

## EFFECTS OF CLIMATE CHANGE ON HEALTH AND EDUCATION OF COASTAL COMMUNITIES OF SINDH PROVINCE IN PAKISTAN.

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### ABSTRACT

Climate change is a serious challenge in developing world especially for vulnerable communities. Climate Change has affected Coastal areas bordering the Arabian Sea and Indus River in Sindh. This study has been conducted to assess the climate change effects on the socio-economic conditions, education and health of the people living in the coastal areas of Sindh province in Pakistan. This quantitative research conducted through a survey method in the coastal districts of Thatta and Badin in Sindh. A total of 224 participants were selected through multi-stage sampling method in initial phase but among them 200 participant agreed to participate in the survey. This study noted major climate change events like excessive heatwaves, abrupt rain pattern, frequent floods, rising sea levels and increasing soil erosion and salinity in the area in recent five to ten years. This study has noted significant impact of climate change on livelihood of people and increased the migration and displacement of the population in the area. According to the survey results the health and education of the local population have been affected at large by the climate change and people are facing various challenges due to changing climate in the region. In this scenario, this study suggests to make robust policies and strategies for resilient infrastructure, enhancing disaster preparedness and improving health and education facilities in the coastal areas of Sindh province of Pakistan.

**Key words:** Socio-economic conditions, Coastal Communities, Climate change, Education.

### INTRODUCTION

Global climate change and its spread have become a major challenge for the life of people on the earth. The main cause of climate change is generally attributed to the increase in global temperature. In Pakistan, changing climate has serious impacts such as: reducing agriculture production, water scarcity, coastal erosion and seawater invasion, and increased extreme climate events. According to German Watch, Pakistan has been ranked among the top ten countries most affected by climate change globally for the last two decades due to its

location. According to the 2020 annual report of the Global Climate Risk Index, between 1999 and 2018, Pakistan lost 0.53 percent of its GDP, suffered economic losses of US\$ 3792.52 million, and experienced more than hundreds extreme weather events (David et al., 2020).

Many countries including Pakistan, are at risk of being affected by the shocking effects of climate change. (Pachauri et al., 2014). Pakistan's coastline is 1,050 km long, divided by the Arabian Sea between Sindh and Baluchistan. The coastal areas of Sindh,

including the Indus Delta, extend for 350 km and include Thatta, Sajawal, and Badin districts (Majeed et al. 2010; Magsi & Sheikh, 2017). During last decade the people of the coastal region in the Sindh province are facing variety of challenges of climate change and its affiliated impacts. There are rare studies on assessments of climate change and its impact on the lives of the people in the region. At the same time the Sindh needs to enhance the capacity to deal with such severe climate change events in future. In that sense, there can be slow growth towards achievement of Sustainable Development Goals (SDGs) in the province (Guriro et al., 2019).

The people living in the Indus delta are vulnerable communities who are the direct victims of climate change in the region. This study has been conducted in the region that falls under the Indus Delta. Coastal communities in this region face the hostile effects of climate change-related events on their lifestyle and livelihood.

#### Literature Review

Climate change can be defined as the long-term changes in the temperature and weather conditions of an area. Its main impacts include unpredictable weather conditions, melting of glaciers, and rise in sea levels, which are being felt significantly both globally and locally (Lipczynska-Kochany 2018; Michel et al. 2021; Murshed and Dao 2020). Previous studies in different countries have shown that coastal communities have faced several problems due to severe environmental changes resulting from sea level rise and seawater intrusion. A study conducted in Vietnam found that climate change has led to coastal land loss, flooding, and increased coastal erosion due to sea level rise (Nguyen, 2021). Another study in Bangladesh highlighted the serious effects of seawater intrusion, including increased land salinity and a significant reduction in the economic resources of coastal populations (Waqas et al., 2021). Agricultural and fisheries sectors are severely affected by flood water infiltration, disturbance in river flow, reduction in rainfall, and other factors (Mansur et al., 2005). Socio-economic development is

essential, but unfortunately, governments have neglected this aspect, especially in regions affected by climate change (Hasan, 2009). The impacts of climate change have profoundly affected socioeconomic indicators of health, education, and other public services (Bradley & Corwyn, 2002). Coastal populations, which depend on agriculture or fishing, are at severe risk from climate change hazards, including sea-level rise and seawater intrusion (Salik et al., 2015). Any significant impact of global climate change will impact local agriculture, which in turn may affect food production and supply. Forecasting the future of agriculture in a changing environment has become a controversial and important topic, which could have significant impacts on global food supply and demand (Abildtrup et al., 2006). A study compared the health challenges of urban and rural populations and found that the impact of environmental disasters is more severe in rural Sindh, largely due to inadequate vaccination, which causes major health problems in rural areas. (Masood, T., Guriro, S., & Mehraj, J., 2020). The Indus River, an important source of livelihood for agriculture and fisheries in the delta region, currently provides limited freshwater supplies to the Arabian Sea. Diversion of water through a series of dams and canals at the source has significantly reduced the water flow below Kotri. Freshwater scarcity has severely damaged the delta's ecosystems and economic resources. It is estimated that about 1.2 million hectares of fertile land have either been eroded or become uncultivable, mainly due to sea level rise (Khan et al., 2002). Coastal areas are considered important economic zones, where socioeconomic activities are largely concentrated. Seawater intrusion has had a profound impact on communities living along the coastline. Over the past fifty years, climate change has increased the intensity and frequency of cyclones, resulting in significant economic impacts on the coastal areas of Sindh, including the districts of Karachi, Badin, and Thatta (S. A., Guriro, S., & Lakho, M. K. 2021).

According to Chandio et al. (2011), a survey by the Board of Revenue shows that more

than 1.2 million acres of land in the Indus River Delta are seriously threatened by seawater intrusion. Badin and Thatta districts of Sindh are particularly affected by this environmental crisis. This issue is highlighted in research titled "Economic Impacts of Floodwater Infiltration on Livelihoods of Coastal Communities in Sindh Region, Pakistan" published in Volume VI, Issue I (Winter 2021), the number of people affected by this effect is 447, who are major victims of this crisis. Eight subdivisions of their coastline are almost entirely under threat. In the present situation, about 5,50,000 acres of fertile land in both districts have been affected by seawater erosion (Memon, 2016). About 10 percent of Pakistan's population lives in coastal areas, of which 20 percent are developed. About 40 percent of Pakistan's industry is near or on the coast. If sudden climate changes occur, saving this important population will become a serious problem (Rabbani et al., 2008). Climate change is a major threat to agricultural production in countries more sensitive to climate impacts. A study estimated the effect of climate change on the production of eight important crops in Africa and South Asia, using a detailed analysis and meta-analysis of data from 52 different studies. The results of that study showed that the average yield of all crops expected to decline by the middle of the 21st century. In South Asia, evidence of climate change impacts on crop yields is evident for sorghum, maize, wheat, and millet (Knox et al., 2012). Continuous drainage of greenhouse gas (GHG) in the layers of our atmosphere closer to the earth's surface due to fossil fuel combustion and other human activities leads to disasters in the climate vulnerable areas and regions (Balsalobre-Lorente et al. 2022; Usman et al. 2022b; Abbass et al. 2021a; Ishikawa-Ishiwata and Furuya 2022). A study conducted to observe the abrupt sea-level rise has been found to reduce mangrove forests, resulting in increased water salinity and reduced mangrove forests, leading to a decline in fishing activities in affected areas. (Mendenhall et al., 2020). Climate change impacts, according to various research models and hypotheses, may cause changes in

primary performance, changes in mobility, and potential abundance reduction of highly preyed-upon marine species (Jagrani et al., 2016). Scientific research makes it clear that to mitigate the effects of climate change, it is necessary to manage it and implement appropriate mitigation measures (Somilla et al., 2011). Fishing and climate change are closely related, as fishing reduces age, size, and geographic diversity, which also affects marine biodiversity and makes both more susceptible to climate change. Inland fisheries are also affected by changes in rainfall and water availability. Extreme weather events are likely to increase in intensity and frequency, which will significantly impact both inland and marine fisheries systems in the future. Reducing prey mortality in most fisheries systems, which are prone to overfishing or overexploitation, is an effective way to mitigate the impacts of climate change on fisheries (Branders, 2007). Although the exact details of the impact of climate change and the resulting changes on fisheries and fish species are unclear, the economic pressures and limited development opportunities in countries that rely on fisheries are clear (Allison et al., 2009). Fisheries will face a variety of direct environmental impacts, including the evacuation and relocation of human populations and settlements; the effects of sea level rise on coastal communities; and changes in the intensity, distribution, or frequency of storms (Daw et al., 2009). It has been seen in this study that seawater encroachment in the coastal belt of Sindh has impacted the production of domestic animals and businesses. Because of the high concentration of salt water, the quantity of domesticated animals has been reduced, and owners sold it to meet their day-to-day requirements. (Jagirani et al., 2021). For some families, opportunities may arise to take advantage of increasingly favourable pasture and agricultural conditions. It has been established so far that climate change has had a profound impact on livestock production and livestock systems in developing countries (Thornton et al., 2009). Environmental uncertainty has threatened agricultural production in Pakistan's coastal regions, as

noted in a study on the effects of climate change, which identified negative impacts on cereal crops such as maize (Mahmuduzzaman et al., 2014). The results of a study in this regard have provided more details about the socio-economic condition of the people of the Indus Delta region, which is being affected by seawater intrusion. The study revealed that 52% of the people in the two coastal districts of Thatta and Badin have lost their land. Hejamaru Creek, located near Ketī Bandar, is facing a critical situation due to the lack of fresh water in the Indus River, which has increased the risk of erosion. Ketī Bandar was known as a harbour in the past, but human activities there are now limited to fishing. If immediate steps are not taken, the time is not far when the natives of Hejamaru Creek will be forced to relocate elsewhere (Memon, 2005). Recent studies highlighted the impact of Ongoing climate change on the physical health of individuals and found it as one of the major causes of health challenges such as the most dangerous disease 'COVID-19' that has affected the world's socio-economic and health conditions (Abbass et al. 2022). Another study has revealed the relationship between climate change and its impacts on the health and education of the affected people that global weather has a great influence by continuous environmental changes that result in extreme flood, drought, and intrusion of rainwater into coastal areas (Pasquier et al., 2020).

### Material and Method

This study was conducted in selected districts of the coastal areas i.e. Badin and Thatta in Sindh province. This socioeconomic study conducted by a survey method and participants were selected multistage sampling technique. Initially, 20 villages in 8 dehs of a union council in the coastal areas of Badin and Thatta were selected. At first stage 224 participants were selected but data analysis includes 200 agreed participant in the selected union councils of Badin and Thatta districts In this process, heads of households were contacted to participate in

the survey to assess the socio-economic conditions, analyze the climate change and its impact on the health, and education. Data was analyzed through the statistical software SPSS (Statistical Tools for Social Sciences) version 22.

### Results and Discussion

First, a descriptive analysis was conducted to determine the frequency and percentage of responses received from the participants on their socio-economic conditions. The climate change impacts on health and education were analyzed through using multivariate regression models.

### DESCRIPT ANALYSIS

There are different climate events which are responsible to affect the life and health of the coastal communities including rising temperature levels, heat waves, air pollution, wild fires, precipitation patterns, changing agriculture systems, rising sea levels, coastal erosion, and others. We focused on very few which are most common in the study area and can be easily identified by the majority of the population. The main reason of focusing and selecting these major climate change variables was the nature of this socio-economic survey which was conducted on the people perception about these climate change events. The other environmental factors could be included in the study but due to technical reasons it was not possible during the survey in the study area. Table 1 provides the data about the climate change variables in the study area. The all participated were asked about the climate change observations during the last 05 years. As per the statements of participants 94% participants observed excessive heat waves in the last five years. 75 percent of the participants were reported abrupt rains in the area. The rising sea levels and salt water intrusion was reported by 90% of the participants. The total of 87 percent of the participant also observed the extended summer season as compared to previous trends of seasons in the region.

**Table 1 Climate Change Observed by the study participants in the last 05 years**

VARIABLES	FREQUENCY	PERCENTAGE
<b>HEATWAVES</b>		
YES	188	94
NO	12	06
<b>ABRUPT RAINS</b>		
YES	150	75
NO	50	25
<b>RISING SEA LEVELS AND SALT WATER INTRUSION</b>		
YES	180	90
NO	20	10
<b>EXTENDED SUMMER SEASON</b>		
YES	175	87
NO	22	13

**Demographic characteristics of the study participants:**

The study participants were consisted of different age groups and source of income. Most of the study participants were young adults. The majority of the population was

illiterate and engaged in the traditional agriculture and fishing activities in the study area. Table 2 provides the detailed information about the demographic characteristics of the participants.

**Table 2 Demographic and socio-economic characteristics of the study participants**

VARIABLES	FREQUENCY	PERCENTAGE
<b>AGE</b>		
18-39	77	38.5
40-60	69	34.5
61 AND ABOVE	54	27
<b>EDUCATION</b>		
Illiterate	146	72
Primary Education	40	20
Secondary Education	14	08
<b>FAMILY SIZE</b>		
06 MEMBERS	93	46.5
ABOVE 06	107	53.5
<b>SOURCES OF INCOME</b>		
Agriculture and Livestock Farming	138	55.5
Fishing	75	37.5
Daily wage workers	14	7.0
<b>CLEAN DRINKING WATER FACILITY</b>		
YES	63	31.5
NO	137	68.5
<b>HOUSE CONDITIONS</b>		
Damaged Houses	11	5.5
Partially Damaged Homes	105	52.5
Not damaged	84	42
<b>MIGRATION</b>		
Displaced	60	30
Not displaced	140	70

In this study 38 % of the participants were belonged to age group of 18-39 years and

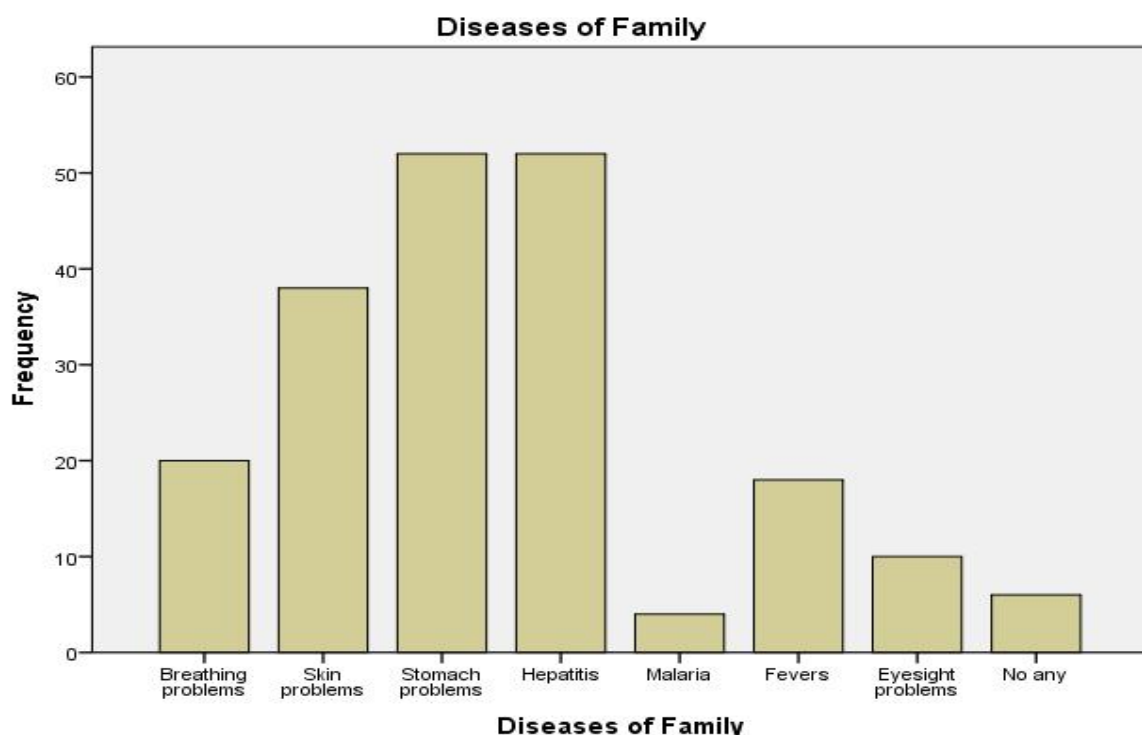
34 % were people of 40-6 years. It shows that majority of the participants were working

people as compared to 27 % participants of retired age in the survey. 46 percent families were consisted on 06 members and 53 were on more than 06 family members. While surveying the education conditions, in Table 2 it is observed that (146) 72% of the total participants are uneducated. Primary and secondary level education is observed from the responses (40) 20%, (14)8.0% of the respondents respectively. An observation of the data in Table 2 reveals that most of the participants in this study depended on agriculture and livestock farming for their livelihood, as 55.5% (138) of the participants depended on these sources. Furthermore, 37.5% (75) of the participants reported fishing as their reliable source of income, while 7.0% (14) were found to be daily wage workers. Results provided in the table also show (137) 68.5% of the participants denied access to clean drinking and (63)31.5% reported access to clean drinking water. When we asked participants about their home condition to climate change factors, they reported that more than half of the

households are damaged due salt water and people have been forced to leave their homes. This study also noted that 30 percent of the study participants were affected by displacement and migrated from one place to another in search of livelihood and safety.

#### Climate Change and Health status in study area

The data of this study reveals the impact of climate change on the health of the people of the coastal belt of Badin and Thatta districts in Sindh, the participants were surveyed if they are facing medical issues. It was found that 97% of the population reported serious sickness since the last year due to climate change. Furthermore, results show that 10% of the respondents shared that their family members are getting sickness due to breathing problems, 19% said due to Skin problems, 26% said due to Stomach problems, 26% said due to Hepatitis, 2% said due to Malaria, 9% said due to Fevers, 5% said due to Eyesight problems.



Study participants also reported child sickness but interestingly 98 percent immunization coverage reported in the area. In our study, we have found a significant association of poor health and sickness with the excessive heat, abrupt rains, soil erosion

and salinity in water. The results show that those persons who are facing sickness are more likely to be affected by the climate change variables in the study area (Table 3).

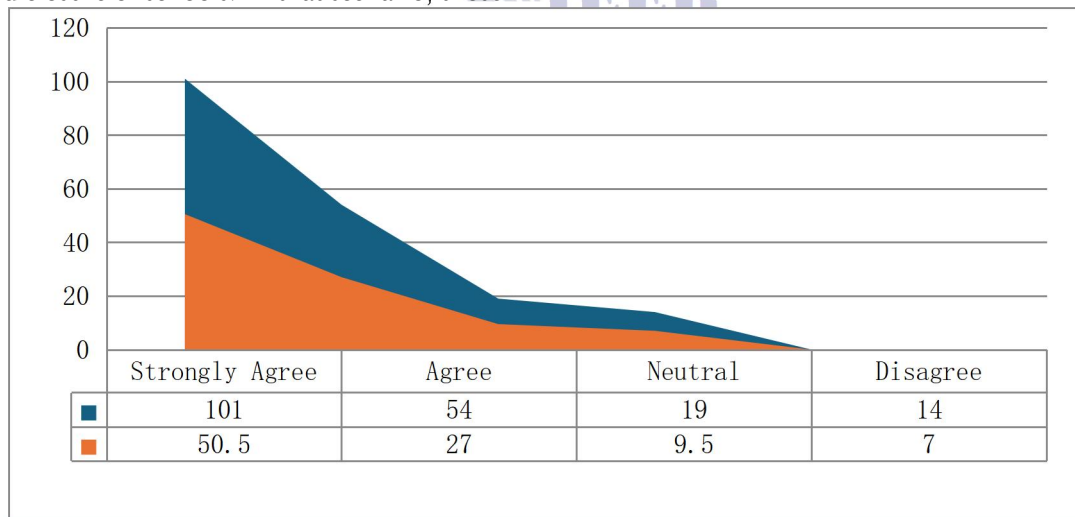
**Table 3: Multivariable logistic regression analysis showing factors associated with poor health and sickness in the study population**

Variables	B	S.E	Wald	df	Sig	Exp (B)	95 % C.I. for Exp(B)	
							Lower	Upper
Excessive Heat	-.267	.055	15.698	1	.000	.659	.680	.759
Abrupt rains	1.189	.288	17.498	1	.000	2.856	2.213	6.111
Soil erosion and Salinity in water	2.289	.298	66.388	1	.000	14.103	8.120	21.289
Constant	-.419	.519	.641	1	.411	.651		

#### Climate Change and Education in the study area

The Status of the Education of people residing in the coastal belt of Badin and Thatta districts in Sindh, is also revealed in the study; the participants were surveyed if they face the closure of schools due to climate change. It has been observed that due to climate change many schools in the study area have been shut down and not functioning properly during recent times. Previously it has been observed that the displacement in the climate change hit coastal area is the main cause of poor education situation. However, there are other factors too are responsible for low enrolment and closure of schools. In that scenario, those

factors could be included in the analysis to observe the effects of climate change on education but we focused on the closure of schools in the area which is very visible sign of climate change impact on education. There can be the variety of factors responsible of the school closures in the area including the migration of the people, shortage of the staff, damage to school infrastructure and lack of facilities in the area. Following figure provides the response of the study participants about the climate change and its impact on education. Results show that (101) 50.5% and (54) 27.0% of total participants responded strongly agree and agree on this point.



**Figure 1: Impact of Climate Change on Education in the study area**

In order to assess the impact of climate change on education we analyzed the factors of school closures in the study area. In our study, we have found a significant association

of school closures with the frequent floods, soil erosion and migration of the people in the study area (Table 3).

**Table 4: Multivariable logistic regression analysis showing factors associated with closure of schools in the study area**

Variables	B	S.E	Wald	df	Sig	Exp (B)	95 % C.I. for Exp(B)	
							Lower	Upper
Frequent floods	-.378	.066	16.709	1	.000	.760	.791	.861
Soil Erosion and Salinity in water	2.290	.399	18.509	1	.000	3.997	3.324	7.222
Migration	3.390	.309	56.499	1	.000	15.214	9.231	19.390
Constant	-.520	.621	.752	1	.525	.653		

### Conclusion

It has been observed that the coastal areas of Sindh, especially Thatta and Badin districts are highly affected by climate change in recent 5-10 years. Due to these climate change effects there are various challenges of livelihood, education and health in the coastal areas. The infrastructure has been damaged at large and people are migrating to other areas. There is an essential need of the making policies and strategies for creating resilient infrastructure, enhancing disaster preparedness and improving health and education facilities in the coastal areas of Sindh province in Pakistan.

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