservation efforts can bridge the gap between human development and nature, ensuring long-term ecological balance.

Several studies have explored different aspects of environmental conservation, yet gaps remain in addressing ecosystem restoration, the effectiveness of reforestation, and the integration of traditional ecological knowledge (Almulhim et al., 2022; Feby et al., 2022; Dwaita Hazra, 2014). A more holistic approach incorporating modern scientific techniques alongside indigenous practices could enhance conservation strategies. Additionally, there is a need for comprehensive frameworks that outline specific conservation methods, including protected areas, sustainable land use, and biodiversity preservation (Mohd Asharuddin et al., 2018).

Sustainable agriculture promotes environmentally friendly farming practices that balance productivity with conservation goals. The excessive use of chemical fertilizers and pesticides contributes to land degradation and pollution, necessitating a shift towards organic and sustainable farming (Kuzmich, 2022; Singh & Bhagwat, 2013). Methods such as agroecology, precision agriculture, and organic farming offer viable alternatives that reduce harmful environmental impacts while ensuring food security (Bulut & Gökalp, 2022). These approaches emphasize the need for integrating environmental conservation with agricultural productivity to create sustainable food systems.

Land use planning plays a significant role in sustainable agriculture by ensuring the efficient use of land resources while preventing degradation (Denisova & Silova, 2021). Effective strategies such as land reclamation, digital monitoring, and improved registration systems contribute to better land management and conservation (Julia et al., 2023; Akbar et al., 2020). Incorporating economic incentives, such as subsidies for sustainable farming practices, can further enhance the adoption of environmentally friendly methods. Encouraging sustainable land use planning not only protects natural resources but also supports rural development and community resilience.

Transitioning to sustainable agriculture requires a shift in farming techniques that prioritize environmental, economic, and social sustainability. Conservation-based farming practices, including reduced tillage and soil carbon sequestration, help mitigate climate change while improving soil health (Francaviglia et al., 2023). Additionally, integrating agroforestry, sustainable intensification, and biodiversity-friendly practices enhances ecological resilience and promotes long-term sustainability (Çakmakçı et al., 2023; Sulaiman & Misnan, 2022). Farmers play a key role in this transition, and supporting their adoption of sustainable methods through training and incentives is essential for widespread implementation.

Existing studies on sustainable agriculture identify various research gaps, including the need for economic support mechanisms, long-term monitoring frameworks, and greater stakeholder engagement (Kuzmich, 2022; Singh & Bhagwat, 2013). Addressing these challenges requires a comprehensive approach that includes scientific research, policy interventions, and farmer participation (Bulut & Gökalp, 2022; Julia et al., 2023). Integrating sustainability measures into national agricultural policies can strengthen conservation efforts while ensuring food security and economic stability.

The adoption of sustainable agricultural practices in Zambia depends on factors such as farm size, access to extension services, and cooperative membership (Mwape Mumba et al., 2023). Precision conservation agriculture, digital agriculture, and resilient farming practices have shown positive impacts on agricultural performance (Ali & Dahlhaus, 2022). However, barriers to adoption remain, requiring further scientific research and policy interventions to enhance farmer participation and address implementation challenges (Coulibaly et al., 2021). Strengthening research on sustainable agriculture frameworks can provide practical solutions for fostering environmental conservation and ensuring agricultural sustainability.

3. Methodology

3.1. Research Design

The study employed a mixed-method research design, integrating both qualitative and quantitative approaches. The qualitative component involved structured interviews with stakeholders on topics related to urban agriculture, land use planning, and environmental conservation. For the quantitative component, surveys were used to collect statistical data, allowing for an analysis of the extent to which environmental conservation goals are incorporated into sustainable urban land use planning.

3.2. Study Area and Sampling Procedure

The research was conducted in Chongwe District, Zambia, specifically in the Kanankatampa resettlement camp. This area consists of 14 villages with 630 households under the National Association for Smallholder Farmers (NASFA) project. Kanankatampa was selected due to its vulnerability to climate change effects, including the El Niño phenomenon in the 2023-2024 farming season. The region faces environmental challenges such as soil degradation, erratic rainfall, and increasing pressure on land resources, making it a suitable location for studying the integration of environmental conservation into urban agriculture.

A probability sampling approach was used to ensure the representativeness of the sample. The study applied Danniel's (1999) sample size equation to determine the appropriate number of participants. Using a 95% confidence level and a 7% margin of error, the study calculated a sample size of 150 smallholder farmers from the NASF database. To ensure fairness in selection, a random selection method using Microsoft Excel was employed. This helped minimize bias and ensured diverse participation. In addition to farmers, government officials from the Ministry of Agriculture and the Ministry of Lands and Natural Resources were included in the study. These officials provided expert insights on policy implementation and the role of environmental conservation in land use planning.

3.3. Data Analysis

For qualitative data**,** thematic analysis was conducted to identify key themes, stakeholder concerns, and recommendations for improving environmental conservation in agriculture. The qualitative data provided insights into farmers' lived experiences, challenges, and perceptions. For quantitative data, statistical techniques were applied to measure patterns, trends, and relationships between urban agriculture and environmental sustainability. Descriptive and inferential statistics were used to assess the effectiveness of conservation strategies and their impact on land use planning.

4. Results

4.1. Quantitative Findings

4.1.1. Demographic

The demographic findings reveal that the majority of the 120 respondents were female, accounting for 61.7% (74 participants), while males made up 38.3% (46 participants). In terms of location, most respondents were from Kanakantapa section A (40.0%), followed by Kanakantapa section G (32.5%) and Kanakantapa section D (27.5%). Age distribution indicates that the largest group of respondents was 40 years and above (49.2%), while those aged 20-29 and 30-39 comprised 26.7% and 24.2%, respectively. These demographic insights provide an overview of the composition of participants in the study, highlighting gender distribution, geographical representation, and age group proportions.

Table 1. Demographic Summary.

Variables	Frequency	Percentage (%)
Sex		
Female	74	61.7
Male	46	38.3
Location		
Kanakantapa section A	48	40.0
Kanakantapa section D	33	27.5
Kanakantapa section G	39	32.5

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Age Group		
20-29	32	26.7
30-39	29	24.2
>40	59	49.2

4.1.2. Conflict Between Agriculture Production and Environmental Conservation

The findings indicate that conflicts between agricultural production and environmental conservation are prevalent, with unstable farming practices being the most frequently reported issue, affecting 30.8% of respondents. Other significant conflicts include competition for resources (24.2%) and deforestation (23.3%), emphasizing the ongoing struggle between maximizing agricultural output and maintaining ecological balance.

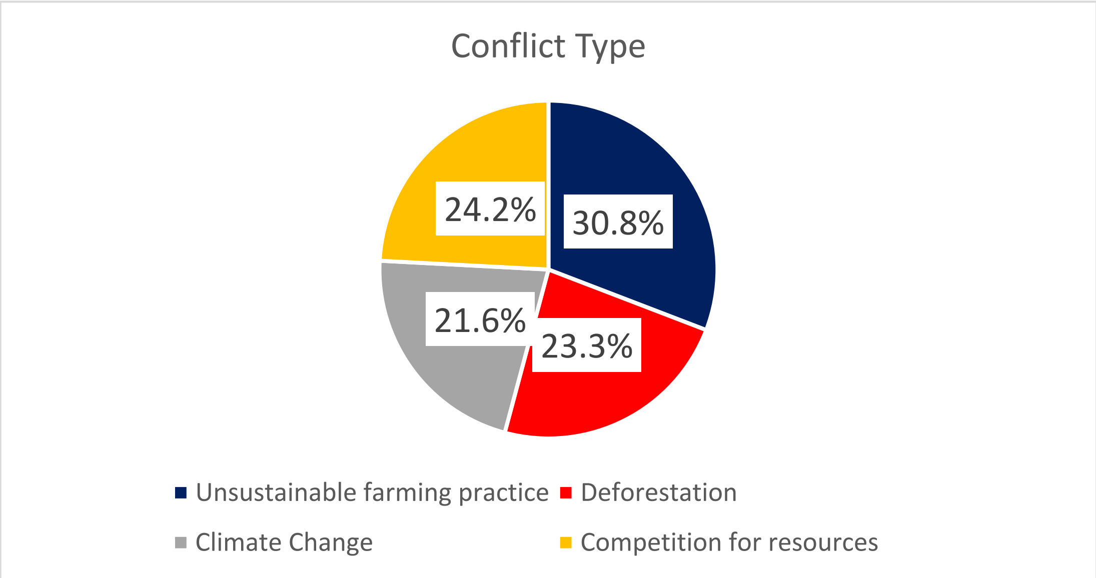

Figure 1. Conflict Types.

Regarding the frequency of these conflicts, most respondents (40.3%) stated that they sometimes experience conflicts between agriculture and conservation, while 33% reported that these conflicts occur often. A smaller percentage (2.5%) noted that conflicts always happen.

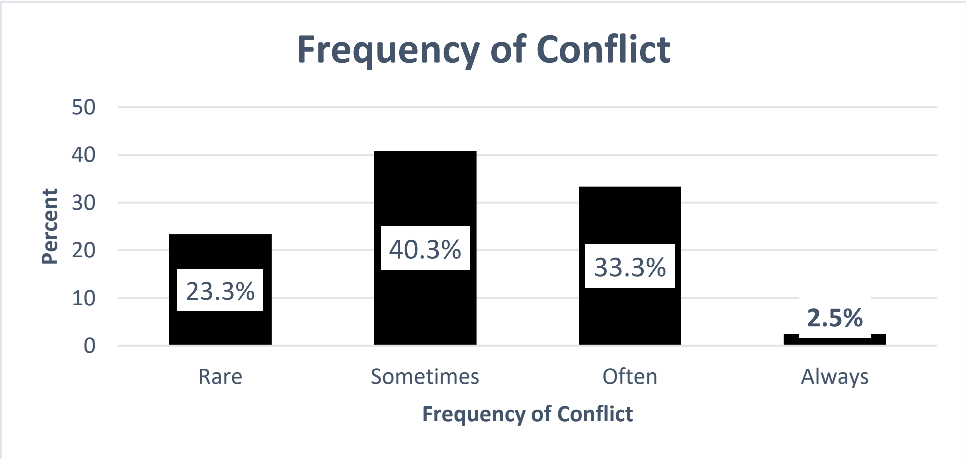

Figure 2. Conflict Frequency.

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4.1.3. Factors Affecting Sustainable Land Development

The findings indicate that lack of financial support is the most significant challenge to sustainable land development, affecting 35% of respondents. Other key barriers include inadequate knowledge (30%), poor extension services (15.8%), and high labour requirements (14.2%).

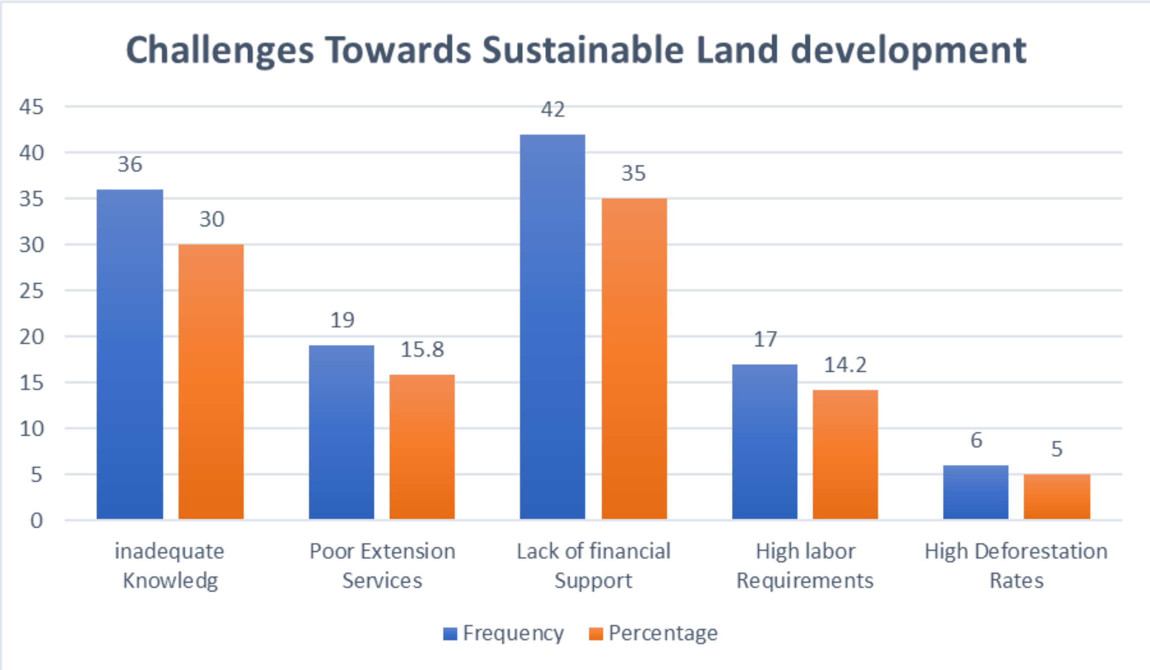

Figure 3. Sustainable Land Development Challenges.

Regarding awareness levels of sustainable practices, the data reveals a mixed level of familiarity among respondents. A significant 38% of participants reported a high awareness of sustainable land management, while 25.8% had a medium awareness, and 35.8% had low awareness.

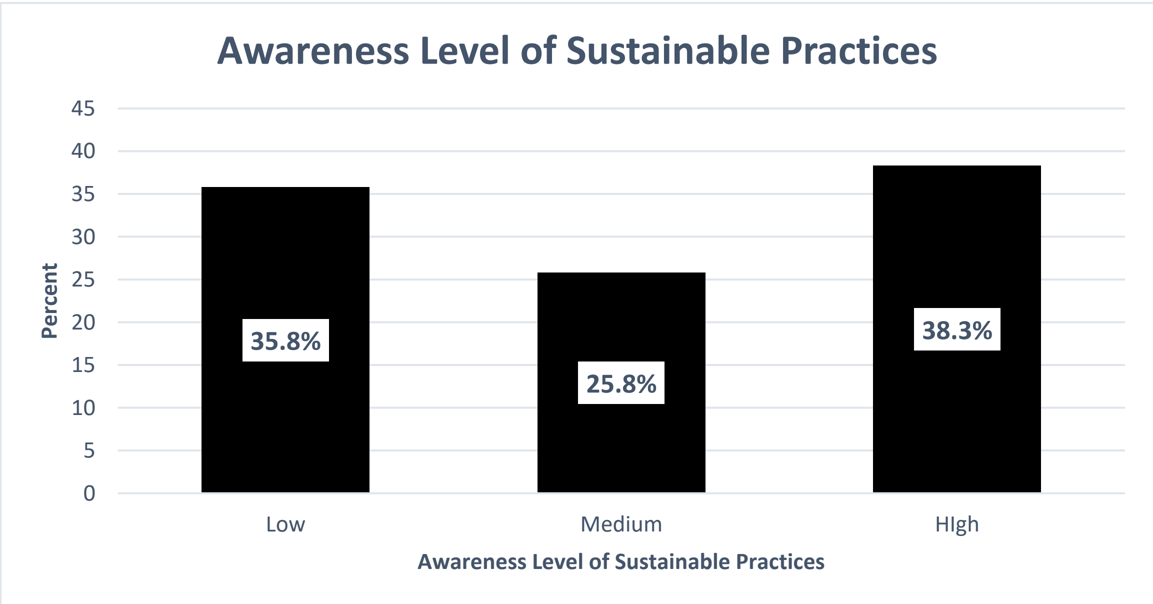

Figure 4. Awareness of Level of Sustainable Practice.

The chi-square test assessing the relationship between awareness levels and the perceived impact of barriers revealed no significant association ($p=0.327$).

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Table 2. Chi-square test between awareness Levels and perceived impact of barriers.

Variable	Barrier Impact rating	Frequency	Percent %	P value
Awareness levels of Sustainable Practices and Barriers impact rating	Low	43	35.8	
	Medium	31	25.8	
	High	46	38.3	
				0.327

4.1.4. Developing a Framework for Sustainable Urban Agriculture

Among the most commonly implemented sustainable practices are crop rotation (30%), conventional agriculture (35.8%), afforestation (22.5%), and conservation agriculture (11.7%). Conventional agriculture and crop rotation are the most widely adopted, while afforestation and conservation agriculture remain less popular.

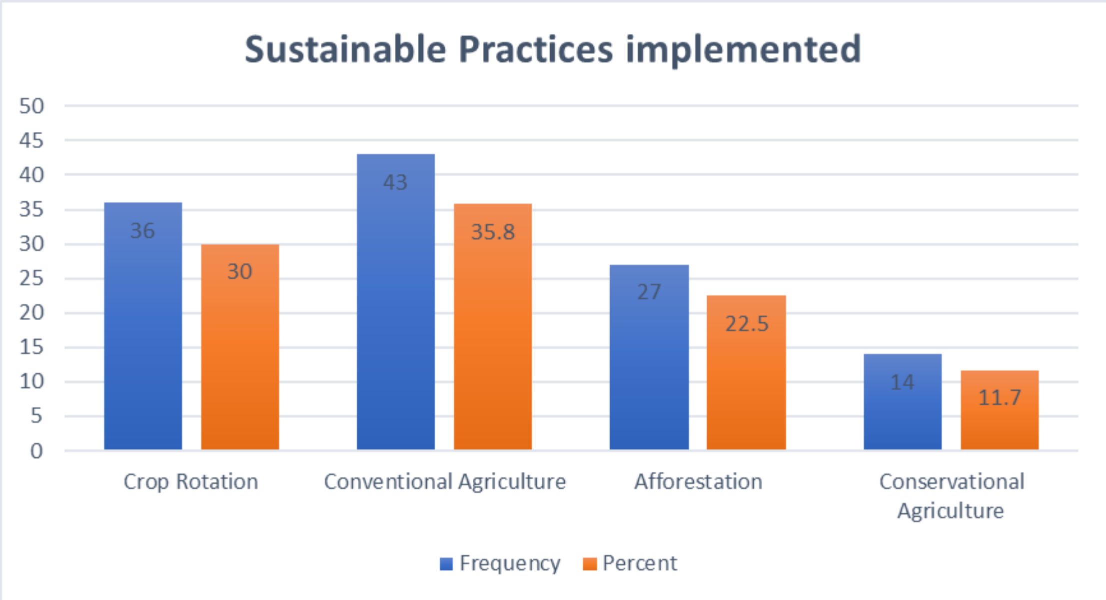

Figure 5. Sustainable practices implemented.

When it comes to recommended sustainable practices, respondents most frequently endorsed crop rotation (37%) and climate-smart agriculture (38%), while afforestation received a lower recommendation rate (25%). In terms of feasibility, crop rotation was considered the easiest practice to implement, with 42.2% of respondents rating it as "easy." On the other hand, climate-smart agriculture was viewed as the most difficult practice to implement, with 37.8% of respondents rating it as "difficult." Afforestation was more varied, with 36.7% rating it as "easy," 33.3% rating it as "moderate," and 30% rating it as "difficult."

Table 3. Recommended sustainable practices.

			Practice Feasibility Rating			Total
			Easy	Moderate	Difficult	
Recommended Strategy	Crop Rotation	Count	19	16	10	45
		% within Recommended Strategy	42.2%	35.6%	22.2%	100%

	Climate-smart Agriculture	Count	15	13	17	45
		% within Recommended Strategy	33.3%	28.9%	37.8%	100%
	Afforestation	Count	11	10	9	30
		% within Recommended Strategy	36.7%	33.3%	30.0%	100%
Total		Count	45	39	36	120
		% within Recommended Strategy	37.5%	32.5%	30.0%	100%

Support for implementing sustainable practices was also assessed, with respondents indicating that government subsidies and educational programs were the most needed types of support (29.2% and 25.56%, respectively). Community workshops, training, and water-saving technology were also noted as necessary support measures, with 25% and 20% of respondents citing them as important. Environmental benefits associated with each practice were explored, showing that crop rotation significantly contributed to soil fertility (31.1%), climate-smart agriculture aided in water conservation and reduced chemical runoff (24.4% and 31.1%, respectively), and afforestation positively impacted soil fertility (40%).

Table 4. Recommended Strategy Expected Environmental Benefit.

Recommended Strategy Expected Environmental Benefit Cross-tabulation							
			Expected Environmental Benefit				
			Soil Fertility	**Balanced Ecosystem**	**Water Conservation**	**Reduced Chemical Runoff**	Total
Recommended Strategy	Crop Rotation	Count	14	11	11	9	45
		% within Recommended Strategy	31.1%	24.4%	24.4%	20.0%	100.0%
	Climate-smart Agriculture	Count	10	10	11	14	45
		% within Recommended Strategy	22.2%	22.2%	24.4%	31.1%	100.0%
	Afforestation	Count	12	5	5	8	30
		% within Recommended Strategy	40.0%	16.7%	16.7%	26.7%	100.0%
Total		Count	36	26	27	31	120
		% within Recommended Strategy	30.0%	21.7%	22.5%	25.8%	100.0%

The regression results show significant relationships between the independent and dependent variables conflict type. Age has a statistically significant negative effect on conflict type (β= -0.0283, p< 0.001). For location, individuals in Section D (β=1.3799, p < 0.001) and Section G (β=1.6554, p< 0.001) are more likely to experience specific conflict types compared to those in Area A (reference category). Regarding sex, being male (β=0.2640) slightly increases the likelihood of certain conflict types, but the result is only marginally significant (p=0.062).

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Table 5. Regression results.

Variable		Coefficient	Standard Error	t-statistics	p-value
	Age	-0.0283***	0.0055	-5.14	0.0000
Location	Section D	1.3799***	0.16215	8.51	0.0000
	Section G	1.6554***	0.1876	8.83	0.0000
	Sex	0.2640*	0.1399	1.89	0.062
Constant		2.5147***	0.2492	10.09	0.000
F-statistic= 30.68,p-value=0.000; R-squared=0.5163; Adj. R-squared=0.4994***					

(*),(**) &(***) imply significance at 10%, 5% and 1% respectively. Source: Author's Calculation (2024).

Another regression model was run to assess the relationship between sustainable practices and soil fertility challenges. The analysis revealed that awareness of sustainable practices had a significant negative relationship with soil fertility challenges (*β= -0.430, p=0.002*). However, the implementation of sustainable practices and the overall awareness levels did not significantly impact soil fertility challenges (*β = -0.141, p =0.506; β = -0.047, p = 0.506*, respectively).

Table 6. Regression Results.

Variable	Coefficient	Standard Error	t-statistics	p-value
Awareness levels of sustainable practices	-0.430***	0.137	-3.138	0.002
Sustainable Practice awareness	-0.141	0.211	-0.667	0.506
Sustainable practices implemented	-0.047	0.087	-0.544	0.506
Constant	3.583***	0.472	7.585	0.000
F-statistic= 3.575, p-value=0.016; R-squared=0.085; Adj. R-squared=0.061***				

(*),(**) &(***) imply significance at 10%, 5% and 1% respectively. Source: Author's Calculation (2024).

The study also examined conflict-related variables and their impact on expected environmental benefits. The regression analysis found that both conflict impact rating (*β = 0.120, p < 0.001*) and the frequency of conflict (*β = 0.812, p < 0.001*) had significant positive associations with expected environmental benefits. However, conflict type did not significantly predict environmental outcomes (*β = -0.150, p = 0.310*).

Table 7. Regression Results.

Variable	Coefficient	Standard Error	t-statistics	p-value
Conflict Impact Rating	0.120***	0.028	4.286	0.0000
Frequency of conflict	0.812***	0.072	11.278	0.000
Conflict Type	-0.150	0.148	-1.014	0.310
Constant	1.450***	0.210	6.905	0.000
F-statistic= 63.003, p-value=0.000; R-squared=0.362; Adj. R-squared=0.36***				

(*),(**) &(***) imply significance at 10%, 5% and 1% respectively. Source: Author's Calculation (2024).

4.2. Qualitative Findings

The focus group analysis highlights key challenges and solutions for sustainable land management (SLM) practices in Kanakantapa Sections A, D, and G. A primary issue raised was the conflict between agricultural production and environmental conservation. Participants in Sections A and D viewed these goals as antagonistic, often resulting in environmental degradation such as deforestation and soil erosion. As one participant from Section A stated,

"We try to farm, but we know it is causing issues like deforestation and soil erosion."

Conversely, Section G emphasized the importance of balancing agricultural productivity with environmental health, recognizing that these objectives can be interdependent when managed correctly, with one participant noting,

"Agricultural production means using modern methods while protecting soil and water."

Water pollution emerged as a significant concern across all sections. The use of fertilizers and pesticides in farming was identified as a major contributor to pollution in local rivers, with participants expressing awareness of the environmental harm caused by runoff and livestock waste. One participant from Section D remarked,

"The waste from our livestock runs into the water, causing problems downstream."

However, the pressure to meet market demands often led to the continued use of these harmful chemicals, indicating a tension between environmental consciousness and economic necessities, as expressed by a participant in Section G:

"We know our waste runoff harms the water, but market demands force us to use more chemicals."

A lack of knowledge and training in sustainable farming practices was identified as a critical barrier in all sections. Although participants expressed an understanding of the importance of sustainability, the absence of proper training and resources hindered their ability to implement sustainable practices. Section A, in particular, called for more educational workshops to enhance knowledge on sustainable land management and improve practical application in farming. One participant in Section A highlighted,

"We don't know how to manage the land sustainably because there is no training or support."

Financial constraints were another significant barrier to the adoption of sustainable practices. High costs associated with equipment such as irrigation systems and soil conservation tools were frequently mentioned as prohibitive. Section G participants highlighted the difficulty in accessing financial support from banks, with one participant saying,

"Banks don't want to lend us money for sustainable farming equipment."

There was a strong consensus on the need for government subsidies or financial assistance to make sustainable farming more accessible.

In response to these challenges, participants emphasized the importance of community-based solutions. Section G highlighted the success of cooperative models, where farmers worked together to share the costs of sustainable farming equipment. One participant from Section G shared,

"Working together as a cooperative has helped us share the costs of sustainable farming equipment."

Sections A and D also advocated for community workshops, suggesting that NGOs should play a larger role in organizing educational sessions and funding initiatives to support sustainable practices.

Government support was another key theme. Participants across all sections called for subsidies to make sustainable farming inputs more affordable. Section A specifically requested government assistance with organic farming inputs, while Section G focused on policies that would protect urban farming spaces as cities expand. One Section A participant remarked,

"The government should provide cheap inputs and allow more control over crop prices."

There was a consensus that government intervention, particularly through financial aid and policy support, is crucial for the success of sustainable land management.

Additionally, Section G emphasized the role of market incentives in promoting sustainable agriculture. Participants noted that if urban farming practices were better supported through policies and market incentives, it would encourage more sustainable practices in the long term.

5. Discussion

5.1. Conflict Between Agriculture Production and Environmental Conservation

The findings reveal a persistent conflict between agricultural production and environmental conservation in Zambia, with unsustainable farming practices such as monoculture being the most prevalent issue. These practices deplete soil nutrients, contribute to deforestation, and exacerbate land degradation, highlighting the tension between maximizing agricultural productivity and preserving the environment. Interviews with farmers and extension officers further underscore the pressure to clear forests for agriculture, particularly through slash-and-burn techniques, which continue due to cultural practices and limited access to modern farming alternatives. This situation is compounded by a lack of awareness about sustainable practices, exacerbating the environmental impact.

The integration of Ecological Urbanism and Biophilic Design principles offers a holistic approach to addressing these conflicts. Ecological Urbanism advocates for systems that work with natural processes, promoting sustainable land-use strategies such as agroforestry, which can reduce deforestation and support both agricultural productivity and ecological health. Biophilic Design emphasizes reconnecting people with nature through community-led projects, such as afforestation and educational programs that highlight ecosystem services. These frameworks provide practical solutions to reconcile agricultural and environmental goals, fostering sustainable practices that benefit both communities and ecosystems.

Regression analysis revealed that demographic factors significantly influence the likelihood of conflicts between agriculture and conservation, with age and location playing key roles. Additionally, awareness of sustainable practices and access to education were associated with more sustainable farming practices. Higher education levels correlated with the adoption of climate-smart agriculture, while financial resources supported afforestation efforts. These findings underscore the importance of education and financial support in mitigating conflicts and promoting sustainable land management practices that balance agricultural needs with environmental preservation.

To resolve these conflicts, a multi-stakeholder approach is necessary, involving policymakers, local communities, and conservation organizations. Awareness campaigns, land-use regulations, and incentives for sustainable practices can help bridge the gap between agriculture and conservation. Additionally, culturally sensitive interventions, such as agro-tourism or urban gardens, can provide alternative income streams while fostering environmental stewardship. By embedding Ecological Urbanism and Biophilic Design into policy and practice, stakeholders can develop innovative strategies that promote food security and environmental sustainability, ensuring that future development is both resilient and inclusive.

5.2. Factors Affecting Sustainable Land Development

The study identifies several barriers to sustainable land development, with financial constraints being the most significant challenge for 35% of respondents. Limited financial resources prevent farmers from acquiring environmentally friendly technologies or accessing necessary training programs. This aligns with research by Mariyono (2019), which emphasizes the role of microfinance in enabling smallholder farmers to adopt sustainable practices by alleviating resource constraints. Financial barriers remain a major hindrance to the widespread adoption of sustainable agriculture in resource-constrained settings.

Inadequate knowledge and poor extension services also emerge as key challenges, with 30% and 15.8% of respondents highlighting these issues, respectively. The lack of adequate information about sustainable farming practices and weak advisory systems leave farmers ill-equipped to implement effective techniques. Zaharia et al. (2021) stress the importance of robust agricultural extension services to bridge this knowledge gap. Addressing these challenges requires improving the capacity and reach of extension services, which could play a pivotal role in helping farmers navigate sustainability-related challenges.

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A significant barrier noted by 14.2% of respondents is the high labor demand associated with many sustainable farming practices. Methods such as conservation tillage and agroforestry are seen as labor-intensive, deterring adoption, especially among resource-limited or aging farming communities. This challenge is consistent with findings from Whitcraft et al. (2019), which highlighted the physical effort required for sustainable practices. Introducing mechanized or technology-driven solutions could alleviate the labor burden and make these practices more accessible to a wider range of farmers.

To effectively address these barriers, the study suggests innovative solutions, including public-private partnerships (PPPs) to mobilize resources and provide technical support. Digital tools for knowledge dissemination, such as mobile apps and SMS-based services, also offer promising solutions for improving access to information. Studies like those by Mapiye et al. (2023) demonstrate the positive impact of mobile-based advisory tools on productivity in Sub-Saharan Africa. A holistic approach, combining financial incentives, mechanization subsidies, and digital literacy programs, is essential for overcoming the barriers to sustainable land development and ensuring a sustainable agricultural future.

5.3. Proposed Framework

The proposed Environmental Conservation Framework for Sustainable Urban Agriculture Land Use Planning integrates financial, technological, and institutional interventions to promote sustainable practices and minimize land degradation. It emphasizes the importance of financial resources and incentives, particularly through public-private partnerships (PPPs) that mobilize investments and foster collaboration. The framework also highlights microfinance for green technologies and subsidies for sustainable construction practices, which help reduce the financial burden on construction managers, farmers and stakeholders transitioning to environmentally friendly agricultural methods.

A key component of the framework is capacity development, which ensures stakeholders acquire the necessary knowledge and skills for sustainable land use planning. This includes training in sustainable agriculture practices and certification programs, promoting Climate-Smart Agriculture (CSA), and incorporating smart climate solutions like precision farming and sustainable soil management. These initiatives aim to enhance agricultural productivity while mitigating environmental impacts, encouraging farmers to adopt innovative techniques and climate-resilient crops.

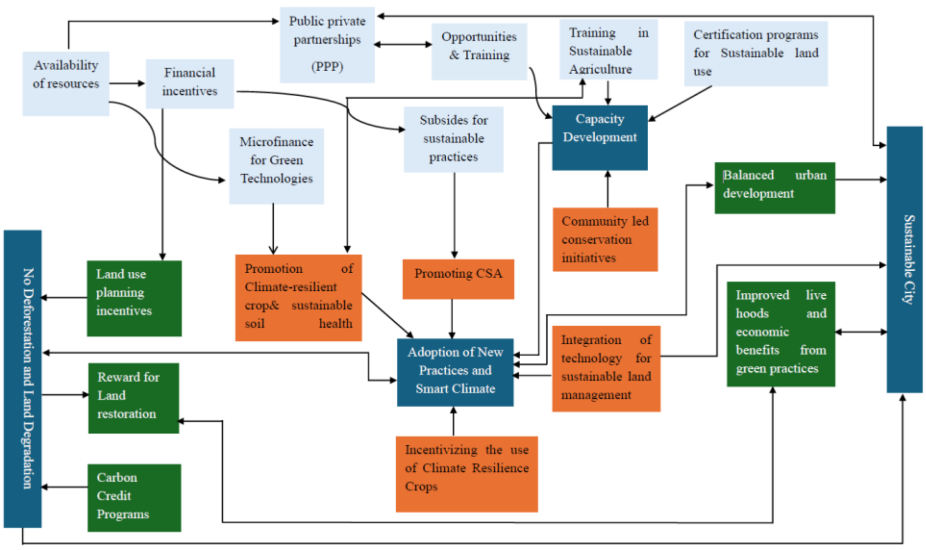

Figure 6. Environmental Conservation Framework for Sustainable Urban Agriculture Land Use Planning.

5.3.1. Availability of Resources and Financial Incentives

The importance of financial resources and incentives becomes paramount in promoting sustainable building practices. Public-private partnerships (PPP) are essential in fostering investments for green infrastructure and encouraging the adoption of eco-friendly construction methods. Financial incentives, such as grants, tax rebates, and low-interest loans for sustainable building technologies, can support the development of energy-efficient, climate-resilient structures. Additionally, offering microfinance options for green technologies provides financial assistance to construction companies seeking to incorporate renewable energy systems, waste management practices, and other sustainable innovations. These financial tools help reduce the financial risks associated with adopting sustainable practices and foster long-term investment in sustainable construction.

5.3.2. Capacity Development and Sustainable Practices

Capacity development plays a crucial role in ensuring that construction professionals acquire the necessary skills and knowledge to implement sustainable building practices. Training programs in green construction, sustainable materials, and energy-efficient design are vital for upskilling workers, architects, and engineers. Certification programs that recognize expertise in sustainable construction practices, such as Leadership in Energy and Environmental Design (LEED), can further incentivize professionals to pursue best practices. This capacity-building process also facilitates the integration of innovative technologies like Building Information Modeling (BIM) to design energy-efficient buildings and smart construction solutions. As sustainability becomes a central focus, the construction industry must embrace Climate-Smart Construction (CSC) that incorporates renewable energy sources, sustainable waste management, and resilient building techniques.

5.3.3. No Deforestation and Land Degradation

Preventing environmental degradation is a key element of sustainable construction management. The framework incorporates policies and incentives that promote responsible land use in the construction industry. These include land-use planning regulations that encourage developers to minimize the environmental impact of their projects. Furthermore, construction companies can be rewarded for implementing land restoration and conservation practices on construction sites. For example, developers who engage in the rehabilitation of brownfield sites or employ eco-friendly land reclamation techniques may qualify for tax incentives or environmental credits. Additionally, integrating green infrastructure such as green roofs, permeable pavements, and urban forests can mitigate the impact of construction on the surrounding environment, prevent land degradation, and promote biodiversity.

5.3.4. Promoting Climate-Resilient Buildings

The construction framework emphasizes the importance of designing buildings that are resilient to climate change. This includes promoting the use of climate-resilient building materials, such as those that are energy-efficient, fire-resistant, and resistant to flooding or extreme weather. Financial and technical support should be provided to construction firms to adopt materials that reduce carbon footprints, such as recycled steel, bamboo, and sustainably sourced wood. Encouraging the use of climate-resilient buildings can also include policies that prioritize the construction of structures that are capable of withstanding the impacts of climate change, such as storms, heatwaves, and rising sea levels. Resilient buildings not only ensure safety and long-term viability but also contribute to reducing the overall carbon footprint of urban areas.

5.3.5. Integration of Technology and Community Engagement

In construction management, the integration of technology plays a pivotal role in enhancing sustainability. The use of digital tools such as BIM, energy simulation software, and project management systems can optimize resource allocation, minimize waste, and ensure better sustainability outcomes. Technologies like 3D printing for construction materials, drone technology for monitoring construction sites, and automated machinery for more efficient construction processes are essential for reducing environmental impact. Furthermore, community engagement is crucial for ensuring that local perspectives are considered in the planning and design of construction projects. By involving local communities in the decision-making process, construction companies can ensure that their projects align with local environmental needs and foster support for sustainability efforts.

5.3.6. Environmental Conservation and Urban Development

Sustainable construction practices must be integrated with urban development strategies to create balanced and eco-friendly cities. This involves designing buildings that contribute to the overall sustainability of the urban environment by providing green spaces, reducing energy consumption, and enhancing waste management. By incorporating renewable energy solutions such as solar panels, green roofs, and rainwater harvesting systems, construction projects can contribute to the resilience of urban areas against climate change. Sustainable urban development also involves creating smart cities that use technology to improve energy efficiency, reduce pollution, and enhance the quality of life for residents. In this way, construction management can align with broader environmental conservation goals, supporting economic growth while maintaining ecological integrity.

6. Conclusion

This study developed an environmental conservation framework for sustainable land use planning integration of agriculture in Zambia, addressing key challenges such as deforestation, resource competition, and land degradation. These challenges persist due to traditional farming practices, policy gaps, and limited access to sustainable alternatives, emphasizing the need for a structured intervention. The proposed framework incorporates awareness and education, financial and policy incentives, capacity-building initiatives, and climate-smart agricultural practices. These components work together to promote sustainable land use, food security, and environmental conservation. By integrating ecological principles and data-driven decision-making, the framework supports farmer resilience, improved land productivity, and reduced environmental degradation.

Findings from this study also highlight the role of demographic and resource-based factors, such as age, education, and financial resources, in influencing the adoption of sustainable techniques like afforestation and climate-smart agriculture.

Balancing agriculture and environmental priorities requires a paradigm shift that integrates policy reforms, financial mechanisms, and capacity-building initiatives. By implementing a holistic, multi-sectoral approach, stakeholders can enhance sustainability, mitigate land-use conflicts, and drive long-term environmental and development goals in Zambia.

7. Recommendations

7.1. Future Research Areas

Further studies should explore the role of artificial intelligence (AI) in sustainable agriculture, particularly in precision farming, automated irrigation, climate adaptation strategies, and soil health monitoring. AI-driven solutions can improve resource efficiency and support data-driven land management decisions.

7.2. Policy and Financial Support

The government and policymakers should establish financial incentives, microfinance schemes, and tax breaks to encourage farmers to adopt sustainable land-use practices. Public-private partnerships should also be strengthened to support funding for climate-resilient agriculture.

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7.3. Stakeholder Collaboration

Sustainable agriculture requires continuous engagement among farmers, policymakers, researchers, NGOs, and private sector actors. A multi-sectoral approach should be promoted to ensure long-term success, with periodic policy reviews to adapt to emerging challenges and opportunities.

7.4. Capacity Building and Awareness

Education and training programs should be expanded to include school-based agricultural education, farmer-led initiatives, and community-based conservation programs. Integrating sustainable agriculture into national education curricula can foster early awareness and long-term adoption of eco-friendly practices.

7.5. Technological Integration and Monitoring

The use of GIS, remote sensing, and precision agriculture should be prioritized for monitoring land-use changes, tracking environmental impacts, and optimizing resource allocation. Data-driven insights can enhance sustainability efforts and guide policy interventions.

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