

# Urban Community Resilience Scorecard at Ward Level

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## Abstract

Measuring the base condition of the resilience of any community is important because it is the first step toward managing disaster risk. Even in the case of Nepal, there have been many good efforts toward measuring the resilience status of communities. Some of these resilience studies have already been successfully applied at the municipality level to address the gap in resilience. For example in the Lalitpur Metropolitan City area. However, the scorecards have been based solely on the views of officials at the local level and do not give a picture of the communities at the ward level. In this context, this research proposes a ward-level scorecard for measuring the resilience of urban communities. For this, a standard procedure has been followed to identify indicators for communities at the ward level, and calculate weightage and resilient scores for wards 5 and 23 of Kathmandu Metropolitan City. The study shows that both wards scored average scores only. They lacked coordination with community members, insurance, incentive mechanism, building codes and by-laws, green energy utilization, knowledge, and awareness programs, and response without proper drills and training along with a lack of proper warning systems and response plans.

## Keywords

Scorecard, Communities, Ward, Urban resilience

## 1. Introduction

The performance of a community in the event of a damaging hazard can be related to its resilience [1]. The very concept of resilient communities is centered around their ability to absorb and bounce back from acute shock and stressors [2]. It achieves this through well-defined mitigation methods, coping capacities, response capacities, and recovery processes [1]. A city can face a wide range of challenges and adversities from climate change to rapid population growth [1], inadequate infrastructures to haphazard migration [1], socioeconomic marginalization [3]. All these challenges reduce the urban communities' capacity to build resilience against shocks and stressors of disaster events [3]. So, making a city and its urban community disaster resilient refers to increasing the capacity of communities and decision-makers to respond to and recover from disasters. This is one of the major goals of Disaster Risk Reduction (DRR) programs including the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 [3].

So, in recent decades, we can see a lot of interest in measuring a communities' resilience as a starting point for developing plans and actions to effectively implement DRR to build resilience [3, 4, 1]. Measuring resilience gives the baseline status of where the community is in terms of its resilience trajectory [3] and also helps decision-makers to identify the areas of priority. Khazai et al. [1] say that "what gets measured gets managed" so the ability to measure resilience has been identified as a significant step in managing the adversities and challenges of urban communities and reducing disaster risk. Many researchers further believe that successive measurements of the resilience status of a community can also help track the progress of intervention programs over time, aimed at increasing resilience [1].

## 1.1 Problem Statement

Nepal is in constant threat of a large number of natural and human-induced disasters like floods, landslides, windstorms, earthquakes, fires, GLOFs, and hailstorms [5]. More than 80 percent of the total population of Nepal is at risk of these natural hazards and disasters [5]. The country is 11th on the list of the 20 most disaster-prone countries in the world [5, 6]. One of the major reasons behind the high risk of disaster is the rapid urban population growth [7] as more than 66.08% [8] of the population is already living in the urban areas i.e metropolitan cities, sub-metropolitan cities, and municipalities. The urban population of the world is predicted to increase to 2 billion by 2050, especially in less-developed urban areas of Asia [4]. So, we can expect the urban population growth of Nepal to continue to increase in the future. This rapid growth of population reduces the resilience of urban communities as it puts additional pressure on the already inadequate infrastructures and further increases socioeconomic marginalization. All of this results in reduced capacity of communities to cope with and recover from the damaging effects of shocks and stressors.

The first key step to addressing this problem would be to know where the urban communities of Nepal are in terms of their resilience status. An Urban Resilience Scorecard can measure the baseline condition of the capacities of communities. There are different types of scorecards to achieve this which have already been used to measure the resilience status of a municipality. For example, the Disaster resilience scorecard for Cities [2, 9], Urban Resilience Scorecard for Nepalese Municipalities [7], and Resilience Performance Scorecard [1]. The implementation of these scorecards has helped municipalities in identifying gaps in resilience and therefore prioritize interventions accordingly [1, 7, 2]. However, these participatory-based scorecards to measure resilience are only intended for the individual officials and authorities of the

municipalities or ward level [1], making it highly subjective [2]. Hence, these municipality-level resilience assessment scorecards may not represent the views of the communities at the grassroots level. Therefore the process of measuring the resilience of urban communities requires a completely different approach. One that allows the assessment of resilience at the ward level so that the baseline status of the capacity of the communities can be assessed. This research is aimed to fill this gap by developing an urban community resilience scorecard for the ward level.

## 1.2 Why a scorecard for the ward level?

There are plenty of scorecard tools to measure disaster resilience at the municipality level, however, a similar assessment tool is missing for the Nepalese communities at the ward level. Furthermore, a thorough review of the literature reveals that there is plenty of research on measuring resilience at a household community level. Some of them have even been successfully applied to measure the capacities of Nepalese communities for disaster resilience. Even in this case, the research is more or less limited in its scope for example only considering gender inclusion [10] or social capital [11]. So, there is no such scorecard that can evaluate the overall resilience capacity of Nepalese communities to cope with and recover from shocks and stressors, at the ward level. Some researchers even suggest that it would be better to measure the socioeconomic capacities of the communities at household levels [12]. So, considering all this, there is a need for a scorecard to measure the resilience of urban communities at the ward level which can be evaluated at the household level.

The Government of Nepal (GoN) is also a signatory of SFDRR 2015-2030. One of the priorities of the SFDRR is building resilient communities by 'investing in disaster risk reduction for resilience' [3]. To achieve this goal, GoN with the support of national and international organizations has developed acts, regulations, guidelines, procedures, and standards reflecting the priorities and goals of the SFDRR 2015-2030 [13]. For example, the Disaster Risk and Management Act 2017, the National Urban Development Strategy 2017, the National Urban Policy 2007, the 15th Periodic Plan, and SDG goals for Nepal [7]. One of the latest documents is the Urban Resilience Scorecard (URS) developed by the Ministry of Urban Development (MoUD). However, the DRR strategies have not trickled down to grassroots community levels to significantly improve disaster vulnerabilities [13]. Urban communities still face a lot of challenges like informal settlements [4], inadequate construction practices [14], social capital and inclusion [11], and economic insecurity [15]. This ward-level scorecard is expected to drastically improve this situation by helping decision-makers to identify areas of low resilience in the community. This can serve as a starting point for targeting and prioritizing DRR programs toward building resilience. Khazai et al. [1] also explains how a scorecard can be important to identify changes in the perception of resilience status due to a disaster event. In this case, an updated assessment of the community will help to reprioritize DRR activities and programs to reflect the change in perception of resilience.

The research conducted by Khazai et al. [1] in Lalitpur Metropolitan City (LMC) assessed the resilience status of the city before and after the 2015 Gorkha earthquake. The

assessment after the earthquake explained how the stakeholders realized inadequacy in budget allocation, human resource mobilization, and dissemination of public information. In the present context, LMC has made major progress in these sectors as explained by Er. Harish Chandra Lamichhane, Section Head of the Disaster Management Section of LMC. For example, every year more and more budget is being allocated towards disaster management and preparedness. LMC has also published a 'Disaster Booklet' with valuable information regarding tools, human resources, and other information related to disaster management activities in its area. This has been serving as a valuable resource for informing the public. In this way, we can see that the application of the scorecard has benefitted LMC in many ways. Hence, this study is important for prioritizing investment in disaster risk reduction which will ultimately help in the achievement of SFDRR goals for the country.

## 1.3 Objective of the study

The primary objective of this research is:

- To develop a ward-level scorecard to measure the resilience of urban communities

The specific objective of this research are:

- To identify a set of relevant indicators to define the resilience of urban communities at the ward level
- To identify the gaps in resilience status of ward 5 and 23

## 2. Methodology

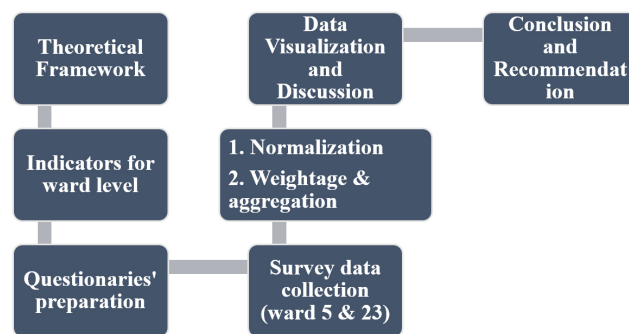


Figure 1: Research methodology flowchart

### 2.1 Indicators for ward level

The first step towards measuring the resilience of a community is the identification of indicators that will impact it. The process of selecting indicators should be backed by a proper theoretical framework [16]. For this study, the 10 essentials for making a city resilient have been considered to be the fundamental framework for the classification of indicators. This gives the initial 10 dimensions such that all other indicators can be grouped accordingly. Ensuring that the ward-level scorecard is also based in terms of the 10 Essentials, will make it very easy for decision-makers to compare against the RPS which is a municipality-level scorecard. Hence, decision-makers can better determine the future course of action based on a comparative

**Table 1:** List of indicators

<b>10 essentials [2, 9]</b>	Indicators	Impact on resilience	Justification
A. Organize for Resilience	Ward coordinates with the community	Positive	[1, 7]
	Gender Inclusive programs	Positive	[10]
	Confidence in governance	Positive	[1]
B. Identify, Understand and Use Current and Future Risk Scenarios	Level of awareness and knowledge	Positive	[1]
C. Strengthen Financial Capacity for Resilience	Insurance for risk	Positive	[1, 7]
	Incentives for DRR approaches	Positive	[12, 1, 7]
	Homeownership	Positive	[3, 12, 15]
	Employment status	Positive	[3, 12, 15]
	Female employment	Positive	[3]
	Access to credit and financing	Positive	[12]
D. Pursue Resilient Urban Development	Building code and by-laws	Positive	[3, 1, 7]
	Green energy utilization	Positive	[7]
E. Safeguard Natural Buffers	Awareness of environmental ecosystems	Positive	[7]
	Green and blue infrastructures	Positive	[3, 7]
F. Strengthen Institutional Capacity for Resilience	Public awareness programs	Positive	[1, 7]
G. Understand and Strengthen Societal Capacity for Resilience	Community groups and roles	Positive	[1, 7, 11]
	Social ties/networks	Positive	[3, 1, 7]
	Special need assistance programs	Positive	[3, 1, 7, 11]
	Acceptance in a community (Length of stay in the community)	Positive	[3, 12, 1, 11, 15]
	Absentee population (Abroad for work/study)	Negative	[3]
	Protection of heritage	Positive	[1]
	Age	Negative	[3]
	Female-headed households	Negative	[3]
	Caste and ethnicity	Negative	[3]
H. Increase Infrastructure Resilience	Clean water	Positive	[12, 1, 7]
	Sanitation and solid waste management	Positive	[12, 7]
	Energy and power access	Positive	[3, 12, 1, 7]
	Transportation	Positive	[3, 12, 7]
	Road	Positive	[3, 12, 7]
	Communications	Positive	[3, 7]
	Health care	Positive	[3, 7]
	Education	Positive	[3, 12, 1, 7]
I. Ensure Effective Disaster Response	Early warning/ Alert system	Positive	[12, 7]
	Standard response procedure	Positive	[1, 7]
	Store food, goods, and fuel for emergency	Positive	[1, 7]
	Local center is established for response operations	Positive	[1, 7]
	Drills training	Positive	[12, 1, 7]
	First responder assets	Positive	[7]

analysis of the results of the two scorecards. Not only this but the objective of the UNDRR scorecard is structured around how the 10 essentials can be used to increase the resilience of communities living in city areas [2]. So, this study argues that the 10 essentials can be translated to communities of ward levels as well.

After this, around 123 indicators were identified from the literature review. These indicators were then classified and grouped based on the 10 essential dimensions. During this process, duplicates were removed and relevant indicators were selected. Aksha and Emrich [3] states that there are two important aspects when it comes to choosing the indicators. 1) Suitable for Nepali context and 2) Availability of data. Finally, 36 indicators reflecting 9 essentials were finalized based on this theoretical framework. The 10th essential being focused on post-event recovery planning at the local level was difficult to answer for the community members during the pilot survey. Hence, this was deducted from the final list of indicators.

## 2.2 Data collection and site

Sample questionnaires have been prepared based on these 35 indicators for the ward and household-level surveys. The replies to these questionnaires will be recorded as ordinal variables from "1" to "3" or "1" to "4" or "1" to "5" based on the type of questionnaire. Some of the demographic questionnaires (gender) will be recorded as category variables. The initial draft of questionnaires has been tested for quality through focus group discussions and sample interviews held on 12th January 2023. The questionnaires have been revised accordingly. A key informant interview was also done with Ar. Monika Maharjan, an urban planner in the New Town Project Coordination Office at DUDBC, MoUD. The informant has been responsible for the coordination of the development of the Urban Resilience Scorecard (URS). She believes that the scorecard is highly technical making it complex for its use in a community context, making it appropriate only for the municipality level.

This research was focused on the ward-level urban communities of Kathmandu Metropolitan City (KMC). KMC has a total population of 845,767 (CBS Nepal, 2022) residing in a total of 32 wards. The target for this research will be two wards (Ward 5 and Ward 23) of KMC. Ward 23 is located in the old core heritage area with a dense settlement while ward 5 is located near the outskirts of KMC with a relatively less dense settlement. As per the 2011 census data, there are a total of 18,320 people living in ward 5 while 8,357 people are living in ward 23. Using the Krejcie and Morgan formula to calculate the sample size, considering 0.10 error margin at 95% confidence level, a sample size of 200 (100 in each ward) were selected.

## 2.3 Data analysis

### 2.3.1 Data normalization (Min-Max method)

The first step for data analysis will be the Min-Max rescaling scheme to normalize the variables by reducing their values to lie between ranges zero and one.

For indicators that impact resilience positively,

$$Y_{iw} = \frac{(X_{iw} - MinX_i)}{(MaxX_i - MinX_i)} \quad (1)$$

For indicators that impact resilience negatively,

$$Y_{iw} = \frac{(MaxX_i - X_{iw})}{(MaxX_i - MinX_i)} \quad (2)$$

$Y_{iw}$  = Normalized score for an  $i$ th indicator of the  $w$ th ward,  $Max X_i$  = Maximum possible value of an  $i$ th indicator,  $Min X_i$  = Minimum possible value of an  $i$ th indicator,  $X_{iw}$  = Mean score of  $i$ th indicator of the  $w$ th ward, The calculated values are given in Table 2.

### 2.3.2 Weight calculation

A method described by Iyengar and Sudarshan [17] had been used to calculate the relative importance of individual indicators. The weights are assumed to vary inversely to the variance of normalized value of indicator over multiple regions.

$$W_i = \frac{k}{\sqrt{Var(Y_{iw})}} \quad (3)$$

Where,

$$k = \left( \sum_{i=1}^m \frac{1}{\sqrt{Var(Y_{iw})}} \right)^{-1} \quad (4)$$

$W_i$  represents the weight of the  $i$ th indicator such that  $W_i$  lies between 0 and 1 and the sum of all 'm' number of weights is equal to 1,  $Var(Y_{iw})$  is the variance of  $Y_{iw}$  and  $m$  is the number of indicators.

### 2.3.3 Aggregation

For calculation of the overall resilient scores ( $R_w$ ), the following equation given by Iyengar and Sudarshan [17] had been used.

$$R_w = \sum_{i=1}^m W_i Y_{id} \quad (5)$$

The calculated values for  $W_i$  and Resilience scores are is given in Table 3.

**Table 2: Normalized scores**

10 essentials	Indicators (Xi)	Normalized scores (Yiw)	
		Ward 5 (Yi5)	Ward 23 (Yi23)
<b>A. Organize for Resilience</b>	Ward coordinates with the community	0.26	0.22
	Gender Inclusive programs	0.50	0.38
	Confidence in governance	0.49	0.37
<b>B. Identify, Understand and Use Current and Future Risk Scenarios</b>	Level of awareness and knowledge	0.42	0.44
<b>C. Strengthen Financial Capacity for Resilience</b>	Insurance for risk	0.02	0.04
	Incentives for DRR approaches	0.00	0.00
	Homeownership	0.49	0.46
	Employment status	0.87	0.98
	Female employment	0.56	0.70
	Access to credit and financing	0.85	0.79
<b>D. Pursue Resilient Urban Development</b>	Building code and by-laws	0.33	0.28
	Green energy utilization	0.27	0.28
<b>E. Safeguard Natural Buffers</b>	Awareness of environmental ecosystems	0.34	0.30
	Green and blue infrastructures	0.38	0.47
<b>F. Strengthen Institutional Capacity for Resilience</b>	Public awareness programs	0.21	0.11
<b>G. Understand and Strengthen Societal Capacity for Resilience</b>	Communities groups and roles	0.14	0.19
	Social ties/networks	0.79	0.77
	Special need assistance programs	0.53	0.21
	Acceptance in a community (Length of stay in the community)	0.63	0.68
	Absentee population (Abroad for work/study)	0.78	0.93
	Protection of heritage	0.68	0.64
	Female-headed households	1.00	0.95
<b>H. Increase Infrastructure Resilience</b>	Clean water	0.89	0.87
	Sanitation and solid waste management	0.98	0.96
	Energy and power access	1.00	1.00
	Transportation	0.67	0.65
	Road	0.62	0.66
	Communications	1.00	1.00
	Health care	0.50	0.39
	Education	0.62	0.54
<b>I. Ensure Effective Disaster Response</b>	Early warning/ Alert system	0.23	0.18
	Standard response procedure	0.54	0.46
	Store food, goods, and fuel for emergency	0.26	0.28
	Local center is established for response operations	0.59	0.62
	Drills training	0.14	0.09
	First responder assets	0.13	0.14

**Table 3: Weightage and Resilience scores**

10 essentials	Indicators (Xi)	Weightage (Wi)	(Yid X Wi)	
			Ward 5 (R5)	Ward 23 (R23)
<b>A. Organize for Resilience</b>	Ward coordinates with the community	0.023	0.006	0.005
	Gender Inclusive programs	0.009	0.012	0.009
	Confidence in governance	0.009	0.011	0.009
<b>B. Identify, Current and Future Risk Scenarios</b>	Level of awareness and knowledge	0.053	0.010	0.010
<b>C. Strengthen Financial Capacity for Resilience</b>	Insurance for risk	0.052	0.001	0.001
	Incentives for DRR approaches	0.000	0.000	0.000
	Homeownership	0.050	0.011	0.011
	Employment status	0.010	0.020	0.023
	Female employment	0.008	0.013	0.016
	Access to credit and financing	0.019	0.020	0.018
<b>D. Pursue Resilient Urban Development</b>	Building code and by-laws	0.020	0.008	0.006
	Green energy utilization	0.066	0.006	0.006
<b>E. Safeguard Natural Buffers</b>	Awareness of environmental ecosystems	0.026	0.008	0.007
	Green and blue infrastructures	0.011	0.009	0.011
<b>F. Strengthen Institutional Capacity for Resilience</b>	Public awareness programs	0.010	0.005	0.002
<b>G. Understand and Strengthen Societal Capacity for Resilience</b>	Communities groups and roles	0.021	0.003	0.004
	Social ties/networks	0.057	0.018	0.018
	Special need assistance programs	0.008	0.012	0.005
	Acceptance in a community (Length of stay in the community)	0.003	0.014	0.016
	Absentee population (Abroad for work/study)	0.020	0.018	0.021
	Protection of heritage	0.007	0.016	0.015
	Female-headed households	0.020	0.023	0.022
<b>H. Increase Infrastructure Resilience</b>	Clean water	0.030	0.021	0.020
	Sanitation and solid waste management	0.039	0.023	0.022
	Energy and power access	0.092	0.023	0.023
	Transportation	0.058	0.015	0.015
	Road	0.025	0.014	0.015
	Communications	0.000	0.023	0.023
	Health care	0.010	0.012	0.009
	Education	0.014	0.014	0.013
<b>I. Ensure Effective Disaster Response</b>	Early warning/ Alert system	0.021	0.005	0.004
	Standard response procedure	0.014	0.012	0.011
	Store food, goods, and fuel for emergency	0.072	0.006	0.006
	Local center is established for response operations	0.035	0.014	0.014
	Drills training	0.023	0.003	0.002
	First responder assets	0.064	0.003	0.003
	<b>Total</b>		1.00	0.43

### 3. Results and Discussions

#### 3.1 Computation of Resilient scores

After the collection of data through a survey of around 215 households, the mean ( $X_i$ ), normalized scores ( $Y_i$ ), weightage ( $W_i$ ), and resilient scores ( $R$ ) for each ward have been calculated and the results have been recorded in Table 3. The overall resilience score of Ward 5 was calculated as 0.45 and that of the Ward 23 was 0.42. So, Ward 5 scored slightly better than Ward 23. Even though these scores can represent the overall status of the ward in comparison to each other, however, the real strength of this scorecard lies in the results of individual dimensions.

#### 3.2 Results and discussions on 10 essentials

In this section, each dimension of the 10 essentials will be discussed in detail.

##### 3.2.1 A. Organize for Resilience

The essential 'Organize for resilience' refers to establishing a coordination mechanism where community members play an active role in engaging with ward officials to identify strategies and make plans towards increasing resilience. The scores for each of the indicators are given in Table 2. The most prominent scores were for coordination of the ward and community. Both wards 5 and 23 scored a very low resilience scores of 0.26 and 0.22. This score was lower than the ward averages. This clearly shows a big gap in the coordination mechanism of the ward and its population. The survey reports that 53.4% (ward 5) and 64.3% (ward 23) respondents stated that there is no coordination between the ward and them. These respondents also highlighted how access to coordination meetings is only restricted to a few members of the communities who have a good relationship with the ward. Researchers like [11] have shown that a better political link means better social capital, which in turn gives access to better opportunities. However, marginalized groups don't get the same opportunities. So, the ward officials from both wards should find effective ways of communicating with representatives from all members of the communities of all social backgrounds and not just the elite [11] few members.

##### B. Identify, Understand and Use Current and Future Risk Scenarios

This essential dimension has only one indicator i.e. 'level of awareness and knowledge' for current and future risk scenarios. Respondents had an average level of understanding and awareness (0.42 in ward 5 and 0.44 in ward 23) regarding the possibility of different disaster risks that their community can face. Some respondents even mentioned the recent COVID pandemic as a disaster along with the loss of intangible cultural heritage. This shows that respondents recognize the multi-dimensional aspects of the hazard on top of the usual hazards of natural events.

##### C. Strengthen Financial Capacity for Resilience

This essential dimension has a total of six individual indicators. All these indicators measure the financial strength of the community. Indicators like insurance (0.02 in ward 5 and 0.04 in ward 23) and incentive mechanisms (0.00 in both wards)

reported some of the lowest scores overall. Especially for the indicator to measure the incentive mechanism, which was completely zero as there is no incentive mechanism whatsoever. Insurance mechanisms are one of the best tools for ensuring the effective recovery of properties from not just a disaster event but also support coverages for lives, and livelihoods [2]. Similarly, incentive mechanisms can promote investment in risk reduction [12, 2]. Hence, the officials of the wards need to focus more on promoting insurance and incentive mechanisms. Other indicators like homeownership, employment, and female employment, access to credit had relatively better scores in both wards.

##### D. Pursue Resilient Urban Development

This focuses on the built environment and how it can be made resilient [7, 2]. There are two indicators to define resilient urban development for the communities at the ward level. One is the knowledge of building codes and by-laws and the other is the utilization of green energies. Both of these indicators scored well below the ward averages for both wards. Knowledge of building codes and by-laws (0.33 in ward 5 and 0.28 in ward 23) indicator showed that most respondents (42.7% in ward 5 and 55.4% in ward 23) had no idea regarding the by-laws and building codes. Those who had some idea only knew about by-laws (48.5% in ward 5 and 55.4% in ward 23) but not the building codes. Even in the case of the use of green energies (0.27 in ward 5 and 0.28 in ward 23) like solar water heaters, the orientation of buildings, and terrace gardening, respondents reported not having used these techniques to access green energy sources.

##### E. Safeguard Natural Buffers to enhance the protective functions provided by Natural Ecosystems

This resilient dimension refers to the protection provided by ecosystems like parks, open spaces, urban vegetation, ponds, etc to increase the resilience of the communities [7, 2]. This study showed that the awareness of environmental systems (0.33 in ward 5 and 0.28 in ward 23) and green and blue infrastructures (0.38 in ward 5 and 0.47 in ward 23) both are lacking. Ward 23 has pockets of open spaces in the form of courtyards. These are easily accessible and provide ample spaces for different activities in the dense city cores from tangible and intangible cultural importance to shelter during the 2015 earthquake as reported by the respondents. This is one of the main reasons for an increase in the score of green and blue infrastructures of ward 23. However, it was noted that recent renovation trends of concrete stone paving of these courtyards have a detrimental effect on the infiltration of rainwater to the ground. Nonetheless, both wards should make significant efforts to increase awareness of environmental systems, especially on the importance of infiltration and recharge of groundwater. The ward planners should also strive for the conversion of public lands into green and blue infrastructures and make them accessible to the communities.

##### F. Strengthen Institutional Capacity for Resilience

The indicator for the communities to measure institutional capacity for resilience is the adoption of different public awareness programs by the wards to disseminate relevant information regarding the roles of communities, training, and other capacity-building activities. The indicator scored a low

0.21 in ward 5 and an even lower score of 0.11 in ward 23. For the resilient dimension of strengthening the institutional capacity, it becomes necessary to disseminate the roles of community members through programs and awareness events.

#### F. Strengthen Institutional Capacity for Resilience

This essential dimension is arguably one of the most important dimensions to measure the resilience of a community and is highly referred to by different authors [3, 12, 1, 18]. It includes some important indicators like involvement in community groups and their roles, social ties, acceptance in the community, absentee population, heritage protection, and female-headed households. The study in wards 5 and 23 suggested good results in all these indicators except for community groups and roles (0.14 in ward 5 and 0.19 in ward 23). This is again due to a lack of public awareness campaigns to increase the capacity of the community as seen in the previous essential dimension 'F'. So, both wards need to organize programs to target awareness of the public and communities. These programs should be focused on the roles of individuals, train community groups as first responders, and provide drills to increase response performance in the event of a disaster.

#### H. Increase Infrastructure Resilience

The infrastructure essential dimension is another important dimension considered by many researchers. It includes indicators like clean water, sanitation and solid waste management, energy and power access, transportation, road, communications, health care, and education. All these reported good scores except for health care (0.50 in ward 5 and 0.39 in ward 23) and education (0.62 in ward 5 and 0.54 in ward 23) which scored only above average scores. One of the main reasons for the decrease in scores for both healthcare and education is due to high expense of quality services. Good hospitals and schools require significant money while affordable ones like government hospitals are overcrowded and mismanaged to be easily accessible. These require good governance from the state and municipality level rather than the ward level, however, wards are organizing free health checkups and old-age education to play their part in improving the resilience of the community members.

#### I. Ensure Effective Disaster Response

One of the important areas of DRR is to build the capacity for response [2]. This essential dimension measures the response capacity of communities in the event of a disaster. Six indicators can be measured in this scorecard to ensure an effective response by the communities. The survey showed a large gap in resilience in the case of disaster response.

The early warning or alert system may not be entirely for natural disasters like floods, landslides, or even earthquakes. One of the basic functions of alert systems as seen installed in some communities is to notify the community members of an emergency like theft, fire, emergency assistance, etc as seen in some communities of ward 5. Some forms of these alert systems have been used in the case of ward 23 also. For example, a respondent suggests that an alarm is used by the ward to notify community dwellers during the time for waste collection. If this alarm sounds at any other time then we can assume that there is

some emergency and we respond accordingly. Regardless these are just isolated cases and do not translate to the whole ward as verified by the low scores (0.23 in ward 5 and 0.18 in ward 23). However, the community members mark themselves as somewhat prepared in case of a disaster event (0.54 in ward 5 and 0.46 in ward 23). This is contradicted by the fact that they do not have any food, goods, or fuels stored in case of emergencies (0.26 in ward 5 and 0.28 in ward 23) even though 31% respondents of in ward 5 and 52% of ward 23 know that they need to store food for emergencies.

The lack of preparedness can be observed in the lack of drill training (0.14 in ward 5 and 0.09 in ward 23) and the lack of knowledge of first responders (0.13 in ward 5 and 0.14 in ward 23). However, the recent earthquake has raised the confidence of the community regarding 'where to go' during a disaster event like an earthquake as 80.6% in ward 5 and 85.7% in ward 23 know where to go. However, it was clear that the ward has not made proper plans for disaster management centers or designated safe places. Furthermore, this essential dimension shows how both wards need to improve their warning systems for fast information flow in the community. Basic knowledge and training related to response to disaster can certainly benefit the community and increase its capacity for disaster response.

## 4. Conclusion

In this way, this study has developed and used an urban resilience scorecard applicable to communities at the ward level. The scorecard has been derived from the URS and UNDRR's 10 essentials for making cities resilient. This enables city officials and planners to closely compare both the ward-level and municipality-level scorecards. Comparison of the two scorecards or only the ward-level scorecard can help concerned authorities to identify the exact gap in resilience capacities as perceived and experienced by the communities. Then targeted plans and programs can be implemented to improve this gap and build resilience. The scorecard can be implemented in the future to assess the progress of these plans and programs as well. The resilience status is everchanging with time and conditions. For example, a disaster scenario can completely disrupt the resilience balance of the communities. This means that recovery from a disaster can be affected. Even in this condition, a scorecard can effectively assess the changing scenarios and support the recovery process.

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