**ORIGINAL ARTICLE**

# Climate Change-Induced Conflicts in Pakistan: From National to Individual Level

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## Abstract

Climate change leading to migration and conflicts is observed in many parts of the world and it is becoming a potential future in Pakistan. Climate change refugees in Pakistan undergo victimization, in situ mitigation, or migration, all three of which have consequences. Direct and indirect security threats posed by climate change can cause great economic losses to Pakistan. Arguably, there is growing evidence of a relationship between climate change and conflicts in Pakistan. Resource depletion and overpopulation result in rural-to-urban migration along with occupational shifts. This unprecedented study explores whether there is a significant relationship between climate change and conflicts in Pakistan. It assesses the given association from national to individual level. The study uses both qualitative and quantitative methodologies to determine the relationship of climate change and conflict. The science of climate change and conflicts is mostly qualitative. The assessment based on surveying, visits, interviews, literature review, multidisciplinary assessment, and examination of the sites. Furthermore, the relationship or association was quantified based on some of the results. Statistical analysis was performed on the results of the study. Relationship between climate change, socioeconomics, and conflicts has been explored. Surveys and interviews significantly supported that the frequency of the disasters such as droughts, heatwaves, floods, and diseases has increased in the study area and significantly affects the lives of local communities. It was also highlighted that the majority of conflicts in the region are due to overpopulation, economic competition, acquisition of land and resources, and migration. It was found that some associations are statistically significant, while others are not. However, site examination and ground realities suggested that there is a high risk and potential for climate change-induced conflicts in the study area. Data presented in the study indicate that Pakistan has the highest risk value for conflicts and human exposure to these risks. There is a significant causal relationship between climate change, migration, and conflicts. Over population together with resource depletion serves as catalyzing factors for climate change migration and dispute. Data on the subject for Pakistan are absent or lacking. However, it can be significantly established that climate change-induced migration and the conflicts are reality in Pakistan, with potential to induct further economic losses in the future.

**Keywords** Climate change · Conflicts · Security · Resource depletion · Karachi Pakistan

## 1 Introduction

Pakistan has one of the fastest growing populations in the world and is highly vulnerable to climate change (Kundzewicz et al. 2014). Overpopulation with poorly planned urbanization and technological development is putting urgent stress on the environment (Lakhan 2015). It is estimated that, to prevent detrimental climate change impacts,

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Greenhouse gases' emissions need to be reduced by 70% by 2050 (Abas et al. 2017). Many experts and federal authorities establish that Pakistan is a prime target of climate change, but only contributes 0.8% of total GHG emissions (Lin and Ahmad 2017). However, consensus can be established on the urgent need of adaptation, if not mitigation in terms of reducing Pakistan's emissions (Khan 2015).

Climate change has become one of the biggest issues of the 21st century and a global threat (Urry 2015). Growing evidences from continuing research are attempting to prove climate change as a reality and further malicious impacts of climate change are being unfolded (Oreskes 2007). According to the Fifth Assessment Report (AR5) of

Intergovernmental Panel on Climate Change, consensus on climate change as a security threat and root of disputes has now developed among the international scientific community (Team 2014).

During the recent 4 decades, the number of climatic disasters increased three times globally (López 2015). Drastic consequences are recorded on human populations, biodiversity, forest covers, animals, lands, and even sea (Watts et al. 2015). Regarding humans, developing countries are the most affected ones and are predicted as the most susceptible ones to climate change consequences (Conway et al. 2015). About 20 million people have been displaced due to severe weather events (de Sherbinin et al. 2011) and about 4.6 million people have been internally displaced by conflicts and violence (Keane 2003). Apart from extreme disasters, slow but increasing changes in the environment are causing impacts on migrations (Warner et al. 2010). During the last 3 decades, 1.6 billion people have been affected by droughts and 718 million people have been affected by storms globally (McCarthy et al. 2001). In 2014, natural disasters have resulted in the migration of 19 million people from 100 countries worldwide (Neumann et al. 2015). This trend can lead to displacement of 25 million to 1 billion refugees by 2050 (Roy 2018).

A theory also suggests that historical civilizations like Moen-jo-Daro, Tigris, and Indus, dwelling at river banks, were rendered refugees due to environmental shifts and climatic variability and their livelihood and survival systems were left destroyed (Possehl 1997). Today, the science of inter-specific competition over limited resources is well established. It is studied that places with stressed and unfavorable environmental conditions are ones with greater risks of generating conflicts and refugees (Raleigh and Urdal 2007). Many developing countries will be resourcefully and environmentally stressed resulting from human-induced climate change. Conflicts due to both climate change and consequences of climate change can contribute to increasing refugees (Fig. 1). The vegetation zones and climate of the Earth are shifting, which will result in some places getting drier and others getting wetter. This will greatly impact already prevailing economic, social, and civilization systems in negative ways. Countries like Italy and Greece may end up getting hotter and more arid leading to the relocation of the population (Giannakopoulos et al. 2009).

Pakistan is prey to increasing issues such as emigration, exponential population growth, and resource depletion. Changing climatic and precipitation patterns, and extreme weather events have become common in Pakistan (Farooqi, Khan and Mir 2005). Efforts are being made to restore lost forests of Pakistan, such as the recent billion tree tsunami project initiated in Northern Pakistan, which are expected to lead toward the sustainable development of natural resources in Pakistan (Kharl and Xie
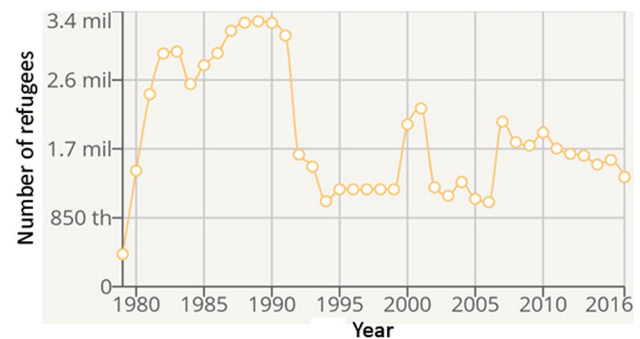


**Fig. 1** Refugees in Pakistan

2017). However, attention towards adaptation, mitigation, and climate policy is lacking. History of climate change agreements from Kyoto Protocol 1997 to Paris Agreement 2015 has accelerated sense of urgency towards this global issue (Mátyás et al. 2018). It is essential for Pakistan to rub shoulders with forerunners of this science, not only for its national, economic, political, and social stability but also for survival (Smit and Pilifosova 2003). The study focuses on security especially in terms of migration, resource depletion, overpopulation, socioeconomics, and intranational conflicts.

Given the lack of data in Pakistan, it is essential to gather the evidences which can be evaluated. This study utilizes the techniques that are frequently used in the past to understand the concealed dynamics of climate change impacts at micro level (Nhemachena and Hassan 2007). The study aims to develop a nexus between climate-induced migration and violent disputes while incorporating factors of overpopulation and resource depletion in the equation (Nordås and Gleditsch 2007). There is sufficient evidence that climate change can cause migration (Reuveny 2007), and also that migration can cause conflicts (Swain 1996). This study establishes research-based elements to fill the void due to lack of research in Pakistan on this subject, as an initiative to develop concrete particulars. This adds another page to climate sciences in Pakistan for the research community and proposes some ground rules in the subjected science. Understanding climate change as a driving force of certain conflicts can improve the conflicts' resolution response (Barnett and Adger 2007). This study explores the conflicts' mechanism and dynamics from the pathways of climate change to discover the significance of their relationship. This study is unprecedented and one of its kinds for Pakistan. There are a few studies globally which address the relationship between climate change and conflict. Despite of the security concerns that climate change poses on Pakistan, research in this area is specifically lacking. Pakistan also lacks framework for climate security and official conflicts' resolution mechanism.

## 2 Study Area

The highlighted study area involves Karachi and District Thatta (Fig. 2). Karachi is the financial hub and the provincial capital of Sindh. Population density of the metropolitan city is above 24,000 people per square kilometer placing it among the most populated countries in the world. Karachi covers the total land area of 3640 km². It is in the south of Sindh province and touches the coast of Arabian Sea. Karachi port and Port Qasim are the two vital ports of Pakistan which are located in Karachi. The city is highly urbanized but also accommodates less developed areas. It is the primary attraction of all immigrants around the country. Literacy rate and economic stance of Karachi are among the highest in Pakistan, but there are great variations. Similarly, Karachi is home to diverse ethnic, social, religious, and political groups, which makes it vulnerable to conflicts. The western part of Karachi is hilly, while the south-eastern is coastal. The climate is moderately temperate and the relative humidity of Karachi remains high throughout the year. The city is highly industrialized and offers various employment opportunities (Qureshi 2010).

According to Fig. 3, the population growth of Karachi is exponentially growing due to natural population growth rate and migrant influx. The coastal areas of Sindh including district Thatta and Karachi have historically been migration destination. During 1960–1980, several different ethnic groups migrated from different areas, including Balochs, Jutts, Khaskhelis, and Dablas, to the coastal outskirts of Karachi, which was previously occupied by Sheikhs, the merchants, for 200 years. Certain coastal areas have fishermen community settlement, which are vulnerable to migrating influx as well as reduced fish resources in the waters (Hasan et al. 2017). Majority of people migrating to these areas were from agricultural background with no skills required for fishing, which gives certain ethnic communities a professional upper hand on others. Ethnic differences are evident causations of dispute and conflicts in Pakistan (Stavenhagen 2016). The fisheries' stock is dwindling due to heavy indiscriminate pollution caused by industrial effluent and cow dung from cattle farming, as well as overexploitation by non-indigenous migrants due to their interest in economic gains and unsustainable fishing practices (Beg et al. 2012; Hameed et al. 2012). Apart from affecting livelihood, severe coastal pollution problem also causes health
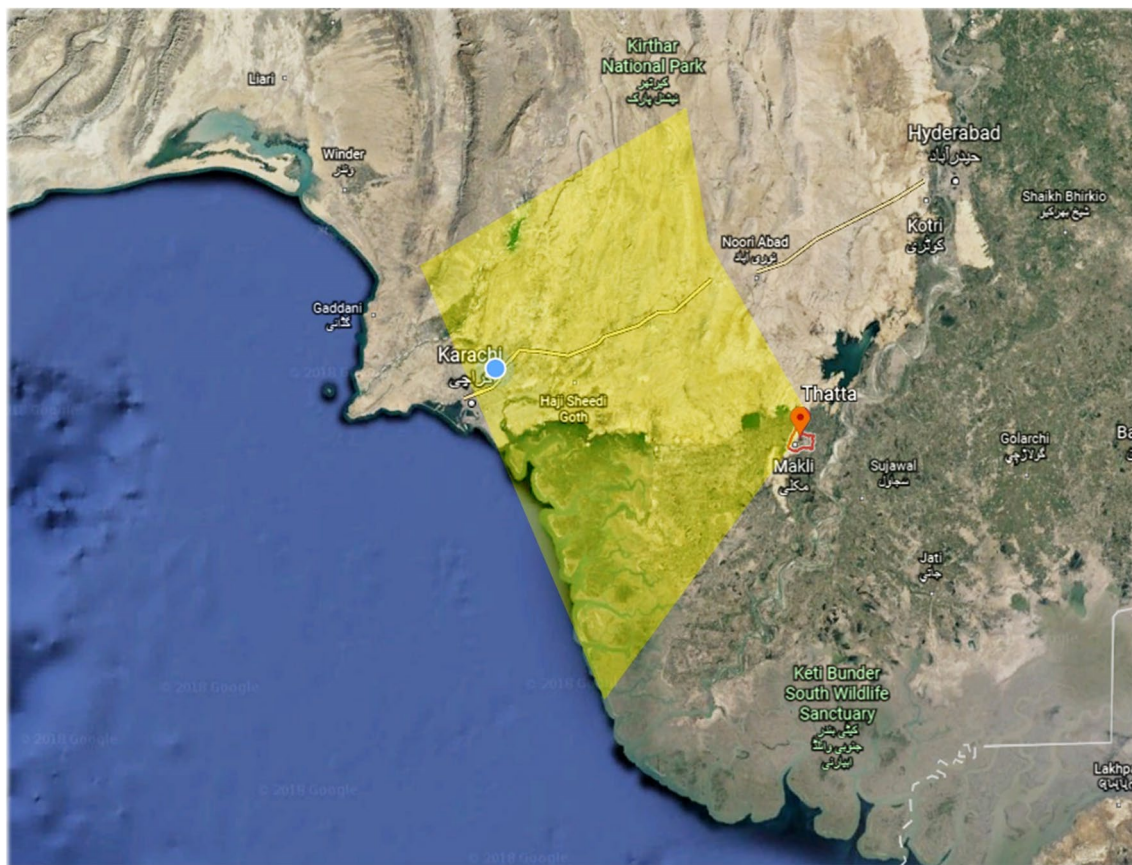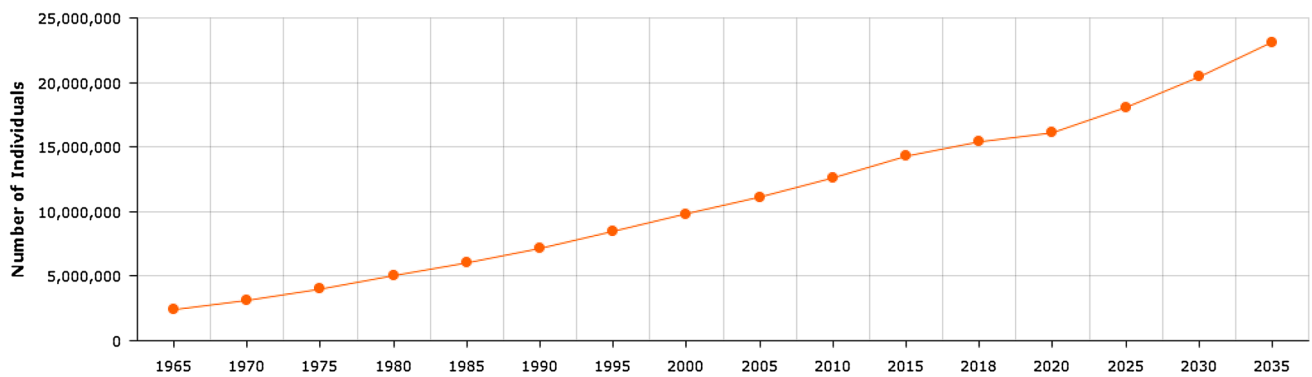


**Fig. 2** Map of the study area

**Fig. 3** Population growth in largest city. Source: world development indicators

problems. Research indicates the presence of severe issues pertaining to land ownership and control issues among new migrants and the previous settlements on clan basis (Hasan et al. 2017) which further intensify conflict possibilities. Mangroves are depleting due to wood logging for timber, fuel, and matchstick which exacerbates the environmental scenario.

Thatta is among the ancient districts of Pakistan with a deep history of cultural and Islamic learning. The popularity was decreased with the shift in waters from River Indus, and people migrated away. Karachi is located on the west of Thatta, and it is surrounding by other lower riparian districts (Gill et al. 2012). The land area of district Thatta is 17,360 km$^2$ and several villages lie within Thatta, such as Keti Bandar and Shah Bandar. Like Karachi, district Thatta also meets Arabian Sea on the southern extreme and it is highly vulnerable to sea intrusion (Magsi and Sheikh 2017). Literacy rate of Thatta is 38%, while female literacy rate is below 5%. The more than 50% of the population in district Thatta is extremely poor, while 80% are considered poor. The local population strives for survival and all the members of the family are responsible to work in most households. Droughts and sea intrusion are common for the villages in Thatta, and events of migration are frequently reported (Salik et al. 2015). The region is highly vulnerable to climate change (Alamgir et al. 2016).

## 3 Methodology

The study undertakes a multi-dimensional methodology. Analysis was conducted using interviews, surveys, contemporary literature, theories, historical data, sociopolitical and socioeconomic data, and conflicts' model.

Relationship between climate change, socioeconomics, and conflicts has been explored with above-mentioned references to bring attention towards Pakistan. The study evaluates the causes leading to conflicts' conditions due to climate change in Pakistan on basis of these methods.

Key issues and major causal chains were highlighted and estimated for evaluation. Remote regions of interior Sindh province were visited to explore the ground-level situation. Surveys and interviews were conducted with the local population to understand conflicts' nexuses.

For the interview and survey, researchers developed a questionnaire to inquire perception of climate change, conflicts, and the relationship between them among the local participants. Survey was conducted in Karachi (Urban) and district Thatta (Rural). Since many respondents were unable to read in rural samples, questionnaires were translated in local language and verbally assisted. Researchers filled out the questionnaires by interviewing certain respondents. They were also encouraged to comment on the subject apart from the questions and useful commentary was recorded. Although respondents were demographically diverse, researchers concentrated on elderly people to utilize their experiences in past 20–25 years. The questionnaire was essentially developed in two segments. First segment recorded demographic parameters, such as gender, age, level of education, and the duration of residence in the area. The latter segment focused on recording each respondent's perception on climate change, socioeconomic factors, conflicts, and the relations between these dynamics. The choices for answers were limited to the subject as a forced-choice approach to keep the respondents focused. To avoid bias, respondents were given options to choose "I do not know" in certain questions. Respondents participated on volunteer basis without financial compensation. Among all questions, the inquiries that were filtered for this paper are the following:

1. What is climate change?
2. What is the biggest threat to your region?
3. What are the primary reasons of climate change? (tick 3)

4. Were there changes in climate-induced disasters in past 20–25 years?
5. What are the reasons for conflicts in your region? (ethnic, political, and other) Tick all that apply
6. Do you think the following factors will aggravate you and increase your tendency to fight or argue? (check all that apply)
7. What are the most common causes of conflicts in the region? (tick 3)

The survey and interview study was based on witness and perception approach. Questions and choices were designed in a way that encourages respondents to reflect on what they currently know even when they are not familiar with climate change. Semi-structured interviews and conversations were carried out with respondents from focus groups. The purpose was to gather useful information which can be manipulated, and not to assess the respondents' awareness on the subject. Therefore, some respondents were also assisted to understand certain foundational information in informal language. A local guide was accompanied to effectively overcome language barriers. The data acquired were presented graphically and studied in the light of prior literature and theories. Through these interview and surveys, climate change and conflicts were linked through an intermediary between the two: consequences of climate change. Therefore, the direction of this part was: Climate change → Consequences → Conflict. Climate change consequences served as a transition to evaluate the connection. For the statistical analysis, SPSS was used to run three different tests on various results. The Chi-square test, Z test for two population proportions, and Spearman's Rho tests were applied. These tests assessed the significance of difference between the conditions of rural and urban regions. The Z test attempted to link different parameters to statistically evaluate whether they have an effect on each other or whether there is a statistically significant association or dissociation between the chosen parameters.

To develop links between climate change and conflict, the Index for Risk Management or INFORM Model is adopted as the secondary source of data for the simulation of other factors associated with the climate change and conflicts' nexus, such as hazard and exposure, vulnerability, and the lack of coping capacity of Pakistan. Secondary data were retrieved from the provided model for the analyses. The subdivisions of each criterion are important for understanding the depth of these factors. The model is three dimensional, and based on the definition and approach of United Nations Office of Disaster Risk Reduction (UNISDR) that stipulates three different factors of vulnerability. The mathematical factoring of physical as well as potential power and capacity of a country in coping up with the disaster risk is essential for determining the estimates of conflicts and the risk of

conflicts in that country effectively. The INFORM utilized 54 different indicators in a three-dimensional model. The scores of risks are on a scale from 1 to 10, with 10 being the highest risk possible. INFORM model itself is not related to climate change. INFORM originally does not address or incorporate climate change, which is the point that this study has covered to establish that link. This study has attempted to present and utilize the data, see it in the light of climate change ground realities, bring it into the picture of this study, and relate it to the unique findings of the study. It is also utilized to support the arguments. The risk values are originally developed by INFORM. Nonetheless, secondary data from INFORM were retrieved which this study utilized for (1) establishing and assessing the relationship between conflicts and climate change, (2) identifying where the two areas coincide for Pakistan, (3) selective choice of data and indicators for Pakistan, and (4) picking out the desired data sets from the comprehensive model. For comparative analysis, profiles of different countries with similar values as Pakistan were identified and were observed, studied, and analyzed qualitatively in relationship to the climate change.

Climatic records for past 50 years were retrieved from World Bank Group. Other sources that were used in the study include United Nations High Commissioner for Refugees (UNHCR), United Nations Department of Economic and Social Affairs (UN DESA), and United Nations Development Program database (UNDP). Diverse data sets were used to assist interdisciplinary analysis.

The argument, i.e., "Can climate change cause resource depletion and conflict" is broken down into numerous segments, and each segment is evaluated individually and in combination with all types of data mentioned above. Various hypotheses based on arguments over subject matter were developed for Pakistan. Description and study on each hypothesis was carried out individually to conclude whether each is true or false in case of Pakistan. The hypotheses tested for this part of the study are:

- Hypothesis 1: Lack of resources due to climate change can lead to two outcomes, either population fights over remaining resources resulting in dispute, or one group can migrate to another region which could arise conflicts between host group and immigrant group. Climate change can cause a dispute in both ways in Pakistan.
- Hypothesis 2: Does climate change cause violence and armed disputes in climate change hotspots of Pakistan? Various violent disputes, terrorist activities, and extremism in Pakistan can be linked to widespread roots of climate change impact, or indirectly linked to the consequences of climate change, like resource depletion, negative impacts, and different losses due to climate change. The impacts of climate change may also work as regulating factors for these disputes.

- Hypothesis 3: Conflicts' hotspots with high population density have greater chances of dispute and security issues due to climate change, while conflicts' hotspots with low population density have lesser. Similarly, low-income populations have a higher risk of climate-induced disputes than hotspot populations of high income. Many other demographic and socio-economic factors may play significant roles in determining the risk of climate-induced disputes.

The hypotheses were tested qualitatively based on the visits, interviews, surveys, site examination, study of literature and interlinking of climate change, and conflicts with the use of associated consequences of either. Since the developed hypotheses in the end are based on qualitative science, they are assessed and justified on qualitative grounds. The study investigates to answer the question: Climate change can lead to conflicts and resource depletion in Pakistan and it explores all dynamic factors associated with it to reach plausible conclusions. In the end, recommendations for further research and policy framework for implementation has been devised exclusively to Science-Policy Conference on Climate change in Pakistan. Due to the qualitative nature of this science, it has been suggested that quantitative assumptions on this issue may be misguiding and more qualitative studies are required for strengthening the science (Scheffran et al. 2012). Various studies have been previously conducted and published in reputable journals that utilized non-quantitative approaches (Buhaug et al. 2010; Raleigh 2010).

## 4 Limitations

The study is limited by the lack of data and the previous research in the area. For the same reason, the study is one of its kinds and looks into multidisciplinary subjects. The scope of this study is also limited by the unreliability of depending solely upon quantitative data and analysis. It is suggested that relying on the quantitative data alone can be confusing and misguiding for understanding the entire situation (Scheffran et al. 2012). To overcome this limitation, this study is designed to be diverse and takes into account both qualitative and quantitative aspects to draw a complete picture.

## 5 Results and discussion

The results were obtained from the survey in both the rural region and the urban region within the study area. It was indicated that the relationship between climate change and conflicts is significantly perceived.

The focus group in the sample was the significantly aged people. Female participants were less reachable in rural region compared to males. For urban study, it was ensured that female proportion was equal to males. Demographics were taken to ensure that samples were correct and to highlight the source of information (Table 1).

### 5.1 Results on meaning of climate change and the biggest threats in the region

Figure 4 represents how the sample respondents within the local communities perceive climate change. More than 55% of the participants acknowledged that climate change is associated with changes in weather conditions. 21% viewed climate change as a change in temperature, and majority of this sample size belong to urban region. On the other hand, fewer believed that climate change is linked to variations in precipitation and environment. Respondents who admitted that they are unaware of climate change were found in rural as well as urban regions. Interestingly, many of the rural respondents were able to understand climate change when translated into their respective languages in easy and informal terminology. As presented in Fig. 5, the question progressed the study by inquiring about what they consider to be the biggest threats among overpopulation, resource

**Table 1** Result of survey Part 1: demographic parameters of respondents

| Participants' demographic | | |
| --- | --- | --- |
| Age | Median | |
|   Rural | 47 years | |
|   Urban | 32 years | |
| Gender | Value | Percentage share |
|   Male (rural) | 38 | 76% |
|   Male (urban) | 30 | 48.4% |
|   Female (rural) | 12 | 24% |
|   Female (urban) | 32 | 51.6% |
| Education (rural) | Value | Percentage share |
|   Primary or below | 32 | 64 |
|   Secondary | 9 | 18 |
|   College | 5 | 10 |
|   University | 4 | 8 |
| Level of education (urban) | Value | Percentage share |
|   Primary | 0 | 0 |
|   Secondary | 6 | 9.6 |
|   College | 10 | 16.1 |
|   University | 46 | 74.1 |
| Region | Value | Percentage share |
|   Urban | 62 | 55.4 |
|   Rural | 50 | 44.6 |
| Total respondents | 112 | 100 |
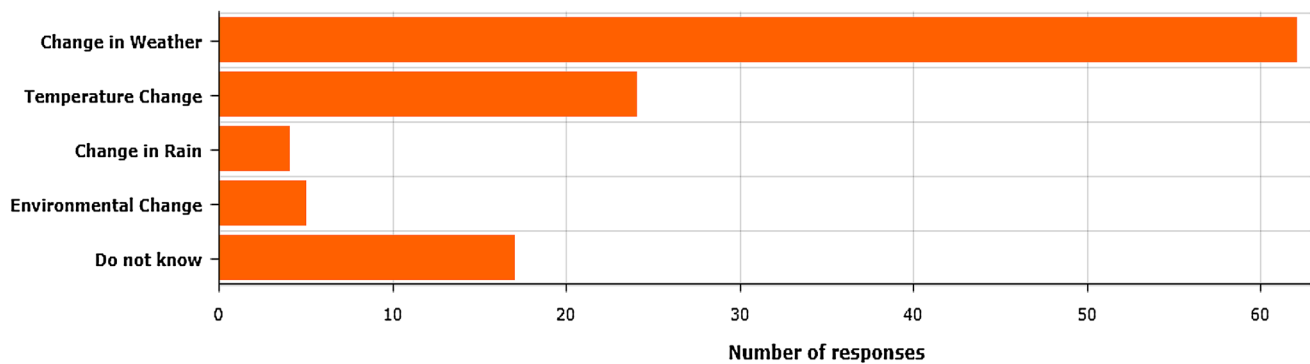
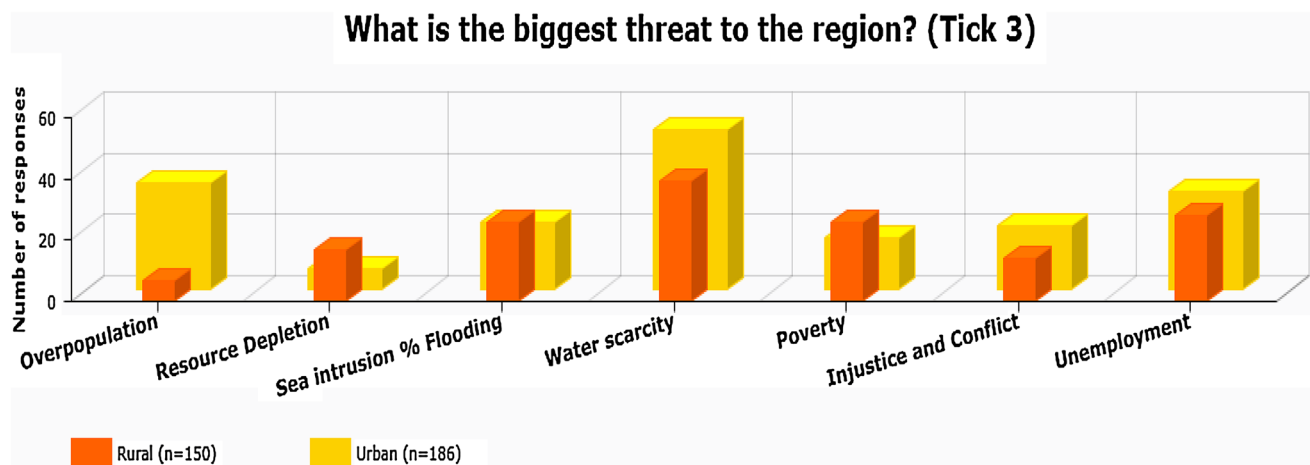**Fig. 4** Responses on what is climate change?



**Fig. 5** Biggest threats to the region

depletion, sea intrusion, flooding, water scarcity, poverty, injustice, conflicts, and unemployment. Majority of both rural and urban participants considered water scarcity and unemployment as the biggest threats within their region. In urban region, overpopulation was also highlighted as a serious threat, while a few from the rural side considered overpopulation an issue. Poverty was considered a threat mostly in the rural side. During the interview, many rural respondents linked their poverty conditions with unemployment. It was highlighted that agricultural activities have been reduced due to water shortage and most unskilled labor remained unemployed. Many rural participants also testified that their family income is continually decreasing for the last 2 decades. 31% of the total participants perceive that injustice and conflicts are among the biggest threats, and majority of them were urban residents. 50% and 35% of the rural and urban respondents, respectively, perceive sea intrusion and flooding as the primary threat to the region.

52% of the rural respondents considered poverty as one of the three biggest threats (Table 2).

### 5.2 Results on primary reasons of climate change in the region

Figure 6 represents the reasons of climate change in the study area. When the reason for climate change was asked during the survey, 89% and 82% of urban respondents answered deforestation and industrial emissions, respectively. Three reasons had to be chosen among the six given options, i.e., deforestation, urbanization, industrial emissions, human activities, act of god, and no idea. In case of rural district, deforestation and industrial emissions were perceived as the primary causes by 76% and 64%, respectively. As a forced-choice approach, respondents were urged to choose at least two reasons even when they had no idea. Yet, 56% from district Thatta admitted that they have no

idea. Interestingly, 44% from the rural side believed that it is an act of God and the works of nature which cannot be altered by human intervention. On the other hand, only 11% from Karachi stated so. 56% and 42% from Karachi believed the primary causes to be urbanization and human activities, respectively. However, district Thatta remained convinced that it is the work of God rather than urbanization or anthropogenic activities (Table 3).

### 5.3 Results on changes in climate-induced disasters in past 20–25 years

The question presented in Fig. 7 served as a transition of the study turning it from climate change toward conflict: Were there any changes in climate-induced disasters in past 20–25 years? This intermediate question focused on the consequences of climate change that may lead to conflict, as mentioned in the methodology section, i.e., Climate change → Consequences → Conflict. Participants were given the liberty to choose one or all the options. As an open question, this received a total of 500 responses for nine choices. Respondents from both regions were highly selective in their choices. Above 90% of both rural and urban admitted that there have been drastic changes in precipitation and heatwaves in their respective regions. Droughts were perceived mostly by rural, chosen as drastically changed by 94% of the participants. 88% of rural also endorsed that floods have become more frequent in the region. Despite of open choice, very few considered that there were changes in fires, landslides, and cold spells.

**Table 2** Biggest threats to the region

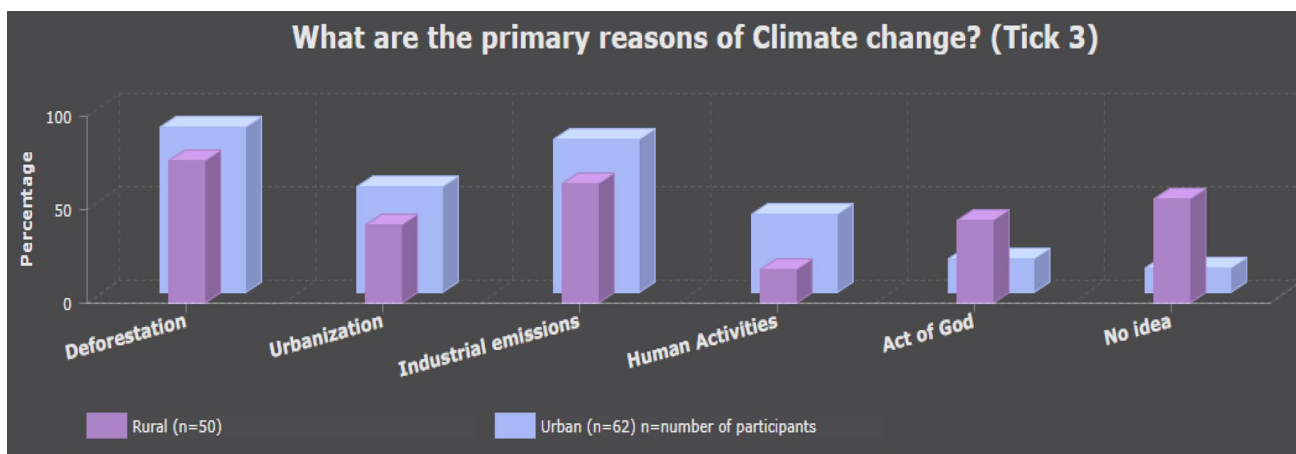| Chi-square results for region (rural and urban) | | Overpopulation | Resource depletion | Sea intrusion % flooding | Water scarcity | Poverty | Injustice and conflict | Unemployment | Significance |
|---|---|---|---|---|---|---|---|---|---|
| Biggest threat to the region | Chi-square | 21.2824 | 8.4783 | 3.083 | 0.6262 | 7.0705 | 0.4441 | 0.2142 | Yes = 3 |
| | $p$ value | 0.000004 | 0.00359 | 0.07911 | 0.42874 | 0.007836 | 0.50517 | 0.64351 | No = 4 |
| | Significant at $p < 0.05$ | Yes | Yes | No | No | Yes | No | No | 42.85% |



**Fig. 6** Primary reasons of climate change in the region

**Table 3** Primary reasons of climate change in the region

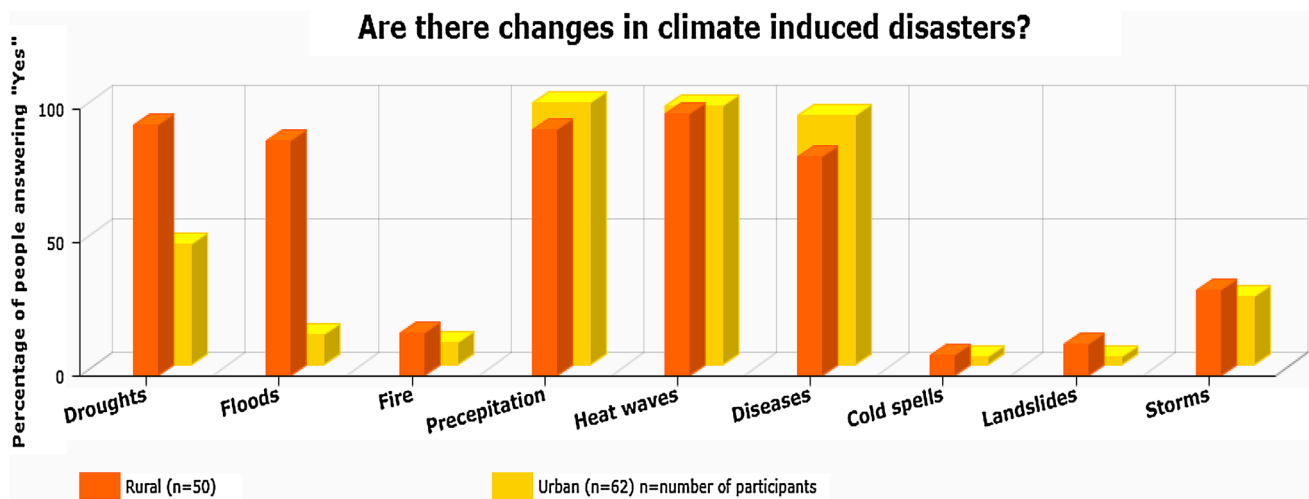| Chi-square results for region (rural and urban) | | Deforestation | Urbanization | Industrial emissions | Human activities | Act of god | No idea | Significance |
|---|---|---|---|---|---|---|---|---|
| Primary reasons of climate change in the region | Chi-square | 3.174 | 2.3123 | 4.8085 | 7.3808 | 9.1826 | 23.5697 | Yes = 4 |
| | $p$ value | 0.074817 | 0.12836 | 0.02832 | 0.00659 | 0.002443 | 0.000001 | No = 2 |
| | Significant at $p < 0.05$ | No | No | Yes | Yes | Yes | Yes | 66.66% |

**Fig. 7** Changes in climate-induced disasters in past 20–25 years

Around 32% and 25% or rural and urban perceived changes in storms (Table 4).

### 5.4 Results on Reasons of Conflicts in the Region

The question presented in Fig. 8 about the reasons of conflicts in the region was asked after the respondents reflected on the previous questions. It was an open choice question which brought in 655 responses from a total of 112 respondents for ten choices given in the question. It was assumed that this approach will set perspective in respondents and produce more effective answers. More than any other reason, around 95% of both rural and urban perceive that acquisition over land and resources is a reason for conflicts in the region. Job competition and droughts were considered by 92% of rural respondents, while 90% of them perceived that increasing population is a reason for conflicts, as well. 78% and 76% of rural region also considered migration and water scarcity as a reason for conflicts in the area. Unlike 48% of urban, 92% of rural perceived that competition for jobs is also a reason for conflicts in the region. During interviews, many urban respondents added that it is unlikely to have a real fight over jobs, while rural opinion was opposite to this. Interestingly, urban respondents were more affirmative than rural when the term economic competition was used. It turned out that around 73% of urban agree that economic competition can create conflicts, while 50% of rural agreed to this notion. Some asked for the difference between competition over jobs and economic competition. The latter reason was explained to have a general, broader scope, while former was specific to jobs and employment only. Some urban respondents even reflected on office politics phenomenon and how various conflicts prevail silently. There was a stark difference in responses for droughts from rural and urban.

Only 8% of the urban respondents considered flood as a cause of conflict, while 92% of rural marked it as a probable reason. Similarly, 98% of urban rejected floods and sea intrusion as a reason for conflict, and 32% of rural admitted to it. Diseases were perceived by 16% and 26% of urban and rural respondents, respectively. 73% and 66% of urban and rural samples, respectively, marked inequality and injustice as a reason for conflicts in the region (Table 5). It was interesting to see that the open choice questions can significantly enhance the responses to show a clearer picture.

### 5.5 Results on Climate-Induced Factors on the Conflicts Tendency

The question presented in Fig. 9 was a turning out of perception for the respondents. There is a series of various studies that find various psychological factors and triggers that can cause aggression (Warburton and Anderson 2015). It remains true that aggression does not translate into conflicts every time. Therefore, the basis of this question was to inquire whether or not certain triggers are likely to translate into a conflict for the respondents. Results of this inquiry were surprising. Majority of the respondents agreed that most of the triggers listed will, in fact, increase their tendency to fight, argue, and have conflict. They also added that it will reduce their tolerance and their temper, and greatly impact their mood. Since it was an open choice question, we were able to estimate that although urban responses (319) were higher than total number of rural responses (303), rural demonstrated a relatively higher response for each trigger than the urban. 95% of urban respondents reported that scorching heat of Karachi is highly likely to increase their tendency to fight and have conflict, while 90% of rural stated so. Around 93% of both rural and urban perceived that

**Table 4** Changes in climate-induced disasters in past 20–25 years

| Chi-square results for region (rural and urban) | | Droughts | Floods | Fire | Precipitation | Heat waves | Diseases | Cold spells | Landslides | Storms | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| The changes in climate-induced disasters in past 20-25 years | Chi-square | 29.8432 | 65.672 | 1.6988 | 2.6475 | 0.1595 | 3.5979 | 1.2443 | 3.2127 | 0.5203 | Yes=2 |
| | p value | . | . | 0.19244 | 0.10371 | 0.689578 | 0.057854 | 0.26465 | 0.07307 | 0.470732 | No=7 |
| | Significant at p<0.05 | Yes | Yes | No | No | No | No | No | No | No | 22.22% |

unavailability of water is likely to aggravate their tendency to fight or have conflict. 96% of the rural also confessed that sickness and experiencing disaster situation will render them more likely to have conflict, and 82% of urban followed the lead. In urban region, scorching heat, financial crisis, and unavailability of water were considered to be the trigger by most, while, in rural region, sickness, disaster, and water scarcity were the leading triggers. Unlike 37% of urban, 82% of rural respondents considered increased competition over limited resources as a trigger for conflict. When they were asked if having power and influence will increase their tendency to have conflicts and fights, 62% and 52% of rural and urban said yes, respectively (Table 6).

## 5.6 Results on Most Common Causes of Conflicts

The question presented in Fig. 10 was an extension of Fig. 9 with lesser options and only three choices rather than an open choice question. Political (67%), ethnic (41%), and unemployment (53%) were chosen the most as the cause of conflicts in urban region, while rural marked ethnic (66%), religious (68%), and land and resources (52%) the most as causes of conflicts in the region. Only 6% of rural perceived immigrants as the cause of conflict, while 33% of urban considered immigrants to be a problem. Around 50% of rural perceived water scarcity as a cause of problems, while 34% of urban respondents said so. Land and resources was perceived by 34% of urban. 40% of rural also chose unemployment as a cause of conflicts in the region (Table 7). Z test for association was conducted (Table 8).

## 6 Z test for Association

### 6.1 Country Outlook

Analyzing the country outlook is important to build the perspective for the study. Since various factors and characteristics of the country are associated with the climate change vulnerability and conflict scenarios in the region, it is important for bringing a complete picture in perspective.

Refugee settlement is a relatively independent parameter and not a viable measure within the time series for estimating the role of climate change. Due to several factors, it is important to consider and navigate the complexity. *Source: UNHCR*

Table 9, 10 present the indicators of Pakistan which determines the country's capacity for resilience and potential of conflict. Pakistan is ranked 147 in the human development index according to Table 3. According to UN DESA (2016), 39.2% of the Pakistan's population is living in urban areas, while 60.8% is rural. The social expenditure of Pakistan in this regard is $9028 million. The international migrant
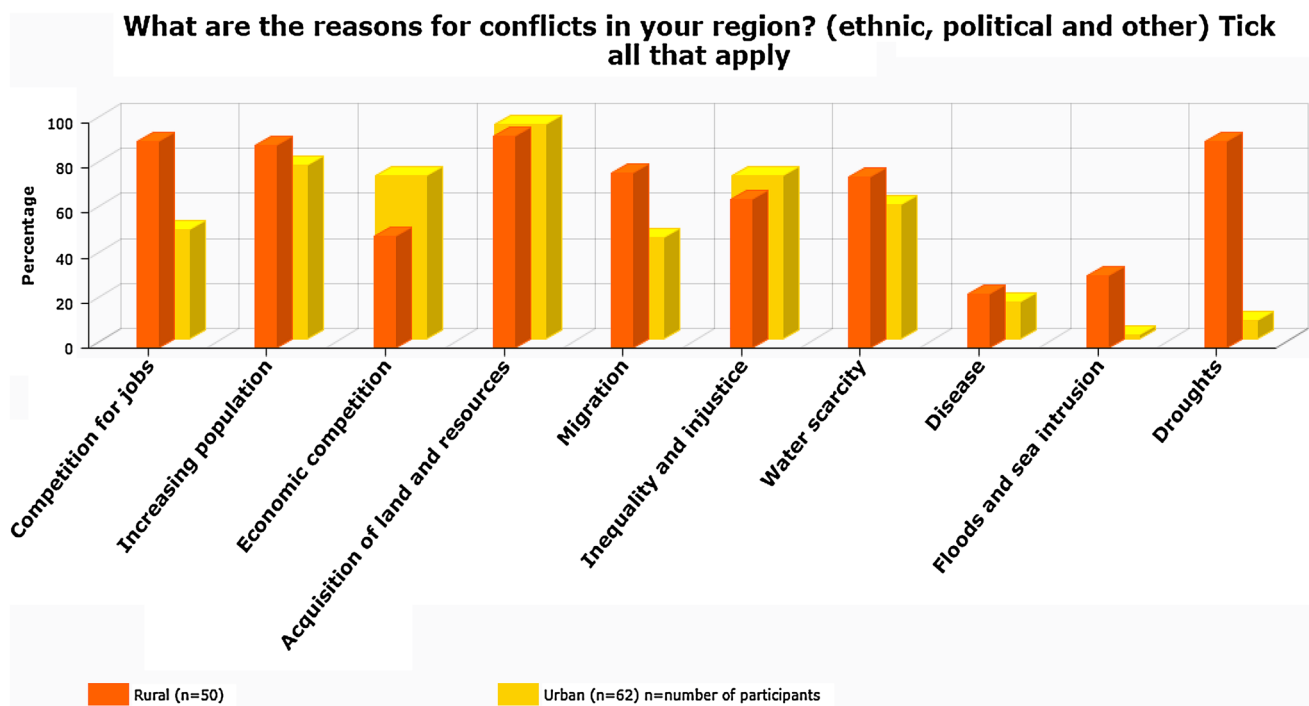
**Fig. 8** Reasons of conflicts in the region

stock in the country is 1.7%, and almost 49% among them are females. Furthermore, the majority of these migrants (15.4%) are of working age, while the rest are young and elderly people. There are 1.55 million refugees in Pakistan who were forced to migrate (UNHCR 2016). Unemployment rate in youth is at the high of 10.8%, while the population is projected to grow as much as 306.9 million by 2050 at the current growth rate.

### 6.2 Average Annual Loss (AAL) by Hazard

Table 11 is for probabilistic risk assessment that estimates the average annual loss by hazards that are caused due to climate change-induced disasters in Pakistan. The estimates provide a useful outlook on losses and future projections. Disaster risk and consequent economic shock risk are relatively high for Pakistan compared to the other countries due to lack of capacity and inefficient disaster management system. Despite of developing policies and disaster risk management systems, proper measures have not been effective due to lack of political will and governance failure (Ahmed 2013). As a result, Pakistan remains vulnerable to civil disorders due to poor disaster management and absence of conflicts' resolution system. Total reserves indicate that the total reserves minus the gold comprise special drawing rights of the country. The total reserves have experienced the greatest annual average loss with flood as the primary causation. These two factors are also strongly associated with migration

and civil unrest, which can result in conflicts (Black et al. 2013). This probabilistic assessment also takes into consideration the damage caused by events on different scales. The risk associated with river flooding and other water-related hazards have a greater contribution toward loss and also remain highly uncertain in Pakistan (Fig. 11).

### 6.3 Conflict Scenario

The regional map indicates the Risk Index score of Pakistan among other neighboring countries which is calculated by INFORM index model. In this region, Pakistan is second only to war-torn Afghanistan in terms of vulnerability according to the UNISDR ranking. This puts Pakistan at a vulnerable position in terms, as well.

### 6.4 Risk Indicators

In Table 12, violent conflicts and national power conflicts have the highest risk values among all other indicators. Exposure to flood is enhanced by exacerbating climate change impacts in Pakistan (Farooqi et al. 2005). Therefore, among these, the highest score for physical exposure to flood is statistical evidence to this nexus, including subsequent displacement, social unrest, and eventually violent conflict. In relative terms, other indicators such as agricultural stress and droughts remain to be on the lower end of the scale.

**Table 5** Reasons of conflicts in the region

| Chi-square results for region (rural and urban) | | Job competition | Increasing population | Economic competition | Acquisition of land and resources | Migration | Inequality and injustice | Water scarcity | Disease | Floods and sea intrusion | Droughts | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reasons of conflicts in region | Chi-square | 24.1376 | 3.1099 | 6.0215 | 0.0736 | 12.4184 | 0.5669 | 3.3335 | 1.0864 | 19.8511 | 78.6269 | Yes=5 |
| | $p$ value | 0.000001 | 0.07782 | 0.01413 | 0.78614 | 0.000425 | 0.451474 | 0.06788 | 0.29728 | 0.000008 | . | No=5 |
| | Significant at $p < 0.05$ | Yes | No | Yes | No | Yes | No | No | No | Yes | Yes | 50% |

## 6.5 Conflicts and Climate Change Consequences

According to Fig. 12, flood (46.8%) is the most frequently experienced event in Pakistan followed by earthquakes (15.3%) and landslides (14.5%). Extreme temperature and storms occur at the frequency percentage of 9.7 and 12.1%, respectively. The INFORM Model utilized 54 indicators obtained from several databases to determine the three-dimensional risk values for Pakistan. The concepts used in Global Risk Indices by IASC, the world risk index by UNU-EHS, disaster risk index by UNEP, and global climate change index by Germanwatch, The variable of vulnerability is segmented into three-dimensional manner, and risk is estimated by the equation Risk = Hazard & Exposure $(1/3) \times$ Lack of coping capacity $(1/3) \times$ Vulnerability $(1/3)$. It considers hazard, exposure, lack of coping capacity, and vulnerability in terms of socioeconomic factors, individual capacity, infrastructure, and vulnerable groups by modeling 54 parameters. The results are plotted individually in the form of bar plots to indicate the significance of relevant conflicts, violence, and dispute scenarios in Pakistan (Figs. 13, 14, 15).

Apart from being the second most vulnerable country in the region after Afghanistan, the Hazard and exposure risk values indicate that Pakistan is at high risk of losses from and vulnerability to floods (Fig. 13). Other natural disasters as well as earthquakes also have a high-risk value for Pakistan. Climate-induced scenarios such as cyclones are minimum, while there is a moderate risk in terms of tsunamis and droughts. The current conflicts' scenario in this perspective have an extremely high value, i.e., 10 out of 10, while future risk associated with climate change-induced conflicts is also towards the higher end with a value of 9.8. With the above data projections acquired from INFORM model simulation for 2018, it is very evident that conflict scenarios in Pakistan are serious threats to national security. Nonetheless, the dynamic relationship among these areas is complex and further research can enhance the reliability of estimations from different models. Due to complexity, certain relationships between climate change and conflicts can be easily misunderstood and can be misleading. To overcome statistical discrepancies, the ground-level studies can further bring empirical and practical dimensions to improve precision of the estimates.

In terms of vulnerability in Fig. 14, the socio-economic factors and inequality have significant and moderate scores. However, values for uprooted people as well as the people vulnerable to displacement are towards the higher end, which indicates immutable risk to civil unrest, social disorder, and conflict scenarios. The score also indicates the lack of coping capacity due to inefficient governance and access to health as the major factors, both of which have a significant impact on the conflict risk (Ahmed 2013; Kälvemark
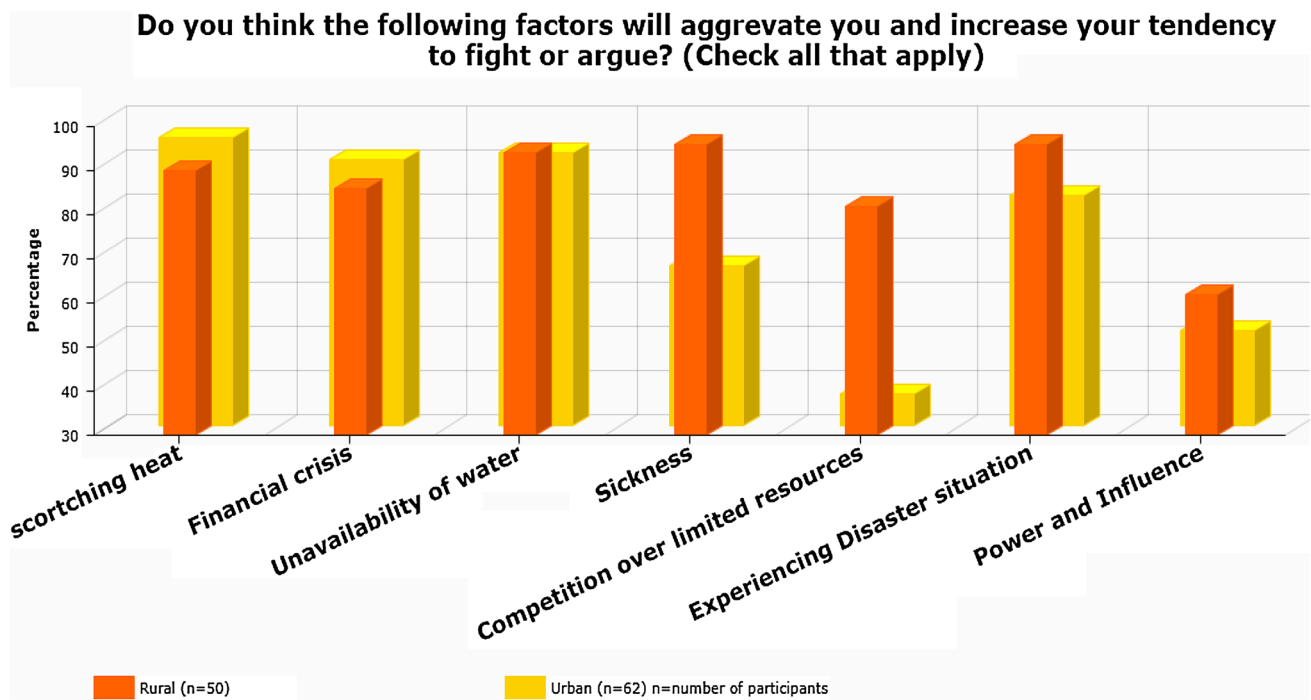
**Do you think the following factors will aggrevate you and increase your tendency to fight or argue? (Check all that apply)**

**Fig. 9** Impact of climate-induced factors on the conflict tendency of people in the region

**Table 6** Impact of climate-induced factors on the conflicts tendency of people in the region

| Chi-square results for region (rural and urban) | | Temper due to scorching heat | Financial crisis | Unavail-ability of water | Sickness | Competition over limited resources | Experienc-ing disaster situation | Power and influence | Significance |
|---|---|---|---|---|---|---|---|---|---|
| Will this aggra-vate your tendency to fight? | Chi-square | 1.1117 | 0.5041 | 0.1779 | 15.1342 | 22.7884 | 5.0944 | 1.2135 | Yes = 4 |
| | p value | 0.291721 | 0.47772 | 0.67321 | 0.0001 | 0.000002 | 0.024003 | 0.27065 | No = 3 |
| | Significant at p < 0.05 | 1.1117 | 0.5041 | 0.1779 | 15.1342 | 22.7884 | 5.0944 | 1.2135 | 57.14% |

et al. 2004; Shekhawat 2009). Inefficiency of communication and lack of infrastructure are also a highly significant factor for Pakistan according to lack of coping capacity plot (Fig. 15).

### 6.6 Comparative Analysis of Similar Country

Table 13 presents countries similar to Pakistan in contexts described in the caption. Studying countries with similar profiles as Pakistan can help in exploring evidences through a qualitative comparative analysis approach. Conflicts in African countries, including Sudan, Nigeria, Republic of Congo, Libya, and Ethiopia, have been linked with population displacement and climate change previously (Nordås and Gleditsch 2007; Obioha 2008; Schilling et al. 2012; Selby and Hoffmann 2014). Similarly, a number of studies linked climate change with resource depletion and conflicts in Myanmar, Syria, and Iraq (Gleick 2014; Kelley et al. 2015; Webersik 2010). Although the reasons may differ from country to country depending on the vulnerability profile of each state, there is still a significant analysis of conflicts emerging due to climate change impacts in these countries. Since Pakistan has a similar profile to these countries in terms of conflicts and climate change, it suggests high probability for conflicts due to climate change in Pakistan.

### 6.7 A Case Study of Karachi

For research hypothesis establishment, Karachi has been taken as a classic example as established in the study area section. Apart from interviews and surveys, Karachi is comprehensively studied for potential of climate change
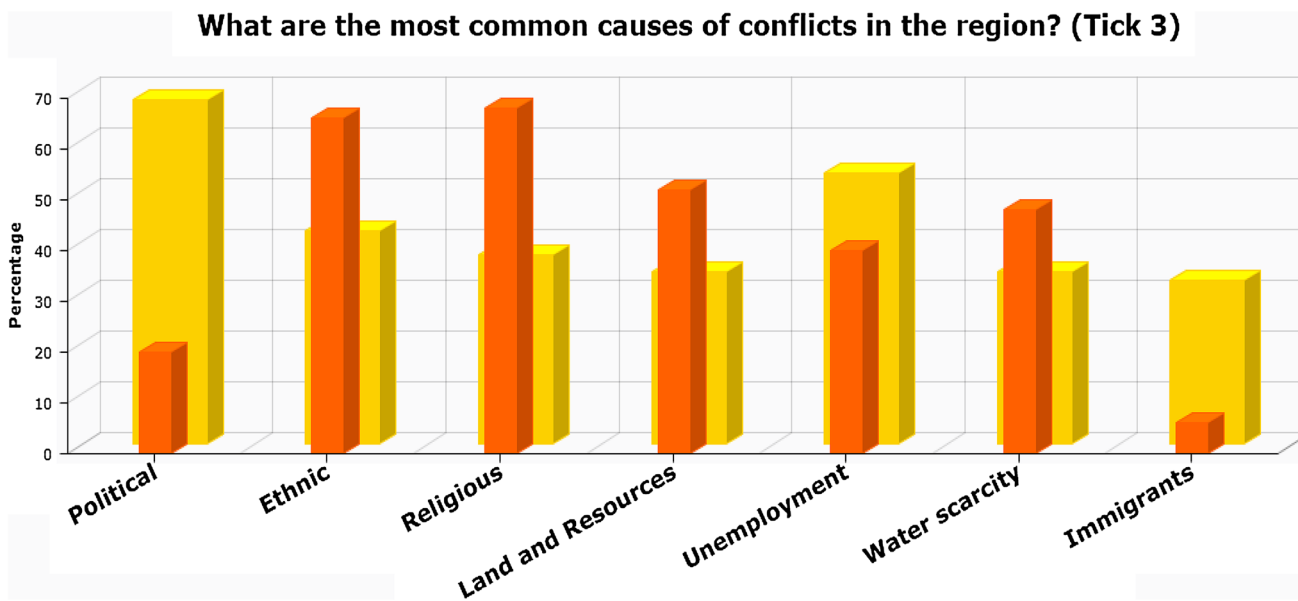
## What are the most common causes of conflicts in the region? (Tick 3)



**Fig. 10** Most common causes of conflicts in the region

**Table 7** Most common causes of conflicts in the region

| Chi-square results for region (rural and urban) | | Political | Ethnic | Religious | Land and resources | Unemployment | Water scarcity | Significance |
|---|---|---|---|---|---|---|---|---|
| Common causes of conflicts in region | Chi-square | 25.3644 | 6.4299 | 10.5767 | 3.7352 | 1.9422 | 2.2989 | Yes = 4 |
| | p value | . | 0.01122 | 0.00115 | 0.05328 | 0.163429 | 0.129467 | No = 3 |
| | Significant at $p < 0.05$ | Yes | Yes | Yes | No | No | No | 57.14% |

consequences and conflicts emerging from it. Karachi, often considered as the financial soul of the country, is the most populated city of Pakistan, and seventh most populated city globally with a population density of over 24,000 people per square kilometer (Karachi Population 2017). Lethal heat strokes in Karachi are more frequently experienced compared to past, and now, sea intrusion heavily threatens the city. It is expected to reach absolute point zero for water, like Cape town, South Africa in coming decades (Ahmad 2007). Pakistan is becoming water stressed as main rivers dry out (Briscoe et al. 2006). This opens a range of possibilities for an international dispute with neighboring power, i.e., Baglihar Dam, and interprovincial conflicts, similar to Sindh Punjab Dispute (1940). Temperature in Karachi is expected to reach new extremes in 2019, and annual temperature will continue to increase throughout the century (Zaman et al. 2009). Heat waves in Pakistan are a major reason of deaths. The frequency of heat waves has increased exponentially during the previous years, and it is expected to increase in future (Zaman et al. 2009). Increasing population is directly associated with resource depletion and environmental

deterioration, and induces migration (Birdsall 1992). In addition, climate change is causing natural disasters, desertification, and resource scarcity which force communities to migrate to another region for survival or in search of livelihood. Migration of environmental refugees to urban regions has been observed throughout the world (Bilsborrow 1992; Aghazarm and Laczko 2009).

The most important aspect of climate change mitigation is improved resilience. For Pakistan, building infrastructure like roads and watersheds is one way to improve resilience, while the other is the provision of energy and resources. Lack of energy and resources threatens the survival of the poor rural population, forcing them to migrate towards urban settlements. Pakistan experiences the consequences of these migrations due to infrastructure absence to handle such an influx. Solid fuel available to most of the rural population produces several times more particulate matter than nonsolid fuel, which inducts environmental cost of several billion dollars (Amegah et al. 2014). Net forest depletion and net resource depletion is apparently increasing in Pakistan according to Fig. 16. This is due to wood logging for

**Table 8** *Z* test for association

| Rural | Biggest threat to region | Proportion | Cause of conflict | Proportion | Z Score | P value | Z significance at $p<0.05$ | Intersection |
|---|---|---|---|---|---|---|---|---|
| Water scarcity | 39 | 0.78 | 38 | 0.76 | 0.2376 | 0.81034 | No | 76% |
| Overpopulation | 7 | 0.14 | 45 | 0.9 | 7.6061 | 0 | Yes | 14% |
| Resource depletion | 17 | 0.34 | 47 | 0.94 | −6.25 | 0 | Yes | 34% |
| Sea intrusion % flooding | 26 | 0.52 | 16 | 0.32 | 2.0261 | 0.04236 | Yes | 32% |
| Unemployment | 28 | 0.56 | 46 | 0.92 | 4.1036 | 0 | Yes | 56% |
| Poverty | 26 | 0.52 | 25 | 0.5 | 0.2 | 0.84148 | No | 50% |
| Injustice and conflict | 14 | 0.28 | 33 | 0.66 | 3.8069 | 0.00014 | Yes | 28% |
| $n=50$ | Spearman's Rho *R* value is −0.09009 and statistically insignificant association | | | | | | | |

| Urban | Biggest threat to region | Proportion | Cause of conflict | Proportion | Z Score | P value | Z significance at $p<0.05$ | Intersection |
|---|---|---|---|---|---|---|---|---|
| Water scarcity | 52 | 0.83871 | 37 | 0.596774 | 2.9928 | 0.00278 | Yes | 59% |
| Overpopulation | 35 | 0.564516 | 48 | 0.774194 | −2.4816 | 0.01314 | Yes | 56% |
| Resource depletion | 7 | 0.112903 | 45 | 0.725806 | −6.9155 | 0 | Yes | 11% |
| Sea intrusion % flooding | 22 | 0.354839 | 1 | 0.016129 | 4.8518 | 0 | Yes | 2% |
| Unemployment | 32 | 0.516129 | 30 | 0.483871 | 0.3592 | 0.71884 | No | 48% |
| Poverty | 17 | 0.274194 | 45 | 0.725806 | −5.0289 | 0 | Yes | 27% |
| Injustice and conflict | 21 | 0.33871 | 45 | 0.725806 | −4.3195 | 0 | Yes | 33% |
| $n=62$ | Spearman's Rho *R* value is −0.18531 and statistically insignificant association | | | | | | | |

| Rural | Cause of Conflict | Proportion | Factors that aggravate for fight | Proportion | Z Score | p value | Z-Significance at $p<0.05$ | Intersection |
|---|---|---|---|---|---|---|---|---|
| Land and resources | 47 | 0.94 | 41 | 0.82 | 1.8464 | 0.06432 | No | 82% |
| Economic competition | 25 | 0.5 | 43 | 0.86 | −3.8587 | 0.00012 | Yes | 50% |
| Inequality and injustice | 33 | 0.66 | 31 | 0.62 | 0.4167 | 0.67448 | No | 62% |
| Water scarcity | 38 | 0.76 | 47 | 0.94 | −2.5205 | 0.01174 | Yes | 76% |
| Disease | 12 | 0.24 | 48 | 0.96 | −7.3485 | 0 | Yes | 24% |
| Disaster | 16 | 0.32 | 48 | 0.96 | −6.6667 | 0 | Yes | 32% |
| Scorching heat | 46 | 0.92 | 45 | 0.9 | 0.3494 | 0.72634 | No | 90% |
| $n=50$ | Spearman's Rho *R* value is −0.59462 and statistically insignificant association | | | | | | | |

| Urban | Cause of conflict | Proportion | Factors that aggravate for fight | Proportion | Z score | p value | Z-significance at $p<0.05$ | Intersection |
|---|---|---|---|---|---|---|---|---|
| Land and resources | 59 | 0.951613 | 23 | 0.370968 | 6.831 | 0 | Yes | 37% |
| Economic competition | 45 | 0.725806 | 56 | 0.903226 | 2.5414 | 0.01108 | Yes | 72% |
| Inequality and injustice | 45 | 0.725806 | 32 | 0.516129 | 2.4064 | 0.01596 | Yes | 51% |
| Unavailability of water | 37 | 0.596774 | 57 | 0.919355 | −4.1939 | 0 | Yes | 59% |
| Disease | 10 | 0.16129 | 41 | 0.66129 | −5.6575 | 0 | Yes | 16% |
| Disaster | 1 | 0.016129 | 51 | 0.822581 | −9.0994 | 0 | Yes | 2% |
| Scorching heat | 5 | 0.080645 | 59 | 0.951613 | −9.7037 | 0 | Yes | 8% |
| $n=62$ | Spearman's Rho *R* value is −0.55858 and statistically insignificant association | | | | | | | |

development and unchecked cutting of wood illegally for timber. Due to occupational shifts and unemployment, more people are getting involved in timber trade as occupation. These projections play a role to drive relocation and disputes among communities, who rely on timber and natural resources for livelihood. Victims may move to another region, welcomed, or mistreated by host community—or choose to stay and compete over remaining resources. A new ethnopolitical minority migrating to a newer region does not find equal opportunities and lacks opposition

| Population (UN DESA, 2016) | Million people | 193.2 million |
|---|---|---|
| Urban | % Total population | 37.860 |
| Rural | % Total population | 62.140 |
| Urban population growth | % Annual | 2.799 |
| Population density | People/km$^2$ | 236.3 |
| GDP per capita | Per capita US$ | 1275.30 |
| Social expenditure | Million US$ | 9028 |
| Gross savings | Million US$ | 48,878.278 |
| Total reserves | Million US$ | 5155.989 |

Socio-economic factors, demographics, and relevant indicators are essential to understand a reliable nexus of climate change and social interactions

capability. However, in some cases, immigrants may turn into a conflicting party. Despite the fastest growing population of Pakistan, total agricultural land for last 50 years has been the same, as shown in Fig. 17. The population percentage involved in agriculture has also reduced (Mahmood

et al. 2016). However, it is safe to say that machinery and technology have increased. Simultaneously, farmers are getting lesser value for crops which they grow due to feudal monopoly, rendering agricultural sector unattractive for newly emerging youth. Wishing for a better livelihood as basic human instinct, youth turns towards attractive urban centers in search of employment, knowing little about actual unemployed and over-capacitated profile of cities. This wide influx leaves thousands of people unemployed, giving birth to numerous social evils. Local survey and interview results discovered these conditions along with a significant number of regional conflicts occurring due to multiple consequences of climate change.

In Karachi, the climate refugees from interior rural areas migrate towards urban areas in search of better lifestyle due to degraded socioeconomic conditions in rural areas resulted from climate change impacts. This increasing emigration of small population and ethnological minorities from other areas coupled with exponentially growing population are causing environmental and social degradation. Such receiving regions can periodically

**Table 10** Various indicators outlining the country profile for Pakistan

| Indicator | Value | Source |
|---|---|---|
| International migrants | 3.4 Million | (UN DESA, 2017) |
| International migrant stock | 1.7% | (UN DESA, 2017) |
| Females in international immigrant stock | 48.7% | (UN DESA, 2017) |
| International migrants ≤ 19 years | 6.6% | (UN DESA, 2017) |
| International migrants ≥ 65 years | 8.8% | (UN DESA, 2017) |
| Total refugees (forced migration) | 1.55 Million | (UNHCR, 2016) |
| Human development index ranking | 147 Rank | (UNDP, 2015) |
| Unemployment rate | 5.9% | (ILO, 2017) |
| Youth unemployment | 10.8% | (ILO, 2017) |
| Total population projection for 2050 (medium variant) | 306.9 Million | (UN DESA, 2017) |
| Population living in urban areas | 39.2% | (UN DESA, 2016) |

These indicators play an essential role in determining the country's capacity for resilience against calamities. Source: Various databases were accessed to collect the data in tabulated form as mentioned in the table

**Table 11** Average annual loss by hazard to conduct probabilistic risk assessment for Pakistan. GFCF is for Gross Fixed Capital formation includes different land improvements, social expenditure is the government's annual expenses on social areas, and total reserves indicate that the total reserves minus the gold comprise special drawing rights of the country. Source: GFCF; Gross Savings, Absolute & Total Reserves: World bank Development indicators; Social exp: International Labour Organisation

| Hazard | GFCF [%] | Gross savings [%] | Absolute [Million US$] | Social exp [%] | Total reserves [%] |
|---|---|---|---|---|---|
| Earthquake | 0.911 | 0.557 | 272.05 | 3.013 | 5.276 |
| Wind | 0.025 | 0.015 | 7.50 | 0.083 | 0.145 |
| Storm surge | 0.061 | 0.037 | 18.10 | 0.200 | 0.351 |
| Tsunami | 0.001 | 0.000 | 0.17 | 0.002 | 0.003 |
| Flood | 3.448 | 2.107 | 1029.80 | 11.407 | 19.973 |
| Multi-hazard | 4.445 | 2.716 | 1327.62 | 14.706 | 25.749 |

**Fig. 11** Profile of Pakistan in terms of vulnerability risk in the region based on INFORM Model 2018 scores. Source: index for risk management 2018 http://www.inform-index.org

**Table 12** Highest and lowest five risk indicators for Pakistan ranking based on the scores obtained from INFORM model 2018 for Pakistan Source: http://www.inform-index.org
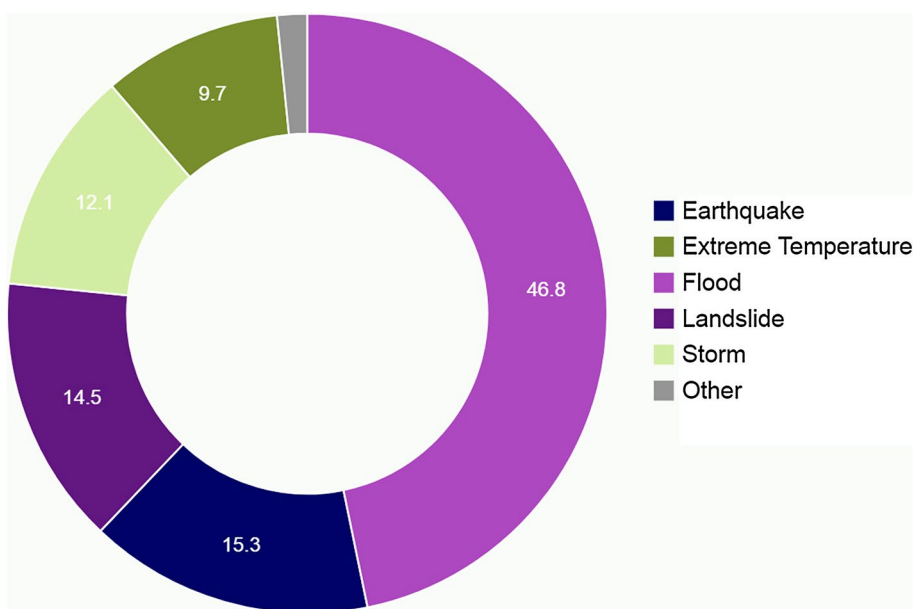
| Highest five risk indicators | | |
|---|---|---|
| Indicator | Rank | Score |
| Violent conflicts probability | 9 | 10.00 Violent conflicts probability score |
| U5UW | 8 | 7.00 Children underweight |
| Physical exposure to earthquake MMI VI (absolute)—raw | 4 | 10.00 Physical exposure to earthquake MMI VIII (absolute) |
| Physical exposure to flood (absolute)—raw | 4 | 10.00 Physical exposure to flood (absolute) |
| Conflicts Barometer National Power | 2 | 10.00 Current national power conflicts |
| lowest five risk indicators | | |
| Indicator | Rank | Score |
| People affected by droughts (relative)—raw | 79 | 0.10 PEOPLE affected by droughts (relative) |
| Agriculture stress index probability | 46 | 6.10 Agriculture drought probability |
| Domestic food price-level index | 25 | 6.80 Domestic food price-level index |
| Conflicts barometer subnational | 14 | 7.00 Current subnational conflicts |
| Conflict barometer national power | 2 | 10.00 Current national power conflicts |

The approach builds on understanding of a significant relationship between conflicts and certain factors pertaining to climate change

experience violence with prevalent tension between different ethnic groups (Suhrke and Hazarika 1993). Karachi being host region is home to diverse ethnic, racial, political, and religious groups. Crossing threshold limit, the population is subjected to resource scarcity, extreme water shortage, lack of planned urban infrastructure, and mass unemployment. This puts psychological stress on mass scale resulting in an uncontrolled conflicts situation between different ethnic groups (Wright 1991).

**Fig. 12** Frequency of events in Pakistan reported on international level from 1990–2014 data. Various factors pertaining to climate change in Pakistan with the estimation of past losses caused in Pakistan. These shares help in predicting the expected future losses for improved resilience. Source: EM-DAT International Disaster Database http://www.emdat.be
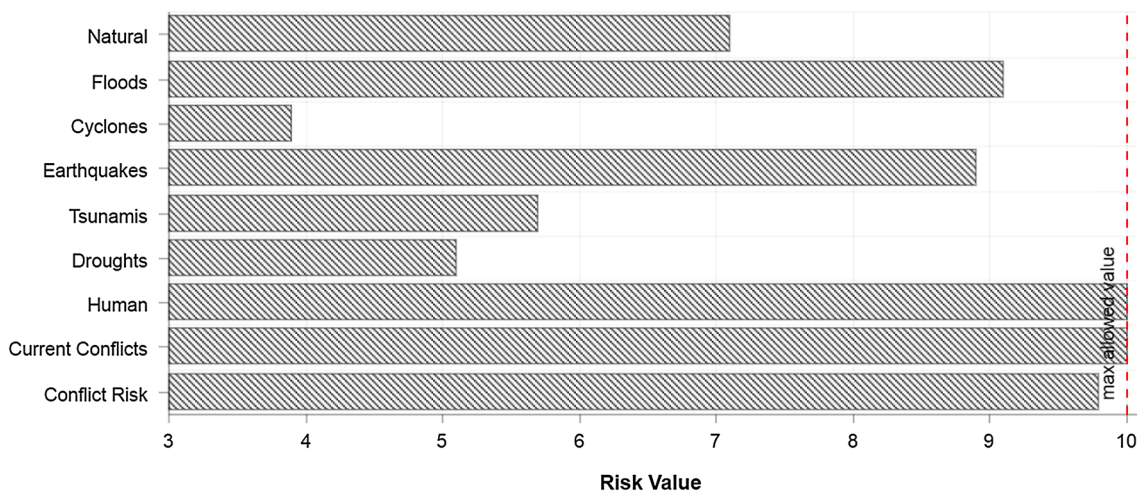


Legend:
- Earthquake
- Extreme Temperature
- Flood
- Landslide
- Storm
- Other

Values: 46.8, 9.7, 12.1, 14.5, 15.3

**Hazard and Exposure**



**Fig. 13** Hazard and Exposure Aspect Subdivisions for Pakistan. The chosen indicators in this graph are the most important factors related to climate change and conflicts nexus. The value represents the risk significance for Pakistan in various sectors. Source: index for risk management 2018. The data were acquired from the source database and figure was made using AM Charts editor available on amcharts.com

## 6.8 Sea Intrusion

For scrutinizing Pakistan's coastal region, area of Thatta, Badin, and Karachi are focused on the map to properly observe the impacts of sea-level rise comparatively. The vast land area has witnessed sea intrusion in Thatta and Badin (Khan 2012). The maps show the impact of sea-level rise at 0 m, 1 m, 2 m, and 4 m of sea-level rise in the region, as sea-level rise up to 6.5 feet is predicted to be experienced. The data for sea-level rise model are mapped in figures above,

showing the alarming levels of sea intrusion in inflicted coasts. The coastal area of Pakistan includes Sindh coast stretching 350 km and Baluchistan coast stretching 770 km.

According to these maps in Fig. 18, Sindh Coast being at declination will be most affected conclusively, while Baluchistan coast will be mostly intact. Nevertheless, Sindh coast is the most developed and most densely populated one. An astoundingly dense population resides in Karachi. It also includes two major ports, handling up to 80% of Pakistan's sea trade. Thatta and Badin are also highly endangered as
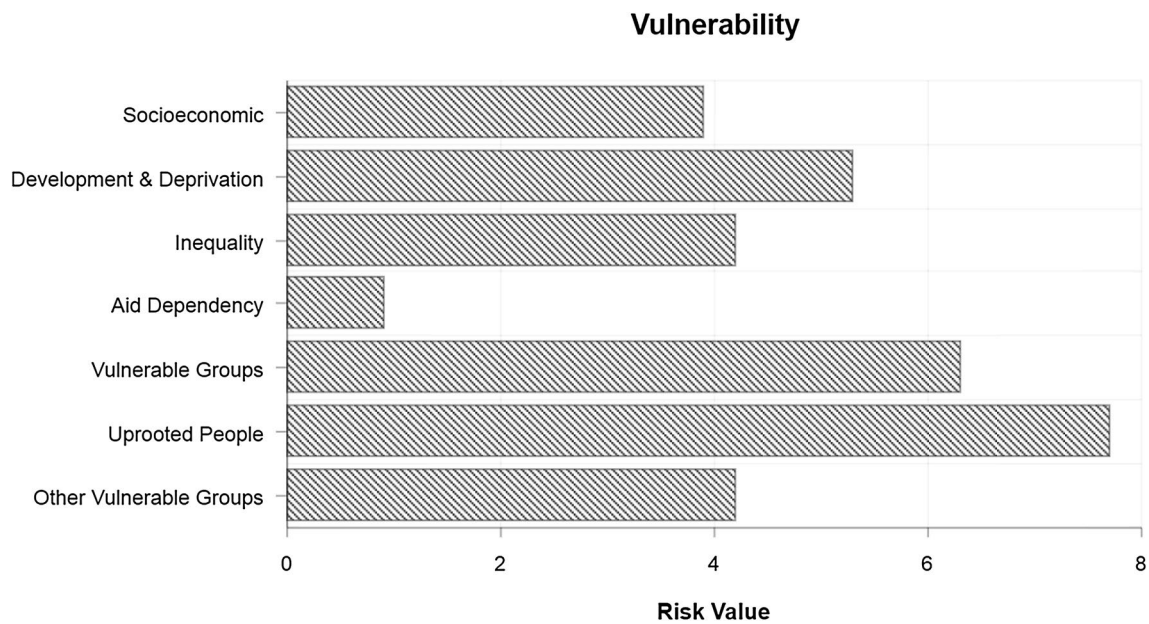
## Vulnerability



**Fig. 14** Vulnerability Aspect Subdivisions for Pakistan. The chosen indicators in this graph explain the vulnerability of Pakistan in terms of disaster resilience. The value represents the risk significance for Pakistan in various sectors. Source: Index for Risk Management 2018. The data were acquired from the source database and figure was made using AM Charts editor available on amcharts.com
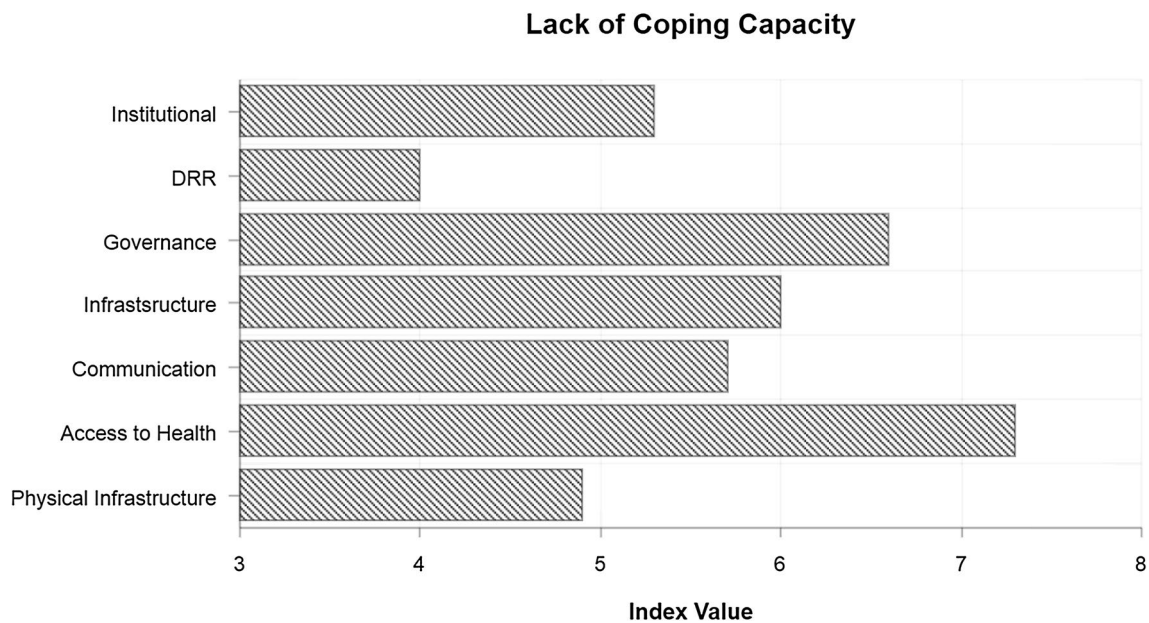
## Lack of Coping Capacity



**Fig. 15** Lack of Coping Capacity for Pakistan. The indicators in this graph outline the lack of coping capacity at times of climate change disasters for Pakistan. The higher value represents greater lack in each subdivision. Source: index for risk management 2018. The data were acquired from the source database and figure was made using AM Charts editor available on amcharts.com

shown. Several villages and communities reside in these areas are prey to dire poverty and depends on nature for livelihood (Gill et al. 2012). Sea intrusion in these areas will cause the demolition of their livelihood infrastructure and most probably force them to migrate to other safer regions.

With their poverty status, the populations will not be able to endure the disaster shock or to take mitigation action. Many areas of these districts are already claimed and swallowed by the unkind sea, while many face soil degradation and tidal sea intrusion. Similarly, the population of the megacity

**Table 13** Countries within the same class as Pakistan having similar profiles in the three aspects of vulnerability defined by UNISDR, i.e., hazard, vulnerability, and coping capacity

| Country | InfoRM | Hazard | Vulnerability | Coping capacity |
|---|---|---|---|---|
| Democratic Republic of Congo | 7.10 | 6.20 | 7.30 | 8.00 |
| Sudan | 7.00 | 7.20 | 6.70 | 7.00 |
| Syrian Arab Republic | 6.90 | 8.50 | 6.90 | 5.70 |
| Iraq | 6.80 | 7.60 | 6.10 | 6.90 |
| Myanmar | 6.40 | 7.50 | 5.50 | 6.40 |
| Pakistan* | 6.40 | 9.00 | 5.20 | 5.70 |
| Nigeria | 6.30 | 6.90 | 5.50 | 6.50 |
| Haiti | 6.30 | 5.70 | 5.80 | 7.40 |
| Ethiopia | 6.30 | 5.50 | 6.60 | 6.80 |
| Cameroon | 6.20 | 6.80 | 5.80 | 5.90 |
| Libya | 6.00 | 8.40 | 3.90 | 6.70 |

InfoRM indicates the overall country score defined by all three aspects. Source: Index for Risk Management 2018
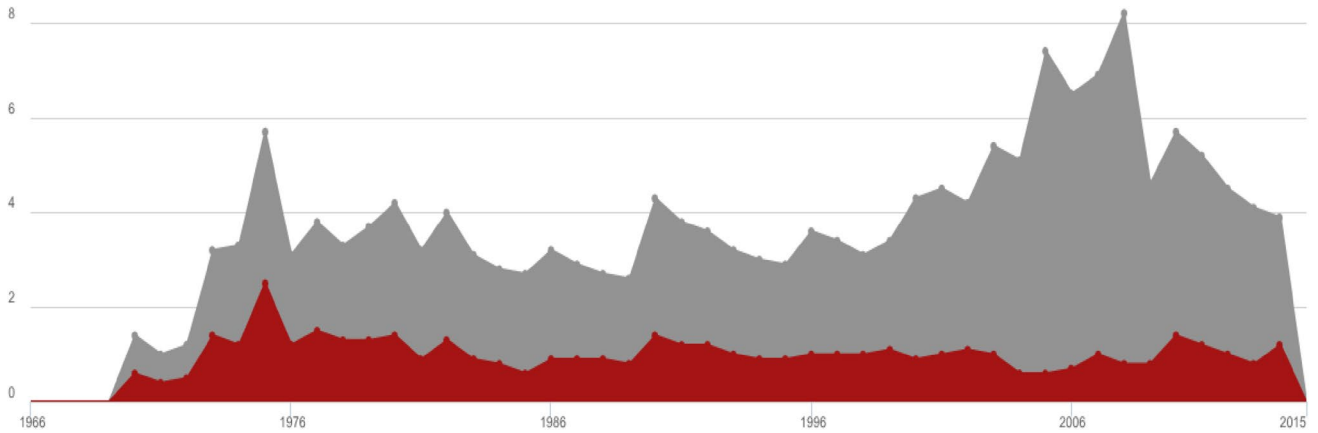


**Fig. 16** Natural resource depletion (gray) and forest depletion (red) (% of GNI) Source: world development indicators
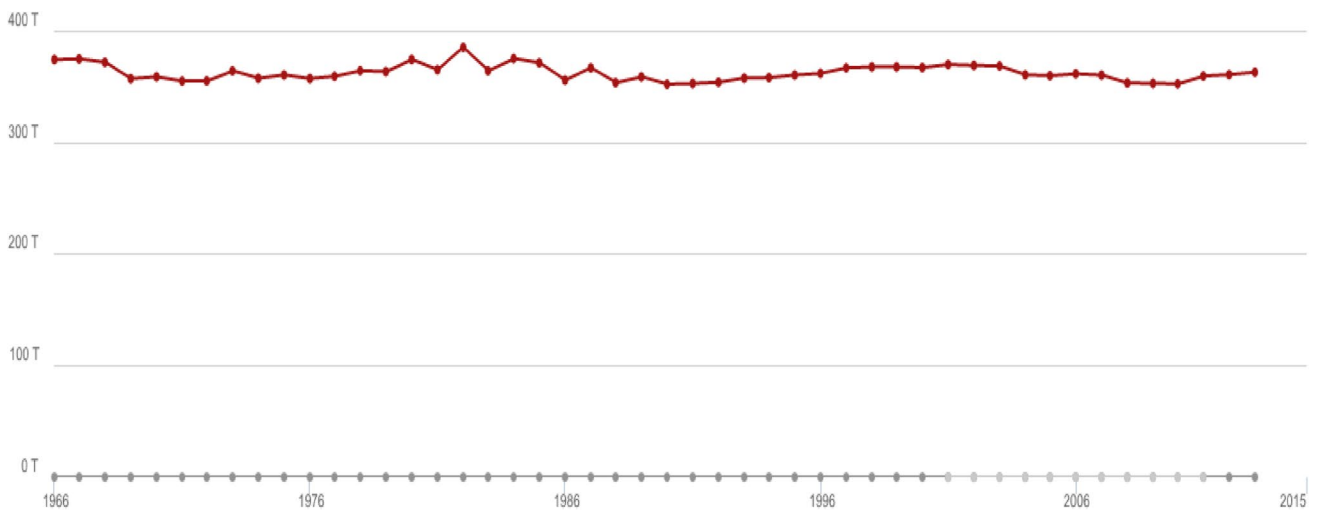


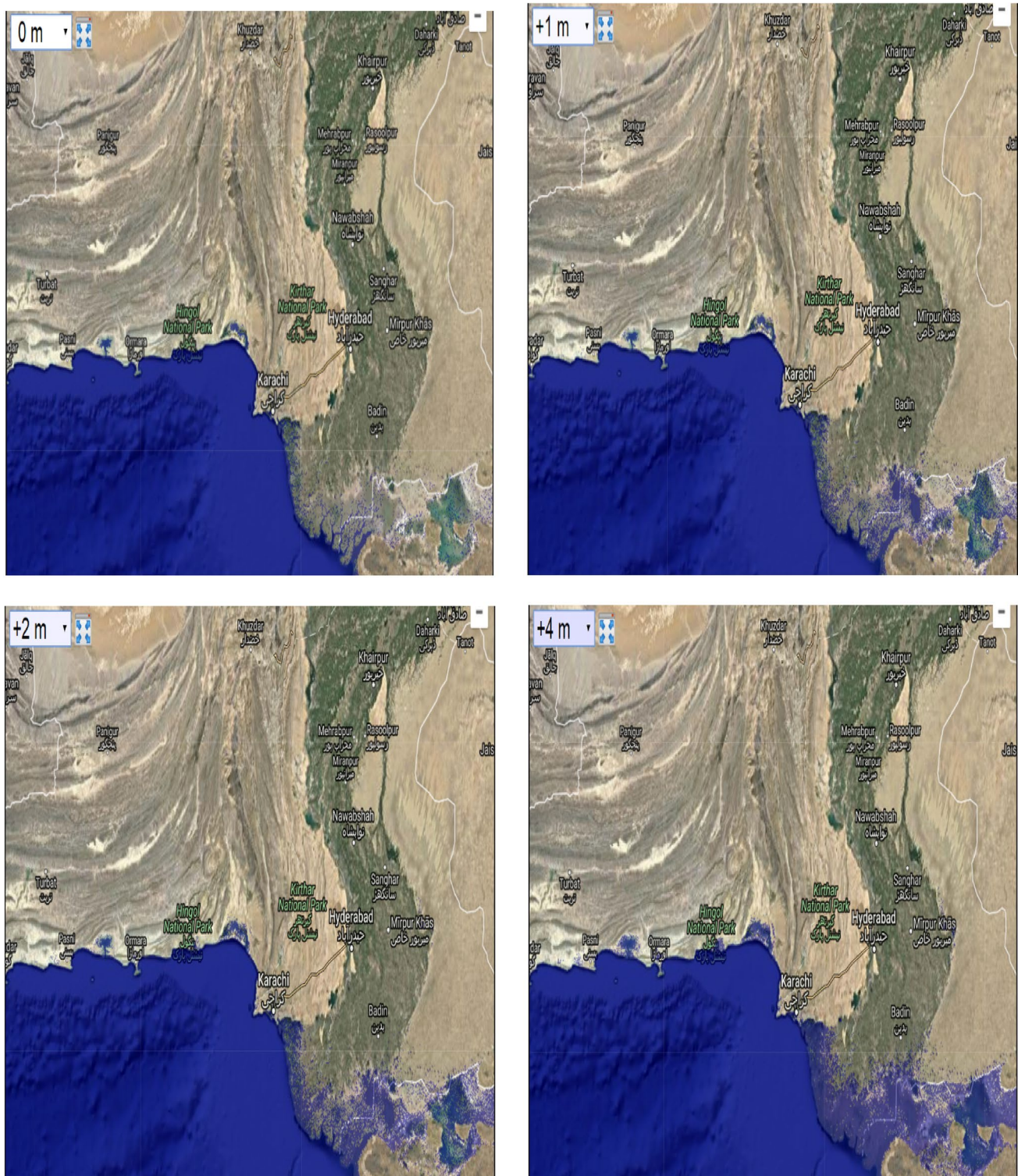**Fig. 17** Agricultural land sq. km. Source: world development indicators

**Fig. 18** Comparative geospatial analysis for sea-level rise at Sindh coast

Karachi will be a prime target in this regard. Migration of such dense proportion of the population can cause extreme conditions of violence and conflicts (O'Malley 2018). Conditions can cause civil unrest, insurgency, civil pressure on governmental and responsible bodies, and shutdown of the country's economic transaction, which highly depends on this region. Residence of such a large portion of the highlighted population will be one of the initial challenges.

With negligible attention over these threats, policymakers are focusing more on mitigation and lack acute adaptation strategy. Senate's Committee of Science and technology warned the officials in 2015, via letter to prime minister, sharply stating that sea will claim financial center Karachi by 2060, and already drowning Thatta and Badin region will be underwater in 2050 (Ali 2015). The warning urged officials to take urgent action pertinently, along with recommendations on putting the case forward and allocating resources to authorities for research to find solutions and taking mitigation measures. Karachi accommodating 20 million people was declared the prime focus, with a demand for timely measures. The report also linked damming in the Indus Delta to increased cyclones and coastal erosion due to the reduction in river discharge and highlighted the resulting migration of local communities from that region in thousands (Rasul et al. 2012). Some studies calculate that 2.2 million acres of farmland are claimed by the sea in Badin and Thatta. A wall stretched to 225 km of the coastal region is pledged to be built along affected Thatta and Badin region, and building a 220 km wide road along the coastline is being considered as a mitigation measure (Butt 2015).

With close analysis, map reveals that 2 m rise in the sea level would sink some major important areas completely, including outskirts of Karachi, Clifton, Keti bander, Badin, Shah Bandar, Kharo Chan, Shah Aqeeq, Mahro Kotri, Mirpur Sakro, Gharo, Port Mohammed Bin Qasim, Abu Dhabi Palace, and Hunting Ground. Buddo Island and Bundle Island will be entirely submerged.

Increasing population and subsequent resource depletion in Pakistan are inducing events of displacement and posing security threats to Pakistan in several ways (Barnett 2003). Navigating the complexities of these relationships and exploring further on several things is important to evaluate links between displacement, resource depletion, and climate change and conflicts (Null and Risi 2016). Analyzing how these factors come into play in Pakistan will strengthen the climate change policy responses, security infrastructure and conflict resolution system (Jehn 1997) studied how conflicts are almost always caused due to a complex chain of dependent and independent events, while environmental and climatic change can interweave in this complex chain (Collier 2000; Homer-Dixon 1991). To understand it better, it is important to take into account the political, social, environmental, economic, and demographic drivers that are functional in Pakistan (Pedersen 2002).

### 6.8.1 Hypothesis 1

"Lack of resources due to climate change can lead to two outcomes, either population fights over remaining resources resulting in dispute, or one group can migrate to another region which could arise conflicts between host group and immigrant group. Climate change can cause conflicts in both ways in Pakistan".

### 6.8.2 Justification

Consequences of climate change will impact already dwindling resources due to rapidly growing populations and increasing needs. All resources have their own importance. However, water, land, energy, and food are considered key resources for the survival of human beings, which are all threatened by impacts of climate change (Pimentel and Pimentel 2007). The demand for resources is currently greater than carrying capacity and sustainable level, which is expected to increase in a more populous world in future.

According to studies, low-level disputes over resources already exist in Pakistan (Blondel 2012). The interviews and surveys from the local rural communities confirmed the presence of conflicts due to factors associated with climate change. These resource-based conflicts in the region are fueled by climate change and its consequences. Local disputes occur regularly in Pakistan (Wood 1994) but are usually neglected, or lack of study and literacy cause failure to recognize it as a potential outcome of climate change. While there is lack of study and research, numerous studies based on the cases of African countries of similar geographical and economical profile to Pakistan link climate change to natural resource dispute, violent dispute, and climate change consequences on resource scarcity that lead to extreme disputes and violence (Adano and Daudi 2012; Messer 2010; Mwiturubani and Van Wyk 2010). Resource scarcity, food crisis, and fluctuating price of food and energy can also create conditions of dispute in Pakistan (Messer et al. 1998). The disputes may be due to resource scarcity, group identity, and relative depletion. However, in some cases of migration in the world, it is observed that immigrants are welcomed in the receiving area and tend to live harmoniously in cooperation in the host region (Buonfino 2004). In case of Pakistan, the diverse roots of ethnic, racial, cultural, and religious boundaries may not allow migrants of a new community to occupy and live peacefully with a differently entitled host community. This can force the suffering community to move to an entirely intact region with no infrastructure to support the human lifestyle (Mileti 1999).

### 6.8.3 Hypothesis 2

"Does climate change cause violence and armed disputes in climate change hotspots of Pakistan? Various violent disputes, terrorist activities, and extremism in Pakistan are outcomes of widespread roots of climate change impact, or at least indirectly linked to consequences of climate change, like resource depletion, negative impacts, and different

losses due to climate change. The impacts of climate change may also work as regulating factors for these disputes".

### 6.8.4 Justification

Studies reveal that disputes over already present ethnic, religious, and social rivalries are being intensified because of the climate change (Radu 2010). Another study links the impacts of floods in Pakistan in 2010 to violent disputes among Islamists, Baluch Separatist dispute, and racial disputes in Karachi (Ghimire and Ferreira 2016). Recent floods which were believed to be induced by climate change received poor disaster relief and mitigation action from government, creating a deleterious picture of democratic government and enthusiastic image for army, military, and other Islamic groups. It is suggested that disputes arising due to climate change are linked to how strong democratization of a country is. Dispute incidences are lesser in countries with strong democratic systems. In the case of Pakistan, the democratic system is vulnerable due to the civilian opposition as well as lack of performance in these matters, which make it more vulnerable to disputes induced by climate change (Skjonsberg 2015). A study suggests that development can serve as a mitigation action in reducing this vulnerability (Helmer and Hilhorst 2006). For example, technological improvement can pave the way for conflicts due to the scarcity of some resources, i.e., disputes over freshwater can be mitigated by application of desalination technology to retrieve freshwater. Another study suggests that terrorist activities prevail more in conditions of reduced capacity and increasing poverty, both of which are fueled by climate change (Smith 2007). This could make government weaker and terrorism activities more evident. A study indicates that areas of Pakistan that are most severely affected by climatic disasters, i.e., floods are sites of insurgency against the government, such as Baluchistan districts and Frontier regions (Radu 2010).

The West Frontier region of Pakistan has been prone to terrorist activities and dispute situations for various geopolitical factors and induction of terrorist groups involved in international terror, counterterror, and political stress, i.e., Afghanistan and USA. Religious extremism is also characteristic of the region for the last few decades.

Karachi is usually prey to ethnic, racial, and sectarian disputes. Rapidly growing population, dense settlements, illegal housing, ill-structured towns, uncontrolled vehicular traffic, and industrial activity put psychological and ecological pressure on the population (Hussain 2010).

Disputes in Baluchistan mostly consist of separatist and secular disputes. However, religious, sectorial, and ethnic disputes are also observed. Racial disputes are common in the region. People, militants, and extremists are intolerant to people of other races in the area. The population of Baluchistan is mainly poor; hence, literacy is low. More than 46% of the population lives below the poverty line.

The region is not thickly populated and holds only 5% of the total population of Pakistan despite being the largest province of the country. For this reason, the socio-economic profile of the region is lower than in the other provinces, due to lack of trade and other economic activities. Nevertheless, Baluchistan is full and rich in valuable natural resources which government often makes use of. Therefore, many Baloch groups consider government a threat at the political and racial levels, as their resources are continually utilized by the government, but regional development activities lag greatly (Waseen and Mufti 2009).

Although climate change has evident relationship with disputes, there are other ethnopolitical factors associated with conflicts in this region. It is essential to consider these variables when estimating the extent of relation between climate change and disputes. In this regard, first, major civil disturbance in Karachi was observed in 1985, claiming 100 lives (Gayer 2007). Target killing had become common in the city before recent actions and indulgence of Pakistan army left Karachi with a relatively peaceful profile. However, it is quite evident that such incidents of target killings, kidnappings, and extortion rackets in the region result from very active political influence in Karachi, in combination with criminal activities (Yusuf 2012). Access to a big number of illegal weapons in Karachi is explained in a study which points to several other factors and links it to the geopolitical situation of Afghan War (Masood and Imtiaz 2010). In addition, sectorial, racial, and inter-ethnic disputes of Karachi are accounted for its wide racial diversity. Karachi is highly vulnerable to climate change and can face drastic impacts of climate change followed by an extremely violent dispute in future in the absence of adaptation and mitigation. However, certain dispute situation of Karachi, along with all the terrorist activities, target killings, extortion rackets, and civil disorder is purely due to other variables such as political recreation, inside jobs, individual businesses, and criminal activities, etc., which are all common in such metropolitan cities globally (Yusuf 2012). In the scope of research, it is important to filter these two overlapping situations of Karachi, and crucial to classify each dispute situation in Karachi as whether induced by climate change or by other factors. It will be, therefore, misinforming and misguiding if we remove that from the equation. Actions over these two situations are two different subjects.

Dispute situations in Baluchistan have not been uniform due to several factors. Three major insurgencies were contended by the military action. In 1973 alone, more than 3000 soldiers died. The animosity between Baloch and government has given rise to civil disorder, independence movements, and anti-government campaigns. A movement in 2005 claimed hundreds of lives and caused thousands to

migrate. Tremendous indulgences of neighboring animosities create inevitable unrest. A report highlights that local and international media are not allowed to access the region (Unrepresented Nations and Peoples Organization 2009). The region of Baluchistan is resource rich and it is quite protected from the impacts of sea intrusion. However, the land is mostly desert with a very little population that lives a tough life. The local population fears that external indulgences will invade their resource-rich lands, which becomes the primary reason for extremism in the region.

Frontier region often faces military action due to frequent insurgency and terrorism. Several groups easily exploit the region for insurgent and terrorist movements in pursuit of different motives and demands. Their prime objective may be criminal activities, smuggling, blackmailing the government, capturing the resources, international politics, terrorism, or resisting an externality. Hundreds of drone attacks by the US military have taken thousands of civilian lives regionally in the previous decade, which is one major reason for an exponential increase in the number of disputes in the region (Shah 2010). Apart from casualties and deaths, a massive displacement of 2 million people is observed in the region. Several methods of attack, violence, and dispute are commonly used, including drones, air strikes, kidnappings, bomb blasting, executions, revolt, and suicide attacks in public places, residential areas, mosques, and schools. The nature of these violent activities is majorly political, due to international indulgence, based on individual interests, propaganda, and international indoctrination. Therefore, various external factors contribute to violent conflicts. Since there are shreds of evidence on how climate change can induce or aggravate terrorism and violent disputes, further research can establish deeper correlations which should be co-factored and significantly considered.

### 6.8.5 Hypothesis 3

"Conflicts hotspots with high population density have greater chances of dispute and security issues due to climate change, while conflicts hotspots with low population density have lesser. Similarly, low-income populations have a higher risk of climate-induced disputes than hotspot populations of high income. Many other demographic and socio-economic factors may play significant roles in determining the risk of climate-induced disputes."

### 6.8.6 Justification

Population and dispute are new dimension in demographic dynamics. Several studies link growths of the population and population density to dispute scenarios and wars (Tir and Diehl 1998). Another report concludes that demographic factors of a region can also add to the calculation of conflicting behavior among people both in small scale and large scale (Choucri 1983). According to some results, age structure characteristic of the population is a powerful factor when it comes to predicting tendencies of violence in communities. Some studies make it evident that a greater number of youth in the population tend to create the conditions of unemployment and other factors, which increases the propensity for violence, stress, and dispute (Castles et al. 2013). The age structure also impacts the determination of political agenda and processes of community. Age structure of Pakistan is also quite relevant to factors inclined towards creating dispute and violent conditions. However, there is a complex, interactive, dynamic, and responsive relationship between conflicts and population dynamics, through which these demographic factors play a part. The links are not straight and direct, but always interactive, and needs a special in-depth study of a particular region in this regard. It is studied that population size, density, and growth are not causes of violence and conflicts single-handedly unless other actors work together with this factor. These conditions may be related to health, pathological, economic, and natural factors, and other conditions due to climate change. The conclusive study of information, therefore, suggests that disputes arising due to climate change will most probably be greater in high population density regions as compared to those of low population density in Pakistan. However, this is not the only variable that functions in the matter of disputes due to climate change. Some low population areas may face higher rates of environmental and climate-induced disputes than the high population areas, due to several other reasons. Many areas in Pakistan are low populated despite being resource rich and resilient to climate change and environmental degradation. In many cases, this is due to political and ethnic influences and hostilities. Therefore, it is important to consider all variables while studying the effect of population dynamics on climate change-induced disputes in Pakistan. Some other factors may include the resource profile of the region, access to technology, political, educational, and socio-economic profile, the status of racial, religious, and ethnic discrimination (Modood 2004).

## 7 Outcome of Surveys

Surveys and interviews significantly supported that the frequency of the disasters such as droughts, heatwaves, floods, and diseases has increased in the study area and significantly affects the lives of local communities. It was also highlighted that the majority of conflicts in the region are due to overpopulation, economic competition, acquisition of land and resources, and migration. These factors are closely linked with the consequences of climate change. Moreover, highly significant majority of respondents admitted that factors

aggravated by climate change, such as scorching heat, financial crisis, unavailability of water, sickness, competition over limited resources, and experiencing disaster situation can significantly increase their tendency to fight or have conflicts. It was also found that socioeconomic challenges, resource depletion, immigrants, and water scarcity are perceived as the most common causes of conflicts in the region. The results are also reflective to the question whether quantitative evaluation is a good way to approach this subject or not.

## 8 Conclusion

Data presented in the study indicate that Pakistan has the highest risk value for conflicts and human exposure to these risks (10 out of 10 risk value). It was also evident from data that vulnerable groups (6.5/10 risk value) and uprooted people (8/10 risk value) due to climate change have the highest vulnerability risk value. The local communities of study area are at high risk of development deprivation and socioeconomic challenges (6/10 risk value). On a scale from 1 to 10, Pakistan overall has the hazard, vulnerability and lack of coping capacity values of 9.00, 5.20, and 5.70, respectively. The study area is highly vulnerable to flooding in the next few decades according to the geospatial analysis, and several villages will consequently be displaced. The survey results indicated that certain indicators of relationship between climate change and conflicts are statistically significant.

There is a significant causal relationship between climate change, migration, and violent dispute. Over population together with resource depletion serve as catalyzing factors for climate change migration and dispute. Data on the subject for Pakistan are significantly lacking. However, it can be significantly established that climate change-induced migration and the violent dispute are a reality in Pakistan, with potential to induct further economic losses in the future. Certainly, more research is required on how climatic variability is deeply rooted in the causes of resource depletion and disputes, and how the impacts can secondarily justify increasing migration in Pakistan. Policymakers should consider introducing the regulatory system, resource conservation, prevention, and mitigation and adaptation strategies in light of following recommendations.

## 9 Recommendations

- The absence of official conflicts resolution body should be highlighted as it is the basis of many actions that may be required.
- Increasing resilience of communities by encouraging rural development, to prevent people to migrate towards

urban shine and strengthen their adaptability, including policies focused on ensuring food security and improved livelihood opportunities.
- Better infrastructures should be provided to climate refugees, basic for survival including boreholes, improved roads, water management, storage, and sustainability. Relief centers should also be established.
- Water storage facilities and management, managed aquifer recharge and other economical technologies to store maximum rainwater should be made.
- Famine and drought-stricken people, and climate refugees should be provided with systems like lost income replacement and crop insurance systems.
- Climate disaster victims should be treated at home regions, the safety of relief camps should be ensured, and micro-credits should be provided.
- In the case of Karachi, adaptation measures should include the improvement of coastal communities, building sea walls, and population displacement support programs.

## Compliance with ethical standards

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