GRASSROOTS JOURNALS

Grassroots Journal of Natural Resources, Vol.9 No.2 (August 2026)
ISSN: 2581-6853 | CODEN: GJNRA9 | Published by The Grassroots Institute
Website: https://grassrootsjournals.org/gjnr | Main Indexing: WoS, CABELL, EBSCO

ISSN 2581-6853 | 9(2) August 2026

00651 | Research Article

Beyond Operational Capacity: Institutional Gaps and Transformative Resilience in the Governance of a Forest Protected Landscape in the Philippines

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How to cite this paper: Grefalda, L.B., Pulhin, J.M. and Harada, K. (2026). Beyond Operational Capacity: Institutional Gaps and Transformative Resilience in the Governance of a Forest Protected Landscape in the Philippines. *Grassroots Journal of Natural Resources*, 9(2): 78-107. Doi: https://doi.org/10.33002/nr2581.6853.090204

Received: 25 June 2026
Reviewed: 23 July 2026
Provisionally Accepted: 26 July 2026
Revised: 30 July 2026
Finally Accepted: 09 August 2026
Published: 30 August 2026
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Abstract

Protected landscapes are increasingly recognized as both ecological conservation areas and complex governance systems exposed to climate and disaster risks. This study assesses perceived governance capacity in the Upper Marikina River Basin Protected Landscape (UMRBPL) in the Philippines. Using a survey adapted from established resilience and institutional capacity frameworks, the study examined seven dimensions: access rights and entitlements, information flows, decision-making processes, application of new knowledge, capacity to anticipate risk, capacity to respond, and capacity to recover and change. Data were gathered from 55 respondents across five local government units, the Department of Environment and Natural Resources, the Rizal Provincial Planning Office, and the Protected Area Management Board. Descriptive statistics assessed perceived institutional capacity, while Spearman's rho and Cramér's V tested associations between resilience conditions and selected sociodemographic variables. Results showed an overall mean score of 3.76, indicating a high level of perceived institutional capacity. Application of new knowledge (3.88) and capacity to respond (3.87) received the highest scores, whereas information flows (3.59) and capacity to recover and change (3.64) received comparatively lower scores. Age and years in office were significantly and negatively associated with selected institutional dimensions. While UMRBPL institutions demonstrate robust operational capacity in response, risk anticipation, and knowledge application, they are constrained by fragmented information flows, weak institutional memory, and limited transformative recovery mechanisms.

Keywords

Institutional resilience; Protected landscape governance; Forested protected area; Transformative resilience; Climate and disaster resilience

Introduction

Protected areas are increasingly recognized not only as sites for biodiversity conservation but also as complex social-ecological systems in which ecological processes and human governance are deeply interconnected (Cumming and Allen, 2017; Dudley *et al.*, 2015). Within these systems, ecological outcomes are shaped not solely by biophysical conditions but also by institutional arrangements, policy decisions, and socioeconomic dynamics operating across multiple scales (Cumming and Allen, 2017; Cumming *et al.*, 2015). In hazard-prone and rapidly urbanizing contexts such as the Philippines, protected landscapes perform critical functions beyond conservation, including water regulation, flood mitigation, and climate-related shock buffering. Global assessments emphasize that ecosystem protection is central to climate-resilient development, particularly in regions facing increasing climate variability (IPCC, 2022; Paudel *et al.*, 2024). Institutional resilience has therefore emerged as a central concept for understanding how governance systems respond to environmental disturbances. Despite this recognition, the effectiveness of protected areas depends not only on ecological integrity but also on the capacity of governing institutions to manage risks, coordinate across sectors, and adapt to changing conditions (Abdulaziz *et al.*, 2019; Borrini-Feyerabend *et al.*, 2013). Resilience literature highlights that institutions play a key role in shaping how systems anticipate, absorb, respond to, and recover from disturbances (Béné *et al.*, 2012; Graveline and Germain, 2022; Tanner, Bahadur and Moench, 2017; Tyler and Moench, 2012). Within protected landscapes, resilient institutions are expected to balance conservation objectives with disaster risk reduction, stakeholder participation, and sustainable resource management.

However, existing studies often assess institutional capacity in fragmented ways, focusing separately on governance structures, response mechanisms, and adaptive capacity. This limits an understanding of how different dimensions of capacity interact within protected landscape governance, particularly in Global South contexts where institutional constraints persist (Borrini-Feyerabend *et al.*, 2013; Simmons and Simmons, 2023). Such approaches offer valuable insight into individual governance functions but say less about how these capacities interact to support resilience across governance levels. In particular, relatively little empirical research has examined whether governance systems possess balanced capacities across operational**,** integrative**,** and transformative dimensions of resilience, especially within protected landscapes in developing countries.

The Upper Marikina River Basin Protected Landscape (UMRBPL) in the Philippines provides a compelling case for examining these issues. As a legally designated protected area under the Expanded National Integrated Protected Areas System Act (Republic of the Philippines, 2018), it operates in a multi-level governance system involving national agencies like the Department of Environment and Natural Resources (DENR), local government units (LGUs), and the Protected Area Management Board (PAMB). Its exposure to urban pressure and climate hazards makes institutional capacity a central determinant of its long-term sustainability.

In the Philippine context, LGUs and public institutions play a key role in resilience-building by enforcing environmental regulations, guiding local planning, delivering public

services, and mediating access to resources. Evidence from local climate and disaster governance studies shows that institutional resilience is shaped by technical competence, stakeholder engagement, organizational capacity, and implementation support systems (Grefalda *et al.*, 2020; Pulhin *et al.*, 2021). At the same time, adaptation priorities may differ across decision-makers and marginalized communities, underscoring the need for inclusive, context-sensitive governance (Nabong *et al.*, 2021). These dynamics make the UMRBPL a relevant case for examining how institutional capacity is distributed across operational, integrative, and transformative resilience functions.

This study adopts an institutional resilience perspective, conceptualizing resilience not as a single aggregate capacity but as a layered governance process composed of operational, integrative, and transformative functions. While existing frameworks distinguish absorptive, adaptive, and transformative capacities (Béné *et al.*, 2012; Folke *et al.*, 2010; Tanner, Bahadur and Moench, 2017; Tyler and Moench, 2012), they remain limited in explaining how these capacities are distributed and interact within multi-level governance systems. This study addresses that gap by adapting and empirically applying a layered institutional resilience framework to examine uneven governance capacities across seven dimensions: access rights and entitlements, information flows, decision-making processes, application of new knowledge, capacity to anticipate risk, capacity to respond, and capacity to recover and change. It aims to assess the institutional capacity of governance actors in the UMRBPL for climate and disaster resilience. Specifically, it seeks to: (1) determine the perceived institutional capacity across seven resilience-related dimensions; (2) examine how these dimensions are distributed across operational, integrative, and transformative resilience layers; (3) analyze associations between institutional resilience dimensions and selected sociodemographic variables; and (4) evaluate institutional gaps and leverage points for strengthening protected landscape governance.

Conceptualizing Layered Institutional Resilience

Drawing on existing resilience and adaptive governance scholarship, the study contributes to resilience research by synthesizing and operationalizing a layered institutional resilience framework that links operational, integrative, and transformative capacities to specific governance functions in protected landscape systems (Figure 1). The framework shows the core governance functions, institutional capacity dimensions, empirical indicators, and theoretical meanings at three levels. It conceptualizes institutional resilience as a layered governance capacity composed of three interdependent functions: (1) operational resilience or the capacity to anticipate risks and respond effectively; (2) integrative resilience or the capacity to coordinate information, make decisions, and apply new knowledge; and (3) transformative resilience or the capacity to recover and change (Cardona *et al.*, 2012; Friend and MacClune, 2012; Friend and Moench, 2013; Tyler and Moench, 2012). This layered approach allows for a more precise interpretation of institutional capacity, revealing how strength in one domain, response, for instance, can coexist with weakness in another, such as coordination or transformation.

This layered view is consistent with resilience scholarship that distinguishes between the capacity to absorb disturbance, adapt through learning and coordination, and transform

institutional arrangements when existing systems are no longer sufficient (Béné *et al.*, 2012; Folke *et al.*, 2016; IPCC, 2022). Rather than treating resilience as a single institutional attribute, the framework positions resilience as a differentiated set of governance capacities that may develop unevenly across institutional functions.

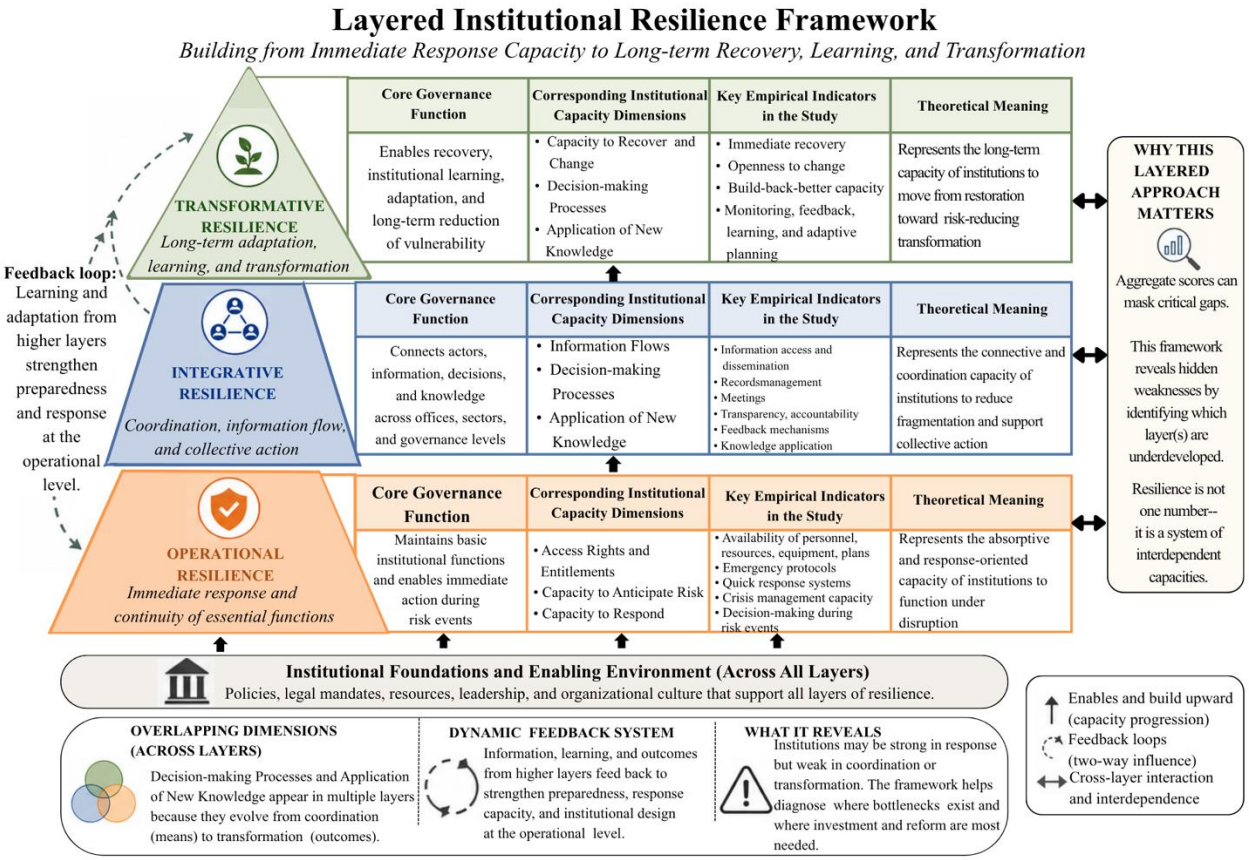

Figure 1: Layered institutional resilience framework: Building from operational to transformative resilience [*Sources:* Cardona *et al.* (2012); Friend and MacClune (2012); Friend and Moench (2013); Tyler and Moench (2012)]

Operational resilience represents the absorptive and response-oriented capacity of institutions. It refers to the ability of governance actors to maintain basic institutional functions and act immediately during risk events. The dimensions access rights and entitlements, capacity to anticipate risk, and capacity to respond are placed in this layer because they reflect the minimum institutional conditions needed to function under disruption, including personnel, resources, equipment, plans, emergency protocols, quick-response systems, and crisis management capacity. It measures whether institutions can absorb shocks and continue operating — a necessary but not sufficient condition for full resilience. In resilience theory, this corresponds to absorptive capacity, or the ability of systems to withstand disturbance while preserving essential functions (Béné *et al.*, 2012; IPCC, 2022).

Integrative resilience refers to the connective and coordinating capacity of institutions. This is central to protected landscape governance because it involves multiple offices, sectors, and governance levels. Information flows, decision-making processes, and the application of new knowledge are placed here because coordination depends on accessible information, records management, regular meetings, transparent decision-making, accountability, feedback mechanisms, and the practical use of knowledge. It reveals whether institutions act individually or are capable of coordinated, collective governance. Weakness at this layer tends to produce fragmented action, duplicated effort, poor institutional memory, or delayed decision-making. This interpretation is consistent with adaptive governance literature, which emphasizes learning, information exchange, institutional networks, and cross-scale coordination as central to governing complex social-ecological systems (Folke *et al.*, 2005; Folke *et al.*, 2016; Gupta *et al.*, 2010). A key distinction in this framework is that integrative resilience primarily involves coordination, information sharing, adaptive adjustment, and maintaining coherence across offices, sectors, and governance levels. It strengthens institutions' ability to work together, align decisions, exchange knowledge, and reduce fragmentation within existing governance arrangements. Transformative resilience, in contrast, refers to deeper institutional redesign, structural and systemic change, and alterations in governance pathways when existing arrangements are no longer sufficient to reduce vulnerability. Integrative resilience, then, improves coordination and adaptation within the existing system, whereas transformative resilience concerns whether institutions can change the system itself.

Transformative resilience refers to the long-term capacity of institutions to recover, learn, adapt, and reduce vulnerability. It moves beyond restoring normal operations toward institutional change and risk-reducing transformation. Capacity to recover and change is central to this layer, while decision-making processes and application of new knowledge also contribute when they support learning, adaptive planning, and feedback that improves future governance. The empirical indicators, including immediate recovery, openness to change, build-back-better capacity, monitoring, feedback, learning, and adaptive planning, assess whether institutions are capable of moving from short-term restoration toward risk-reducing transformation. This aligns with literature on transformative resilience, which views recovery as an opportunity not only to return to pre-disruption conditions but also to reduce future vulnerability and enable systemic change (Béné *et al.*, 2012; Graveline and Germain, 2022; Tanner *et al.*, 2015).

Although presented in layered form, the framework is not linear. Instead, institutional resilience develops through recursive interactions among response, coordination, learning, and adjustment. Transformative processes, such as learning, monitoring, and adaptive planning, can strengthen lower layers by improving preparedness, refining response protocols, and informing future decisions. Similarly, integrative processes facilitate both immediate response and long-term adaptation by enabling continuous information exchange. This feedback logic is consistent with adaptive governance theory, which emphasizes iterative learning, institutional flexibility, and cross-scale interaction in managing complex social-ecological systems (Folke *et al.*, 2005; Gupta *et al.*, 2010).

The framework is further supported by institutional foundations that operate across all layers, including policies, legal mandates, resources, leadership, and organizational

culture. These conditions shape how institutional capacities are developed and sustained. Weak foundations may constrain performance even when specific capacities exist within individual offices or programs, while strong enabling conditions reinforce coherence across operational, integrative, and transformative functions. This is consistent with institutional adaptive capacity literature, which highlights leadership, resources, fairness, learning capacity, and governance arrangements as key conditions for responding effectively to environmental change (Gupta *et al.*, 2010).

Operational resilience corresponds to absorptive capacity, integrative resilience reflects adaptive capacity through coordination and knowledge exchange, and transformative resilience aligns with the capacity for systemic change and long-term vulnerability reduction (Béné *et al.*, 2012; Folke *et al.*, 2016; Graveline and Germain, 2022; IPCC, 2022). Adapted from existing resilience and adaptive governance literature, the framework was operationalized in this study to examine how institutional capacity dimensions are distributed across operational, integrative, and transformative layers. Its value lies in revealing that institutional resilience is not only multidimensional but also structurally uneven, with weaknesses that aggregate capacity scores may hide.

Methodology

Study Site

The study was conducted in the Upper Marikina River Basin Protected Landscape (UMRBPL), a legislated protected area covering approximately 26,125.64 ha in Rizal Province (Figure 2). Located about 20 km east of Metro Manila, it spans the municipalities of Rodriguez, San Mateo, Baras, Tanay, and Antipolo City and is governed under Republic Act No. 11038. The study area is situated upstream of Metro Manila at approximately 14°40′16″N and 121°12′50″E.

Under the Modified Coronas Climate Classification, the Upper Marikina River Basin falls under two climate types, I and III. The entire Wawa Sub-river Basin and the western portions of the three other sub-river basins experience a Type I climate, characterized by two pronounced seasons: a wet season from June to September and a relatively dry season during the remainder of the year. In contrast, the eastern portion of the study area, which includes the headwaters of the three sub-river basins, is influenced by a Type III climate. Although generally similar to the Type I climate in the western portion, Type III has less pronounced seasonal variations, with relatively dry conditions from November to April and wetter conditions during the rest of the year. The major vegetation communities include the following: (a) Agricultural areas/ Agroforestry/ Plantations; (b) Grasslands; (c) Bamboo thickets; (d) Secondary Growth Vegetation; (e) Lowland evergreen Forest; (f) Forest over Limestone; and (g) Montane Forest (AECOM Philippines, Inc., 2012).

The UMRBPL plays a critical role in watershed protection, biodiversity conservation, and disaster risk mitigation, yet its proximity to Metro Manila leaves it exposed to mounting land-use pressures. Despite its protected status, rapid urban expansion, land conversion, illegal resource extraction, and infrastructure development linked to Metro Manila's growth continue to erode the landscape. In addition, the landscape is

increasingly vulnerable to climate change impacts, including more frequent extreme rainfall events, flooding, and landslides. These challenges make UMRBPL a useful case for examining institutional resilience, governance capacity, and adaptive management in protected-area systems.

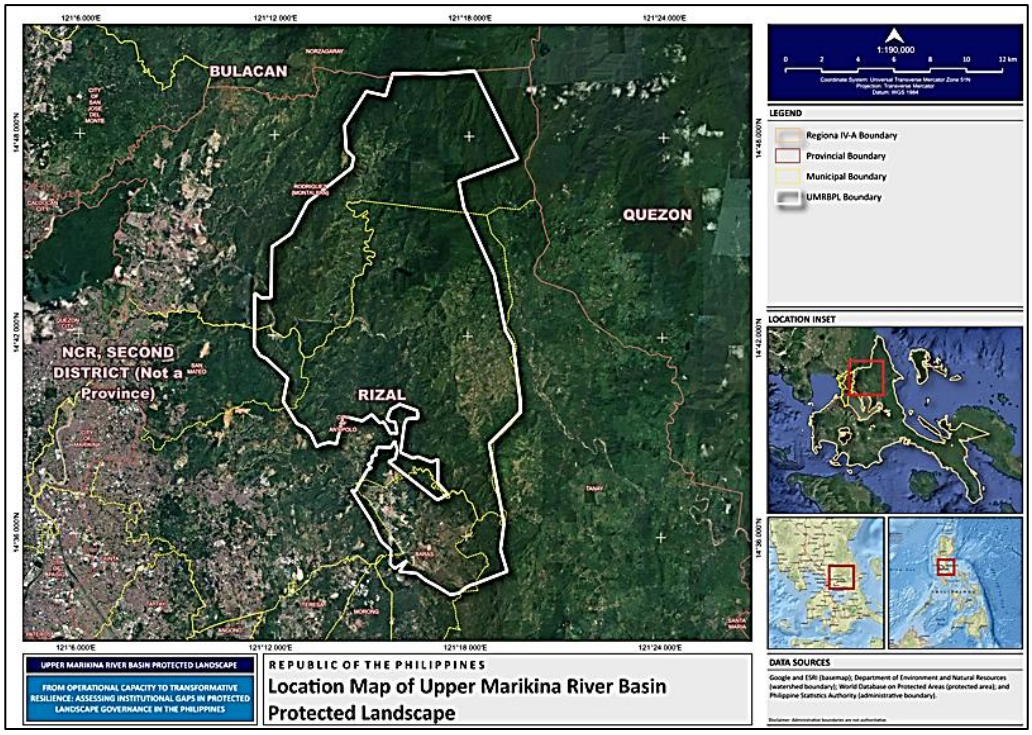

Figure 2: Location map of the Upper Marikina River Basin Protected Landscape
Source: QGIS Association (2026). Base map adapted from Google (n.d.) and Esri (n.d.). Boundary data layers adapted from UNEP-WCMC and IUCN (2026) and Philippine Statistics Authority (2016)

Survey Instrument

This study employs a quantitative institutional assessment using a structured survey instrument adapted from established resilience and governance frameworks (Friend and MacClune, 2012; Grefalda *et al.*, 2020; Tyler and Moench, 2012) (Table 1). It measured seven dimensions: access rights and entitlements, information flows, decision-making processes, application of new knowledge (Friend and MacClune, 2012; Tyler and Moench, 2012), capacity to anticipate risk, capacity to respond, and capacity to recover and change (Cardona *et al.*, 2012; Friend and Moench, 2013). Responses were measured using a 5-point Likert scale.

The corresponding Likert scales are presented in table 2. The verbal interpretation of average scores was based on a common 5-point Likert equal-interval scheme: 1.00–1.80 as very low; 1.81–2.60 as low; 2.61–3.40 as moderate; 3.41–4.20 as high; and 4.21–5.00 as very high (Nyutu, Cobern and Pleasants, 2021). In this study, these were adopted to reflect institutional capacity levels, with 1.00–1.80 interpreted as lacking capacity; 1.81–

2.60 as low capacity; 2.61–3.40 as moderate capacity; 3.41–4.20 as high capacity; and 4.21–5.00 as very high capacity (Table 3).

Table 1: Institutional Capacity Dimensions and Number of Survey Indicators

Dimension Sets	*Number of Indicators*
Access rights and entitlements	16
Information flows	14
Decision-making processes	18
Application of new knowledge	4
Capacity to anticipate risk	10
Capacity to respond	5
Capacity to recover and change	3

Table 2: Likert scales used in the dimension for institutional capacity

Likert Scale	*Dimension Set 1–4* Friend and MacClune (2012), Tyler and Moench (2012)	*Dimension Set 5–7* Friend and Moench (2013), Tyler and Moench (2012)
1	Very dissatisfied	Poor
2	Dissatisfied	Below average
3	Slightly satisfied	Average
4	Satisfied	Above average
5	Very satisfied	Excellent

Reliability of the dimensions was assessed using Cronbach's alpha (Table 4), with coefficients ranging from 0.9126 (capacity to anticipate risk) to 0.9578 (capacity to respond), well above the conventional threshold for excellent reliability (McNeish, 2018; Taber, 2017). However, Cronbach's alpha should not be treated as the sole evidence of scale quality; thus, reliability results were interpreted alongside the theoretical alignment of the dimensions with the study's institutional capacity framework (Hayes and Coutts, 2020). The high alpha coefficients support the instrument's reliability for assessing institutional capacity in the UMRBPL governance context.

Table 3: Interpretation of Mean Scores for Institutional Capacity Levels

Likert Scale Interval	*Interpretation*
1.00–1.80	Lacking capacity
1.81–2.60	Low capacity
2.61–3.40	Moderate capacity
3.41–4.20	High capacity
4.21–5.00	Very high capacity

Institutional capacity was measured through respondents' assessments of their own agencies, functions, and practices; thus, the findings are interpreted as perceived institutional capacity rather than direct evidence of actual performance. Potential self-assessment bias was mitigated through neutral, behavior-oriented dimensions, confidentiality assurances, and aggregate reporting. Nevertheless, self-assessment approaches may still produce socially desirable or favorable responses, particularly when respondents evaluate institutions in which they are directly involved. Given the

reliance on self-assessment data from 55 respondents, future studies may triangulate these findings with document analysis, key informant interviews, budget records, disaster response reports, and longitudinal institutional performance data.

Table 4: Cronbach's alpha reliability coefficients of the institutional capacity dimensions

Dimension Sets	*Inter-item Correlation Value*	*Alpha*
Access rights and entitlement	0.4390	0.9260
Information flows	0.5565	0.9461
Decision-making process	0.5538	0.9572
Application of new knowledge	0.8317	0.9519
Capacity to anticipate risk	0.5109	0.9126
Capacity to respond	0.8196	0.9578
Capacity to recover and change	0.8104	0.9276

Conduct of Survey and Selection of Participants

The institutional capacity assessment targeted key local stakeholders involved in governing the UMRBPL in Rizal Province. Participants included representatives from the five LGUs within the protected area, namely Antipolo City, Baras, San Mateo, Tanay, and Rodriguez, as well as members of the PAMB, the Provincial Planning Office, and DENR Region IV-A. In total, 55 respondents completed the survey. The respondents were purposively selected based on their direct involvement in the governance and operations of the protected area. As members of the PAMB, DENR, LGUs, and related offices, they are familiar with the day-to-day functioning of the protected landscape and participate in its decision-making processes. Thus, they are in a position to provide informed and relevant assessments of institutional capacity. The sample reflects the maximum number of available and qualified respondents reached during data collection. Because the study targeted institutional governance actors directly involved in UMRBPL management rather than the general population, a purposive institutional sampling approach was used. The 55 respondents represent key agencies and governance actors responsible for protected landscape planning, coordination, environmental management, disaster risk reduction, and decision-making within the UMRBPL governance system. Thus, the study prioritizes institutional relevance and governance representation over statistical generalization. Data collection began during the regular PAMB meeting on June 24, 2025, followed by additional survey administration through researcher visits to participating LGUs and concerned agencies on August 15, 2025.

Data Analysis

Survey data were analyzed using R statistical software. Descriptive statistics included means, standard deviations, frequencies, and percentages. The Likert-scale results were interpreted as indicative patterns of perceived institutional conditions rather than precise measurements of actual institutional effectiveness; accordingly, the analysis emphasized comparative patterns across governance dimensions. Cronbach's alpha was used to assess the internal consistency of each institutional capacity dimension. Spearman's rank correlation coefficient was used to examine associations involving age, years in office, and educational attainment, while Cramér's V was used for sex and professional role. Statistical significance was set at $p < .05$. For consistent interpretation, the absolute

magnitude of Spearman's rho was classified as negligible (< .10), weak (.10-.29), moderate (.30-.49), or strong (≥ .50), following the convention summarized by Akoglu (2018). Because qualitative thresholds are context-dependent, the coefficients and p-values are reported alongside the verbal descriptors.

Results

Respondent Profile

Among the 55 respondents, 24 were female (43.64%), and 31 were male (56.36%). Regarding educational attainment, the respondents were generally highly educated. Most possessed a tertiary (bachelor's) qualification (81.82%), while 16.36% had completed postgraduate studies. Only one respondent (1.82%) reported elementary education, and none reported secondary education as their highest educational attainment. This profile suggests respondents had the academic background needed to assess institutional governance and management practices with some degree of informed judgment (Table 5). In terms of professional role, 30 occupied supervisory positions, 13 held technical roles, 5 performed administrative functions, and 7 were elected officials involved in local leadership or governance. Respondents had an average tenure of 5.8 years in their current positions and a mean age of 46.1 years, suggesting considerable professional experience and organizational familiarity. These characteristics lend some credibility to the assessments, as respondents were likely familiar with governance structures, operational procedures, and institutional challenges within the UMRBPL.

Table 5: Sociodemographic profile of the respondents

	Frequency	*Percentage (%)*
Sex		
Female	24	43.64
Male	31	56.36
Professional Role		
Supervisory	30	54.55
Technical	13	23.64
Administrative	5	9.09
Elected official	7	12.73
Educational attainment		
Elementary	1	1.82
Secondary	0	0
Tertiary	45	81.82
Postgraduate	9	16.36
Average years in office	5.8 years	
Average age	46.1 years	

Perceived Institutional Capacity Across the Seven Dimensions

The overall mean score was 3.76, which falls within the high perceived institutional capacity category (Table 6). Application of new knowledge recorded the highest mean (3.88), followed by capacity to respond (3.87), access rights and entitlements (3.79),

decision-making processes (3.78), and capacity to anticipate risk (3.75). Capacity to recover and change (3.64) and information flows (3.59) obtained the two lowest dimension-level means, although both remained within the high category.

Item-level results showed the greatest limitations within information flows. The lowest scores concerned the availability of databases and records-management support systems (3.29), transfer of information from previous to incoming personnel (3.29), ease of retrieving relevant records (3.31), and availability of historical records (3.38). Relatively lower scores were also observed for staffing (3.44), equipment and supplies (3.53), access to new technologies (3.58), monitoring the impacts of decisions (3.42), and incentives for good performance (3.36). Detailed item-level results are provided in Appendix A.

Table 6: Summary of institutional capacity assessment

Dimension	*Average Score*
Access rights and entitlements	3.79
Information flows	3.59
Decision-making processes	3.78
Application of new knowledge	3.88
Capacity to anticipate risk	3.75
Capacity to respond	3.87
Capacity to recover and change	3.64
Mean	3.76

Note: Detailed item-level results for each institutional capacity dimension are provided in Appendix A.

Sociodemographic Associations with Institutional Resilience

Age was significantly and negatively associated with access rights and entitlements (ρ = -0.274, p = .043), information flows (ρ = -0.396, p = .003), application of new knowledge (ρ = -0.326, p = .015), and capacity to respond (ρ = -0.282, p = .037). The associations with information flows and application of new knowledge were moderate, while those with access rights and entitlements and capacity to respond were weak (Table 7).

Years in office was significantly and negatively associated with access rights and entitlements (ρ = -0.311, p = .021), information flows (ρ = -0.271, p = .046), capacity to anticipate risk (ρ = -0.331, p = .014), and capacity to respond (ρ = -0.282, p = .037). The associations with access rights and entitlements and capacity to anticipate risk were moderate, whereas those with information flows and capacity to respond were weak. Educational attainment was not significantly associated with any institutional resilience dimension.

Table 7: Spearman's rho for age, years in office, and educational attainment

Sociodemo-graphic Variable	*Indicators*	*p-value*	*ρ*	*Interpretation*
Age	Access rights and entitlement	0.043	–0.274	Significant, weak negative association
	Information flows	0.003	–0.396	Significant, moderate negative association

	Decision-making process	0.285	–0.147	Not significant, weak negative association
	Application of new knowledge	0.015	–0.326	Significant, moderate negative association
	Capacity to anticipate risk	0.107	–0.220	Not significant, weak negative association
	Capacity to respond	0.037	–0.282	Significant, weak negative association
	Capacity to recover and change	0.270	–0.151	Not significant, weak negative association
Years in office	Access rights and entitlement	0.021	–0.311	Significant, moderate negative association
	Information flows	0.046	–0.271	Significant, weak negative association
	Decision-making process	0.147	–0.198	Not significant, weak negative association
	Application of new knowledge	0.064	–0.251	Not significant, weak negative association
	Capacity to anticipate risk	0.014	–0.331	Significant, moderate negative association
	Capacity to respond	0.037	–0.282	Significant, weak negative association
	Capacity to recover and change	0.069	–0.248	Not significant, weak negative association
Educational attainment	Access rights and entitlement	0.570	0.078	Not significant, negligible positive association
	Information flows	0.424	0.110	Not significant, weak positive association
	Decision-making process	0.934	–0.012	Not significant, negligible negative association
	Application of new knowledge	0.394	0.117	Not significant, weak positive association
	Capacity to anticipate risk	0.582	0.076	Not significant, negligible positive association
	Capacity to respond	0.791	0.037	Not significant, negligible positive association
	Capacity to recover and change	0.615	–0.069	Not significant, negligible negative association

Note: ρ = Spearman's rank correlation coefficient. Statistical significance was set at $p<.05$. Magnitude was interpreted using absolute values: <.10 = negligible, .10-.29 = weak, .30-.49 = moderate, and ≥ .50 = strong (Akoglu, 2018).

Chi-square tests indicated that sex was not significantly associated with any of the seven institutional-resilience dimensions, with all p-values exceeding .05 (Table 8). Cramér's V values ranged from 0.058 to 0.239, indicating weak-to-moderate descriptive associations. The largest observed association was between sex and capacity to respond

(V = 0.239, p = .372), while the weakest was between sex and information flows (V = 0.058, p = .980).

Professional role was likewise not significantly associated with any institutional-resilience dimension, as all p-values exceeded .05. Cramér's V values ranged from 0.125 to 0.291, indicating moderate descriptive associations within the sample. The largest association was observed for application of new knowledge (V = 0.291, p = .123), followed by capacity to recover and change (V = 0.264, p = .242) and decision-making processes (V = 0.261, p = .263).

Table 8: Cramér's V for sex and professional role

Sociodemo-graphic Variable	*Indicators*	χ^2	*df*	*p-value*	*V*	*Interpretation*
Sex	Access rights and entitlement	1.021	2	0.600	0.136	Not significant, moderate association
	Information flows	0.184	3	0.980	0.058	Not significant, weak association
	Decision-making process	1.499	3	0.682	0.165	Not significant, moderate association
	Application of new knowledge	2.211	3	0.530	0.201	Not significant, moderate association
	Capacity to anticipate risk	2.290	3	0.515	0.204	Not significant, moderate association
	Capacity to respond	3.131	3	0.372	0.239	Not significant, moderate association
	Capacity to recover and change	0.678	3	0.878	0.111	Not significant, moderate association
Professional role	Access rights and entitlement	1.724	6	0.943	0.125	Not significant, moderate association
	Information flows	9.534	9	0.390	0.240	Not significant, moderate association
	Decision-making process	11.197	9	0.263	0.261	Not significant, moderate association
	Application of new knowledge	13.972	9	0.123	0.291	Not significant, moderate association
	Capacity to anticipate risk	7.680	9	0.567	0.216	Not significant, moderate association
	Capacity to respond	7.754	9	0.560	0.217	Not significant, moderate association
	Capacity to recover and change	11.520	9	0.242	0.264	Not significant, moderate association

Note: χ^2 = chi-square statistic; df = degrees of freedom; V = Cramér's V. Statistical significance was set at p <.05. Cramér's V was interpreted based on the magnitude of association, where values closer to 0 indicate weaker relationships and values closer to 1 indicate stronger relationships.

Discussion

Institutional Capacity as a Layered and Uneven Governance Condition

The results demonstrate that a high aggregate institutional-capacity score can coexist with important functional weaknesses, indicating that institutional resilience in the UMRBPL is layered rather than uniform. Institutions performed relatively well in knowledge awareness and immediate response but showed comparatively weaker capacities in information flows, institutional memory, recovery-oriented learning, and transformative change. Within the layered framework, access rights and entitlements, capacity to anticipate risk, and capacity to respond were interpreted as dimensions of operational resilience because they reflect the ability of institutions to maintain essential functions and act during climate- and disaster-related events. Information flows, decision-making processes, and the application of new knowledge were treated as dimensions of integrative resilience because they represent communication, coordination, knowledge exchange, and collective decision-making among governance actors. Capacity to recover and change, together with the learning-oriented components of decision-making and knowledge application, was interpreted as transformative resilience because it reflects the ability of institutions to move beyond restoring previous conditions toward adaptation, institutional learning, governance redesign, and long-term vulnerability reduction.

Operational capacities appear stronger because they are embedded in routine institutional functions, formal mandates, and existing response protocols. Integrative capacities remain weaker, by contrast, because cross-agency coordination, information-sharing, and records management are not yet fully institutionalized across agencies and governance levels. Transformative capacities are even more limited because recovery processes are not consistently connected to feedback mechanisms, adaptive planning, institutional learning, and the redesign of governance arrangements.

This uneven pattern closely parallels the empirical assessment of local governments in Aurora, Philippines, where institutions performed better in risk response and management but continued to face limitations in staffing, external financial support, and knowledge-management systems (Grefalda et al., 2020). Pulhin et al. (2021) similarly found that collaborative capacity-building was constrained by limited data availability and insufficient functional knowledge for local climate planning. Evidence from protected areas in Australia, Colombia, and South Africa further demonstrates that site-level adaptation is shaped by institutional readiness, technical and resource capacity, and the ability to coordinate responses across multiple governance levels (Múnera-Roldán et al., 2024). Collectively, these findings and empirical comparisons support the study's central claim that institutional resilience cannot be adequately inferred from a single aggregate score, as a high overall assessment may conceal weaknesses in information management, cross-agency integration, institutional learning, and transformative recovery. Although UMRBPL institutions appear capable of fulfilling routine mandates and responding to immediate risks, their capacity to institutionalize information exchange, sustain learning, and translate recovery into long-term adaptation and vulnerability reduction remains comparatively limited.

Operational Resilience is the Strongest Institutional Layer

The strongest pattern appears at the operational layer. High scores for capacity to respond, capacity to anticipate risk, and access rights and entitlements suggest that participating LGUs, DENR, PAMB, and related agencies have established basic mechanisms for risk awareness, emergency response, and institutional support (Grefalda *et al.*, 2020). These capacities indicate that the governance system has a functional absorptive capacity (Béné *et al.*, 2012) and can maintain operations and act during disruptions (Tyler and Moench, 2012).

However, the operational layer is not without constraints. Lower item-level scores for staffing, equipment, technology, and external funding show that response capacity depends heavily on existing personnel and available resources. In a Swedish public-sector case, Cedergren and Hassel (2024) found that organizational adaptive capacity depended on flexible procedures, leadership, coordination, and the ability to reconfigure resources during a crisis. Empirical work on local adaptation has similarly shown that shortages in personnel, technical systems, infrastructure, and finance can limit the sustainability of response capacity during prolonged or compound extreme events (Birchall, Kehler and Weissenberger, 2025). The UMRBPL institutions may therefore perform adequately during routine or moderate disruptions but face greater strain when hazards are recurrent, simultaneous, or large in scale.

Integrative Resilience is Functional but Fragmented

The integrative layer shows a mixed pattern. The high score for application of new knowledge indicates that institutional actors are aware of climate change, protected area governance, and related environmental concepts (McNaught, 2024). Similarly, the high score for decision-making processes suggests that regular meetings, planning structures, transparency, and accountability mechanisms are present (Ahrens and Rudolph, 2006; Tyler and Moench, 2012). However, the lower information-flow score, particularly for databases, historical records, retrieval systems, and turnover of information, indicates that knowledge is not consistently embedded in organizational systems.

This finding is consistent with the Aurora case, in which data limitations and knowledge-management gaps constrained the translation of capacity-building into institutional practice (Grefalda *et al.*, 2020; Pulhin *et al.*, 2021). It also reflects the cross-scale implementation challenges identified by Múnera-Roldán *et al.* (2024), who found that protected-area adaptation required enabling institutional contexts, clear rules, and coordinated responses across actors and sectors. In the UMRBPL, weak records and turnover mechanisms may leave knowledge person-dependent, thereby reducing continuity across changes in personnel and administrations and limiting cumulative organizational learning.

When record systems, databases, and turnover mechanisms are weak, knowledge remains person-dependent rather than institutionally embedded. This weakens coordination and limits cumulative learning, which is a critical concern because protected landscape governance depends on continuity, coordination, and cumulative learning (Borrás *et al.*, 2024; Cedergren and Hassel, 2024). This also limits adaptive

governance because lessons from previous events may not be systematically retained or used to improve future decisions.

Transformative Resilience Remains the Least Developed Layer

The weakest functional pattern appears in the transformative layer. Although the capacity to recover and change was still rated high, it received one of the lowest scores among the seven dimensions. This suggests that recovery mechanisms are less developed than response capacities. This gap may arise because disaster-related institutions tend to be organized around immediate restoration rather than long-term learning and redesign (Béné *et al.*, 2012; Folke *et al.*, 2010; Graveline and Germain, 2022). The finding is consistent with the broader distinction in the literature between restoring pre-disruption functions and using recovery as an opportunity to reduce future vulnerability (Folke *et al.*, 2010; Graveline and Germain, 2022). Whether UMRBPL governance can translate recovery into institutional reform and long-term vulnerability reduction remains an open question.

Recovery does not automatically mean transformation. Rather, recovery becomes transformative only when it moves beyond restoring pre-disaster conditions and instead supports institutional learning, risk reduction, and changes in governance arrangements (Folke *et al.*, 2010; Udovyk *et al.*, 2025; UNDRR, 2017). This aligns with the disaster risk reduction and biodiversity governance literature, which emphasizes that transformative change requires shifts in institutions, values, governance arrangements, and decision-making systems that address the underlying causes of environmental degradation and vulnerability (IPBES, 2024).

Empirical studies of public-sector transformation emphasize that transformative capacity requires more than short-term restoration; it depends on organizational learning, strategic direction, resource mobilization, and the ability to alter established structures and practices (Borrás *et al.*, 2024). Comparative disaster-governance cases similarly show that institutional resilience is strengthened when lessons from major events are retained and translated into governance reform rather than lost after the immediate response phase (Woodall *et al.*, 2024). Without these mechanisms, the UMRBPL governance system risks remaining in a cycle of repeated response rather than progressing toward long-term risk reduction and transformative protected-landscape management.

Sociodemographic Associations with Institutional Resilience

Age and years in the office showed statistically significant negative associations with selected institutional resilience dimensions. These results suggest that institutional experience does not automatically translate into stronger perceived resilience. One possible explanation is that longer-serving personnel may be more aware of recurring procedural gaps, resource constraints, weaknesses in information transfer, and other institutional limitations. Alternatively, this may reflect institutional inertia, in which established routines and long-standing procedures limit adaptive learning, innovation, and response improvement, rather than automatically strengthening resilience (Ashok *et al.*, 2021; Kauffman and Hill, 2021). This supports the view that institutional resilience

depends not merely on accumulated experience but on adaptive capacity, or the ability of organizations to adjust, redesign, and improve responses when conditions change (Cedergren and Hassel, 2024). The negative associations may also indicate that personnel with longer service are more aware of institutional limitations, procedural gaps, resource constraints, and recurring governance weaknesses.

In contrast, educational attainment was not significantly associated with any of the seven institutional resilience dimensions. Although some values indicated weak-to-moderate associations, all *p*-values exceeded .05. Therefore, the data do not provide sufficient statistical evidence to conclude that educational attainment significantly influences perceived institutional resilience in the UMRBPL governance context. This suggests that formal education alone may not strengthen institutional resilience unless it is translated into practical skills, institutional learning, technical competence, and decision-support capacity.

For the nominal variables, sex was not significantly associated with any institutional resilience dimensions. Although several Cramér's V values fell within the moderate range, all *p*-values exceeded.05. Sex therefore cannot be treated as a statistically significant correlate of institutional resilience in this dataset. Nevertheless, sex-responsive participation remains important as a governance principle because disaster risk and resilience are shaped by unequal access to information, resources, leadership, and decision-making opportunities (UNDRR, 2023). Similarly, professional role showed moderate but non-significant associations across the seven resilience dimensions, with the highest association observed for the application of new knowledge. Since these associations were not statistically significant, they should be treated as descriptive patterns rather than confirmed relationships.

The pattern also differs from the Aurora institutional assessment, which reported associations involving professional role and organizational position (Grefalda *et al.*, 2020). In the present study, educational attainment, sex, and professional role were not significantly associated with any resilience dimension. The contrast suggests that sociodemographic associations may be context-specific and sensitive to institutional composition, sample size, role distribution, and local governance arrangements. Follow-up interviews or longitudinal assessments would be needed to determine why age and tenure were negatively associated with selected dimensions in the UMRBPL.

Generally, the findings suggest that institutional resilience in the UMRBPL was more clearly associated with age and years in office than with educational attainment, sex, or professional role. However, the significant negative associations for age and tenure indicated that seniority and length of service do not necessarily translate into stronger perceptions of resilience. This highlights the need for resilience-building efforts that go beyond formal qualifications, demographic characteristics, and accumulated experience. Capacity building should focus on organizational learning, knowledge management, and information-sharing systems, as resilience is strengthened when institutions continuously acquire, share, and apply knowledge rather than relying solely on routine experience (Ashok *et al.*, 2021; Jiao and Bu, 2024). This aligns with the IPCC's view that resilient governance requires flexible and responsive institutions supported by information, capacities, finance, human resources, technology, inclusive processes, and

social learning (IPCC, 2022). For UMRBPL governance, capacity development should prioritize continuous learning, updated technical training, stronger information systems, inter-agency coordination, and adaptive decision-making, along with mechanisms that help personnel convert experience into innovation rather than routine.

Implications for Protected Area Governance

The findings imply that protected area governance should not rely solely on aggregate assessments of institutional capacity. In the UMRBPL, high overall capacity masks uneven resilience across governance layers: operational capacities are relatively strong, while integrative and transformative capacities remain more constrained. This pattern aligns with the resilience literature, which distinguishes between absorptive, adaptive, and transformative capacities in governance systems (Béné *et al.*, 2012; Tyler and Moench, 2012). For the PAMB, DENR, LGUs, and partner agencies, this means preparedness for immediate climate-related hazards must be complemented by stronger systems for information management, institutional memory, inter-agency learning, monitoring, and recovery governance. These capacities are critical because protected landscape governance requires institutions that can not only respond to disruption but also retain knowledge, coordinate across agencies, and redesign practices to reduce future vulnerability. Recovery becomes transformative only when it is linked to learning, risk reduction, institutional reform, and build-back-better approaches (IPCC, 2022; UNDRR, 2023). These findings identify key leverage points for strengthening UMRBPL governance, particularly by improving information and records management, institutional memory, inter-agency learning and monitoring systems, and recovery governance. These priorities align with global calls for governance shifts that address the underlying drivers of biodiversity loss and vulnerability (IPBES, 2024).

Conclusions

This study examined institutional capacity for climate and disaster resilience in the governance of the Upper Marikina River Basin Protected Landscape (UMRBPL) in the Philippines. Using a layered institutional resilience framework, the findings show generally high institutional capacity, with an overall mean of 3.76, but uneven performance across resilience functions.

Institutional resilience was strongest at the operational layer, particularly in risk anticipation, access to institutional support, and emergency response. This suggests that LGUs, DENR, PAMB, and other participating agencies have established basic mechanisms for maintaining functions and responding to climate-related and disaster events. However, lower scores for information flows and capacity to recover and change indicate persistent weaknesses in the integrative and transformative layers.

These findings support the study's central argument that protected landscape governance should not be assessed solely on aggregate capacity scores. High overall capacity may conceal gaps in information management, institutional memory, records systems, inter-agency coordination, post-disaster learning, and build-back-better recovery. Thus, while UMRBPL institutions can respond to immediate risks, they remain less equipped to convert recovery into long-term risk reduction and adaptive governance.

The study contributes to institutional resilience literature by operationalizing a layered framework that distinguishes operational, integrative, and transformative capacities. The framework reveals where institutional resilience is concentrated and where governance weaknesses persist across resilience functions. This provides a more nuanced understanding of protected landscape governance under climate risks, land-use pressures, and multi-level institutional arrangements.

Therefore, strengthening UMRBPL governance requires investments in information and records management, institutional memory, human resource sufficiency, inter-agency coordination, monitoring systems, and recovery governance. These improvements are needed to shift the governance system from reactive resilience to more proactive, transformative protected landscape management.

Acknowledgments

The authors gratefully acknowledge the funding support of the Nagoya University Asian Satellite Campus Institute and the Philippine Department of Science and Technology. They also thank the Protected Area Management Office, Department of Environment and Natural Resources (DENR); Protected Area Management Board (PAMB); and the local government units of Baras, San Mateo, Antipolo, Rodriguez, and Tanay for their support and cooperation. Special thanks are extended to Forester Ma. Louiella Rose O. Catudio for assistance in data gathering, Forester Adrian Pablo V. Sasi for the location map, and Associate Professor Lara Paul Ebal and Instructor Kyle Vincent R. Singson for their statistical support.

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Appendix A. Item-level scores for the seven institutional capacity dimensions

Table A.1: Specific indicators for the access rights and entitlements dimension

I. Access Rights and Entitlements	*Average Score*
1. Location of your office in the municipal/city hall (including the positions of your desk, shelves, documents, etc.)	3.89
2. Number of staff members	3.44
3. Technical capacity of staff members to carry out their responsibilities	3.69
4. Relationship among staff members of your office	4.09
5. Relationship of your office with other offices within the municipality/city	4.07
6. Relationship of your office with other offices at the provincial level	3.95
7. Opportunities to attend training/seminars/workshops	3.98
8. Training/seminars/workshops attended during the time spent in your office	4.09
9. Financial support (within LGU or the Mayor's Office)	3.89
10. Financial support (provincial level to your municipality/city)	3.75
11. Financial support from other sources (e.g., private sector, other funding agencies)	3.62
12. Equipment and supplies for daily operations	3.53
13. Access to new technologies to facilitate operations	3.58
14. Existence of rules and regulations within the office to harmonize operations	3.78
15. Development that happened in your sector/office (in terms of politics/governance)	3.73
16. Physical development in your office	3.58
AVERAGE	3.79

Table A.2: Specific indicators for the information flows dimension

II. Information Flows	*Average Score*
1. Access to information/resources at the barangay level	3.60
2. Access to information/resources at the municipal/city level	3.91
3. Access to information/resources at the provincial level	3.82
4. Access to information/resources at the national level	3.82
5. Accuracy of information accessed from different sources	3.62
6. Completeness of information accessed from different sources	3.56
7. Availability of historical records and information concerning changes/developments in your sector/office	3.38
8. Availability of a database and other support systems for managing records and information used by the office	3.29
9. Ease in accessing and/or retrieving relevant records and information used by the office	3.31

10. Data/information passed on from previous officials to new ones (or from absent to present staff members)	3.29
11. Safety of important materials/documents needed by information users	3.44
12. Capacity to produce relevant reports/documents needed by information users	3.76
13. Capacity to package or prepare information produced by the office, specific to the needs of the end-users	3.65
14. Dissemination of information to relevant users	3.80
AVERAGE	3.59

Table A.3: Specific indicators for the decision-making processes dimension

III. Decision-making Processes	*Average Score*
1. Regular meetings within the office to discuss issues, etc.	4.05
2. Regular meeting with other sectoral offices at the municipal/city level	3.95
3. Regular meeting with other sectoral offices at the provincial level	3.76
4. Venue for dialogue with constituents/communities to know their needs	3.67
5. Venue to hear feedback from constituents/communities	3.64
6. Participation, cooperation, and unity among staff members/officials when finalizing decisions	3.80
7. Decision-making following the principle of transparency	3.93
8. Decision-making following the principle of accountability	3.91
9. Decision-making following the principle of responsiveness	3.89
10. Capacity to implement decisions (e.g., policies, programs) from your sector	3.89
11. Flexibility to change decisions if the need arises	3.67
12. Acceptability of decisions made to constituents/communities	3.76
13. Mechanism to monitor the impacts of decisions made	3.42
14. Avenue to provide incentives or reward good works	3.36
15. Ability to handle conflict situations within the office	3.80
16. Ability to handle conflict situations with other offices	3.80
17. Availability of development plans/strategies to manage the concerned sectors	3.91
18. Ability to update development plans/strategies to manage the concerned sectors	3.76
AVERAGE	3.78

Table A.4: Specific indicators for the application of the new knowledge dimension

IV. Application of New Knowledge	*Average Score*
1. Awareness of the concept of climate change	4.00
2. Awareness of the concept of protected area	3.87
3. Awareness of the protected area (or holistic) approach in managing socio-ecological systems	3.76
4. Awareness and knowledge about the protected area in your municipality	3.89
AVERAGE	3.88

Table A.5: Specific indicators for the capacity to anticipate risk dimension

V. Capacity to Anticipate Risk	*Average Score*
1. Thorough knowledge of the sector you are currently working on (status, concerns, challenges, etc.)	3.95
2. Knowledge of risk events related to the concerned sector at the municipal and provincial levels	3.93
3. Knowledge of potential impacts of climate-related risk events on the concerned sector	3.85
4. Availability of human resources to respond to climate-related risk events in the concerned sector	3.45
5. Availability of resources (goods, including relief goods, seed, etc.; funds) to respond to climate-related risk events in the concerned sector	3.75
6. Availability of equipment to respond to climate-related risk events in the concerned sector (communications, vehicles, etc.)	3.65
7. Availability of infrastructures/facilities to respond to climate-related risk events in the concerned sector (evacuation centers, crop dryers, etc.)	3.55
8. Availability of disaster risk reduction and management plan for the sector	3.87
9. Capacity to prepare people/constituents in anticipation of disaster risks	3.76
10. Presence of emergency response systems (with an organized chart) in the concerned sector to guide actions and decision-making during risk events	3.78
AVERAGE	3.75

Table A.6: Specific indicators for the capacity to respond dimension

VI. Capacity to Respond	*Average Score*
1. Quick response to problems/emergencies (during disasters, calamities, or accidents)	3.89
2. Effective implementation of guidelines/protocols (e.g., command responsibility) to respond to disasters and risk events	3.87
3. Efficiency of people/group networks to disseminate information	3.76
4. Capacity to make quick and relevant decisions during risk events (e.g., use of resources and their distribution, prioritization, etc.)	3.93
5. Capacity to manage crisis for the concerned sector during risk events	3.89
AVERAGE	3.87

Table A.7: Specific indicators for the Capacity to recover and change dimension

VII. Capacity to Recover and Change	*Average Score*
1. Immediate recovery of the concerned sector from the impacts of risk events and disasters	3.65
2. Capacity to build better to reduce risks in the future for the concerned sector	3.58
3. Capacity to welcome change brought about by the impacts of risk events and disasters	3.67
AVERAGE	3.64

Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*	*Author 3*
Conceived and designed the research or analysis	Yes	Yes	Yes
Collected the data	Yes	No	No
Contributed to data analysis & interpretation	Yes	Yes	Yes
Wrote the article/paper	Yes	No	No
Critical revision of the article/paper	Yes	Yes	Yes
Editing of the article/paper	No	Yes	Yes
Supervision	No	Yes	Yes
Project Administration	Yes	No	No
Funding Acquisition	Yes	No	No
Overall Contribution Proportion (%)	50	25	25

Funding
Funding for the research and preparation of the manuscript was provided by the Department of Science and Technology - Science Education Institute (DOST-SEI) - Nagoya University Joint Scholarship for PhD in the Fields of Bioagricultural Sciences for Filipinos.

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PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
The author(s) has/have NOT complied with PRISMA standards to an extent.

Competing Interests/Conflict of Interest
Author(s) has/have no competing financial, professional, or personal interests from other parties or in publishing this manuscript. There is no conflict of interest with the publisher or the editorial team or the reviewers.

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