

Predictors of Environmental Protection and Disaster Management

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Abstract

This study examines the predictors of Environmental Protection and Disaster Management (EPDM) capacity within local governments in Nepal, using the Local Government Institutional Capacity Self-Assessment (LISA) framework developed by the Ministry of Federal Affairs and General Administration. The LISA framework assesses local government capacity across ten domains. The study uses secondary data from the LISA framework, analyzing scores from 544 local bodies. The reliability analysis of the framework resulted in a Cronbach's alpha of 0.905, indicating a high internal consistency. A linear regression model identified Physical Infrastructure, Social Inclusion, and Collaboration and Cooperation as statistically significant predictors of EPDM capacity, explaining 52% of the variance. These findings underscore the importance of these three areas in building resilience within local governments in Nepal. The study underlines the importance of comprehensive capacity building, whereby improvements in one domain contribute to others, and suggests that targeted investments in infrastructure, inclusive policies, and coordination mechanisms are ways to improve the

capacity of local governments to cope with environmental and disaster-related challenges. The LISA framework stands out as a reliable tool for capacity assessment, laying the foundation for further research.

Introduction

Environmental protection and disaster management are increasingly critical concerns in global governance, especially for countries like Nepal that are prone to natural disasters. Nepal's geographical location in the seismically active Himalayan region and its susceptibility to flooding, landslides, and climate change impacts underscore the need for robust disaster management strategies (Twigg, 2004). Local governments in Nepal play a pivotal role in implementing these strategies, making their institutional capacity a key determinant of the country's overall resilience (Maharjan et al., 2023).

The Local Government Institutional Capacity Self-assessment (LISA), a self-assessment framework for institutional capacity of local government developed by the Ministry of Federal Affairs and General Administration (MoFAGA) of Nepal, offers a systematic approach to evaluating the capacities of local governments across various indicators, including infrastructure development, social inclusion, and service delivery. Previous studies have highlighted the importance of institutional capacity in effective disaster management, noting that well-developed infrastructure and inclusive governance practices can significantly enhance a community's ability to respond to and recover from disasters (World Bank, 2013). Furthermore, the integration of environmental protection with disaster management has been recognized as essential for sustainable development, particularly in vulnerable regions like South Asia (Blaikie et al., 2014).

Despite the critical role of local governments, there is limited empirical research on the specific factors that contribute to their capacity for environmental protection and disaster management in Nepal. This study aims to fill this gap by examining the predictors of Environmental Protection and Disaster Management Capacity within the LISA framework. By identifying key capacity indicators that influence this domain, the study provides insights that can inform policy and practice, ultimately enhancing the resilience of local communities in Nepal.

The Local Institutional Self-Assessment (LISA) framework, developed by the Ministry of Federal Affairs and General Administration (MoFAGA) in 2022, evaluates the capacity of local governments across ten domains, each weighted based on its relative significance. The Governance (GOV) domain, with the highest weight (21%), assesses

transparency, accountability, and participatory decision-making, including adherence to procedural standards, frequency of meetings, and use of the SUTRA system for financial management. Organization and Administration (OA) (16%) evaluates the efficiency of administrative structures, the implementation of capacity development plans, clarity of roles, and the presence of employee performance agreements. Annual Budget and Planning Management (ABPM) (15%) focuses on budget formulation, participatory budgeting, and SDG localization, ensuring alignment with national development objectives. Financial Management (FM) (12%) assesses revenue generation, financial discipline, procurement transparency, and the publication of audit reports. Service Delivery (SD) (16%) examines the local government's responsiveness to public needs, accessibility of ward offices, citizen satisfaction, and the adoption of technology to enhance service efficiency.

The remaining five domains focus on specialized aspects of local governance. Execution of Judicial Acts (EJA) (5%) evaluates the effectiveness of local judicial committees in resolving disputes fairly and transparently. Physical Infrastructure (PI) (10%) assesses planning and sustainability in infrastructure projects, adherence to building codes, disaster resilience, and accessibility for marginalized groups. Social Inclusion (SI) (5%) emphasizes the prevention of discrimination, representation of marginalized communities in governance, and gender-responsive budgeting. Environmental Protection and Disaster Management (EPDM) (5%) examines local disaster preparedness, pollution control efforts, and environmentally friendly policies. The study focuses on EPDM domain and analyzes how it is associated with other nine domains. Lastly, Cooperation and Coordination (CC) (5%) assesses intergovernmental collaboration, revenue distribution, and engagement with international organizations for resource management and development projects. Together, these ten domains provide a comprehensive evaluation of local government capacity, ensuring efficiency, accountability, and responsiveness in governance.

Review of Literature

EPDM capacity can be considered interlinked areas of governance, particularly for countries under exposure to natural risks like Nepal. The existing literature emphasizes that high institutional capacities, strategic investment in infrastructure, policy inclusivity, and intergovernmental collaboration must be invested to establish disaster resilience and environmental sustainability (Bosher, 2008; Cutter et al., 2003). This section reviews key theoretical and empirical literature that explain determinants of EPDM capacity in the local government, with an emphasis on governance, infrastructure, social inclusion, collaboration, and policy frameworks.

Institutional capacity plays a critical role in guaranteeing the effectiveness of disaster management interventions at the local level (Twigg, 2004). The concept of institutional capacity embraces governance structures, administrative capabilities, finance, and regulatory systems whereby local governments can handle environmental risks effectively. Literature shows that well-governed local governments with robust institutional systems can implement disaster risk reduction (DRR) strategies and facilitate environmentally friendly management (World Bank, 2013). Maharjan et al. (2023) further highlight that Nepal's local governments' institutional readiness has a significant influence on the extent to which they can respond and reduce disasters.

The Ministry of Federal Affairs and General Administration (MoFAGA) of Nepal has formulated the Local Government Institutional Capacity Self-Assessment (LISA) approach, which is a structured method of institutional capacity evaluation in various sectors (Ministry of Federal Affairs and General Administration, 2022). This design is critical to assessing the level at which governance structures influence EPDM outcomes. Studies employing LISA-like designs in other uses have shown that governance and institutional development has unambiguous correspondence with higher resilience against environmental shocks (Blaikie et al., 2014).

Infrastructure is a critical driver of disaster resilience because it affects a local government's capacity to prepare for, respond to, and recover from disasters in real time (Bosher, 2008). Physical infrastructure, including roads, drainage systems, emergency shelters, and communication networks, plays a critical role in minimizing the effects of disasters and facilitating quick response mechanisms (Gaillard, 2010). Inadequate infrastructure has been a major setback to effective disaster management in Nepal, particularly in rural municipalities with inadequate road links and emergency facilities (Maharjan et al., 2023).

Environmental investment in sustainable infrastructure as well as hazard-sensitive land-use planning has been pinpointed as an important EPDM capacity-building strategy. For instance, municipal governments that make disaster risk assessment a part of their infrastructure development planning are likely to be environmentally hazard-resilient (Bosher, 2008). Empirical evidence from Nepal shows that those municipalities with future-oriented infrastructure planning, including building code compliance and integration of early warning systems, have substantially enhanced disaster response capability (World Bank, 2013).

Social inclusion is a critical but often overlooked component of disaster management. Disaster risk is not uniformly distributed; vulnerable groups, including women, ethnic minorities, and people with disabilities, often carry disproportionate burdens (Gaillard, 2010). Socially inclusive governance ensures that disaster preparedness and response strategies address the interests of all stakeholders in a community, thereby enhancing overall resilience. Studies have established that local governments with effective social inclusion policies perform better in relief and rehabilitation during disasters (Cutter et al., 2003). In Nepal, the use of gender-responsive budgeting and inclusive decision-making within local government institutions has been linked with improved disaster preparedness and environmental management outcomes (MOFAGA, 2022). Policies emphasizing equitable resource distribution and proactive community participation have been shown to reduce the socio-economic impacts of disasters as well as guarantee long-term resilience (Blaikie et al., 2014).

Effective disaster management requires coordination among various stakeholders, including national authorities, international organizations, community associations, and local governments (World Bank, 2013). Inter-governmental coordination is also essential in Nepal, as disaster risks are widespread and require multi-level governance interventions. Evidence has established that local governments engaged in active coordination with international organizations and upper government authorities have stronger disaster management capacities (Blaikie et al., 2014). The existence of institutionalized partnership frameworks, such as coordinated emergency response teams and shared data platforms, enhances the efficacy of disaster prevention and response measures (Twigg, 2004). Evidence from Nepal indicates that municipalities with the capacity to collaborate with NGOs and private sector entities have greater access to finance and technical expertise, which corresponds to improved environmental and disaster management (Maharjan et al., 2023).

Mainstreaming of disaster management policies within broader environmental governance systems has been widely accepted as best practice in building resilience (Bosher, 2008). Nepal has made significant progress in policymaking, with legislations such as the Disaster Risk Reduction and Management Act (2017) framing a legal framework for comprehensive disaster governance. Efforts are still required to translate policies into action at the local level primarily due to a shortage of resources and lackadaisical enforcement (World Bank, 2013). Comparative studies have shown that countries with strong and well-enforced environmental conservation legislations tend to exhibit lower

loss related to disasters (Cutter et al., 2003). For Nepal, efforts should be made to ensure that local governments have the necessary financial and technical support for promoting national policies for developing EPDM capacity (MOFAGA, 2022). The EPDM literature points to several significant factors influencing the capacity of local governments to manage environmental and disaster risk effectively. Institutional capacity, physical infrastructure, social inclusion, intergovernmental coordination, and policy frameworks all influence resilience outcomes in significant ways. The LISA framework provides an important tool for quantifying these capacities and identifying areas of specific improvement.

Empirical evidence suggests that locally governed areas with investments in infrastructure, inclusive policy implementation, and cooperation with external partners have improved performance in conservation of the environment and disaster management. Nonetheless, there are wide gaps in incorporating policies into action in local governance, and policy action and more research is still required. Long-term impacts of capacity development programs need to be analyzed and explored by future studies, and it needs to be assessed how specific interventions can contribute to building disaster resilience in Nepal. By prior adjustment of these vital determinants, policymakers can make better decisions about implementing strategies for improving Nepal's local government disaster management capability that will result in sustainable development and the strengthening of resilience.

Research Methodology

The study is based on secondary dataset obtained from MoFAGA's publicly available web-portal (MOFAGA, 2024). The dataset includes scores on 10 different LISA indicators across all local governments in Nepal. The primary aim was to identify the predictors of the Environmental Protection and Disaster Management (EDM) as a LISA capacity indicator by examining the relationships between this indicator and the other nine indicators. LISA framework and the maximum score possible in each capacity is outlined below in Table 1. The abbreviations for each indicator are assigned for the purpose of this study only.

There are 753 local bodies in Nepal including including 6 metropolises, 11 sub-metropolises, 276 municipalities, and 460 gaunpalikas (rural municipality). It must be noted that all local bodies, didn't report measures in all LISA indicators and this is the reason why only data from 544 local bodies were analyzed.

Table 1*LISA Framework of local government of Nepal*

S.N.	Indicators	Maximum Possible Score
1.	Governance (GOV)	9
2	Organization and Administration (OA)	8
3	Annual Budget and Planning Management (ABPM)	11
4	Financial Management (FM)	11
5	Service Delivery (SD)	16
6	Execution of Judicia Act (EJA)	7
7	Physical Infrastructure (PI)	13
8	Social Inclusion (SI)	10
9	Environmental Protection and Disaster Management (EDM)	9
10	Collaboration and Cooperation (CC)	6

Source: Ministry of Federal Affairs and General Administration (2022)

To assess the reliability of the LISA framework, an internal consistency analysis was conducted using Cronbach's α , yielding a score of 0.905, indicating high reliability. Average last four years scores of each 10 indicators of LISA framework were calculated for all local bodies. Local bodies with incomplete data were dropped from the calculation. Linear regression model where environment protection and disaster management (EPDM) was criterion variable (dependent variable), and other remaining 9 LISA indicators as predictors was developed and tested.

The general form of a multiple linear regression model is:

$$EPDM = \beta + \beta_1 GOV + \beta_2 OA + \beta_3 ABPM + \beta_4 FM + \beta_5 SD + \beta_6 EJA + \beta_7 PI + \beta_8 SI + \beta_9 CC + \epsilon$$

Where:

EPDM = Dependent variable (Environmental Protection and Disaster Management Capacity)

GOV, OA, ABPM, FM, SD, EJA, PI, SI, CC = Independent variables (factors influencing EDM)

β_0 = Intercept (Baseline level of EPDM when all predictors are zero)

$\beta_1, \beta_2, \dots, \beta_9$ = Coefficients (representing the change in EPDM for a one-unit change in each respective independent variable, holding others constant)

ϵ = Error term (captures unobserved factors influencing EPDM)

Findings and Discussion

A reliability analysis of the framework produced a Cronbach’s alpha of 0.905, signifying high internal consistency among the indicators for assessing local government capacity. This strong reliability indicates that each of the framework’s indicators consistently contributes to evaluating local governments’ overall capacity, making the LISA framework a dependable tool for understanding institutional readiness in various domains.

The correlation analysis, which is summarized in Table 2, revealed significant positive relationships among all the framework’s indicators, meaning that high scores in one capacity area are generally associated with higher scores in others. This interconnectedness suggests that capacity building in one domain often strengthens others, indicating a mutually reinforcing system within local governance. For example, local governments with effective governance or financial management structures are more likely to excel in service delivery, infrastructure, and social inclusion, which ultimately supports disaster management and environmental protection efforts. The findings emphasize the need for an integrated approach to capacity building, as improvements in any one domain can yield broader benefits across the governance structure.

Table 2

Correlation Matrix among LISA Domains

	n	Mean	SD	1	2	3	4	5	6	7	8	9	10
GOV	540	7.49	0.76	—									
OAD	540	5.57	1.08	0.590	—								
BFP	540	7.17	1.27	0.521	0.606	—							
FBM	540	8.10	1.22	0.580	0.655	0.659	—						
SDL	540	11.09	1.78	0.621	0.688	0.629	0.655	—					
JUM	540	5.70	1.05	0.368	0.276	0.358	0.356	0.394	—				
INF	540	6.37	2.02	0.531	0.511	0.586	0.541	0.617	0.406	—			
SOI	540	5.60	1.58	0.484	0.565	0.520	0.508	0.639	0.270	0.525	—		
EDM	540	4.35	1.39	0.499	0.471	0.517	0.482	0.560	0.370	0.635	0.596	—	
CCO	540	2.43	1.35	0.465	0.445	0.438	0.427	0.498	0.353	0.553	0.487	0.552	—

Note: All correlation coefficients were significant at 0.05 level

Source: Ministry of Federal Affairs and General Administration (2024)

When the study applied a general linear regression model to determine specific predictors of EPDM capacity, three indicators emerged as statistically significant: Physical Infrastructure (PI), Social Inclusion (SI), and Collaboration and Cooperation (CC). The

output of the regression fit is summarized in Table 3 and Table 4. Table 3 shows model fit measures where R, correlation coefficient, is 0.724 and R^2 , coefficient of determination, is 0.524. These three predictors collectively explained around 52% of variance in EPDM capacity. Coefficient of each of the three predictors can be viewed in Table 4. Based on the values of coefficients of the three domains, SI was the top predictor followed by PI and then CC. This finding implies that local governments with inclusive policies, better physical infrastructure, and effective collaboration mechanisms have a greater ability to manage disaster and environmental challenges. Specifically, physical infrastructure aids in risk mitigation through better facilities and more efficient emergency responses. Social inclusion ensures equitable disaster management, safeguarding vulnerable populations and enhancing community resilience. Collaboration and cooperation foster alignment across governmental levels and agencies, facilitating unified and effective responses in crisis situations.

Although these three predictors account for a significant portion of EPDM capacity, 48% of the variance remains unexplained by the model. This suggests that additional, unmeasured factors may influence a local government's capacity for environmental protection and disaster management, warranting further investigation into other potential predictors or contextual influences. The positive coefficients for PI, SI, and CC underscore the essential role of these areas in building resilience within Nepal's local governments, reinforcing the importance of infrastructure, inclusive policies, and coordinated efforts.

Table 3

Model Fit Measures

Model	R	R^2
1	0.724	0.524

Source: MOFAGA (2024)

Table 4

Model Coefficients Predicting EPDM

Predictor	Estimate	SE	t	p
Intercept	0.723	0.1674	4.32	<.001
PI	0.250	0.0264	9.47	<.001
SI	0.272	0.0322	8.46	<.001
CC	0.209	0.0385	5.42	<.001

Source: MOFAGA (2024)

Overall, the study's results highlight the need for a comprehensive, interdependent approach to capacity building. By focusing on physical infrastructure, social inclusion, and collaboration, policymakers can enhance local governments' resilience and capability in environmental protection and disaster management. The strong reliability of the LISA framework not only validates it as a robust tool for capacity assessment but also sets a foundation for further research to explore causal relationships and assess the long-term impact of capacity-building initiatives.

The findings underscore the importance of focusing on three specific areas: Physical Infrastructure, Social Inclusion, and collaboration and cooperation to enhance the capacity for environmental protection and disaster management within local governments. Physical infrastructure not only aids in the mitigation of risks through better facilities but also enhances the efficiency and reach of disaster response efforts. Social inclusion ensures that disaster management practices are equitable and protect the most vulnerable groups, enhancing the community's overall resilience. Finally, collaboration and coordination among government levels and external agencies ensure a unified response, maximizing resource use and operational effectiveness.

The study reveals a holistic, interdependent framework where capacities in governance, finance, and service delivery mutually reinforce each other. Improvements in one domain often leading to corresponding benefits in others, advocating for a comprehensive approach to capacity building.

This analysis provides valuable insights for policymakers, suggesting that targeted investments in infrastructure, inclusive policies, and coordination mechanisms can significantly enhance Nepal's local governments' resilience to environmental and disaster-related challenges. The high internal consistency of the LISA framework further establishes it as a reliable tool for capacity assessment, laying a foundation for future research to examine the causal mechanisms and effectiveness of capacity-building interventions over time.

These results are consistent with existing literature, which emphasizes that robust infrastructure is essential for disaster resilience, providing the necessary physical foundation for effective emergency response and recovery efforts (Bosher, 2008). Social inclusion, on the other hand, ensures that disaster management strategies are equitable and that vulnerable populations are adequately protected (Gaillard, 2010). The positive correlations between the various indicators suggest that improvements in one area of capacity are likely to benefit others, reinforcing the need for a holistic approach to capacity building.

Effective disaster management requires not only strong infrastructure and inclusive policies but also seamless coordination among various stakeholders, including government

agencies, non-governmental organizations, and local communities (Cutter et al., 2003). Enhancing collaboration and coordination could therefore amplify the overall capacity for environmental protection and disaster management, leading to more resilient local governance in Nepal.

This study contributes to the growing body of literature on local governance and disaster management in Nepal by identifying specific capacity areas that can be targeted for improvement. The high reliability of the LISA framework, as evidenced by the Cronbach's α score, further supports its utility as a robust tool for assessing and improving local government capacities. Future research could explore the causal mechanisms underlying these relationships and investigate the impact of targeted interventions on enhancing capacity in the identified areas. Additionally, longitudinal studies could provide insights into how these capacities evolve over time and their long-term impact on disaster resilience and environmental sustainability in Nepal.

Conclusion

This study highlights the important role of local governments in Nepal toward EPDM, highlighting the role of physical infrastructure, social inclusion, and coordination and cooperation as critical predictors of EPDM capacity. The evidence reveals that local governments with advanced infrastructure, inclusive policy, and inter-governmental coordination are in a better position to respond to environmental and disaster challenges.

The study also emphasizes the interconnectedness of institutional capacities in the LISA model. The significant positive correlations across different capacity domains show that improvement in one area can have spill-over benefits on others. This underscores the necessity of an overall, integrated capacity development strategy in which investments in governance, financial management, and service delivery all contribute to local disaster resilience building.

The excellent internal consistency of the LISA instrument as indicated by the Cronbach's alpha score demonstrates the instrument as a reliable institutional capacity measure. However, the regression model only explains 52% of EPDM capacity variation, meaning that other unknown factors also influence EPDM capacity. Future research would explore other variables such as political leadership, community engagement, and measures of climate change adaptation to add to the knowledge of local government capacity in disaster management.

As Nepal is prone to natural hazards, the policymakers must invest more in infrastructure, social equity, and inter-agency coordination to enhance disaster resilience. Development in these areas will not only enhance the ability of local governments to

respond to crises but also long-term sustainability and development. The study can be a good reference for stakeholders who want to improve local governance and institutional resilience in disaster-risk-prone areas.

Author Introduction

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