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Mapping Adaptive Capacity of Urban Residents: A Case Study of Rawalpindi, Pakistan

Naeem Ahmed[1], Ihtsham Ul Haq Padda[2] and Azra Khan[3]

[1] Corresponding Author, Department of Economics, National University of Modern Languages (NUML), Islamabad, Pakistan; Email: mnaeem@numl.edu.pk
[2] Department of Economics, Federal Urdu University of Arts, Sciences and Technology (FUUAST), Islamabad, Pakistan; Email: ihtsham91@yahoo.com
[3] Department of Economics, Federal Urdu University of Arts, Sciences, and Technology (FUUAST), Islamabad, Pakistan; Email: azraphd@gmail.com

Abstract

The study estimated the adaptive capacity ranking of urban union councils of Rawalpindi through composite index considering fifteen economic, social, and institutional indicators as drivers of adaptive capacity through a structured questionnaire. The required sample size was 385 households and questionnaires were distributed to the residents of thirty urban union councils at random. The results showed that union councils of MC Stadium Block B, Khayaban e Sir Syed (KSS) Sector III and New Katarian- I had adaptive capacity 709, 676, and 674 respectively. Lakhan union council was found to have the lowest adaptive capacity of 422. The difference between the lowest and the highest adaptive capacity is surprisingly high with the difference of 287. KSS Sector III had highest savings ratio as compared to other union councils. New Katarian-I was bestowed with institutional as well as non-institutional sources of loan. Lakhan was found to be weak in almost all indicators of adaptive capacity except availability of institutional and non-institutional sources of loan. Pakistan, with high mass urban population, needs to be well prepared for climate change risks as well as health hazards, therefore, new planned urban spaces are a dire need.

Key Words: Climate Change, Health Hazards, Adaptive Capacity, Urban Planning, Clean Drinking Water

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1. INTRODUCTION

In past centuries, increasing human influence on the natural environment has resulted in major global issues for human health as well as for the whole planet, of which COVID-19 may be the most significant indication (Klenert et al., 2020). Human intervention with natural ecosystems

causes climate change and a boom in zoonotic diseases like COVID-19 (Settlee et al., 2020). Learning from policy decisions that are made during the COVID-19 catastrophe might help to increase efforts to combat global climate change and prepare mankind for future disasters (Klenert et al., 2020). Many of these reasons of health inequity are being exacerbated by climate change; weakening the conventional coping mechanisms for dealing with severe incidents like pandemics (Zavaleta-Cortijo et al., 2020). A number of people are affected by the disease, global fatalities continue to rise to alarming levels, particularly among the elderly and health-compromised, as well as in marginalized and racialized segments of community and that conditions are tough for those confined, particularly if they are constrained to small, crowded apartments or rooms (Heyd, 2021). COVID-19 spread over long distances, becoming globalized (Hyder et al., 2020), and when it reached disadvantaged communities, it caused widespread illness and a large death toll.

Greenhouse gases are emitted in specific places benefiting specific individuals, companies, and communities; yet the repercussions of these emissions are globalized over enormous geographical (and temporal) borders. Similarly, emitted greenhouse gases cross borders, becoming globalized, and the consequent global warming causes significant droughts, heat waves, storm intensity, and floods along with sea level rise and ocean acidification. It may cause major societal disruptions, such as an increase in life-threatening disasters, resulting in losses in dwellings and crops, the expansion of disease vectors to new locations, forced migrations among other factors, resulting in higher morbidity and mortality, as well as general adversity, particularly among vulnerable communities (Filho, 2015; Heyd, 2021). Whether it is a pandemic or climate change, the most vulnerable members of society will always be the elderly, those already health compromised, and the economically marginalized (including the racial discrimination), most of whom live in proximity with one another, resulting in high morbidity and significant fatalities.

Pakistan is a developing country, and its pace of urbanization is the highest in South Asia. Rural areas are the most neglected part of a society in perspective of resource distribution. Hence, high urbanization rate in Pakistan can be due to rural-urban migration as well as high urban population growth rate. Cities in Pakistan are expanding, but with no planning; therefore, so significant disorganization is seen in provision of housing, transportation, health, and water and sanitation. Those with high income enjoy a lavish life in lush green areas, large houses, availability of clean water, and proper sanitation; while a large part of the society with low income, is bound to live

in small quarters and densely populated areas, with low health care facilities, and become the victims of climate change and pandemics. Urbanites of almost all cities in Pakistan are facing the same crises. Cities already experience major climatic and environmental issues such as the urban heat island effect, in which cities are typically warmer than rural counterparts due to higher absorption of heat and limited cooling provided by greenery and impervious surfaces, air pollution aggravated by extreme heat, and existing climate extremes (World Bank Group & Group, 2011). Poor communities, particularly those located in high-risk locations, are more susceptible because they have less adaptive capacity and are more reliant on climate-sensitive resources such as local water and food supply (Hunt & Watkiss, 2011). The ability of a system to adapt to climate change in order to mitigate possible harms, seize opportunities, or cope with the consequences is known as adaptive capacity (Intergovernmental Panel on Climate Change, 2014).

As societies respond in specific and non-linear ways to numerous hazards, the phrase ‘adaptive capacity’ has been used to emphasize the necessity to comprehend variety and variability in adaptive capacities of different groups and at different scales (Barton et al., 2021). Many characteristics of adaptive capacity are effectively hidden in the network and information systems of people who are likely to be affected (Adger et al., 2004b). The pace at which a specific type of hazard's risk (or biophysical vulnerability) is reduced (or raised) is determined by the timeframes associated with the design of adaptation strategies (realization of adaptive capacity by means of adaptation) (Barton et al., 2021) in addition to the timescales involved with the hazard's emergence or occurrence (in the case of global-scale anthropogenic climate change, the latter will be influenced by global development pathways and the extent to which mitigation is pursued) (Klenert et al., 2020). Strong institutions are essential for guiding these sectors' outcomes towards a more sustainable future (Yasmeen et al., 2021).

Here the question arises why some parts of society are more vulnerable as compared to others? It is due to the difference in the adaptive capacity of those parts of society. Hence, this study measured the factors that contribute to the adaptive capacity of residents of different union councils of Rawalpindi, a densely populated large metropolitan.

2. DESCRIPTION OF THE STUDY AREA

Rawalpindi, located in north-central Pakistan, is an ancient city with inscriptions of a Buddhist population. The busy metropolis with a population

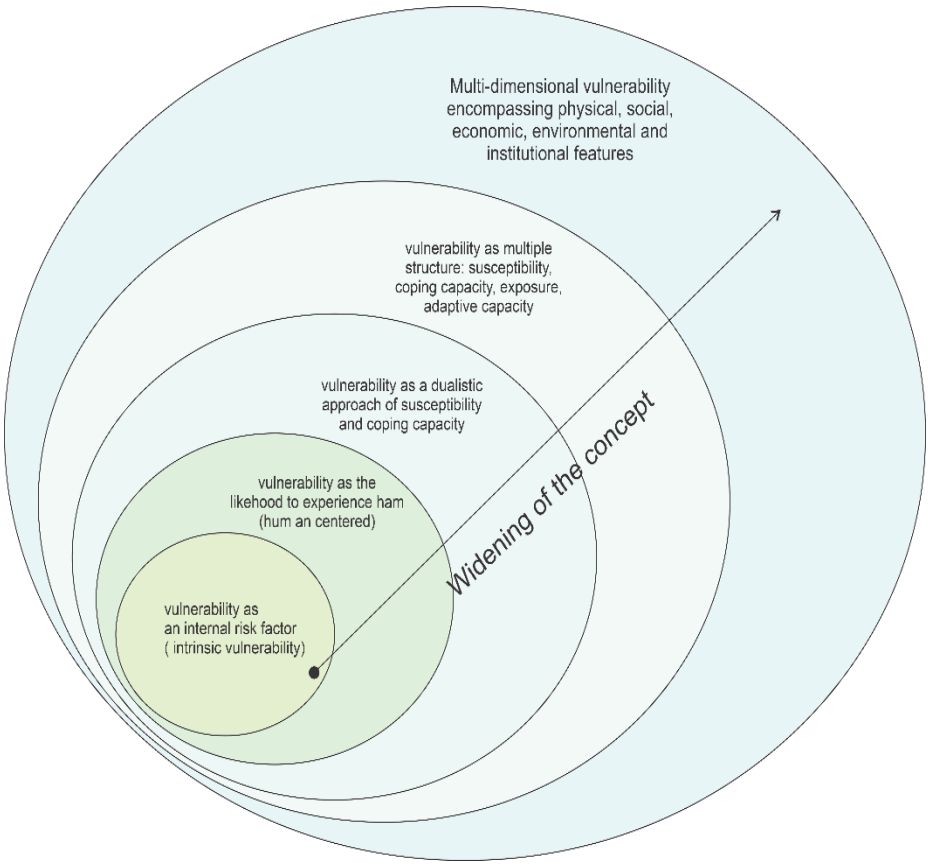
of over 2.2 million is plagued by traffic jams, damaged roads, densely populated areas, and a haze-filled environment because of unplanned growth. Such chaos and population density can easily be understood, as the area of Rawalpindi city is 259 KM^2 with population 2.2 million (Pakistan Bureau of Statistics, 2017b) is well above the global average population density of 25 people per KM^2 .

3. THEORETICAL BACKGROUND

Adaptive capacity evaluation is a useful tool that uses a top-down approach to determine a community's priorities and resources. The IPCC's precise definition of vulnerability incorporates indicators of social, economic, and natural sciences to describe vulnerability as a function of exposure, sensitivity, and adaptive capacity (Intergovernmental Panel on Climate Change, 2014). Another element to consider when assessing adaptive ability is the relative distribution of health, education, and wealth. The more disadvantaged, handicapped, old, very young, poorly educated, and ill individuals there are in a society or community, the more susceptible they are to climate change and the poorer its adaptive capacity. Climate change will have a greater influence on the urban environment, affecting both people and physical infrastructure (Gill & Moeller, 2018).

This study, like earlier research, considers a variety of economic, social, and institutional variables as drivers of adaptive capacity, with an emphasis on contemporary climate change. Settlements and society, on the other hand, are viewed as capable of significant adaptation, relying significantly on the competency and ability of individuals, communities, businesses, and local governments, as well as access to financial and other resources (Intergovernmental Panel on Climate Change, 2014). This study takes the methodology of (Garschagen & Birkmann, 2014), as it coincides with the present study that is more spatial, incorporating indicators of social, economic and institutional factors to calculate climate change adaptive capacity. Vulnerability may be viewed as a sequence of increasing degrees of complexity and size dependency on adaptive capacity (Birkmann & Wisner, 2006; Garschagen & Birkmann, 2014; Smit & Skinner, 2002; Wisner & Wisner, 2016).

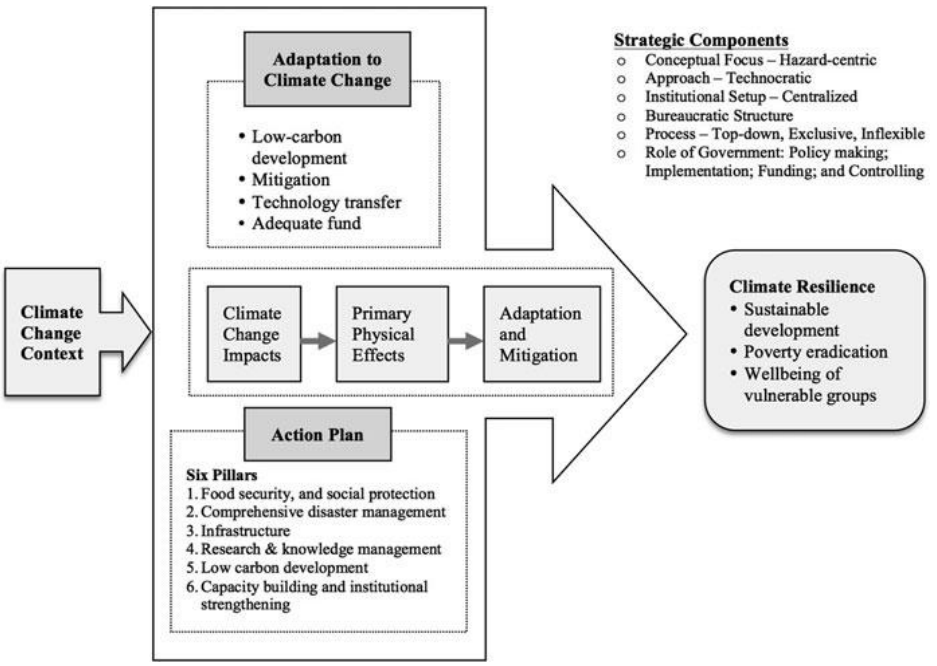
Figure 1. Conceptualizing Vulnerability of Any Area
(Garschagen & Birkmann, 2014)



The Integrated Assessment Approach (IAA) considers interactions and feedbacks among numerous drivers, as well as their effects on cross-sectoral interactions of various sorts and scales (Intergovernmental Panel on Climate Change, 2014). According to the Intergovernmental Panel on Climate Change (2014), "vulnerability describes all the factors that determine the outcome of a hazard event of a given nature and severity". Exposure will depend on where populations choose to (or are forced to) live, and how they construct their communities and livelihoods.

In the following figure, the models would all come under the outermost two circles:

Figure 2. Illustration of the Climate Change and Its Coping Mechanism (Filho, 2015).



As people utilize resources and manage the environment for their own interest in the short or long term, environmental variables will change in relation to human activities. It is impossible to give a list of "off-the-shelf" indicators that reflect universal drivers of adaptive capacity at the project level (Adger et al., 2004a). The ideological underlying causes of catastrophe susceptibility have been recognized at the global level as various types of society-nature relationships, i.e., social, political, and economic systems. Dynamic processes at an intermediate level include population boom, urbanization and population pressure, environment factors, loss of ethics, and so on, whereas hazardous circumstances at a local level include social vulnerability, future consequences to natural and built environments, and poverty. To lower local baseline vulnerability and enable the household to move onto the intermediate level of the vulnerability continuum, it is critical to ensure "safe conditions" at the household level (Filho, 2015).

Economic activity at the micro, meso, and macro scales should be intimately related to community resilience, and this activity should be included in any evaluation of community resilience, not just for post-shock recovery but also for resilience to numerous, immanent threats (Barton et al., 2021). The creation of a practice-based approach and conceptual framework

to better comprehend heat tolerance will result in a multidimensional, systems-oriented knowledge of how susceptibility may be minimized (Maller & Strengers, 2011). Each case requires its own set of indicators for measuring adaptive capacity. Building adaptive capacity entails gathering the evidence and establishing the necessary prerequisites (regulatory, institutional, and managerial) before implementing adaptation measures (*Planning for Adaptation to Climate Change - Guidelines for Municipalities — Climate-ADAPT*, n.d.).

A system that is totally resilient to all risks will have zero vulnerability, meaning that its adaptive capacity fully offsets all types of vulnerabilities, resulting in the aforementioned relationship being operationalized as: Adaptive Capacity = (Bio-Physical Vulnerability) + (Socio-Economic Vulnerability) And:

Adaptive capacity = f (Economic, Social, and Institutional factors)

4. DATA AND METHODOLOGY

This portion of study explains the methodology adopted to quantify adaptive capacity of different urban union councils of Rawalpindi and to identify which factors or indicators determine the adaptive capacity.

4.1. Sampling Design and Size

Keeping in view the nature of the current study, simple random sampling technique was used within each union council of Rawalpindi city. Population of Rawalpindi is 2.098 million in 30 urban union councils (Pakistan Bureau of Statistics, 2017a). This study conducted a comprehensive survey through a carefully designed structured questionnaire and a pilot study was also conducted from the urban residents of Rawalpindi to measure the vulnerability towards climate change. Informed consent was taken at the time of data collection from the respondents. To achieve a good representative sample, population proportion to the size from the target population has been adopted by collecting fifteen questionnaires from each urban union councils of Rawalpindi. For several factors, a sample of 410 respondents was eventually chosen, which was seven percent greater than the required sample. For instance, having a bigger sample size increased the confidence that sample responses do not differ considerably from real opinions. Oversampling helped guarantee that the required sample size of 385 people was met. Furthermore, the large sample size helped in ensuring adequate stratification.

Survey collected information on demographic, social, economic, physical aspects of adaptive capacity. Although the results from the study area might not be generalized to the universe of urban populations, however, this study can be a good road map for future research on urban indicators of adaptive capacity quantification.

4.2. Composite Index Development

The adaptive capacity index in this study is based on the notion that ability to adjust to present and future changes is a function of adaptive capacity. If indicators and indices are intuitively comprehensible, unbiased, and geographically comparable, they are excellent instruments for presenting a complex reality in simple terms and permitting comparisons across place and time (Vincent, 2004). A composite indicator is a mathematical aggregate of individual variables or thematic collections of data that reflect multiple facets of a topic that no single indicator can fully express (Cutter, 2012).

4.3. Standardization of Indicators

The composite index is calculated from standardized indicators. The indicators are standardized using min-max approach:

Index sd= $\frac{S_{d,v}-S_{min}}{S_{\max}-S_{min}}$

where, $S_{d,\,v}$ is value of sub-component indicator for v^{th} household, and S_{max} and S_{min} are maximum and minimum values, respectively, of indicators among households considered.

4.4. Computation of Sub-component Index

To compute the sub-component values, composite-index approach with equal weight can be adopted. After standardization of the indicators, each sub-component (M_v) with 'n' number of indicators and with value Indicator sv_i for the i^{th} indicator can be calculated as follows:

$$M_v = \frac{\sum_{i=1}^{n} \text{Indicator}_{svi}}{n}$$

Many studies have developed a composite vulnerability index without weighting (Cutter, Boruff, & Shirley, 2003; Khan, 2012; Schipper, 2009; UNFCCC, 2007).

Table 1. Adaptive Capacity Indicators Chosen from Previous Research.

Indicator number	Explanation of indicators	Assumed relation to adaptive capacity
A1	Income	Higher income decreases the adaptive capacity.
A2	Percentage distribution of households by economic perception of, as not better than last year.	The perception of the community, not being as well off as earlier, would affect the total assets building of the community to counter hazards.
A3	Percentage distribution of households by material used for roofs other than cement	Living in houses with roofs made of wood/mud greatly increases the risk of loss of life in a hazardous event.
A4	Filtration plant	Availability of clean water increases adaptive capacity.
A5	Provision of livelihood	Male head of household is a reliable source of livelihood thereby increasing adaptive capacity.
A6	Loan (Institutional & Non-institutional)	Availability of loan in hazard increases adaptive capacity.
A7	Savings	Savings increases adaptive capacity.
A8	Awareness	People with awareness about natural hazards can better cope with such situations.
A9	Availability of help	NDMA and Rescue 1122 can increase adaptive capacity.

The majority of the indicators are chosen by writers subjectively, based on assessments of related literature (Chang et al., 2020). Only a few studies have utilized empirical methods to generate locally derived indicators of hazard susceptibility. The most essential factor to consider when choosing indicators is that they should answer the research question and test the ideas that are being operationalized (Mavhura et al., 2017). The model indicators (Barton et al., 2021; European Environment Agency, 2019; Filho, 2015; Maller & Strengers, 2011; Mitchell et al., 2021) chosen to quantify each determinant of adaptive capacity to cope climate change are given in Table 1.

5. RESULTS AND DISCUSSION

The mean age of the respondents in different union councils of Rawalpindi was found to be 48 years with minimum 21 years and maximum 99 years with slightly high standard deviation of 13 years of Rawalpindi, shown in Table 2 below. Highest education was found to be eighteen years, out of these while 18% were illiterate, 35% of the respondents had primary level education and 25% were matriculate, the remaining 22 % had higher

qualification. A comparing of education of Rawalpindi with Islamabad shows that in Rawalpindi education was slightly lower than that of Islamabad. The mean household size was 6 persons per HH with minimum 2 persons and maximum 9 persons per HH. About 58% were male and the remaining 42% were female respondents; within the respondents, 53% were married and 47% were single. Maximum monthly income of the respondents was PKR 195,000 and the mean income was 39000, well above the PKR 17000 per-capita income of Pakistan.

About 28% of the sample respondents outsourced drinking water, while the remaining 72% had access to filtration plant water, indicating that Rawalpindi residents had poor water quality. In terms of home ownership, 43% of respondents leased their homes, while the remaining 57% owned their own. Most of the respondents complained that municipal corporation does not collect solid waste, therefore, piles of solid waste can be seen in streets and landfills are present in the vicinity of their homes. Congestion, air pollution, noise pollution, and unfiltered source of drinking water were the main characteristics of living in Rawalpindi city. Residents of Rawalpindi were facing extreme infection of CVOVID-19 and were found to be highly susceptible to the disease. Moreover, most of the respondents were found to be hesitant to participate in the immunization program started by the Government against COVID-19.

Table 3 below shows the adaptive capacity ranking of union councils of Rawalpindi city. To measure the adaptive capacity of union councils all the indicators were standardized first. Standardization of first indicator is done for all respondents individually as follows:

$$\text{Index} = (55{,}000 - 10{,}000)/(195{,}000 - 10{,}000) = 0.562$$

Then all the individual indicators were summed for all respondents of any given union council. Top three union councils with the highest adaptive capacity are found to be MC Stadium Block B, Khayaban-e-Sir Syed (KSS) Sector III and New Katarian-I, while Lakhan union council was found to have the lowest adaptive capacity. The difference between the lowest and the highest adaptive capacity is surprisingly high with the difference of 287. This difference can be due to several factors included in this survey. It can better be visualized by sub-components of the adaptive capacity of each union council of Rawalpindi city.

Table 2. Descriptive Statistics of Respondents of Rawalpindi

	N	Range	Min	Max	Mean	Std. Deviation
Age	410	99.00	21	99	48.61	12.276
Education	410	16.00	0	16	12	3.104
Income	410	20000.00	10000	195000	39578.05	16666.879
No. of children	410	0.00	0	8	2.29	1.633
Family member HH	410	3.00	2	12	6.44	2.792
Mean age of HH	410	25.00	2	59	28.36	14.117
HH aged over 65	410	0.00	2	39	28.36	14.114
HH aged below 15	410	0.00	1	25	18.60	11.558
Highest Education of HH	410	8.00	0	16	12.67	3.304
Residential Status (Rented)	410	175				
Personal residence	410	235				
COVID-19 patients in HH	410	3.00	0.00	2.00	0.4683	0.80050
Deaths due to COVID-19	410	0.00	0.00	2.00	0.2537	0.52707
Source of drinking water Hand pump/motor/Tube well	410	115				
Piped/Tanker truck, water bearer/Mineral Water/Filtered	410	295				

Source: Authors owns calculation.

Adaptive capacity map of Rawalpindi city is presented below (Figure 3). The dark green parts show union councils with the highest adaptive capacity ranking due to the availability of spacious and green streets, better sewage system, availability of clean drinking water, availability of institutional as well as non-institutional sources of loan and availability of help from the Government in case of any kind of hazard and risk. The lighter green spaces of the map represent union councils not fortunate enough to have civic amenities enjoyed by darker green parts of Rawalpindi city. It is evident from the map that inner parts of the city are unfortunate because of the built environment of the areas such as, Dhamial and Lakhan union councils. These unplanned areas have been built with narrow streets and low sewage capacity with low income to move or change their fate.

Top three union councils with the highest adaptive capacity in Table 3 were respondents whose economic perception was seen (in Table 4) to be better than others, along with green spaces, large streets, and playgrounds in these union councils. KSS Sector III had the highest savings as compared to other union councils. New Katarian-I is bestowed with institutional as well as non-institutional sources of loan. Lakhan was found to be weak in almost all

indicators of adaptive capacity except availability of institutional and non-institutional sources of loan.

Table 3. Adaptive Capacity Ranking of Union Councils of Rawalpindi

Union Council	Adaptive Capacity Index	Adaptive Capacity Ranking
MC Stadium B Block	709	1st
KSS Sector III	676	2nd
New Katarian-I	674	3rd
New Katarian-II	665	4th
D Block Satellite Town	662	5th
Dhaman	658	6th
Girja	637	7th
Saidpur Scheme	630	8th
Afandi Colony	627	9th
Mohan Pura	599	10th
Shakrial	583	11th
Ratta Amral	562	12th
Bangash Colony	561	13th
Banni	559	14th
Kartar Pura	546	15th
Ranial	530	16th
Dhok Hassu	526	17th
Gunj Mandi	516	18th
Morgah	509	19th
Khota Kallan	506	20th
MC Dispensary Purana Qilla	498	21st
Dhok Ratta	495	22nd
Kalial	495	23rd
Cricket Stadium Road	489	24th
Chittian Hattian	489	25th
Dhamial	468	26th
Banjial	466	27th
Chaklala	463	28th
Adiala	458	29th
Lakhan	422	30th

Source: Authors' own calculations.

Respondents from D Block Satellite Town union council were able to seek help from the government as well as private sources during any type of hazard as its adaptive capacity in the said indicators was high.

Figure 3. Adaptive Capacity Map of Rawalpindi City

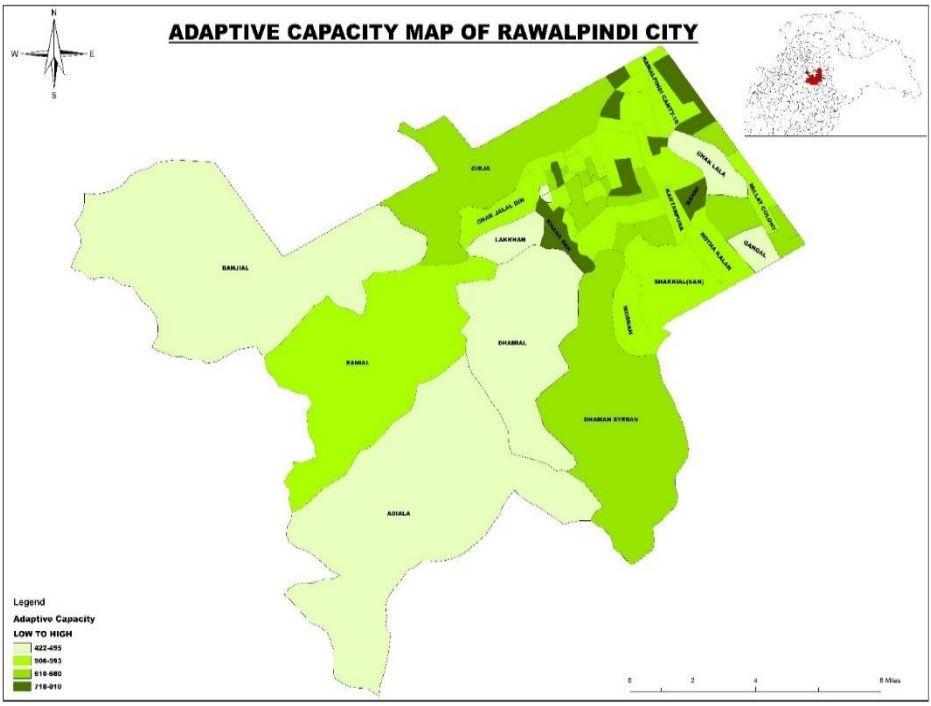


Table 4 below shows the sub-components of adaptive capacity of each union council. Top three union councils with the highest adaptive capacity in Table 3 were respondents whose economic perception was seen (in Table 4) to be better than others, along with green spaces, large streets, and playgrounds in these union councils. KSS Sector III had the highest savings as compared to other union councils. New Katarian-I is bestowed with institutional as well as non-institutional sources of loan. Lakhan was found to be weak in almost all indicators of adaptive capacity except availability of institutional and non-institutional sources of loan. Respondents from D Block Satellite Town union council were able to seek help from the government as well as private sources during any type of hazard as its adaptive capacity in the said indicators was high.

Most of the respondents of different union councils were not satisfied with the availability of clean drinking water. The respondents also complained about the availability of loan and government's support during risks and hazards especially in the current scenario of COVIDovid-19 pandemic.

Table 4. Sub-components of Adaptive Capacity of Each Union Council

UC	Green streets	Income	Economic perception	Residential capacity	RCC Rooftop	Water Filtration	Saving	Institutional borrowing	Non-Institutional	Awareness	Govt. source	private source
Ratta Amral	410	510	600	180	510	310	720	810	100	360	720	730
Dhok Ratta	250	369	228	196	089	228	607	428	785	785	785	785
Dhok Hasu	446	440	571	214	357	257	678	428	785	428	785	571
Bangash Colony	909	309	818	204	431	290	863	818	636	454	272	454
KSS Sector III	442	555	898	384	365	400	961	769	846	538	846	846
New Katarian-I	479	486	666	395	520	383	833	833	916	250	583	750
New Katarian-II	343	460	800	218	281	350	375	375	375	0	125	125
Siadpur Scheme	409	604	854	113	204	327	199	545	818	727	545	636
Cricket Stadium Road	446	233	514	160	357	228	928	100	928	714	214	214
D Block Satellite Town	409	565	618	318	340	309	954	100	909	545	909	454
MC Stadium B Block	604	594	833	250	333	366	250	750	083	333	750	416
Kartar Pura	458	288	566	250	520	266	916	333	666	250	833	416
Banni	714	305	542	321	375	257	100	857	100	214	214	357
Gunj Mandi	464	328	614	142	303	242	892	928	857	214	357	357
Mohan Pura	307	419	661	557	480	276	038	076	769	307	384	384
UC	Green streets	Income	Economic perception	Residential capacity	RCC Rooftop	Water Filtration	Saving	Institutional borrowing	Non-Institutional	Awareness	Govt. source	private source
Afandi Colony	227	490	745	295	454	218	100	909	100	636	545	636
Chittian Hattian	200	508	626	216	216	226	600	467	667	467	667	600
Purana Qilla	323	554	635	205	102	223	764	470	823	411	647	411
Shakrial	295	655	872	204	272	254	772	545	727	545	636	636
Chaklala	303	280	528	196	428	228	785	285	571	285	642	357
Kotha Kallan	464	267	514	267	375	242	928	714	857	214	285	357
Morgah	466	295	520	267	417	253	833	533	733	200	600	400

Source: Author's own calculations.

6. CONCLUSION AND POLICY RECOMMENDATIONS

Many forecasts have documented that urban growth is inevitable due to population growth and will dramatically drive the Global Environmental Change such as Land Use and Land Cover Change (LULCC) and climate change (Nations, 2020; United Nations, Department of Economic and Social Affairs, 2018). Lately, the increasing variability of the climate has also been observed and repeatedly recognized as one of the most severe threats to the environment. Unfortunately, causes and effect of the changing climate are not entirely understood at global, regional, and local scales. South-Asia, especially the sub-continent has been identified as one of the severely threatened regions of the world.

By far in the sub-continent, Pakistan is the fifth most populated country in the world and has the 2nd highest population with one of the highest population growth rates. This factor will continuously serve as a driver for land conversion from natural state to build environment. With land conversion effects observed and significantly increasing at the expense of natural cover, Pakistan is urbanizing at the fastest rate in South-Asia.

According to the findings, most urban residents' adaptive capacity is insufficient to meet their needs in the face of hazards, particularly health-related anomalies that can be fatal. A vast majority of the households have low adaptive capacity—as bottom 40 percent of the respondents have adaptive capacity ranking in the range of 500 and below in Rawalpindi, whereas only 18 percent of the households have adaptive capacity ranking between 500 and 700. Pakistan, a developing country with such high mass urban population needs to be well prepared for climate change risks as well as health hazards, hence, new planned urban spaces are a dire need of the current situation. Although the present government is planning a cheap housing for everyone but if such proposed planned cities are built keeping in mind the climate change, urban heat island effect and health hazards, such cities will be sustainable, energy efficient, with availability of clean drinking water.

Integrate water resource management is needed in such a way that it promotes coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Health facilities are provided in city centers, but it does not encompass the masses of population so dispensaries at union council level are recommended with the emphasis that the rich can afford private health facilities, but the poor cannot. People living in densely populated areas face

high temperatures, which reduce their productivity due to health losses and the number of bedridden days. Therefore, health facilities to the poor and marginalized people should be provided at their doorstep.

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Availability of data and material Data will be available on request.

Conflict of interest the authors declare that they have no conflict of interest.

Ethical Approval We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

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