



Government of Sindh
Environment, Climate Change and Coastal
Development Department
Directorate of Climate Change

Climate Change Policy – 2022

EXECUTIVE SUMMARY

Climate Change and the challenges, the world in general and Pakistan are facing, need immediate actions being a harsh reality which the humankind have to deal so that the world and the nature can be protected for our future generations...

With the evolving world words like global warming, greenhouse effect, CO₂ emission & carbon footprint, relentless use of fossil fuel, rising sea temperature resulting in rising sea levels, heatwaves, glaciers melt down at a faster pace resulting in GLOF (Glacial Lake Outburst Floods), unprecedented and extreme weather conditions, floods, and droughts, to name a few, are no more new to us. It's high time now that we should acknowledge these issues to find a way out.

As all these are impacting daily life, health, livelihood and trigger climate change induced internal migration for some as well as compromising global food security due to impact on agriculture.

Taking cognizance of the issue, the Government of Sindh has come up with a Climate Change Policy, in line with the Final Updated National Climate Change Policy 2021 to have an effective and robust response mechanism for the province.

The Government has taken initiatives for restoration of mangrove plantation, the natural carbon neutralizers and the natural flood & storm surge barriers as well as protection of Indus Delta with its rich biodiversity and adjoining coastal regions which are getting compromised with ever increasing sea intrusion other livelihood interventions. But as Climate Change, being a cross cutting subject, a dedicated policy framework is needed, encompassing development portfolio and all the line Departments of the Government to better cope up with Climate Change shocks.

Actions taken by the Government of Sindh under the Sindh Climate Change Policy-2022 would translate into mutually agreed action plan and implementation framework for the province, ensuring a better environment for the future generations and would enable the Government to help the Government of Pakistan in fulfilling its commitments under the Paris Agreement and other international commitments.

LIST OF ACRONYMS

AF	Adaptation Fund
BAU	Business As Usual
°C	Centigrade / Celsius
C3	3-carbon molecule
CBD	Convention on Biological Diversity
CBOs	Community Based Organizations
CDM	Clean Development Mechanism
CO ₂	Carbon Dioxide
CSR	Corporate Social Responsibility
DoCC	Directorate of Climate Change
ECC&CDD	Environment, Climate Change & Coastal Development Department
FAO	Food and Agriculture Organization
FCPF	Forest Carbon Partnership Facility
GCF	Global Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GER	Gross Enrolment Rates
GHG	Green House Gases
GoP	Government of Pakistan
IBAs	Important Bird and Biodiversity Areas
IFPRI	International Food Policy Research Institute
IUCN	International Union for Conservation of Nature
KPK	Khyber Pakhtunkhwa
KWSB	Karachi Water & Sewerage Board
LPG	Liquefied Petroleum Gas
MAF	Million Acre Feet
MNHSR&C	Ministry of National Health Services Regulation and Coordination
MoCC	Ministry of Climate Change
MT	Metric Ton
NbS	Nature Based Solutions
NDCs	Nationally Determined Contributions
uNDCs	updated Nationally Determined Contributions
NDMA	National Disaster Management Authority
NGOs	Non-Governmental Organizations
P&D	Planning & Development
P&DB	Planning & Development Board
P&DD	Planning & Development Department
PDHS	Pakistan Demographic and Health Survey
PDMA	Provincial Disaster Management Authority
PHED	Public Health Engineering Department
PKR	Pakistani Rupees
PMU	Project Management Unit
PSLM	Pakistan Social and Living Standard Measurement
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RUTFs	Ready to Use Therapeutic Foods

SCDA	Sindh Coastal Development Authority
SDGs	Sustainable Development Goals
SEPA	Sindh Environment Protection Agency
SFD	Sindh Forest Department
SIDA	Sindh Irrigation Development Authority
SME	Small & Medium Enterprise
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change United Nations International Children's Emergency Fund <i>now</i> United Nations
UNICEF	Children's Fund
UN-WFP	United Nations World Food Programme
WAPDA	Water & Power Development Authority
WASA	Water and Sanitation Agency
WWF	World Wide Fund for Nature
YDI	Youth Development Index
W&S	Works & Services Department

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1. INTRODUCTION

1.1 Pakistan and Global commitments in fighting Climate Change

Government of Pakistan (GoP) as a Party to the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC) and has performed its role to support the global efforts in combating climate change. Government of Pakistan submitted to UNFCCC an updated Nationally Determined Contributions (NDCs) which is inclusive and represents national consensus to accelerating the transition to net-zero and a climate-resilient economy.

Green House Gases (GHG) at National Level:

- Based on the National Green House Gases (GHG) Inventory for 2014-15, the total GHG emissions of Pakistan add up to 405 MT CO₂-equivalent.¹
- Updated GHG Inventory for 2017-18 showed a total of 489.87 MT CO₂-equivalent.²
- GHG emissions trajectory of 1603 MT CO₂-equivalent of carbon dioxide is to be achieved by 2030 as per Pakistan's updated NDC 2020-21.

Pakistan intends to set a cumulative ambitious aim of conditional and voluntary contributions of overall 50% reduction of its projected emissions by 2030, with a 15% drop below business as usual (BAU) from the country's own resources, and an additional 35% drop below BAU subject to international financial support. To reach the target, Pakistan aims to shift to 60% renewable energy, and 30% electric vehicles by 2030 and completely ban imported coal. Moreover, Pakistan seeks to expand Nature Based Solutions in Forest sector.

The Climate Change Policy by the Government of Sindh is in line with the National Climate Change Policy 2021 and the updated Nationally Determined Contributions so that Sindh shall be able to give its contribution in Climate Change and Climate Adaptation, which would help the Government of Pakistan to honour its commitments at the international forum at UNFCCC.

This Policy shall address key issues like:

- Promote renewable energy resources to reduce Green House Gases (GHG) emissions from industries
- Control emissions and effluents from the industries and transport sectors
- Encourage efficient and green transportation modes
- Reduce the aviation emissions to combat climate change
- Ensure Nature Based Solutions (NbS) to achieve mitigation and adaptation
- Steps to minimize marine pollution
- Develop resilience for the Province against Climate Change & Climate induced impacts

1.2 Geography, Location and Climate of Sindh

Being the second largest province in terms of population after Punjab and linked with Baluchistan in the west and north, Gujarat and Rajasthan of India in the southeast and east, the Runn of Kutch and the Arabian Sea in the south, Sindh has its unique and peculiar climatic scenario ranging from extreme heat in Jacobabad to desert in Tharparkar and Umerkot to hilly terrain in Jamshoro to cold and high altitude area in Gorakh Hill, Dadu to beaches and coastal areas spreading over 330 kilometers from borders of India to the borders of Balochistan. The capital of the province, Karachi is the most populous metropolis and the commercial hub of the Country. The Province of Sindh forms the lower Indus basin and covers 1,40,915 square kms of land (Government of Sindh- Official Web Portal). The geographical terrain of Sindh is extremely diverse. Sindh consists of a diverse range of landscapes including deserts, wetlands,

¹ <https://www4.unfccc.int/sites/submissions/INDC/INDC/Published%20Documents/Pakistan/1/Pak-INDC.pdf> accessed on 12-04-2022 at 1350 hours

² <https://www4.unfccc.int/sites/ndcstaging/INDC/PublishedDocuments/Pakistan%20First/Pakistan%20Updated%20NDC%202021.pdf> accessed on 12-04-2022 at 1348 hours

riverine and mangrove forests, mountains, hills, agricultural and coastal areas (Kanwal, Hussain, Siddiqui, & Yasmin, 2018).

Sindh is categorized into three climatic regions: Siro (the upper region, centered on Jacobabad), Wicholo (the middle region, centered on Hyderabad), and Lar (the lower region, centered on Karachi). The thermal equator passes through upper Sindh where the air is generally very dry. Central Sindh's temperatures are generally lower than those of upper Sindh but higher than those of lower Sindh. Dry hot days and cool nights are typical during the summer. Central Sindh's maximum temperature typically reaches 43–46°C. Lower Sindh has a damper and humid maritime climate affected by the southwestern winds in summer and north-eastern winds in winter, with lower rainfall than Central Sindh. Lower Sindh's maximum temperature reaches about 35–38°C. In the Kirthar range at 1,800 m (5,900 ft) and higher at Gorakh Hill and other peaks in Dadu District, temperatures near freezing have been recorded and brief snowfall is received in the winters.

Cotton, rice, wheat and sugarcane are the main crops produced in Sindh. Rice is by far the most important crop cultivated in Sindh as it is the only crop that can be grown in the annually inundated lands within the delta of the Indus. In Larkana, Jacobabad, Sukkur, Badin, Thatta and Dadu a great quantity of rice is cultivated. Cotton is produced mainly in Sanghar, Nawabshah, and Hyderabad. Sugarcane is another important crop which is chiefly grown in the Ghulam Mohammad Barrage zone in South. The waters around Karachi are rich with seafood and are considered to be some of the best fishing spots in the world. Surmai, pomphret, lobsters, shrimps, sharks, dolphins, crocodiles and other aquatic life especially Pallas exists in plenty in the sea as well as in the sweet waters of the Indus, Manchar, Keenjhar, Haleji and other lakes (Government of Sindh- Official Web Portal).

Due to presence of various ecosystems and landscapes, Sindh had traditionally been rich in wildlife heritage. Sindh has 1 National Park, 33 Wildlife Sanctuaries, 16 Game Reserves, 10 Ramsar Sites, 19 IBAs and 3 Eco-Regions (Rann of Kutch flooded grassland, Indus River Delta, and North Arabian Sea). However, climate change has resulted in a drastic reduction in biological diversity of Sindh (Kanwal, Hussain, Siddiqui, & Yasmin, 2018).

1.3 Social Baseline of Sindh

1.3.1 Demographic Structure and Work Status

Sindh's portion in overall population of Pakistan persists at 23%, at 47,854,510 inhabitants. Out of which 24,832,634 live in urban areas and 23,021,876 reside in rural areas. Around 52% of Sindh's inhabitants are in urban areas. Total number of male population is 24,876,186. Out of the total population 11,627,892 live in rural areas while 12,948,294 males are in urban areas. Female population's share in total population is 22,972,370. Urban share of female population is 11,880,533 and rural population of female is 11,091,837. The number of transgender population is 5,954. Out of which 3,807 are in urban areas, while 2,147 live in rural areas. The average household size of the province is 5.55. 42.76% population of the province less than 15 years of age (Population Census 2017)

The labor force participation of males in Sindh is 81.9%, as compared 14.0% of females. 78.7% males and 12.3% females above the age of 15 years are employed. 85.0% males are employed in agriculture sector, as compared to 83.1% females. The average monthly household income is PKR 39,078, while the average monthly consumption is PKR 37,504 (Pakistan Employment Trends 2018).

1.3.2 Literacy Rate

As per Pakistan Social and Living Standard Measurement (PSLM) Survey 2019-20 the literacy rate of Sindh for 10 years and above is 58% (68% male and 47% female). The Gross Enrolment

Rates (GER) at the primary level for the year 2019-20 is 71% whereas in 2014-15 it was 79%. 33% children in Sindh, aged 5-16 years, have never attended school. Youth Literacy for the age group 15-24 – 64% (73% male, 55% female) (PSLM 2019-20).

1.3.3 Health

As per Pakistan Demographic and Health Survey (PDHS) 2012-2013, the infant mortality rate of Sindh was recorded at 74 deaths per 1,000 (56 in urban and 86 in rural) live births. Whereas, the under-five mortality rate was 93 (68 in urban and 109 in rural) for 1,000 live births. Comparingly, PDHS 2017-2018 reported a slight decrease in infant mortality rate for Sindh at 60 deaths per 1,000 live births (50 in urban and 69 in rural). Similarly, the under-five mortality rate for the province is 77 deaths per 1,000 live births (urban 56 and rural 93). Additionally, only 49% of children age 12-23 months in Sindh receive basic vaccines. Only 40% women get post-natal consultations in Sindh (48% urban and 32% rural) (PSLM 2019-20).

PDHS 2017-2018 also reports diarrhea in 14.4 percent children under five in Sindh, with 17.7 percent in urban areas and 11.7 percent in rural areas. Further, 49.9% percent children in Sindh and in rural areas of Sindh 63.3% are reportedly stunted. This clearly indicates the poor status of nutritional uptake among the children and their vulnerability to water borne diseases.

1.3.4 Housing Structure and Availability of utilities

Only 80.44% housing units in Sindh have access to electricity (rural 64.85% and urban 95.39). 61.80% of houses in Sindh are made of bricks/ stones, while 22.09% of the houses are made of mud (Population census 2017).

Around 70.9% overall population of the province has access to drinking water within their residential premises, where water accessibility is greater in urban areas at 73.7% than rural areas at 67.6%. Similarly, the availability of water when required is slightly greater in urban areas at 80.2% as compared to rural areas at 78.0%.

Approximately 95% of overall households in Sindh have soap or any other cleaning agent available for handwashing whereas 47% of those households have a specific dedicated place for handwashing with soap or any other cleaning agent. 5% of households (1% in urban and 9% in rural) do not have any facility available for handwashing.

Solid waste collection and its safe disposal is an emerging challenge, especially due to the sprouting urbanization. Approximately 65% households in Sindh do not have any proper mechanism available for garbage collection whereas, municipality collects waste from approximately 28% households and approximately 8% households utilize private services for garbage collection. The absence of garbage collection system in the majority of households depicts poor solid waste management system right for collection of solid waste up to its proper disposal (PSLM 2019-20).

1.4 Climate Change in Sindh

1.4.1 Precipitation

According to the data from 1960-2010, the average precipitation of Sindh is 160mm/ year. The annual deviation depicted in the figure suggests that Sindh is a drought prone province with occasional extremes of rainfall, resulting into heavy flooding. The province has a long history of droughts, stretching over years, such as the drought periods of 1968-69, 1971-74, 1985- 87 and 1999-2002 are infamous for causing damage to crops, livestock, soil, and ecosystems, causing massive migrations and additional pressure on already limited natural resources in the affected areas of the province.

Just considering the precipitation data of Sindh over the decades, the vulnerability of the province to floods cannot be depicted. Floods were relatively uncommon in the province. The problems of floods in Sindh are mostly connected to the downstream flow of water through the

Indus River. Therefore, the focus should be directed towards the local conditions as well as the changing precipitation patterns of the Upper Indus Basin. The heavy downpour of KPK inundating the Indus Delta in 2010 and 2011 and local rainfall resulted in heavy flooding in Sindh. The adverse effects of drought conditions resulting due to lack of rainfall in the Indus Delta can be mitigated if the required water supply is maintained through canal irrigation from upstream water reservoirs.

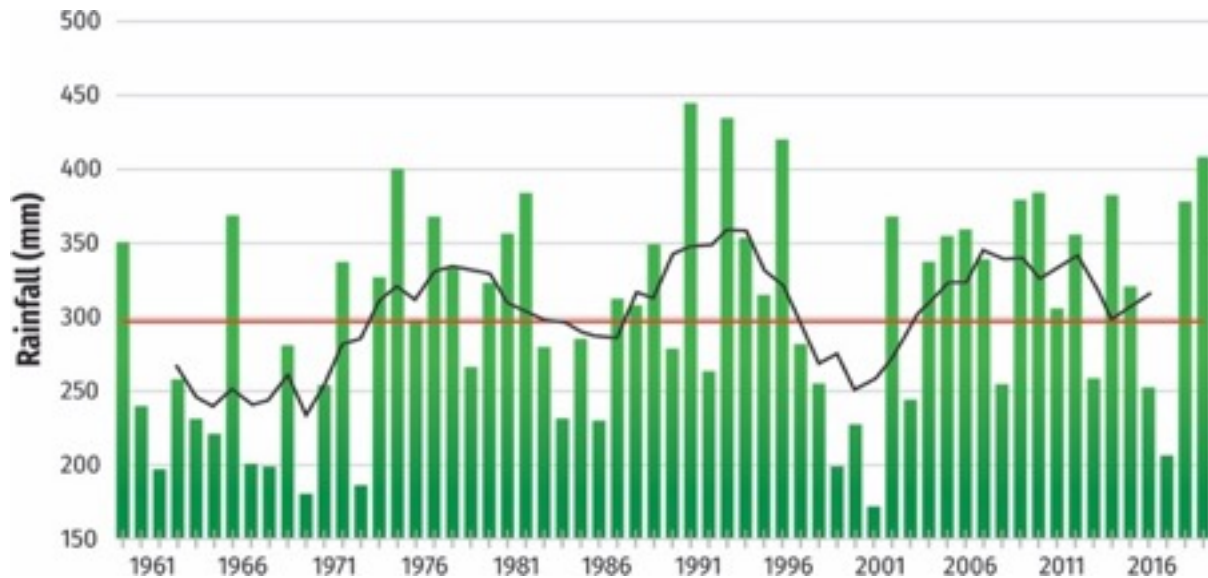


Figure 1: Variability of precipitation (mm) over Pakistan (Pakistan, 2021).³

1.4.2 Temperature

Pakistan’s temperature has warmed up considerably since 1960s. Analysis of the data from 1961-2018 reveals that annual mean temperature of the country has risen by over 0.74°C, much greater than the rise in temperature across the globe. This rise in temperature is apparent over almost the entire country and is greater over major parts of south-eastern and southwestern Sindh, Balochistan and eastern parts of Punjab. Overall, annual hot days have increased by 14 days while annual cold nights have decreased by two days. The number of annual hot days have increased by 10 days in Karachi.

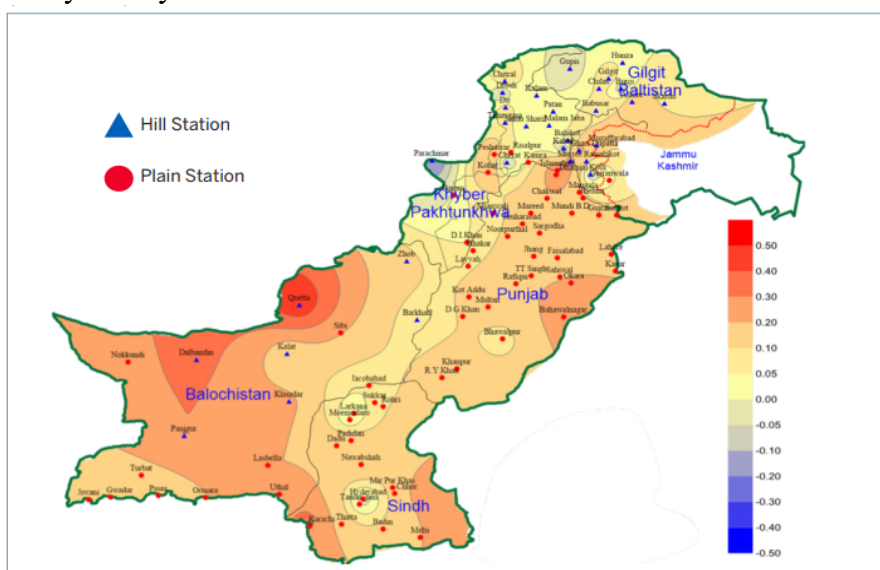


Figure 2: Spatial distribution of mean annual temperature trends, 1961 to 2018 (°C/decade)⁴

³ Source: <https://www.inp.net.pk/rainwater-harvesting-is-solution-to-avert-water-crisis/> accessed on 12-05-2022 at 1215 hours

⁴ (Arif, Riaz, Faisal, Khattak, & Sathar, 2019)

1.4.3 Climate Projections for Sindh

Precipitation Projections for Indus Delta:

Due to high temperatures and low elevations, the amount and time of precipitation is important for the dwellers of Indus Delta. Future projections estimate higher rainfall in Sindh than normal patterns during the monsoon season. The projections also indicate that the rainy season in the province might extend towards autumn. This can prove to be a challenge for wheat cultivators as wet season will not allow the soil to dry, which is essential for sowing of seeds. Both excessive and insufficient water will prove to be a challenge for the food security in the province. The excessive water will pose a threat to agriculture due to rise in water table, degrading the drainage capacity of the soil and increasing water logging and salinity. Whereas the decrease in water will result in drought like conditions.

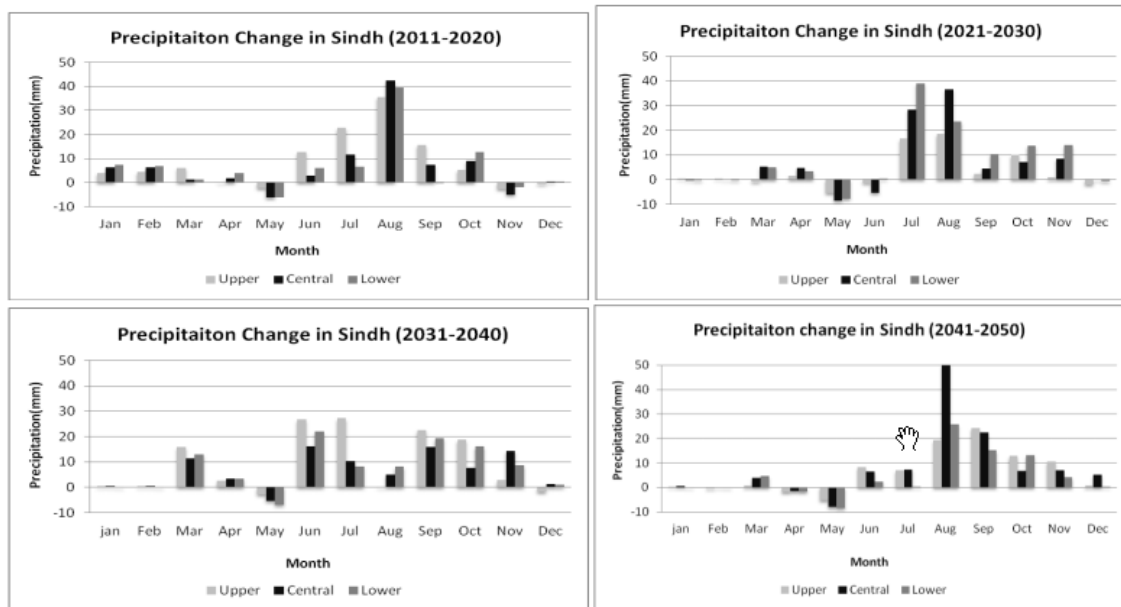


Figure 3: Future projections of precipitation for lower, central and upper parts of the Sindh ⁵

Temperature Projections for Indus Delta:

The Indus Delta is highly vulnerable to climate change in terms of flooding and droughts due to the changes in local weather systems and air masses over land and sea. For understanding the thermal features of Indus delta in the future, temperature increase in multiple cities/towns of Sindh has been projected. In general, the mean daily temperatures in Sindh province are projected to increase by about 5°C during 21st century. During the first half of the century, the increase in temperature is about 2°C whereas in second half it has been estimated as 3°C.



⁵ G. Rasul, A. Mahmood, A. Sadiq, S. Khan (2012), Vulnerability of the Indus Delta to Climate Change in Pakistan



Figure 4: Mean daily future temperature projections for the Indus Delta on decadal basis during 21st century⁶

1.4.4 Impact of Climate Change on Agriculture in Sindh

The agricultural sector is a major contributor to Pakistan’s GDP and employment. Agriculture is also a major source of income for most of the rural population (Ahmad, Oxley, & Ma, 2020).

The vulnerability of agriculture sector to climate variation, such as precipitation and temperature, is extremely high. Agriculture sector includes crops, livestock, fisheries, agro-forestry, and rangeland, and is strongly linked with other sectors in outputs and inputs. Cereals especially wheat and rice will not just experience a decline in yields; in addition, decrease in protein and micronutrients due to increase in atmospheric CO₂ concentrations is also likely. Short cycle crops such as buckwheat need to be introduced and disseminated in order to gain widespread acceptability. Buckwheat is lower yielding than conventional staples, but with higher nutritional value. In addition, decline in nutritive quality of cereals due to the effect of increasing atmospheric carbon concentrations may also need to be kept in consideration.

Irrigation is currently heavily reliant on large quantities of surface wastewater. The implication is that this practice will increase, further contaminating drinking water supplies, with increased illness and poorer nutrition outcomes. This in turn contributes also to increased soil erosion which degrades the natural resource base, the resilience of communities and overall food production capacity. However, in addition calcium, iron and zinc are leached from the soil, reducing their availability to growing crops and ultimately human diet.

⁶ Source: G. Rasul, A. Mahmood, A. Sadiq, S. Khan (2012), *Vulnerability of the Indus Delta to Climate Change in Pakistan*

Many agro-based industries, such as textile, leather, and food processing, have either direct or indirect links to agriculture and its products. Changes in household income based on changes in agro-based income also impact the household consumer demand from other sectors. Consequently, climate change directly or indirectly will continue to impact the overall economy of the agriculture sector. The changing climate may affect both crop yields and returns to the farmers. Due to its diverse geography, climate variability is likely to create a great deal of uncertainty about agriculture sector, and the economically related sectors that depend on agriculture, causing a great impact on income, poverty, and livelihood in Sindh (Lohano & Mari, 2020).

In Pakistan, impacts of climate change on agriculture are projected to be highest in Sindh, as compared to other provinces and regions (Yu, et al., 2013). Livestock is a major source of income for small farmers of Sindh. Climate change may impact livestock production in the province through spread of vector borne diseases, macro parasites, and drought-induced shortage of fodder. This can push rural households into chronic poverty (WWF, 2014). Rise in temperature can also cause psychological impact on animals, reducing milk and meat production (Lohano & Mari, 2020). The deltaic region of Indus is getting drier and saltier due to inadequate influx of fresh water. This can severely deplete fish populations along the coast (Ernesto, Enriquez, Bjorn, Peter, & Javaid, 2015) Rise in temperature can also result in distribution of fish species, effects on growth rates and decreased oxygen availability (WWF, 2014).

Due to the growing water scarcity in Sindh, the saltwater intrusion into the Indus Delta has increased, resulting in increased soil salinity, deterioration of mangrove cover, and loss of marine fisheries (Ernesto, Enriquez, Bjorn, Peter, & Javaid, 2015). It is estimated that within the period of 2000-2025, the sectors of agriculture, forestry, and fisheries may face a loss of PKR 1.3 billion due to climate change. By 2015, 39% of agricultural land in Sindh had already been affected due to saltwater intrusion (Ernesto, Enriquez, Bjorn, Peter, & Javaid, 2015). Due to heavy reliance of marginalized communities, particularly in rural areas, on natural resources, climate change impacts can significantly reduce their assets, trapping them into a never-ending cycle of poverty (Lohano & Mari, 2020).

The adverse impacts of climate change on agriculture and related sectors can be addressed through appropriate policy responses and their implementation at field level. Adequate investment for adaptation measures can minimize the climate change impacts through building resilient agriculture, including sustainable infrastructure.

1.4.5 Climate Change, Food Security, Health and Nutrition: –

Climate change and variability will have significant impacts on food security and malnutrition. They will lead to more intense and longer droughts and the frequency of heavy precipitation events has increased over most land areas. Droughts and water scarcity diminish dietary diversity and reduce overall food consumption, and this may lead to malnutrition. The risk of flooding may increase, from both sea-level rise and increased heavy precipitation in coastal areas. This is likely to resulting an increase in the number of people exposed to diarrheal and other infectious diseases, thus lowering their capacity to utilize food effectively.

Projected climate-change related exposures are likely to affect the health status of millions of people, particularly those with low adaptive capacity, through increased prevalence of disease and injury due to heatwaves, floods, storms, and droughts; increases in malnutrition; altered spatial distribution of some infectious-disease vectors; and increased burden of diarrheal diseases. Due to the very large number of people that may be affected, malnutrition, linked to extreme climatic events, may be one of the most important consequences of climate change.

In the long term, in some areas the geographical range of malaria will contract due to the lack of the necessary humidity and water for mosquito breeding, but elsewhere, it will expand and the transmission season may be changed.

A rise in the food bill for households that are net buyers of food may lead to the substitution of starchy staples for micronutrient-rich animal source foods, legumes, processed foods, fruits and vegetables and to a reduction in the average number of meals and the amount of food consumed and therefore to reduced micronutrient intakes among poor people. Extremely poor people will experience decreased calorie consumption. IFPRI projects that in 2020, if biofuel development proceeds at or exceeds its current pace, calorie availability will decline and child malnutrition will increase substantially, particularly in the districts where wasting and stunting prevalence are already on higher side (Cohen M.J, 2008)

1.4.6 Sindh's Vulnerability to Climate Change

Some major threats to Sindh due to climate change are:

- Increasing incidences of drought due to change in precipitation patterns and subsequently drought-led food insecurity and malnutrition.
- Water insecurity leading to decrease in crop yields, ultimately increase agricultural burden.
- Increase in intensity and frequency of heatwaves due to global warming and its negative effects on agricultural production.
- Increase in level of air pollution due to rapid urbanization and industrialization and burning of agricultural residues.
- Increased risk of natural calamities due to the rising sea level.
- Destruction of agricultural land, human settlements, groundwater, fish breeding grounds and mangrove cover due to salt-water intrusion in the areas surrounding Indus Delta.
- Drastic changes in marine ecosystems and marine life due to rising carbon level and global warming.
- Increased incidences of climate induced migrations and subsequent socioeconomic burden. Multiple health risks arising from direct and indirect impacts on climate change.
- Increased atmospheric carbon will affect the C3 crops, wheat and rice, causing a reduction in protein and micronutrients content of these staples.

1.4.7 Climate Financing

The need for large scale investments to reduce GHG emissions from major sectors and adaptation to the socioeconomic impacts of climate change, renders climate finance a necessity (Changing the Finance, Financing the Change - UNEP). Sindh requires additional financial resources to respond to the climate change impacts. Exploring public, private, domestic, and international financial resources and funding mechanisms are essential for strengthening the existing response practices and for implementation of mitigation and adaptation measures identified in the provincial policies and plans. The financial needs of the province to address low carbon, and climate resilient related measures in all the sectors and develop investment plans should be assessed and partnerships with the private sector should be developed for implementation of these measures. It would be prudent that to further this, a medium-term expenditure framework be developed and put in place, to provide for the required resources in a more predictable manner and duly aligned with the short-, medium- and long-term strategies of this policy.

To secure adequate international financial resources, the opportunities provided through Global Climate Fund (GCF), Clean Development Mechanism (CDM), Adaptation Fund (AF), Global Environmental Facility (GEF), World Bank's Forest Carbon Partnership Facility (FCPF), REDD+ etc. should be implored. Climate change should be considered an integrated part of budget allocation. Additionally, the financial capacity of organizations which can implement

the climate related projects should be enhanced, like; 50% of the overall allocations of CSR by corporate sector should be focused/ allocated for implementation of SCCP. Moreover, there is need for developing specific guidelines for the departments to identify investment opportunities for climate resilient actions and interventions. All this would form part of the medium-term expenditure framework.

1.4.8 Gender Inequalities and Climate Change

A growing body of research has substantiated that gender is an important aspect of social transformations associated with climate change. Socioeconomic and cultural circumstances that women face across the globe shape the factors, such as poverty and opportunities for income and education, associated with climate change, making them at a higher risk to climate related burdens. Scientific research has shown that there is a significant difference in knowledge and beliefs about climate change among women and men. Not only are women more likely to report concerns regarding climate change and have a stronger understanding of the climatic issues but they are also more likely to perceive environmental change. Their knowledge of climate change is essential to ensure food security and climate change induced droughts (Batool, Ali, Manzoor, & Mahmood, 2018).

The role of women always remained very crucial in environmental management globally. Education and empowerment of women within the domain of climate change is a crucial factor of sustainable development. The role of women in food and nutrition, improving livelihoods, and overall wellbeing of the society depicts that without their full participation, any initiative is unlikely to succeed. The SDGs have reinforced the agenda of equality of education for all genders, including environmental education (Imran, Akhtar, Chen, & Ahmad, 2021).

Heat waves, droughts, rising sea levels, and storms etc. disproportionately affect women, particularly those residing in rural areas, because they are more likely to live in poverty than men, have reduced access to basic human rights, such as ability to move freely and acquire land, and face systematic violence. The Paris Agreement includes specific provisions to ensure adequate support to women to cope with climate change impacts. Climate-related health hazards increase gender inequalities as they increase workloads on women, indoor and outdoor occupational hazards, psychological and emotional stress, and higher mortality as compared to men. Gender inequality further limits women's capacities to be actors of climate action. Due to access to fewer resources, more women are prone to climate-related displacements than men. Displacement also threatens women's health in a number of gender-specific ways, particularly of expecting women. When pregnant women are displaced, they are less likely to receive pre- and post-natal care. Food and water insecurity prevent pregnant women from getting the required nutrients. Worsening heat waves expose women who have to travel to get water and fuel sources to health problems like dehydration, heat stroke, and sexual violence. The pressure that changing environment conditions exerts on family budgets, also makes it harder for women to seek medical treatment (McCarthy, 2020).

In Pakistan, women are particularly vulnerable to natural calamities due to gender inequalities inherited in the social system. Women in Pakistan have lower access to valuable resources, limited decision-making power, inadequate information about climate change and limited coping strategies (Batool, Ali, Manzoor, & Mahmood, Women's Perception of Climate Change and Coping Strategies in Pakistan: An Empirical Evidence, 2018). Women constitute about 48% population of Sindh (Population Census, 2017). Women in rural Sindh work on an average 12 to 14 hours a day. Not only do they participate in crop production, livestock and dairy development, forestry, poultry, and fishing but they are also responsible for household chores such as food preparation, fetching water and firewood, childcare, and other domestic duties. Women in rural areas of Sindh are also required to collect water for daily usage. Decreased water availability due to climate change will not only impact the agricultural potential of

women but also their time. Climate change effects such as drought, salt water intrusions and varying rainfall patterns will result in women working longer to secure water resources and having less time to earn income.

The disadvantaged position of women in the society further increases the challenges faced by them due to climate change. Social inequalities influence the degree to which women are affected due to climate change, such as lack of women's property rights and land tenure forces them to work on less productive land and results in their exclusion from access to agricultural training services that might enable them to increase their resilience to the impacts of climate change. The provincial government of Sindh, with the collaboration of Sindh Rural Support Organization, are ensuring gender sensitive interventions to incorporate the role of women in community organizations. However, the role of women in society is still largely ignored and the situation has worsened due to lack of opportunities (Kayani, 2017). Gender inequalities are also evident in institutional responses. Underrepresentation of women in governing agencies and climate policies can negatively affect groups of women. Women's representation in government delegations to UNFCCC has also been historically low (Pearse, 2017).

Developing countries such as Pakistan need to promote environmental education and women's participation to ensure that the inhabitants of the country are concerned about not only the awareness of environmental sensitivity but also the role of gender in it. Considering the unequal distribution of resources in the province and the prevalent gender disparity, it is essential for the government to ensure gender equality and give high importance to women's perception about climate change. It is also essential for the government to examine the policies that can improve the social, political and economic status of women.

1.4.9 Sustainable Development Goals and Climate Change

The Sustainable Development Goals (SDGs) comprise of 17 universal goals, as a call to action to end poverty, protect the planet, and ensure the health, prosperity, peace and well-being of the inhabitants of the planet. The targets of SDGs are interconnected to achieve different aspects of human well-being. The actions in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. The human-development challenges in climate hotspots are addressed in a number of ways under the 2030 Agenda for Sustainable Development and their accompanying indicator framework. Firstly, the specific goal of climate change, SDG 13, "take urgent action to combat climate change", focuses on different responses to the challenges introduced due to climate change, including building resilience and adaptive capacities, improving education, awareness raising, human and institutional capacity on climate change mitigation, adaptation, impact reduction, early warning systems, integrating climate change measures into national policies, strategies and planning, and monitoring progress towards financial commitments, especially in least-developed countries, and among women, youth, and marginalized communities. SDG 13 mainly covers progress towards outcomes, rather than outcomes themselves. To successfully implement the SDG 13, policies and actions related to climate change should be guided by their interactions with other SDGs and the institutions implementing them.

The goals of No Poverty (SDG 1), Zero Hunger and elimination of malnutrition (SDG 2), Good Health and Well Being (SDG 3), Gender Equality (SDG 5), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Industry, Innovation and Infrastructure (SDG 9), Reduced Inequality (SDG 10), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), Life Below Water (SDG 14) and Life on Land (SDG 15) are directly linked to climate change impacts. These goals are also interlinked with human development, well-being and economic growth.

Six indicators, including number of deaths caused by air pollution (SDG3), air pollution mortality (number of people under water stress) (SDG6), share of renewable energy (in primary energy) and energy intensity (SDG7), unemployment rate (SDG8), food waste (SDG12), and forest area (SDG15) show co-beneficial relationships with climate change mitigation. Factors enhancing climate change mitigation will also improve share of renewable energy (SDG7). Three indicators show trade-off relationships with climate change mitigation: population at risk of hunger (SDG2), secondary industry share (measured by manufacturing value added as a proportion of GDP; SDG9), and biodiversity index (SDG15) (Fujimori, et al., 2020). Similarly, the interconnections of SDGs' targets for universal healthcare (SDG 3.8) will be impossible to sustain without climate action (SDG 13) (Salas & Jha, 2019).

In Pakistan, climate change is already threatening the lives, livelihoods, health and well-being of millions, especially the poor and vulnerable who already lack the financial, technical, human and institutional resources to adapt. Future changes in precipitation, incidence of extreme events, sea level and glacial cover are expected to affect food security, nutrition, access to water, sanitation, shelter, health, labour productivity, productive sectors and household incomes. These changes may exacerbate the already low levels of human development in the country. Those most heavily dependent on natural resources and exposed to multiple risks of climate change are the most vulnerable. Urban slum dwellers, with poor access to basic sanitation are the first to suffer from damages to assets, spread of disease and loss of lives as the incidence of flooding, extreme events become more prevalent in the future (Ahmed , Dalal, & Foruzs, 2009). The province of Sindh is facing multisectoral problems due to climate change.

In order to prepare itself for the damaging impacts of climate change in the future, it must formulate adaptation and mitigation strategies to reduce the impacts of climate change to increase the quality of life of its citizens. As a commitment towards sustainable development, SDGs must be prioritized and considered as an integral part of development. Since the actions in one area will affect the outcomes in others, the development must balance social, economic and environmental sustainability.

1.4.10 Lack of Youth's Representation in Combating Climate Change Initiatives and Planning

Pakistan has a rich human resource with immense potential, in the form of youth. The increasing population of youth in Pakistan between 15 and 29 years of age is a vital factor for enhanced economic growth and human development. Unfortunately, the potential of Pakistani youth has been largely untapped at all fronts. Pakistan has a Youth Development Index (YDI) value of 0.605, out of a potential maximum of 1. The indicators that have improved over time include years of schooling, enrolment in higher education, and the youth survival rate. However, other indicators seem to be worsening, mainly employment-to-population ratio and the percentage of fully-employed youth. An additional concern is that the male YDI value is twice the female YDI value. Young women seem to fare worst in employment-related indicators, meaning that educated women are choosing not to seek employment, or are unable to secure decent work. Sindh has the highest YDI value among Pakistan's provinces (UNDP, Pakistan Human Development Report, 2020).

Poor engagement of youth in the productive political, educational, economic and socio-cultural activities indicates ineffectiveness of the public and private sectors policies especially at the state level. Youth partnership, empowerment, and engagement in all sectors is the only way forward to address the increasing challenges of the country (Hafeez & Fasih, 2018). Connecting young people in designing developmental schemes is much more complicated than establishing youth panels. Meaningful youth participation at the grassroots level is essential to ensure that the policies and programs address the requirements of youth. Poor lobbying and lack of

advocacy skills is not meeting the desired results required to harness potential of the youth in the country (Rauf, 2019).

Participation of youth in democratic processes is essential for creating responsive political structures. Formation of recognized representative bodies of young people to provide them with a platform to participate and influence the democratic process is a critical need of time (UNDP, Youth and Politics in Pakistan, 2018).

Similarly, educating youth is the most important tool to combat the destructive change due to climate change. Due to the intergenerational nature of climate challenges, youth remain the biggest stakeholder in climate action and therefore, should be at the forefront of the climate-related policies, programmes and actions (Pakistan Economic Survey: Chapter 16: Climate Change , 2020-21). The youth play a crucial role in combating climate change as they are adaptable and are more forthcoming towards making low carbon lifestyle choices. Since they will be the next generation which inhabits the earth, inheriting the responsibility to protect the planet, it is essential to conduct major studies among youth regarding awareness about climate change as well as role of youth in combating climate change. Therefore, they should be given a chance to actively participate in decision making at local, national and global level. They can actively support initiatives that will lead to the passage of far-reaching legislation (Pandve, Deshmukh, Pandve, & Patil, 2009).

Recognizing that the legislators should consider the population at the receiving end of their policies, SDG 10 aims to include the concerns and voices of youth in the development of policies. Although the involvement and empowerment of youth has increased in the sector of climate change, through the initiatives of Ten Billion Tree Tsunami Program, Clean Green Pakistan Programme, Recharge Pakistan Program, Protected Areas Initiative to join government's adaptation and mitigation actions (The News International, 2020), there is an overall lack of youth representation in the environmental decisions of the country, a gap that requires to be eliminated urgently (Jamal, 2018).

2. POLICY GOALS AND OBJECTIVES

2.1 Vision

A future when climate change will have minimum possible adverse impacts and consequences on natural resources of Sindh, its people and their livelihood and to ensure sustainability of those resources for coming generations.

2.2 Goal

The overall goal of Sindh Climate Change Policy is to ensure that climate action is mainstreamed in the development planning, particularly the economically and socially vulnerable sectors of the economy, and to steer Sindh towards economic growth⁷ and climate compatible development⁸.

2.3 Policy Objectives

1. Formulate a province specific policy presenting the full picture of the climate change situation in the province, its affects and provide for a robust set of solutions and implementation plans to mitigate the effects, keeping in view the National Climate Change Policy (October 2021) and Twelfth Five Year Plan (2018-23) of the Federal government that combines inclusive growth with green development.

⁷ As envisioned by the Government of Sindh.

⁸ **Climate compatible development:** While climate resilient development increases adaptive capacity against climate impacts it does not necessarily cater to the mitigation aspects. Climate compatible development, on the other hand, is a holistic approach that minimizes the harm caused by climate impacts, while maximizing human development opportunities presented by a low emission and resilient future.

2. Embed the concepts of Climate Compatible Development and Sustainable Development Goals in the climate change policy in order to improve the understanding of the policy makers and ensure water, food, energy, health & nutrition security for Sindh province in the face of a changing climate.
3. Ensure interests of vulnerable groups and that gender aspects are adequately addressed in climate development strategies and planning.
4. Develop bases to provide for the required human, financial and play technological resources and inter and intra coordination mechanisms and frameworks which are required to further the policy objectives and undertake necessary actions, in a clear, timely manner to mitigate the adverse effects of climate change
5. Enhance awareness of the impacts of climate change among all stakeholders for necessary appropriate measures to combat and minimize these impacts.

The policy has suggested specific measures with key focus on mitigation, adaptation and capacity development processes for different sectors and sub-sectors like agriculture, irrigation, forestry, industries, health, nutrition, education, energy, etc.

2.4 Institutional and Legislative setup

Environment, Climate Change & Coastal Development Department (ECC&CDD), Government of Sindh, was established in 2016. The ECC&CDD is engaged with field work as well as their execution and monitoring of different development activities. The department's mission is to create an environment free from any pollution, based on sustainable development. The Department is key focal point at provincial level, integrating with Federal Ministry of Climate Change, UN Agencies, I/NGOs and development partners working diligently to make a better environment for the future generations.

Below are key actions for the implementation of Sindh Climate Change Policy in the area of legislation and policy:

LEGISLATION, POLICIES AND STRATEGIES	
Strategic Objectives/ Outcomes	Responsibility and Lead Department
Adapt Pakistan Climate Change Act 2017 and National Climate Change Policy 2021 with items relevant to the Province of Sindh.	Directorate of Climate Change ECC&CDD and its allied establishments with the support of Law, Agriculture, Fisheries, Health, and Planning & Development Departments, with active coordination with MoCC
Legislative review to harmonize existing legislation, policies, and rules of line departments with Climate Change	Environment, Climate Change and Coastal Development Irrigation Forestry, Health, Planning & Development, PHED, Local Government, Water Resources and Industries
Sectoral operating procedures (design guidelines) for planning and management developed	Environment, Climate Change and Coastal Development and P&D Board Sindh & MoCC
Operational guidelines for NGOs and CBOs and for government executed projects, working for Climate Change	Directorate of Climate Change ECC&CDD with Sindh Climate Change Council and relevant government line ministries / departments

LEGISLATION, POLICIES AND STRATEGIES	
Strategic Objectives/ Outcomes	Responsibility and Lead Department
The provincial and municipal services duty bearers have necessary managerial and leadership skills for an integrated climate change adaptation and mitigation approaches	Environment, Climate Change and Coastal Development, Local Government, P&D, PHED, Agriculture, Fisheries, Women Development, PDMA / Rehabilitation and respective line departments

3. ADAPTATION ACTIONS

3.1 Socio-Economic Measures

The effects of climate change and the resulting increase in incidences of natural disasters not only compromised the efforts to alleviate poverty and food insecurity but also has negative impacts on overall development efforts. The economic sector is either directly or indirectly dependent on weather conditions. Mainly the agriculture and fisheries sectors are being increasingly subjected to the climate change impacts. Due to environmental and demographic pressures, natural resources are declining at an extremely accelerated pace, further increasing the intensity of climate change. There are increasing concerns about the rising threats due to the current income and consumption patterns of households that earn livelihood from these sectors. Possible disruptions in the production processes due to climate change and weather shocks make farmers and fisherfolks the most vulnerable population. Urban consumers are also affected when food prices increase in order to reflect the impacts of climate change and adjusting the cost of food to reflect environmental concerns. Different social groups are vulnerable to different types of climate events and their impacts. Across these groups, a gender dimension is also evident. Women and female-headed households are at a greater risk in both urban and rural areas. Either as food consumers or as food producers, female-headed households tend to have reduced access to assets (such as land and other physical or human capital), savings and credit. As a result, women farmers typically achieve lower yields than men, making them more vulnerable to production and income shocks. Women have fewer assets and less access to different sources of income than men (Karfakis, Lipper, & Smulders, 2012).

Sindh and Balochistan have the highest rural poverty rates among Pakistan's provinces and the highest urban-rural poverty gaps. Quality of basic infrastructure in Sindh is also unsatisfactory with only 7% households in Sindh are connected to piped water with more than 6 hours of water supply a day. In Sindh, in particular, poorer districts tend to receive smaller resource allocations than richer ones (Redaelli, 2019). The percentage of people who are identified as multidimensionally poor in the urban and rural areas of Sindh are 10.6% and 75.5% respectively (Multidimensional Poverty in Pakistan). These factors reflect households' lower adaptive capacity and higher susceptibility to the impacts of the events and refer to low levels of human and physical capital, insufficient access to assets and services weak institutional structures, inexistent or inefficient social protection programs and greater exposure to uncertainty in the physical and economic environment (Karfakis, Lipper, & Smulders, 2012).

Below are key actions for the implementation of Sindh Climate Change Policy Socio-economic steps needed in the wake of Climate Change:

SOCIAL AND ECONOMIC DIMENSIONS OF CLIMATE CHANGE	
Strategic Objectives/ Outcomes	Responsibility and Lead Department
Strengthen the quality of data collection systems, and reducing the knowledge gap among the communities	Sindh Bureau of Statistics, Universities, P&D, PMU, and Directorate of Climate Change ECC&CDD

SOCIAL AND ECONOMIC DIMENSIONS OF CLIMATE CHANGE	
Strategic Objectives/ Outcomes	Responsibility and Lead Department
Increase community participation in decision making processes, particularly encouraging participation of women	Women Development, Sindh Bureau of Statistics, Universities, NGOs, Media, P&D, PMU, and Directorate of Climate Change ECC&CDD
Provision of equal opportunities across all sectors	Health, Education, PHED and Local Government Departments Sindh Bureau of Statistics and Directorate of Climate Change ECC&CDD
Ascertain the most affected population among the vulnerable population	Sindh Bureau of Statistics, P&D and Directorate of Climate Change ECC&CDD
Reduce food insecurity by strengthening the agriculture sector	Agriculture, Supply and Price Department and Sindh Social Protection Authority.
Reducing burden on the natural resources by increasing a shift to the renewable resources	Population Welfare, Labour, NGOs and Sindh Social Protection Authority

3.2 Human Health with specific reference to vulnerable segment of the society

The negative impact of climate change on human health is a well-established scientific fact. Research indicates that heatwaves can cause heat strokes and can impact cognitive abilities, rainfall extremes can result in vector borne diseases such as malaria and can cause sewage contamination leading to waterborne diseases, increasing greenhouse gases' emissions can lead to respiratory issues, climate induced droughts can threaten food security and can subsequently result in malnutrition. Additionally, extreme events due to climate change, such as droughts, floods and heatwaves, can also cause psychological stress (Patz & Thomson, 2018).

The costs of premature deaths and illnesses caused by environmental health risks are equivalent to 10 percent of Sindh's GDP. Deaths from the environmental risk factors represent 18 percent of all deaths in Sindh. Environmental health risks are also the cause of millions of cases of illness, injuries, and cognitive impairments in Sindh (Sanchez-Triana, Enriquez, Larsen, Webster, & Afzal, 2015). Rapid urbanization, industrialization and transportation has resulted in deterioration of air quality in Sindh, resulting in severe respiratory and dermatological issues (Ali, Memon, Panhwar, & Bhutto, 2019). The drop in the water table due to drought conditions in Sindh has greatly impacted the food production systems and subsequently human health. Shortage of safe water and nutritional food also gives rise to numerous diseases (Akram, 2019).

Due to severe droughts in the past, conditions of child malnutrition are severe in Sindh. 45.5% children in Sindh are stunted whereas 23.3% are wasted (National Nutrition Survey, 2018). 22% of the children in Sindh were reported to suffer from severe malnutrition after the 2010 flood, by UNICEF (Memon & Sharjeel, 2015). Sindh has the highest proportion of iron deficiency anemia with about a quarter (23.8%) of all women of reproductive age affected. 22.6% women of reproductive age are underweight and 21.4% women of reproductive age in Sindh are zinc deficit. 52.9% households in Sindh are food insecure where 26.0% households suffer from severe food insecurity (National Nutrition Survey, 2018).

There will be a reduction in the quality of food due to climate change, notably less protein and micronutrients in wheat and rice because of growing atmospheric carbon and less omega 3 n chain fatty acids in fish due to increased temperature. Soil salinity reduces zinc in soil, growing plants and human diets. Soil erosion reduces soil zinc as well as iron and calcium, with the same agronomic and dietary impact.

Accordingly, there is a need to use a “nutrition lens” to direct multi-sectoral actions to improve; household food security; food quality and safety; prevent, control and manage infectious diseases and micronutrient deficiencies; promote appropriate diets, including breast-feeding and healthy lifestyles; provide care for the vulnerable, introduce productive safety nets; and provide direct assistance (through Cash transfers).

The flood of 2010 and 2011 not only injured thousands and caused deaths of hundreds of residents of Sindh, but also caused forceful migration of millions of people within the province. Limited disaster preparedness and untimely actions after the floods due to lack of planning and coordination further aggravates the situation of natural calamities (Memon & Sharjeel, 2015).

Below are key actions for the implementation of Sindh Climate Change Policy to ensure a better health for all:

HUMAN HEALTH	
Strategic Objectives/ Outcomes	Responsibility and Lead Department
Draft, prioritize, and implement district-wise health & nutrition, heat and disaster management plans which can help reduce risks to human health from climate-induced disasters and diseases. Nutrition policies can provide incentives for improving diets, for strengthening the nutrition focus of health services and for ensuring nutritionally balanced food aid as a safety net.	Department of Health – collaboration with Environment, Climate Change and Sindh Coastal Development Authority, P&D, PDMA, Information and NGOs-MNHSR&C and MoCC
Conduct Needs Assessment of the health sector, identifying infrastructure, human resource and financial resources required by sub-urban and rural health facilities to equip them to handle climate induced diseases and disasters	Departments of Health and Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority in collaboration with PDMA, P&D, SEPA and Finance Department
Capacity building through education of the healthcare staff and the public regarding the health issues due to climate change.	Department of Health, PHED Local Government, NGOs and Media
Ensuring availability of medication and clean drinking water during climatic extremes and emergencies	Department of Health – PHED, W&S and Local Government
Ensure availability and access to sufficient, safe and nutritious food to meet the dietary needs	Department of Health- UN partners and NGOs
Promote research on the nexus of climate change and health (spread, prevalence, and incidence of disease; food security; water security; indoor air etc.	Department of Health- UN partners, Bureau of Statistics and NGOs/Universities

3.3 Agriculture and Livestock

Threats to sustainability of agriculture and food security are at the forefront of the impacts of climate change. Agriculture employs approximately 42% (including forestry and fishing) of the labour force of Pakistan (Labour Force Survey, 2017-18) and generates over 75% of export revenue through Agri-based textiles and agri-food products. Many climatic extremes will influence agriculture in the near future, including rise in temperatures leading to an increased demand for irrigation; variability in rainfall patterns, shifting of seasons (prolonged summers

and shortening of winters), changes in water quality and quantity and increased frequency and intensity of climatic events (Arif, Riaz, Faisal, Khattak, & Sathar, 2019).

Sindh is home to numerous crops including wheat, cotton, rice, sugarcane, tobacco, corn, sunflower, rape seed; vegetables including tomato, potato, cauliflower, carrots, peas, onions, melon, chilies; and orchards including mango, citrus, banana, pomegranate and guava (National Agromet Centre).

The arid and semi-arid soil of Sindh is vulnerable to degradation due to rise in temperature and shifting of seasons. The shortening length of growing season, heat stress in reproductive stages of both kharif and rabi crops and increased water requirements can decrease crop yields in arid and semi-arid areas by 6-18%. Approximately 95% of the country’s water is used for agricultural purposes. Although the country has the largest irrigation system in the world, poor drainage system leads to waterlogging and salinity. The water demand for agriculture was 109 million acre-feet (MAF) in 2017. Based on population growth projections, it is estimated that this demand will increase to 124 MAF by 2030. Continuously increasing demand for irrigation will be challenging as the available water supply is very limited. It is estimated that climate change will lead to a decline in 30% of total agricultural productivity of the country. It is further estimated that an increase of 1 degree Celsius (°C) in mean temperature will reduce yields by 5–7% and an increase of 1°C during the wheat-sowing months will reduce its yield by 7.4%.

Livestock, a very important sector within agriculture, is also being greatly affected due to climate change. Outbreaks of diseases due to sudden changes in climate, decreased production due to unavailability of fodder and decreased water quantity due to over-pumping for irrigation purposes are some of the ways climate change is affecting livestock. These issues are likely to worsen in the future. By the end of the current century, Pakistan’s agricultural sector could be losing US\$2–6 billion per year due to climate change impacts (Arif, Riaz, Faisal, Khattak, & Sathar, 2019). There is a need to promote local high pedigree and drought-resistant varieties of livestock and poultry to reduce disaster risk to livestock and livelihoods. This needs to be part of an overall strategy aiming to achieve a mix of animals and climate friendly livestock production models.

Feeding small amounts of animal foods to children will make a major dietary contribution to reducing stunting. There is furthermore a need to restore the link between livestock and cropping for both environmental and nutritional reasons. Local breeds will produce lower yields of milk but with higher vitamin A content.

At the planning level, there are currently no strategies for meeting the current water deficit or future demand. Due to the magnitude of impacts on agriculture, livestock and food security, it is essential to build resilience in the agriculture to the impacts of the changing climate. Being an agro-based economy, below mentioned are key actions for the implementation of Sindh Climate Change Policy in the agriculture sector:

RESILIENCE BUILDING OF THE AGRICULTURAL SYSTEMS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Develop climate resilient agriculture systems to prevent crop failure due to climatic extremes such as floods and droughts	Agriculture, Supply and Price; Irrigation, Finance, Water Resources, Forestry, Environment, Agri Credit Banks, Livestock and Fisheries, Directorate of Climate Change ECC&CDD
Discourage the use of fertile agricultural land for unproductive and unsustainable practices	Agriculture Supply and Price Department, Agri Extension, Forestry, Irrigation, P&DD, Law, Directorate of Climate

RESILIENCE BUILDING OF THE AGRICULTURAL SYSTEMS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
	Change ECC&CDD, Sindh Coastal Development Authority, Private Sector and NGOs
Enable financial mechanisms for farmers to invest and adopt the technologies to overcome the climate related stress	Agriculture Supply and Price Department, Sindh Irrigation Development Authority, Agri Credit Banks, Agri Extension Services, Media, Forestry, P&DD, Private Sector and NGOs
Mobilize the farmers to adopt drought management practices as a part of climate variation rather than as disaster management to increase adaptability of agricultural systems	Agriculture Supply a Price – Pakistan Metrological Department, Media, Sindh PDMA, Irrigation, Water Resource Management,
Create sustainable agricultural productivity by improving irrigation and land management	Agriculture Supply and Price Department, Sindh Irrigation Development Authority, Agri Credit Banks, Agri Extension Services, Media, Forestry, P&DD, Private Sector and NGOs
Utilize genetic engineering for introducing climate tolerant crops and livestock	Agriculture Supply and Price Department, Sindh, Agri Credit Banks, Agri Extension Services, Livestock & Fisheries, Media, Finance, P&DD, Private Sector, Universities and NGOs
Impart scientific knowledge among the farmers to increase their educational capacity regarding climate change	Directorate General Agri Extension Services Sindh, NGOs and Media
Strengthen DRR response for livestock management	Sindh PDMA, Livestock and Fisheries, and Agri Extension Services, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority

3.4 Fisheries

Marine fisheries are a substantial economic activity off the coasts of Sindh. Fishing is continued all along the coastline throughout the year, where August to November is the main fishing season. There are relatively complex pathways through which climate change can have an impact on the productivity and distribution of fishery reserves, the resilience of fisheries and the livelihood and economic linkages associated with them. Climate change has a huge influence on the fisheries in Pakistan. Increasing saline water in the Indus Delta is already harming the fish breeding grounds. High temperatures are reducing the river flows, further exacerbating the habitat of marine fisheries in the delta. Rising sea levels and increasing frequencies of cyclones due to high sea surface temperatures are a huge threat to mangroves, which are crucial to the breeding of shrimp, one of Pakistan's largest export fisheries. These challenges have put a huge restraint on the communities relying on fisheries for their livelihood.

Due to changes in the ocean temperature and acidity due to climate change, distribution and abundance of marine fish is predicted to be altered. The tropical zones of the world's oceans, which includes Pakistan's ocean territory, are estimated to experience comparatively high rates of extinction, decreases in catch and sized of the fish (Ali M. R., 2018).

Managing fisheries is a struggle to find a balance between protecting resources, ensuring equitable access and increasing economic stability. To develop adaptive capacity of marine

species to climate change, ecosystem-based management strategies are required, focusing on anthropogenic stressors accompanying climate change (Hillebrand, et al., Climate Change: Warming Impacts on Marine Biodiversity, 2018). Below are key actions for the implementation of Sindh Climate Change Policy to take maximum advantage of fisheries being the only province after Baluchistan which is having a coastline:

MANAGEMENT OF THE FISHERIES SECTOR	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Maintain a marine ecosystem to ensure a healthy fisheries' sector	Fisheries and Livestock, Forestry and Wildlife Environment Directorate of Climate Change ECC&CDD, Sindh Coastal Development Authority and Sindh Environment Protection Agency
Restore fish resources and habitat	Fisheries and Livestock, Forestry and Wildlife, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority
Minimizing the loss of livelihoods from fisheries by providing alternate employment opportunities	Fisheries and Livestock, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, NGOs, WWF, Private Sector
Promote use of safe and sustainable fishing gears to prevent entanglement of and damage to marine life	Fisheries and Livestock, Forestry, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority and Private Sector, WWF, and NGOs.

3.5 Water Resources

Water is an essential component of economic and social development. It is essential to maintain health, growing food, managing the environment and creating numerous employment opportunities. Lack of water causes hindrance in sustainable socioeconomic development and lack of development causes hindrance in solving the water related problems. Lack of water availability, collection and distribution mechanisms can increase energy consumption in gathering daily water needs. Domestic water supply is a major component in well-being of its direct consumer. Increase in agricultural activities, urbanization and industrialization has resulted in a huge increase in the demand of water supply (Goswami & Bisht, 2017).

Indus River is the primary source of surface water for Sindh. The estimated ground water resources of the province vary between 13 to 16.2 MAF with an estimated safe yield between 4.4 to 8.1 MAF. The continuous population growth is putting additional burden on the limited water resources of the province. The rural population of the province depends on water supply from the canal system for livelihood. It is estimated that by 2025 the irrigation water requirements for agriculture would increase by about 50% if the current irrigation practices continue. The current water use in the province is about 42.6 MAF, meaning that an additional 26.3 about 21.3 MAF will be required to maintain the current balance between supply and demand of agriculture products. A similar increase is expected in the municipal and industrial water requirements, where about 2.4 MAF of additional water will be needed. As the major municipal water requirements in Sindh are met from the surface water source, these requirements will reduce the water availability for agriculture use. For meeting the water requirements in 2025, it has been estimated that an additional 23.7 MAF of water would be required (Tahir, Marri, & Hassan, 2010).

Katcho area (flooded area) is approximately 810,000 hectares in the lower basin along the Indus, which is flooded by Indus River. This area is rich in forests, grazing lands, poultry,

animal husbandry, agriculture, and fishing. About a million people were living there and were engaged in the timber trading, firewood supplying, fishing and boating. As the shortage of water is witnessed, the economy of this area has tremendously declined, and resultantly unemployment, migration to other areas, and crime rates have risen in this region. Sindh is home to many lakes and wetlands, majority of which are fed by Indus. The lakes in Sindh are an important source of drinking water, fish, agriculture, and employment to many people and are hosts to numerous birds, flora and fauna. These lakes and wetlands are degrading at an alarming rate due to the shortage of water (Magsi, 2012).

Managing water as an economic good is an important aspect of achieving equitable economic growth. Better access to clean water, safe sanitation and water management are essential to boost economic growth. Water is also a critical part of ecological services. Therefore, optimal management to control the scarcity of water due to population growth, increasing agricultural demand, climate change and decreasing water supplies are the need of time.

Below are key actions for the implementation of Sindh Climate Change Policy in the water sector:

MANAGEMENT AND CONSERVATION OF WATER RESOURCES	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Conserve rain water and flood water resources for productive purposes	Sindh Irrigation Department, Sindh PDMA, SIDA, PHED and Local Government
Manage groundwater resources through regulatory frameworks and water licensing etc.	Irrigation, Karachi Water Sewerage Board, WASA Hyderabad, P&D, PHED and Local Government, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, MoCC
Increase public awareness to understand the importance and of conservation of water resources	Directorate of Climate Change ECC&CDD, Irrigation, PHED, Local Government, Urban Unit, Education and Extension Department including health workers
Allocate water use according to the changes made in the sectoral demand due to climate change as water resource management practices	Irrigation, Karachi Water Sewerage Board, WASA Hyderabad, P&D, PHED and Local Government. Environment Climate Change and Coastal Development, MoCC, NGOs, SEPA, UN and other development partners
Develop grey water recycling mechanism and ensuring its reuse for agricultural activities and groundwater recharge	Directorate of Climate Change ECC&CDD, Irrigation, KWSB, WASA P&D, PHED and Local Government. MoCC, NGOs, SEPA, Urban Unit, UN and other development partners
Protect water catchments from degradation, irrigation system contamination and silting	Irrigation, KWSB, WASA P&D, PHED and Local Government. MoCC, NGOs, SEPA, Urban Unit, UN and other development partners
Encourage the use of green agricultural practices among the farmers for conservation of water in the agricultural sector	Irrigation, Agriculture Supply and Prices, UN and other development partners

MANAGEMENT AND CONSERVATION OF WATER RESOURCES	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Develop short-term contingency plans to adapt to the prevailing drought conditions	Irrigation, PHED, Local Government, SIDA, P&D, UN and other development partners
Manage salinity to maintain the volume of water balance between the volume of water entering (recharge) and leaving (discharge) the groundwater system	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Irrigation, Agriculture Supply and Prices, P&D, Academics, Research, UN and other development partners
Instauration of irrigation infrastructure of the country to build resilience to the future incidences of climate related disasters	Irrigation, Agriculture, Pakistan Metrological Department, Water Resources

3.6 Biodiversity

Pakistan is a signatory to Convention on Biological Diversity (CBD). The components of Biodiversity Action Plan, 2000 are based of the provisions CBD, requiring the member countries to undertake measures for conservation and sustainable use of biological resources (Biodiversity Action Plan, 2000).

Due to the presence of various ecosystems and a diverse range of landscapes, the province of Sindh has a very rich wildlife. To conserve the dwindling wildlife of Sindh, 50 Protected Areas have been established. The key species found in protected areas include Sindh Wild Goat, Urial, Chinkara, Leopard, Blue-bull, Hog, Deer, Hyaena, Caracal, Honey Badger, Fishing Cat, Desert Fox, Indus Dolphin, Humpback Whale, Indian Peafowl, Sarus Crane, Houbara Bustard, Marbled Teal, Grey Partridge, Chakur, Indian White-backed Vulture, Indian Long-billed Vulture, Shaheen Falcon, Marsh Crocodile, Green Turtle, Olive Ridley Turtle, Indian Python, Desert Monitor, Fat tailed Gecko, Spiny tailed Lizard and Freshwater Turtles (Kanwal, Hussain, Siddiqui, & Yasmin, 2018).

Reduced freshwater flow from diversions upstream, cutting of mangroves, water drainage and pollution and agricultural intensification has threatened the wetlands and Indus delta and the migratory and local species dependent on these ecosystems (National Biodiversity Strategy and Action Plan , 2015).

The wildlife of Sindh is declining at an alarming rate. Unregulated hunting, pollution, habitat loss to development activities, habitat degradation and deforestation are major threats to the wildlife of Sindh. Many species of reptiles, mammals and birds have already gone extinct whereas a huge number of species in the province are threatened with extinction (Kanwal, Hussain, Siddiqui, & Yasmin, 2018). Sindh also has a rich source of plants species which are an important source for livestock production. The traditional knowledge of plants shown in relation to medicinal use reflects a diversity of plant species that can be found in the province (Yaseen, 2019).

To ensure a better future for coming generations, it is imperative to conserve the rich biodiversity which the province is having. Below are key actions for the implementation of Sindh Climate Change Policy for the same:

CONSERVATION OF BIOLOGICAL DIVERSITY	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Increase institutional and organizational research regarding existing biodiversity and	Directorate of Climate Change ECC&CDD and Sindh Coastal

CONSERVATION OF BIOLOGICAL DIVERSITY	
Strategic Objectives/Outcomes	Responsibility and Lead Department
conservation practices in the province, focusing on the impacts of climate change on biodiversity	Development Authority, Forestry and Wildlife, Fisheries and Livestock, Agriculture, Supply and Prices, P&D, MoCC, Academia, WWF, IUCN and NGOs
Facilitate natural flow of ecological activities and enhance monitoring mechanisms and processes	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Forestry and Wildlife, Fisheries and Livestock, Agriculture, Supply and Prices, P&D, MoCC, Academia, WWF, IUCN and NGOs
Strengthen institutional and legal capacities to enhance biodiversity conservation practices	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Forestry and Wildlife, Fisheries and Livestock, Agriculture, Supply and Prices, P&D Tourism, MoCC, Academia, WWF, IUCN and NGOs
Protect priority wildlife species	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Forestry and Wildlife, Fisheries and Livestock, Agriculture, Supply and Prices, P&D, MoCC, WWF, IUCN and NGOs
Induce behavioural change for improving consumption and utilization patterns to reduce stress on biological resources and ecosystem services	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Forestry and Wildlife, Fisheries and Livestock, Agriculture, Supply and Prices, P&D, MoCC, Academia, WWF, IUCN and NGOs

3.7 Forestry

Climate is one of the most important determinants of vegetation patterns globally and has a significant influence on distribution, structure, and ecology of forests. Non-climate factors such as unsustainable dependence of communities on forests, land use change, forest management practices associated with harvesting wood and other forest resources and plantation of single species plantations would further add on to the impacts of climate change (Chaitra, et al., 2018).

Mangroves are extremely important for wildlife and ecology and provide numerous sources of livelihood for the communities. In addition to being a nursery ground for many marine organisms, they provide environmental security by reducing erosion and stabilizing the coastal zones, acting as barriers against cyclones, windstorms and floods. They provide fish and other resources such as firewood as livelihood opportunities for the surrounding communities. The Indus Delta mangroves provides habitat to plants, crustaceans, birds, mammals and 98 species of fish. The population of migratory birds, including flamingos, pelicans, and cranes, visiting the Indus delta every year has declined due to degradation of mangroves. The number of dolphins has also declined in mangroves due to marine pollution. The mangroves of Indus delta are an important breeding zone for marine fish, lobsters, shrimps and crabs which generate an export revenue of USD 100 million. They are also a source of employment of 100,000 people.

Riverine forests are the mainstay of forestry in Sindh. They provide support to biodiversity and numerous livelihood services including timber, firewood, forage, tannin, gum and honey. They act as carbon sinks, prevent soil erosion and decrease the impacts of floods. There has been large-scale degradation of riverine forests due to severe decrease in flow of freshwater. Recent incidences of drought have further worsened the situation of these forests (Forest Department, Government of Sindh).

Pakistan's forests contain 213 M. metric tons of carbon in living forest biomass. These forests are a home to about 1027 species of reptiles, mammals, birds and amphibians. Less than 5 percent of Pakistan's total area is under forest cover and 1.5 percent of these forests are lost every year. Between 1990 and 2010, Pakistan lost an average of 42,000 ha or 1.66% forest cover each year. In total, during 1990 and 2010, Pakistan has lost approximately 33.2% of its forest cover (Ali C. I., 2018). This has profound impacts on country's biodiversity, environment and agriculture. With climate change, such events are becoming more frequent and more devastating, pointing to the urgent need to conserve Pakistan's indigenous forests (Sustainable Forest Management to Secure Multiple Benefits in Pakistan's High Conservation Areas, 2019).

Sindh province occupies land area of 14.091 million ha. (34.81 million acres). Out of above, an area of 1.125 million ha. (2.782 million acres) is under the control of Sindh Forest Department, which is 8% of the total area of the province. However, out of aforementioned total area, riverine forests and irrigated plantations which are categorized as productive forests cover only 2.29% area, clearly indicating that the province is deficient in forestry resources. The remaining area under the control of Sindh Forest Department (SFD) consists of mangrove forests and rangelands, which are classified as protective forests. Poverty, weak controls and lack of awareness contributes to over-exploitation of forest resources. Bringing communities into forest management and thereby helping them achieve sustainable livelihoods can conserve forestland across Pakistan.

To combat the rising temperature and Green House Gas effects, to which Pakistan is not a major contributor, but a victim like any other developing nation, the resilience of forests is required as per key actions given in the Sindh Climate Change Policy:

INCREASING RESILIENCE OF FORESTS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Increase climate resilient forests in the province	Forestry and Wildlife, MoCC, Environment, Coastal Development Authority, P&D, WWF, IUCN, FAO, and NGOs
Enhance educational capacity to develop a clear understanding regarding the impacts of climate change on forests of the province	Forestry and Wildlife, Agriculture Supply and Prices, Fisheries and Livestock, Irrigation, Academia and P&D.
Promote sustainability of forests to ensure ecosystem services	Forestry and Wildlife, WWF, IUCN, Agri Extension, Social Protection Authority, Law, P&D
Raise awareness regarding climate change adaptation among the public and the communities dependent on forests for livelihood	Forestry and Wildlife, Environment, Climate Change and Coastal Development, Academia and NGOs

3.8 Disaster Preparedness

An increase in the frequency and magnitude of natural disasters has been observed due to climate change. Statistics demonstrate the critical multi-hazard environment to which the global population is exposed. Increase in incidences of floods, heavy rainfall, tsunamis, cyclones and earthquakes have caused losses to human life, ecology, infrastructure and subsequently economy. The combination of human and economic losses, together with reconstruction costs, makes natural disasters both a humanitarian and an economic problem (Bronfman, Cisternas, Repetto, & Castañeda, 2019).

The province of Sindh is particularly affected by the impacts of climate change. At one end, heat stresses and drought-like conditions are very common in Sindh. Warming is apparent in the entire country, but it is most prominent in southwestern Sindh. The second highest increase in the annual mean temperature of the country has been observed in Karachi. Most of the soil of Sindh is vulnerable to a wide range of degradation processes that are exacerbated by the rising temperature. On another end, flash floods and cyclones near the coastal areas are responsible for causing socio-economic distress (Arif, Riaz, Faisal, Khattak, & Sathar, 2019).

Although there are no countries or communities that are currently immune to the impact of natural disasters, it is possible to reduce the effects of these events through management strategies focused on risk reduction and adaptation. In addition to building resilience to the infrastructure, citizen preparedness strategies play a key role in reducing the effects of hazards that cannot be mitigated, as such strategies seek to improve the ability of individuals and communities to respond in the event of a natural disaster (Bronfman, Cisternas, Repetto, & Castañeda, 2019).

Such as emergency rations can be introduced, especially during natural disasters in the case of children who are severely wasted, if there are no medical complications, community-based therapeutic care is preferable to treatment in a hospital or clinic. Low-income families often cannot readily reach such in-patient facilities. Ready to use therapeutic foods (RUTFs) play an important role in community-based treatment. Children with moderate acute malnutrition may be provided with traditional blended and fortified food aid, (Bhutta et al.,2008). For refugees and internally displaced people in camp settings, fortification of rations, frequently using enterprises located in the host countries, has helped reduce “hidden hunger (Bhutta, ZA 2008)

The apparatus of Disaster Management needs to work hand-in-hand with the Sindh Climate Policy to avert and minimize impacts of natural and man-made disasters. The Strategic objects for Disaster Management are given as under:

DISASTER PREPAREDNESS AND RISK REDUCTION	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Strengthen community-based disaster preparedness and mitigation programs to build a society that is more informed about and resilient to a changing climate	Sindh PDMA, NDMA, Education, Information, Directorate of Climate Change ECC&CDD, Sindh Coastal Development Authority, Media and District Governments.
Enhance awareness about climate change and its implications towards incidences of natural disasters	Sindh PDMA, MoCC, Environment Climate Change and Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Local Government, PHED, Health, and NGOs.
Make disaster risk reduction a priority with a strong institutional basis for implementation	Sindh PDMA, Directorate of Climate Change ECC&CDD and Sindh Coastal

DISASTER PREPAREDNESS AND RISK REDUCTION	
Strategic Objectives/Outcomes	Responsibility and Lead Department
	Development Authority, MoCC, Media, Information NGOs,
Developing climate responsive infrastructure	Sindh PDMA, District Governments, Local Government, Agriculture, Supply and Prices, PHED, W&S, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, MoCC and Ministry of Water Resources.
Manage the increasing incidences of climatic extremes	Sindh PDMA, Irrigation, Local Government, PHED and P&D, NDMA, SIDA and Ministry of Water Resources in coordination with Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority

3.9 Land and Vulnerable Ecosystems

3.9.1 Coastal and Marine Ecosystems

Climate change has drastic impacts on the marine ecosystems (Hillebrand, et al., Climate Change: Warming Impacts on Marine Biodiversity, 2018). In coastal areas, climate change and eutrophication can lead to severe oxygen loss in “dead zones”, areas which have too little oxygen to sustain life. Global and regional models project that the oxygen content of marine waters will continue to decline as atmospheric and ocean temperatures rise and human population size increases. Moreover, the anthropogenic carbon dioxide being absorbed into the oceans leads to ocean acidification. These changes in temperature, acidity and oxygen content effect the ecological performance of marine species and ecosystems, resulting in changes in habitat availability, interaction of species and their productivity. Ocean warming tends to provoke a loss in species abundance and diversity in tropical regions, as maximal thermal tolerance levels are exceeded (e.g., in coral reefs). Climate change and ocean acidification are expected to further reduce the resilience of ecosystems by increasing the sensitivity of species to destructive and unsustainable fishing practices, heavy metals and organic pollutants, eutrophication and habitat degradation or loss (Harding, 2019).

Saltwater intrusion will have adverse impacts on the productivity of coastal agriculture in Sindh. The trend in sea level rise has been observed to be 1.1mm/year at the Karachi Harbour. Over the last 40 years, 10 to 15% decrease in precipitation in the coastal belt and hyper arid plains of Pakistan has been observed. It has been predicted that the Western Himalayan glaciers may retreat during the next 50 years, resulting in decrease in downstream river flows by 30% to 40%. Coastal areas of Sindh are highly vulnerable to tropical cyclones and associated storm surges. Tropical cyclones have struck coastal areas of Pakistan in 1999, 2000 and 2010 causing damage to the lives and properties of coastal communities. The changing climate is resulting in increased frequency, intensity and changes in tracks of storms (Memon & Shah, 2016).

Below are key actions for the implementation of Sindh Climate Change Policy in line with policies and actions in place with Sindh Coastal Development Authority:

ADAPTATION OF COASTAL AND MARINE ECOSYSTEMS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Decrease the impact of water related natural disasters by increasing the climatic adaptability of coastal areas	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, SEPA, Fisheries, NGOs and Local community groups

ADAPTATION OF COASTAL AND MARINE ECOSYSTEMS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Construct structural barriers for the protection of communities residing in low lying coastal areas against the rising sea level to reduce the vulnerability of the population to the natural hazards by exposure reduction	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority. W&S, P&D and Local Government - Pakistan Engineering Council
Increase adaptability and resilience of agriculture to climate change in coastal areas by introducing salinity tolerant crops	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Agriculture, Supply and Prices, Agriculture Universities, Directorate of Extension, P&D.
Reduce waste disposal in the coastal areas to improve the overall health of marine ecosystems	SEPA, Irrigation, PHED, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority
Maintain marine ecosystem to ensure a healthy fisheries' sector	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Fisheries and Wildlife, P&D, NGOs, WWF, IUCN and Pakistan Navy.

3.9.2 Rangelands

Not only the rangelands in Pakistan are a major source of forage for livestock, they are also a source of biodiversity and provide habitat to wildlife. The population of sheep and goat in Pakistan has increased at an annual rate of 2% and 1.25% respectively over the last 30 years. This increase, combined with increased area for crop production, clearing of area for residential and commercial purposes has put a substantial pressure on rangelands. Increased grazing pressure coupled with decreased landcover will subsequently lead to desertification of rangelands. In Sindh, these rangelands support millions of people and their livestock by providing a source of fodder, forage, food and fuelwood etc. In the absence of canal irrigation, seasonal rainfall during Monsoon is only source of water in these areas. Due to scarcity of water, the water resources of the area have not been recharged resulting in the local people having to wait long hours to collect water from the wells. Women and children spend six to eight hours daily to collect water. Consecutive droughts, over-grazing and exploitation of vegetation has decreased the productivity of rangelands. This has caused severe damage to the economy resulting in land degradation, reduction in milk & meat production and loss of biodiversity. Due to their extreme importance, they have been recognized within priority areas of environmental concern under National Conservation Strategy (Forest Department, Government of Sindh).

Below are key actions for the implementation of Sindh Climate Change Policy under this section.

RESTORATION AND CONSERVATION OF RANGELANDS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Facilitate the regeneration of rangelands	Forestry and Wildlife, Agriculture Supply and Prices, Agri Extension, NGOs, and Media. MoCC and Directorate of Climate Change ECC&CDD
Promote grazing management systems	Fisheries and Livestock, Directorate of Climate Change ECC&CDD, Agriculture, Research organizations, veterinary institutes, private sector, NGOs, and Media

3.9.3 Wetlands

Sindh supports more than 100 wetlands, where approximately 90% of wetlands are located on the left bank of river Indus. These wetlands range from marine, estuarine, lacustrine and riverine to palustrine wetlands. These wetlands provide livelihood to local communities and support species of flora and fauna. Wetlands are highly vulnerable to the impacts of climate change. The threats to the wetlands of Sindh are both natural and anthropogenic. These threats include shortage of water, disposal of untreated agricultural and industrial effluents, siltation, threats to local biodiversity due to introduction of exotic species, urban sprawl, illegal hunting, over-exploitation of natural resources, overgrazing, wetland deforestation, low rainfall, high evaporation rate, coastal erosion, population explosion and droughts etc. Out of 19 declared Ramsar wetlands in Pakistan, 09 are situated in Sindh province (Siyal D. A., 2020).

Below are key actions for the implementation of Sindh Climate Change Policy to secure wetlands:

SUSTAINABILITY OF WETLANDS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Prevent wetlands' degradation by effective management practices	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Forestry and Wildlife, Irrigation, Agriculture Supply and Prices, Accademia, WWF, IUCN and NGOs
Build capacities of research and development and education regarding wetland conservation	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Academics, Forestry and Wildlife, Irrigation, Agriculture, P&D, Environment, Climate Change and Coastal Development, MoCC, Ministry of Water Resources, Ministry of Food Security

3.9.4 Deserts

The Sindh province is primarily arid. The desert region in Sindh covers approximately an area of 68,000 km sq. and comprises of Thar, Nara and Kohistan. Majority of the people living in these deserts are involved in livestock production and cattle raising. Due to lack of infrastructure, education and resources, the economic potential of the residents is very limited. Animal mortality is very high in this region due to consecutive droughts. Since rain is the main source of water in this region, agriculture and livestock activities are dependent on rainfall, the failure of monsoon means no fodder for the cattle and livestock (Indus Ecoregion Programme). Aridity, scare and variable rain, extremely high temperatures, low humidity and high evaporation rates render many areas in Sindh highly vulnerable to drought (Rahman, Khan, & Shaw, 2015). Below are key actions for the implementation of Sindh Climate Change Policy under this section.

REGENERATION OF DESERT ECOSYSTEM	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Improve and develop water availability to manage the limited water resources	Irrigation, PHED, Local Government, Directorate of Climate Change ECC&CDD and P&D initiatives.
Enhance the use of advanced irrigation technologies to increase vegetation	Irrigation, Sindh PDMA, Agriculture Extension Services and Directorate of Climate Change ECC&CDD
Increase vegetation cover to reduce degradation of land	Directorate of Climate Change ECC&CDD, Forestry and Wildlife,

REGENERATION OF DESERT ECOSYSTEM	
Strategic Objectives/Outcomes	Responsibility and Lead Department
	Fisheries and Livestock academics, NGOs, extension services

4. MITIGATION ACTIONS

4.1 Energy Sector

Energy demand is increasing by approximately 9% in Pakistan. It is further expected that energy demand will increase 8-fold by 2030 and 20-fold by 2050 in the country. Dependence on the energy structure of the country on limited thermal resources and underutilization of renewable energy resources (fulfilling only 0.3% needs of the country) is a significant reason for energy crisis in the country (Irfan, Zhao, Ahmad, & Mukeshimana, 2019). The constantly growing population of the country puts a significant strain on energy availability. Coupled with the consequences of climate change, there is a constant rise in the insecurity of access to energy resources. Climate change also adds to the energy insecurity by increasing the energy demand of already limited resources (such as need for air conditioning and heating appliances) and reducing energy supply (such as inconsistent water supplies can reduce hydropower production and affect the cooling facilities of thermal plants). Energy infrastructure is also at a great risk due to extreme weather events, particularly in low-lying coastal areas (Parry, 2016). Below are key actions for the implementation of Sindh Climate Change Policy under this section.

ENABLING GREEN ENERGY GROWTH	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Increase access to information (research, data collecting and monitoring, and awareness raising), and institutional development (governance, partnerships, and institutions)	Energy Department, Industries, Pakistan Meteorological Department, MoCC, Ministry of Water Resources, Irrigation, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Media, Research Institutes, Private Sector and NGOs
Improve existing infrastructure and incorporate climatic considerations in future planning by investing in climate-resilient assets	Energy Department, Industries, PHED, Sindh Coal Authority, Directorate of Climate Change ECC&CDD, Sindh Coastal Development Authority, and P&D.
Reducing consequences of climate change by decreasing technological, behavioural and structural vulnerabilities of energy infrastructure to climate change	Energy, Industries, Revenue, Coastal Development Authority, Sindh Coal Authority, Irrigation, WAPDA, Ministry of Water Resources, Directorate of Climate Change ECC&CDD and MoCC.
Diversify energy systems to have a profound impact on resilience to climate change by having alternative means to produce energy to reduce vulnerability of the sector to climate change impacts and reduce issues of energy security due to climate change	Energy Department, Industries Department, Sindh Coal Authority, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Private Sector and Universities
Energy regulation to reduce energy losses due to disruption in supply and high demand	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Ministry of Water Resources, Energy Department, Industries, Pakistan Meteorological Department Mines and Mineral Department,

4.2 Industries

6% of Pakistan's annual CO₂ emissions are caused by industries (Abas, Kalair, Khan, & Kalair, 2017). Sindh is the most industrialized province of Pakistan. Industrial development has taken place in the province since the emergence of Pakistan. A number of steps were taken to establish industrial estates and zones in the province. Currently more than 50% of Pakistan's industry is located in Sindh (Ahmed & Mahmood, 2012). There are numerous industries currently operating in Sindh, including Engineering, Textiles, Consumer Goods, Defence vendors, Auto-parts, Hosiery, Light Engineering, Soap, Poultry, Electronics, Cotton, Leather products, Pharmaceuticals, Basic Chemicals, paints, LPG Plants, Food Processing, Flour Mills, Copper Wire, Looms and Sugar Mills etc. (Industrial Zones in Sindh)

The strategy for industrialization in Sindh promoted the creation of planned industrial estates and an engineering base. The first industrial estate to be established was the Sindh Industrial Trading Estate (SITE) in Karachi in 1947, which was meant to be the industrial hub of the country. SITE Karachi was provided with infrastructure such as water, roads and a sewerage network with the specific condition that it would be used only if the effluent from the factories was treated according to the requirement of the Factories Act of 1934. The plants and systems put up were not equipped to treat the effluent, it was also argued that treating the effluents would raise the cost of production. As a result, the industries excessively polluted air and water systems. The establishment of industrial estates in Landhi (1953), Korangi (1959) and North Karachi townships (early 1970s) resulted in intensive land use changes, causing an extensive harm to the environment (Industry in Sindh, 2015). Below are key actions for the implementation of Sindh Climate Change Policy under this section.

INDUSTRIES	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Promote renewable energy resources to reduce GHG emissions from industries	Industries Department, MoCC, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority and SEPA
Control emissions and effluents from the industries by encouraging treatment of industrial waste	Industries Department, MoCC, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, P&D and SME Banks and SEPA
Monitor the industrial emissions	Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Industries, SEPA and Corporate Sector

4.3 Transport

The transport sector in Pakistan is continuously growing. The transport sector contributes 24% of carbon dioxide. The emissions are caused by sea travel (10%), rail (2%), buses (6%), wheelers (2%), passenger cars (45%), trucks (23%), local (5%) and international (7%) air travel. The air pollution caused by excessive emission of GHG from transportation sector further results in global warming (Abas, Kalair, Khan, & Kalair, 2017). The transportation infrastructure is in-turn impacted by the weather extremes and disasters. More storms in regions may increase the number of weather-related delays and flight cancellations. Higher temperatures near airports may reduce the maximum take-off weight or require longer runways due to less dense air. Extreme heat can also soften paved roads, disrupting road transportation. Unpaved roads and bridges are especially vulnerable to intense rainfall and flooding. Frequent freeze-thaw cycles in cold regions will damage both the base and paved surface. Increased rainfall, flooding, sea-level rise and increased incidence of freeze-thaw cycles undermine the stability of railways (Intergovernmental Panel on Climate Change, Fifth Assessment Report).

Below are key actions for the implementation of Sindh Climate Change Policy under this section.

4.3.1 Road Transportation: Minimizing GHG Emissions

ROAD TRANSPORTATION	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Develop low emission fuels to reduce the GHG intensity from the road transportation systems	Transport Department, Energy, Ministry of Petroleum, Directorate of Climate Change ECC&CDD, MoCC and Private Sector
Generate evidence for impact of transportation on climate change	Transport Department, Energy, P&D, Directorate of Climate Change ECC&CDD, Research Institute/ Academics, MoCC and Private Sector
Encourage efficient and green transportation modes	Transport Department, Energy, P&D, Directorate of Climate Change ECC&CDD, Research Institute/ Academics, MoCC and Private Sector
Promote behaviour change through education and awareness	Transport Department, Energy, P&D, Directorate of Climate Change ECC&CDD, Research Institute/ Academics, MoCC and Private Sector
Overcome the urban flooding through effective drainage approaches and systems	PHED, Local Government, District Government, Directorate of Climate Change ECC&CDD and Transport Authorities.

4.3.2 Air Transportation: Minimizing Impacts from Aviation

AIR TRANSPORTATION	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Reduce the aviation emissions to combat climate change	Pakistan Civil Aviation Authority – Airlines, Energy, Directorate of Climate Change ECC&CDD and MoCC

4.3.3 Railways: Increasing Railway Efficiency

RAIL TRANSPORTATION	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Amplify the railway systems to combat climate change	Pakistan Railways – Private Sector, MoCC and Directorate of Climate Change ECC&CDD

4.4 Solid Waste

Approximately 1% of annual CO₂ emissions in Pakistan is caused by the waste generated. Pakistan needs to improve its solid waste management techniques to increase efficiency and reduce emissions (Abas, Kalair, Khan, & Kalair, 2017).

The most common types of solid waste in Pakistan are: Municipal Solid Waste, Industrial Waste and Agricultural Waste. The average generation rate of Municipal Solid Waste ranges from 1.9 Kg/house/day to 4.3 Kg/house/day in the major cities of Pakistan. More than 90% of the collected waste is either openly dumped in low laying areas or placed into open surface water carrying channels and sewers (Korai, Mahar, & Uqaili, 2014). In Karachi and Hyderabad, the two biggest cities of Sindh, 9,440 tons/day and 3,581 tons/day solid waste is generated (Ghauri, 2018).

Contamination of existing water resources due to discharge of untreated industrial and sewage effluents in waterbodies has rendered the water resources of the country deficit. Utilizing this

polluted water results in a plethora of health issues. Waste water from plastic factories, illegal cattle pens, slaughterhouses and untreated sewage is discharged into nearby water bodies like canals and rivers. These further supply water for irrigation, resulting in numerous foodborne diseases (IJAZ, MAHAR, SOLANGI, PANHWAR, & ANSARI, 2017). Below are key actions for the implementation of Sindh Climate Change Policy under this section.

MANAGEMENT OF WASTE	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Develop an effective solid waste management and sewage treatment / disposal plan in the province including for all major cities considering the 5Rs ‘reduce, reuse, recycle, recover and redesign’, particularly for non-biodegradable plastic waste	Solid Waste Management Board, Solid Waste Management Companies and Units Agriculture, Local Government, PHED, P&D, Industries and Directorate of Climate Change ECC&CDD
Implement good site practices for efficient management of waste	Solid Waste Management Board, Local Government Authorities, Workers, SEPA, P&DD and MoCC
Adopt approaches to reuse the waste generated	Solid Waste Management Board, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority
Enhance the community resilience by promoting waste segregation for composting, recycling and reuse of materials	Solid Waste Management Board, Local Government Authorities, Workers, SEPA, MoCC, P&D, CBOs, NGOs, Private Sector

4.5 Forestry and Wildlife

Forests are essential for management and sequestration of carbon. They play a major role in climatic regulation by acting as a sink and reservoir for carbon dioxide, but at the same time climate change will have a direct bearing on global forest cover often resulting in migration of forest species (Buizer & Humphreys, 2013). Only 8% area of Sindh is under forest cover where the productive forests (riverine forests and irrigated plantations) cover only 2.29% area, indicating extremely scarce forest resources of the province (Forest Department, Government of Sindh).

The forests of Sindh hold a very important economic value for humans and provide habitat to numerous amounts of wildlife. Afforestation and reforestation are therefore essential to sustain ecosystems and subsequently human life. Under UNFCCC, REDD+ safeguards added poverty alleviation and an environmental dimension, denoting that forests provide a range of public and private goods in addition to carbon sequestration. Below are key actions for the implementation of Sindh Climate Change Policy under this section.

MANAGING CURRENT FOREST RESOURCES	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Strengthen the resilience of forest ecosystems	Forestry and Wildlife, Fisheries and Livestock, Agriculture Local Government, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, MoCC, WWF, IUCN and academics
Implement the principles of REDD+ (reduce emissions from deforestation and forest degradation)	Forestry and Wildlife, Fisheries and Livestock, Agriculture Local Government,

	MoCC, WWF, IUCN, NGOs, and academics
Conduct regular analysis to assess the progress and effects of implementation actions	Forestry and Wildlife, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, MoCC, WWF, IUCN and academics

4.6 Agriculture, Livestock and Fisheries

According to the national GHG inventory of Pakistan for the year 2011–2012, 44.8% of GHG are produced by the agriculture and livestock sector (Chaudhry, 2017). The global GHG emissions from agriculture sector is similar to the total emissions from industries and is greater than the emissions from transport sector. Methane and nitrous oxide produced from the livestock sector contribute much more to the warming of earth than carbon dioxide. Livestock production, including deforestation for grazing land and soy-feed production, soil carbon loss in grazing lands, the energy used in growing feed-grains and in processing and transporting grains and meat, nitrous oxide releases from the use of nitrogenous fertilizers, and gases from animal manure (especially methane) and enteric fermentation, are major sources of GHGs (McMichael, Powles, Butler, & Uauy, 2007). Livestock and livestock systems are a major cause of global warming and hence climate change. Climate change will have major impacts on poor livestock keepers and on the ecosystem goods and services on which they depend. (Thornton, Herrero, & Ericksen, 2011).

Below are key actions for reducing Green House Gases (GHG) under Sindh Climate Change Policy to comply Nationally Determined Contributions of CO₂:

GHG REDUCTION	
Strategic Objectives/ Outcomes	Responsibility and Lead Department
Reduce gaseous emissions from the agriculture, livestock and fisheries sectors	Fisheries and Livestock, Agriculture, Irrigation, W&S, Energy, Industries, Local Government, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, MoCC, WWF, IUCN, NGOs, and academics
Initiate behaviour changes for changing consumption patterns	Fisheries and Livestock, Agriculture Supply and Prices, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Media, Information and NGOs
Create and promote awareness regarding impact of climate change on livestock	Fisheries and Livestock, Agri Extension, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority, Corporate sector and NGOs.

4.7 Urban Planning

Climate change poses a serious threat to sustainable urban development, placing many cities at risk. The increasing natural disasters have escalated the human and economic losses. If no effective adaptation and mitigation actions are taken, climate change will further increase the negative impacts on urban societies. Cities have always been perceived as places of refuge from disasters but today they are better described as disaster hotspots. The environmental changes humanity is facing are deeply intertwined with complex urbanization processes and are happening at a before unseen rate and magnitude. Therefore, it is essential that policy

makers and development planners take the impact of climate change on urban centres into account in order to ensure sustainable development (Wamsler, Brink, & Rivera, 2013).

Cities have essentially three roles in the climate change arena. The first is to reduce the risk of climate change; second is to develop vulnerability profiles for the range of risk faced on the basis of geography and geology and finally, developing strategies for adapting to climate change on a macro and micro-scale. Each of these roles needs to be examined in some depth so cities can act responsibly in responding to the impacts of climate change (Cobbinah, Asibey, Opoku-Gyamfi, & Pephrah, 2019).

Due to better employment opportunities and living standards, unchecked migration from rural to urban areas is increasing. Urbanization must be planned and urban plans must be implemented. Failure to do so will result in negative social, environmental and economic consequences. This has indeed happened in the case of Sindh. Sindh has the highest urbanization rate in Pakistan. Its land resources have already been degraded to a great extent, its water resources have depleted besides seriously salinizing and waterlogging the fertile soil and the infrastructure of its urban centres are in shambles (Panhwar, 2020).

Below are key actions for Urban areas under the Sindh Climate Change Policy under this section.

CLIMATE RISKS TO URBAN AREAS	
Strategic Objectives/Outcomes	Responsibility and Lead Department
Develop profile of risks around climate change on urban areas	Urban Unit, Planning and Development Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority
Update town planning in accordance with the changing climate	Urban Unit, W&S, Forestry, Agriculture, and Planning and Development, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority
Create awareness among the public regarding limitation of natural resources	Urban Unit, Planning and Development, Local Government, Media, Information, Directorate of Climate Change ECC&CDD and Sindh Coastal Development Authority,
Manage the existing urban framework	Social Protection Authority, Urban Unit, Transport, PHED, KWSB, Local Government, P&D Directorate of Climate Change ECC&CDD and Finance. Sindh Building Control Authority.
Manage the municipal and industrial waste	Directorate of Climate Change ECC&CDD, Solid Waste Management Board, Local Government, Industries, SEPA, Energy, Sindh Building Control Authority

5. MONITORING AND EVALUATION OF IMPLEMENTATION FRAMEWORK OF SINDH CLIMATE CHANGE POLICY

In line with National Climate Change Policy 2021, the updated Nationally Determined Contributions, the Sindh Climate Change Policy 2022 shall develop a robust implementation

framework and action plan for the Climate Change and Climate Adaptation initiatives for the province.

The implementation framework and action plan shall be developed in coordination with United Nations World Food Programme (UN-WFP)'s initiatives on Climate Change and shall be all inclusive, taken all the stakeholders on board, like UN Agencies, local and international NGOs working in the province, development partners and corporate entities.

The implementation framework and action plan shall make a difference for Sindh in ensuring a better and climate friendly environment for its citizens.