



SINDH CLIMATE CHANGE POLICY

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List of Abbreviations

ADB	Asian Development Bank
AF	Adaptation Fund
AQI	Air Quality Index
AR5	Fifth Assessment Report of IPCC
AWDT	Alternate Wetting and Drying Technique
CC	Climate Change
CCD	Climate Compatible Development
CDM	Clean Development Mechanism
COP	Conference of the Parties
CPEC	China Pakistan Economic Corridor
DMP	Disaster Management Plan
DRR	Disaster Risk Reduction
ENERCON	National Energy & Conservation Centre
FCPF	World Bank's Forest Carbon Partnership Facility
FFC	Fauji Fertilizer Company
GCF	Green Climate Fund
GCF	Global Climate Fund
GCISC	Global Change Impact Studies Centre
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse gas
GoS	Government of Sindh
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LCD	Low Carbon Development
LEAD	Leadership for Environment and Development
MMCFD	Million cubic feet per day
MW	Megawatt

NCCP	National Climate Change Policy
NDC	Nationally determined contributions
NDMA	National Disaster Management Authority
NFP	National Forest Policy
NTFP	Non-Timber Forests Produce
Oxfam	Oxford Committee for Famine Relief
Pak EPA	Pakistan Environmental Protection Agency
PDMA	Provincial Disaster Management Authority
PMD	Pakistan Meteorological Department
PPIB	Private Power and Infrastructure Board
PPP	Public Private Partnership
R&D	Research and Development
REDD	Reducing Emissions from Deforestation and Forest Degradation
SCCP	The Sindh Climate Change Policy 2017
SDG	Sustainable Development Goals
SITE	Sindh Industrial Trading Estate
SME	Small and medium-sized enterprises
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VETS	Vehicular Emissions Testing Stations
WAPDA	Water and Power Development Authority
WWF	World Wild Fund

Preamble

Due to higher Green House Gas emissions, the earth is experiencing a higher rise in average temperature (Up to 4° Centigrade or higher in 100 years), which is drastically influencing the changes in the weather patterns, resulting in melting the Ice-caps, causing flash floods, droughts, cyclones, hurricanes, abnormal increase or decrease in rainfall, arising water scarcity, desertification, change in crop-yield, sea level rise or coastal flooding, causing vector-borne diseases, and many unexpected natural disasters including the changes in major river systems and even adversely affecting Bio-diversity. Following the 1992 Rio Earth Summit, climate change has become an area of high politics, engaging the whole world at the international and diplomatic level. What matters, though, is how this translates into tangible policies at national as well as provincial levels, and how these different scales interact.

Pakistan, a signatory to the Paris Agreement, is the seventh most affected country impacted by weather-related events, as calculated through available data from 1997 to 2016, according to the 2018 Long-Term Climate Risk Index Pakistan. During this 20-year period, the country saw 141 extreme weather-related calamities, taking the annual average death toll to 523 and causing an economic loss of USD 3,816.82 million. In 2016 alone, there were 566 climate-induced casualties in Pakistan and the nation suffered a loss of USD 47.31 million¹.

The country saw 1,800 people displaced due to natural disasters in 2017. Sindh in particular has faced the consequences of Climate Change with living patterns and livelihoods of people being adversely affected. Droughts in Thar, floods and cyclones in Badin, Sujjawal and Thatta in 2010 and 2011, heat waves in Karachi in recent years, particularly in 2015, are some of the affects that have already been felt. Furthermore, sea intrusion near the Indus Delta has triggered coastal floods and caused large-scale inland migration.

Sindh's Policy on Climate Change serves as **a reference framework for the various interventions in the areas of climate change in Sindh**. The vision of the Policy is to define a framework by Sindh government for sustainable socio-economic development that integrates the challenges of climate change in all sectors of its development in order to improve the well-being of the populations. Sindh's Climate Change Policy comprehensively addresses all possible challenges of Climate Change adaptation and mitigation in foreseeable future; and sure to provide rock solid foundational framework for ensuing Climate Change Action Plans, Programs and Projects.

The policy thus provides a comprehensive framework and support from the province for the development of Action Plans for national efforts on adaptation and mitigation. Successful implementation of the Policy in relevant sectors like agriculture, water resources, forestry, wildlife etc. will help in achieving targets pertaining to Climate Change resilience. This policy document is a '**living**' document and will be reviewed and updated regularly to address emerging concepts and issues in the ever-evolving science of climate change.

¹ <https://www.iucn.org/news/pakistan/201901/sindhs-climate-migration-report-launched-policy-dialogue>
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Acknowledgement

Formulation of Sindh Climate Change Policy (SCCP) is a milestone in the history of Sindh environment and climate change sector as well as start of new era where policy making as per provincial government vision will set the future agenda of development, public sector leadership and way forward.

For this particular task of developing SCCP, Government of Sindh acknowledges the efforts by the staff of LEAD Pakistan Consultants, Officers and Staff of Environment, Climate Change & Coastal Development Department, and especially Mr. Waqar Hussain Phulpoto, Director (Technical) Sindh Environmental Protection Agency for his contribution towards framing & publishing this policy, who coordinated all the essential work to make this policy a reality, various other government departments and all those experts, stakeholders who participated in this exercise with a keen interest in climate action for their proactive help, support and participation in the whole process of developing the Policy.

The valuable support and input of different federal & provincial ministries, the Chief Secretary Sindh Office, Planning and Development Department, Government of Sindh, Ministry of Water and Power, Ministry of Food Security, Ministry of Industries, Ministry of Foreign Affairs, and other Government agencies and various national institutions including Pakistan Fisherfolk Forum, WWF-Pakistan, IUCN, different NGOs through their contributing inputs are also highly acknowledged. We also appreciate the role of academia, especially Bahria University Karachi and Agha Khan University by providing invaluable critique and feedback in evaluating this Policy document. The invaluable guidance provided by Mr. Shams-ul-Haq Memon, Mr. Rafi-ul-Haq and Mr. Nasir Panwhar is greatly appreciated.

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1 Goal

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 *growth*² and *climate compatible development*³.

2 Policy Objectives

- Formulate a nuanced province specific policy that is line with National Climate Change Policy (September 2012) and Twelfth Five Year Plan (2018-23) of the federal government that combines inclusive growth with green development.
- Enhance awareness of the impacts of climate change among all stakeholders for necessary appropriate measures to combat and minimize these impacts.
- 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.
- Link the province's needs to the *National Climate Change Policy Framework for Implementation*
- Enhance interdepartmental coordination and cooperation for effective climate action.
- Ensure water, food, and energy security for Sindh province in the face of a changing climate.
- Address climate change risks particularly those arising from climate-induced disasters.
- Ensure interests of vulnerable groups and that gender aspects are adequately addressed in climate development strategies and planning.
- Develop bases to secure sufficient financial and technological support, and strengthen institutional and human resource capacities to achieve policy objectives; and to be able to tap financial and technological opportunities available internationally.

3 Climate Change – Definitions and Concepts

Climate Change impacts can be reduced or tackled by adopting mitigation and adaptation strategies in accordance with the geographic location, terrain, availability of resources and potential natural disasters threats in that area. Various market based economic forums, strategies and instruments are in place to incentivize reduction and control of emissions and reduce global Climate Change.

Global Warming- is an increase in the Earth's average surface temperature from human-made greenhouse gas emissions.

Climate Change- to the long-term changes in the Earth's climate, or a region on Earth, and includes more than just the average surface temperature.

² As envisioned by the Government of Sindh.

³ ***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. See chapter 10 for more comprehensive explanation.

Adaptation- is a process, or set of initiatives and measures, that aims to reduce the vulnerability of natural and human systems against actual or expected climate change effects. It is considered as the art of learning how to live with the consequences of climate change.

Mitigation- the term used to describe the process of reducing GHG emissions that contribute to climate change. It includes strategies to reduce GHG emissions and enhance GHG sinks.

Carbon Capture and Storage- The collection and transport of concentrated carbon dioxide gas from large emission sources, such as power plants. The gases are then injected into deep underground reservoirs. Carbon capture is sometimes referred to as geological sequestration.

Carbon Offsetting- A way of compensating for emissions of CO₂ by participating in, or funding, efforts to take CO₂ out of the atmosphere. Offsetting often involves paying another party, somewhere else, to save emissions equivalent to those produced by your activity.

Cap and Trade- An emission trading scheme whereby businesses or countries can buy or sell allowances to emit greenhouse gases via an exchange. The volume of allowances issued adds up to the limit, or cap, imposed by the authorities.

Carbon market- A popular term for a trading system through which countries may buy or sell units of greenhouse-gas emissions in an effort to meet their national limits on emissions, either under the Kyoto Protocol or under other agreements, such as that among member states of the European Union. The term comes from the fact that carbon dioxide is the predominant greenhouse gas, and other gases are measured in units called "carbon-dioxide equivalents."

Kyoto Protocol- An international agreement standing on its own, and requiring separate ratification by governments, but linked to the United Nations Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol, among other things, sets binding targets for the reduction of greenhouse-gas emissions by industrialized countries.

Conference of the Parties (COP) - The supreme body of UNFCCC, which meets once a year to review the Convention's progress. The word "conference" is not used here in the sense of "meeting" but rather of "association". The "Conference" meets in sessional periods, for example, the "fourth session of the Conference of the Parties."

Green Climate Fund (GCF) - At COP 16 in Cancun in 2010, Governments established a Green Climate Fund as an operating entity of the financial mechanism of the Convention under Article 11. The GCF will support projects, programs, policies and other activities in developing country Parties. The Fund will be governed by the GCF Board.

NDC- According to Article 4 paragraph 2 of the Paris Agreement, each Party shall prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

National Climate Change Policy 2012 - It supports the shift to a resource-efficient, low-carbon economy to achieve sustainable growth. It provides a long-term framework for action to factor in resource efficiency in a balanced manner in many policy areas, including climate change, energy, transport, industry, agriculture, biodiversity and regional development.

UNFCCC - United Nations Framework Convention on Climate Change (UNFCCC) seeks to reduce international GHG emissions by setting National level targets based on the concept of 'common but differentiated responsibility'. This means that nations which emit majority of GHGs need to reduce GHGs at a greater rate.

4 Climate Change Impacts and Challenges in Sindh

In Pakistan, the annual mean temperature has increased by about 0.5°C during the last half a century and the number of heat wave days per year has increased fivefold. The projections are that increased temperature will intensify irrigation water and household energy demand due to higher evaporation rates and air conditioning requirements respectively. Yields of wheat and basmati rice are expected to decline. Urban drainage systems will be stressed during extreme rainfall events and flash floods⁴.

Overall, Pakistan has suffered most in terms of loss of life i.e. 174,000 deaths and US\$26bn of economic loss during 1995 to 2014 due to extreme climate events⁵. State University of New York calculates that only the super floods of 2010 caused an infrastructural damage of \$7.1 billion and washed away more 5,000 miles of roads and railways, 7,000 schools destroyed and 302,000 houses in Pakistan. A major part of damage was done in Sindh Province. Sindh's climate is described as arid owing to low precipitation patterns, River Indus flowing through the heart of the province, and seasonal streams inundating some parts of the province during monsoon season. Sindh is an agrarian and pastoral economy. Agrarian practices in the province depend entirely on irrigation. Natural resource extracted from the province contribute significantly to the national output. Industries located in the province play an active role in meeting domestic needs and exports of the country (PDMA 2016).

Sindh is particularly affected with various manifestations of Climate Change such as increased variability of river flows and floods, heat waves and drought. Sea level along the Karachi coast has risen approximately 10 centimeters in the last century and is expected to further rise by 60 centimeters by the end of the century to threaten the low-lying coastal areas south of Karachi toward Keti Bander and the Indus River delta affecting the infrastructure and livelihoods in these areas. By the end of this century, the annual mean temperature is expected to rise by 3°C to 5°C⁶.

These risks are impacting the health and economic well-being of the population and are resulting in social conflicts as well. Different natural events such as floods, droughts and storm surges have also led to "climate migration". Climate change repercussions in Sindh merit attention, since it is the country's most urbanized province with an estimated population of nearly 47.55 million people, 49.5 percent of whom live in urban areas⁷. According to World Bank, 15 per cent of the total GDP of Sindh is being lost yearly due to the environmental degradation and climate change, which is much higher than national figures. According to the National Disaster Management Authority (NDMA), the 2011 floods in Sindh damaged nearly 80 percent of the cash crops in Sindh.

Minimum and maximum temperatures in summers and winters have increased throughout Pakistan. With winter season showing a greater warming trend than summers. These have

⁴ Chaudhry Q.Z. (2017). Climate Change Profile of Pakistan. ADB. Accessed at <https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf>

⁵ TIU, 2014
https://www.academia.edu/35243533/CLIMATE_RISK_MANAGEMENT_FRAMEWORK_FOR_BUSINESS_ORGANIZATIONS_IN_PAKISTAN

⁶ ibid

⁷ Pakistan Bureau of Statistics, 2016

added to heat stresses and water requirements throughout the province. However the coastal belt has not shown any cooling or warming trends. Find the implications for Indus delta mentioned in the figure below (Afzal et al. 2012).

Implications for Indus Delta

Increase in maximum and minimum temperature in winter season results in shorter winter and longer as well as summer. Following implications are foreseen due to ongoing trend;

- Late onset and early ending winter will reduce the length of the growing season for crops which will complete their biological life cycle quickly causing reduction in the economic yields as the plants will gain accelerated maturity without reaching proper height and size.
- Early end of winter means that temperatures will start rising in February when wheat crop reaches the grain formation stage. Sharp rise in temperature will cause forced maturity of grains. Neither the grains will gain proper size and weight nor accumulate optimum starch contents hence reducing the grain yield.
- Banana is another major crop of Indus Delta in which pollination will be affected due to early end of winter and high spring temperatures. Thermal stress would result in poor fruit set and dwarf yields.
- Such adverse effects are already visible and there is a dire need of adaptation strategies by introduction of crop varieties which require shorter span and bear the stress conditions.

Figure 1 Implications For Indus Delta(AFZAL ET AL. 2012)

The Indus Delta supports habitat for wildlife and 97% of the total mangrove forests and is home to over one million people, 135,000 of which depend on mangroves for their livelihood. It is expected that sea level rise will inundate low-lying areas and result in degradation of mangrove forests, declining drinking water quality, and decrease in fish and shrimp productivity⁸.

Changing precipitation patterns in Sindh depict predominant conditions of drought. Some flood years are a result of upstream water flowing downstream through the Indus River. The upstream and downstream river system is connected, surplus water in the upstream directly affects the low elevation plains of Sindh. Weak monsoons results in high temperatures and reduce water availability in Sindh, as upstream areas consume the scarce resource leaving little for downstream areas. This has deleterious impacts on crop production, especially in Sindh (Afzal et al. 2012)(Rasul 1992) (Rasul et al. 2004).

The Mangroves control or reduce cyclones and storms in coastal areas as tropical cyclones are likely to become more frequent and intense (Rasul et al. 2005). Strong winds from these cyclones have the potential to wipe off coastal infrastructure and life (Haider et al. 2008) these could have serious implications on the exports from Pakistan which are largely dependent on the ports located in Sindh province.

⁸ Chaudhry Q.Z. (2017). Climate Change Profile of Pakistan. ADB. Accessed at <https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf>

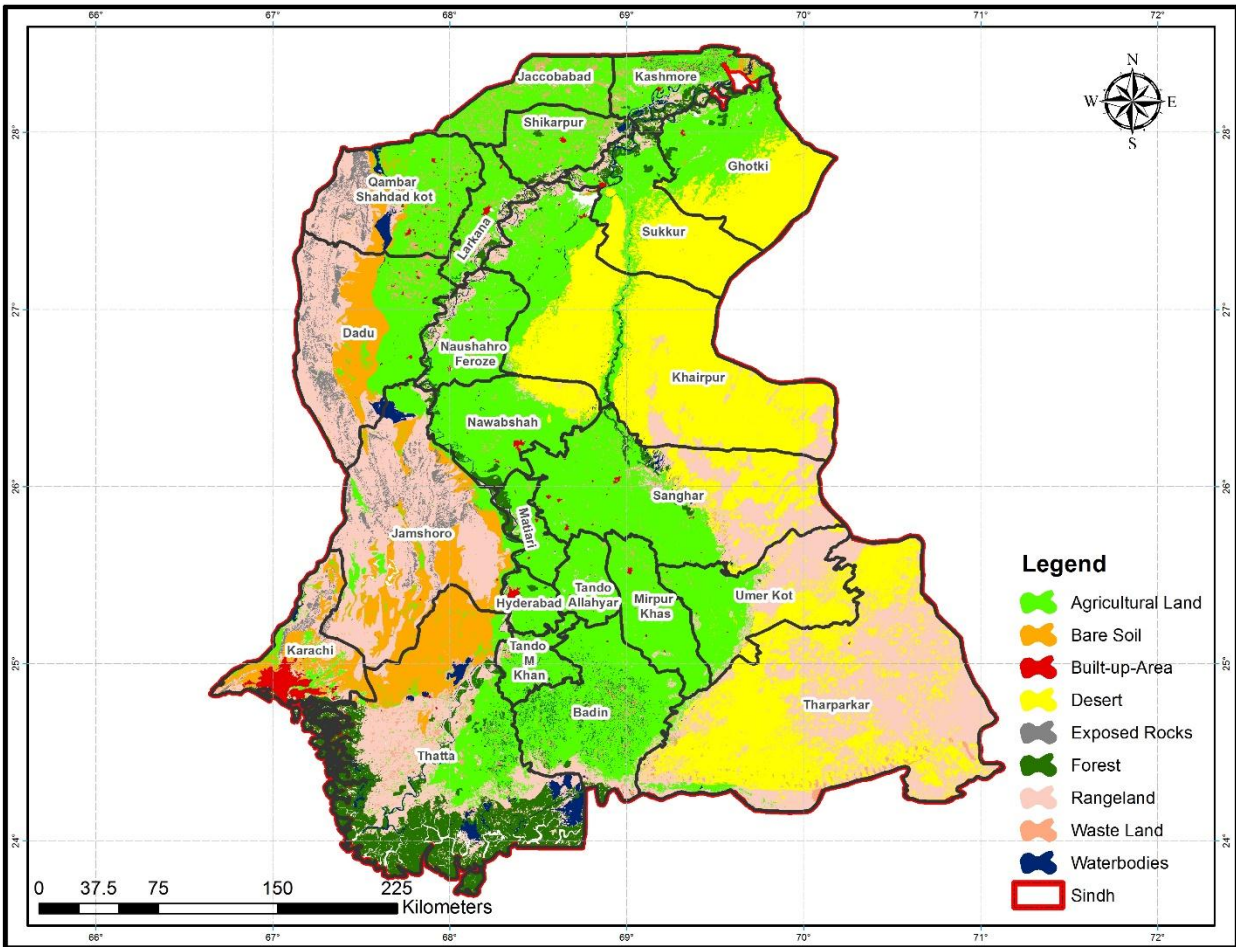


FIGURE 2 SINDH TOPOGRAPHY

The geographical terrain of Sindh is diverse and so is the health impact. The impact in Thar and desert areas, Larkana, Khairpur and similar districts, and the cities of Karachi and Hyderabad are not the same. These varied climate impacts need to be studied to come up with appropriate mitigation and adaptation measures for each segment of the population. Hence, many climate change impacts crosscut different ecological zones, the geographical diversity Sindh boasts of requires a region or area-wise climate change strategy and investment plans.

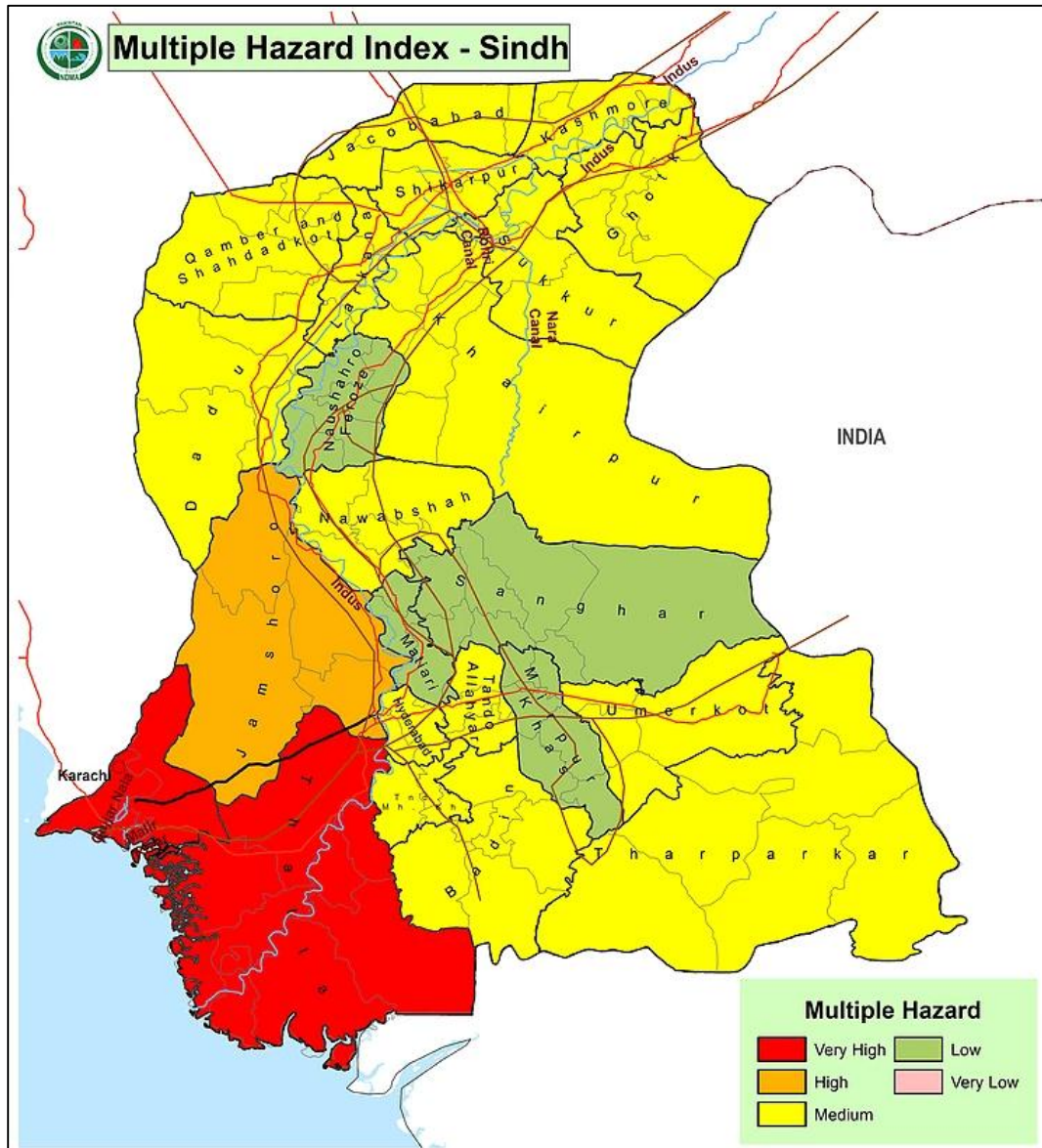


Figure 3 Multiple Hazard Index – Sindh (NDMA)

Droughts

About 65% of Sindh is arid with less than 100mm of average rainfall. The province has a long history of droughts such as in 1968-69, 1971-74, 1985-87 and 1999-2002. The districts of Tharparkar, Dadu and Sukkur (NDMA 2007) are especially prone to droughts (Khan & Gadiwala 2013). Tharparkar district has frequently being declared a 'drought calamity area' (Global Water Partnership 2015). Droughts in Achhro Thar, Nara, Kohistan, Kachho and the coastal belt have been wrought largely by climate change. The impact of droughts on communities depends on their vulnerabilities, exposure, and sensitivities.

According to the IPCC "The term drought may refer to meteorological drought (precipitation well below average), hydrological drought (low river flows and water levels in rivers, lakes Environment, Climate Change & Coastal Development Department, Govt of Sindh

and groundwater), agricultural drought (low soil moisture), and environmental drought (a combination of the above). The socio-economic impacts of droughts may arise from the interaction between natural conditions and human factors, such as changes in land use and land cover, water demand and use. Excessive water withdrawals can exacerbate the impact of drought.” (IPCC 2007).

Generally speaking, there are four kinds of droughts:

- Meteorological drought – Significant decrease from normal precipitation over an area.
- Agricultural drought – Soil moisture and rainfall inadequate to support the crops.
- Hydrological drought – marked depletion of surface water and fall in water tables.
- Socio-economic drought – The demand for goods or services exceeds the available supply as a result of precipitation conditions.

Tharparkar district is the only district in Pakistan whose Human Development Index value has plummeted over the years (Jamal, Haroon 2007). Droughts are slow on-set events which affect lives and livelihoods; their impact on cattle health & their mortality rates are pronounced; droughts increase short term and long term climate induced migration (National Disaster Management Authority 2011).

Floods

The districts along the River Indus are highly vulnerable to floods (National Disaster Management Authority, 2011). Flooding occurs due to glacial melt in upper catchment area, which is likely to accelerate owing to impacts of climate change. In the lower catchment area, consisting of Punjab and Sindh, flooding occurs as a result of water release from the upper catchment area and precipitation in the lower catchment area (Afzal et al. 2012). High temperatures, especially in the pre-monsoon period, are likely to increase the intensity of rains in Sindh. These affect the intensity, frequency, and impact of the five categories of floods the province is likely to be affected by. Historically, the districts most commonly affected, in terms of damages to human, wildlife, and rural/urban infrastructure, during 2010 and 2013 floods are Hyderabad, Shaheed Benazirabad, Sukkur, and Thatta (PCO, IMA, NASA 2012)(World Health Organization 2013). Experts from Sindh have commented on the historical trend of the Indus River changing its course every twenty to twenty five years, which changes the geographical pattern and extent of flooding.

According to the Government of Sindh flood hazard in Sindh can be divided into these five categories:

Monsoon Floods: Seasonal monsoon rains coupled with melting glaciers and torrential rains from decaying hurricanes inundate river basins.

Flash Floods: Rain water from storms enters arid regions through arroyo, water carved gully. As this water quickly moves through the dry soil a small fast moving river or a flash flood is created.

Floods due to breaches: Floods which occur due to breaches in river embankments and canals.

Urban floods: lack of climate resilient infrastructure reduces the ability of urban areas to absorb rain water, filling underdeveloped land in these areas.

Coastal floods: Hurricanes and cyclones hit the coastal areas by producing heavy rains or driving ocean water into land (PDMA 2016).

Heat Waves

Heat waves are caused by a prolonged period of hot weather. The World Meteorological Organization defines heat-wave as "when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 5°C, from the normal temperature of an area". In Pakistan these are common occurrences in the pre-monsoon period. Recently, some districts of Sindh have suffered disproportionately from their impacts on human health and mortality. Hot and humid weather prevalent in Sindh in the pre-monsoon period worsens the impact of heat wave as the Heat Moisture Index elevates⁹ the stress on human health. The trends of heat waves is likely to become a regular occurrence (Afzal et al. 2012) (uz Z. Chaudhry et al. 2015). Most of the province is located in the intense heat zone, which is expected to see 4-5oC temperature increase in 21st Century, therefore, the burden on human health will be immense due to heat strokes, diarrhea, cholera and vector borne diseases.

Effect on Crops

The increase in temperature will increase the rate of evaporation of moisture from the soil surface and transpiration from the plant tissues in the vegetated areas of the province. They will directly enhance the water requirement of field crops, animals, human beings as well as the domestic and the industrial sectors. ADB claims that the rise in temperature between 0.5-2°C would bring agriculture productivity down 8-10% by 2040.

The increased requirements of irrigation water in the province due to higher evapotranspiration will be compounded with lesser water availability mainly because of water diversions and damming upstream, inadequate storage capacity, and changes in river flows due to glacier melting and altered precipitation pattern. This will also result in degradation of rangeland and further deterioration of the already degraded cultivated land areas such as those suffering from water erosion, wind erosion, water-logging, salinity etc.

Cyclones and Sea Level Rise

Sindh has over 350 KMs long coast, rich in natural resources. The coastal areas of Sindh are most vulnerable and exposed to cyclones. According to some reports, Sindh coast had an average of four cyclones in a century. However, the frequency and intensity has increased manifold and the period 1971-2001 records 14 cyclones (A Review of Disaster Management Policies and Systems in Pakistan for WCDR 2005).

In summer, generally southwesterly winds prevail along the coastal areas of Sindh which bring monsoon rains to the area. Dynamics of south westerly has increased significantly producing enhanced precipitation over southeastern parts of the province. As these winds face the coast from south therefore their increased force has been rapidly eroding the land mass along the coast.

⁹ Heat Moisture Index is usually simplified as a relationship between ambient temperature and relative humidity versus apparent temperature (Chaudhry et al. 2015).

There is evidence of sea-level rise along the coast also. The figure below shows an upward positive trend of sea-level rise between 2007 and 2011. There are primarily two reasons for this; (i) thermal expansion of the oceans due to warming up of the water bodies and (ii) the loss of land-based ice due to melting.

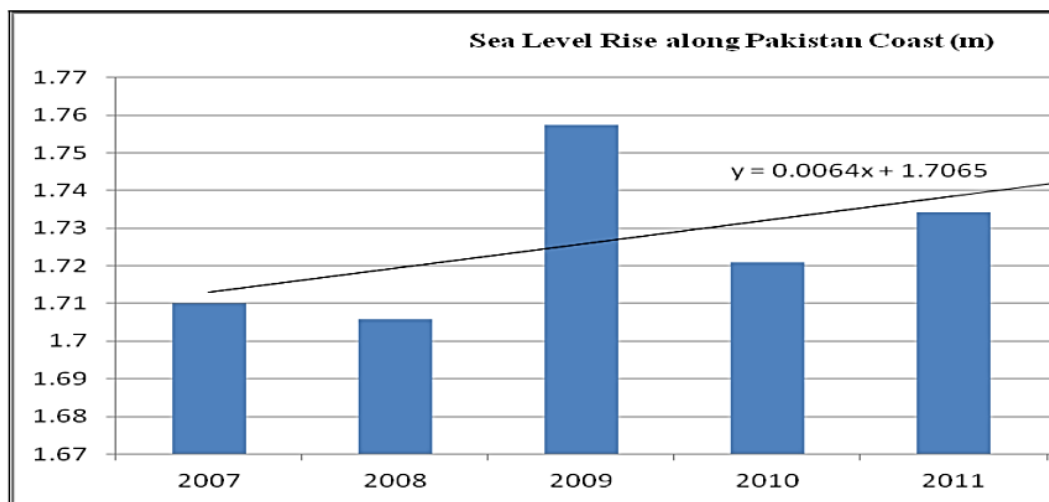


FIGURE 4 SEA LEVEL RISE ALONG PAKISTAN COAST (M)(AFZAL ET AL. 2012)

Saline Water Intrusion

Due to increased frequency of storm surges combined with the sea level rise, the sea water intrusion has become an emerging challenge which would claim more land area with the passage of time. The increased saline and sodaic contents of soil would deteriorate the yielding potential of fertile deltaic soils (Bot et al., 2000) and eliminate natural habitat along the shoreline and northward shift of biodiversity.

Besides that, the rising temperatures have led to an increased demand for water and excessive groundwater extraction in Sindh. Among other reasons, due to excessive groundwater extraction the interface boundary of saltwater and fresh water starts to move laterally towards the land and hence contaminates coastal aquifers – known as *sea-water intrusion in coastal aquifers*. Studies have shown that sea-level rise also has an impact on the state of saltwater intrusion in coastal aquifers. Coastal districts of Sindh, such as Karachi, Badin, and Thatta are highly vulnerable and the livelihoods of fisher communities is being negatively impacted by it.

Impact of climate change on coastal and marine environment:

Climate change threatens coastal areas, which are already stressed by human activity, pollution, invasive species, and storms. Sea level rise could erode and inundate coastal ecosystems and eliminate wetlands. Warmer and more acidic oceans are likely to disrupt coastal and marine ecosystems. Coastal development reduces the ability of natural systems to respond to climate changes. Coastal waters have warmed during the last century, and are very likely to continue to warm in the 21st century, potentially by as much as 4 to 8°F.

Marine species affected by climate change include plankton - which forms the basis of marine food chains. Coral bleaching; One of the most visually dramatic effects of climate change is coral bleaching, a stress response caused by high water temperatures that can lead to coral death. Altered lifestyles; rising temperatures can directly affect the metabolism, life cycle, and behavior of marine species. For many species, temperature serves as a cue for reproduction. Clearly, changes in sea temperature could affect their successful breeding. Acidic oceans; The effect could be that fish, squid, and other marine animals may find it harder to "breathe", as the dissolved oxygen essential for their life becomes difficult to extract as water becomes more acidic.

Effects on Mangrove Ecosystem

The important eco-systems in Sindh, such as mangroves, have come under extreme pressure due to sea water encroachment and deforestation. There has been mass depletion of mangrove forests in the area due to illegal logging, irrigation and untreated industrial waste. According to some estimates, merely 130,000 hectares of mangroves of the 600,000 hectares that existed at the start of the 20th century are now left (AFP, 2015). The region's dwindling mangrove resources merit attention because of their vast economic potential. For instance, fish produce from mangroves accounts for 68 percent of the total foreign exchange the country earns from fisheries exports (IUCN Pakistan, 2005).

Climate Change Impact on Fisheries

There are several factors that have an impact on the distribution and productivity of fish such as winds, water currents, rainfall and temperature. These factors are affected by climate change and natural hazards. Inland fisheries and aquaculture are affected by rising temperatures, changing evaporation rates, reduced rainfall and competing needs of water utilization. Impact of climate change on the fisheries include: changes in phenology such as the timing of spawning; altered diseases and parasite susceptibility and physiological stresses; changes to growth and reproduction rates; decreased oxygen availability; enhanced suppressed feed-conversion ratios in aquaculture systems; increased range and availability of warm water species for longer periods in a year (WWF 2014).

The above threats lead to major survival concerns for Sindh, particularly in relation to the province's water security, food security and energy security. Climate change is directly linked with sustainable development. In order to deliver and secure the region for future generations, the interlinked challenges of climate change and sustainable development must be understood and urgently addressed

5 Linking Policy with the Climate Compatible Paradigm and Sustainable Development Goals

5.1 Sindh Development Plans

Sindh's priorities areas, according to the Sindh Government Vision are, energy, water management, agriculture, industrial development, education and health, urban management and infrastructure building. The document recognizes climate change as the biggest threat to

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the physical environment and *water, energy* and *food* as three key sectors crucial for survival and a pre-requisite for economic growth. These are also closely related with climate change, where they are both affected by it and, at a different level, also have an impact on the climate themselves.

This policy is one of the first initiatives undertaken by any government of Sindh to prepare a comprehensive plan and strategy to combat climate change and promote green-growth in the economy.

5.2 Climate Compatible Development

There have been several emerging challenges since the beginning of the century, these include climate-induced floods, unprecedented rains, melting of glaciers, prolonged droughts and heatwaves, sea-level rise and earthquakes. They have triggered a new set of responses from countries across the world and have led policy makers, researchers and practitioners to think along new lines of development. The debate on who is responsible for the rise in GhG emissions and who is bearing the consequences has led to *climate finance* finding its way into the global trade and development discourse.

In the face of natural hazards, it is essential to have development that is able to bear the impacts of these hazards. *Climate resilient development* is defined as 'development that has the capacity to absorb and quickly bounce

back from climate shocks and stresses. Resilience in this context describes the amount of change a system can undergo, the degree to which it can re-organize and the extent to which it can build capacity to learn and adapt' (Mitchell & Maxwell 2010, p.5).

Climate resilience is being woven into development approaches worldwide which provide different development outcomes from business as usual scenarios. Climate resilient development therefore needs to be understood from various dimensions; Climate resilient agriculture, infrastructure planning, coastal zone development and Integrated water managements systems.

Low Carbon Development (LCD) aims to reduce carbon emissions, build resilience, support the development agenda and lift the living standards of those furthest behind without comprising on overall economic growth. LCD implies a needs-based approach that takes into account local specificities including the requirements, constraints and opportunities. Developing nations, although have contributed less to the emissions, they have had the

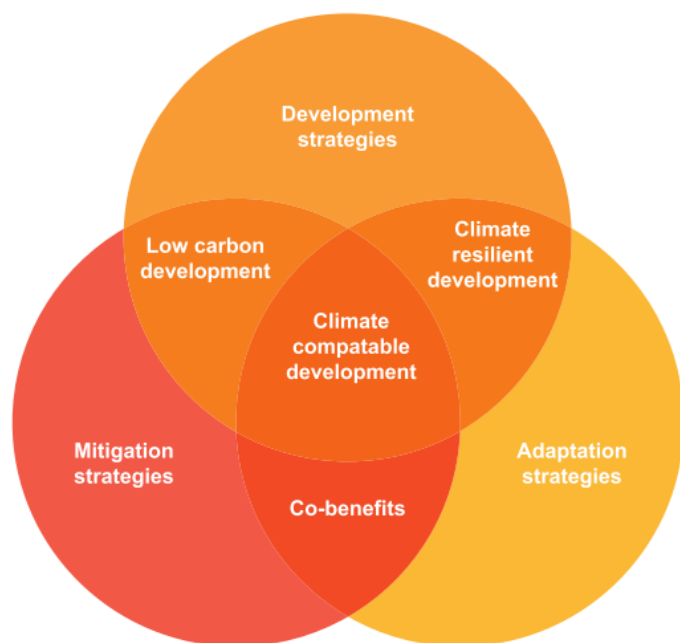


FIGURE 5 CLIMATE COMPATIBLE DEVELOPMENT

greatest impact on the developing and underdeveloped world. It stands to reason that countries like Pakistan can no longer promote this model of growth where emission-intensive finite resources are exploited freely. It is imperative that there is a shift in development paradigms that promotes using cleaner fuel and power generation.

Co-benefits emerge from linking the adaptation and mitigation by making mitigation strategies more resilient to climate change and implementing low-carbon adaptation strategies. The combination of development strategies, adaptation and mitigation leads to the realization of *climate compatible development*.

5.3 Linkages with Sustainable Development Goals

The new development agenda carved by the SDGs applies to all countries and aims to promote peaceful and inclusive societies, create better jobs and tackle the environmental challenges of our time, particularly that of Climate Change. In the Paris Climate Change Conference 2015 the world leaders reaffirmed their commitment and reached a global agreement to combat the challenge of climate change¹⁰ (CC).

Developing and developed nations must shape their development agendas in accordance with the 17 SDGs and the 169 targets that compliment them. Within the SDGs, climate change and environment are embedded in a greater number of goals and targets than before. Keeping this in mind, countries must make broader development agenda and frameworks that incorporate climate change and the environment.

The issue of anthropogenic climate change¹¹ itself stems from the rise in GHG emissions in the atmosphere and the various impacts it has on our lives and the environment. Sustainable development covers a wider array of subjects and stretches across various fields of study- climate change being one of them.

The SDGs present a greater challenge to sub-national entities on various levels. On the surface there are greater number of targets to be met (169) along with more than 200 indicators to be monitored.

Annex I summarizes the goals and targets related to climate change policy measures.

SDG 13 has been proposed as a dedicated goal towards combating climate change; SDG 13 *Climate Action: Take urgent action to combat climate change and its impacts*. It includes several targets that specifically aim to minimize the risk ensuing from climate change. Building resilience and adaptive capacity to climate related disasters, improve education, awareness

¹⁰ "Climate Change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods."

¹¹ "Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century" (IPCC 2014a, p.4).

and institutional capacity on CC mitigation, adaptation, impact reduction and early warning are components of goal 13. Furthermore, it states incorporation of climate change [adaptation and mitigation] measures into national policies, strategies and planning. The incorporation of these measures entail an integrated approach of development that take into account the consequences of climate change. This is why climate and environment-related targets can be found in 9 out of the 12 other SDGs.

The poor, most notably in the rural areas, rely heavily on the natural environment for their sustenance and livelihoods. Climatic change has an impact on the natural environment and therefore affects the livelihoods of the poor.

The Goals of eradicating poverty, improving food security, health and education are key aspects of human development. Economic growth is linked to these areas of human development and the nature of this association has an impact on the environment. The prevalence of poverty pushes people towards unsustainable use of natural resources such as burning of wood for fuel, cutting of trees, lack of proper sanitation and so on. Considering the fact that 51.2% of the people in Sindh live in the rural areas (PBS), this facet of the human – environment relationship cannot be ignored. When climate change is coupled with the prevailing negative relationship, it has a compounding impact on food security, health, education and water resources. From a policy perspective the context of Sindh must be taken into account before formulating policies. The SDGs not only provide targets but also a holistic picture of development through which priorities can be set. For Pakistan and Sindh the priority must be to uplift the living standards of those furthest behind.

Pakistan is among the lowest in the world when it comes to contribution to total global greenhouse gas emissions but most of its region, particularly Sindh, are most vulnerable to climate change with very low technical and financial capacity to adapt to its adverse impacts. For Sindh to continue on a development path and make considerable contributions towards achieving the goals articulated in the Planning Commission's Vision 2030 document, it is imperative to prepare the ground to enable it to face this new challenge. The more immediate and pressing task that Sindh faces right now is to prepare itself for adaptation to climate change and come up with a mitigation strategy. Only by devising and implementing appropriate adaptation and mitigation measures will it be possible to ensure water, food and energy security for the province as well as to minimize the impact of natural disasters on human life, health and property.

6 Climate Change Policy Measures: Adaptation

The Sindh Climate Change Policy (SCCP) proposes policy measures in different relevant sectors. These measures need to be prioritized in short, medium and long term in the Action Plan to be developed based on this policy, available resources for implementation of measures and capacity of the relevant government departments. There is also a dire need to increase the resilience of the communities that are most vulnerable and have already been affected by climate change through capacity building.

6.1 Socio-economic measures

6.1.1 Background

Relevant SDGs:

Goal 1: End poverty in all its forms everywhere

Goal 5: Achieve gender equality and empower all women and girls

Alleviation of Poverty cannot be achieved without factoring in the vulnerability of the communities to climate-induced hazards and taking measures to build their resilience. The poverty ranking of the Southern districts of Sindh are far worse than the Central and Northern Sindh, thereby making South and South Eastern Sindh the most vulnerable to the impacts of climate change. Agriculture practicing and livestock rearing communities' livelihoods are threatened by floods and droughts. In Sindh, an increasing amount of people are falling victim to [climate-induced] heat-waves. Exacerbated by lack of knowledge and poor early warning systems, these impacts have a more pronounced impact on the vulnerable poor. The impact of disasters is different on women from that of men; mortality rates of women are higher during droughts, floods, and heat waves. Socio-cultural factors add to the vulnerabilities of women which restricts their mobility, knowledge and skills.

6.1.2 Proposed Policy Measures

- I. Mainstream climate-poverty nexus in provincial planning, poverty reduction strategies, provincial population planning strategies and annual development plans.
- II. The province of Sindh needs to regularly generate segregated data sets around socio-economic indicators for its constituent districts up to UC level for evidence-based policy making. They must be linked to the Sustainable Development Goals (SDGs) and their targets as well, with a particular focus on the environment dimensions.
- III. South Sindh, has the highest poverty ranking and therefore a special emphasis needs to be placed on its socio-economic development vis-à-vis climate change adaptation through cash transfers and social pensions, particularly for the disaster-affected communities.
- IV. Climate change impacts on coastal communities needs to be studied in greater depth through regional integration and coordination.
- V. The indigenous knowledge of agriculture practices, yields, landholding size and other relevant information must be documented by key government departments responsible for social welfare, safety-nets and poverty alleviation.
- VI. Incorporate the gender aspects of climate change impacts in development and planning and ensure the vulnerability of women to natural hazards is reduced.
- VII. Increase women participation in the decision-making processes at the provincial level as an initial step to uplift the socio-economic conditions of women in the face of climate change. At later stages, the same may be introduced at district levels.

6.2 Human Health

6.2.1 Background

Relevant SDGs Goal 3 Ensure healthy lives and promote well-being for all at all ages

NCCP Framework (Adaptation)

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Objective 10.7.1: To address the Impact of climate change on human health

Due to increased temperatures and precipitation there is an increased risk of vector-borne disease (e.g. malaria, dengue) and heat related mortality due to warmer temperatures. Increased risk of deaths and injuries from extreme weather events and diarrheal out-break due to reduced access to clean drinking water (Climate Change Division (CCD) 2013).

Sindh has issues pertaining to child under-nutrition (moderate and severe: 42%), maternal (62%) and child anemia (73%) and food insecurity (72%). The burden of under-nutrition is borne by the rural poor. Following the floods in 2010 and 2011, there was a large amount of displacement of people and several health facilities were damaged. These events exposed the weaknesses of the health system to face such situations and the rescue efforts that were put in place lacked preparation and planning. The private sector was involved in the rescue efforts too, though in an uncoordinated fashion, highlighting a missed opportunity for effective action (HSRU 2012).

6.2.2 Proposed Policy Measures:

- I. Conduct needs assessment of the health sector to identify infrastructure, human resource and financial resources in urban and rural areas for developing and implementing effective district wise health, heat and disaster management plans that could minimize the climate induced disasters on human health
- II. Ensure just and equitable access to health insurance by working with the private sector
- III. Counter the prevalence of malnutrition and stunted growth by ensuring access to food and clean water
- IV. Ensure availability and access to sufficient, safe and nutritious food to meet the dietary needs
- V. Take measures to reduce water-borne diseases and insure access to safe clean drinking water
- VI. Improve geographical spread of health facilities between urban and rural areas
- VII. Promote low carbon and climate resilient building designs which improve insulation, provide adequate ventilation, and green space
- VIII. Promote research on the nexus of climate change and health (spread, prevalence, and incidence of disease; food security; water security; indoor air etc.)

6.3 Agriculture

6.3.1 Background

Relevant SDGs:

Goal 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

NCCP Framework

Objective 1: To build climate change resilience into Pakistan’s agricultural system

Objective 2: To enhance crop productivity through improved irrigation and land management techniques

Objective 3: To enhance institutional capacities of the relevant institutions to undertake research & development on agriculture and livestock.

Objective 4: To enhance the understanding of climate change issues by farmers, agricultural Industries and policy makers to enable them to make informed decisions.

Indus River brings rich silt and sandy loam, from northern areas which enhance the fertility of the soil which enables agricultural activities in the province. Agricultural activities in Thar and Kacho tracts of Hyderabad, Dadu Larkana districts are rain-fed. The variety of ecosystems is evident as Sindh is home to riverine, scrub, and mangrove forests, deserts, coastal areas, wetlands, and agri-ecosystems (Government of Sindh 2007)

Sindh has been divided into three zones, Coastal South of Thatta, Southern from Thatta through Hyderabad to Nawabshah, and Northern from Nawabshah to Jacobabad.

- Upper Sindh - Larkana, Shikarpur and Jacobabad are suitable for growing rice as main crop, cotton, rape and mustard and safflower/sunflower as dobari crops. Sukkur & Khairpur districts are best suited for dry crops viz: cotton, wheat, rape and mustard and sunflower.
- Middle Sindh - cotton, rape and mustard and sunflower are grown.
- Lower Sindh - are suitable for cotton, wheat, sunflower, soybean, rape and mustard and groundnut, some districts also grow sugarcane, rice, sunflower, rape, mustard, mash, and masoor (Government of Sindh n.d.).

Sindh has experienced certain observed changes in the cultivation of crops such as Bananas, whose cultivation has gradually moved northwards, Strawberry and Grapes, that were not produced anywhere in Sindh up to recently, are produced in Sindh now.

Agriculture is the primary economic activity in Sindh. Work is conducted as a family unit, with men primarily performing manual / labour-intensive duties (such as ploughing) while women commonly undertake less manual / labour-intensive duties such as drying and packaging along with other responsibilities such as doing the household chores and take care of the children. Earning is based on quantity of production and money is given to the head of the household (male unless he has migrated). This indicates that women and other marginalized groups have lower social status than men which contributes to their enhanced vulnerabilities to the effects of climate change. Women have limited access to financial resources, household decision making, and limited social status in wake of climate change threats, women are likely to have higher vulnerability with the same degree of exposure. Keeping the disparities in perspective and the severe risk of climate change, there is a need for specialized climate change risk reduction strategy for women in Sindh.

6.3.2 Proposed Policy Measures

- I. Take measures to reduce crop failures, and improve crop health by reducing disease outbreak and impact of extreme events
- II. Promote use of climate resilient, organic (fertilizers & pesticides), and high yielding inputs and practices
- III. Commission relevant institutions and departments to undertake scientific studies on plant-pathogen relationship and patterns of pest and disease spread specific to Sindh and specific to projected changes in temperature

- IV. Develop appropriate digital simulation models for assessment of climate change impacts on physical, chemical, biological and financial aspects of agricultural production systems in various agro-ecological zones
- V. Reduce migration to urban areas by providing farmers and communities localized livelihood diversification options
- VI. Improve demand forecast, access to farm produce, market structures & supply chains, ensure value addition of produce
- VII. Through viable legislation and land-use planning ensure that fertile land is prioritized for agricultural use and discourage conversion of this land for town planning, non-agricultural purposes, and deforestation
- VIII. Establish climate change units or centers at agriculture research organizations in the province to; categorize areas according to their vulnerability to extreme climate change events, climate resilient crop varieties, modern farming techniques
- IX. Promote water efficient farming techniques, especially in low rainfall areas, such as drip irrigation, precision farming, laser levelling, and nutrient management etc.
- X. Increase reliance on crops & agricultural inputs, and improve food security
- XI. Reduce the soil degradation caused by water logging, and salinity through crop rotation techniques, water efficiency, and rainwater harvesting
- XII. Introduce cropping zones and new crop rotations as per climatic conditions of different areas of the province
- XIII. Introduce bio-pesticides and bio-fertilizers for soil conservation

6.4 Fisheries

6.4.1 Background

Relevant SDGs:

Goal 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development

NCCP Framework

Objective 5.3.0: To build climate change resilience into Pakistan's agricultural and food security systems

Objective 10.3.1: To develop adaptation to climate change impacts on Coastal and Marine Ecosystems and Fisheries.

Objective 10.5.1: To protect the habitat of birds and biodiversity including fish in Wetlands Ecosystem.

Marine fishing accounts for 59% of fish cash in Pakistan. Sindh coast is one of the two major hubs of fishing activity in Pakistan. Marine Fish, especially shrimp, are a source of foreign exchange. Climate change impacts threaten growth, mortality, and reproduction of fish.

Rising ocean temperatures will affect fish distribution and location, thereby affecting the fish catch. Ocean acidification and its impact on fisheries needs to be studied further. A decline in *Palla* fish has been observed, but more research is required on the impact of temperature and acidification on various indigenous fish species. Changes in breeding behavior, feeding, and migration patterns need to be looked at in greater detail. Impact of climate change on small

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inland freshwater fisheries is one of the worst examples affecting fisheries based livelihood in inland Sindh. Wildlife species of high ecological and economic significance are also greatly impacted by the climate change.

The impact of the above mentioned threats on livelihoods and socio-economic condition of fishing communities is a major concern. The extent of these impacts needs to be studied further. Discovering and tapping on new fishing ground which will experience increases supply owing to climate change impacts (Shelton 2014)(FAO 2014).

6.4.2 Proposed Policy Measures

- I. Adopt integrated ecosystem approach with three main pillars: managing fisheries and aquaculture; adapting to climate change; and reducing risk from natural disasters
- II. Promote and develop to climate resilient, indigenous, and high yielding fish varieties
- III. Initiate training programs on sustainable fishing techniques and business development skills for small scale farmers especially the fisherwomen
- IV. Formalize fish farms and aquaculture as an industry
- V. Promote use of low energy intensive technologies which increase heat recovery in refrigeration and encourage the use of solar water heating on fish farms
- VI. Protect the fish habitats including Mangroves (Marine) and terrestrial ecosystems (Fresh water) by strengthening regulatory regime to reduce the release of harmful chemicals from industrial and municipal sources and control the use of illegal fishing techniques
- VII. Fill critical gaps in knowledge to assess the vulnerability of fisheries and aquaculture to climate change, especially on small scale farmers
- VIII. Improve lives and livelihoods of fisherman through sustainable management of fisheries and its by-products
- IX. Devise strategies for maintaining current and restoring damaged ecosystems to respond to the challenges faced by wildlife due to climate change

6.5 Water Resources

6.5.1 Background

SDGs: Goal 6: Ensure availability and sustainable management of water and sanitation for all

NCCP Framework:

Objective 4.1.0: To conserve water by adopting appropriate techniques and measures. Strategy.

Objective 4.1.2: To increase awareness to adapt to changing water resource situation due to climate change

Objective 4.1.3: To develop and implement integrated water resource management.

Objective 4.1.4: To develop and enforce required legislative and regulatory framework to protect water resources from climate change related vulnerabilities.

Objective 4.1.5: To enhance capacity to manage the country's hydrological system. Strategy

Objective 4.1.6: To develop climate change resilient water infrastructure in the country and strengthen it according to the needs.

Water resources are essential for survival of the people in the province, not only this but they also play a crucial role in the agro-based livelihoods of millions of people in Sindh. Overall, in Pakistan the agriculture sector uses 93%, domestic sector 5% and industry 2% of the water resources of the country. The share of the latter two is expected to rise to 15% by 2025¹². The impact of climate change on water resources is profound and is essential to incorporate in planning and development initiatives of the country and for every province.

6.5.2 Proposed Policy Measures

- I. Promote water-efficient irrigation strategies such as drip/ sprinkle irrigation in order to conserve water in the highest water consuming sector.
- II. Promote rainwater harvesting in villages as localized solution for improving availability of water
- III. Develop and implement integrated water resource management
- IV. Regulate, monitor and protect groundwater usage especially in the coastal areas to curb sea-water intrusion in coastal aquifers.
- V. Introduce laws pertaining to private sector usage (domestic and industrial) of water and enforcement of existing laws to protect the water resources of the province.
- VI. Prepare an up-to-date inventory of water resources for the province, including surface and ground water.
- VII. Address the needs for additional water storage and distribution infrastructure particularly small dams in arid/ semi-arid areas of the province and improve municipal water resources and infrastructure
- VIII. Increase expenditure on research in the water sector to minimize water losses and encourage conservation practices.
- IX. Strengthen the capacities of relevant stakeholders and government officials for monitoring, protection and conservation of water resources including municipal water authorities.
- X. Ensure access to water in arid areas of the province and invest in building early-warning systems in the face of natural hazards such as floods and droughts.
- XI. Reverse Osmosis Plants to be employed in areas that lack water fit for human consumption.

6.6 Biodiversity

6.6.1 Background

Relevant SDGs:

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

NCCP Framework

Objective 10.1.1: To strengthen legal and institutional set up to materialize efforts towards biodiversity conservation

Objective 10.1.2: To enhance scientific research on and practice of biodiversity conservation

¹² Framework for implementation of Climate Change Policy, 2013

Objective 10.1.3: To enhance national and provincial capacities to identify, conserve and monitor conservation processes

Sindh hosts a multitude of migratory species. Migrating birds from the South Asian subcontinent, East Africa, Europe, and much of Asia use the wetlands as wintering grounds. Some fly in to stay for the winter and breed here, while the rest fly through.

Plant species play an integral role in the biodiversity of the province, are a source of fodder, and an important source of raw material.

Sindh also has a variety of medicinal plants, which are used in healthcare products, traditional medications, dyeing, as culinary spices, and in natural cosmetics and perfumes.

Wildlife species have come under threat due to loss of habitat, expansion of human settlements, lack of water supplies, and unregulated hunting, include the Houbara bustard, the Sindh Urial, the Sindh Ibex, the Indus Blind Dolphin, the Marsh Crocodile, the Indian Cobra and Python, and the Oliver Ridley turtles (*Lepidochelys olivacea*), to name just a few.

- According to the Biodiversity Action Plan, Sindh has a total of 54 protected areas, with 14 game reserves, 35 wildlife sanctuaries, and one national park. The remaining four remain unclassified.
- Nine wetland sites are protected under the RAMSAR Convention (Government of Sindh 2007).
- Biodiversity has been negatively affected by a multitude of factors including the effects of unplanned industrialization/ urbanization, deforestation especially the loss of Mangroves and Freshwater Ecosystems, poor implementation of laws pertaining to hunting and protection of reserved areas and the decreasing supplies of freshwater from the Indus River etc.

6.6.2 Proposed Policy Measures

- I. Facilitate ecosystem based adaptation of biodiversity to climate change by increasing resilience of, in particular, the protected areas to ensure sustainable benefits ensuring complementary schemes to mitigate adverse impacts on livelihood of local communities
- II. Establish natural migration corridors in areas that are rich in native and migratory biodiversity and establish nature reserves, botanical gardens, zoological parks, and gene banks in all districts
- III. Conduct species level vulnerability assessment; perform biodiversity indexing in each district and protect endangered species as per obligations under international agreements
- IV. Develop capacity of responsible institutions on wildlife management and conservation under stressed climate conditions
- V. Engage corporate and private sectors including energy providers, manufacturing, and industry to contribute to protection of biological diversity
- VI. Encourage the use of biological control for disease and weed control in agriculture

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- VII. Research and establish links between impacts of climate change on biodiversity and the water-energy-food nexus
- VIII. Monitor and improve understanding of the Climate Change impacts on biodiversity, including through application of modeling techniques to assess vulnerability of priority species particularly Indus Dolphins and the Waterfowl population
- IX. Conduct pieces level climate change vulnerability assessment and biodiversity indexing

6.7 Forestry

6.7.1 Background

SDGs: Goal 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

NCCP Framework

Objective 7.1.1: To promote the understanding of forests and climate relationship through enhanced scientific research

Objective 7.1.2: To minimize the damages and to increase resilience of forest ecosystems

Objective 7.1.3: To improve governance and management of forests in Pakistan to acclimatize to the impact of the changing climate

Objective 7.1.4: To intensify mass awareness and build capacities of institutions and professionals on climate change adaptation.

Climate change has an impact on forests, it not only affect growth and productivity of forests but also leads to other forest disturbances. Forests in Pakistan are becoming susceptible to prolonged dry spells, decreased rainfalls during the monsoon and increased vulnerability of trees to widespread dieback, insect infestations, fungal diseases and forest fires. It is also important to note that the vulnerable communities, in the rural areas, are often dependent on forest resources for their survival. Any changes in the productivity of forests would have an impact on the rural poor and other vulnerable groups. Hence the link between poverty and the forestry sector is multi-faceted, where there is two-ended arrow of causality between forest resources and poverty.

6.7.2 Proposed Policy Measures

- I. Carry out research on the current and future impacts of climate change on forest resources of the province and identify climate resilient tree species suitable for afforestation programmes in Sindh
- II. Introduce sustainable forest management by developing and implementing forest management plans and increasing awareness of the masses for forest conservation
- III. Increase capacity of Sindh Forest Department and other relevant departments to rehabilitate Mangrove cover area to its original level of 600,000 hectares.
- IV. Conserve rehabilitated Mangroves and riverine forests through community mobilization and engagement of local farmers
- V. Create protected areas of forests, buffer zones and ecological corridors to preserve biodiversity with a particular focus on Mangroves

- VI. Rangelands be given due priority to facilitate livestock owners and conservation of water in such areas
- VII. Explore alternate sources of fuel for the vulnerable communities that depend on forest wood for survival.
- VIII. Improve and adhere to regulations on tree cutting and compensatory plantation especially in urban areas

6.8 Livestock

6.8.1 Background

Relevant SDGs:

Goal 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

NCCP Framework

Objective 5.3.0: To build climate change resilience into Pakistan’s agricultural and food security systems

Objective 5.3.2: To enhance institutional capacities of the relevant institutions to undertake research & development on agriculture and livestock.

Objective 5.3.3: To enhance the understanding of climate change issues by farmers, agricultural Industries and policy makers to enable them to make informed decisions.

The livestock and fisheries sector are very important for the province of Sindh, it adds value to agriculture, employs a large number of people and plays a crucial role in food security.

6.8.2 Proposed Policy Measures

- I. Promote local high pedigree and drought-resistant varieties of livestock and poultry to reduce disaster risk to livestock and livelihoods
- II. Diversify income streams in the livestock sector by treating livestock as saleable asset and animal by-products as fuel and recognizing their role in poverty reduction, resilience building, and increasing food security
- III. Arrange livestock management training programmes for farmers, including women, especially during disasters
- IV. Improve grassland and grazing management by controlling intensity and timing of grazing

6.9 Disaster Preparedness

6.9.1 Background

Relevant SDGs:

Goal 13: Take urgent action to combat climate change and its impacts

NCCP Framework

Objective 9.2.0: To increase awareness of climate change related natural disaster’s impact and our capacity to respond

Objective 9.2.1: To improve our understanding of the processes that produce natural hazards

Objective 9.2.2: To develop integrated hazard mitigation strategies

Objective 9.2.3: To assess future likely flood levels in Indus River System against future climate change scenarios.

Objective 9.2.4: To provide reliable natural disaster’s information and early warning where and when it is needed

Objective 9.2.5: To develop climate change resilient Infrastructure.

Division	Hazard
Larkana	Urban, Riverine and Flash Flood
Sukkur	Riverine Floods and Heat Waves
Hyderabad	Riverine, Flash, urban floods, and Heat Waves
Shaheed Benazirabad	Urban and Riverine floods, and Heat Waves
Mirpurkhas	Droughts, Urban Floods, and Heat Waves
Karachi	Urban flooding, Flash floods and heat waves

- The most common climate hazard which impact Sindh are floods, droughts, tropical cyclones, and heat waves.
- Most districts of Sindh are prone to riverine floods and flash floods, while some are prone to droughts. The divisions listed below are highly exposed to the hazards mentioned
- Floods and rains are more likely to cause death, injury, and destruction to houses.
- Flash floods, floods, and rains cause more people to evacuate and relocate.
- Cyclones, floods, and rains affect a larger number of people.
- Floods and droughts victimize a larger number of people.
- Rains and floods cause more damage to crops.
- Droughts, earthquakes, flashfloods, floods, and rain affect livestock the most.
- Earthquakes and floods have a strong impact on road destruction (PDMA 2016)(National Disaster Management Authority, 2011) (Q. uz Z. Chaudhry et al. 2015)(Anon n.d.).

6.9.2 Proposed Policy Measures

- I. Prepare an integrated natural hazard zoning map of the province, including layers of physical, biological, social, and demographic vulnerabilities
- II. Develop an ‘assessment and compensation mechanism’ including insurance of losses and damages in the aftermath of disasters and measures for rehabilitation
- III. Redesign, construct and upgrade disaster resilience multipurpose buildings to be used as shelter during natural calamities
- IV. Assess construction and strengthening of protection bunds, dykes and coastal infrastructure to control sea intrusion and reduce its impacts on communities
- V. Develop strategies for disaster risk management (including evacuation plans, local flood forecasting & early warning system, drought monitoring, strengthening and enhancement of barrages capacity, retarding basins and providing escape channels etc); Clearly define roles and responsibilities of each concerned government department and local government body during natural disasters to strengthen coordination
- VI. Introduce measures to reduce the risk of urban flooding through better spatial planning, agroforestry and land use; Improve and strengthen flash flood response mechanism of local & district disaster managers to minimize the damages
- VII. Through timely provision of relief and rehabilitation reduce climate induced migration

- VIII. Promote non-grid renewable energy to reduce vulnerability during natural disasters
- IX. Develop disaster safe and energy efficient building codes based on the vulnerability assessments
- X. Allocate adequate financial and other resources to implement “National Disaster Risk Management Framework” formulated by NDMA;
- XI. Community participation in early warning dissemination and disaster risk activities; strengthening the local governments to compliment and enable the aforementioned.
- XII. Ensure that the elderly, children, disabled and women get particular priority in evacuation strategies.
- XIII. Provide guidelines to ensure that infrastructure, including water supply, food, telecommunication, power, utilities and transport are climate resilient.
- XIV. Research and development, and collaboration with researchers/academics to gather baseline information on crops, buildings, infrastructure, livelihoods, populations etc before a disaster strikes.
- XV. Global discourses and agreements on disaster risk reduction should feed into annual planning and policies.
- XVI. Proactive storage and supply of relief goods in disaster prone areas.

6.10 Land and Vulnerable Ecosystems

6.10.1 Background

Relevant SDGs:

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

NCCP Framework

Objective 10.2.1: To map out vulnerability of ecosystems to climate change in mountainous areas and prepare action plans for its mitigation.

Objective 10.2.2: To sustain food security from agriculture crops and livestock production in mountain areas of Pakistan

Objective 10.2.3: To sustain and protect mountain ecology and plain areas from degradation and pollution

Objective 10.4.1: To develop climate change adaptation strategy for rangelands and pastures

Objective 10.6.6: To combat land degradation and desertification.

Objective 10.6.7: To introduce low delta crops and dry land trees & livestock Strategy
Severe droughts and low human development index ratings categorize the desert of Tharparkar as vulnerable to climate change impacts (Government of Pakistan, 2011). The coastal belt and the communities dependent on it are likely to become more vulnerable to climate change impacts.

6.10.2 Proposed Policy Measures

- I. Identify vulnerable ecosystems and integrate ecosystem conservation into development policies and planning; Develop resilience of communities still dependent on these ecosystems or have migrated to other areas due to climate change
- II. Arrange joint watershed management of catchment areas with neighboring provinces

- III. Promote eco-tourism to ensure maintenance and improvement of vulnerable ecosystems
- IV. Revive threatened ecosystems, such as rangelands and riverine ecosystems by creating artificial wetlands and increasing grasslands in water logged areas
- V. Discourage conversion of land use (rangeland to agriculture, agriculture to urban spread etc.)
- VI. Design adequate procedures to control organic and inorganic pollution of wetlands that includes flow of agricultural chemicals and pesticides into the wetlands
- VII. Develop inventories of assimilative capacities of different locales and align local development strategies accordingly
- VIII. Ensure close coordination among forest and livestock departments for efficient management of rangelands and other resources while ensuring the rights of the indigenous people
- IX. Maintain soil and sub-soil moisture and vegetative cover to safeguard arid and semi-arid land from desertification
- X. Increase vegetative cover in extremely difficult and harsh areas of arid zone through technological advancements
- XI. Promote and advocate sustainable land use
- XII. Devise strategies for infrastructure strengthening including shore protection and measures to avoid coastal erosion such as harden, bulkheads, sea walls and breakers

6.11 Indigenous Adaptation Measures

Indigenous knowledge transferred from one generation to the next among the communities forms the basis of indigenous adaptation measures. These are some of the measures which communities are undertaking based on their experience and knowledge. For example, from centuries communities have observed that after a good season of monsoon rains, the occurrence of droughts is imminent in the area, thus the communities tend to store as much water as possible in the rainy period. Similarly, in many districts of Sindh summer temperatures can rise up to 50 degrees centigrade and rainfall is plentiful in late summer, making conditions extremely hot and humid, thus each rural household ensures good ventilation in their houses. To ensure ventilation, numerous windows are built in the house, however the most effective adaptation is the building of slanted straw roofs. These slanted roofs are light weight, give excellent protection against rain and provide good ventilation in summers. As the communities are feeling more and more heat impacts in the summers, an adaptive measure undertaken by the communities is the raising of roof height. Like these, there are numerous examples of communities' own experiences in adapting to climate stressors.

The effects of climate change faced by women resident in rural Badin is severe and more intense than other groups. Thus, the women have come with various indigenous alternatives to deal with the vulnerabilities that they face. One such alternative is the concept of community-based resource pooling commonly known as "Committee" allowing them to gain a significant amount of cash relatively instantly when needed. This traditional way of reserving capital for times of need is practiced widely across Sindh. Thus, these indigenous alternatives,

and many more, prove to be a viable mechanism of adapting to the risks faced by the local communities due to climate change.

7 Climate Change Policy Measures: Mitigation

The Sindh Climate Change Policy (SCCP) proposes policy measures in different relevant sectors. These measures need to be prioritized in short, medium and long term in the Action Plan to be developed based on this policy, available resources for implementation of measures and capacity of the relevant government departments.

7.1 Energy

7.1.1 Background

Relevant SDGs: Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all

NCCP Framework

Objective 11.0.1: To develop and enhance renewable energy sources and uses to achieve green growth in the energy sector.

Objective 11.0.2: To develop and obtain clean energy technologies and uses to achieve low carbon growth in the energy sector.

Objective 11.0.3: To reduce total energy demand through conservation and efficiency.

The population of Sindh has reached 47.89 million¹³ with about 50% of the population concentrated in the cities. The demand for energy has also increased with rapid urbanization and industrialization in the province. In the past decade alone Sindh has faced energy shortages, more specifically the electrical power gap: 5000MW and Gas: 1000-2000 MMCFD shortage in winters. 30% of the rural population in Sindh (approximately 8.4million people) have no access to grid electricity and 75% of the total population have no access to Gas. Sindh contributes to 70% of the country's gas reserves and 42% of the oil reserves(Government of Sindh 2016).

New projects in the pipeline:

Sindh has large economically viable renewable energy resources:

Source	Quantity
Wind	55,000 MW
Solar	10,000 MW
Hydro (Small)	130 MW (Run of River)
Bagasse Cogeneration	1,000 MW (32 sugar mills & agro)
Waste to Energy	500 MW (Karachi 11,000 MTPD)

(Energy Department -Government of Sindh 2016)

Status of Wind Energy in Sindh

¹³ Pakistan Bureau of Statistics (2018). Population Census, 2017.

- Average wind speed ranges from 7-10 m/sec square in the province. GoS has allocated the required land for development of wind farms
- 590 MW electricity is being supplied through by 12 companies
- 5 projects - 300 MW are under construction - to supply electricity by June 2017
- Wind Tower manufacturing facility by "China Three Gorges" is already operational
- More than 43 projects - 3360 MW capacity are at various stages of approvals and studies

Status of Solar Energy in Sindh

- 24 "on-grid" projects-1400 MW initiated through private investments
- 5 "on -grid" projects of 20 MW each initiated under PPP mode
Solar Insolation (5.3 kWh/m²/day)
- Completed two pilot projects for solarization of 350 schools in Nangarparker and 140 households in Khipro
- Upscaling this project to 5000 schools & 300 villages during the current financial year
- Electrification of primary Health facilities through Solar PV technologies.
- Completed electrification of 5 villages of Ghotki districts through solar PV technology (Village Muhammad Bux Khan Dahar, Village Muhammad Sachal Chachar, Village Allah Ditto Chachar, Village Kamoo Shaheed, Village Mithan Khan Dahar)
- Providing Solar System on rural water supply and sanitation schemes having capacity of 4.7 Mega Watt to run 316 schemes in Sindh

At the same time, there is significant investment being made to harvest the potential of indigenous and imported coal to contribute to Sindh's energy mix. According to the Private Power and Infrastructure Board (PPIB), there are six projects based on indigenous coal with cumulative capacity of 4290 MW, and seven projects based on imported coal with capacity of 5201 MW currently at different stages of the process (Associated Press of Pakistan Corporation, 2017). The most notable is the Thar Engro Coal Power Project, developed under Public Private Partnership mode articulated and implemented by Government of Sindh.

7.1.2 Proposed Measures

- I. Develop a provincial energy policy that aims to reduce reliance on imported sources of energy and promote the local renewable energy sources such as micro-hydel, solar, wind, geo-thermal, waste to energy, bioenergy and nuclear.
- II. Promote local and foreign investment in the renewable energy market through financial support mechanisms, and provide further incentives such as carbon taxes, subsidies and tax reforms.
- III. Identify regulatory gaps or bottlenecks, address them through amendments, in existing regulatory framework for renewable energy, particularly supply off-grid rural populations
- IV. Develop a GHG inventory of energy consumption and production in Sindh to provide the energy and environment department with key information on which they should base their annual planning.
- V. Conduct applied research to increase the insight and knowledge about possible carbon reduction by the introduction of low carbon energy and renewable technologies, as

- well as on the feasibility and cost-effectiveness of these measures from a carbon mitigation perspective;
- VI. Promote decentralized renewable energy generation in industrial, commercial and residential areas such as community based off-the-grid renewable energy production, and smart metering and smart grids etc.
 - VII. Create R&D cell at the SEPA to study the possible options for carbon reduction through employing various low carbon and renewable energy technologies.
 - VIII. Identify regulatory framework gaps in renewable energy generation and effectively address them.
 - IX. Establish a Research and Development (R &D) cell at SEPA office to study options for carbon emissions' reduction.

7.2 Industries¹⁴

7.2.1 Background

SDGs: Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

NCCP Framework Objective 13.1: To reduce carbon dioxide emissions from the industrial processes used in Pakistan's major industries.

Sindh's process of industrialization began with the creation of planned industrial estates and the development of an engineering base. The Sindh Industrial Trading Estate (SITE) was the first industrial estate to be established in Karachi in 1947 and it was meant to serve as the industrial hub of the country (IUCN 2007). The share of manufacturing and services has increased over the years which is indicative of economic growth in the province. The increased demand for goods and services is one major contributing factor to the expansion of the manufacturing sector. Currently, the manufacturing sector constitutes 36% of the province's GDP. There are several problems that the industries in Sindh Currently face. These problems include shortage of water for industrial use, law and order, flooding, rising temperatures and droughts.

The impact of climate change on manufacturing is multi-dimensional. It impacts both the supply side and demand side of goods. In terms of production, climate change impacts like rising temperatures, droughts and floods hinder production, often increasing costs. On the other hand, climate induced natural hazards may also lead to reduced consumption of goods with elastic demand. Due to this the manufacturing sector is greatly affected by climate change and its impacts.

7.2.2 Proposed Measures:

- I. Mainstream climate change considerations in Sindh Industrial Policy 2016 to ensure a climate resilient and compatible industrial sector.
- II. Prepare industry profiles and vulnerability scenarios of small, large and cottage industries

¹⁴ Industries not only comprise of manufacturing and services but also primary sector industries such as agriculture and livestock which are essential components of the economy. At the same time it should be noted that the process of industrialization is often referred to the expansion of the manufacturing sector in the developing world.

- III. Prioritize the needs of SME's as the driver of economic growth by providing them access to sustained renewable energy
- IV. Develop and implement environmental management systems and secure international accreditation
- V. Generate data to study the impact of climate change on manufacturing industry; Develop a GHG inventory to understand which industries are heavy polluters; Strengthen regulatory framework on Industrial carbon emissions, integrating with existing and new regulations including the industries policy; Develop framework for technology transfer to industries to control and cap emissions
- VI. Draft a framework for technology transfer to industries to control and cap emissions; Explore carbon capture and storage options for heavily polluting industries.

7.3 Transport

7.3.1 Background

Relevant SDGs:

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

NCCP Framework

Objective 12.1.1: To minimize GHG emissions from transport sector. Strategy

Objective 12.2.1: To minimize the adverse effects of aviation's emission on the environment in the context of climate change.

Objective 12.3.1: To upgrade, expand and modernize the railway network in the country.

Transportation is one of the major GHG emitting sectors worldwide besides power generation, industry and agriculture. Floods and other natural disasters severely impact the transportation facilities and infrastructure, which is already in poor conditions in Sindh province, resulting in increased emissions and deterioration of urban air quality. Investments in low carbon transport and infrastructure will reduce emissions in spite of increased fuel consumption due to rapid urbanization and motorization.

7.3.2 Proposed Policy Measures

- I. Integrate climate risk planning in transport strategies and develop climate resilient plans for road transport, aviation, and rail. Develop sustainable transport policy for Sindh aiming at Climate resilience in the transport sector of the built environment.
- II. Rationalize competing priorities of livelihood creation and mass transit (GHG reduction)
- III. Improve traffic management and sustainable transport through education, public awareness, digital technologies and regulatory monitoring.
- IV. Set aside annual budget for technical capacity development required for implementation of sustainable transport related projects.
- V. Reduce passenger travel demand and time consumption through better land-use planning and promoting non-motorized modes of transport
- VI. Encourage private sector investment in increasing access to low GHG emission, clean, affordable, and sustainable transport
- VII. Increase energy efficiency standards for both new and used vehicle, establish vehicular emissions testing stations (VETS) all over Sindh and phase-out old/outdated/high

emission producing vehicles and promote low sulfur fuel for the transport sector and adoption of Euro VI standards.

- VIII. Invest in efficient transport, transit systems and infrastructure
- IX. Increase access to agricultural inputs and outputs through improvements in freight traffic, vehicle efficiency, electrification, and logistics
- X. Develop Air Quality Index (AQI) for all major cities of Sindh.
- XI. Promote mass transit system for Karachi and other major cities of Sindh.

7.4 Waste

7.4.1 Background

Relevant SDGs:

Goal 12: Ensure sustainable consumption and production patterns

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

NCCP Framework

Objective 14.1: To introduce innovations in town planning to adapt and mitigate the impact of climate change

Objective 11.0.2: To develop and obtain clean energy technologies and uses to achieve low carbon growth in the energy sector

Objective 10.2.3: To sustain and protect mountain ecology and plain areas from degradation and pollution.

Objective 4.1.3: To develop and implement integrated water resource management. Strategy

Waste from industries and municipal sewerage are two major sources of solid and liquid waste. Lack of solid waste management services reduces recycling, and re-using of materials. Climate induced disasters have increased the negative externalities posed by uncollected municipal waste.

7.4.2 Proposed Policy Measures

General:

- I. Create jobs in waste management and recovery through research and creating partnerships between different stakeholders
- II. Rationalize environmental quality standards in view of assimilation capacities of receiving environment
- III. Promote the concept of 3Rs to increase sustainable waste management
- IV. Engage stakeholders and create partnerships for waste management
- V. Promote energy-from-waste projects

Municipal Waste:

- VI. Improve municipal solid waste management
- VII. Develop provincial solid waste standards for waste storage, collection, transport, treatment and disposal, in line with air and water quality standards
- VIII. Promote decentralization of the disposal system to the local environment and organizing the collection system on the lines of a resource recovery system.
- IX. Promote public awareness on sustainable waste management through electronic and print media and street campaign, through community organizations such as schools,

- institutions, and households, using a public-address system, distributing leaflets, and by using the division’s public-awareness team
- X. Existing waste treatment schemes to be made more effective and functional and new schemes to be installed on need-basis.
Industrial Waste:
 - XI. Ensure proper labeling, handling and prevent illegal dumping of hazardous industrial waste
 - XII. Encourage treatment, and re-use of waste water from manufacturing, commercial, and industrial processes
 - XIII. Promote waste management technologies which provide co-benefits (e.g. anaerobic digestion)

7.5 Forestry and Wildlife

7.5.1 Background

SDGs: Goal 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

NCCP Framework

Objective 8.1: To build institutional and professional capacities for development and implementation of REDD plus and A/R CDM mechanisms

Objective 8.2: To restore, conserve and enhance forest carbon sinks and minimize carbon loss from the existing forests

Land area of Sindh Province	34.84 million acres
Riverine Forests	595,511 acres
Irrigated Plantations	202,622 acres
Mangrove Forests/Coastal Forests	852,495 acres
Rangelands	1,129,247 acres
Total Forests Area	2,779,875 acres
Percentage of Forest Cover	8% of total land area of Sindh Province

(Sindh Forest Department)

The National Forest Policy (NFP) 2015 seeks to expand, protect and promote sustainable use of national forests, protected areas, natural habitats and watersheds for restoring ecological functions, improving livelihoods and human health in line with the national priorities and international agreements. However, there are critical gaps in the capacity of provinces to implement NFP and improve the forest cover in Pakistan, which is as low as 2.2% according to FAO. The illegal logging continues in the country and Pakistan loses at least 42,000 hectares of forests each year.

7.5.2 Proposed Policy Measures:

- I. Develop a provincial GHG inventory and strive to reach zero net emissions through forests as carbon sinks
- II. Develop forest cover assessment at district level through GIS/ RS in decision making and forest carbon accounting system to assess changes in carbon stocks in forest areas

- III. Promote afforestation especially on abandoned lands in rural and urban areas and re-forestation by planting indigenous species for carbon storage and sequestration and reduction of health risks associated with Urban Heat Island Effect
- IV. Ban all kinds of exploitation, illegal digging and trashing in the national parks and wildlife zones to halt deforestation and protect biodiversity and maintain ecosystem integrity
- V. Ban large scale fishing activities in the reservoirs to avoid disturbance to the habitat of Wetlands' birds
- VI. Demarcate boundaries of all protected areas to ensure the intensive management of strictly protected core areas
- VII. Introduce alternate fuels and livelihoods among the communities dependent on forests
- VIII. Ensure capacity building of Forest and Wildlife Department officials on conservation of ecosystems such as Mangroves and protection of habitat of fauna such as Sindh Ibex, Hog, Deer, Urial, Chinkara etc.
- IX. Increase public awareness and develop management frameworks that engage local communities for better management and conservation of the protected areas

7.6 Agriculture, Livestock and Fisheries

7.6.1 Background

Relevant SDGs:

Goal 13 Take urgent action to combat climate change and its impacts

Goal 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development

NCCP Framework

Objective 6.1.1: To reduce greenhouse gas emissions from agriculture and livestock sector

Objective 5.3.2: To enhance institutional capacities of the relevant institutions to undertake research & development on agriculture and livestock.

Objective 5.3.3: To enhance the understanding of climate change issues by farmers, agricultural Industries and policy makers to enable them to make informed decisions.

In 2008 GhG emissions from the agriculture and livestock sectors accounted for about 39% of the total emissions. The emissions are primarily in the form of Methane (CH₄) 79% and Nitrous Oxide (N₂O) 21%¹⁵. They are originated from the following sub-sectors: 1) Enteric fermentation in cattle (all in the form of Methane), 2) Rice cultivation, 3) Releases of Nitrous Oxide from agricultural soils/ Nitrous Fertilizer, and 4) Manure management.

7.6.2 Proposed Measures

- I. Reduce water and emissions intensity in agriculture sector through technologies such as introducing Alternate Wetting and Drying Technique (AWDT) to replace the traditional fully flooded rice cultivation
- II. Encourage and incentivize the use of renewable energy and low carbon emitting technologies on farms and agricultural land especially RE tube wells and biogas
- III. Encourage agro-forestry and replantation of Mangroves for soil conservation, carbon sequestration, livelihood opportunities and disaster prevention

¹⁵ Framework for implementation of Climate Change Policy, 2013

- IV. Develop and promote best management practices for methane and nitrogen management
- V. Improve productivity of livestock through genetic breeding and efficient use of technologies
- VI. Promote public-private partnership in livestock sector for research, training, livelihood opportunities, value-added production, transportation etc.
- VII. Promote research on climate change impacts on the aquatic systems and the special needs of the communities depending on aquatic resources for their food and livelihoods
- VIII. Promote energy efficiency across the fish capture, processing, packaging and distribution sub-sectors such as heat recovery in refrigeration, use of bio-gas technology etc.
- IX. Promote fish farming and the culture of filter feeders and seaweeds to reduce carbon footprint, preservation of coastal ecosystems and energy efficiency
- X. Implement the ecosystem approach as a means of climate proofing the fish production sector
- XI. An integrated approach to improved resource management should be designed and implemented in order to mitigate negative aspects of capture fisheries

7.7 Urban Planning

7.7.1 Background

Relevant SDGs:

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

NCCP Framework

Objective 14.1: To introduce innovations in town planning to adapt and mitigate the impact of climate change

Unplanned urban expansion is reducing availability of land which could be used by agriculture. Rapid and unregulated climate induced rural-urban migration is also taking place. Uneven urbanization patterns concentrated in slums and informal settlements; Lack of climate resilient infrastructure; Increases vulnerabilities to climate induced stresses, such as heat waves and urban floods are all important issues Sindh is currently dealing with. In addition, there is limited access to basic services of vulnerable populations in urban areas

7.7.2 Proposed Policy Measures

- I. Conduct comprehensive climate risk assessment for all districts
- II. Allocate budget to increase urban resilience based on climate risk assessments
- III. Introduce slums alleviation program to increase resilience of the most vulnerable segments of the urban population
- IV. Entrepreneurship and specialization clusters must be developed to get benefit from the innovation potential of cities
- V. Develop and implement affordable housing programs in collaboration with private sector, capital markets and financial institutions.
- VI. Improve municipal service delivery
- VII. Replace non-porous surfaces in urban areas with green space to create more areas for absorption of excess water, flood abatement and groundwater recharge

- VIII. Promote renewable energy options, especially solar panels, for heating and cooling of buildings and other domestic purposes
- IX. Implement climate resilient, energy and water efficient building codes and laws in residential and commercial buildings sector
- X. Critical gaps in urban infrastructure and basic services need to be catered to by improving the efficiency of urban markets through better regulation
- XI. Promote sustainable water management strategies, especially in urban areas
- XII. Develop master plans for all major cities considering water-energy-food nexus and including sub-urban areas

8 Climate Innovation

Climate change presents the single biggest threat to sustainable development everywhere and its widespread, unprecedented impacts disproportionately burden the poorest and most vulnerable. Urgent action to halt climate change and deal with its impacts is integral to successfully achieving all Sustainable Development Goals (SDGs). When it comes to climate innovation, affordable and scalable solutions are now available globally to enable countries to leapfrog to cleaner, more resilient economies. The pace of change is quickening as more people are turning to renewable energy and a range of other measures that will reduce emissions and increase adaptation efforts.

8.1 Capacity Building

According to article 11 of the Paris Agreement capacity building is an integral part of climate action. Stemming globally, capacity building should facilitate capability and skill development at the national and sub-national level. Capacity building should aim at skill enhancement and increase in technical know-how improving access to climate finance. At the sub-national level capacity building can play an integral role in bringing together public and private (businesses and communities).

Proposed policy measures

- I. Develop programs which address the need for human resource development in key provincial departments; Provide technical training to different departments on low carbon and climate resilient policy measures;
- II. Encourage a participatory, inclusive and gender sensitive approach in decision making and capacity building;
- III. Encourage all segments of society in mobilizing political interest and support for accountability through increased capacity building and increased government involvements;
- IV. Increase transparency of action by incorporating implementation mechanisms and accountability procedures;
- V. Break away from silo-ed work patterns through increased inter-provincial and inter-departmental coordination and collaboration Enhance sectoral coordination; strengthen the role of institutions in developing, securing, and implementing projects
- VI. Raising awareness of local government departments and community members through public awareness and trainings;

- VII. Ensure that skills correspond to departmental needs and priorities;
- VIII. Ensure continued access to financial resource which facilitate capacity and capability development.

Technical Capability

- I. Develop provincial action plans for low carbon, and climate resilient related measures;
- II. Establish a mechanism for development, analysis, management, monitoring and reporting of a provincial GHG database;
- III. Develop climate models to allow for better analysis and understanding of the climatic processes in Sindh, particularly for major sectors of agriculture, water resources, energy and land-use planning (urban areas);
- IV. Develop and update hazard maps for climate induced hazards;
- V. Review the design criteria and building codes to include climate change concerns;
- VI. Conduct financial planning to access, deliver, monitor, report and verify flows of finances required to uptake low carbon, and climate resilient related;
- VII. Develop expertise of young professionals on climate services to provide research, technical assistance, policy and planning, and knowledge management related support to Govt of Sindh;
- VIII. Collect and archive baseline data to inform the specific studies and analysis that will be required for the vulnerability assessments.

8.2 Climate Finance

According to article 9 of the Paris agreement developed countries are required to assist developing countries in financing adaptation and mitigation related efforts. International monetary support provided should enable technology and skill transfer to developing countries in order to build their resilience to climate change impacts and disasters. At the sub-national level climate action should be resourced through public, private, and public-private partnerships and collaboration.

Sindh requires substantial additional resources from both public and private sources to respond effectively to climate change impacts. A mix of public, private, international and domestic sources shall be explored to ensure a coordinated approach that reinforces existing practices in national planning and public financial management. Climate compatible development in all the sectors is necessary to ensure public spending in each sector for sustainability and longevity.

Sindh should increase its participation in international carbon market mechanisms and strengthen NAMA development and implementation as means of financing mitigation measures.

Financing Policy Implementation

- I. Assess financial needs of Sindh to address low carbon, and climate resilient related measures in all the sectors and develop investment plans for each sector;

- II. Take a pro-active approach in exploring and accessing international funding for low carbon, and climate resilient measures through Global Climate Fund (GCF), Clean Development Mechanism (CDM), Adaptation Fund (AF), Global Environmental Facility (GEF), World Bank's Forest Carbon Partnership Facility (FCPF) etc.;
- III. Mobilize domestic (public and private) resources, integrate climate change in budget allocation and develop new approaches for climate proofing as a tool to support project selection and budget allocation from public spending;
- IV. Explore potential to participate in international carbon markets and REDD+ (Emissions from Deforestation and Forest Degradation) system particularly for tree plantation programmes planned by Government;
- V. Establish a unit that develops and promotes projects responsible for generating carbon credits, both in the compliance and voluntary markets;
- VI. Develop partnerships for financing and implementation of low carbon, climate resilient related measures with private banks and financial institutions;
- VII. Establish a provincial climate change fund for financing climate change related projects;
- VIII. Establish financing agreements with development partners and donor agencies;
- IX. Enhance the capacity of organizations which can implement and execute climate projects from climate investment.

8.3 Technology Transfer

The transfer of technology occurs in various forms, from state to people, from one country to another and domestically from one locality to another. Technological innovations around the world have led to a greater use of renewable energy applications for households and industries. In the face of climate change, the role of technology has become abundantly clear and has become necessary to move away from traditional carbon-based fuels.

The second aspect of technology transfer is improving adaptation to climate change. This entails a far broader scope of technology and aims to integrate it with key sectors of the economy. For developing countries, like Pakistan, it includes improvement of health, water sector, agriculture, livestock and fisheries, education and early warning systems.

8.3.1 Proposed Policy Measures

- I. Identify the technology needs of the districts in Sindh that are furthest behind in socio-economic development indicators and enable them to come to par with the rest on a priority basis.
- II. Develop energy efficiency strategies for industry and households
- III. Identify and promote energy efficient technologies for household appliances that are high consumers of electricity such as, solar water heaters and energy efficient chillers.
- IV. Take immediate measures to redirect rapid urbanization into the sustainable cities' framework.
- V. Identify the technological challenges, policy gaps and opportunities pertaining to water and food security for the province.
- VI. Promote research and development (R&D) on renewable energy application in universities, technical institutes, engineering colleges and research institutions.

- VII. Encourage and enable science-policy interfacing so that the policy makers are cognizant of the developments in technology pertaining to energy efficiency and renewable energy.
- VIII. Promote learning of best-practices from other countries, create opportunities for international collaboration in innovation and utilize foreign investments (such as CPEC) for acquiring skills and knowledge about renewable energy and sustainable development.
- IX. Identify funding opportunities and other international mechanisms that provide support in technology development and transfer.
- X. To arrange training programs on renewable energy for Engineers of various Government departments who are extensively involved with preparation of projects involving energy (part component).

FIGURE 6 UNFCCC ARTICLE 6 EDUCATION, TRAINING AND PUBLIC AWARENESS

In carrying out their commitments under article 4, paragraph 1 (i), the Parties shall:

(a) Promote and facilitate at the national and, as appropriate, sub regional and regional levels, and in accordance with national laws and regulations, and within their respective capacities:

(i) the development and implementation of educational and public awareness programmes on climate change and its effects; (ii) public access to information on climate change and its effects; (iii) public participation in addressing climate change and its effects and developing adequate responses; and (iv) training of scientific, technical and managerial personnel.

(b) Cooperate in and promote, at the international level, and, where appropriate, using existing bodies:

(i) for the development and exchange of educational and public awareness material on climate change and its effects; and (ii) for the development and implementation of education and training programmes, including the strengthening of national institutions and the exchange or secondment of personnel to train experts in this field, in particular for developing countries.

8.4 Learning and Knowledge Management: Education

Relevant SDGs:

Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 12: Ensure sustainable consumption and production patterns

Objective 7.1.4.: To intensify mass awareness and build capacities of institutions and professionals on climate change adaptation.

Objective 8.1: To build institutional and professional capacities for development and implementation of REDD plus and A/R CDM mechanisms.

Objective 12.8: To ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.

Education plays a vital role in tackling climate change impacts, influence behavioral change, and include participation from different stakeholders. Article 6 of the UNFCCC is pertaining to education and public awareness raising. Formal and non-formal education to enhance public

awareness on climate change issues could help in enhancing adaptation and mitigation efforts. Making use of indigenous knowledge enables to tackle climate impacts. Technical knowledge increase through formal education can help in addressing climate change impacts and develop ways of dealing with them.

- Integrate climate change science and information into curriculum and academic frameworks of different grade levels of schools, colleges and universities with emphasis on special departments teaching environmental sciences and management and issues related to climate change;
- Reflect training and education on low carbon, climate resilient (sustainable cities), and water-energy-food nexus related issues for policy makers and practitioners alike in curriculum of vocation training and higher education;
- Encourage and support NGOs, academia and the private sector led initiatives to improve climate change related education and awareness by facilitating them to secure the required funding and technical information.

9 Policy Implementation

Following approval of Sindh's Climate Change Policy, the Provincial Government shall develop an "Action Plan" for its implementation. All relevant ministries, departments and agencies shall also devise plans and programs to implement the policy provisions relating to their respective sectors/sub-sectors.

9.1 Policy Alignment

This policy is closely aligned with National strategies, policies and programmes and the detail of this alignment is as:

- Pakistan is a signatory of United Nations Convention to Combat Desertification (UNCCD) since 1994. Being party to this convention, Pakistan endures to support its global obligations along with commitments to implement the 10-Year Strategy of the UNCCD. In light of this commitment, Pakistan formulated a National Action Programme (NAP) to combat desertification in 2002. The interventions built in the project such as SLM practices, Watershed Management practices and LDN based social enterprise development align strategically with NAP.
- Likewise, National Environment Policy (2005) stresses to plan strategies and projects to address desertification in line with the NAP" such as increasing productivity of land and efficient water usage. In addition, it promotes usage of recycled water for tree rearing and to halt land degradation and desertification as highlighted in the NAP. This project aligns itself with this policy through increase in access to LDN and SLM practices rendering a significant control over land desertification.
- The project is also designed in the context to support the implementation of one of the core objectives of the 10th Five Year Peoples' Plan 2010-15 i.e. "to ensure sustainable management of land" and this objective emphasize to reverse the land degradation which is exactly what this project envisions to do i.e. achieving neutrality and reclaiming degraded land.

- The National Forest Policy and National Biodiversity Strategy and Action Plan (NBSAP) approved by Government of Pakistan (GoP) also realizes the problem of land degradation and desertification in the country and suggests measures to reduce these problems through sustainable land management practices. However, due to paucity of funds and limited allocations by GOP, adequate measures were not undertaken to control desertification, let alone to meet national volunteer LDN targets. This project is designed in a manner that will not only meet goals set by National Forest Policy and NBSAP but also our National obligations to UNCCD in context of LDN. Project is also aligned with the Biodiversity Action Plan (BAP) (2000) and propose measures to protect and conserve indigenous species.
- The national Climate Change policy introduced by MoCC in 2012 suggests effective monitoring of land degradation in the country. Through its LDN target setting interventions, this project aligns with the aspirations of the National Climate Change Policy.
- More recently, the National Agriculture and National Water Policies promulgated in 2018 emphasizes the increase of land productivity and adoption of a wise approaches to water resource management.
- In addition, this project has been conceived for the upscaling and promotion of the theme of combating deforestation and desertification. It advocates concrete measures to combat land degradation across the country. Therefore, it also aligns with following national and provincial documents under development;
 - Draft Rangeland Policy
 - Draft provincial rules for Sustainable Land Management Practices Integration
 - Draft Provincial Climate Change and Environmental Policies.

9.2 Sustainability

Adaptation to climate change can be achieved through a long-term sustained effort by governments both at the center and in the provinces. The Paris agreement put forth by the UNFCCC in 2015 requires countries, through a proposed timeline from 2020 and beyond, to take concrete actions to mitigate climate change and limit global warming to 2 degrees Celsius above pre-industrial levels. The following steps will ensure that the climate change policy for Sindh is sustainable in itself and can play a crucial role in fulfilling the countries ambitions in low carbon climate-resilient development.

- Anchoring Climate Change in legal frameworks and integrating in provincial and sector policies and planning;
- Supporting federal government actively in the international agreements;
- Raising awareness on climate change and the benefit of early action;
- Rigorous reporting, monitoring and verification of implementation of policy measures;
- Continuous research to improve knowledge and information on Climate Change impacts;
- Sustained multi-stakeholder involvement and participation to ensure multi-sectoral approach to decision making;
- Revising and updating the policy every 3 to 4 years (or as necessary) to reflect increasing knowledge on climate impacts and provincial circumstances

9.3 Governance and Coordination

Inclusive governance, where stakeholder from beyond the policy circle, including private sector, civil society, media and academia are taken onboard. Such a governance structure would require coherence and efficient decision making with each stakeholder having a clear pre-defined mandate.

This governance structure can be translated into an implementation committee as proposed in the National Climate Change Policy or as deemed appropriate by the government of Sindh in implementing the new Sindh Climate Change Policy. The task of such a committee will be to meet bi annually or as proposed to discuss strategic plan for implementation, to oversee all climate-related policy areas and coordinate activities to minimize duplication and maximize synergies particularly with existing institutions and programs.

The proposed composition as put forth in National Climate Change Policy for the Provincial Climate Change Policy Implementation Committee is as below¹⁶:

- Provincial Minister for Environment (Chairperson)
- Chairman/Additional Chief Secretaries Planning and Development Department;
- Secretaries Environment/ Agriculture/ Forest & Wildlife/ Irrigation/ Local Government/ Public Health/ Finance etc.;
- DGs PDMA, SCDA, SEPA
- Three representatives from corporate sector/Chambers of Commerce and industries;
- Three representatives from Civil Society Organizations;
- Three eminent experts from the field;
- Director General, Climate Change or any other senior officer from ECC&CDD, member/Secretary.

As one of the most vulnerable provinces, Sindh needs to embark on low carbon and climate compatible development. A recent LEAD study has shown that the Federal and Provincial Governments are spending more than 8% of their budgets on climate change related interventions/projects, but these investments are fragmented and uncoordinated. Climate-compatible development requires a coherent strategy and investment plan. Sindh needs to mobilize private sector funds and investments from domestic and international markets, and this will require mainstreaming climate change or climate-compatible developments across all sectors and planning departments under Sindh Government.

¹⁶ **This proposed mechanism is to be finalized by Government of Sindh**
Environment, Climate Change & Coastal Development Department, Govt of
Sindh

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Annexures

Annexure- I

TARGETS DIRECTLY RELATED TO CLIMATE CHANGE

#	Target
1.5	By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters
2.4	By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
3.d	Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks
4.7	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development
6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
7	Ensure access to affordable, reliable, sustainable, and modern energy for all
7.1	By 2030, ensure universal access to affordable, reliable and modern energy services
7.2	By 2030, increase substantially the share of renewable energy in the global energy mix
7.3	By 2030, double the global rate of improvement in energy efficiency
8.4	Improve progressively through 2030 global resource efficiency in consumption and production, and endeavor to decouple economic growth from environmental degradation in accordance with the 10-year framework of programmes on sustainable consumption and production with developed countries taking the lead
9.4	By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
11.5	By 2030 significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with the focus on protecting the poor and people in vulnerable situations
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management

12.4	By 2020 achieve environmentally sound management of chemicals and all wastes throughout their life cycle in accordance with agreed international frameworks and significantly reduce their release to air, water and soil to minimize their adverse impacts on human
12.8	By 2030 ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
13	Climate Action: Take urgent action to combat climate change and its impacts
13.1	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
13.2	Integrate climate change measures into national policies, strategies and planning
13.3	Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
13.a	Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
13.b	Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities
14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
14.3	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels
15.1	By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
15.2	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally
15.3	By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
17.7	Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed.

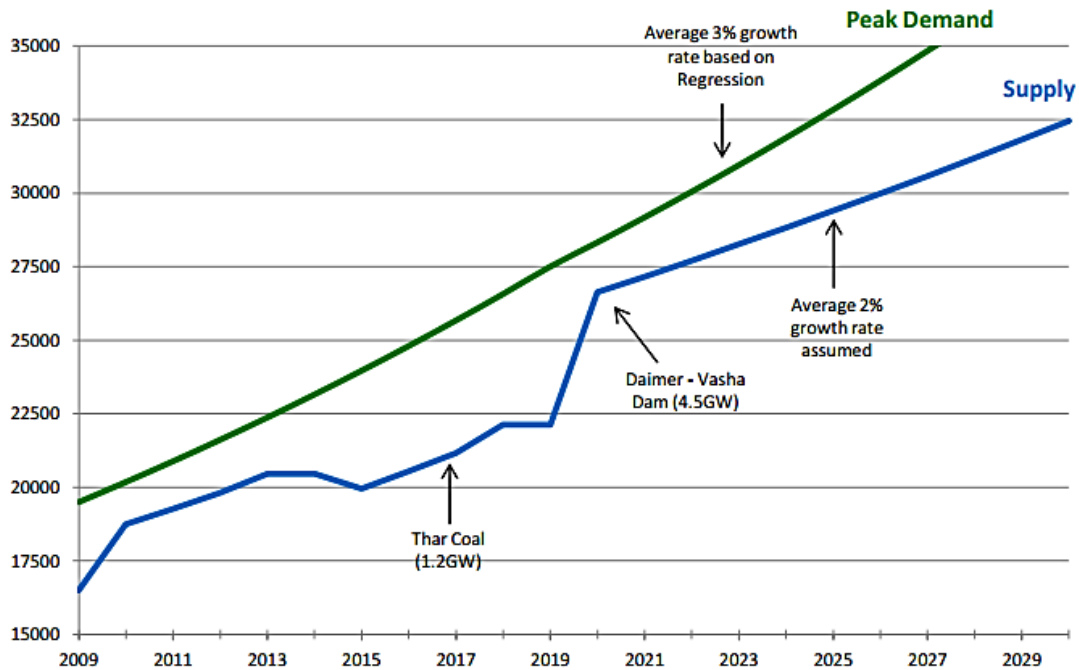
Annexure- II

THE RENEWABLE ENERGY POLICY OF SINDH INVOLVES

I.	<p>ATTRACTIVE RENEWABLE ENERGY POLICY</p> <ul style="list-style-type: none"> a. Return on Equity 17% (USD based) b. ii. Priority dispatch c. iii. Power Purchaser is responsible for providing interconnection d. iv. Wheeling is allowed e. Allows net metering f. Facilitates the projects to obtain carbon credits. g. Standardized Security Package - Energy Purchase Agreement and Implementation Agreement <p>IA is appended with GoP guarantee underwriting the performance of power purchaser, change in law and political force majeure</p>
II.	Independent Regulator
III.	NEPRA Upfront Tariff

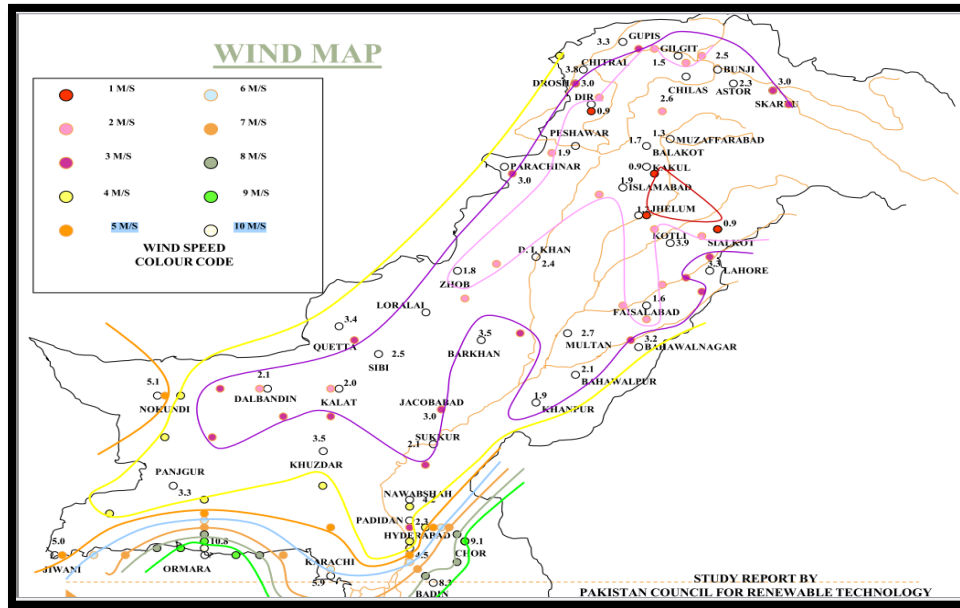
Annexure- III

ELECTRICITY DEMAND SUPPLY 2009-2030 PREDICTION



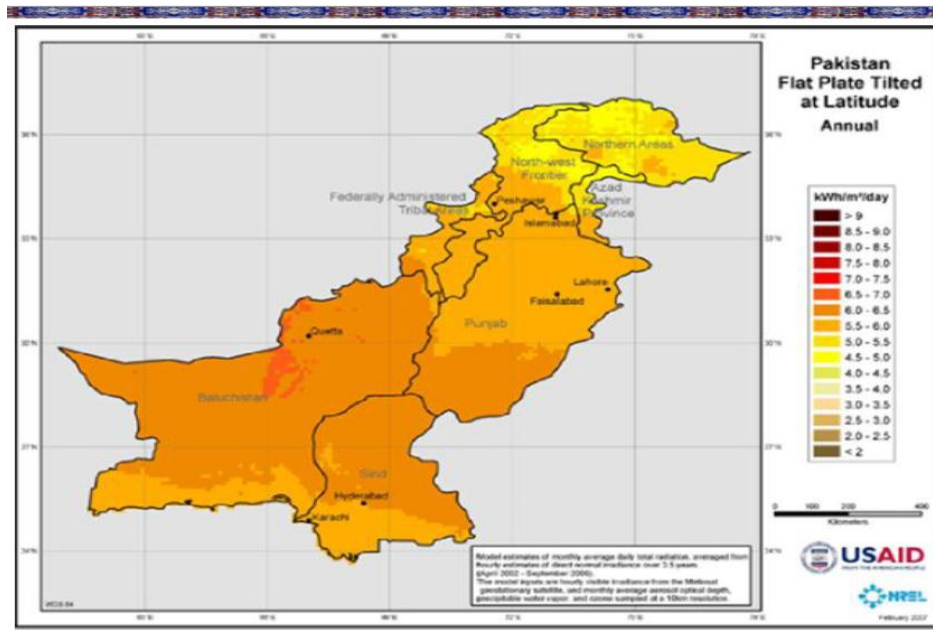
Annexure- IV

WIND MAP



Annexure- V

PAKISTAN FLAT PLATE TILTED AT LATITUDE



Annexure- VI

District Wise Population of Sindh (National Population Census 2017)

TABLE - 5: DISTRICT WISE POPULATION BY SEX AND RURAL/URBAN

ADMINISTRATIVE UNITS	HOUSEHOLDS	POPULATION - 2017				POPULATION 1998	SEX RATIO 2017	1998- 2017 AVERAGE ANNUAL GROWTH RATE
		MALE	FEMALE	TRANSGENDER	ALL SEXES			
1	2	3	4	5	6	7	8	9
SINDH	8,585,810	24,927,046	22,956,478	2,527	47,886,051	30,439,893	108.58	2.41
RURAL	4,186,828	11,919,109	11,056,183	301	22,975,593	14,744,436	107.80	2.36
URBAN	4,399,782	13,007,937	11,900,295	2,226	24,910,458	15,695,457	109.31	2.46
LARKANA DIVISION	1,055,050	3,176,416	3,015,803	161	6,192,380	4,210,650	105.33	2.05
RURAL	717,961	2,176,351	2,062,803	36	4,239,190	3,001,041	105.50	1.83
URBAN	337,089	1,000,065	953,000	125	1,953,190	1,209,609	104.94	2.55
JACOBABAD DISTRICT	177,867	515,480	490,778	39	1,006,297	727,190	105.03	1.72
RURAL	125,341	363,684	345,486	0	709,170	536,883	105.27	1.47
URBAN	52,526	151,796	145,292	39	297,127	190,307	104.48	2.37
KASHMOR DISTRICT	185,143	564,843	524,307	19	1,089,169	677,120	107.73	2.53
RURAL	140,872	433,475	402,076	5	835,556	509,199	107.81	2.64
URBAN	44,271	131,368	122,231	14	253,613	167,921	107.48	2.19
KAMBAR SHAHDAD KOT DISTRICT	223,154	682,859	656,148	35	1,341,042	924,294	103.75	1.97
RURAL	155,051	480,164	463,297	17	943,478	690,371	103.64	1.65
URBAN	68,103	202,695	194,851	18	397,564	233,923	104.03	2.83
LARKANA DISTRICT	261,331	778,249	746,093	49	1,524,391	1,001,608	104.31	2.23
RURAL	140,795	419,609	403,141	4	822,754	596,129	104.08	1.71
URBAN	120,536	358,640	342,952	45	701,637	405,479	104.57	2.92
SHIKARPUR DISTRICT	207,555	634,985	596,477	19	1,231,481	880,438	106.46	1.78
RURAL	155,902	479,419	448,803	10	928,232	668,459	106.82	1.74
URBAN	51,653	155,566	147,674	9	303,249	211,979	105.34	1.90
SUKKUR DIVISION	972,569	2,865,909	2,672,444	202	5,538,555	3,447,935	107.24	2.52
RURAL	639,691	1,879,470	1,759,544	38	3,639,052	2,256,444	106.82	2.54
URBAN	332,878	986,439	912,900	164	1,899,503	1,191,491	108.06	2.48
GHOTKI DISTRICT	296,670	849,226	797,051	41	1,646,318	968,797	106.55	2.82
RURAL	223,706	640,467	602,300	13	1,242,780	764,799	106.34	2.58
URBAN	72,964	208,759	194,751	28	403,538	203,998	107.19	3.65
KHAIRPUR DISTRICT	412,857	1,240,424	1,163,806	104	2,404,334	1,547,751	106.58	2.34
RURAL	280,079	839,708	788,759	17	1,628,484	1,042,543	106.46	2.37
URBAN	132,778	400,716	375,047	87	775,850	505,208	106.84	2.28
SUKKUR DISTRICT	263,042	776,259	711,587	57	1,487,903	931,387	109.09	2.49
RURAL	135,906	399,295	368,485	8	767,788	449,102	108.36	2.86
URBAN	127,136	376,964	343,102	49	720,115	482,285	109.87	2.13
HYDERABAD DIVISION	2,039,954	5,495,980	5,096,242	413	10,592,635	6,829,537	107.84	2.33
RURAL	1,282,254	3,475,736	3,228,139	75	6,703,950	4,439,953	107.67	2.19
URBAN	747,700	2,020,244	1,868,103	338	3,888,685	2,389,584	108.14	2.59
BADIN DISTRICT	359,376	932,488	871,979	49	1,804,516	1,106,272	106.94	2.60
RURAL	282,574	731,235	682,883	20	1,414,138	872,490	107.08	2.57
URBAN	76,802	201,253	189,096	29	390,378	233,782	106.43	2.73
DADU DISTRICT	286,810	797,857	752,385	24	1,550,266	1,106,717	106.04	1.79
RURAL	217,340	601,163	565,927	7	1,167,097	871,600	106.23	1.55
URBAN	69,470	196,694	186,458	17	383,169	235,117	105.49	2.60
HYDERABAD DISTRICT	434,869	1,145,788	1,053,510	165	2,199,463	1,494,866	108.76	2.05
RURAL	71,523	189,696	177,009	3	366,708	233,568	107.17	2.40
URBAN	363,346	956,092	876,501	162	1,832,755	1,261,298	109.08	1.98
JAMSHORO DISTRICT	180,922	523,259	469,839	44	993,142	582,094	111.37	2.85
RURAL	103,199	296,145	262,809	1	558,955	437,282	112.68	1.30
URBAN	77,723	227,114	207,030	43	434,187	144,812	109.70	5.94
MATIARI DISTRICT	143,623	396,799	372,518	32	789,349	494,244	106.52	2.35
RURAL	110,382	302,258	284,465	16	586,759	380,934	106.25	2.29
URBAN	32,841	94,541	88,033	16	182,590	113,310	107.39	2.54
SUJAWAL DISTRICT	153,018	406,754	375,193	20	781,967	513,702	108.41	2.23
RURAL	136,397	362,585	333,675	2	696,262	452,667	108.66	2.29
URBAN	16,621	44,169	41,518	18	85,705	61,035	106.39	1.80
TANDO ALLAHYAR DISTRICT	165,503	432,746	404,112	23	836,887	493,526	107.09	2.81
RURAL	114,105	297,324	277,764	6	575,094	344,944	107.04	2.72
URBAN	51,398	135,422	126,348	23	261,793	148,582	107.18	3.02
TANDO MUHAMMAD KHAN DISTRICT	131,565	350,010	327,202	16	677,228	438,624	106.97	2.31
RURAL	103,853	276,338	258,833	7	535,178	338,254	106.76	2.44
URBAN	27,712	73,672	68,369	9	142,050	100,370	107.76	1.84

TABLE - 5: DISTRICT WISE POPULATION BY SEX AND RURAL/URBAN

CENSUS - 2017 SINDH

ADMINISTRATIVE UNITS	HOUSEHOLDS	POPULATION - 2017				POPULATION 1998	SEX RATIO 2017	1998- 2017 AVERAGE ANNUAL GROWTH RATE
		MALE	FEMALE	TRANSGENDER	ALL SEXES			
1	2	3	4	5	6	7	8	9
THATTA DISTRICT	184,868	510,279	469,504	34	979,817	599,492	108.68	2.61
RURAL	152,881	418,992	384,754	13	803,759	508,214	108.90	2.44
URBAN	31,987	91,287	84,750	21	176,058	91,278	107.71	3.51
<u>KARACHI DIVISION</u>	2,770,074	8,439,659	7,610,365	1,497	16,051,521	9,856,318	110.90	2.60
RURAL	193,871	606,588	534,499	82	1,141,169	407,510	113.49	5.56
URBAN	2,576,203	7,833,071	7,075,866	1,415	14,910,352	9,448,808	110.70	2.43
KARACHI CENTRAL DISTRICT	538,983	1,543,950	1,427,349	327	2,971,626	2,277,931	108.17	1.41
RURAL	538,983	1,543,950	1,427,349	327	2,971,626	2,277,931	108.17	1.41
URBAN	538,983	1,543,950	1,427,349	327	2,971,626	2,277,931	108.17	1.41
KARACHI EAST DISTRICT	509,239	1,528,019	1,379,225	223	2,907,467	1,472,896	110.79	3.64
RURAL	509,239	1,528,019	1,379,225	223	2,907,467	1,472,896	110.79	3.64
URBAN	509,239	1,528,019	1,379,225	223	2,907,467	1,472,896	110.79	3.64
KARACHI SOUTH DISTRICT	327,518	943,546	848,010	195	1,791,751	1,478,047	111.27	1.02
RURAL	327,518	943,546	848,010	195	1,791,751	1,478,047	111.27	1.02
URBAN	327,518	943,546	848,010	195	1,791,751	1,478,047	111.27	1.02
KARACHI WEST DISTRICT	634,459	2,065,847	1,848,553	357	3,914,757	2,089,509	111.75	3.35
RURAL	44,051	149,220	134,014	13	283,247	73,568	111.35	7.34
URBAN	590,408	1,916,627	1,714,539	344	3,631,510	2,015,941	111.79	3.14
KORANGI DISTRICT	421,618	1,284,015	1,172,737	267	2,457,019	1,561,742	109.49	2.41
RURAL	421,618	1,284,015	1,172,737	267	2,457,019	1,561,742	109.49	2.41
URBAN	421,618	1,284,015	1,172,737	267	2,457,019	1,561,742	109.49	2.41
MALIR DISTRICT	338,257	1,074,282	934,491	128	2,008,901	976,193	114.96	3.86
RURAL	149,820	457,368	400,485	69	857,922	333,942	114.20	5.08
URBAN	188,437	616,914	534,006	59	1,150,979	642,251	115.53	3.11
<u>MIRPUR KHAS DIVISION</u>	800,528	2,218,094	2,010,485	104	4,228,683	2,585,417	110.33	2.62
RURAL	648,103	1,801,103	1,626,359	37	3,427,499	2,087,397	110.74	2.64
URBAN	152,425	416,991	384,126	67	801,184	498,020	108.56	2.53
MIRPUR KHAS DISTRICT	286,547	778,172	727,650	54	1,505,876	1,006,329	106.94	2.14
RURAL	209,861	558,838	521,274	12	1,080,124	683,876	107.21	2.43
URBAN	76,686	219,334	206,376	42	425,752	322,453	106.28	1.47
THARPARKAR DISTRICT	301,625	882,365	767,266	30	1,649,661	914,291	115.00	3.15
RURAL	274,691	812,320	705,251	19	1,517,590	868,146	115.18	2.98
URBAN	26,934	70,045	62,015	11	132,071	46,145	112.95	5.68
UMER KOT DISTRICT	212,356	557,557	515,569	20	1,073,146	664,797	108.14	2.55
RURAL	163,551	429,945	399,834	6	829,785	535,375	107.53	2.33
URBAN	48,805	127,612	115,735	14	243,361	129,422	110.26	3.37
<u>SHAHEED BENAZIRABAD DIVISION</u>	947,435	2,730,988	2,551,139	150	5,282,277	3,510,036	107.05	2.17
RURAL	693,948	1,979,861	1,844,839	33	3,824,733	2,552,091	107.32	2.15
URBAN	253,487	751,127	706,300	117	1,457,544	957,945	106.35	2.23
SANGHAR DISTRICT	374,609	1,064,484	992,509	64	2,057,057	1,319,881	107.25	2.36
RURAL	270,891	761,365	707,277	10	1,468,652	920,185	107.65	2.49
URBAN	103,718	303,119	285,232	54	588,405	399,696	106.27	2.05
NAUSHAHRO FEROZE DISTRICT	275,693	832,569	779,747	57	1,612,373	1,087,571	106.77	2.09
RURAL	212,073	637,153	595,399	19	1,232,571	855,746	107.01	1.94
URBAN	63,620	195,416	184,348	38	379,802	231,825	106.00	2.63
SHAHEED BENAZIRABAD DISTRICT	297,133	833,935	778,883	29	1,612,847	1,102,584	107.07	2.02
RURAL	210,984	581,343	542,163	4	1,123,510	776,160	107.23	1.96
URBAN	86,149	252,592	236,720	25	489,337	326,424	106.70	2.15

Annexure- VII

ORGANIZATIONS AND EXPERTS CONSULTED IN FORMULATING THE POLICY