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Conceptual Framework for Climate Vulnerability and Conflicts in the Coastal Districts of Thatta and Sujawal, Sindh, Pakistan

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Abstract

This paper explores the linkages between climate change, vulnerability and conflict in the coastal communities of districts Thatta and Sujawal in Sindh province of Pakistan. This coastal region is highly vulnerable to climate change and is exposed to several climatic issues and their implications. Trend analysis shows that during 1961-2020, the average maximum temperature of district Thatta and Sujawal varied from 30.9 to 34.6°C having an overall mean of 32.3°C. Similarly, the minimum average temperature of district Thatta extended between 19.6 to 28.0°C with an overall mean minimum temperature of 21.7°C. The average minimum and maximum amount of precipitation fluctuated between 0.01mm (2018) to 713 (1967) mm with an overall last 60 years mean rainfall of 160.63 mm. The adaptive capacity of these districts is low due to weak infrastructure and poor governance. The Human Development Index (HDI) of Thatta and Sujawal was 0.4 and 0.3 respectively. The Education Index for both districts was 0.3 and the values of the Health Index were 0.6 and 0.5 respectively. Similarly, the Living Standard Index of Thatta and Sujawal was 0.3 and 0.2 respectively. Climate change increases overall stress on resources, human insecurity and societal instability, which are likely to breed conflicts among farmers, fishermen and pastoralists. Political factors further prevent effective resource utilization; through capturing resources that aggregate vulnerability, increase a conflict risk and rendering the fragile region less resilient.

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Introduction

Globally, climatic changes in conjunction with an exponential increase in human population have caused overexploitation of natural resources which has resulted in resource scarcity (Hook and Tang, 2013) and increased social instability (Hallegatte *et al*., 2018). Climate change serves as a risk multiplier that combines and converges with additional hazards and may intensify the probability of conflicts (Lukas and Rüttinger, 2016). Several countries facing the problem of weak infrastructure, social and political uncertainty, insecurity and violent conflict due to climate change. There is a strong indication that climate change intensifies human insecurity especially in the poorest and vulnerable societies (IPCC, 2014; Adger *et al.,* 2014). Countries in the southern part of Asia and Africa are suffering more than others from negative impacts of climate change where the problem of food security already exacerbates (Lobell *et al.,* 2008).

Numerous researchers reported an additional role of climate stressors on ongoing conflicts in different countries, for example, in the western part of Sudan (Richard Reeve, 2012), in Syria (Martin *et al.,* 2013) in Afghanistan (Brown and Blankenship 2013 cited in Lukas and Rüttinger, 2016) and in Pakistan (Schilling *et al*., 2013). The ranking of Pakistan in the Climate Vulnerability Index of 2019 is 8th amongst the 10 most-affected countries by extreme climate events between 1997 and 2016 (German Watch, 2019). It has challenged terrific climatic calamities comprising of flood, droughts, cyclones and heatwaves in the last twenty years. The current highly violent conflict intensity score of Pakistan is 8 and the projected conflict risk is 9.7 out of 10 (INFORM, 2019). The country is experiencing multifarious issues of poverty, deprived institutional framework, fragile governance structure; unsustainable economy and other social, cultural and ethnic issues. Socio-economic issues creating the rural region, in particular, more vulnerable to natural and climate disasters.

The objective of this study is to explore the recent scenario of climate vulnerability in context to resource scarcity, adaptive capacity and key conflicts that are prevailing due to climate change in the study area.

Methodology

Conceptual framework

The nexus of climate change and conflict can be best described in conjunction with the concept of vulnerability (Schilling, 2012). IPCC defines vulnerability in a wide consensus as “the tendency of a community to be adversely affected” and identifies its three main components i.e. exposure, sensitivity and adaptation capacity (IPCC, 2014). Exposure is the extent of climatic change to which a community is exposed may be of two categories, Type-I Exposure of climate change (Temperature and Precipitation) and Type II Exposure (Floods, Droughts, Cyclones, Heatwaves, Sea-level Rise, Sea Water Intrusion). Sensitivity is the extent to which climate change has affected directly (damages due to Type – I Exposure) or indirectly (damages due to Type II Exposure). Adaptive capacity is to adapt to climate change and extremes in relation to the socio-demographic features of the community, their sociopolitical network, livelihood strategies, infrastructure, natural resources and knowledge and skills to cope with the situation. In relation to this, the other two concepts of resilience and environmental security are also significant, resilience is the capacity of a community to endure, improve, and acquire from external instabilities (Schilling *et al*., 2017) and Environmental security is the lack of risk or hazard to the environment on which communal dependency exists for their livelihood (Vivekananda *et al*., 2014). The community having low adaptive capacity and resilience is considered as more vulnerable and environmentally insecure to the desecrating impacts of climate change.

In this study, climate change is linked to a conflict, which is a state in which at least two groups (persons, community, etc.), view their goals, desires, alues or behavior dissenting with each other. In conflict dynamics, the interactions are identified between dormant grievances and resiliencies, and the key actors who mobilize people and resources centered upon them. Mobilized grievances are frequently the drivers of a certain conflict (USAID, 2012). In this study, the climate is identified as a key mobilizer that may project to more instability and conflict in the vulnerable regions. The relationship between climate change and conflict might be linear or non-linear. In a linear relationship, climate change-induced resource scarcity results in a violent conflict where communities compete for resources. In a non-linear relationship, climate change would have varying effects on resources. But changes can often create conflict and stress when opportunistic players split up a formal and informal local framework, and also where resources are more available.

Fig.1 reveals the complex linkage between climate change, vulnerability and conflict in relation to stress, Impact and response respectively. Climate change causes major fluctuations in temperature and precipitation, affecting the availability of resources to maintain the socio-economic system and impact the livelihood of the communities in various ways. In response to stress and the impact of climate change, human insecurity and societal instability occur that can potentially contribute to breeding conflict among vulnerable communities.

Study area

Sindh coastal region is mainly divided into districts Badin, Sujawal, Thatta and Karachi. District Thatta and Sujawal are selected as hotspot regions for the research where climate security is already been affected by climate change (Schilling *et al.*, 2013). These districts are located in the southern region of Pakistan between 23°43' to 25°26' N and 67°05' to 68°45'E (Fig.2). District Thatta covers an area of 8570 sq.km comprising 4 sub-districts: Mirpur Sakro, Ghorabari, Thatta, KetiBunder. District Sujawal covers an area of 8785 sq.km comprising 5 sub-districts: Shah Bunder, Kharo Chan, Mirpur Bathoro, Sujawal, and Jati. The population in these two districts is 1761784 (Census of Pakistan, 2017) and more than 85% of them live in the rural ship (Fig.3) and rely on agriculture and fisheries for their livelihoods.

Data sources

During the field study, the primary data was collected by the focus group discussion (FGD) and key informant survey that is mainly qualitative. The key informant interviews through semi-structured questionnaires were conducted to collect information from major community members such as heads of villagers, Key mobilizers and stakeholders within the local administration and Institutional experts. The quantitative data used in this study was taken from the Pakistan Social and Living Standard Measurement (PSLM) Survey 2014/15, Development Statistics of Sindh, 2018 and other secondary data sources. The climatological data of the study area was acquired from Pakistan Metrological Department, Karachi. Since no monitoring station is present in district Thatta and Sujawal therefore; the data of Karachi is used for the analysis. The temperature and precipitation trend analysis was done from 1961 to 2020.

Index computation

Adaptive capacity can be best understood with generic and Impact specific indicators of the community (Adger and Vincent 2005; IPCC 2007). Human Development Index (HDI) is used to evaluate the generic adaptive capacity of the region which collectively quantifies triple dimensions of human life; education, health, and the standard of living (NHDR, 2017). Impact-specific adaptive capacity is evaluated through socio-political networks and livelihood and income strategies of the community. As per the guidelines and data are given in the Pakistan NHDR 2017 (technical note 1) dimension indices are calculated as (a) Health Index (HI) (b) Education Index (EI) and (c) Living Standard Index (LSI). Minimum and maximum goals are posts for indicators used for the Index computation (Table 2). Globally, gross domestic product (GDP) in terms of purchasing power parity is used to calculate the standard of living in the given region. Indicators used for the calculation of living standards from the Multidimensional Poverty Index (MPI) are electricity, drinking water, sanitation, infrastructure, household fuel and household assets. The dimension indices are calculated as follows:

$$= Dimension\ index = \frac{(Actual\ Value - Minimum\ value)}{(Maximum\ value - Minimum\ value)}$$

For the HI and EI, dimensions are calculated for each selected indicator and then aggregated taking the arithmetic mean of the two resulting indices. For the LSI, the percentage of people living in non-deprived households is used.

Results and discussion

The results are discussed into three main sections (i) Climate vulnerability, (ii) Adaptation and adaptive capacity (iii) Resource scarcity and climate change-induced conflicts in the study region.

Table 1. Climate induced disasters reported in coastal region during last two decades.

Type II Exposure	Potential consequences reported during last two decades	References
Flood	Since 1942 to 2007 Fourteen floods have been reported.	NDMA, 2019
	Agriculture sector is badly affected due to recent floods and vulnerable climate conditions.	Warner *et al.*, 2011; Kazi *et al.*, 2014
	The flood of 2010 devastated the entire district of Thatta.	Hashmi, 2012; Kazi, 2014
	Floods in Sindh are mainly associated with precipitation and excess flow of water from the upper part of River Indus.	Rasul*et al.,* 2012
	Breaching was also triggered by the flooding of rivers at certain reservoirs, including *Muarki* and *KotAlmo* embankments.	Kabooro, 2014
	Flooding (2010) forced landless farmers and peasants into debt cycles.	Looney, 2012
	The flood of 2010 claimed the lives of 116,000 heads of livestock.	FAO, 2012
	In village Sajjan Mallah around 5000 inhabitants destroyed due to flood of 2010.	Alamgir, 2015a
Cyclone	The coastal belt of Sindh has recorded fourteen cyclones from 1970-2010.	Balochistan Times, 2009.
	During 1902 to 2014, the most spectacular cyclones were created over the coast of Sindh, the Arabian.	NDMA, 2019
	The intense coastal tehsils of the district of Thatta, KetiBander, have been wiped out many times by cyclones surges	Alagha *et al.*, 2001
	Cyclones not only destroyed human villages, but have negatively affected the livelihoods of the population.	Kabooro, 2014
	District Thatta and Badin suffered badly from tropical cyclone in 1999 that has left huge quantity of sea salts on the soil.	Chaniho, *et al.,* 2010
Drought	Thatta and Sujwal considered as a drought vulnerable districts in the form of economic loss as well as life.	Adnan *et al.*, 2015
	The drought seasons of Southern Sindh were sporadic between 1971 and 1999 and the latest drought prevailed in 2002.	NDMA, 2019
	About 1.4 million human settlements, 12.5 million farm crops and have been lost as a result of drought	Kabooro, 2014
	Seawater intrusion due to drought towards land particularly in deltaic region	Archer, *et al.,* 2010.
	More than 5 million livestock population in the coastal region is also badly threatened by grassland degradation.	Kabooro, 2014
	Collapsed agriculture economy and many of the paddy farmers were bound to shift their traditional occupation	Memon and Thappa, 2011.
Seawater Intrusion	The major danger of seawater intrusion is primarily present in the district of Thatta as a result of reduce Indus River flow.	Alamgir *et al.,* 2015b
	Thatta is facing problem of infiltration of sea water and rising of sea water level	Qureshi *et al.,* 2008
	The salinity problem in coastline of Sindh is mainly attributed to seawater intrusion, capillary up flow in groundwater and flooding.	Samdani, 1995

Climate Vulnerability (Exposure and Sensitivity)

Exposure-Type I (Temperature and Precipitation): The coastal districts of Thatta and Badin have been adversely impacted by all types of climate variables. Various data from researchers are found in the literature that the area has undergone high temperature and rainfall fluctuations over the last 20 years (Salma *et al.*, 2012; Gajbhiye*et al.*, 2016; Khan *et al.,* 2019a; Zahid *et al.,* 2010). According to IPCC, (2001) the average surface temperature has augmented to 0.6°C since the mid-19th century and is expected to rise by 1.1°C to 6.4°C by the completion of the 21st century. Furthermore, the hottest years from 1995 to 2006 were observed with strong and frequent heat waves as reported by IPCC. The outcomes of the temperature rise have brought obvious variations in the hydrological cycle resulting in lack of water accessibility, concentrated hot spells, rainfall deviations and drought. The crop productivity of the region has been reduced due to augmented temperature and altered rainfall patterns (Ali *et al.*, 2017; Chandio *et al.*, 2017).

Table 2. Generic Adaptive Capacity Indicators (PSLM 2015 and NHDR 2017).

Region		Health			Education			Standard of Living		HDI Status
	HumanDevelopment Index (HDI)	Immunization rate (%)	Satisfaction with health facility (%)	Health Index (HI)	Expected years of schooling (years)	Mean years of schooling (years)	Education Index (EI)	Standard of Living (%)	Living Standard Index (LSI)	
Thatta	0.4	50.6	74.1	0.6	5.9	2.5	0.3	26.8	0.3	Low
Sujawal	0.3	47.7	61.3	0.5	5.4	2.4	0.3	21.2	0.2	Low
Sindh	0.6	73.0	73.2	0.7	8.3	5.1	0.5	67.6	0.7	Medium
Pakistan	0.7	82.1	75.5	0.7	9.4	4.5	0.5	74.5	0.7	Medium
Range	0-1	0-100	0-100	0-1	0-15	0-10	0-1	0-100	0-1	Low (0.1-0.5) Medium (0.5-0.8) High (0.8-1)

Immunization Rate: Fully immunized children between the ages of 12-23 months.

Satisfaction with Health Facility: A household is considered as deprived in 'satisfaction with health facility' if any of its members did not use health care facility due to high cost, limited resources and facilities.

Expected years of schooling: Number of years of schooling that a child of school admission age can expect to receive if prevailing patterns of age-specific enrolment rates persist throughout the child's life.

Mean Years of Schooling: Average number of years of education received by people ages 25 and older, calculated from education attainment levels using official durations of each level.

Living Standard: A composite index based on 6 indicators linked to access and quality of community services, household infrastructure and household asset.

During 1961-2020, the average maximum temperature of district Thatta and Sujawal varied from 30.9 to 34.58°C having an overall mean of 32.25°C. Similarly, the minimum average temperature of district Thatta extended between 19.6 to 28°C with an overall mean minimum temperature of 21.73°C. Similarly, the trend analysis of minimum and maximum temperature is alarming and it is shown in Fig.4 and Fig.5 that minimum temperature shows a considerable increasing trend but no substantial change is observed in maximum temperature. These findings corroborate with the observations of Rasul (2012) who have also pointed out a similar trend.

The rainfall in the study area is scanty throughout the year and is mostly arid. Mostly, July and August are the wet months due to the influence of the southwestern monsoon. The minimum and maximum rainfall in district Thatta and Sujawal are shown in Fig. 6. The average minimum and maximum amount of precipitation fluctuated between 0.01mm (2018) to 713 (1967) mm with an overall last 60 years mean rainfall is 160.63 mm. There is no significant rain has been observed from 2009 to 2020. The years where >200mm of rain was observed are 1962(278mm). 1967 (713mm), 1973 (213mm), 1976(406mm), 1977 (488mm) 1979 (381mm), 1983(281mm), 1984 (270mm), 1992(273mm), 1994(481mm), 1995(260mm), 2003 (325mm), 2006(301mm) and 2007 (466mm).

Table 3. Climate variability concerns, potential consequences and key conflict risk in the study region (Observation from survey).

Climate Variability Concerns	Affected Area: Economic Sector	Affected Area: Resources	Affected Area: livelihood	Degree of Impact	Potential Consequences	Potential for Conflict	Institutional Mitigating/exacerbating Roles in relation to conflict
Temperature	x	x	x	Critical	- Early or Late Harvesting of Crops - Reduction in freshwater flow - Gradual degradation of natural habitats and ecosystems. - Livelihood shift - Food insecurity - Vector borne diseases - Poverty	- Conflicts over destitution of natural resources. Habitat destruction and illegal hunting aggravates the specie reduction and breeding conflict between locals, conservatives and landlords.	- Landlords playing exacerbating role in conflict who open their land for illegal hunting with a substantial cost.
Rain	x	x	x	Critical	- Changes in crop pattern - Livelihood shift - Structural damages - Food insecurity - Poverty	- Conflicts over destitution of natural resources. Shifts in crop pattern forced local people to over exploit the indigenous riverine plant to satisfy their demand of fuel wood.	- Ruling Elite and Landlords intensifying the conflict.
Flood	x	x	x	Critical	- Land degradation - Structural damages - Crop destruction - Breeching - Migration - Disease and Health issues - Food Insecurity - Poverty - Indebtedness	- Conflict over debit between money lenders and poor people which were forced into debt cycles after recent floods.	- Private money lenders and feudal families exacerbating the conflict.
Drought	x	x	x	Critical	- Land degradation - low crop productivity - less grazing land - low livestock population - Seawater intrusion - Food Insecurity - Migration - Disease and health issues	- Conflict over grazing land and pastures owing to land degradation and livestock reduction due to drought; reduce fresh water flow and extensive wood cutting.	- Landlords or influential tribes mostly own grazing land and they don't permit the people of another tribe to graze their animals their land. Exacerbating the conflict among the local population
Storms/Cyclones		x	x	Critical	- Obstruction in Fish Catch - Low fish productivity - Impact on livelihood and income generation - Migration	Conflict over fisheries due to obstruction in fish catch during cyclone and storm surges.	The role of fishermen cooperative society to mitigating the conflict is ineffective.
Sea water Intrusion	x	x	x	Critical	- Water logging salinity - Land degradation - Low agriculture productivity - Livelihood shifts - Vector borne diseases - Migration	- Conflict over fisheries due to occupational shift from farming to fishing - Conflict over access to and control on depleting freshwater resources	- Landlords having big trawlers overexploit the fish resources, thus further increase the conflict between poor fishermen. - Politicization of technical roles and capturing of resources by ruling elite worsening the situation and breeding conflicts

Exposure-Type II (Flood, Cyclone, Drought, Seawater Intrusion): The coastal belt of Sindh is extremely prone to floods and cyclones owing to flat surface topography and geographical location respectively. The majority of riverine and torrential flooding in the area occurs during the monsoon season. Table 1 summarizes the review of Type II exposures and the important climate-induced disasters that occurred in the region during the last twenty years. Since the community infrastructure is already fragile (Work Bank, 2005) therefore the livelihoods of villagers and vulnerable coastal populations have been severely impacted by climate disasters (Ali and Erenstein, 2017). Start with a cyclone in 1999, drought in 2000, followed by floods in 2003, megafloods in 2010, flash floods in 2011 (SCDA, 2012).

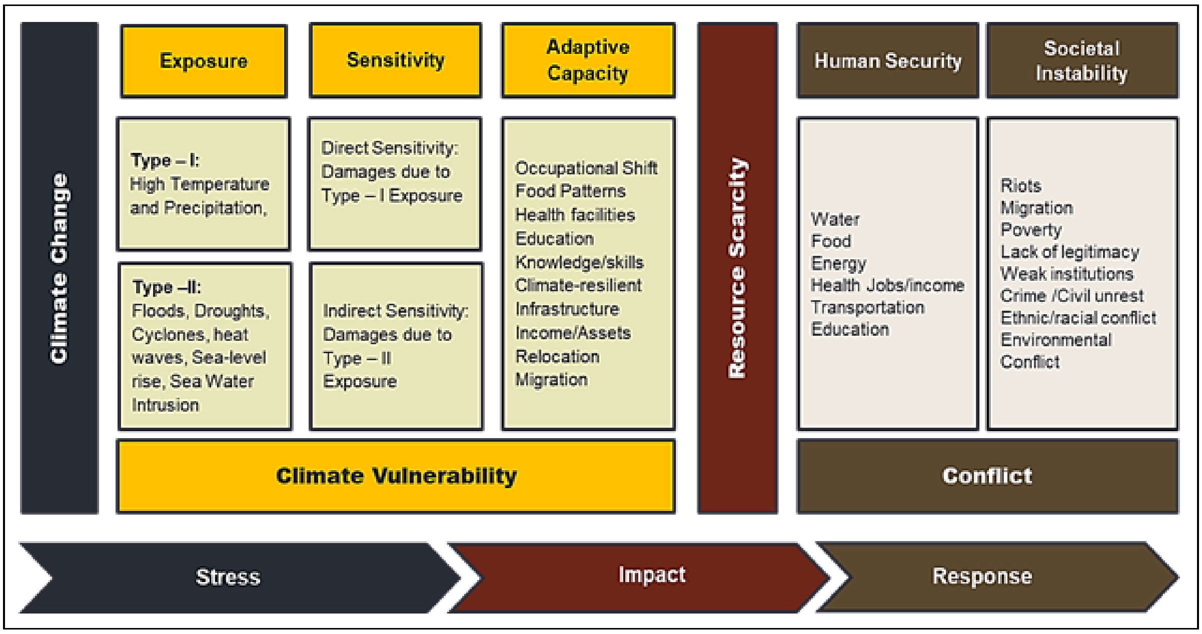

Fig. 1. Conceptual Framework for nexus between climate change, vulnerability and conflict (Modified from Rebecca and Janpeter 2019).

The main cyclones reported in the region are Cyclone 2A (1999), Onil (2004), Gonu and Yemyin (2007), Phyan (2009), Phet (2010), Kiela (2011), Nanauk and Nelofar (2014). According to the fishermen, these cyclones caused extensive damages especially in Keti bunder and wiped human settlements more than 3 times in the recent past. Despite massive losses of lives and livestock the fishing boats were also damaged and severely disturbed the livelihood of the major fishing community of the Thatta. Half of the million people were affected by Cyclone Yemen (1999) which claimed more than 200 lives, 40177 animals perished, destroyed 400 health and education facilities in Thatta, Badin and Karachi (DDMA, 2017). Since 1984, Thatta and Sujawal experienced 24 mega and flash floods and severely impacted by the flood in 2010 and 2011 (DDMA, 2017). According to the Damage and Needs Assessment (DNA) report 2011, almost 9.6 million people have been affected in Sindh during the 2010 flood. As shown in Fig.7 the major damages occur in agriculture, livestock and fisheries constituting a damage cost of Rs.160,107billion (US$ 1840.31) followed by housing, economy and infrastructure. The total damage cost amounts of Rs. 324,533 billion (US$ 3730 million). In Thatta 0.21 million households and 0.28 million acres of cultivated land were affected during the 2010-2011 flooding (FAO, 2011). According to the farmers and data collected from the district government, main flood damages occur in cotton crops (84%) followed by rice (65%), sugarcane (26%) and other crops (78%).

From 1997 to 2002 the area experienced dreadful drought incantations where rainfall was exceptionally low and agricultural productivity was badly hampered. The last drought continued till the year 2002 and affected more than 1.3 million people, 5.6 million cattle heads and 12.5 million acres cultivated area (DDMA, 2017). Most of the farmers blamed that seawater intrusion and the emergence of new plant diseases are also consequences of drought which further decrease crop productivity. The drought period not only produced food shortages but also cause involuntary displacement of the people from Thatta.

Fig. 2. Map of Coastal Districts of Thatta and Sujawal.

Adaptive Capacity

Adaptation to Climate Change: During a field visit it was observed that owing to drastic climatic exposures and low adaptive capacity most of the farmers left their profession and shift towards fishing, labor and logging. Some of them adopted scarce water environments and started cultivation of water-resistant crops like maize and sunflower to make some profit and continue their livelihoods.

The progression of seawater towards fertile agricultural land exacerbates the soil salinity problem and degrades 80% of the land (DDMP, 2017). Further emergence of new plant diseases also forced farmers to grow less profitable crops like tomatoes and chilies instead of wheat, rice and sugarcane that are more prone to vectors and occupy a large area for their cultivation. The degradation of grazing grounds created the livestock population more vulnerable in the study region. As the capacity for adaptation of large animals like cattle, camel and buffalo is very low therefore farmers move towards goats and sheep that can survive on sparse vegetation. Moreover, shifting from farming to fishing creates havoc and overexploitation of fisheries. Fishermen traveled far distances to get the maximum fish catch. This is a typical situation of maladaptation in the study area. Furthermore, according to the key informants, adaptation mechanisms of villagers are also developed through indebtedness, retailing milk and animals and craft creation from women.

Generic Adaptive Capacity: Pakistan's HDI remained constant between 2009 and 2015; NHDR 2017 indicates a steady increase in human growth from 0.6 to 0.7 for the same period. As shown in Table 2, Sindh is categorized in HDI status of medium level of human development (HDI Sindh 0.6) while Thatta and Sujawal lie in a low human development category (HDI Thatta 0.4 and Sujawal 0.3). During the survey, the majority of respondents were illiterate, belonging to the extreme coastal Tehsils of Jati, Ghorabari, Shah

Bander, Keti Bander and Kharochan. Most of the respondents claimed that aftermath of recent floods their livelihood has badly hampered. They can hardly afford two meals a day, therefore they prefer their children to work rather than to take schooling. The Education Index for both districts is 0.3 (Fig.8) where an expected year of schooling is 5-6 years and the mean year of schooling is 2-3 years. The number of schools and the total enrolment of primary schools in both districts decreased (DSS, 2017).

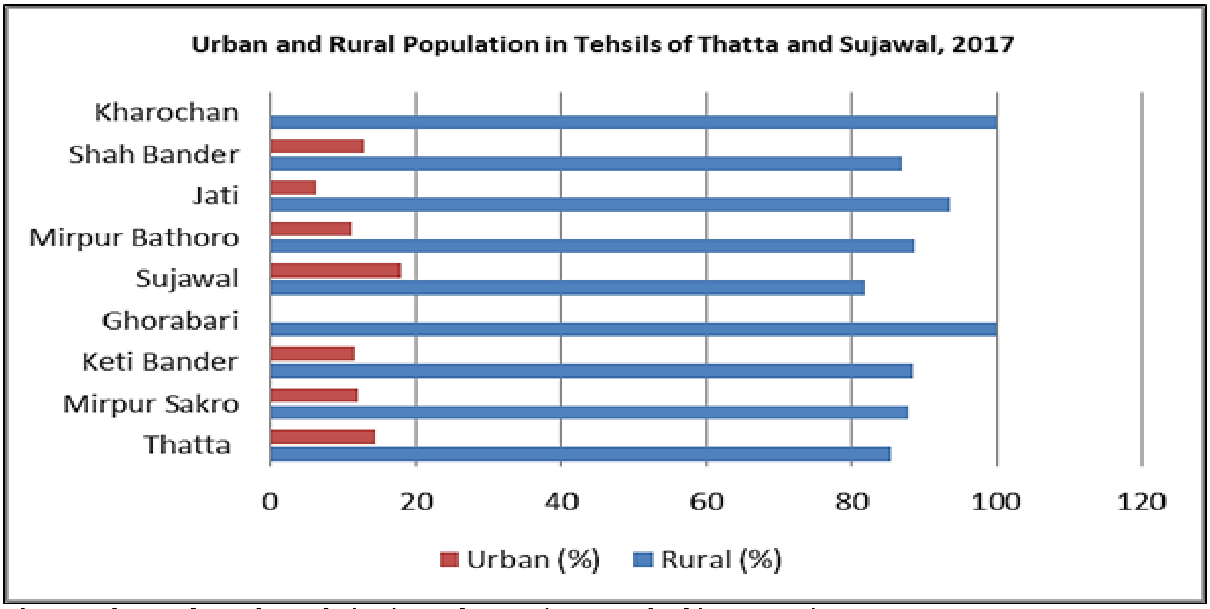

Fig. 3. Urban and Rural Population in Study Area (Census of Pakistan, 2017).

The low education Index and loss in facilities are a significant sign of a poor adaptive potential for awareness and decision-making. Similarly, due to food scarcity and poverty, the health of the community also compromised and half of the population especially children (5 Years Age) in these regions were observed as malnourished. The Health Index value for Thatta and Sujawal is 0.6 and 0.5 respectively (Fig.8) where the Immunization rate of children between the ages of 12-23 months is 47-50% and 26-39% of household did not use healthcare facility due to high cost, limited resources and facilities (Table 2).

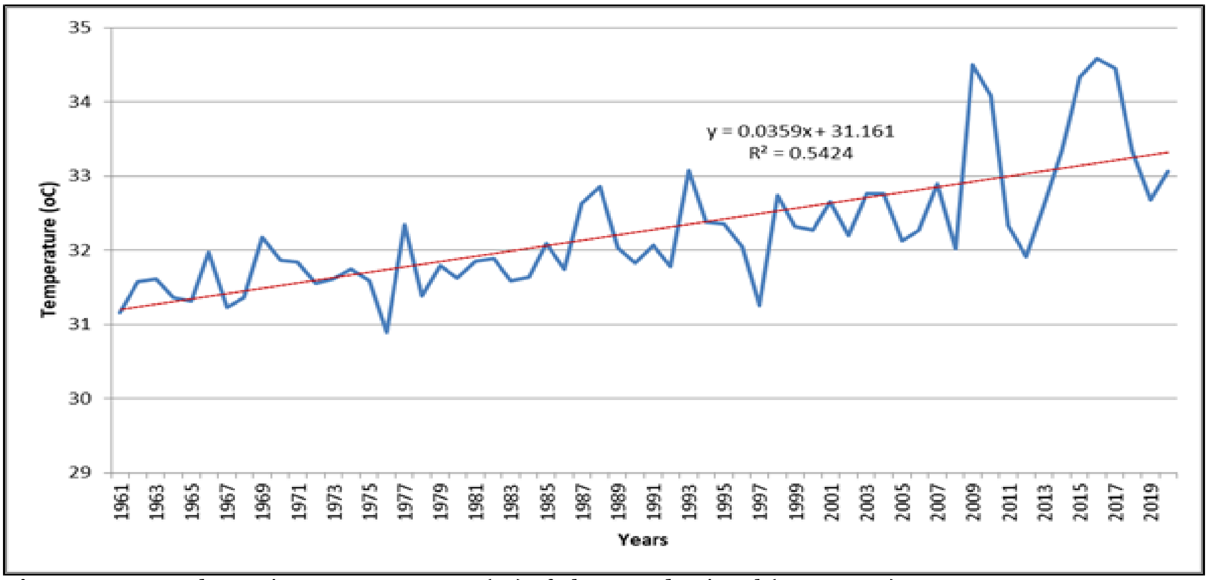

Fig. 4. Mean Yearly Maximum Temperature (°C) of Thatta and Sujawal (1961-2020).

According to the respondents, the facilities are adequate, but the availability of supplies and staff is not sufficient and in case of chronic emergency people rush to the central hospitals of Hyderabad and Karachi. Increased temperatures in summer and heat waves are significant challenges for heat-specific death and a troubling increase in vector-based pathogens (Alamgir *et al.,* 2015c).

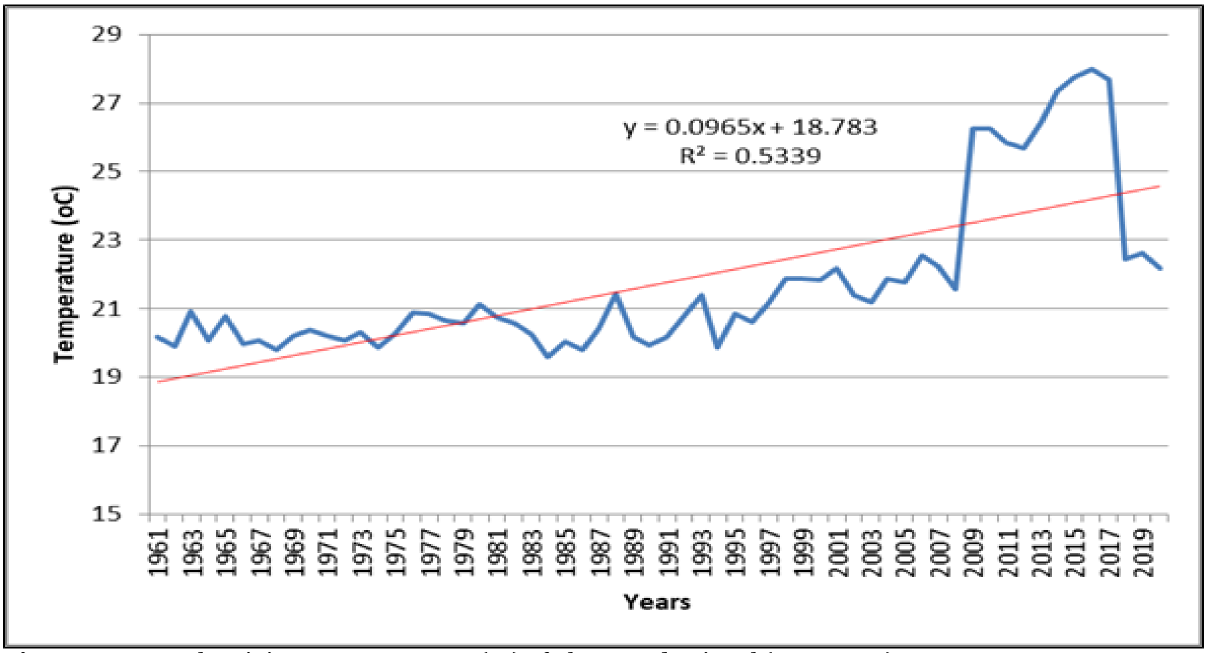

Fig. 5. Mean Yearly Minimum Temperature (°C) of Thatta and Sujawal (1961-2020).

The Living Standard Index (LSI) of Thatta and Sujawal is 0.3 and 0.2 respectively (Table 2). The area is considered as a low profile region with 0.4 MPI (NHDR, 2017). Fig.9 shows the contribution of deprivation of education, health and standard of living to overall poverty in Thatta and Sujawal is more the 40%. Around 31% of households in the districts have piped water services particularly confined to an urban coastal region (PSLM, 2015). In rural region communities still relies on the traditional methods to harvest freshwater in the form of dug wells. Moreover, only 36.6% in Thatta and 41.4% in Sujawal, the household population living with improved sanitation facilities while 49-55% has open defecation facilities (MICS, 2014). The Infrastructure of both coastal districts is inadequate to overcome the future climate induced disasters. It was found that electricity is practically non-existent in rural areas and only available in 70% of the urban region. The primary source of energy for cooking is natural gas and firewood also used in some of the villages. Income and Livelihood Strategies: Agriculture, fishing and livestock rearing are the primary livelihoods of the coastal region population (Alamgir., 2015a; SCDA, 2012). While 61.7% of the population does not have a secondary occupation and the largest proportion of the population is engaged in logging (World Bank, 2005). Women also contribute to the production of revenue, and 36% of women play their role as day-to-day wages, while 34% have agriculture as their secondary source of income (SCDA, 2012). According to 90% of the respondents, their monthly income is between Rs.5000-15,000 and debt is very common in local areas. The money lent (indebt Rs. 25,000 to Rs. 50,000/family/year with 2-4% interest rate) is primarily used for the procurement of crops, manure, and employ of tractors or weddings. Since they are not capable to return the debt therefore they remain indebtedness during their entire lives which makes them more vulnerable and less resilient.

Socio-Political Network (SPN): The socio-political network (SPN) and poor governance are the two main indicators that are identified as the main obstacles to adaptation that exists in the region. The governance in the region is mainly divided into two types, the formal group (federal and provincial governments) and the informal ruling elite (landlords, industrialists, businessmen and religious leaders). At the regional and provincial level, the federal government has a weak role and most of the decisions are taken with the consent of a former group. According to the respondents, the ruling elite has access to major of the resources as compared to the local population.

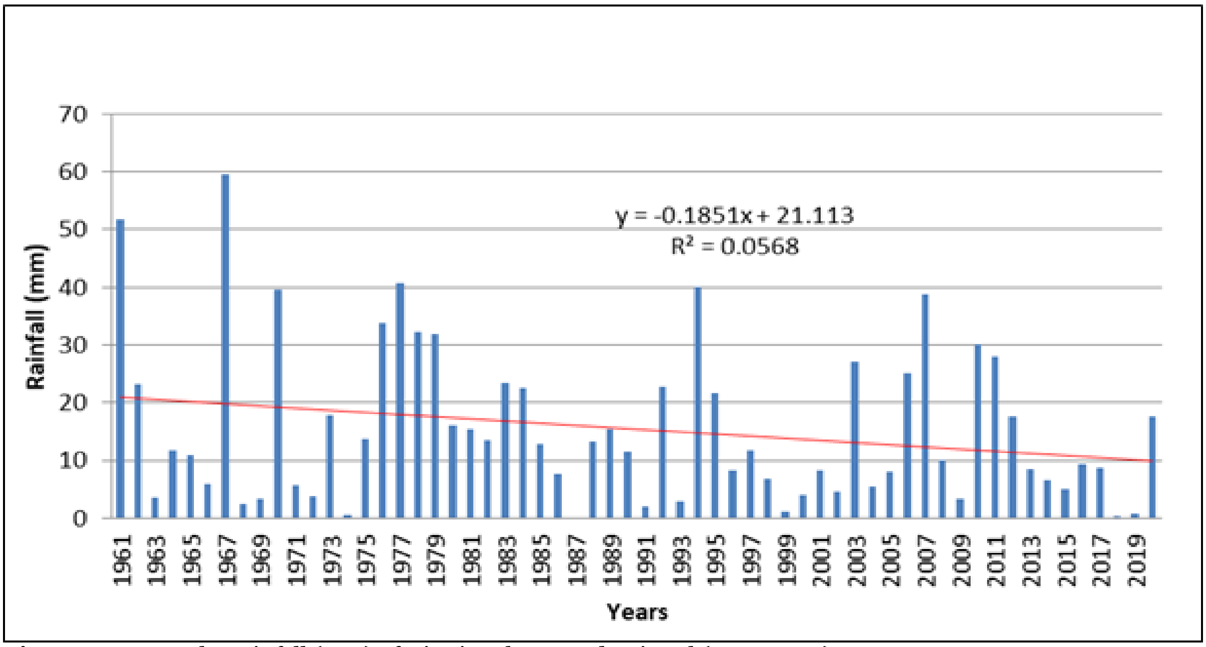

Fig. 6. Mean Yearly Rainfall (mm) of District Thatta and Sujawal (1961-2020).

In the existing system of slack government, land ownership reduces the collective resilience of the community when the land is now owned by larger landowners and the poor cannot move against the permission of the landowner. As a consequence, villagers are not able to raise the question and request their rights from their landlords. This presents a significant obstacle not only to international agencies who wish to work through the proper channel but also to those who do not have vertical responsibility and transparency. Legitimate, participating and transparent models of government are important to reduce the likelihood of conflict and improve the capacity to adapt (Janani *et al.*, 2014).

Climate Change, Resource Scarcity and Conflicts in the Study Region

As discussed in the above sections, climate change would affect all socioeconomic sectors of the vulnerable region and produce critical consequences. During field visits, it has been found that due to resource scarcity and livelihood shifts, those consequences have a high potential for breeding conflict in the study region. The matrix of Table 3 describes the linkages between climate change and conflicts among farmers, fishermen and pastoralists in the coastal region. One such linkage identified is the risk of direct conflict over access to or control of scarce water, land and fish resources.

Due to climate change and upstream water diversion, the flow reaches the Indus delta and remained only 2467 m^3 throughout of the year (Abbasi, 2002). To maintain the Indus deltaic system at least 3304 m^3 of water should be released downstream (IUCN, 2004). As a result the hydraulic flow of the River Indus remarkably decreased in the study region, which lies at the extreme lower riparian region. During the field visit, it was observed that most of the canal water flow has reduced for the irrigation system. To overcome the situation landlord divert the remaining canal water through motorized pumps towards their agricultural land and local farmers remain unhanded for their agricultural activity. This creates conflicts between farmers and landlords over access to or control of scarce surface water resources.

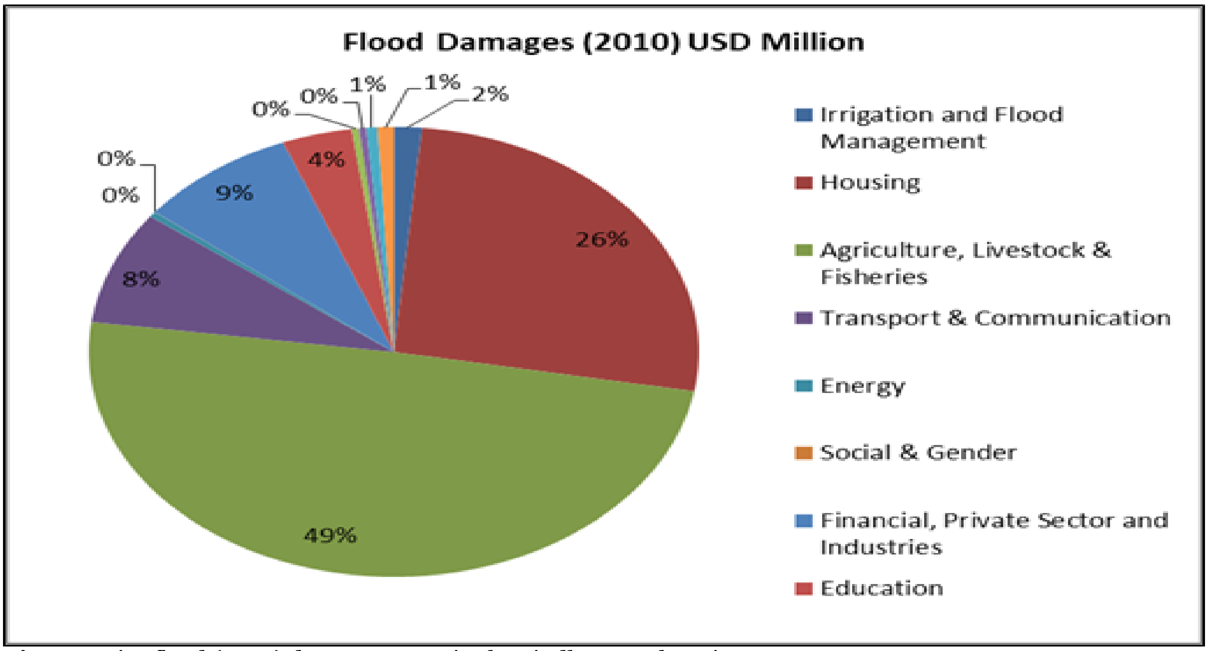

Fig. 7. Major flood (2010) damages occur in the Sindh Coastal Region.

According to most of the villagers, the only available water resource in the region remained groundwater which was already in a declining phase owing to upsurge salinity. Overexploitation of which decreases groundwater level evolving conflicts over the indiscriminate use of groundwater between poor and middle-income villagers.

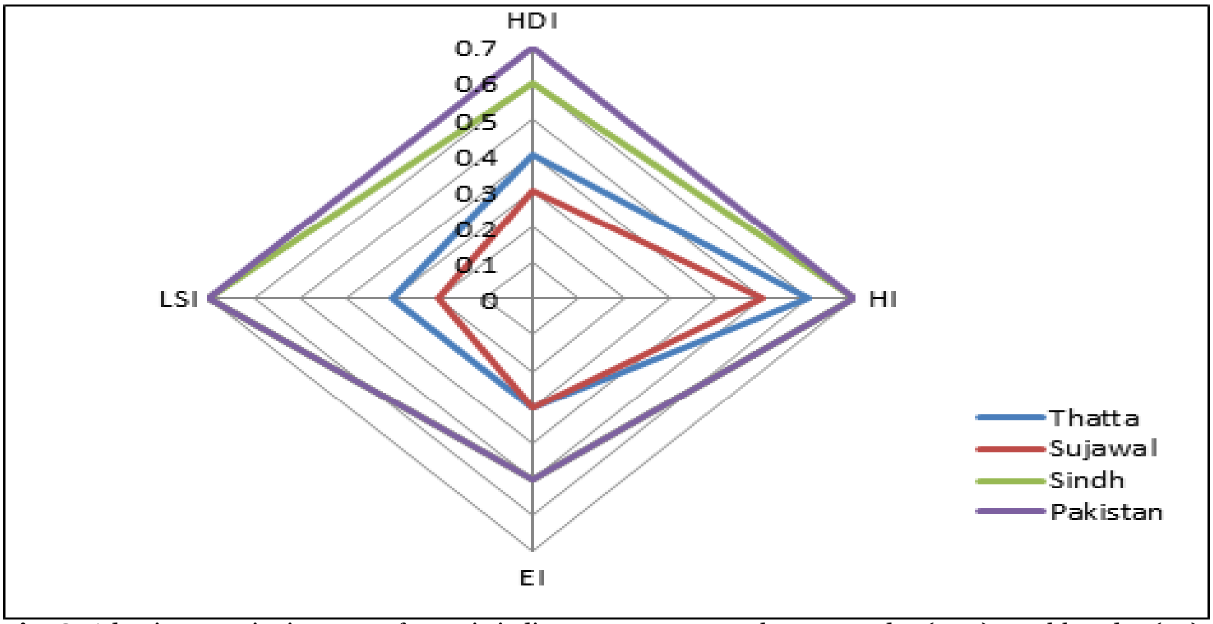

Fig. 8. Adaptive capacity in terms of generic indicators: Human Development Index (HDI), Health Index (HI), Education Index (EI) and Living Standard Index (LSI).

The current River Indus flow is also not sufficient to push the seawater at its original position as result seawater intruded up to 54 Km inland on regions nearby Indus River (IUCN, 2003), 80 km upstream in the canal system and 150 km from the river mouth up to Thatta-Sujawal Bridge upsetting 567,000 hectares of formerly fertile land (SIDA 2013). During the field survey, many exhibits of sea intrusion near land have witnessed. Land degradation and low crop productivity forced many of the farmers especially from Jatt community to shift their livelihood to fishing. This connects direct linkage of conflicts over fisheries between old and newly formed fishermen. As a result of completing each other, the communities overexploited the fish resources. On the other hand, recent floods also forced landless and shelterless farmers into debt cycles which they cannot refund throughout their entire life. As a result, another conflict is also prevailing between money lenders and poor farmer communities.

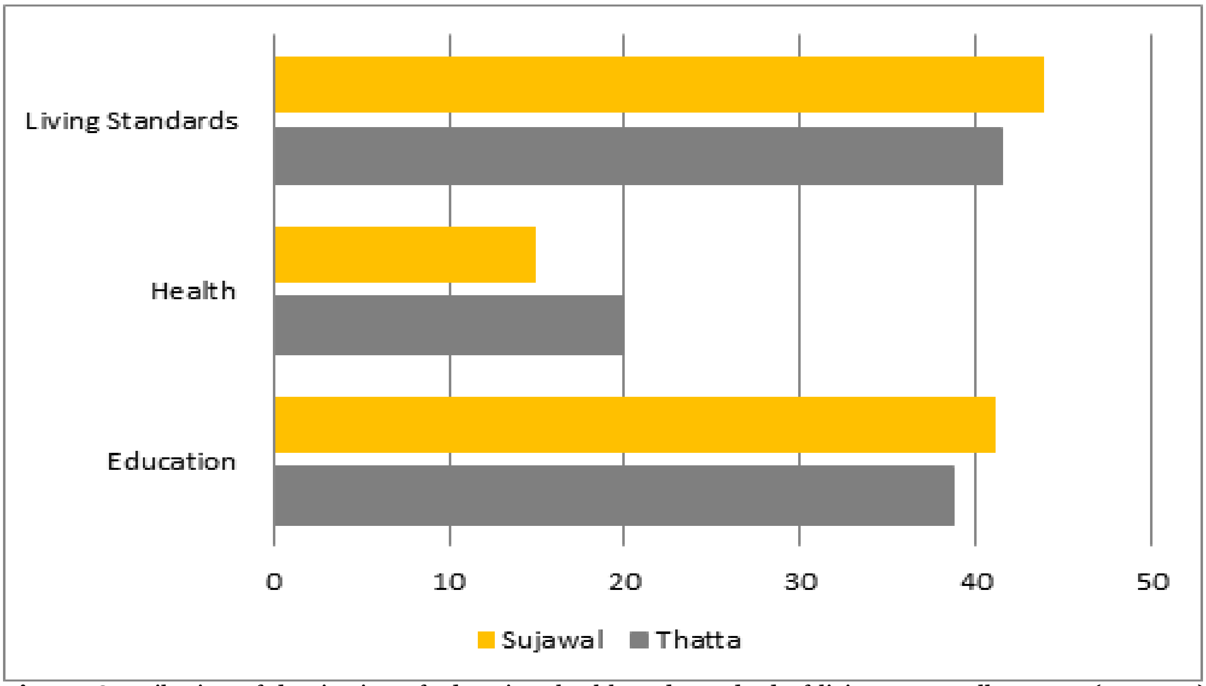

Fig. 9. Contribution of deprivation of education, health and standard of living to overall poverty (MPI=0.4) (NHDR, 2017).

Another conflict linkage is identified among different pastoralists over grazing land and pastures. Since most of the grazing land is owned by influential tribes who do not allow the herders of another tribe to graze their animals on their land consequently breeds conflict among herders and farmers. Since livestock is an important source of income thus the further reduction in pastures due to climate change will exacerbate the prevailing conflicts in the study region.

Climate change also damaged most of the habitat in the coastal region. Habitat destruction reduces a source of the tourist trade that provides the advantage to the local population for mitigating poverty. According to the key Informants, landlords also allow their land for illegal hunting with a substantial cost without taking prior permission from the government agencies. This also aggravates the species reduction and breeding conflict between locals, conservatives and landlords. Moreover, villagers also started illegal felling and brutal cutting of the riverine mangroves species to satisfy the demand for fuelwood and for commercial purposes to produce business. In the absence of poor governance, the overexploitation of indigenous species reduced the natural buffer zones to prevent inundation (White, 2011) and also breeding conflicts among locals over the destitution of natural resources.

Conclusion

This study envisaged that the coastal communities of districts of Thatta and Sujawal are highly vulnerable to climate change. The region is exposed to all types of climate variations and their sensitivities. An increase in temperature and erratic rainfall patterns frequently increase the probability and durability of droughts, floods, cyclones and seawater intrusion. This is due to the regional sensitivity to exposures since the major community's livelihood depends on rain-fed agriculture and lived in a poor setting. In terms of adaptive capacity, the districts are characterized as low human development regions where education, health and living standards of the community are inadequate. Besides weak infrastructure, the other weakness to adaptive capacity is the high influence of the political factors, poor governance system, uncertain roles of the stakeholders and informal ruling elite. Climate change increases overall stress on resources, human insecurity and societal instability. Political factors further prevent effective resource utilization, making an unrest situation in the communities having the potential to breed conflicts among vulnerable communities. The direct linkages are identified between climate change and conflicts over scarce water, land and fish resources. The only way forward to build harmony and making peace opportunities is to implement resilience and climate change adaptation policies focusing on political growth and capacity building of the governance at the grass-root level in the context of a local government structure. Further, a conflict-sensitive approach should be applied to build climate change mitigation and adaptation measures to reduce the risk of breeding further local conflicts.

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