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Social and Political Determinants of Natural Resource Use in Liuwa Plain National Park and Simalaha Community Conservancy, Western Zambia

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Abstract

Natural resources (e.g., forest, fisheries and wildlife) play a key role in rural livelihoods and national development; however, the social and political drivers of their use remain poorly documented, particularly in remote ecosystems. This study examines these determinants in western Zambia, comparing Liuwa Plain National Park (multi-stakeholder management) and Simalaha Community Conservancy (community-based management). We hypothesized that local social and political factors significantly influence resource-use behavior. In this study, cross-sectional data (which is not ideal for causal relationships) was collected through a mixed research framework by employing household surveys (n = 758), semi-structured interviews (n = 12), and focus group discussions (n = 6) and analyzed using binary logistic regression within a frequentist framework. Results revealed site-specific social determinants of participation, which was significant at both sites, while networking, technology, and collective action were significant only in Liuwa, and cooperation and trust only in Simalaha. Political determinants also diverged: land tenure and resource monitoring were shared across sites, while exclusion shaped Liuwa and power relations influenced Simalaha. The presence of shared determinants suggests opportunities for harmonized policy approaches, whereas site-specific factors necessitate targeted interventions. We conclude that sustainable resource management and conservation planning must explicitly integrate these key social and political determinants, tailored to the prevailing governance regime, to enhance rural entrepreneurship and long-term ecological sustainability.

Keywords: traditional ecological knowledge; social capital; resource management; local communities; power relations; resource actors

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1. Introduction

In sub-Saharan Africa, natural resources, such as forests, fisheries and wildlife, have declined largely due to overharvesting and inadequate capacity by government agencies to manage these resources [1,2]. Sustainable management of natural resources requires

effective social–ecological systems. However, these systems are characterized by various governance issues, including weak policies, scarce resources, and the existence of communities under destructive social and political hegemonies [3,4]. Over 70% of the environmental degradation in Africa is attributed to social and political anthropogenic elements, such as agricultural expansions, high poverty levels and uncoordinated governance systems [5]. Africa is a natural resource degradation hotspot, with countries such as Zambia losing between 250,000 and 300,000 ha of forest per annum [6] and currently retaining only 10% of the original and potential wildlife stocks [1,6]. The sustainability of natural capital in these areas is highly influenced by social–ecological systems (SESs).

A social–ecological system refers to an integrated and complex system that identifies robust interdependence between local communities and ecosystems [7]. The implications and relevance of considering the social, political, and ecological dimensions in natural resource use are that anthropogenic actions and natural resource systems are highly interconnected and need integrated and cohesive models to address complex challenges, such as resource degradation, climate change, and growing demographic factors such as human population increase [8]. Social–ecological systems also help to identify the sustainable natural resource use synergies that improve rural livelihoods in remote ecosystems. The global demand for natural resource utilization translates into the need for ecosystem resilience as human society interacts with complex ecological systems in contested landscapes [9]. This study aligns with social exchange theory, which highlights how individuals engage in social interactions/networks to maximize bundles of benefits and minimize the associated costs [10]. It also resonates well with the theory of power, which includes how power operates within social and political systems, its sources and impacts, and how it is exercised and controlled [11].

This study draws on social exchange theory and the theory of power to guide both variable selection and questionnaire design. Social exchange theory explains how cooperation, reciprocity, and mutual benefit shape decisions about resource use and benefit sharing among actors, while the theory of power highlights how differences in influence and bargaining strength determine who gains access, control, and authority over resources and who may be marginalized [10,11]. Together, these frameworks provide a lens for examining the structural and relational conditions, such as trust, power asymmetries, and negotiation processes, that shape outcomes in complex social–ecological systems [9]. To reflect this, the questionnaire was designed to capture key constructs from both theories, including levels of trust, power relations, social networks, and institutional arrangements. This integrated approach enables a systematic analysis of how different governance regimes, whether multi-stakeholder or community-based, influence resource use and benefit distribution in the study landscapes [12].

The sustainable governance of common-pool resources (CPRs) is influenced by interconnected social and political determinants that are explained through complementary theoretical frameworks [3,7,12]. Social exchange theory highlights the importance of communication, information sharing, reciprocity, age, and education in fostering cooperation and collective action [7,8,12], while Traditional Ecological Knowledge (TEK) emphasizes the value of cultural diversity and gender in contributing place-based ecological knowledge for sustainable resource stewardship. Power Theory explains how leadership, power relations, exclusion, and community institutions shape governance outcomes, whereas the social–ecological system (SES) framework [11,13, 14], together with TEK, underscores the importance of adaptive management, secure resource rights, equitable participation, and locally appropriate institutions. Collectively, these frameworks demonstrate that inclusive participation, effective institutions, and the integration of scientific and local knowledge are fundamental to the long-term sustainability and resilience of

common-pool resource governance (see the Supplementary Materials for summarized linkages between theories and factors).

The decentralization of resource use and management entails devolution of power, authority and rights to local communities to govern natural resources, especially in remote landscapes [13]. Moreover, Pailler et al. [14] report that sustainable natural resource use could be influenced by democratic devolution of natural resource governance to local institutions in order to enrich stewardship and access to benefits accrued from resource utilization. The empirical research also shows that in many African countries, inadequate devolution of resource management rights to local actors has weakened resource governance and undermined community-based natural resource management (CBNRM) strategies, which promote community participation [15,16]. Recent empirical research in Tanzania shows that recentralization negates the past efforts of decentralization in resource management [17]. In addition, the integration of Traditional Ecological Knowledge (TEK) involves the use of taboos, beliefs, myths and traditional restrictions anchored on natural resource use [18]. The application of TEK is a robust strategy to complement empirical/scientific knowledge in the utilization and sustainable conservation of natural resources. The literature shows that effective ecological restoration outcomes require active local community participation to enhance resource management and utilization [13-16].

Management and utilization of natural resources are anchored on both social and political determinants [17,19]. These determinants of resource use entail social and political dynamics that influence how natural resources are accessed and utilized by the resource actors/users [20,21]. Resource use in this context refers to human access, and utilization of natural resources (forests, fisheries and wildlife) [21]. The social capital refers to social factors that influence how the state or local community, or Non-Governmental Organizations (NGOs), manage and utilize its natural resources (e.g., cooperation, trust, reciprocity, and quality of communication) [22]. Other social factors may include demographic factors, such as age, occupation, employment, gender and upsurge of human population in protected areas, leading to high demand for resource and human encroachment [22,23]. Additionally, elements of social–cultural norms may also be determinants of natural resource use [24]. Political capital refers to political dynamics that shape and influence how the state, local community or NGOs manages and utilizes its natural resources [25,26]. The political determinants may include power relations, decision-making rights, governance structures, by-laws, national legislation and policies [19,27]. The application of resource property rights and its attendant land tenure have an impact on resource utilization [28]. Elements of resource ownership, control, access, inadequate land use plan and ownership transfer determine the management and rate of resource utilization [21]. Ultimately, the rights to and benefits from natural resources can form the nexus to resource use and management and be actualized through collective action. All these are part of the social and political determinants of natural resource utilization co-occurring in a complex social–ecological system [29,30].

Like many countries in sub-Saharan Africa, Zambia has implemented policies, laws and regulations to govern natural resource management and utilization, yet enforcement of these legislations remains flawed [21,31]. During the pre-colonial era, traditional leaders governed natural resources in Zambia using traditional rules and regulations devised to manage and regulate resource utilization [6]. The application of indigenous knowledge, norms and beliefs served as control mechanisms for management and sustainable use of natural resources. The governance systems of natural resources changed when the colonial government usurped power from traditional leaders [6]. For successful management of the available resources, users ought to be well defined and their rights and conservation obligations well devolved in line with their interests and influences [20,22]. Failure to regulate natural resource use may result in degradation of the natural resources, commonly

known as the "tragedy of the commons" [32–34]. Thus, effective resource management requires strong collective action by resource users to ensure sustainable natural resource management and utilization.

Liuwa National Park is a state protected area managed through a shared governance multi-partner conservation approach which has integrated multiple resource actors according to their interests and expertise [12,35]. On the other hand, Simalaha, the second area of interest, is a private community-driven conservation area in a customary land governed by indigenous peoples and local communities in which the local community is the main resource actor [13,29,36]. Nyirenda and Nkhata [37] indicated that in both sites, traditional leadership which is largely guided by TEK is key in the management of resources. Additionally, the government is the principal resource actor in the management of Liuwa Plain National Park because it is state land, where as in Simalaha the government is not a partner or signatory in the management of the conservancy and only provides oversight/technical expertise when need arises. The establishment of Liuwa plains national park is backed by Zambia Wildlife Act No. 14 of 2015, whilst the establishment of Simalaha lacks legal backing in Zambia. Hence, certain conservation decisions are made in an ad hoc approach leading to conservation and resource utilization gaps [15,30,38].

The social and political determinants of natural resource use in Zambia, as in many countries across Southern and Eastern Africa, remain insufficiently understood because they have received limited empirical attention [35]. Existing studies from Zambia and the wider region have predominantly examined collaborative governance, community participation, benefit sharing, human–wildlife conflict, and general protected area management, demonstrating that these factors contribute to conservation outcomes [19,22,36]. While these studies provide valuable insights into institutional arrangements and community-based natural resource management, they largely examine governance components in isolation and do not systematically evaluate the broader social and political determinants that collectively influence sustainable resource use. Consequently, there is limited empirical evidence comparing the relative influence of social factors, such as communication, social networks, reciprocity, and demographic characteristics, alongside political factors, including leadership, power relations, exclusion, land tenure, and resource-use rights, within Zambian protected landscapes.

This study addresses this important local knowledge gap by providing a comprehensive assessment of the social and political determinants of resource use in the Liuwa Plain National Park and Simalaha Community Conservancy. Its novelty lies not only in integrating these determinants within a single analytical framework but also in generating empirical evidence from two contrasting conservation landscapes, thereby advancing understanding of the governance mechanisms that shape sustainable resource use in Zambia. The findings contribute to the local and regional literature on natural resource governance and protected area management and provide evidence to support policymakers and other stakeholders in designing context-specific governance frameworks, policies, and legislation that strengthen sustainable natural resource management while improving the livelihoods and resilience of local communities.

2. Materials and Methods

2.1. Study Sites

This study was conducted in Liuwa and Simalaha in western Zambia (Figure 1). The rationale of conducting the study in both Liuwa and Simalaha is that these two landscapes are anchored on different management models and unique natural resource experiences [37,38]. The Liuwa Plain NP conservation model contributes threefold, where the state-centric natural asset, the park, is managed in a tripartite governance system by the government through the Department of National Parks and Wildlife (DNPW), with the

participation of the private-sector African Parks (AP) and the local community legally settled in the park and represented by Barotse Royal Establishment (BRE). In this management partnership, local communities are availed greater participation in natural resource management, and the accrued benefits from resource use are shared with them [37]. Conversely, the SCC model contributes twofold, where a community-driven conservation area established under local traditional leadership integrates the local community at the center of resource conservation through a trust and is partnered with the Peace Parks Foundation (PPF) to improve resource protection and enhance rural livelihoods in the remote social–ecological system [38,39]. Moreover, both landscapes are associated with communities characterized with high poverty levels of about 78.6%, putting pressure on natural resources [40]. As such, critical analysis and comparisons of social and political determinants of resource use and how these factors influence resource use and management are essential in informing effective management and resource utilization [5,21].

2.1.1. Liuwa Plain National Park Landscape

Liuwa, located in western Zambia, comprises Liuwa Plain NP and the Upper West Zambezi Game Management Area, GMA (Figure 1). Covering approximately 3660 km^2 and 38,070 km^2, respectively, this area features a unique landscape with Kalahari sands and alluvium deposits [41,42]. The landscape experiences three distinct seasons: hot-wet, hot-dry and cold-dry seasons. It annually receives 800–1000 mm of precipitation and has a mean temperature of 21 °C. Humans co-exist with wildlife, with around 34,033 inhabitants in 432 villages practicing fishing and mixed farming [37]. Notably, Liuwa Plain NP is one of Zambia's few national parks allowing human settlements in it. It is renowned for its seasonal blue wildebeest migration between Zambia and Angola, with an estimated population of 45,000 blue wildebeest, and provides a sanctuary for 357 bird species [42].

The Liuwa Plain National Park (LPNP) is in category (ii) of the IUCN protected areas and was a hunting ground for King Litunga of Barotseland until the government of Zambia took over the management mandate of natural resources from Barotse Royal Establishment (BRE) through a legal statute (Statutory Instrument) when the park was established in 1972 [42]. However, the combination of inadequate state funding and alarming levels of poaching escalated by the civil war in the neighboring Angola in the 1980s contributed to the formation of a shared governance system through multiple partnerships anchored on the decentralization policies for rural development and poverty alleviation. Therefore, in 2004, a multi-partner governance represented by a partnership board was established between the DNPW, as the government conservation agency, the African Parks Foundation (SAPF), being a private partner, and the Barotse Royal Establishment, representing the local communities to manage the common property resources in LPNP. LPNP hosts the second largest blue wildebeest migration between Zambia and Angola; as such, the management team of the LPNP Partnership Board leveraged knowledge from experiences from other national parks and designed an incentive-based adaptive management strategy to resuscitate management of four key pillars: (i) park law enforcement/resource protection; (ii) community relations; (iii) tourism development, and (iv) infrastructure development [41,42].

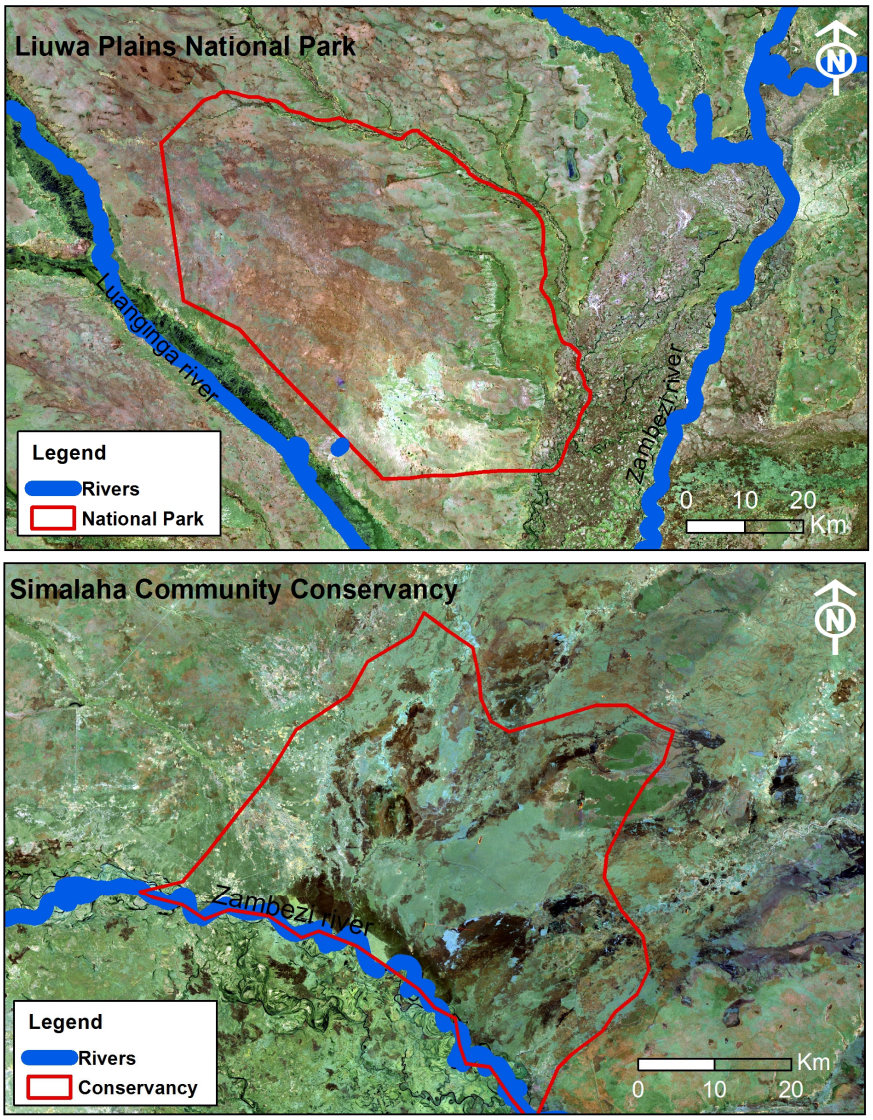


Figure 1. Liuwa and Simalaha landscapes in western Zambia on a Landsat basemap. The Liuwa landscape includes the Liuwa Plain National Park and the West Zambezi GMA, while Simalaha Community Conservancy is close to the Zambezi River.

2.1.2. Simalaha Community Conservancy Landscape

SCC is Zambia's community-driven conservation area, covering 180,000 ha (Figure 1). Established in 2012, it aims to conserve wildlife and improve rural livelihoods [43]. The area is part of the Kavango Zambezi Transfrontier Conservation Area (KAZA-TFCA) and connects wildlife corridors between Angola, Botswana, Namibia, Zambia and Zimbabwe. It is inhabited by 548 villages and about 40,418 people and has infertile soils, mopane vegetation, and semi-arid plains [38]. It receives 400–700 mm of annual rainfall, making it unsuitable for much arable farming but suitable for livestock and wildlife [44]. Currently, the area is home to over 1600 animals of 13 large mammal species, including red lechwe, buffalo, sable antelope, and eland [38].

2.2. Sampling Design

To assess social and political determinants of resource use and how these factors have influenced resource management and use in the past and present, a household survey was conducted in 10 Village Action Groups (VAGs) (5 from each study area) with a target sample size of 708 households, 95% confidence level and 5% margin of error [45]. The

rational of choosing 10 VAGs out 20 VAGs was that we considered the geographical vastness of the two study areas, endowed with abundant sand and waterlogged, making it difficult to conduct the survey in all the VAGs. Second, the 20 VAGs (10 VAGs per each study site) share similar social–ecological characteristics such as resource distribution, livelihoods and resource governance patterns, justifying the need for multi-stage random sampling of the 10 VAGs used in other studies [45,46]. The VAG registers were used as sampling frames and household heads as sampling units (Tables 1 and 2).

Table 1. Number of households (HH) and sample size for Liuwa Plain National Park landscape.

	Liuwa Ecosystem *n*= 4846; Sample Size *n* = 370; Actual *n* = 385					
VAG/Stratum	**Liuwa**	**Lumei**	**Mulinga**	**Luola**	**Mishulundu**	**Total**
No. of HH in VAG (Nh)	337	1350	1400	641	1118	4846
Sample size (nh)	26	103	106	49	86	370
Actual no. of households interviewed/surveyed	31	104	109	51	90	385

Table 2. Number of households (HH) and sample size for Simalaha Community Conservancy landscape.

	Simalaha Ecosystem *n* = 2196; Sample Size *n* = 338; Actual *n* = 373					
VAG/Stratum	**Simalaha**	**Kakulwani**	**Makanga**	**Mabumbu**	**Sankolonga**	**Total**
No. of HH in VAG (Nh)	28	674	305	738	451	2196
Sample size (nh)	4	104	47	114	69	338
Actual no. of households interviewed/surveyed	16	113	55	117	72	373

The household survey sample size (n) was determined using Yamane's formula with a 95% level of significance and a margin of error (e) of 5% [43,45]. Proportionate stratified sampling was used to determine the sample size for each stratum. The strata were defined by villages, referred to as Village Action Groups (VAGs). Sample sizes for each stratum were calculated using Equation (1) and were proportionate to the total number of households in each village (see Table 1). Households to be interviewed were then selected using a random number table.

$$\boldsymbol{n} = \frac{\boldsymbol{N}}{\boldsymbol{1 + N(e)^2}} \quad (1)$$

$$\boldsymbol{ni} = \left(\frac{\boldsymbol{Ni}}{\boldsymbol{N}}\right)\boldsymbol{x}\,\boldsymbol{n} \quad (2)$$

where n is the required sample size, ni is the sample size for a specific stratum, Ni is the population size of that stratum, N is the total population size, and e is the margin of error.

In addition, 14 key informants participated in the study, and six focus group discussions (FGDs) were organized, leveraging the concept of saturation in qualitative research [47]. Data saturation was confirmed collaboratively by two independent coders throughout the analysis process. Saturation was determined when no new codes or themes emerged from consecutive transcripts, with both coders agreeing on this endpoint. Quantitatively, the inter-coder reliability was substantial with a Kappa score of 0.92 (i.e., 92% agreement) based on 75% of the questionnaires. The focus group discussants validated the responses derived from the household survey respondents and were able to construct their own interpretations to strengthen the inadequate explanatory power of semi-structured questions administered on household survey respondents and gain in-depth insight

of social and political facets of resource use [48]. The Supplementary Materials show methodological process and key informants and participants of focus group discussions.

2.3. Data Collection

Data collection was conducted in November 2024. With the help of six trained field research assistants, semi-structured questionnaires (Supplementary Materials) were administered using the Kobo Collect ToolBox (https://www.kobotoolbox.org/), an open-source application. A total of 758 household survey respondents (385 for Liuwa Plain NP, and 373 for SCC) were administered. This number is relatively higher than the target 708 sample size since many respondents volunteered to participate. Ostrom [20] and Noel [34] indicated that the potential data collected on social dynamics of resource use include trust levels, cooperation, commitment, participation, information sharing, social networking, and cultural diversity by resource actors. The data collected on political factors that have the potential to influence resource utilization include power relations, land tenure, benefit sharing, management, leadership, resource monitoring and graduating sanctions. We also employed a 5-point Likert scale (1 = Low, 5 = High) to score selected questions during household interviews. To attain data reliability, the research questions on the questionnaire and interview guide were clearly stipulated, and a pre-testing of the research data collection tools was conducted on 50 households that were not part of the final survey; as such, necessary adjustments were made [17]. The validity of data was achieved through triangulation and by linking research questions to specific research objectives [49,50]. Lozi ethnic language was used by the research assistants during data collection. Prior to questionnaire administration, free, prior and informed consent was sought from respondents. Only respondents of 18 years and above who stayed in the study areas for at least 5 years were involved in the survey. A 5-point Likert scale was used to gauge and value the participants' responses [47]. For example, 1: Disagree strongly, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree.

At most, 40 min was spent to complete each household survey. The data on policies, legislation, property rights, resource governance, traditional norms, and social capital levels were collected from 14 key informants and six FGDs using in-depth semi-structured interviews/an interview schedule as organized by [43,48]. The FGDs also triangulated and validated the data collected from the household survey respondents. This in turn enhanced the understanding of various themes and concepts on the social and political determinants of resource use and the effects of these factors on the past, present, and future of management of natural resources [51].

2.4. Data Analysis

The quantitative data were analyzed using frequentist approaches in Statistical Package for Social Sciences (SPSS) version 23, suggested by [51,52], and binary logistic regression in R-statistical software (2024 version 4.4.0) [53]. The probabilistic output, high interpretability, computational efficiency, resistance to overfitting and lack of strict distribution assumptions compared to other models such as linear regression were the major the reasons for model selection and adaptability advantages of binary logistic based on the characteristics of the binary dependent variable in this study. As such, the use of binary logistic regression was adopted as a standard choice since the dependent variable (resource use outcome) was dichotomous and coded as 0 for unsustainable resource use or 1 sustainable resource use. For the response variables, we used a self-assessment approach supported by follow-up questions to assist respondents in selecting the most appropriate responses.

The potential explanatory variables as social determinants of resource use included trust, commitment, information sharing, communication, participation, cooperation, collective action choice, cultural diversity, age, gender, and location, whilst the political

determinants of resource use included power relations, management, exclusion, boundary, resource use rights, monitoring, leadership, community constitution, alienation, and land tenure. These potential social and political determinants of resource use were first subjected to Cronbach's alpha analysis to measure the internal consistency and reliability of the variables as a selection criterion. To warrant further analysis, variables had to bear internal consistency and reliability higher than the recommended 0.70 [54]. Cronbach's alpha for key social determinants of resource use in SCC was 0.901, indicating a higher level of internal consistency and reliability for the scale with this study sample (Supplementary Materials). Similarly, Cronbach's alpha for key political determinants of resource use in SCC was 0.792. In Liuwa Plain NP, Cronbach's alpha for social determinants of resource use was 0.802, while for political determinants of resource use, Cronbach's alpha was 0.731. For the Likert Scale, their corresponding numerical scores were 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

The binary logistic values 0 or 1 were assigned to the dependent/response variable of resource use outcome (i.e., sustainable natural resource utilization or unsustainable resource). To examine for multicollinearity, if certain independent variables correlated and negatively influenced the effects of other explanatory variables in a cause–effect setting, variance inflated factors (VIF) were calculated by regressing resource use as a response variable on possible explanatory variables. A threshold of VIF ≥ 5 was used to flag unacceptable multicollinearity. All variables were below this threshold. By convention, VIF > 10 indicates severe multicollinearity and VIF > 5 indicates moderate multicollinearity. The *faraway* package in R (2024 version 4.4.0) was used for VIFs, while *DescTools* and *manipulate* packages were applied for binary logistic regression [55] for social and political determinants of resource use in Liuwa Plain National Park and Simalaha Community Conservancy, western Zambia, in 2024. As part of the binary logistic regression analysis, several models were developed to examine the effects of potential confounding variables, including income level, resource dependence, length of residence, and ethnicity. After comparing model performance and interpretability, a pooled model incorporating all confounding variables was selected because it provided a more comprehensive assessment of the determinants of resource use and captured the combined influence of these factors.

Thematic content analysis was applied in identifying, describing, and reporting patterns of key social and political themes influencing natural resource use and management, based on the experiences and realities of various research respondents, and to ensure objective evaluation of the research outcome as suggested by [56]. Hence, the emerging themes on social dynamics and political ideologies in resource management in the past and present times were synthesized and conceptualized using thematic content analysis [57]. Scoring and selection of the factors was based on the literature and expert knowledge. The expert interviews and the cross-sectional data from participants assisted in scoring the different factors.

3. Results

3.1. Demographic Characteristics

A total of 758 household survey respondents were interviewed; of these, 385 were from Liuwa Plain NP and 373 were from SCC. In Liuwa Plain NP, 53% (n = 203) household survey respondents were male, while 47% (n = 182) were female, of which 54% (n = 208) of the respondents were married. Of these respondents, 56% (n = 212) of household survey respondents attained primary education. Similarly, in Simalaha, 51% (n = 189) of household survey respondents were male, while 49% (n = 184) female. A total of 60% (n = 224) of respondents were married. A total of 57% (n = 212) of household survey respondents attained primary education. In both Liuwa Plain NP and SCC, > 60% of families ranged between 5 and 8 members, and most of them had stayed in the study sites for more than

5 years and were above the age of 18 years. Most of the participants (90%) were Lozi-speaking people, while Mbunda, Tonga, Kaonde, Luvale, Chewa and Bemba were the minority respondents (Table 3).

Table 3. Characteristics of the local household survey respondents in Liuwa Plain National Park and Simalaha Community Conservancy, western Zambia, 2024. The percentages (%) are indicated in brackets.

Characteristic	Category	Liuwa Plain NP	SCC	Combined
Household head Gender	Male	200 (52)	193 (52)	393 (52)
	Female	185 (48)	180 (48)	365 (48)
Age group	15–20	5 (1)	7 (2)	12 (1)
	21–30	20 (5)	30 (8)	50 (6)
	31–40	50 (13)	65 (17)	115 (16)
	41–50	60 (16)	105 (28)	165 (22)
	51–60	100 (26)	98 (26)	198 (27)
	61–70	90 (23)	50 (14)	140 (18)
	71 +	60 (16)	18 (5)	78 (10)
Tribe	Lozi	365 (95)	335 (90)	700 (92)
	Mbunda	15 (3)	10 (3)	25 (4)
	Luvale	3 (1)	8 (2)	11 (1)
	Tonga	2 (1)	20 (5)	22 (3)
Household head education	No education	60 (15)	51 (14)	111 (15)
	Primary (1–7)	220 (57)	204 (55)	424 (56)
	Secondary	97 (25)	111 (29)	208 (27)
	Tertiary	5 (2)	3 (1)	8 (1)
	University	3 (1)	4 (1)	7 (1)
Marital status	Married	220 (57)	212 (57.5)	432 (57)
	Single	131 (34)	134 (35)	265 (35)
	Widow	30 (8)	25 (7)	55 (7)
	Widower	4 (1)	2 (0.5)	6 (1)
Household size range	2–4	145 (38)	147 (39)	292 (39)
	5–8	240 (62)	226 (61)	466 (61)
Household age Distribution	Young (>36 years)	130 (33)	120 (32)	250 (33)
	Middle (<36–65 years)	205 (54)	210 (56)	415 (55)
	Elder (>65 years)	50 (13)	43 (12)	(12)

3.2. Social Determinants

3.2.1. Social Determinants of Resource Use in Liuwa Plain NP

In Liuwa Plain NP, the most influential social determinants of resource use were social networking and technology (Table 4). Other influential factors include collective action choice, participation, age, and gender (Table 4). However, the rest of the factors (i.e., communication, information sharing, trust, cultural diversity, cooperation, commitment, reciprocity, education, and location) did not seem to significantly influence sustainable resource use in the area (Table 4).

Table 4. Social determinants of resource use in Liuwa Plain National Park, western Zambia, in 2024.

Social Determinants	VIF	Std. Error	Z-Value	p-Value
Communication	2.13	0.359	1.602	0.109
Information sharing	0.308	0.301	−1.023	0.306
Trust	1.22	0.341	−0.294	0.769
Cultural diversity	1.22	0.304	−0.737	0.461

Cooperation	2.43	0.304	1.444	0.149
Commitment	2.61	0.316	1.931	0.053
Collective choice	2.89	0.315	2.828	0.005 **
Social networking	2.14	0.298	3.863	<0.001 ***
Technology	1.18	0.301	3.921	<0.001 ***
Reciprocity	2.05	0.289	−0.190	0.849
Age	2.75	0.337	−2.210	0.027 *
Gender	1.79	0.311	−2.343	0.019 *
Education	0.42	0.311	1.350	0.177
Location	2.13	0.281	−0.562	0.574
Participation	1.01	0.325	2.768	0.006 **

Note that *** indicates very highly statistically significant; ** highly statistically significant, * statistically significant.

3.2.2. Social Determinants of Resource Use in Simalaha Community Conservancy

In SCC, the most influential social determinants are trust, cooperation and participation (Table 5). Other influential factors include information sharing, commitment and cultural diversity (Table 5). However, communication, social networking and location did not seem to significantly influence sustainable resource use (Table 5). As such, both influential and non-influential social factors for the two study sites are summarized for easy comparison (Table 6).

Table 5. Social determinants of resource use in Simalaha Community Conservancy, western Zambia, in 2024.

Social Determinants	VIF	Std. Error	Z-Value	p-Value
Communication	1.52	0.342	0.672	0.502
Information sharing	3.33	0.319	−2.640	0.008 **
Trust	2.11	0.329	−4.058	<0.001 ***
Cultural diversity	0.33	0.306	2.224	0.026 *
Cooperation	1.51	0.308	4.900	<0.001 ***
Commitment	1.78	0.296	2.638	0.008 **
Social networking	1.28	0.313	0.410	0.682
Location	1.64	0.265	0.241	0.809
Reciprocity	1.56	0.304	2.642	0.501
Age	2.12	0.314	0.412	0.683
Gender	3.01	0.267	0.245	0.807
Education	2.12	0.312	0.413	0.679
Participation	1.09	0.268	4.074	<0.001 ***

Note that *** indicates very highly statistically significant; ** highly statistically significant, * statistically significant.

Table 6. Significant and nonsignificant social determinants of resource use in LNP and SCC.

Liuwa Plain National Park	*p*-Values	Simalaha Community Conservancy	*p*-Values
Social networking	<0.001 ***	Participation	<0.001 ***
Technology	<0.001 ***	Trust	<0.001 ***
Collective action choice	0.005 **	Cooperation	<0.001 ***
Participation	0.006 **	Information sharing	0.008 **
Information sharing	0.306	Commitment	0.008 **
Trust	0.769	Cultural diversity	0.026 *
Cultural diversity	0.461	Social networking	0.305
Cooperation	0.149	Technology	0.462

Commitment	0.053	Collective action choice	0.149
Communication	0.109	Communication	0.502
Reciprocity	0.849	Reciprocity	0.501
Age	0.027 *	Age	0.683
Gender	0.019 *	Gender	0.807
Education	0.177	Education	0.679
Location	0.574	Location	0.809

Note that *** indicates very highly statistically significant; ** highly statistically significant, * statistically significant.

A comparison of the two study areas revealed that there was significant correlation between resource use and social networking (p-value ≤ 0.001), technology (p-value = <0.001), collective action choice (p-value = 0.005), participation (p-value = 0.006), gender (p-value = 0.019), and age (p-value = 0.027) for Liuwa Plain NP, and trust (p-value ≤ 0.001; cooperation (p-value = 0.001), participation (p-value = 0.001), information sharing (p-value = 0.008), commitment (p-value = 0.008) and cultural diversity (p-value = 0.026) for SCC. Key informants and focus group discussions confirmed that variations in social capital elements (i.e., social networking, technology, collective action, participation, information sharing, commitment and cooperation) influence sustainable resource use in both study areas. Both gender and age were key pillars that influenced resource use, as men were more involved in resource use, being the majority of the heads of households relative to women in Liuwa compared to SCC. Furthermore, both youth and adults were reported to be actively involved in accessing and utilizing resources in Liuwa.

The FGDs indicated and validated that some Barotseland cultural practices in both Liuwa Plain NP and SCC promoted conservation of biodiversity, such as forest, wildlife and fisheries. The FGDs and key informants indicated that the integration of Traditional Ecological Knowledge has invaluable influence on resource use and management including forests, fisheries and wildlife. The social norms that influence resource use and promote sustainable resource management analyzed include collective operational restrictions, such as no cutting of tree species associated with utilitarian values, including Zambezi teak (*Baikiaea plurijuga*), Mukwa (*Pterocarpus angolensis*), and Mabula (*Parinari curatellifolia*). The FGDs and key informants also stated that the Lozi culture does not allow hunting of endangered animal species, such as lion (*Panthera leo*), eland (*Taurotragus orix*), sitatunga (*Tragelaphus spekii*) and leopard (*Panthera pardus*). These animals are culturally perceived by the local community as "*chief's sacred animals*"—chief referring to the top traditional leader in the chiefdom. Similarly, the harvesting of fish species, such as perch (*Ctenopona multispine*) and silver catfish (*Schilbe intermedius*), is also regulated using Traditional Ecological Knowledge to avoid exploitation of fishery resources. In addition, ladies are prohibited from eating bird eggs, which are associated with the myth of affecting their fertility and also bearing children with bald heads. Rotational livestock grazing (*kutulisa*) is encouraged to avoid over-utilization of the same grazing ground and habitat degeneration.

3.3. Political Determinants

3.3.1. Political Determinants of Resource Use in Liuwa Plain NP

In Liuwa Plain NP, the most influential political determinants of sustainable natural resource use were exclusion and land tenure (Table 6). Other influential factors were management and resource monitoring (Table 7). In contrast, the rest of the factors (i.e., power relations, boundary, resource use rights, leadership, community constitution, and alienation) did not seem to significantly influence sustainable resource use in the area (Table 6).

Table 7. Political determinants of resource use in Liuwa Plain National Park, western Zambia.

Political Determinants	*VIF*	*Std. Error*	*Z-Value*	*p-Value*
Power relations	2.13	0.564	0.399	0.690
Management	1.45	0.474	2.908	0.004 **
Exclusion	3.13	1.114	4.129	<0.001 ***
Boundary	0.11	0.492	0.070	0.944
Resource use rights	2.33	0.464	−0.734	0.463
Leadership	2.11	0.492	−1.715	0.086
Comm. constitution	3.11	0.517	−0.771	0.441
Land tenure	2.56	1.312	6.425	<0.001 ***
Alienation	2.11	0.511	−1.064	0.287
Resource monitoring	0.55	0.537	−2.001	0.045 *

Note that *** indicates very highly statistically significant; ** highly statistically significant, * statistically significant.

3.3.2. Political Determinants of Resource Use in Simalaha Community Conservancy

In SCC, the most influential political determinants were power relations and land tenure (Table 8). Other influential factors include exclusion, boundaries, resource use rights, alienation, and resource monitoring. However, the rest of the factors (i.e., management, leadership, and community constitution) did not seem to significantly influence sustainable resource use in the area. As such, both influential and non-influential political dynamics for the two study sites are summarized in a table for easy comparisons (Tables 8 and 9).

Table 8. Political determinants of resource use in Simalaha Community Conservancy, western Zambia, in 2024.

Political Determinants	*VIF*	*Std. Error*	*Z-Value*	*p-Value*
Power relations	2.33	0.595	−2.997	0.003 **
Management	3.11	0.608	0.115	0.908
Exclusion	2.46	0.490	2.041	0.041 *
Boundary	1.75	0.559	1.994	0.046 *
Resource use rights	3.66	0.594	−2.301	0.021 *
Leadership	3.33	0.497	−0.017	0.309
Comm. Constitution	1.44	0.586	0.018	0.985
Land tenure	1.75	0.607	2.884	0.004 **
Alienation	1.186	0.535	2.216	0.027 *
Resource monitoring	2.974	0.458	−2.128	0.033 *

Note that ** indicates highly statistically significant, * statistically significant.

Table 9. Summary of political determinants of resource use in Liuwa Plain NP and Simalaha Conservancy.

Liuwa Plain National Park	*p*-Values	Simalaha Community Conservancy	*p*-Values
Land tenure	<0.001 ***	Power relations	0.003 **
Exclusion	<0.001 ***	Land tenure	0.004 **
Management	0.004 **	Resource use rights	0.021 *
Resource monitoring	0.045 *	Alienation	0.027 *
Power relations	0.690	Resource monitoring	0.033 *
Alienation	0.287	Exclusion	0.041 *
Boundary	0.944	Boundary	0.046 *
Resource use rights	0.463	Management	0.908

Leadership	0.086	Leadership	0.309
Community constitution	0.441	Community constitution	0.985

Note that "***" indicates very highly statistically significant, "**" indicates highly statistically significant, while "*" shows statistically significant.

A comparison of the two study areas revealed that there was a significant correlation between resource use and exclusion (p-value ≤ 0.001); land tenure (p-value ≤ 0.001); management (p-value = 0.004); and resource monitoring (p-value = 0.045) in Liuwa Plain NP. There was an equally significant correlation between resource use and power relations (p-value = 0.003); land tenure (p-value ≤ 0.004); exclusion (p-value = 0.041); boundary (p-value = 0.046); resource use rights (p-value = 0.021); alienation (p-value = 0.027); and resource monitoring (p-value = 0.033) in SCC's landscape.

The FGDs in both study areas validated that the political capital dynamics, such as exclusion, land tenure, management, power relations, alienation, boundary, resource use rights, and resource monitoring, were the main factors influencing resource use. Moreover, the traditional authority key informants and FGDs in Liuwa said the following: *"People spear and axe each other and shade blood every year due to fighting in an attempt to exclude and protect their fishing pools from intruders in Liuwa Plain NP, especially in Katulamwa area of chief Isimwa under Senior Chieftainess Mbwanjikana in Kalabo district".*

The results also indicated that the majority (95%) of the respondents in both study areas acknowledged accessing and utilizing forests, fisheries and wildlife resources as livelihood strategies. There was a significant association between resource use dependence and household strategies (χ^2 = 3.997, df = 1, p = 0.001). The forest products mostly utilized by the household respondents involved fuel wood, charcoal, timber, poles and reeds. Wildlife products utilized include bush meat, skins and tails. Moreover, more than 55% of respondents in Liuwa Plain NP confirmed declines in fishery resources. There was a strong association between fishery resource use and fish decline (χ^2 = 36.392, df = 1, p = 0.00). More than 50% of respondents agreed that there was a decrease in forest biomass in SCC and Liuwa Plain NP relative to the rate of resource replenishment. There was a strong relationship between forestry resource use and forests decrease (χ^2 = 10.764, df = 1, p = 0.01). Furthermore, more than 50% of respondents agreed that the fish stock was decreasing in SCC and that the wildlife population was steadily increasing (Figure 2).

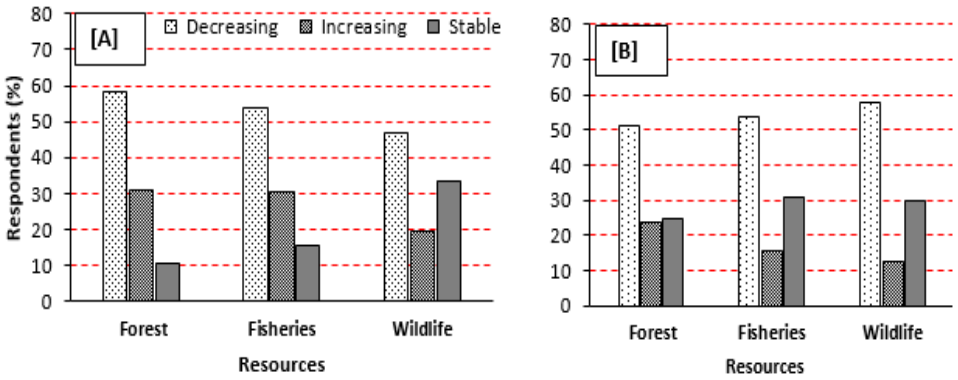


Figure 2. Proportions of respondents' perceptions of available resources in Liuwa Plain National Park (**A**) and Simalaha Community Conservancy (**B**) in 2024. The bar charts indicate the percentage (%) of respondents on the status (decreasing, increasing, and stable) of each particular resource.

4. Discussion

4.1. Social Determinants of Resource Use in Conservation Areas

The findings of this study show that resource utilization and management are influenced by different social determinants. These determinants include social networking, collective choice, participation and trust. This study also showed that most social determinants are linked to a number of theories which included social exchange theory [7,12], social–ecological systems [8,20] and Traditional Ecological Knowledge theories [58,59]. Participation in resource management is common regarding influential social capital cutting across Liuwa Plain National Park and Simalaha Community Conservancy landscapes. This commonality is attributed to the chain of the governance systems which puts the local community at the center of resource conservation and benefit sharing derived from sustainable resource use [58,60,61]. The improved community participation could have been attributed to the collaborative conservation models in both study areas, which embrace higher levels of local community participation in resource management. The female participants in Liuwa Plain NP actively participate in resource use, especially fishing, and participate in decision making despite the cultural barriers that limit their participation in decision-making rights associated with land tenure rights [59, 62-64]. Hence, enhanced local community support towards resource conservation leads to sustainable resource use and social behavioral change. These results are relatively similar with the findings presented by Akello et al. [58], who found that effective and sustainable resource management and use of fisheries, forests, and wildlife require robust social dynamics such as social networking and collective action choice [65,66]. This intervention is achieved through integration of the local community, government, NGOs and other resource actors.

In Liuwa Plain National Park (i.e., social networking, technology, collective action choice, age and gender), key social dynamics that shape resource use are relatively similar to the findings advanced by Akello [58], who urged that effective and sustainable resource management and use of fisheries, forests, and wildlife require robust social dynamics, such as social networking and collective action choice. This intervention is achieved through integration of the local community, government, NGOs and other resource actors. Other scholars show that technological innovations, such as digital monitoring, artificial intelligence, mobile communication and fishing gear influence social, economic and environmental sustainability of fishery resources [59,67]. Moreover, Pacheco [60] indicated that the use of technology, such as satellite imagery, is central in resource monitoring and sustainable use and management of natural resources including wildlife, forests and fisheries. On the other hand, the degeneration of social capital, such as social networks by the social actors, has the potential to escalate unsustainable exploitation of natural resources [61,68-70]. These findings also relate to other studies that show that social networking among stakeholders shapes the opinions and attitudes towards resource use and management [62,71-74].

According to Lowitt [63], the integration of local community participation in resource governance decisions would improve small-scale fishery management and utilization. Other scientific studies show that strengthened community participation in natural resource management, such as forest governance [75,76], promote local community resource ownership, thus contributing to sustainable resource use and management [64]. The low community participation in natural resource management leads to degeneration of fragile resources [65, 77]. Empirical evidence indicates that community integration and participation in planning and decision making is a novel synergy in promoting sustainable resource management [56,77]. Conversely, Milupi et al. [66] argued that the passive local community participation in wildlife governance escalated resource use in Zambia's

Mumbwa GMA. Demographic dynamics, such as gender and age, have significant influence on sustainable resource use, as well as environmental awareness and attitude of people towards forestry management and conservation [67, 77].

The Key informants and FGDs in Liuwa Plain NP confirmed that robust traits of social trends characterized with high levels of social networking, technology, collective action choice and community participation were key social elements that influenced resource use and management in the study area. Female participants in Liuwa actively participated in resource use decision-making processes, despite the cultural barriers that limit their participation in land tenure [11, 78]. The key informants advised that the application of technology, such as the Spatial Monitoring and Reporting tool (SMART), EarthRanger system, and mobile and radio communication, enhanced resource monitoring of biodiversity, especially wildlife, through real-time tracking of wildlife movement and distribution. Each VAG chairperson and Area Chief was equipped with a radio and mobile phone to enhance social networking and resource monitoring, thus informing key management interventions. However, the abuse of technology by some households such as using the wrong fishing methods (i.e., mosquito nets, *sefa sefa net* and *fish* poison) contributed to the decline in fishery resources [68–70].

Similarly, the social capital improvements, such as trust, cooperation, commitment, information sharing, and cultural diversity, in SCC could have been attributed to the successful establishment of SCC by the local community themselves and various benefits derived from sustainable resource use by households [37,39, 79]. These results relate to the findings by other scholars who revealed that strong social capital levels, including trust and cooperation, can enhance cohesion and coordination on resource use among resource actors [71, 80]. The enhanced local community participation profiles in resource use and management could be a result of adequate household engagement and devolved resource user rights [2,11,29]. In addition, the presence of robust social–cultural diversity with at least 25 ethnic groupings characterized by strong traditional norms and beliefs could have been associated with wildlife perpetuation in SCC [49,72]. These results also coincide with the findings by Zhen et al. [73], who attributed sustainable natural resource conservation to rich cultural diversity and Traditional Ecological Knowledge. Therefore, conservation should integrate indigenous ecological knowledge in education as an essential route towards sustainable resource management for the benefit of future cohorts [74,81].

The steady increase in wildlife populations in both study areas could be attributed to novel social governance structures put in place by the Lewanika CRB and SCC, which have partnered with cooperating partners (African Parks and Peace Parks Foundation) to revive wildlife protection through increased foot patrols in the protected areas [77]. Increases in the wildlife population in SCC could also be driven by deliberate introduction of and subsequent effects of the bilateral collaborative management model between the local community and Peace Parks Foundation [78] while in Liuwa Plain NP, the tripartite collaborative management by the government, African Parks and traditional leadership has proven to be efficient [79].

Based on this study's outcomes in both study areas, we recommend that the key interventions for sustainable resource use should integrate social capital enhancements, such as community participation in conservation planning, rural entrepreneurship, and resource management of protected areas, and build trust and technology innovations among resource actors [80]. In addition, the improvement in communication and coordination/social networking in resource use are also key resource management strategies [9]. The breaking of cultural barriers will also improve women's participation in key decision-making methods and foster sustainable resource use and management [67].

4.2. Political Determinants of Resource Use in Conservation Areas

Our findings regarding power relations, land tenure, exclusion, boundaries, resource use rights, alienation and resource monitoring align with other scholars who revealed that improved power relations among resource actors can significantly contribute to sustainable resource use when property rights regimes and resource boundaries are well defined [24,57]. The findings of this study also emphasize the links between the political factors and a number of theories including Power Theory, social exchange theory and social–ecological theories. This study showed that managing power relations and robust land tenure dynamics in resource management is a novel collaborative conservation approach emphasized by several scholars [43,81]. The well-delineated resource boundaries and adequate resource user rights among collaborative resource actors are key elements in cementing power relations and reversing the loss of biological resources, including forests, fisheries and wildlife [82]. The enhanced resource monitoring capacity in SCC with support from the Peace Parks Foundation has reversed the over-exploitation of resources, especially wildlife [6]. However, during data collection it was not uncommon to observe unsustainable forest resource use, especially unlicensed charcoal and timber along the roads in SCC. These findings are similar with the evidence adduced by Zhang [77], stating that some natural resource governance policies regarding forestry, fisheries and wildlife can escalate resource utilization.

Protected areas are considered threats rather than opportunities for sustainable development. From the qualitative analysis of our study, it was evident that some households in both study areas perceived the establishment of protected areas as a threat anchored on the following motivations: Resource alienation/loss of resource access was noted, in which the local communities have limited access to natural resource use such as grazing land for livestock and agricultural land due to strict park rules and regulations in Liuwa Plain NP. The rising cases of human–wildlife conflicts was attributed to the establishment of protected areas. Similarly, in SCC, the FGDs revealed that some households were denied access to the grazing land and water bodies in SCC at the expense of wildlife conservation. These results resonate with the study by Avelino [11], in which the exclusion of the local community from resource use and benefits caused negative attitudes toward biodiversity conservation.

Lessons from this study can be used as strategic motivation for policy shifts by political actors to devolve adequate bundles of resource user rights and access in order to promote a culture of sustainable resource use and lower the poverty levels [29]. The key strategies to these challenges include improving the political capital levels, such as power relations, increased resource monitoring, clearly defined resource use boundaries, and devolution of resource use rights to local actors suggested by Lindsey [1]. The application of even power relations and transparent land tenure regimes are potential pillars that can change the local community's attitude towards sustainable resource management and use [7]. Hence, there is a need for the realignment and harmonization of the three resource policies and legislations for forests (Forest Act of 2015 and Forest Policy of 2015), fisheries (Fisheries Act of 2011), and wildlife (Wildlife Act of 2015, and National Parks and Wildlife Policy of 2018) so that they can speak to each other effectively and embrace holistic conservation approaches to foster sustainable resource use and management, instead of contradicting each other [1,39].

4.3. Comparison Social and Political Determinants in Liuwa and Simalaha

The comparative analysis reveals that both Liuwa Plain National Park and Simalaha Community Conservancy share foundational social and political drivers that shape resource use, yet the manifestations and outcomes of these determinants diverge significantly (see Table 10). In both landscapes, community participation emerges as the most

influential social capital, underpinned by collaborative governance models that place local communities at the center of resource conservation and benefit sharing [58,76]. Similarly, both sites experience persistent challenges of resource alienation, where households perceive protected areas as threats rather than opportunities due to restricted access to grazing and agricultural land, alongside escalating human–wildlife conflicts that generate negative attitudes towards conservation [11,77]. The revival of wildlife populations in both areas is attributable to functional multi-stakeholder partnerships, tripartite relationships (Government, African Parks, Traditional Leadership) in LPNP, and bilateral groups (Community, Peace Parks Foundation) in SCC, which have strengthened protection through increased foot patrols and monitoring [76–79]. These convergences suggest that collaborative governance, regardless of its specific structural configuration, provides a necessary foundation for sustainable resource use.

Table 10. Summary Matrix of Comparative Determinants.

Determinant	Liuwa Plain National Park (LPNP)	Simalaha Community Conservancy (SCC)
Community Participation	High; females active in decision making despite cultural barriers.	High; driven by household engagement and devolved user rights.
Social Networking	High; facilitated by technology (radios, SMART, EarthRanger).	Low; constrained by poor infrastructure and weak trustee engagement.
Trust & Cooperation	Low; undermined by power disparities, inequitable benefits, and HWC.	Moderate; improved by community-led establishment but lacks formal oversight.
Technology Utilization	High; effective for monitoring but abused for illegal fishing.	Low; limited by inadequate communication towers and mobile networks.
Governance Institutions	Weak; lacks Forestry/Fisheries Management Committees.	Moderate; lacks a formal community constitution and by-laws.
Power Relations	Uneven; exclusionary concessions (timber) create alienation.	Relatively even; but informal illegal extraction persists.
Land Tenure/User Rights	Restrictive; park regulations alienate communities from grazing/agriculture.	Devolved; but some households denied access to water/grazing.
Cultural/Demographic Factors	Female participation progressive; cultural barriers to tenure persist.	Diverse ethnicities; strong TEK supports wildlife conservation.
Primary Resource Threats	Fisheries decline (gear abuse), HWC, timber exclusion.	Unlicensed charcoal/timber, grazing exclusion, weak networking.

Despite these commonalities, the two sites exhibit pronounced differences in social networking, trust, institutional completeness, and political power relations. Liuwa demonstrates higher levels of social networking and technological integration, with VAG chairpersons equipped with radios and mobile phones, and the application of SMART and EarthRanger systems enhanced real-time wildlife monitoring. However, this technological advantage is undermined by elevated mistrust stemming from power disparities, inequitable benefit sharing, and the exclusionary issuance of timber concessions in the West Zambezi Game Management Area to non-residents, which has eroded local confidence in governance structures [58,59,75]. Conversely, Simalaha exhibits more stable power relations and relatively higher trust, attributed to the community's foundational role in establishing the conservancy and devolved resource user rights [2,11,29]. Yet SCC struggles with inadequate social networking due to poor communication infrastructure, weak engagement by the Board of Trustees, and the absence of a formal community constitution to institutionalize self-governance and transparency. Furthermore, Liuwa lacks specific sub-structures such as Forestry Management Groups and Fisheries Management Committees, while SCC, despite its community-driven establishment, faces challenges with unlicensed charcoal and timber extraction. These divergences underscore that social

capital is not inherently positive; its effects are contingent on institutional quality, political equity, and the presence of formal governance mechanisms that foster trust, transparency, and collective action [71,82].

4.4. Implications of Social and Political Determinants of Resource Use

In Liuwa Plain National Park, the suggested specific tailor-made interventions to enhance resource governance and sustainable resource utilization behavior include the promotion of social networking platforms that connect local resource users to markets, technology, and conservation information [83,84]. In addition, investment in appropriate technologies (e.g., fuel-efficient stoves, sustainable harvesting tools) would help to reduce unsustainable extraction of biological resources. Further, to address the element of exclusion, there is a need for developing novel co-management agreements that provide tangible benefits (e.g., employment, and equity in revenue sharing). There is also a need to map and rebalance power relations by ensuring representation of marginalized groups (women, youth, ethnic minorities) in governance bodies which, in turn, will build confidence, transparency, and trust among the resource actors [85,86].

Conversely, in Simalaha Community Conservancy there is a need to strengthen collective action through the establishment of legally recognized community institutions with enforceable by-laws, legally recognize TEK (taboos, sacred sites, seasonal restrictions) as complementary to scientific knowledge in resource use regulations [87,88], and establish community–technology interfaces where traditional knowledge informs adaptive co-management. There is a need to devise a robust community constitution that would clearly define the resource governance functions and benefit-sharing modalities. The community constitution should also encourage and motivate local households' participation in key decision-making strategies and integrate demographic factors (age, gender, education) into resource use models to predict demand and tailor extension services [89,90].

4.5. Limitations of the Study

This study had several limitations that should be considered when interpreting the findings. These limitations relate to logistical constraints, the study design, and aspects of the analytical approach. First, the inaccessibility of certain areas due to sandy terrain or being waterlogged limited data collection. However, efforts were made to collect representative and generalized data, and a point of data saturation was attained. Second, language barrier was also another notable limitation as the study areas have more than 25 ethnic groups. However, the integration of trained local research assistants helped us to fully interact with the respondents. Third, there were methodological shortcomings such as the inability to make causal inferences due to the lack of cross-sectional data, the absence of control for confounding variables in regression analysis, lack of consistency checks in qualitative coding, insufficient representativeness of single regional cases, and limited recent literature related to our study from the same region. The regression model's exclusion of key demographic confounders, including household income, resource dependence, residence duration, ethnicity, and household head age, may have biased the correlation estimates, thus limiting the interpretability of the findings and highlighting the need for future robustness checks [91,92]. Finally, for the binary logistic regression analysis, the dependent response variable (sustainable vs. unsustainable) was classified based on respondents' self-assessments, which may have introduced reporting or misclassification bias despite the inclusion of follow-up questions to improve response accuracy. Future studies should include longitudinal time-series tracking to establish temporal dynamics of climate change, multi-regional comparative designs to test the generalizability of findings across diverse social–ecological contexts, model optimization using advanced

analytical techniques to better isolate the relative contributions of social, political, and ecological predictors, and systematic quantification of Traditional Ecological Knowledge to assess its operational role and conditional effects on resource use outcomes under varying environmental and governance pressures.

5. Conclusions

This study provides empirical evidence that the social and political factors associated with sustainable resource use are highly context-specific rather than uniform across protected areas in western Zambia. In Liuwa Plain National Park, resource utilization patterns are significantly related to social networks, technology, collective action, participation, age, and gender, whereas in Simalaha Community Conservancy, the most salient correlates are trust, cooperation, participation, information sharing, commitment, and cultural diversity. Politically, land tenure, exclusion, and resource monitoring emerge as significant related factors in both sites; however, Liuwa is further distinguished by its associations with broader management dynamics, whereas Simalaha is more distinctly characterized by linkages to power relations, boundary negotiations, resource use rights, and experiences of alienation [93,94]. Collectively, these findings underscore that unsustainable resource use in western Zambia is not merely an ecological problem but one embedded in complex social and political relations. A critical caveat, however, is that the cross-sectional nature of the data precludes causal inferences; all observed associations should be interpreted as statistical relationships that identify key variables warranting further investigation through longitudinal or quasi-experimental designs.

Theoretically, this study demonstrates the utility of integrating Social Exchange Theory, social–ecological systems (SES) theory, and theories of power to frame how trust, reciprocity, collective action, and governance structures are related to resource-use behavior. The findings also highlight the enduring relevance of Traditional Ecological Knowledge and Barotseland cultural practices, wherein sacred sites and customary fishing restrictions appear to function as informal institutions that co-vary with regulated resource use [95–97]. Practically, this study advocates for a shift toward community-driven, multi-stakeholder governance models that place local communities at the center of conservation, as exemplified by the Liuwa Plain NP and Simalaha Community Conservancy models, which demonstrate potential for fostering human–wildlife coexistence, promoting collective resource ownership, and reducing poaching [98,99]. To sustain these outcomes, we recommend strategic investment in social and political capital, transparent benefit-sharing mechanisms, and inclusive decision-making processes that integrate state, non-state, and indigenous institutions. Addressing these underlying social and political dynamics, while acknowledging the correlational basis of our evidence, is critical for achieving lasting biodiversity conservation, sustainable resource use, and improved rural livelihoods in Zambia. Future research should use long-term tracking, cross-regional comparisons, advanced modeling, and systematic TEK [99,100] quantification to better understand climate impacts, test findings across contexts, isolate key predictors, and assess how Traditional Ecological Knowledge affects resource use under different governance and environmental conditions.

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Informed Consent Statement: The study was conducted in accordance with international ethical standards, as guided by the Copperbelt University Ethical Clearance Committee under the Directorate of Research and Innovation, with ethical clearance No. 2023/2/13/1 and research permit No. NPW/8/27/1 granted by the Department of National Parks and Wildlife (DNPW).

Data Availability Statement: Data will be provided upon reasonable request to the corresponding author. The data is held in Google Drive and can be accessed using the following link: https://docs.google.com/spreadsheets/d/1pWeVtU-kHOtLtK4SSMBIdp8SnjLOGYH/edit?gid=1787951185#gid=1787951185 (13/02/2026).

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