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Based on Regression Models to Analyze the Role of Disaster Management Authorities in Disaster Prone Areas in Sindh

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Abstract

This research investigates the role of Disaster Management Authorities (DMA) in disaster-prone areas of Sindh, i.e., District Dadu. The area is exposed to Disasters such floods, heavy rain falls, droughts and heat waves frequently. This study aims to evaluate the operational role, preparedness capacity and response effectiveness of DMA in disaster-prone districts of Sindh. Additionally, a comprehensive review of theoretical, conceptual and empirical literature related to Disaster Risk Management (DRM) studies are also included in this paper. The study adopts mixed-method in research methodology to examine the role of DMA, including regression models. The study used two Binary logistic Regression models for empirical results; Community based model and DMA organization's model. The research further presents empirical findings and their interpretation for evaluating the effectiveness of DMA operations in the selected district. The hypotheses testing further validate the results. The findings overall stress on the need of enhancing institutional capability of DMAs in Sindh. Moreover, this study provide recommendation of there should have integration of Community-based disaster risk reduction approach with institutional governance which will ultimately improve the preparedness, response, recovery outcomes in disaster-prone areas of Sindh, particularly in district Dadu.

Keywords: Regression Models; Analysis; Disaster Management Authorities; Logistic Regression; Disaster Prone Areas; Disaster Risk Reduction.

1. Introduction

In the 21st century, disasters have become more frequent and severe. It is causing serious loss of life, property, and development around the world. About 7,348 major disasters were reported globally from 2000 to 2019. It led to around 1.23 million deaths, affecting over 4.2 billion people, and causing almost US$2.97 trillion in economic damage highlighted provided facts (UNDRR, 202

0). This growing trend shows that societies are becoming more vulnerable to natural and climate related disasters. The studies indicated that the most of these disasters are linked to climate factors. These factors include floods, droughts, storms, and heat waves. These are happening more often and with greater intensity as global temperatures rise (UNDRR, 2020; World Meteorological Organization, 2021). Wen (2023) noted that climate change continues to make weather related disasters worse. It increases risks for both developed and developing countries. Therefore, having strong and research-based Disaster Risk Reduction (DRR) strategies is now more important than ever.

Disaster Risk Reduction (DRR) is now widely seen as an essential part of sustainable development and resilience. Including DRR in government policies helps reduce losses, improves community readiness, lowers poverty, and builds the ability to adapt to future disasters (UNDRR, 2025; United Nations Development Program, 2022). Pakistan is one of the world's most climate vulnerable countries and it often appears in the top ten of global climate risk rankings (Eckstein et al., 2021). According to World Bank, (2023), UNICEF, (2022), heavy monsoon floods submerged almost one third of Pakistan in 2022. It further adds, more than 33 million people were affected. The damages were over 30 billion US dollars. It made it one of the most expensive disasters in Pakistan's history. Other than floods, Pakistan often faces droughts, glacial lake outburst floods, heat waves, and earthquakes, showing that the country is exposed to many types of hazards (Qamer et al., 2023).

In this situation, Sindh is one of the most affected provinces. Its river plains, coastal areas, and dry lands make it more vulnerable to disasters (Khuwaja et al., 2024; Mustafa et al., 2018). Usmani et al. (2025) highlighted that in the 2022 floods, Sindh was the hardest hit. It further noted that around 25,000 square kilometers went under water, more than 14,500 villages were flooded, and Dadu District suffered heavy damages. These repeated hazards and risks show Sindh needs urgent local studies. District Dadu, lies between the Indus River and the Kirthar mountain range, is highly prone to repeated disasters in the history which severely damaged agriculture, homes, and livelihoods (Qamer et al., 2023). MSF South Asia (2023) noted that in the 2022 floods, large areas of the district went under water. About 300 villages were affected, many people were displaced.

The District Disaster Management Authority (DDMA) was created under the 2010 National Disaster Management Act problems still remain in coordination, financial resourcing, and early warning dissemination (Shah, 2019). Therefore, it is important to study how the DDMA works in preparedness, response, and recovery. The 2010 National Disaster Management Act set up a formal system of disaster management authorities (NDMA, PDMA, and DDMA) and required clear links between them (Maqbool & Hussain, 2014). Despite existence of formal disaster management system, actual working especially at the district level is still weak and not well studied Pakistan as a whole. Pakistan has DRR frameworks and institutions at the national and provincial levels. But there is still very little research on how disaster management works at the district level.

In summary Pakistan is facing growing and intense disasters specially climate related and Sindh particularly district Dadu is highly-vulnerable to these disasters and in this situation the role Disaster Management Authorities become more important to examine thoroughly on district level. The present study explores the role of Disaster Management Authority in preparedness, mitigation and response and recovery.

This study aims to identify the strength and weakness in their performance not only from DMA perspectives but also from the community perspectives. The findings will contribute to the existing academic knowledge but also insights for the policy makers, practitioners and local communities. The following sections explain the study's objectives, research questions, and methods used to explore these issues.

2. Literature Review

Disaster Risk Management (DRM) is a systematic process through which disaster risks are identified, assessed, and reduced. This is done via coordinated institutional and community-level actions. Earlier, disaster management was largely concentrated on post disaster response and relief. But, now days DRM places greater emphasis on prevention, preparedness, and the strengthening of resilience (Coppola, 2015). This shift shows a growing recognition DRM. Disasters are not solely the result of natural hazards but are significantly influenced by social, economic, and governance conditions

The studies found in the literature argue that hazards change into disasters especially when these are experienced by vulnerable populations that lack adequate capacity to tackle disasters (Blaikie et al., 2005). From this perspective, disasters are caused not just by strong hazards. But disasters are also caused by poor governance, bad land-use planning, poverty, and limited access to basic services. Due to this DRM is seen as integral element of sustainable protection from disasters, instead of a narrow or standalone emergency response activity (UNDRR, 2020).

At the global level, disaster risk assessment has developed significantly. The world has made progress in geospatial technologies and data analysis methods. Advances in climate modeling, remote sensing, and big data have improved the way disaster risks are studied and understood. Tools such as Geographic Information Systems (GIS), satellite imagery, and probabilistic risk models now allow researchers and policymakers to identify multiple hazards and map patterns of exposure with greater accuracy (UNDRR, 2017; World Bank, 2019). In recent years, research on climate change has further strengthened disaster risk assessment by including projections of future climate conditions. This approach helps policymakers anticipate possible changes in the frequency and intensity of hazards data (IPCC, 2022). As a result of these technological and analytical advances, many high- and middle-income countries have increasingly adopted risk-informed approaches in their development planning.

The preparedness is a broader term it usually refers to policies, capacities, institutional functionaries and the actions before disasters happen basic purpose of the preparedness is to ensure the effective and coordinated response at the times of emergencies. Frameworks like Sendai frameworks for Risk Reductions label preparedness one the key components which can reduce the disaster-related losses (UNDRR 2015). The global experience demonstrates that effective preparedness plays important role in reduction disasters impacts like loss of lives, Socio-economic damages, infrastructures damages. World Bank (2021) suggests that long-lasting savings can be made by investing on preparedness because it saves not only human lives and miseries but also reduces the financial burden and losses in post-disaster situations in response and recovery phases.

Early Warning Systems (EWS) is known as one of the most key elements of disaster management authorities. The technological tools have become more important for improving the disaster preparedness. In disaster-vulnerable areas where the mobile base alert systems platforms are helping to strengthen spread of the early warnings and also improve the real time awareness during emergencies (UNDRR 2021).

As stated by Noor et al. (2022) the mobile applications and digital platforms are able to make the warning messages and information regarding the preparedness more accessible on the community level and in Sindh the usage of technology is still limited in its scope. There are several factors which contribute in this situation like institutional capacity constraints, weak digital infrastructures and the low level of digital literacy. And these challenges more prevail in remote rural areas where the digital technology remains restricted. The Disaster response mechanisms are those comprehensive actions which take place during and after a catastrophic disaster which hit any area or the region to save the human lives, reduce human sufferings, protect livestock and livelihoods and prevent the secondary losses. Effectiveness of response efforts depend on prior levels of preparedness, institutional coordination, leadership roles, and the availability of logistical capacity (Coppola, 2015) This approach is used in order to reduce duplication, enhance accountability, and improve information sharing among responding actors (IASC, 2006).

Recovery is the medium- and long-term process after a disaster. Recovery involves restoring livelihoods, rebuilding infrastructure, reestablishing public services, and supporting the recovery of social systems after a disaster. In modern DRM frameworks, recovery is not viewed simply as a return to pre disaster conditions. Instead, it is considered an opportunity to address structural weaknesses. Structural weaknesses may have increased vulnerability in the first place. According to UNDRR (2015), this perspective is reflected in the principle of Build Back Better (BBB). The idea behind BBB is to promote recovery strategies that reduce future disaster risks, strengthen resilience, and prevent the re-emergence of earlier vulnerabilities. For this reason, the concept has been widely adopted in international policy frameworks.

Principally the devolved framework corresponds with the International best practices specifically stress was put to strengthen the local governance for the disaster risk reduction mechanisms assigned by the Sendai Framework (United Nations office for Disaster Risk Reduction 2015). The District Disaster Management Authorities (DDMAs) have been authorized implementing the policies regarding disasters on the ground level within the framework working in Pakistan. The DDMAs have variety of the functions which they perform like conducting risk assessments, hazard mapping, evacuation plans, providing food shelter and medicines. The DDMA also plays the role in recovery phase in simple words the DDMA works in the areas of Preparedness, mitigation, response and recovery. These all functions performed by the DDMA with the coordination of different government and non-governmental organizations. Therefore, the efficient DDMAs are the central force which translates the national DRM policies into practices.

The Sindh is regarded as one of the most disaster-vulnerable provinces in the Pakistan due to its geographical composition and locations like it has one of the biggest rivers systems in the world, arid regions, coastal belt, mountains ranges and socio-economic problems like poverty, unemployment and low literacy rate (Mustafa et al 2018). The province is prone to mostly floods due to Indus River, Kirthar mountain ranges and worst environmental conditions and then weak irrigation systems and infrastructures like Bunds and barrages. The studies observed that impacts of the disasters are not equal on the whole province rural areas suffer more than urban areas due to socio-economic conditions and infrastructures but the studies also suggest that Sindh is the most urbanized province and due to recent heavy rainfalls and development of urban centers without planning have also increased urban floods phenomenon in recent years. Combining the all factors considerably play role in exposures of vulnerability and disasters throughout the province (Khan and Ahmed 2022, World Bank 2021).

The district-level plans explain the local disasters vulnerabilities, define the role of different organizations and outline the steps for the preparedness and emergency response and recovery operations (PDMA Sindh 2014). But the studies indicated that there are huge gaps between what the responsibilities are assigned to the institutions and their practical role on the ground level. Panhwar (2010) suggested that district Dadu is one of the highly disaster-prone districts of the Sindh and many factors based on the local level contribute in it such as weak and outdated infrastructures, poverty and illiteracy, limited administrative capabilities, insufficient funds and human resources, lack of modern technology, political interference and geographical locations and isolation. These are the issues which create constraints and weaken the disaster management functions, although formal plans and institutional guidelines already exist.

3. Methodology

3.1 Dataset

This study adopts a mixed-methods approach, combining both primary and secondary data. Primary Data was collected through structured interviews and formal questionnaires. Respondents are divided into two categories first was Institutional Respondents Officials which is further divided into two sub-categories first government officials district Disaster Management Authority (DDMA) from district level to Taluka and Union council's level.

There are Community Respondents (Affected Population) who are residents of district Dadu's Taluka Khairpur Nathan shah and its two Union Councils UC Chhor-Kamabr and Thalho to assess the DMA effectiveness. The community respondents are described into Table 1, while DMA respondents are described into Table 2.

In primary data, it provides insights and experiences of the DMA Official non officials, NGOs civil society and mostly of affected community their perspectives ground realities. Secondary data Provides background and contextual insights into disaster management. The sources of secondary data are government records and official reports. Academic studies, journals, books, and publications. National and international reports on disaster management.

Table 1. Sample Size for Community Respondents.

Aspect	**Details**
Selected District	Dadu District, Sindh, Pakistan
Talukas in District	1.Dadu, 2. Johi, 3. Mehar, 4. Khairpur Nathan Shah
Selected Taluka	Khairpur Nathan Shah
Total Households in Selected Taluka	76, 845
Total Union Councils (UCs)	15 (Within selected Taluka)
Selected Union Councils	ChhorKambar and Thalho
Total Households in Selected UCs	4,770
Sample size	**257 Households**

Source: 1.Pakistan Bureau of Statistics Census (2023). 2. Election Commission of Pakistan. 3. Pakistan Almanac Website. 3 Multi-Hazard Vulnerability Risk Assessment (MHRVA) Report (2023-2030).

Table 2. Sample Size for DMA Respondents in District Dadu, Sindh.

Authority	**Officials**	**Non-Officials**	**Total**
District Disaster Management Authority (DDMA)	24	26	50
Taluka K N shah	36	52	88
Union Council	87	470	557
Total	147	548	695
Sample size	**47**	**61**	**108**

Sources: Provincial Disaster Management Authority (PDMA 2025) 2. Multi-Hazard Vulnerability Risk Assessment (MHRVA) District-Dadu- 2023-2030.

In this study, officials and non-officials include stakeholders from non-governmental sectors all government departments community respondents of affected population. On the hand, disaster-affected households from flood-prone areas purposively identified and sampling ensured representation across age, gender, and socioeconomic groups. Furthermore, institutional respondents (authorities) officials from DDMA, Taluka level and UC level are selected based on their role and involvement in disaster risk reduction, preparedness, response and recovery.

3.2 Data collection methods

This study used mixed-method for data collection which is discussed here. The primary data was collected from affected population, community members ensuring representation all genders and income groups and Disaster management Authority's officials and non-official stakeholders and local authorities through semi-structure interviews and questionnaires in district Dadu. On the other hand, the secondary data was acquired from government documents, official reports, local, national and international media reports, academic literature and publications by the national and international forums and organizations. By utilizing the numerous data sources strengthened the validity and reliability of findings.

3.3 Data Analysis Techniques

The obtained data were examined by using the both descriptive and inferential statistical techniques. The Descriptive statistics includes percentages. The other statistics methods include minimum and maximum values were used to summarize characteristics of data.

Additionally, the Binary logistic Regression analysis was applied to analyze relationship between dependent and independent variables. The definitions of key variables of interest for DMA Model and Community Model are defined into Table 3 and 4, respectively.

Table 3. Definitions of Key Variables of Interest for DMA Model.

Variable name	Type	Operational Definition
Organizational preparedness	Dependent (Binary)	The extent to which Disaster Management Authorities (DMA) are adequately prepared to manage coordination (UNDRR 2017, FEMA 2018)
Risk Assessment (RA)	Independent	The systematic process if identifying hazards, analyzing exposure and vulnerabilities and estimating potential disaster impacts (UNDRR 2015, ISO)
Geographic Information System utilization (GIS)	Independent	The use of Geographic Information system by DMAs for hazard mapping, spatial analysis and disaster planning (Cutter et al 2003, UNDP 2016)
Contingency Planning (CP)	Independent	Availability and effectiveness of disaster contingency and emergency preparedness plans developed by DMAs (IFRC 2014, FEMA 2018)
Inter-Agency Coordination (Coord)	Independent	Levels of coordination and Information sharing among DMAs, line departments NGOs, and Local institutions(Kapucu 2006, UNDP 2015)

Table 4. Definitions of Key Variables of Interest for Community Model

Variable Name	Type	Operational Definitions
Perceived Effective Recovery Support	Dependent (Binary)	Community perception of whether disaster recovery support effectively restored living conditions (IFRC 2016, UNDRR 2017)
Early warning system (EW)	Independent	Timelines and reliability of disaster early warning information received by communities. (UNDRR 2015, WMO 2018)
Prompt response	Independent	Speed at which DMA officials responded after disaster occurrence (FEMA 2018, Kapuccu 2008)
Community Accessibility towards DMA(CA)	Independent	Community accessibility towards DMA officials refers to how easily and frequently, community members can approach and communicate with disaster management authorities before and after disaster (UNDRR, 2015, IFRC, 2018, UNDP, 2014)
Recovery support (RS)	Independent	Provision of financial, material housing or livelihood support during post-disaster recovery phase (UNDP 2017, World Bank 2019)

3.4 Tools

We have used the tools for data collection includes structured interviews and questionnaires. Sample size determined by using Rao soft sample size calculator. The statistical analysis was adopted by using SPSS software and Microsoft Excel was used for generating tables and charts for the graphical presentation of obtained results.

4. Results and Discussions

In this section, we provide the discussion on results taken during our experimental analysis including analysis and regression models. Firstly, we provide the results of DMA officials, then results of community respondents are explained.

4.1 Study results of DMA officials

In this section, the results taken while considering DMA officials input and its analysis. Figure 1. shows 78% responded with high preparation for future disasters while 22% responded with low preparation. It has population n=108, source taken from organization's preparedness for future disasters (Data Survey 2025). Figure 2. shows whether the organization conducts regular disaster risk assessments, where total 82% population responded as in yes that their organization conducts regular disaster risk assessments while the rest i.e., 18% voted No. It has total n=108 population of organization conducts regular disaster risk assessments (Data Survey 2025). Figure 3. shows the assessment that the majority 73% of the respondents say that their organization use GIS and other technologies for Hazard mapping or say risk assessment, while the percentage 22% responded that they do not know and the rest 5% responded in No. Similarly, it has total population n=108, and assess the use of GIS by Organization, Hazard Mapping and other Technologies in risk assessments (Data Survey 2025).

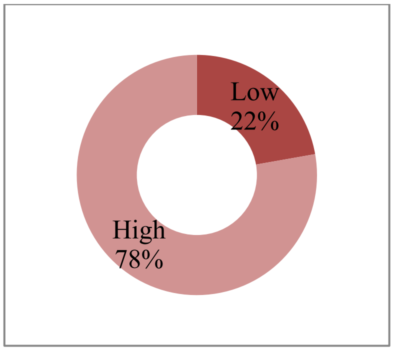

Figure 1: organization's preparedness for future disasters (Data Survey 2025).

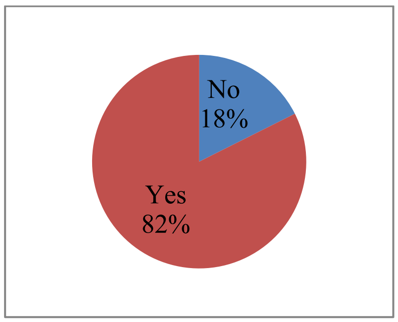

Figure 2: organization conducts regular disaster risk Assessments (Data Survey 2025)

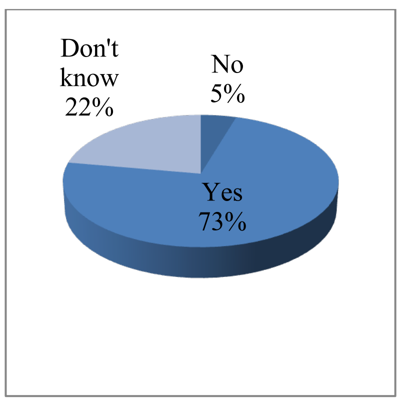

Figure 3: Use of GIS by Organization, Hazard Mapping and other Technologies in Risk Assessments. n=108 (Data Survey 2025)

Table 5. Contingency Plan in Place for Disasters Scenarios in Dadu. n=108 (Data Survey 2025)

Contingency plans for disaster scenarios in Dadu	Frequency	Percent
No	19	17.6
Yes	89	82.4

Total	108	100

Table 5. indicates that out of 108 participants, i.e., total 89 (82.4%) respondents said that contingency plan exists, while the rest 19 (17.6%) respondents reported that no such plan is available. Despite the majority's response of Yes the District Disaster Management Authority had no published or accessible contingency plan of its own; only the documents issued by the Provincial Disaster Management Authority were available.

Table 6. The Coordination Mechanisms with other Agencies are Effective. n= 108 (Data Survey 2025)

The coordination mechanisms with other agencies are effective.	Frequency	Percent
Yes	95	88.0
Partially	9	8.3
No	4	3.7
Total	**108**	**100**

Table 6. shows majority of the respondents (i.e., 88%) said that coordination mechanism with other agencies is well while the percentage 8.3 % responded in partially and the rest 3.7% respondents voted in no. Although in last disasters there many gaps of decisions and other policies to implement on ground during disaster lack of coordination was visible and therefore such catastrophe happened and people suffered.

Table 7. Model Summary for DMA

-2 Log Liklihood	Cox and Snell 2	Nagelkerke R2
101.74	0591	0.646

Table 7. shows the summary of model. The Nagelkerke R^2 value of 0.646 suggests that approximately 64.6% of the variance in organizational preparedness is explained by the independent variables included in the model. In addition −2 Log Likelihood value of 101.74, indicating an acceptable level of unexplained variation

Table 8. Hosmer–Lemeshow Test

Chi-square	Df	Sig.
4.88	8	.772

Table 8. shows the Hosmer–Lemeshow test. The result yielded a non-significant result ($\chi^2 = 4.88$, df = 8, p = .772), indicating that the observed outcomes closely match the predicted probabilities generated by the model. This confirms a good model fit, suggesting that the logistic regression model adequately represents the data and that the predictions are reliable.

Table 9. Variables in the Equation

Variables	**B**	**S.E**	**Wald**	**Sig**	**Exp(B)**
Risk Assessment	1.63	.37	19.4	.000	5.10
GIS Use	1.02	.34	9.0	.003	2.77

Contigency planning	1.74	.39	19.8	.000	5.70
Coordination	0.94	.33	8.1	.004	2.56
Constant	-2.36	.56	17.8	.000	.09

Table 9. shows that all variables are statistically significant (Sig. $\leqslant$ 0.004). Such results are: Contingency Planning has the strongest effect (Exp(B) = 5.70), increasing the likelihood of organizational preparedness by nearly six times. Risk Assessment shows a strong positive effect (Exp(B) = 5.10). GIS Use increases the likelihood of preparedness by about 2.77 times. Coordination has a positive and significant impact (Exp(B) = 2.56). All B values are positive, indicating that these factors improve organizational preparedness for future disasters. The constant is negative (B = –2.36), suggesting a low baseline probability of preparedness when the other factors are absent.

Table 10. Multicollinearity Diagnostics

Variables	Tolerance	VIF
Risk Assessment	.69	1.45
GIS use	.72	1.39
Vulnerability	.66	1.52
Contingency	.63	1.59
Coordination	.74	1.35

Table 10. shows Multicollinearity diagnostics indicate that tolerance values range from 0.63 to 0.74, while Variance Inflation Factor (VIF) values range from 1.35 to 1.59. Since all VIF values are well below the critical threshold of 5, multicollinearity is not a concern. This confirms that the independent variables are sufficiently independent and that the regression coefficients are stable and reliable

$\text{Logit}(Pr_i)=\beta 0+\beta 1RA_i+\beta 2GIS_i+\beta 4CP_i+\beta 5Coord_i$…………………………..Eq1

$\text{Logit}(Y_i/\text{Preparedness}) = -2.36 + 1.63(RA) + 1.02(GIS) + 1.18(VA) + 1.74(CP) + 0.94(Coord)]$……Eq2

Where:

Y_i= dependent variable for the i^{th}observation (Preparedness: 1 = High, 0 = Low)

β_0= intercept (constant)

$\beta_1, \beta_2, \beta_3, \beta_4$= regression coefficients

RA = Risk Assessment

GIS = GIS Utilization

CP = Contingency Planning

Coord = Inter-agency Coordination

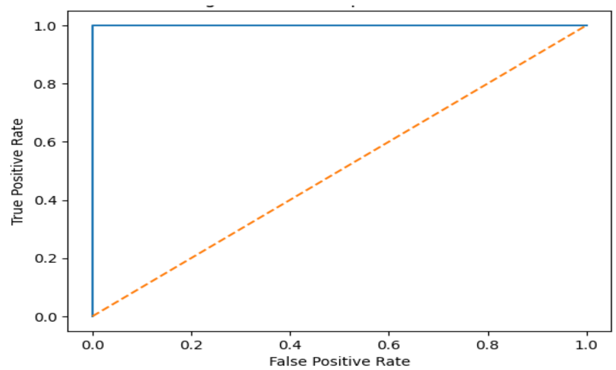

Figure 4: ROC Curve for DMA Model (AUC = 1.00)

ROC Curve:
In this study, as performance metric to evaluate the performance of the regression model, In Figure 4, the Receiver Operating Characteristic (ROC) curve was used to evaluate the predictive performance of the binary logistic regression model for organizational preparedness in District Dadu. The Area under the Curve (AUC) ranged from approximately 0.85 to 0.90, indicating excellent discriminatory power. This demonstrates that the model effectively distinguishes between Disaster Management Authorities with high and low preparedness. The results confirm that key predictors—risk assessment, GIS use, contingency planning, and inter-agency coordination—strongly predict organizational preparedness.

Over all the statistical analysis provides substantial empirical evidences as in DMA model The institutional preparedness models the NagelkerkeR2(square) value of 0.646 demonstrates strong explanatory power, with 64.6% of variance in organizational preparedness explained by risk assessment, GIS utilization, contingency planning and inter-agency coordination. The model fit was confirmed by the Hosmer-leme show test (p=.772) and absence of multicollinearity (VIF<5). The ROC curve (AUC ranging 0.85-0.90) further confirmed excellent predictive performance. Among preparedness predictors, contingency Planning (Exp(B) =5.70) and Risk assessment (Exp(B)=5.10) had the strongest impact on organizational readiness, GIS utilization and coordination also significantly enhanced preparedness levels.

4.2 Study results of Community Respondents

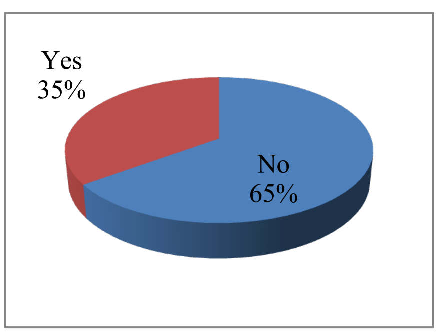

Figure 5: Did you Receive any Effective Assistance and Support from Government before and after Disaster. n=257, (Data Survey 2025)

Figure 5. shows the analysis results that the percentage 35% of the respondents out of 257 received support and assistance from government before and after disaster while majority which counts 65% did not receive any support or assistance from government.

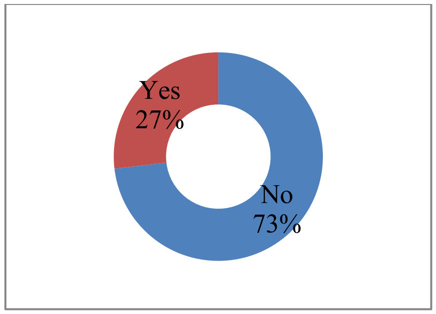

Figure 6: Were you Informed or Issued Early Warning before the Last Disaster. n=257, (Data Survey 2025)

Figure 6. indicates that total percentage 27% of the respondents were informed or given any early warning by the Disaster Management Authority (DMA) while majority 73% of respondents said that they were neither informed nor issued any proper early warning from the DMA officials.

Table 11. DMA officials Arrived Promptly After Disaster. n=257, (Data Survey 2025)

DMA official arrived after Disaster	Frequency	Percent
No	188	73.2
Yes	69	26.8
Total	**257**	**Total**

In the Table 11., the data reveals that majority of the respondents (i.e. 73.2%) stated that DMA officials did not arrive promptly after disaster, while 26.8% said that officials arrived after disaster promptly.

Table 12. Community Accessibility towards DMA. n=257 (Data Survey 2025)

Communication clarity and accessibility of DMA	Frequency	Percent
No	188	73.2
Yes	54	21.0
Somewhat	15	5.8
Total	**257**	**100**

Table 12. presents that the 21% percent of the respondents said that DMA was accessible for community in emergency times. And 6% responded in somewhat which means that neither it was accessible nor it was totally beyond the reach while majority 73% of respondents' response was that DMA was not accessible.

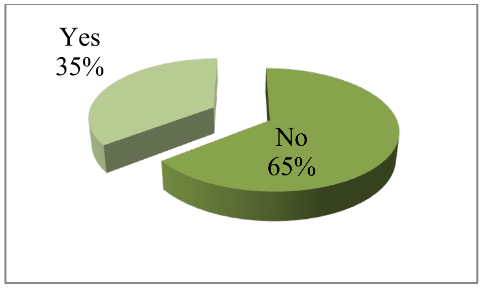

Figure 7: The Recovery Support Restored Your Living Conditions. n=257, (Data Survey 2025)

Figure 7. shows that majority of the respondents' living conditions were not restored fully. Even 4 years had passed the last disaster. There was no plan for the livelihood's restoration.

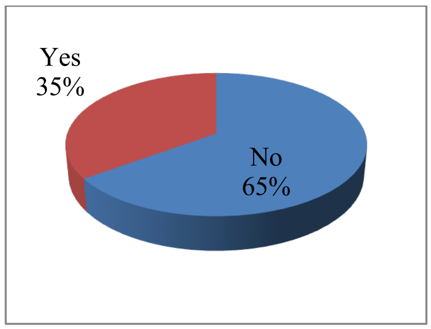

Figure 8: Did You Receive any Assistance and Support from Government before and after Disaster. n=257, (Data Survey 2025)

Figure 8. shows 35% of the respondents received support and assistance from government before and after disaster while majority which counts 65% did not receive any support or assistance from government.

Table 13. Model Summary for Community

Step	-2liklihood	Cox and Snell R2	Nagelkerke R2
1	121.90	.546	.638

Table 13. shows Model summary shows a −2 Log Likelihood value of 121.90, indicating an acceptable level of unexplained variation. The Nagelkerke R^2 value of 0.638 suggests that approximately 63.8% of the variance in perceived recovery effectiveness is explained by the predictors included in the model.

Table 14. Hosmer–Lemeshow Test

Chi-square	Df	Sig.
6.02	8	.645

Table 14. shows Hosmer–Lemeshow test yielded a non-significant result ($\chi^2 = 6.02$, df = 8, p = .645), indicating that there is no significant difference between observed and predicted values. This confirms a good model fit

Table 15. Variables in the Equation for Community Model

Variables	B	S.E	Wald	Df	Sig.	Exp(B)
Early warning	1.21	0.34	12.6	1	.000	3.35
Prompt Response	1.48	0.37	16.0	1	.000	4.39
Community Accessibility	1.09	0.32	11.7	1	.001	2.97
Recovery support	1.67	0.39	18.4	1	.000	5.31
Constant	-2.14	0.51	17.6	1	.000	0.12

In the Table 15. all variables are statistically significant (Sig. $\leqslant$ 0.001). Such are: Recovery Support has the strongest effect (Exp(B)=5.31), increasing the likelihood of effective recovery by about 5 times. Prompt Response also shows a strong positive effect (Exp(B)=4.39). Early Warning increases the likelihood by about 3.35 times. Community Accessibility has a positive and significant impact (Exp(B)=2.97). All B values are positive, indicating these factors improve perceived recovery effectiveness. The Constant is negative (B = -2.14), suggesting low baseline probability when other factors are absent.

Table 16. Multicollinearity Diagnostics

Variables	Tolerance	VIF
Early warning	0.69	1.45
Prompt response	0.66	1.52
Community Accessibility	0.72	1.39
Recovery Assistance	0.63	1.58

Table 16. shows Multicollinearity diagnostics show tolerance values ranging from 0.63 to 0.72 and VIF values between 1.39 and 1.58. Since all VIF values are well below the critical threshold of 5, multicollinearity is not present. This confirms that the independent variables are sufficiently independent and that the regression coefficients are stable and reliable

Binary Logistic Regression Equation for Community Model

$\text{Logit}(Pr_i) = \beta0 + \beta1EW_i + \beta2PR_i + \beta3CA + \beta4RA$…………………………..Eq1

$\text{Logit}(Y_i/\text{Recovery}) = -2.14 + 1.21(EW) + 1.48(PR) + 1.09(CA) + 1.67(RS)]$…….Eq2

Where:

Y_i= dependent variable
β_0= intercept (constant)

$\beta_1, \beta_2, \beta_3, \beta_4$= regression coefficients

EW=Early Warning

PR=Prompt Response

CA=Community Accessibility

RS=Recovery Support

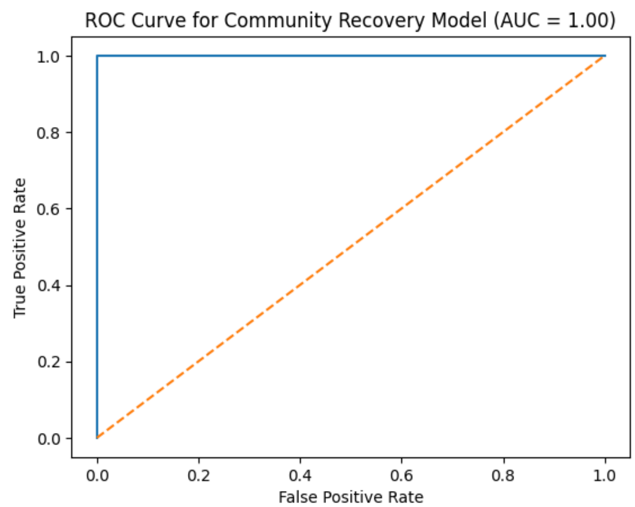

Figure 9: ROC Curve for Community Recovery Model (AUC=1.00)

Figure 9. the Receiver Operating Characteristic (ROC) curve analysis yielded an Area under the Curve (AUC) value of 0.87, indicating excellent discriminatory power. This result demonstrates that the model is highly effective in distinguishing between households that perceive recovery support as effective and those that do not.

Overall, in community/household model binary logistic regression demonstrated strong explanatory power (Nagelkerke R2= (.638), suggests that approximately 63.8% of the variance in perceived recovery effectiveness is explained by the predictors. The Hasemer-Lemeshow test confirms good model fit (p=.645) and multicollinearity diagnostics verified coefficient stability. The ROC curve (AUC= 0.87) indicated excellent discriminatory capacity. Recovery support emerged as the strongest predictor (Exp(B)= 5.31) followed by prompt response (Exp(B)=4.39) Early warning (Exp(B)=2.97) All coefficients were positive and statistically significant ($p<0.01$), indicating that improvements in these factors significantly increase the likelihood of effective disaster recovery. The negative constant suggests that without institutional support mechanisms baseline recovery probability remains low.

5. Conclusion

This study thoroughly investigated the role of Disaster management Authorities (DMAs) in disaster prone areas of Sindh with specific focus on district Dadu. The study inspected preparedness, mitigation, response and recovery with empirical and mixed-method approach. With incorporation of institutional approaches and community-level experiences this study offers theoretical understanding and data-driven results to comprehend the functional efficiency of disaster management on district level. The study provided foundations for theoretical concept of this study by explaining the vulnerability of district Dadu to different disasters as Floods, heavy rains and heat waves. The study emphasized the DMA's role and its importance and its operational effectiveness with the relationship of DRR framework and ascertained the gaps between policy and implementation on local level.

Furthermore, study carefully analyzed the Theoretical and empirical literature on Disaster Risk Management (DRMs) at international, regional, national and local level. Study adopted rigorous mixed-methods with the combination of qualitative and quantitative analysis. The data collection was based on two categories first was from DMAs officials. Binary logistic regression was applied with support of SPSS. The study demonstrates that DMAs has structural foundation in district Dadu but functional efficiency is depended on coordination, planning, technological utilization and incorporating community as stakeholder. DMAs in district Dadu's performance is mostly reactive but an empirical data shows that when preparedness, mitigation and response recovery systems are strengthened and properly utilized the outcomes improve. The study contributes in the disaster management literature by establishing quantitative validation of DRR principles at the district level Sindh. The data suggests that effective and functional institutions and community engagement must operate together for sustainable disaster risk reduction and this study offers policy roadmap for strengthening Disaster Management in Disaster prone areas in Sindh and Pakistan.

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