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Assessing the effectiveness of national park's policies and laws in promoting biodiversity conservation and ecological development in Pakistan

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Ecological history is crucial in ecosystem restoration, serving as a tool to identify and characterize suitable restoration targets. Pakistan has implemented laws and policies to enhance forest sustainability and preserve biodiversity, as it is becoming a global strategy for future water planning and management. This study seeks to analyze the impact of national park policies and laws on various factors, including biodiversity conservation, ecological processes preservation, water resource protection, consumptive and non-consumptive benefits, research and education, and the promotion of recreation and tourism. To assess the effectiveness of established policies in 19 National Parks in Pakistan, a mixed-mode research design was utilized, combining both quantitative and qualitative approaches. Data was collected from 300 participants through a close-ended questionnaire employing a Likert scale. Analysis of the collected data was conducted using the software Smart Partial Least Squares method. The findings demonstrate that the existing policies and laws have contributed to the preservation of forest sustainability in Pakistan. The policies related to recreation and tourism; consumptive benefits; and research are more effective respectively compared to other sets of regulations. The laws and policies related to preservation of ecological processes are least effective. The study suggests that laws related to national parks need to be revised to preserve biodiversity and ecological processes. The preservation of water resources should be a major concern, and the consumptive benefits of these parks should be rechecked. Awareness campaigns are to be part of the expansionary policy framework, and while tourism opportunities should be created, a check on natural resource misuse should be implemented. The non-consumptive benefits of these parks should also be assessed. Due to its potential limitations, such as limited stakeholder analysis, difficulty in creating legitimacy in national parks due to bureaucratic structures, lack of community sensitization, and long-term trends in sustainable conservation strategies, there are certain future research directions that can address challenges in studying the impact of policies on national park

habitats. There is a pressing demand for a more dynamic approach to ecological policymaking. Continuous evaluation and adaptation of policies will be essential in creating an environment conducive to sustainable development.

KEYWORDS

ecology, laws and policy, national parks, Pakistan, legalization, mixed mode study

1 Introduction

Forest sustainability has received much attention globally not only due to ecological wellbeing but also as the source of income generation from tourism activities; this motivates several countries to protect the forest and establish related policies. As per the International Union for Conservation of Nature (IUCN, 2022), there are more than 4,000 national parks globally, and more than 270 million people visit the national parks of the United States. To increase the benefit from natural resources, sustainable forestry is intensively needed country-specific via establishing effective policies, including planting artificial forests, which is in a good stage of implementation; for instance, there are more than 200 parks and protected areas around the world (Aarts and Leeuwis, 2010 and effective measures for wellbeing therein (Adams et al., 2004). Australia has 45 different protected areas, including national parks and lands designed for further purposes for generating income (Adams and Hutton, 2007). Not only does this country reserve an area for natural resources, but there has also been a significant increase in global security assets (Agrawal and Gibson, 1999). Currently, the estimates show that more than 12% of the land is protected for forest purposes and other activities for income generation. However, it was reduced compared to the 1950s, when at least 15% of the world's land area was reserved (Butt et al., 2023). Despite being critical to human wellbeing, the future supply of many Family Economic Support Services (FESs) is threatened by many factors, including habitat loss and destruction, pollution and nutrient excess, climate change, and others (Arts and Tatenhove, 2004). Biodiversity loss is directly linked to the loss of many FESs (Bajgier-Kowalska and Rettinger, 2014). Forests are subject to market forces that prioritize the provision of specific services over the organization and culture of external free zones. However, forest owners are unable to generate income from the broad ecosystem services, forcing them to make management decisions based on marketable inputs, such as wood production (Ahmad et al., 2022; Císař, 2022). In turn, forest management practices have been identified to significantly affect the different levels of FESs provided by forests and their habitat's suitability and species (Kovacic and Benini, 2022). Conservation function and regional biodiversity were noted as indicators of synergistic relationships between specific FES arrangements (Beunen and de Vries, 2011). The ecosystem services have entered the political arena (Bezák and Halada, 2010). On the other hand, competing demands on forests are also increasing as multipurpose, such as hunting, the industrial economy's demand for vital raw materials, non-market cultural and organizational FESs, such as recreation, biodiversity, water conservation, and social needs (Carmin, 2010; Gani et al., 2023). Therefore, the management plan relied on effective policy implications from the scientific studies that can enhance the sustainable forest for ecosystem and environmental issues across global and country-specific. Recent studies revealed that laws and policies make sure that national parks support extensive conservation, act as an anchor for large ecosystems, and are catalysts for ways to conserve wildlife habitat and resources (Armitage et al., 2010) and for the park to grow the air, water, and wildlife must be safe to enter and exit the park (Quick and Bryson, 2022).

Currently, each country has different laws, policies, and regulations for forest management. Like the rest of the world, Pakistan the sixth largest population in the world is one developing countries (Butt et al., 2023b) also has laws and policies for national parks, including recreation and tourism, biodiversity conservation, non-consumptive benefits, preservation of ecological processes, preserving water resources, research and education, and consumptive benefits. The Wildlife Conservation Act inherited from British India includes provisions amended by the West Pakistan Wildlife Conservation Act of 1959 and the West Pakistan Wildlife Conservation Act of 1960. In addition, neither the West Pakistan Forest Protection Act nor the Pakistan Forest Act applies to five fixed regions of Pakistan (such as the Kabul and Indus floodplains and all eastern countries), nor does it apply to part of the country, mountainous areas of the country and special/royal areas where many valuable species are found in Pakistan (Butt et al., 2023c). The Wildlife Research Council was established in 1968 to review regulations (Williams and Baláž, 2002), but the scientific research regarding eco-system services is still at a low stage (Sotirov et al., 2017). Currently, the management of national parks in Pakistan falls under the jurisdiction of the Pakistan Environmental Protection Agency (Pak-EPA) and the respective provincial environmental protection agencies. The most relevant policy instruments include the Pakistan Environmental Protection Act, of 1997, and the provincial environmental protection acts. These laws outlined the framework for environmental protection and conservation efforts, including the establishment and management of national parks. Additionally, specific policies and regulations related to wildlife conservation and protected areas are also operating. (Afzal et al., 2023; Banerjee et al., 2023).

The orientations towards ecological development research are also facing several challenges due to a lack of available resources, access to information, and awareness. Population growth, rapid urbanization, unregulated industrialization, increased auto-mobilization, regulated/unregulated land use, and land cover transformations are the cardinal challenges for urban social life in Pakistan. The enforcement and implementation of environmental laws and policies are challenging due to resource constraints, such as limited financial and human resources, which hinder the agency's ability to monitor and enforce compliance, potentially impeding its

mandate (Kumar et al., 2023). The lack of specialized skills in environmental science, ecology, and law poses challenges in recruitment and retention. Regular legal reviews are crucial to address emerging environmental issues. Robust policies are needed for climate change mitigation and adaptation, while industrial compliance and effective waste management are additional environmental protection complexities (Shah and Rana, 2023). The anthropogenic interventions in the natural environment and the rapid proliferation of consumer culture are further stressing the environmental and social resilience of urban areas (Wells, 1992; Pathak et al., 2023). Therefore, the sustainability of urban ecological resources is a valid point for the equity and justice debate. This makes it incumbent upon community research to investigate the dynamics, orientations, and factors responsible for current urban environmental degradation in Pakistan. The outcomes of such research initiatives are a prerequisite for ensuring the resilience and environmental health of urban areas in this country. Currently, Pakistan is facing several environmental issues which may impede ecological development, such as population growth, deforestation, and others. Current statistics show that the population growth rate is about 2.7%, and this growth is associated with high demand for food, more housing, more jobs, and the production of more waste, and linked with a weak environment, with the right regulations, newer and better technology (Young et al., 2007). Pakistan, in its efforts to enhance forest sustainability and conserve biodiversity, has implemented several policies and laws (Wilson, 1999). However, the effectiveness of these measures remains to be thoroughly explored, and only a few studies have been conducted on this issue, and there is a gap in the existing literature (Banerjee et al., 2020). Therefore, this study addresses the existing gap in the literature by conducting an in-depth mixed-mode analysis to delve into the phenomena and acquire comprehensive insights. The primary objective of this study is to analyze the effectiveness of national park policies and laws on various sustainability factors in Pakistan. These factors include biodiversity conservation, preservation of ecological processes, protection of water resources, consumptive benefits, research and education, recreation, and tourism, as well as non-consumptive benefits. To the best of our knowledge, these is no such study found on the subject related to national parks in Pakistan that engages all the stakeholders and provides a basic analysis that how the laws should be tailored, taught and executed in their naturally blessed areas.

The findings will offer valuable guidance to policymakers and environmental organizations in formulating effective strategies for preserving the country's precious natural resources.

The present study hypothesized that.

H1: There is a positive relationship between laws and policies and the biodiversity conservation of national parks in Pakistan.

H2: There is a positive relationship between laws and policies and the preservation of the ecological process of national parks of Pakistan.

H3: There is a positive relationship between laws and policies and preserving the water resources of the national parks of Pakistan.

H4: There is a positive relationship between laws and policies and the consumptive benefits of the national parks of Pakistan.

H5: There is a positive relationship between laws and policies and research and education of national parks of Pakistan.

H6: There is a positive relationship between laws and policies and the recreation and tourism of the national parks of Pakistan.

H7: There is a positive relationship between laws and policies and the non-consumptive benefits of national parks in Pakistan.

2 Datasets and methodology

2.1 Research design and data collection

A mixed-mode research design integrating quantitative and qualitative approaches is employed to comprehensively evaluate the effectiveness of established policies for 19 National Parks in Pakistan out of a total of 28 such locations. To include at least one Park from each region (because some regions have very few parks), 19 are selected on the basis of geographically distinct, biodiversity and habitat. The study's population consists of environmental organizations based in Pakistan. A strategic sampling approach which is the application of focused data collection across targeted areas of the conceptual site model, is used to select 300 participants, including forest beneficiaries and policymakers, who are well-informed about the protection status of the National Parks. Brown (2006) provides significant details about strategic sampling approach. Data are collected through a close-ended questionnaire designed to capture responses related to the forest sustainability policies and their effectiveness. The questionnaire was administered to the selected participants, allowing for a thorough assessment of the policies' impact on National Park protection. The main constructs observed in this study pertain to the established policies' impact on various aspects of National Park protection, including biodiversity conservation, preservation of ecological processes, water resource preservation, consumptive and non-consumptive benefits, research and education, and recreation and tourism. Details of these constructs are outlined in (Table 1).

2.2 Data analysis

To achieve the main objective of the study, confirmatory factor analysis (CFA) was performed using Smart-PLS 4 software (see Ringle et al., 2022). CFA enables the evaluation of the relationship between observed variables (forest sustainability policies) and the underlying latent variable (established laws and policies for National Park Protection) by estimating direct and indirect factor loadings. In CFA, researchers distinguish between observed variables (directly measured) and latent variables (unobserved constructs). Latent variables are abstract ideas that researchers attempt to indirectly assess using observable indicators.

Structural Equation Modelling (SEM) was applied, incorporating CFA and path analysis, to explore the interconnectedness of variables and assess the overall model fit (Ramayah et al., 2018). CFA helps determine the reliability of

TABLE 1 The main constructs along with the observed variables.

Main constructs	Items (observed variable)	Codes
Biodiversity Conservation (BC)	Reliable laws for the protection of species	Q1
	Satisfactory policies for the growth of habitats	Q2
	Sustainability of laws and policies for ecosystems	Q3
	Law to protect genetic diversity	Q4
Preservation of Ecological Process (PEP)	Law enforces the preservation of ecological process	Q5
	Extraction of natural resources under laws and policies	Q6
	Spread awareness about the preservation of ecological process	Q7
	Management takes certain steps to ensure preservation	Q8
Preserving Water Resources (PWR)	Law enforces the preservation of water resources	Q9
	Preservation of water resources under laws and policies	Q10
	Spread awareness about the preservation of water resources	Q11
	Management takes certain steps to ensure water resource preservation	Q12
Consumptive Benefits (CB)	Consumptive benefits are extracted under laws and policies	Q13
	Legal framework for the non-market value of resources	Q14
	Restrict the excessive exploitation of consumptive benefits	Q15
	Awareness is spread through different legal channels	Q16
Research and Education (RE)	Educational and research setup for growth and development	Q17
	The curriculum includes national parks and national resource preservation	Q18
	National parks in Pakistan are highlighted by recent research	Q19
	Separate institutes and departments in Pakistani universities about national parks	Q20
Recreation and Tourism (RT)	National parks are used for recreation and tourism	Q21
	Protection of national parks while using them as recreational places	Q22
	Recreational laws are satisfactory	Q23
	Policies promote tourism in national parks	Q24
Non- Consumptive Benefits (NCB)	Non-consumptive benefits are extracted under laws and policies	Q25
	Legal framework for the market value of resources	Q26
	Restrict the excessive exploitation of non-consumptive benefits	Q27
	Awareness is spread through different legal channels	Q28

construct measures and understand the nature of these variables. Additionally, Pearson correlation analysis was conducted to identify any linear relationships among observations, elucidating the importance of each factor influencing forest policy. The conceptual framework of the study is visually presented in Figure 1 and Table 2.

3 Results

3.1 Distributive statistics of participants

Table 3 presents the descriptive statistics of the participants involved in capturing the effectiveness of laws and policies in strengthening the protection of national parks and resources in Pakistan, as outlined by the seven identified laws and policies. Out of the 300 respondents, approximately 82% were male, while the remaining participants were female. The majority of respondents, 43%, fell within the age group of 30–45 years, while 32% were less than 30 years old, and 25% were above 45 years old. These demographics indicated a diverse representation of age groups, allowing for a comprehensive perspective on the effectiveness of the policies.

Regarding educational qualifications, 53% of participants were graduates, 36% were undergraduates, and 11% were postgraduates. This distribution ensured a well-informed and varied respondent pool capable of providing relevant insights for achieving the study's objectives.

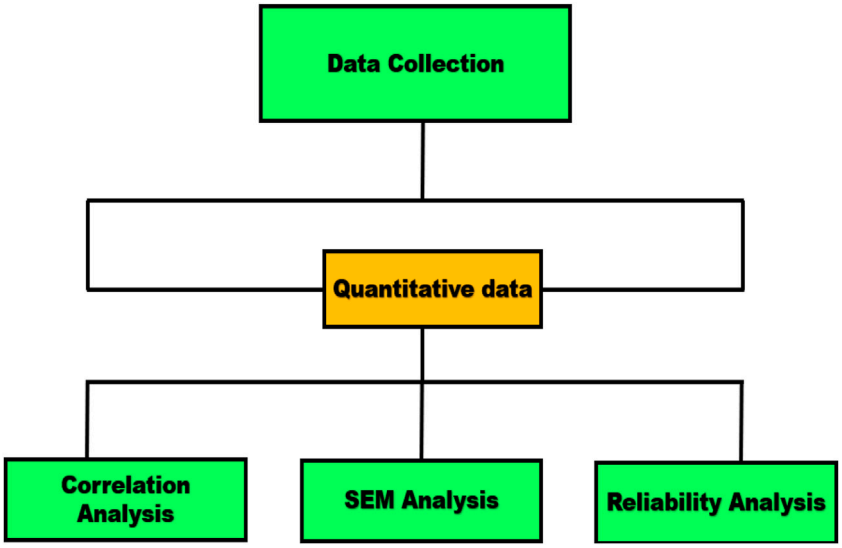

FIGURE 1
Conceptual framework of the study.

TABLE 2 List of covered national parks in Pakistan.

Name of national park	Territory	IUCNCategory	Area (ha)	Year of declaration	Characteristics
Ayubia	KPK [a]	V	1,684	1984	It is important for wildlife conservation
Central Karakorum	G B[b]	II	13,90,100	1995	It comprises the Baltoro, Panmah, Biafo, and Hispar glaciers and their tributary glaciers
Chinji	Punjab	II	6,095	1987	It is an important place for wildlife conservation
Chitral Gol	KPK	II	7,750	1974	Markhor goats and snow leopards are important animals found in this park
Deosai Plains	G B	II	358,400	1993	It provides a natural habitat for the Himalayan brown bear
Ghamot	AJK[c]	-	27,394	2004	It provides a natural habitat for wildlife
HazarganjiChiltan	Balochistan	V	15,555	1980	It is an important habitat for wildlife
Hingol	Balochistan	II	165,004	1997	A number of animal and bird species are protected in this park
Khunjerab	G B	II	226,913	1975	It protects wildlife
Kirthar	Sindh	II	308,733	1974	Kirthar provides an important habitat for wildlife
Lal Sohanra	Punjab	V	87,426	1972	It provides a natural habitat for wildlife
Lake Lulu Sar	KPK	-	30,375	2003	It protects wildlife
Lake Saiful Muluk	KPK	-	4,867	2003	It is important for natural and cultural biodiversity
Margalla Hills	Islamabad	V	17,386	1980	It is important for wildlife habitat
Machiara	AJK	-	13,593	1996	It is important for wildlife conservation
Pir Lasora	AJK	-	5,625	2005	It provides a natural habitat for biodiversity
Shandur Hundrup	G B	-	164,000	1993	It is important for biodiversity conservation activities
Sheikh Buddin	KPK	-	15,540	1993	It provides a natural habitat for Markhor
Toli Pir	AJK	-	5,045	2005	It is important for wildlife conservation

[a]KPK, stands for Khyber Pakhtunkhwa.
[b]GB, for Gilgit-Baltistan.
[c]AJK, for Azad Jammu and Kashmir.

TABLE 3 Descriptive statistics of the respondents.

Demographics		Frequencies	Percentages
Gender	Male	247	82
	Female	53	18
Age	Less than 30 years	95	32
	30–45 years	128	43
	More than 45 years	77	25
Education	Undergraduates	109	36
	Graduates	158	53
	Postgraduates	33	11
Annual Income	Less than 500,000	95	32
	500,000–1,000,000	132	44
	More than 1,000,000	73	24

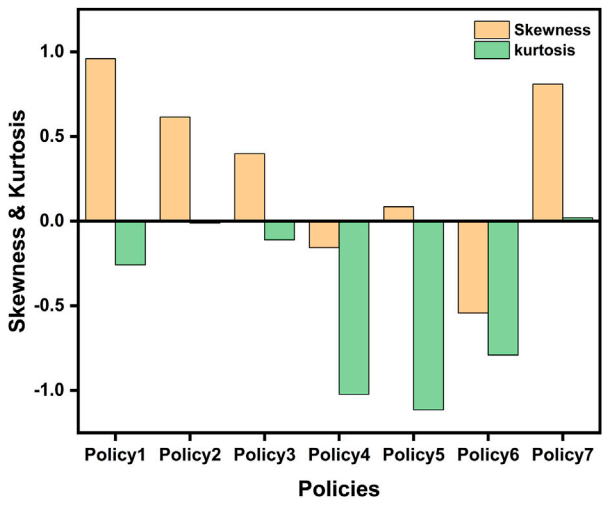

FIGURE 2
Descriptive statistics and normality of data within policies or constructs.

Analyzing annual income, 32% of respondents had an annual income of less than 500,000, while 44% had an annual income between 500,000 and 1,000,000, and 24% had more than 1,000,000. This income distribution ensured a balanced representation of participants from different economic backgrounds, contributing to a holistic understanding of policy effectiveness.

To validate the normal distribution of the primary data, a normality test was conducted (Figure 2). The results from kurtosis and skewness indicated that the data were approximately normally distributed. The large sample size further supported the normality of the data. The Cramer-von Mises test statistic has the null hypothesis that a sample, comes from a pre-specified population distribution indicates that the highest statistic is 6.861 for policy 1, and lowest for policy 5. It indicates α greater than0.95 in all cases (Table 4).

3.2 Reliability and validity of testing outcomes

To assess the effectiveness of policies on forest sustainability, Smart Partial Least Squares (Smart-PLS version 4.0) was employed. Reliability testing of the selected features to respond to the effectiveness of laws and policies for protecting biodiversity and ecological processes in national parks of Pakistan, based on several strategic views from respondents, was conducted; the results are presented in Figure 3 and Table 5. The Cronbach's alpha values obtained indicate the reliability of the policies' effectiveness in protecting national parks in Pakistan.

Based on the reliability statistics, the scores from Cronbach's Alpha are quite close to 1, suggesting that the information gathered from respondents is highly reliable in reflecting the effectiveness of laws and policies in protecting national parks. These findings are consistent with previous research, which also recommended the acceptance level of Cronbach's alpha coefficient as an indicator of reliability (see, for example, Saris and Gallhofer, 2014; Dillman, et al., 2016; DeVellis and Thorpe, 2021).

Furthermore, the outer loading and particular cross-loading, analyzed for construct reliability, exceeded the threshold limit of 0.7. This indicates that the item measurements taken from the sample accurately represent the actual scores in the population, confirming the reliability of the related information.

3.3 Finding of confirmatory factor analysis

Confirmatory factor analysis was conducted using Smart PLS-4 to assess the validity of the scale, specifically the strategic features concerning the laws and policies of national parks. The results revealed that some of the factor items, representing strategic questions aimed at capturing the effectiveness of laws and policies, did not elicit strong responses regarding the protection of biodiversity and other ecological processes in national parks.

As per the criteria for model building, items with factor loadings and average variance less than 0.5, as well as composite reliability less than 0.6, were deemed unsuitable and were subsequently deleted from the analysis. The remaining items, with factor loadings and average variance greater than 0.6, were retained in the model, as shown in Figure 4.

The decision to exclude certain items from the analysis was essential in ensuring the accuracy and reliability of the results. By focusing on the retained items with strong factor loadings and sufficient composite reliability, the study's validity was enhanced, and a more accurate representation of the effectiveness of laws and policies in protecting national parks was achieved.

Figure 4 provides a clear visualization of the remaining items, demonstrating their significance in evaluating the impact of laws and policies on biodiversity conservation and ecological processes within national parks. These findings serve as a valuable guide for policymakers and stakeholders, highlighting the specific areas that need further attention and improvement to bolster the protection and sustainability of Pakistan's national parks. Thereby, aiding in the formulation of targeted strategies and initiatives for the effective conservation and management of these ecologically vital areas.

TABLE 4 Outcomes of Normality test.

Policies	Median	Min	Max	Kurtosis	Skewness	Observations	Cramer-von mises test stat	*p*-value
Policy1	−0.39	−1.226	2.118	−0.259	0.959	299	6.861	0.001
Policy2	−0.2	−1.602	2.898	−0.012	0.615	299	0.701	0.001
Policy3	−0.012	−1.928	2.532	−0.111	0.399	299	1.257	0.001
Policy4	0.008	−2.124	1.641	−1.023	−0.156	299	0.521	0.002
Policy5	−0.016	−1.739	1.901	−1.115	0.085	299	0.588	0.001
Policy6	0.093	−2.044	1.529	−0.791	−0.543	299	1.072	0.001
Policy7	−0.237	−1.426	2.51	0.02	0.809	299	1.151	0.001

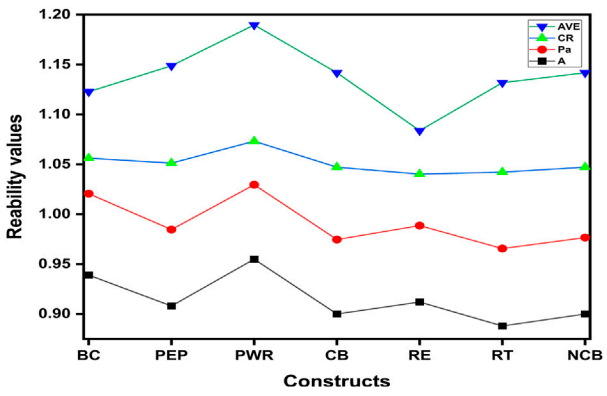

FIGURE 3
Reliability variation of each construct in model building.

3.4 Regression analysis for testing hypothesis

Table 6 presents the results of the hypothesis testing conducted on the laws and policies of national parks in Pakistan. The results indicate a positive relationship between laws and policies and various aspects of national park protection, including biodiversity conservation, preservation of ecological processes, preservation of water resources, consumptive benefits, and research and education.

These findings are statistically significant at the 5% significance level, with *p*-values less than 0.05 (i.e., $p < 0.05$). This suggests that the laws and policies implemented for protecting national parks in Pakistan have proven to be effective in promoting biodiversity conservation, preserving ecological processes, and safeguarding water resources, providing consumptive benefits, and supporting research and education initiatives.

However, the significant positive relationships between laws and policies and these key aspects of national park protection highlight the importance of effective policy implementation in achieving sustainable conservation goals. Policymakers and stakeholders can draw valuable insights from these results to further strengthen and refine existing laws and policies for the continued preservation and sustainability of Pakistan's national parks.

3.5 Correlation and covariances between policies

Figure 5 and Table 7 display the results obtained from correlation and covariances tests between the policies themselves. The correlation analysis indicates that all selected policies, treated as latent variables in the model, demonstrate moderate correlations, both negative and positive, with each other. Notably, a strong positive correlation was observed between CB (Consumptive Benefits) and PEP (Preservation of Ecological Processes), as well as between RE (Research and Education) and PEP. These findings suggest that the strategies for protecting national parks, specifically in terms of research and

TABLE 5 Constructs validity and reliability.

Constructs	α	ρA	CR	AVE
Biodiversity conservation (BC)	0.939	0.946	0.961	0.890
Preservation of ecological processes (PEP)	0.908	0.910	0.956	0.916
Preserving water resources (PWR)	0.955	0.955	0.978	0.957
Consumptive benefits (CB)	0.900	0.900	0.952	0.909
Research and education (RE)	0.912	0.914	0.945	0.851
Recreation and tourism (RT)	0.888	0.891	0.947	0.899
Non-consumptive benefits (NCB)	0.900	0.902	0.952	0.909

Note: *α= Cronbach's alpha, ρA= rho_A, CR, composite reliability; AVE, average variance extracted.*

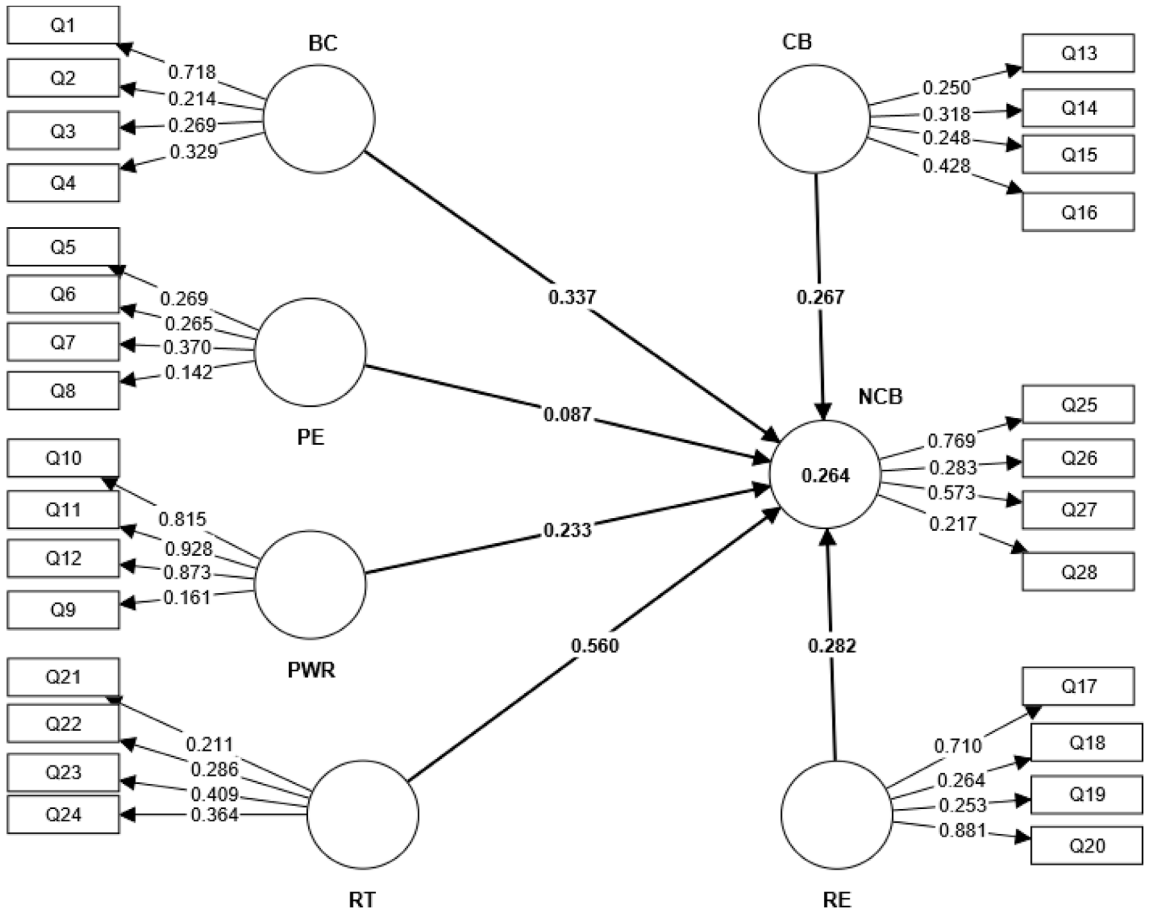

FIGURE 4
Model building for the factor loading.

TABLE 6 Hypothesis testing results.

	Original sample (O)	Sample mean (M)	(ST. DEV)	*p* values
Biodiversity conservation - > laws and policies	0.020	0.019	0.004	0.001
Preservation of ecological processes > laws and policies	0.004	0.003	0.001	0.002
Preserving water resources - > laws and policies	0.006	0.006	0.002	0.001
Consumptive benefits - > laws and policies	0.990	0.991	0.003	0.001
Research and education - > laws and policies	0.001	0.001	0.002	0.928

education, recreation and tourism, and law implementation, are closely interconnected and aligned in Pakistan.

The variability observed in policies has a particularly noteworthy impact on research and education, in addition to recreation and tourism policies, which are also significantly affected. Conversely, when it comes to other policies, the variations are relatively minimal, with both negative and positive associations being evident. Overall, the findings from examining correlations and covariance provide compelling evidence that policy execution and implementation operate independently, yet contribute significantly to the protection and promotion of national parks and ecological resources within the country.

3.6 Evaluation of the inner structural model

After validating the data and measurement model, the next step in the analysis was to assess the results of the inner structural model. This involved measuring the predictive relevance of the model and examining the relationships between variables using various criteria, including coefficient of determination (R-square), path coefficient (β), effect size (f^2), and goodness of fit (GOF).

Figure 6 and Table 8 present the results of the path coefficients for all selected policies, showing that they are statistically significant at the 5% level. Additionally, the model fit is considered good, as evidenced by the acceptance of the standardized root mean square

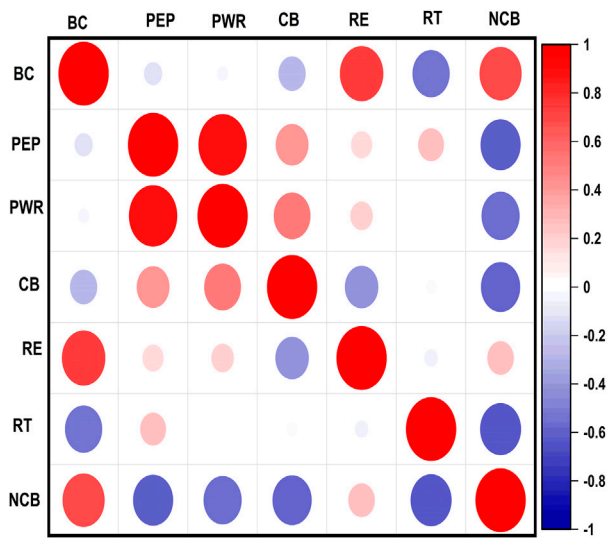

FIGURE 5
The correlation results of the constructs.

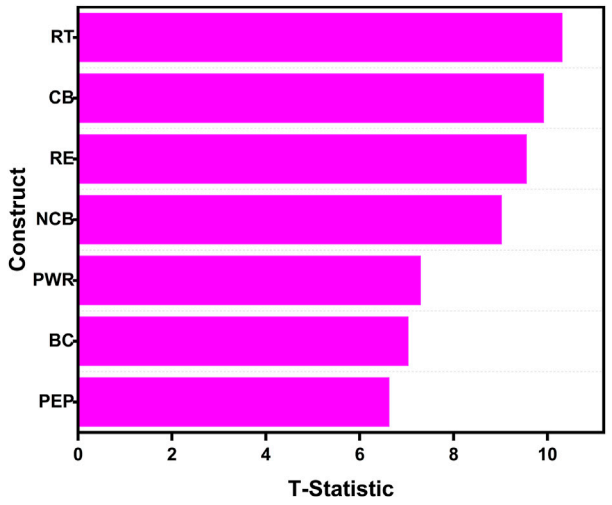

FIGURE 6
Path coefficient estimates.

TABLE 7 Correlation and covariance results between policies.

	BC	PEP	PWR	CB	RE	RT
BC	1					
PEP	−0.07	1				
PWR	0.565	0.685	1			
CB	0.293	0.839	0.651	1		
RE	0.5413	0.809	0.65	−0.85	1	
RT	0.767	0.178	0.175	0.467	−0.169	1
NCB	0.744	−0.271	0.263	0.284	−0.053	0.353
Covariances						
BC						
PEP	−0.146					
PWR	0.056	−0.089				
CB	0.222	0.176	0.022			
RE	−0.189	0.014	−0.016	−0.042		
RT	−0.12	0.197	−0.127	0.063	0.586	
NCB	−0.058	0.217	−0.016	0.069	0.043	0.289

TABLE 8 Path coefficient estimates.

Law -policies against	Beta	T –statistic	*p* values
Biodiversity conservation	0.492	7.032	0.040
Preservation of ecological process	0.328	6.625	0.050
Preserving water resources	0.482	7.293	0.040
Consumptive benefits	0.611	9.916	0.010
Research and Education	0.597	9.551	0.000
Recreation and tourism	0.648	10.312	0.000
Non-consumptive benefits	0.491	9.019	0.020
Chi-Square	0.629		
SRMSE	0.08		

error (SRMSE), which is less than 0.08. The chi-square statistic and coefficient of determination, which is closer to one (0.629), further support the satisfactory model fit. These results indicate that the empirical data in this study fit well with the proposed model. Table 8 further explains that the policies related to Recreation and tourism; Consumptive benefits; and Research are more effective respectively compared to other sets of regulations included in the model. The laws and policies related to preservation of ecological processes are least effective.

Table 9 demonstrates the validity of discrimination, with all the Heterotrait-Monotrait (HTMT) values in this study being less than the benchmark of 0.85. This signifies that there are no issues with discriminant validity, indicating that the constructs are distinct from each other and accurately measure different aspects of the phenomenon under investigation.

Table 10 displays the goodness-of-fit of the inner model, determining whether the model adequately describes the empirical data of the study. The goodness-of-fit index scores range from 0 to 1, with readings of 0.10 (small), 0.25 (medium), and 0.36 (large) indicating the overall acceptance of the path model. The goodness-of-fit estimate of 0.561 suggests that the model fit is strong and reliable. The results from the inner structural model analysis affirm the soundness of the measurement and indicate that the proposed model effectively explains the relationships between the variables. The satisfactory model fit, along with strong discriminant validity and goodness-of-fit, further strengthens the credibility and validity of the study's findings.

TABLE 9 Discriminant validity of constructs involved in measurement models.

	BC	PEP	PWR	CB	RE	RT
BC						
PEP	0.69					
PWR	0.52	0.736				
CB	0.161	0.849	0.329			
RE	0.64	0.308	0.314	0.425		
RT	0.647	0.238	0.004	0.572	0.919	
NCB	0.729	0.383	0.663	0.054	0.387	0.176

4 Discussion

Contemporarily research orientation has progressively shifted by comprising ecological development and government laws together with policies to protect national parks. A National Park is a protected area that is primarily managed for ecosystem protection and recreation. It is described as a natural area of land or water that has been designated to (a) protect the ecological integrity of one or more ecosystems for current and future generations, (b) prohibit exploitation or occupation, and (c) provide a foundation for spiritual, scientific, educational, recreational, and visitor opportunities, all of which must be open to the public. The present study aimed to analyze the effectiveness of policies and laws on the sustainability of national parks through various factors, including biodiversity conservation, preservation of ecological processes, preserving water resources, consumptive benefits, research and education, recreation and tourism, and non-consumptive benefits in Pakistan. The results revealed that forest sustainability is preserved under various laws and policies (Qasim et al., 2014). However, the study has further found that there are certain limitations and gaps in the laws and policies of national parks in Pakistan. There is a need for a periodic system to re-examine and reform ecological policies and laws to provide the requisite atmosphere for the performance-oriented and change-conscious public sector organizations we have all been craving in this country. The Pakistani government is constantly working to improve the country's overall environmental sit situation. International organizations have accelerated biodiversity conservation efforts, but most of Pakistan's national parks lack management plans to help improve the preservation of biodiversity of these parks. As a result, conservation efforts fall short of world standards. Additionally, a lack of laws and policies results in a depletion of wildlife in national parks. There have been initiatives in recent years to address these shortcomings. The framework for management provided by current wildlife laws is insufficient. The provincial wildlife departments are given authority by the laws to manage protected areas, but these departments are not given any authority to manage neighboring areas. As a result, development activities close to protected areas frequently interfere with efforts to preserve biodiversity. The enforcement of laws pertaining to biodiversity conservation has a number of flaws. The law has a serious flaw when it comes to species conservation because it focuses too much on animal species and makes no provisions for the protection of threatened and endangered plant species. The laws in place make an effort to restrict the hunting of animals that have been designated as game. However, the majority of these regulatory measures have proven challenging to uphold. A few rules have been established under the current laws to protect a few specific species (falcons, cranes); however, other important threatened species require the introduction of additional control measures. As a result, the ongoing loss of biodiversity and the fragmentation and degradation of natural habitats are the ecological trends that Pakistanis are currently most concerned about.

Throughout Pakistan, a number of projects related to the management and development of Protected Areas have been launched for conservation purposes. However, these projects are not very successful because of a number of internal problems that create barriers to the desired results. There is a lack of sufficient data in many respects. The current ability to gather, store, analyze, and disseminate information is limited, and data about Pakistan's biodiversity are dispersed among a wide range of institutions. Additionally, knowledge of this aspect of biodiversity is sadly lacking. In order to maintain, store, organize, analyze, and disseminate data in a useful form, there is no biodiversity information and monitoring center. Furthermore, the creation of management plans and policies for these areas is fraught with flaws. For effective management to take place, local communities must use the protected area and be involved. None of the protected area classifications allow for community involvement. Local communities have a responsibility to protect and utilize the resources of biological diversity because they are its primary users. Local communities playing the roles of protectors and beneficiaries may be crucial to halting the loss of biodiversity in Pakistan. The rigidly prescribed framework of Pakistan's national parks prevents locals from planning and carrying out. The legislation governing national parks forbids a number of uses. Additionally, it is critical to put policies and practices into place that promote resource conservation and responsible use. All parties must participate equally in the decision-making and execution processes in order for co-management to take place. The government must grant local communities and user groups equal management power and responsibility. Under this strategy, utilization, and control might coexist. Authorities must delegate decision-making to all user groups, including local communities, while also defending and enhancing local communities' aspirations, knowledge, skills, and resources for practice (Rashid et al., 2020).

Due to inadequate enforcement, public indifference, and population growth, Pakistan's biodiversity loss problem persists

TABLE 10 Goodness of fit of the inner model.

Constructs	BC	PEP	PWR	CB	RE	RT	NCB	Average values	AVE*R-square	GOF
AVE	0.501	0.655	0.659	0.54	0.596	0.555	0.656	0.500	0.315	0.561

despite numerous regulations. To address these issues, Pakistan must strengthen its legal and regulatory frameworks, enhance law enforcement, and increase public awareness of biodiversity protection (Sotirov et al., 2017). The detrimental effects of tourism on the environment can be reduced through careful planning and management of tourism within protected areas. A framework was put forth by (Usmani, 2001) that prioritized three things: safeguarding the natural resource on which tourism is based, expanding and diversifying the tourism industry to have a positive economic impact, and dispersing the gains to nearby communities near PAs. However, as disturbances from recreational activities were the second most frequently reported threat to terrestrial *p*As worldwide, increasing trends in tourism within protected areas could have negative ecological and social impacts, which would be made worse by ineffective protected area management. Managers of protected areas must communicate with other sectors more frequently. To accomplish this, in-service training programs for resource managers, conservationists, and other concerned employees are crucial, as are initiatives to boost nongovernmental organizations' and community institutions' capacity to contribute significantly to biodiversity conservation by providing funding, personnel, and resources to existing training programs (Knudsen, 1999). Protected areas and biosphere reserves require more scientific investigation, monitoring, training, and instruction because conservation and wise use of natural resources depend on a solid foundation in the natural, social, and humanities. This is essential for nations with protected areas that lack the funding and skilled human resources.

5 Conclusion

Pakistan faces numerous environmental issues such as deforestation, fragmentation, degradation, and biodiversity loss, hindering ecological development. Despite government efforts and international organizations' involvement in biodiversity conservation, most national parks lack management plans, resulting in conservation efforts not meeting global expectations. In this regard, the regulations and policy reforms play a significant role in protecting the preserved national parks. This study examined the impact of various policies and laws on the sustainability of national parks in Pakistan, including the conservation of biodiversity, the preservation of ecological processes, the preservation of water resources. This study also describes the potential benefits of these efforts to consumers, researchers, and tourism (Lapov, 2018). The study found a strong link between legal frameworks, regulatory measures, and governmental policies in Pakistani national parks, enhancing the maintenance and preservation of living organisms and their habitats. These regulations and policies have a positive impact on the preservation of ecological processes, contributing to ecological balance and stability. They also preserve water resources like rivers, lakes, and groundwater reservoirs, ensuring their availability for future generations. Enforcement of these laws has resulted in sustainable resource utilization, responsible tourism, and employment opportunities for local communities. Legal frameworks and policies not only protect biodiversity and ecological processes but also foster an environment conducive to scientific research and educational activities, promoting knowledge and understanding of the natural world and its interconnections. Overall, these measures contribute to the overall stability and sustainability of Pakistani national parks. The study reveals that laws and policies used for Pakistan's national parks face restrictions and gaps, necessitating the need for a periodic system to review and reform ecological policies and laws to foster performance-oriented public sector. Current wildlife laws do not provide a sufficient framework for management. The current legal system is seriously flawed when it comes to protecting threatened and endangered plant species because it places an excessive amount of emphasis on animal species. Communities are not permitted to participate in any of the protected area classifications. Because they are its main consumers, local communities must safeguard and make use of biological diversity's resources. For co-management to occur, each stakeholder must have an equal voice in the decision-making and execution processes. Thus, there is a need for a periodic system to re-examine and reform ecological policies and laws to provide the requisite atmosphere for performance-oriented and change-conscious public sector organizations (Qadir, 2000). Some of the recommendations that should be taken into consideration for formulating a pertinent policy for effective conservation and sustainable utilization of natural resources.

The results of this study imply that there is a need to revise policies and laws of national parks to preserve the biodiversity conservation of the national parks of Pakistan. The preservation of the ecological process of the national parks of Pakistan is dependent on the policies and laws, so special consideration should be paid in this regard. Preserving water resources of the national parks of Pakistan should be one of the major concerns of the national laws and policies of Pakistan. The consumptive benefits of national parks of Pakistan should be rechecked while formulating the laws and national policies. Awareness campaigns for the people living in and visiting these areas should be part of an expansionary policy framework. Although tourism opportunities should be created, however, a check on the misuse of natural resources should be implemented. The non-consumptive benefits of the national parks of Pakistan should be assessed.

The study has certain limitations, which should be focused on in future studies. A future study should be carried out with detailed stakeholder analysis involving overwhelming communities. Creation of legitimacy in national parks is difficult and often fragile due to external and internal pressures. The bureaucratic structure in park management limits community participation, while poverty conditions and lack of community sensitization also hinder active participation. Long-term trends in evaluation of sustainable conservation strategies are the key challenge and pose another limitation to study the impact of policies on the habitat of national parks. These challenges arise from the vulnerability of these mechanisms to external and internal pressures.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the [patients/ participants OR patients/participants legal guardian/next of kin] was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

BJ: Data curation, Formal Analysis, Methodology, Software, Visualization, Writing–original draft, Writing–review and editing. DH: Conceptualization, Funding acquisition, Resources, Supervision, Project administration, Writing–review and editing. DS: Data curation, Resources, Validation, Writing–review and editing. MA: Data curation, Methodology, Writing–original draft, Writing–review and editing. WS: Data curation, Validation, Writing–review and editing. ABa: Data curation, Methodology, Software, Writing–review and editing. QY: Data curation, Software, Writing–review and editing. ABu: Data curation, Software, Writing–review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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