



Master's thesis:

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Declaration I, Sana Javed, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature:.....

Date:.....

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Abstract:

Pakistan is one of the developing countries that have been struck hard by climate change although it contributes very small in green house gas emissions. Pakistan's vulnerability is high because of its dependence on agriculture which is highly climate sensitive. To cope with potential impacts of climate change the policy and institutional setup has been formulated. This research aims to study the knowledge that policy makers and governmental actors have on vulnerability and adaptation. Vulnerability in terms of people's social and economic well being is termed as contextual in contrast to seeing climate change as the ultimate threat to the exposure unit and adapting accordingly is termed as outcome vulnerability. Seeing vulnerability in contextual way is one of the key features of achieving sustainable development. Institutional and policy makers have many challenges for an effective implementation of climate change adaptive strategies but the main gap lies in lack of participation of vulnerable communities in any level of policy making. There is a need of climate change education and awareness at governmental and local level which will help in capacity building of researchers, policy makers and local communities.

A study on Pakistan’s Vulnerability to Climate Change, current policies and Institutional Set up for dealing with it

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Thesis Structure:

This thesis consists of seven chapters. Chapter one consists of purpose of the study, research questions and theoretical framework or background for the empirical findings in the following chapters. Chapter two provides insight into methodology, research design, data collection methods and the reasons for the choices. The third chapter introduces the study area and gives an overview of the vulnerability of the country to climate change with the help of several studies. Fourth chapter gives description about the Institutional and policy framework for climate change at governmental and provincial level and includes key findings about the gaps or challenges based on the theoretical framework presented in the chapter one. Fifth chapter first involves a brief description of the Institutional framework for Disaster risk management at governmental and provincial level and a critical review on Pakistan national disaster management act 2010. Sixth chapter presents climate budgeting at governmental and provincial level followed by seventh chapter which presents and discusses the organizations working on climatic data collection and research and their challenges. Eighth chapter highlights the role of academia. Ultimately, conclusion and some recommendations are made in the end of the thesis.

Chapter 1:

1.1.Introduction:

Climate change is a serious threat to life on Earth and to our future development. According to IPCC (2013) a significant change in Earth's climate has happened over the last century i.e. an increase of 0.85 degrees in the atmosphere from the period of 1880-2012. The Earth's average temperature is expected to increase further if the anthropogenic activities continue to emit greenhouse gases. Fluctuating precipitation patterns, frequent floods, droughts, intense heat waves, melting of glaciers, increase in sea level are some of the major consequences we can expect to see as a result of human induced greenhouse gas (GHG) emission. (IPCC, 2013).According to IPCC "Warming of the climate system is unequivocal, as is now evident from observations of increase in global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea-level."(IPCC , 2007)

Climate change has wide ranging impacts all over the world and different countries have been predicted to have varying vulnerability and exposure. Resultantly it demands a whole set of new transformative adaptive strategies and mitigation measures. Climate change dilemma can be overcome by reducing the amount of carbon emissions and to adapt to the changes as a result of it. (Stern, 2006)

Pakistan today is considered to be among the top 20 countries in the world that are gravely endangered to the adverse effects of climate change. Pakistan is facing severe impacts of climate change that is recurrence of floods and droughts. There were severe floods in the years of 1950,1956,1957,1973,1976,1978,1988,1992,2010,2011 and 2012 and worst droughts during the period from 1998-2004. It is crucial to have an effective response to Climate change across all sectors including health, social services, education, transport, energy and infrastructure, which requires a 'whole-of-government' approach implementing adaptation and mitigative strategies from the grass root level to the upper level. (Hussain, Mumtaz & Mumtaz, Saniea, 2014)

The weather extremes in Pakistan include high and low temperatures, heaviest rainfall and flooding. The highest temperature ever recorded in Pakistan is 53.5 °C (128.3 °F) which was considered to be the hottest reliably measured temperature ever recorded on the continent of Asia and the fourth highest temperature ever recorded on earth.(Jeff Masters,2010). The threat of climate change can be coped with by identifying its effects on different socio-economic sectors of the country. Substantial efforts have been made to establish reliable and accurate records of surface air temperatures of the region (Singh N. and Sontakke N.A, 1996). A study on climatic normal of Pakistan, 1931 – 1960 and 1961 – 1990, revealed that there was cooling over Northern Pakistan and south-eastern Pakistan due to the increase in monsoon cloudiness and rainfall (Kruss, P. O et al., 1992). Analysis of reconstructed long term temperature time series from 1876 – 1993 yielded the presence of large variability in temperature of the country and warming since the beginning of last century with total change of 0.2 degree Celsius(Singh N. and Sontakke N.A, 1996).

Pakistan produces more than 30 million metric tons of carbon emissions. This is about 0.4% of global emissions. Realizing the importance of climate change issue, Pakistan has been actively participating in global climate change mitigation efforts initiated at Rio Earth

Summit in 1992 where historical UNFCCC was adopted by 189 parties. The country acceded to Kyoto protocol on 11 January 2005 in the UN secretariat. (GOP, 2003)

The understanding of the concepts of adaptation and vulnerability is crucial in effective mitigative strategies. The contextual conditions of the area i.e. social, economic and political status often reveals the grass root causes of the disasters. Climate change vulnerability is similarly caused by multiple stressors which is termed as contextual vulnerability. Analysing and assessing the grass root causes can help in better adaptive policies and sustainable management of the disaster risk reduction plans. (Wisner et al, 2004).

1.2.Problem Statement, Objectives and Research Questions:

1.2.1.Problem Statement:

Pakistan has recently been hit by several climatic-related disasters such as floods and droughts, as well as other disasters including earthquakes and conflict, which together or separately have caused human as well as financial loss. Climate change related disasters have struck hard on Pakistan and although there is an institutional and policy set up to address it's vulnerability and possible adaptive or mitigative measures, the gaps and challenges faced by them are the biggest hurdle in achieving effective reduction in risk posed by climate change. As those gaps can be climatic data collection, it's research, policy makers knowledge about vulnerability, adaptation and mitigation or it can be lack of budget. As these issues need to be highlighted and worked upon by not only state actors but also by non-state actors such as NGO's which can help in capacity building of institutes. However each actor have their own interpretation of looking at climate change issue which in itself is a major issue in achieving an effective implementation of sustainable adaptive strategies against climate change. So this study aims to look at handling of Climate Change dilemma by Pakistan in terms of Institutional setting at governmental and local level and to analyse their challenges.

1.2.2.Objective of the study and Research Questions:

As there has been an increased focus on the sustainable adaptive capacity of the countries hit by the worst climate related disasters as in the case of Pakistan but there is still lack of information and knowledge about how the actors can practically achieve this target. So there

is a need of examining how the current initiatives against climate change are in function and this leads to the purpose of the study that is to analyse Pakistan's vulnerability to climate change, current policies and institutional set up to cope with it and what are their main challenges in achieving sustainable adaptation practices.

To meet this purpose the overarching research question is *How does Pakistan's vulnerability to climate change has affected the system and how it is being dealt at Governmental Institutional and private level?* There are some sub research questions that are helpful in fulfilling the aim of the main research question

- What is the institutional setup at Governmental and provincial level for dealing with climate change and what are the main challenges and gaps faced by it?
- What is the process of climate funding at governmental level?
- What is the role of NGO's and academia in dealing with climate change mitigation and adaptation?

1.3.Theoretical Framework and literature Review:

The main theoretical framework focus on the vulnerability and adaptive measures that are currently being used by different actors i.e. Governmental institutions and private ones (NGO's) and it also highlight the shortcomings in the understanding of the core concepts by them which can influence the country's sustainable development against climate change impacts. This research aims to develop guidelines for suggesting effective humanitarian policies and programmes which helps in long term sustainable development.

1.3.1.Vulnerability and it's different Interpretation:

Vulnerability:

Vulnerability assessment has been done by both natural and social scientists to measure it with the perspective of regions, sectors or ecosystems. According to IPCC third assessment report "climate change vulnerability is considered to be a function of exposure, sensitivity and adaptive capacity". (McCarthy et al., 2001 ,pg 6:IPCC,2014). Exposure is defined as "the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected".(IPCC,2014) In the case of Pakistan it's geographical location is expose to climatic change as it has Indus plain in the west expose to flooding because of sea level rise and also to cyclonic activity,

Hindu Kush-Karakoram-Himalaya ranges in the north expose to glacier and snow melt, Baluchistan and Thar desert in the south expose to severe droughts and the extreme weather events, which have enhanced in their frequency and intensity in the country. As the impacts are hard to reverse that is increase in flooding and as glaciers recede it will damage the ecosystems and livelihoods affecting regional food security.

Adaptive capacity can be a “function of wealth, technology, information, skills, infrastructure, institutions, equity, empowerment, and the ability to spread risk”.(IPCC,2014) It is mostly unevenly distributed as some regions even in the same country will be able to adapt better than others. Adaptive capacity also concerns the character of systems, whether they promote climate considerations, learning, coproduction of knowledge, and local climate knowledge in decision making processes. Adaptive capacity in the case of Pakistan includes Institutional and policy reforms, mitigative and adaptive strategies against disasters, climatic awareness through educational institutes and NGO’s collaboration which has been discussed in detail in different sections of this thesis.

Interpretation of Vulnerability:

Vulnerability has different interpretations which are manifesting different discourses on climate change. There has been a very little understanding how these different discourses represent not only different approaches to measure vulnerability but also it determine a contrasting political and institutional response to climate change as well. (Demerritt, 2001; Forsyth, 2003). These interpretations are named as outcome and contextual vulnerability and links them to scientific and human security framing respectively. Kelly and Adger (2000) identify two main approaches to vulnerability in the climate change literature: ‘end-point’ and ‘starting-point’. The end-point approach considers vulnerability as “the end point of a sequence of analyses beginning with projections of future emission trends, moving on to the development of climate scenarios, and thence to biophysical impact studies and the identification of adaptive options”(p. 326). End point vulnerability sees climate change as an ultimate threat to an exposure unit which can be any community and demands adaptive measure and strategies accordingly as it can be shown in the figure 1a. In this approach vulnerability level is determined by the residual of what has been left after adaptation has been taken place according to climate changes. However starting point approach considers vulnerability a characteristic of social, economic and ecological systems which are linked by multiple factors and processes as shown in figure 2b. In the case of Pakistan it is highly crucial

to analyse vulnerability in terms of contextual one as it's a highly political influenced state resulting in varying policies and institutional set up. As the climate change impacts are quite evident it has a direct impact on people's economic and social condition which need to be addressed while making national or provincial climate change adaptive or mitigative policies.

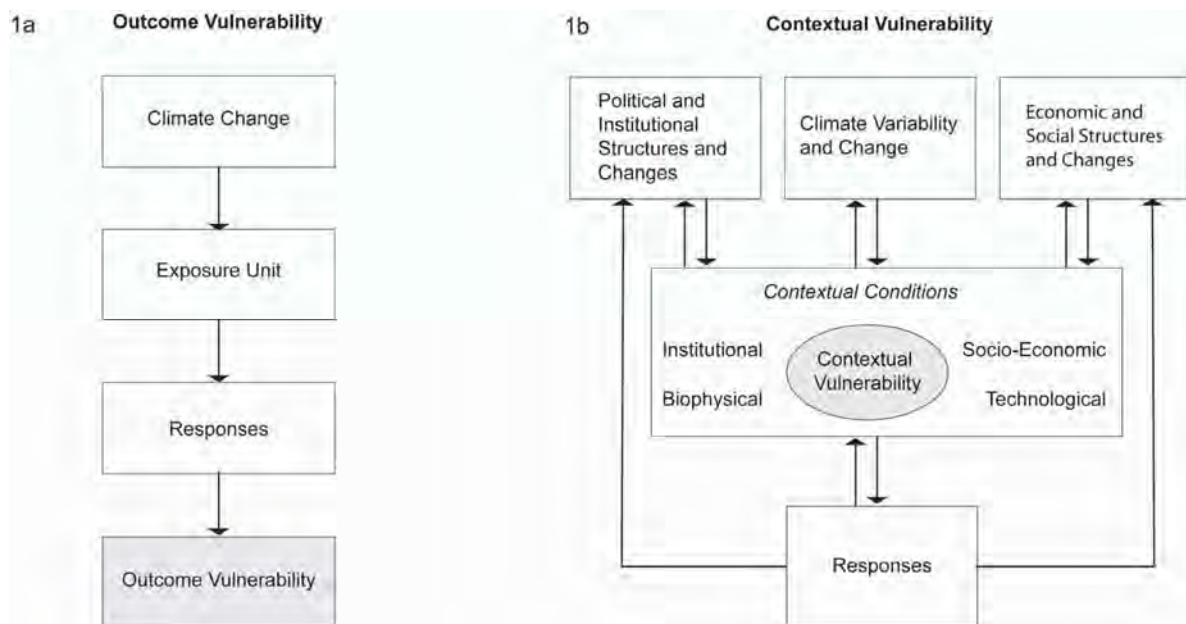


Figure 1: Frame-works depicting two interpretations of vulnerability to climate change: (a) Outcome vulnerability; (b) Contextual vulnerability. (O'Brien, K. Et al ,2007)

Adaptation:

IPCC defines Climate Change adaptation as: “the process of adjustment to actual or expected climate and its effects [and] to moderate or avoid harm or exploit beneficial opportunities” (IPCC, 2014, p. 5). According to IPCC scientific definition adaptation to climate change impacts can be done without integration of social, cultural , economic or political issues. (Adger, Lorenzoni, & O'Brien, 2009). This definition of adaptation covers a single cause of

vulnerability that is climate change and involves changes accordingly and it will result in an improved or status quo condition of the affected area.(Lemos & Tompkins, 2008). However a second perspective on adaptation involves addressing multiple contextual causes of vulnerability i.e. power structures, financial or economic condition of the area, social dimensions and several other root causes of it. (S. Eriksen et al., 2011; Finan & Nelson, 2009; Ribot, 2010).From this perspective adaptation can be defined as “a social process that involves empowering individuals, households, communities, institutions and states, not only to react and respond to impacts of change, but also to challenge the drivers of risk and promote alternative pathways to development” (K. O'Brien, Eriksen, Inderberg, & Sygna, 2015, p. 273). Although the causes of vulnerability are mostly global as the GHG emission and resultant global warming issue but the adaptation need to be done at local level. (Agrawal, 2010; S. Eriksen et al., 2011; Finan & Nelson, 2009; Ribot, 2010).In the case of Pakistan ,to build adaptive capacity it is crucial to implement “two tier approach”as mentioned by Lemos and Tompkins(2008).The first tier is to make institutional and policy setup for climate change including disaster management and risk reduction strategies. It is crucial for a country like Pakistan to include second tier which is social and political transformation. Governance ,stakeholders participation, local knowledge integration, allocation of resources ,type of policies and social and economic structures can highly affect the vulnerability and adaptation. (S. Eriksen et al., 2011; S. Eriksen & Lind, 2009). Governance is structure or institution that make policies at federal or local level for any political or global issue as in the case of climate change. (Finan & Nelson, 2009). Pakistan governance work on the issues lack community participation in some of the major policies for climate change. Participation is key in effective policy in which power is shifted from policy makers to local people. This power involves choosing of adaptation practices by the local people and having a full involvement in decision making process of key issues where they can present their issues and challenges. (Finan & Nelson, 2009).

Community based adaptation (CBA)is defined as “a community-led process, based on communities’ priorities, needs, knowledge, and capacities, which should empower people to plan for and cope with the impacts of climate change.” Reid et al. (2009, p. 13).Community based adaptation focuses on integrating local knowledge with scientific one to have a productive and sustainable adaptation (J. Ensor & Berger, 2009; Reid et al.,

2009). Sustainable adaptation is defined as “adaptation that contributes to socially and environmentally sustainable development pathways, including both social justice and environmental integrity” (S. Eriksen et al., 2011, p. 8). S. Eriksen et al. (2011) identified four principles of sustainable adaptation.

1. Recognize the context for vulnerability, including multiple stressors
2. Acknowledge that different values and interests affect adaptation outcomes
3. Integrate local knowledge into adaptation responses
4. Consider potential feedbacks between local and global processes
5. Empower vulnerable groups in influencing development pathways and their climate change outcomes. (S. Eriksen & Marin, 2015).

In the context of Pakistan it is important for the development actors to conduct vulnerability analysis in the contextual way as it is key for achieving long term adaptation goals. Community based adaptation empowers vulnerable local people to have a say in decision making process of policies either at national or local level. Consideration of economic and social conditions of the vulnerable people can lead to effective implementation of the policies made by climate related institutions.

Chapter Two: Methodology

2.1. Research Approach:

This thesis set out to identify how Pakistan’s institutions are dealing with climate change issue at Governmental and private level. This includes an analysis of the institutional setup at federal and provincial level which gives an overview of the organizations working for climate change, their approaches, framework and policies towards handling this issue. The analysis of the organizational understanding of the vulnerability and adaptation or mitigation in a sustainable way or not is reflected in the policy and agenda they are working on. To get an understanding of the gaps found in these institutions at federal level or local level implementation a qualitative methodological approach is used throughout the research.

Qualitative research is research on “the meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things” (Berg & Lune, 2012, p. 3). Research strategy has two main stance one is ontological which shows the perspective of the world and nature of reality while the epistemological one shows how we as researchers can view or study this reality and what kind of knowledge can be acceptable. As a research strategy, qualitative research generally adopts a constructivist ontological position which sees the world as constantly shifting and emerging. The social reality is not considered as a definite one rather it is constructed by individuals or social actors. Every individual having its own interpretation of reality leads to an assumption of multiple realities. On the other hand, qualitative research embodies interpretivist epistemological position which also considered social reality being constructed by individuals and not just by scientific framework.(bryman,2008). As this study also shows the importance of individuals perspectives and involvement in making a social reality in terms of policies and adaptation measures against climate change. It also emphasizes that knowledge is indeterminate which means that every researcher is somehow influenced by conceptual and theoretical work.(Lund 2014).

2.2.Research Design and Plan:

As this research is based on interpretivist epistemological position and aims to understand how Pakistan is dealing with climate change and what are the possible gaps at governmental institutional level. Research design method that have been used to collect the data from organizations is Interview survey method. Interviews were done of the main governmental department’s directors which gives a handful knowledge about their organizational policies and implementation processes and work done upto so far related to climate change.

2.3.-Methods of Data Collection and analysis:

Data collection method involves primary and secondary sources. Primary sources involves six key informant interviews with the persons of the governmental departments i.e. Ministry of environment and climate change, Pakistan Metrological department, National disaster management authority (NDMA). It also involves interviews of directors of private non-governmental organizations i.e. Lead (Islamabad) and Inter-corporation (Peshawar) and also of Climate change centre, University of Peshawar.

Individuals	Type of data collected	Method
Deputy director at Ministry of Environment and Climate Change	Overview of Institutional setup and the work done i.e climate related reports and national climate change policy draft.	Semi-structured Interview involving open ended questions
Director of Pakistan Metrological Department	Institutional setup of the organization, Climate research publications and work of collaborative organizations	Semi-structured interview
Deputy Director of National Disaster Management Authority	Main achievements and challenged faced by the organization, draft of PNDMA 2010	Semi structured interview
Senior researcher of Lead Pakistan (Islamabad)	Organizational setup and orientation of their climate related work in terms of adaptation.	Semi structured interview
Director of Inter-corporation (Peshawer)	Views on adaptation and vulnerability, Reports of work done upto so far by the organization	Semi structured interview
Head of Climate Change Centre, University of Peshawer, Pakistan	Insight of work done by the centre in terms of climate corridors and Climatic awareness	Semi structured interview

Research instruments included semi structured and open ended questions to gather desired data from beneficiaries. Secondary data has been collected from various Governmental and non-governmental departments such as Metrological climate centres, humanitarian

organization and Environment protection Departments. Secondary sources includes governmental publications, reports, previous researches and their official documents obtained from different state departments and authorities working on climate change which provides a very handful information. Further, the reports from different non-governmental organizations through internet resources were also obtained and these documents and reports are of PMD (Pakistan Metrological Department); WAPDA (Water and Power Development Authority) Pakistan Flood Commission; National disaster management authority (NDMA),Ministry of Climate Change(MCC), Provincial disaster management authority (PDMA) Pakistan Agriculture Research Council(PARC).In addition reports, documents, policy briefs were obtained from different NGOs especially Lead and Intercorporation working in Pakistan. The results were then coded and analysed according to the thereotical framework.

2.4.-Limitations and ethical considerations:

This study aims to cover the main institutions at governmental level however it does have it's own limitations. It doesn't cover all the aspects of the institutional and policy setup. Not all the institutions and policies have been included for in-depth analysis. Similarly work on disaster management have solely collected from the National disaster management authority. It lacks the public or vulnerable local people perspectives on these setups and their challenges in terms of economic and social resources. During the research the ethics has been taken into consideration by assuring the interviewers that information gained from them will be only for academic purpose and also their privacy will be kept. The interviewer's willingness to respond and to record the interviews has been asked before interviewing.

Chapter Three:

3.1.Pakistan's Vulnerability to Climate Change:

This chapter includes a brief introduction of Pakistan's geographical context and climatic dimensions of the area with the help of various studies done by the different organizations. It

will help to get an understanding of the vulnerability and severity of the climatic change for Pakistan in both social and economic way. As climate change impacts various sectors and ecosystems such as food, water and energy; forests and biodiversity; coastal and marine environment; as well as on the occurrence and intensity of climate related hazards such as floods and droughts. It also highlights the vulnerability of Pakistan to disasters and the need of disaster management and disaster risk reduction. Climate variability has been shown with the help of parameters such as Area weighted mean annual temperature, mean maximum temperature, snow melt, heat wave and annual precipitation which together explain some of the dynamics of the climate change of Pakistan. It has been achieved by climatic studies done by different organizations in the perspective of vulnerability and adaptation.

3.2. Geographical Context:

Pakistan has the most spectacular mountain ranges in the north and landscapes on the southern border. Pakistan's geographical location is very unique having India in the east, Iran and Afghanistan on the west and China in the north. "Pakistan has varied terrain with flat Indus plains, Deserts in the east ; mountains in the north and northwest; Baluchistan Plateau in the west." (PMD, 2009). Pakistan is particularly vulnerable to climate change because it has generally a warm climate and also it lies in a geographical region where the temperature increases are expected to be higher than the global average. its land area is mostly arid and semi-arid (about 60 per cent of the area receives less than 250 mm of rainfall per year and 24% receives between 250-500 mm); its rivers are predominantly fed by the Hindu Kush Karakoram-Himalayan (HKH) glaciers which are reported to be receding rapidly due to global warming. As it is an agriculture based country so it's sensitivity to climate change is really high in terms of variability in monsoon rainfall. Combination of all these factors has resulted in causing serious threat to water, food and energy security. Sea level rise have increase the risk of flooding of coastal areas and indus deltaic region. The Indus Delta is already located in the intense heat zone and any rise in temperature would impact human health due to heat strokes, diarrhea, cholera, vector-borne diseases; and human settlements due to frequent floods, droughts and cyclones (Robert, et al., 2009)."The total arable land is estimated to be approximately 27.87% with permanent crop cover of 0.87% and others at 71.26%. Of country's total area 24% is cultivated, of which 80% is irrigated. Forests and

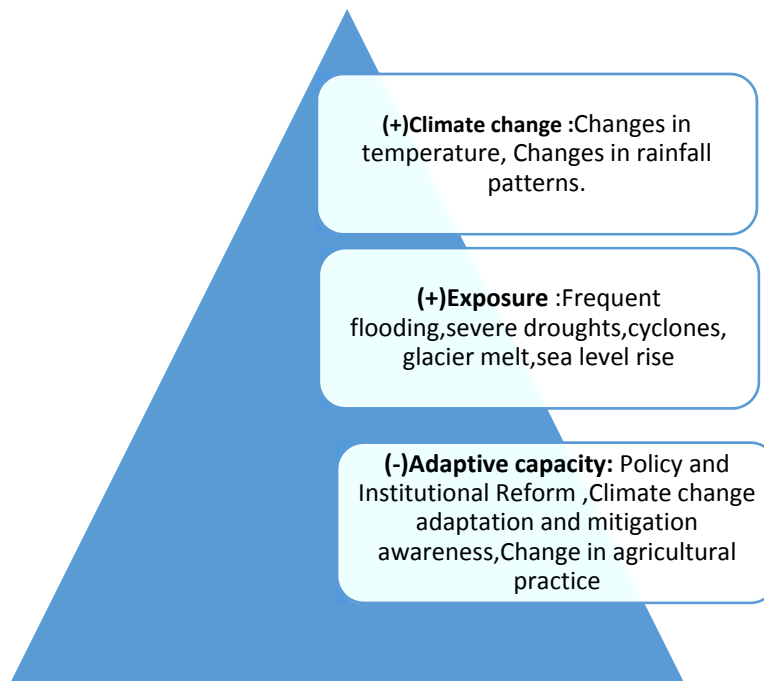
grazing land cover is 4%, about 31% is not fit for agriculture use and about 2% is under cover.”(PMD,2009)

Pakistan’s vulnerability to climate change is a reality as it is evident from the current intensified and frequent disastrous climatic events. The impacts of climate change is quite wide ranging amongst all the sectors i.e. water, agriculture, human health, biodiversity, forestry and vulnerable ecosystems. However marking extent of vulnerability to climate change is difficult in the case of Pakistan as there is no detailed or comprehensive assessment done on it until so far at national or international level. However different vulnerability indices has ranked Pakistan amongst the top countries affected the most. Maplecroft’s (2011) Index of vulnerability to climate change has ranked Pakistan on 16th where-as Global Climate Risk Index (GCRI) of German watch in 2012 (Harmeling 2011) ranked it on eighth level and first in 2010.

Although Pakistan is considered to be among top 20 vulnerable the irony is Pakistan’s status as GHG emitter is quite low. Carbon emissions produced by Pakistan are 30 million metric tons which accounts for only about 0.4% of global emissions. More than half of these emissions almost 53% is contributed by the energy sector followed by agriculture sector which contributes almost 37%, industrial processes 5% and other activities 5% (GOP, 2003). On per capita basis, Pakistan produce almost 1.9 tonnes GHG emissions which parallels to about one-third of the world average, one-fifth of the average for Western Europe and one tenth of the per capita emissions in the U.S. Pakistan stands at 135th place in the world ranking of countries on the basis of their per capita GHG emissions.

According to IPCC third assessment report “vulnerability is considered to be a function of exposure, sensitivity and adaptive capacity.”(IPCC, 2014)

Figure:2 Vulnerability framework showing indicators and components in Pakistan



In the case of Pakistan as shown in figure 2 Climate change is quite evident as the studies have shown evident fluctuations in temperature and precipitation pattern. It has resulted in frequent occurrence of droughts and floods. Pakistan geographical context is being more exposed to climatic changes as it has mountain ranges in northern parts where the snow cover is reducing and plain agricultural land prone to frequent floods and droughts. Different parameters have been selected to show that climate change has affected mean temperature, rainfall and snowmelt glaciers in the north in the section below. Resultantly Pakistan has been exposed to severe flooding, droughts and some of the major disaster events have been highlighted in the section. Adaptive capacity includes Institutional and policy reforms, mitigative and adaptive strategies against disasters, climatic awareness through educational institutes and NGO's collaboration which has been discussed in detail in different sections of this thesis.

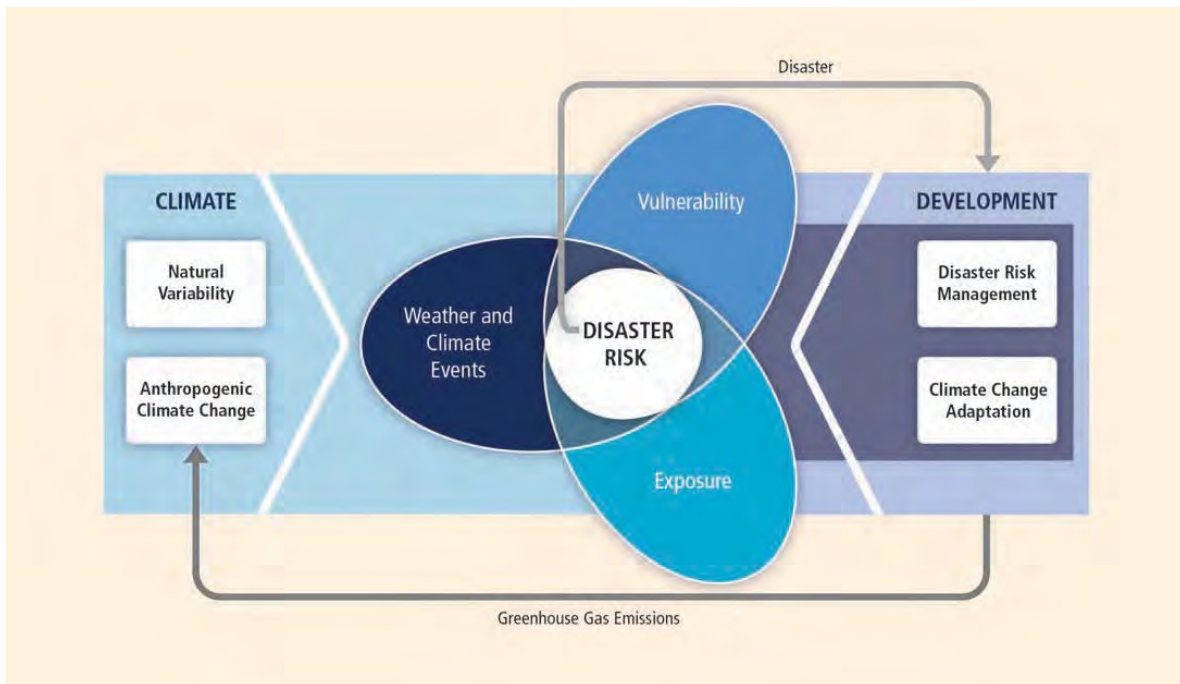


Figure 3 : SREX framework has been used to explain the disaster risk situation in Pakistan. As the weather and extreme situation has been described in detail by different studies done by Pakistan meteorological department. It has been used to explain how exposure and vulnerability to climate extremes can increase the likelihood of disasters. It also considers the role of development in trends in exposure and vulnerability, implications for disaster risk, and interactions between disasters and development. (IPCC,2012)

3.3.Past and Expected Future Climatic Changes over Pakistan:

According to IPCC Climate Extreme (extreme weather or climate event):*The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as ‘climate extremes.’*(IPCC,2013).According to IPCC there are tipping points for every state if there is a shift in mean and variance of temperature it can lead to a new state which will result in extreme events. It doesn't necessarily need big changes in mean or variance as shown in figure 3.

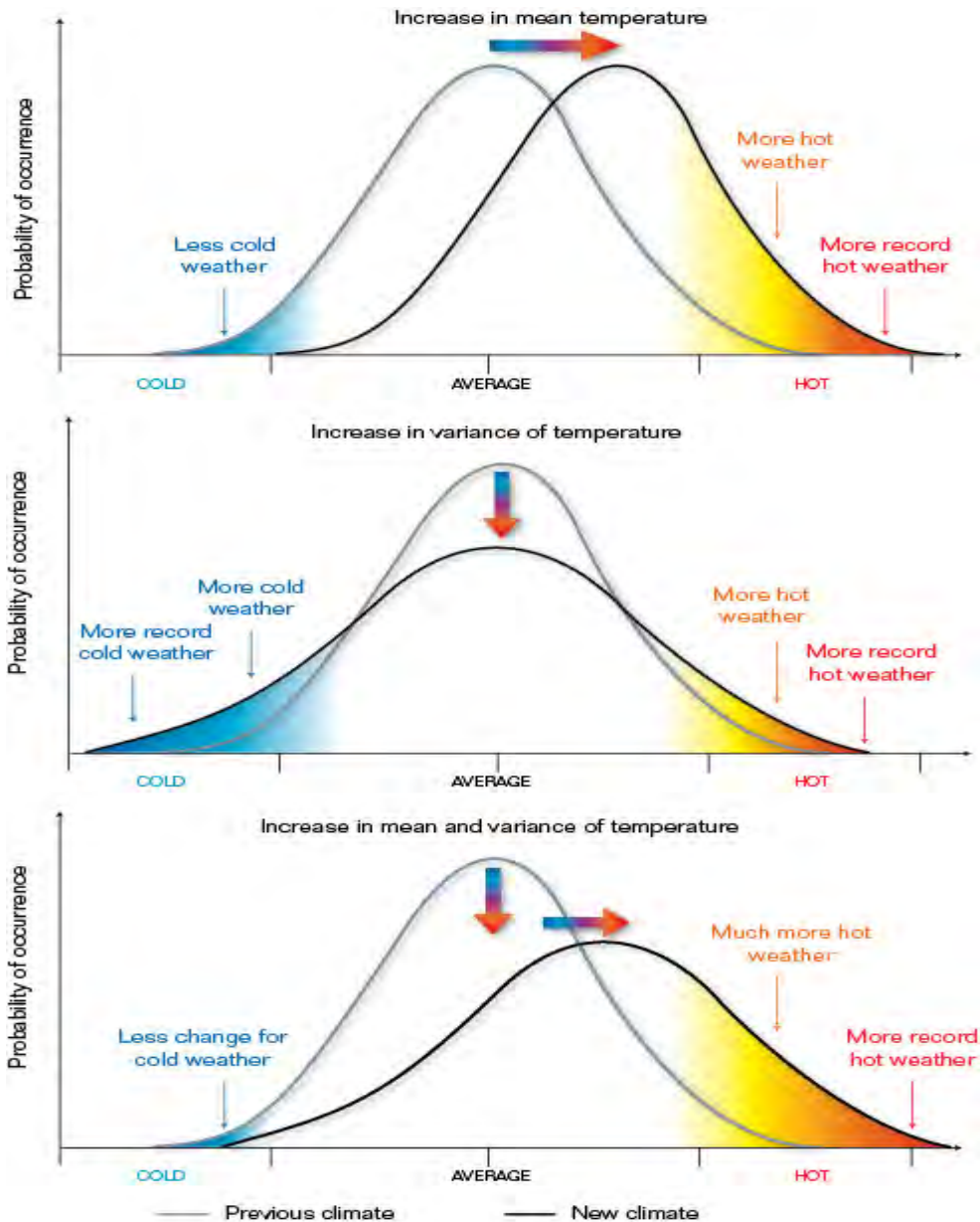


Figure:2(IPCC,2013)

In the case of Pakistan an analysis from 52 metrological stations indicates that frequency of highest daily temperature and precipitation has shown a significant increase from the period of 1961-2000(PMD, 2009).Social drivers also play a key role in the temperature fluctuations. As the anthropogenic activities continue to increase the GHG's emissions in the atmosphere the process of global warming will continue. As those gases once entered in the atmosphere will stay there as average life of these gases in the atmosphere is quite high. Some of the parameters have been discussed to have an overview of climatic situation of Pakistan.

3.4. Area weighted Annual Mean Temperature:

The studies conducted by Global Change Impact Studies Centre (GCISC 2009a, b, c) and Pakistan Meteorological Department (Farooqi et al. 2005; Husain et al. 2005; Gadiwala and Sadiq 2008; Zahid and Rasul 2009; Ahmad et al. 2010) clearly shows that Pakistan's climatic conditions are changing considerably. These studies analysis data, matches with the global predictions about climatic changes in regions like Pakistan, indicating the average annual temperature in the country has increased by 0.6 °C. The northern part of the Pakistan has shown 0.8 degree Celsius rise as compared to southern part which has shown a rise of 0.5 degree Celsius.

The time series of Area-weighted annual mean temperatures of Pakistan clearly indicates a warming trend from 1901 to 2007 (Afzaal et al. 2009) as shown in Figure 3 . The change recorded per decade was 0.06 which is significant at 95% confidence level.

In the period from 1933 to 1945 a rise in temperature of 0.6 degree Celsius has been recorded followed by a decrease at the rate of 0.03 °C per decade up to 1993. The increase in temperature after 1993 was quite sharp that is 0.53 degree Celsius per decade that continued to the end of the time series. The average temperature recorded in the last decade was 22.3 °C.(Afzal et al.2009).In the 20th century, Pakistan's warmest year occurred was 1941 while the warmest year in the global record was 1998(PMD,2009)



Figure 3: Temperature Variation across the time period 1901-2007 (Afzaal et al,2009)

The three out of four provinces of Pakistan, Baluchistan, Punjab and Sindh, has shown a warming trend in their mean temperatures in the period from 1960 – 2007, significant at 95% level. The total change in temperature in Baluchistan, Punjab and Sindh is 1.15, 0.56 and 0.09 degree Celsius respectively as shown in table below.(PMD ,2009)

Table 1: Change in Annual Mean Temperature

Change in Area-Weighted Annual Mean Temperature (C)	
1960 – 2007	
2 NWFP	*0.15 ± 0.24
3 Punjab	0.56 ± 0.25
4 Sindh	0.44 ± 0.20
5 Azad Kashmir	*0.30 ± 0.27
6 FANA	*0.16 ± 0.27
7 PAKISTAN	0.47 ± 0.21
* <i>Non-Significant</i>	

3.5.Mean Maximum Temperature:

Pakistan Metreological centre has worked on the temperature fluctuations in Pakistan by collecting the data from 40 stations across the country from the period of 1960 to 2007. The rise in maximum temperature can clearly be seen. The air has been warming at the rate of 0.18 degree Celsius per decade and the total change is 0.85 degree Celsius over the period mentioned above. This change is significant at 99% level. There is no significant change from start of the series upto 1997, but after that the warming increased very rapidly at the rate 0.36 degree Celsius per decade and so was the rise in maximum temperature in the last decade.(PMD,2009)

“All the provinces of Pakistan display rise in mean maximum temperature for the period, aforementioned, which is significant at 99% level except Sindh and Punjab. The linear trend ranges from 0 – 0.23 C per decade. The largest change occurred in NWFP and smallest in Punjab. It has been observed that increase in annual maximum temperature is higher in Balochistan, NWFP, Federally Administered Northern Areas (FANA) and Azad Kashmir. This increase is 1.10 C, 0.96 C, 0.91 C and 0.82 C, respectively”.(PMD,2009)

3.6.Heat Wave Duration

Heat wave conditions have been reported to make some huge casualties in Pakistan. In response to global warming heat waves in the country are expected to rise in future. *Heat wave is defined “as the number of days when, for some consecutive days, the temperature is greater than a certain threshold, keeping in view the climatology of the station. In this report the number of days has been counted as heat wave days when, for at least 6 consecutive days, the $T_{max} \geq 90^{th}$ percentile of the temperature records in a year.”* (IPCC,2007).For this purpose PMD collected data from 35 stations which gives the daily maximum temperature data for the period from 1980 – 2007. Number of heat wave days has been calculated for each station. (PMD,2009)

Number of heat waves represents the real picture of the heat wave trend of a station there is a significant rise in number of heat wave days at the rate of 11 days per decade. The total rise in the number of heat wave days is 31, over the period. This means at presents we are having a warm month more than in past in a year.(PMD,2009)

Snowmelt Flood:

Snow and ice are the most important part of the ecosystem and any change in the thermal cycle have a direct impact on them. As the temperature is increasing there is an increased trend of melting of these reserves converting into new glacial lakes and results in the local flooding. Glacial lake Outburst floods and snow melt water all meet downhill into rivers which ultimately result in river flooding. In 2005 the river Indus and Kabul experience the worst flood of the era. During that season the temperatures quickly rose above 40°C at most of the meteorological stations up to 2500m. “This hot

spell was recorded as the longest persistent time and also result in the new record of maximum temperature of 43.6 degree Celsius at gilgit.” (Rasul G, et al. 2008).

A large amounts of melted snow water rushed through the streams and flooded the main rivers. The river discharge of the Indus at Tarbela and the Kabul at Naushera are compared for the last 5-years. (figure 4).However Figure 5 shows a comparison of the river discharge of the Indus and Kabul indicating an increasing trend and during 2005 a peak curve which resulted in flood. This flood took hundreds of lives and huge damage to agricultural crops and infrastructure. (Rasul G, et al. 2008).

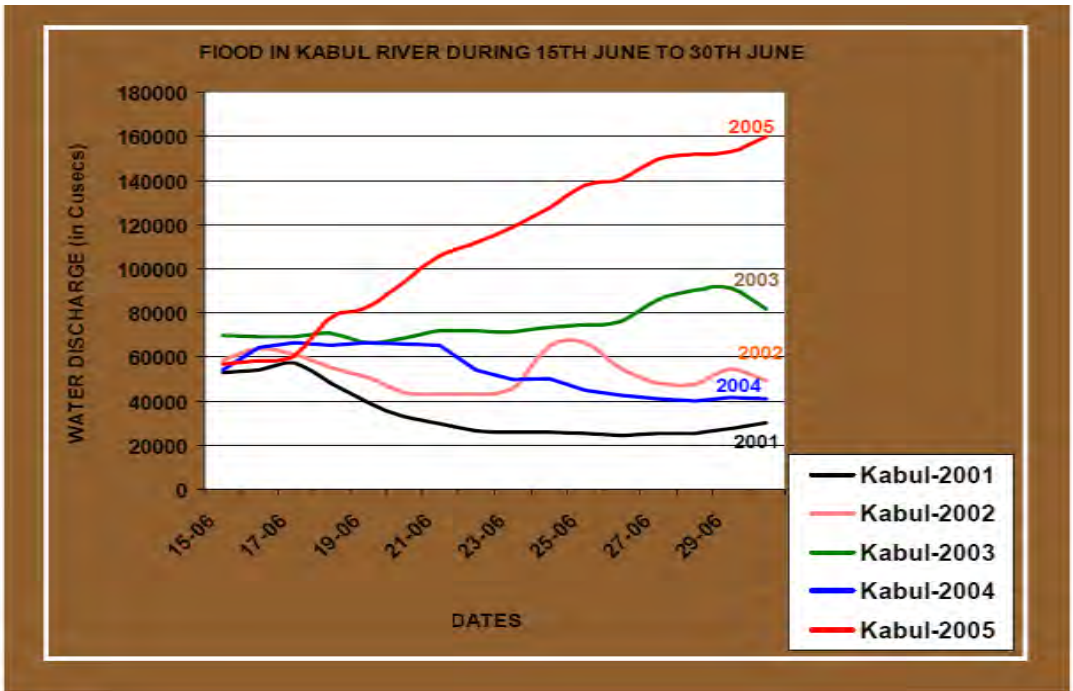


Figure 4

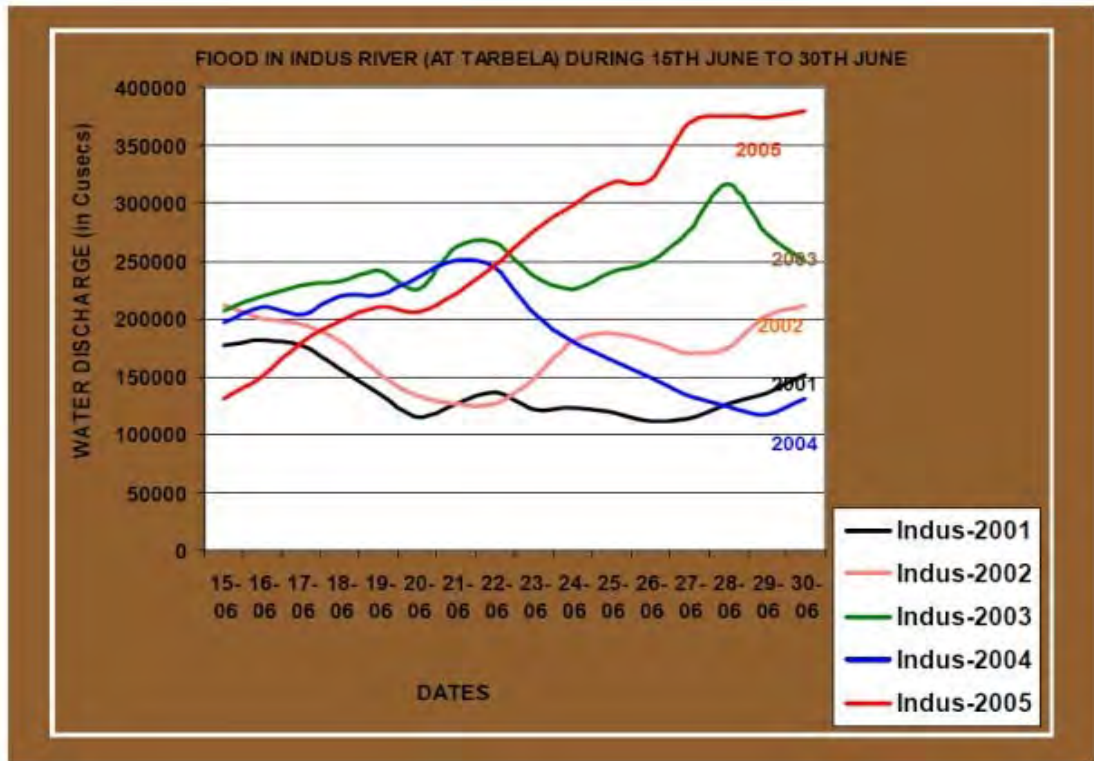


Figure 5: Comparison of 5-year river discharge (in cusecs) for river Kabul and Indus

3.7. Precipitation Indicators in Pakistan

Annual Rainfall

A study based on the data collected from 1901-2007 has been done by the PMD to find out the precipitation pattern of the whole Pakistan. The study reveals that the average annual rainfall has shown a remarkable increasing trend. As shown in the figure 6 from early 1900's to 1940 the rainfall has shown a decrease from 600 mm average to less than 400 mm a year. After 1940's the net trend has shown a positive increasing change of 133 mm. (PMD,2009)

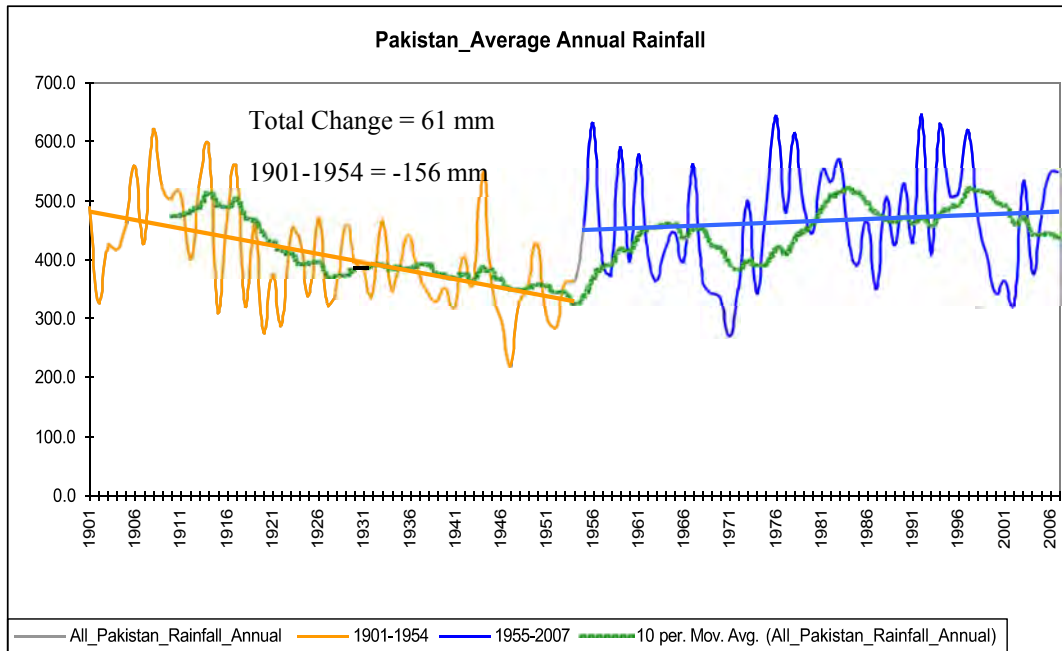


Figure 6: Time series of Annual Average Rainfall over Pakistan (1901-2007)(PMD,2009)

3.8. Future Climate Projections of Pakistan

The fourth assessment report given by the intergovernmental Panel on Climate Change has predicted that there is an expected rise in temperature in Pakistan and it has been done with the help of Different Global Circulation models. (IPCC 2000a, b)

A report work has been done by the joint effort of Pakistan Meteorological Department (PMD) and Global Change Impact Studies Centre (GCISC) to forecast the future climatic situation of Pakistan. The study revealed that almost all the areas have shown a prominent change in their maximum and minimum temperature indices. (PMD & GCISC joint Report on climate change 2007).

“Precipitation over Pakistan will also show an increase in the average by about 25 %. Studies based on the ensemble outputs of several Global Circulation Models (GCMs) project that the average temperature over Pakistan will increase in the range 1.3-1.5 °C by 2020s, 2.5-2.8 °C by 2050s, and 3.9-4.4 °C by 2080s, corresponding to an increase in average global surface temperature by 2.8-3.4 °C by the turn of the 21st century. Precipitation is expected to increase slightly in summer and decrease in winter with no significant change in annual precipitation. Furthermore, it is projected that climate change will increase the variability of monsoon rains and enhance the frequency and severity of extreme events such as floods and droughts.” (PMD 2009, pg 38:PMD & GCISC joint Report on climate change 2007).

Table 2: All Pakistan Climate Projections (2011-2050)(PMD,2009)

Pakistan	Precipitation (mm/Decade)			Temperature (C /Decade)		
	A2	A1B	B1	A2	A1B	B1
	+1.73	+1.26	-0.89	+0.51	+0.41	+0.24

Region	Precipitation (mm/Decade)			Temperature (C/Decade)		
	A2	A1B	B1	A2	A1B	B1
Northern Areas	+4.6	+2.9	-1.3	+0.76	+0.63	+0.39
Potohar & Upper NWFP	+6.1	+3.8	-0.5	+0.01	-0.34	-0.01
Central / Southern Punjab & Lower NWFP	-2.98	-1.78	-3.5	+0.63	+0.71	+0.05
High Balochistan	+1.48	+0.92	-0.57	+0.15	+0.26	+0.03

South-Eastern Sindh	+5.1	+3.0	-0.1	0.00	-0.1	+0.01
Sindh & Lower Balochistan	-1.8	-0.98	-0.05	+0.5	+0.27	+0.01

3.9. Disaster profile of Pakistan:

According to the Global Climate Risk Index (GCRI), Pakistan was the most affected country in 2010, while being at number eight during 1991–2000. (Hermeling, 2012) According to SREX framework definition of disaster risk is “The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery”. (IPCC 2014, pg 3) The country is at high risk of natural hazards including floods, rains, landslides, cyclones, earthquakes, and droughts, devastating vulnerable communities every few years. In its 65-year history, the country has gone through major floods such as in 1950, 1973, 1976, 1988, 1992, 1997 and 2010 and 14 cyclones have hit the coastal areas of Pakistan between 1971 and 2001. (Memon N, 2012)

Table 3 Pakistan: extreme weather events of twenty first century (CRED 2014)

2013	Flash floods affected nearly 1.5 million people, almost 80,000 houses, and 1.5 million acres of crops. 234 people were killed. More than 4,100 people were housed in 408 relief camps
2012	Floods affected 5 million people, 14,270 villages and 1.1 million acres of crops. Almost 270,000 people were housed in 478 relief camps. More than 465,000 houses
2011	Floods in Pakistan’s southern province of Sind affected 22 out of 23 districts claiming 500 lives. Nearly 2.2 million ha cropland was damaged and 72 % of crops were lost in the
2010	Monsoon rainfall of 300 mm over a 36-h period resulted in swelling of rivers and caused the history’s worst flood in Pakistan. The unprecedented flood submerged 20 % of the country’s area
2009	Karachi received 205 mm of rain at Masroor Airbase and 143 mm at Airport on 18th and 19th July. The previous heaviest rainfall recorded at Karachi Airport was 207 mm on 1st July 1977. Normal rainfall at Karachi Airport for the periods 1961–1990 and 1971–2000 was 85.5 mm and

2007	A record heat wave gripped Pakistan during June 2007. The temperature reached 48 °C on 9th June at Lahore, repeating the record of 78 years earlier on 8th June 1929
2007	Two super cyclones Gonu (02A) of Cat-5 and Yemyin (03B) of Cat-1 developed in the Arabian Sea during June 2007 and hit Makran coast of Pakistan and adjoining countries. Not ever before two such events occurred in the same month in the Arabian Sea
2006	Monsoon-related flooding in Pakistan resulted in more than 185 deaths between late July and mid-August 2006. In neighbouring eastern Afghanistan, heavy rainfall generated flooding that claimed at least 35 lives
2005	Heavy rain caused flooding in parts of Balochistan, Khyber Pakhtunkhwa and Afghanistan during March. There were more than 30 fatalities in south-western Pakistan
2005	During June, unusually warm temperatures in the mountainous areas of northern Pakistan occurred, accelerating snowmelt and causing extensive flooding along the Kabul, Swat, Kunar and Chitral rivers
2003	Heavy rain and snow produced flooding during February (around 17th) and was responsible for more than 60 deaths in Balochistan province. Flash floods washed away parts of roads and highways
2003	Seasonal monsoon rains affected at least one million people in southern Pakistan. Heavy rains caused 162 deaths, 153 in the Sind province
2003	During early June, a heat wave caused maximum temperatures to reach 52 °C at Jacobabad on the 5th of June; normal highs in early June are around 44 °C
2001	621 mm rainfall in Islamabad during 10 h period on 23rd July; it caused flooding in Lai Nullah (rivulet)
1998–2001	History's worst drought gripped southern parts of Pakistan and parts of surrounding countries

3 Disaster related damages in Pakistan 1900–2014

Disaster type	No of disasters	No of casualties		No of affected people		Damage (000 US\$)	
		Total	Average per event	Total	Average per event	Total	Average per event
Flood	77	16,161	210	75,201,880	976,648	18,968,178	246,339
Drought	1	143	143	2,200,000	2,200,000	247,000	247,000
Earthquake	28	143,445	5,123	6,772,571	241,878	5,329,755	190,348
Landslide	10	222	22	29,719	2,972	18,000	1,800
Tropical cyclone	7	11,555	1,651	2,599,940	371,420	1,715,036	245,005
Total	123	171,526	1,395	86,804,110	705,724	26,277,969	213,642

Source: CRED (2014), EM-DAT

3.10.Threats of Climate Change in Pakistan:

According to national climate change policy of Pakistan 2010 the most important climate change threats to Pakistan are:

- “1. Considerable increase in frequency and intensity of extreme weather events, coupled with erratic monsoon rains causing frequent and intense floods and droughts;
2. Projected recession of Hindu Kush-Karakoram-Himalayan (HKH) glaciers due to global warming and carbon soot deposits from trans-boundary pollution sources, threatening water inflows into Indus River System (IRS);
3. Increased siltation of major dams caused by more frequent and intense floods.
4. Increased temperature resulting in enhanced heat- and water-stressed conditions, particularly in arid and semi-arid regions, leading to reduced agriculture productivity;
5. Further decrease in the already scanty forest cover from too rapid change in climatic conditions to allow natural migration of adversely affected plant species;
6. Increased intrusion of saline water in the Indus delta, adversely affecting coastal agriculture, mangroves and breeding grounds of fish;
7. Threat to coastal areas due to projected sea level rise and increased cyclonic activity due to higher sea surface temperatures;
8. Increased stress between upper riparian and lower riparian regions on sharing the water resources;
9. Increased health risks and climate change induced migration.

The above threats are the cause of major survival concerns for Pakistan, particularly in terms of country’s Water Security, Food Security and Energy Security considerations.”
(NCCP,2012)

Chapter Four:

Institutional and Policy framework for Climate Change in Pakistan:

This chapter aims to look at main policies functioning in various sectors like agriculture, water, environment including climate change policy and to analyse the usage of climatic data, level of understanding of vulnerability to climate change by the practitioners and how are the outcome or responsive adaptive or mitigative measures are influenced by it. Policy maker's interpretation of climate change, vulnerability and adaptation is key for an effective framework laid for the institutions to work on climate and will determine the response and possible adaptation measures that can be taken. Few of the policies that have been analysed have shown a poor understanding of the vulnerability to climate change of sectors that are linked and need collaborative work for adapting against climate change. This drawback can be a major problem at Institutional level for overcoming the potential impacts in Pakistan. Institutional framework that is functioning currently have some major drawbacks.

4.1.Policy Framework:

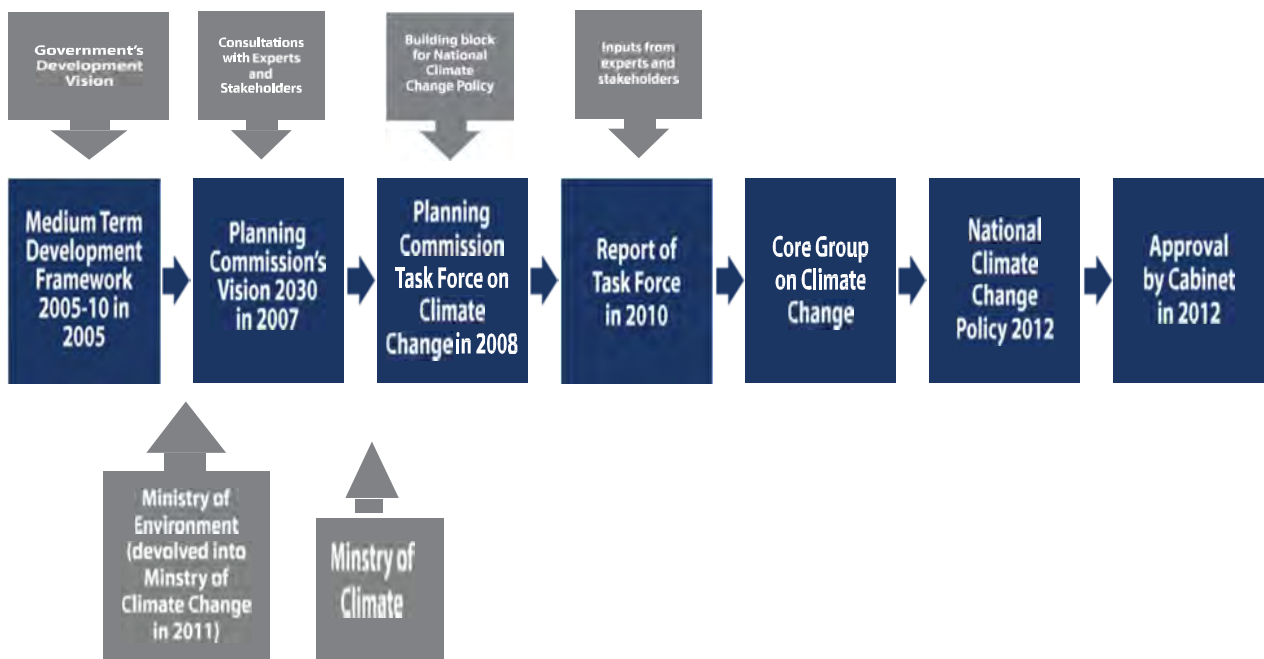
Pakistan's Government strong commitment and intention to overcome climate change dilemma and it's potential impact, at national and international level, can be seen in its national policy frameworks such as the Climate Change policy of Pakistan (GOP 2012), Framework for Economic Growth (2011), National Environmental Policy (GOP 2005b) as well as the National Energy Conservation Policy (GOP 2005c).

“The Framework for Economic Growth” (long-term growth strategy of Pakistan) gives great importance to climate change in view of its grave negative consequences for the country (GOP 2011). The Framework under the subtitle, “Ensuring economic growth is sustainable and climate resilient” highlights approaches to combat climate change under various themes. The first theme on protecting growth from the risk and costs of climate change-induced disasters, stresses integration of risk reduction and management concerns within the planning process. The second theme related to climate proofing economic growth from the impacts of climate change in particular covers the agriculture, water and energy sectors. The third theme focuses on mitigation by green growth through investment in low carbon technologies. “The Framework pledges provision of adequate resources for the

Government’s climate change policy and related action plan.

The National Climate Change Policy approved by the Federal Cabinet in September 2012, provides a framework for coping with the threats of climate change. It aims to promote climate resilient approach to development and ensure that the measures to combat climate change are mainstreamed in the economic and social development plans. The coping measures recommended cover wide ranging sectors from water, agriculture, livestock and forestry to human health, disaster preparedness, transport and energy. Envisaged financing options for projects under the climate change policy include procurement from the international Green Climate Fund that has a target to raise \$100 billion by 2020 and a proposed National Climate Change Fund.”(CPEIR,2015 pg 31)

Figure 6: Significant developments leading to the formulation of the NCCP(CPEIR,2015)



4.2.NCCP POLICY OBJECTIVES

“Pursue sustained economic growth by appropriately addressing the challenges of CC;

Integrate CC policy with other interrelated national policies;

Focus on pro-poor, gender-sensitive adaptation while also promoting mitigation to the extent possible in a cost-effective manner;
Ensure water, food and energy security in the face of challenges posed by CC;
Minimize the risks arising from expected increases in frequency and intensity of extreme weather events such as floods, droughts and tropical storms;
Strengthen inter-ministerial decision-making and coordination mechanisms on CC;
Facilitate effective use of opportunities, particularly financial, available both nationally and internationally;
Foster the development of appropriate economic incentives to encourage public and private sector investment in adaptation measures;
Enhance the awareness, skill and institutional capacity of relevant stakeholders;
Promote conservation of natural resources and long-term sustainability.”(NCCP,2012)

In terms of approach to the implementation of multilateral environmental agreements on climate change, Pakistan acceded to the United Nations Framework Convention on Climate Change (UNFCCC) as a Non Annex-I Party in June 1994. Subsequently the country adopted the Kyoto Protocol in 1997 and acceded to it on 11th January 2005. Pakistan submitted the Initial National Communications on Climate Change to UNFCCC in 2003 (GOP 2003). The country also announced and implemented the CDM National Operational Strategy (GOP 2006) as a signal for its entry into the global carbon market.

In order to identify and implement various approaches to climate risk reduction, a high level Task Force on Climate Change was established, which submitted its report (GOP 2010) in 2010. In addition, the Government in collaboration with UNFCCC commissioned a National Economic and Environmental Development Study (NEEDS).

4.3.Policy Gaps:

Climate Change Vulnerability and adaptation:

Pakistan response to Climate Change in the form of National Climate Change policy which highlights coping strategies in various sectors from water, agriculture, livestock and forestry to human health, disaster preparedness, transport and energy. This demands a policy

change and integration of knowledge of climate change, vulnerability and adaptation. The critical review of different policies indicates a very poor understanding of climate change, vulnerability and adaptation which is grass root cause of being more vulnerable to adverse impacts of climate change.

Framework of Economic growth focuses on three main perspectives. The second one include economic growth dependent on climate proofing of agriculture and water or sanitation sector. Pakistan's agricultural policy clearly indicates a significant gap in presenting climate change perspective and vulnerability of the sectors. None of the documents presented after 2000 have shown either the pros or cons of climate change as drivers of policy instruments. Review done by the National Commission on Agriculture sector is almost twenty years old which clearly indicates that there has been no addition of any new adaptation methods to meet the challenges in agriculture sector. The five year plan or policy document has overlooked the topic of climate change and lack the interconnectedness of agriculture sector with marketing, processing, social and economic dimensions of it.

The few of the documents that have marked climate change clearly focus on the current situation of the climatic situation of Pakistan and have not address the contextual conditions of the vulnerable communities which is key for sustainable adaptation. None of the policy have involved the local knowledge instead the focus is on the scientific research done by the climatic research bodies such as IPCC and Pakistan metrological department.

There is no formal linking method in which Provincial Environmental Protection Act is linked with provincial Environmental protection departments. As PEPA 1997 was aimed to be implemented at both federal and provincial level but after the devolution Now PEPA work through surveys and some projects related to international treaties and agreements. There is a need of coordination mechanism for the effective implementation and sanctification at the planning stage. There is a need of coordination between provincial EPA's and local government department for effective implementation of adaptation and mitigation strategies at grass root level. Transparency and climate proofing of the projects at the federal level is responsibility of the government so that provinces needs of the adaptation can be fulfilled.

The larger problem in developing countries lies in the implementation of policy, mainly due to the lack of capacity building, intention and commitment of the governments and scarcity of financial and skilled human resources. There have been an increased focus on policy formulation and legislation. But these policies usually lack capable administration, and efficient and legitimate regulatory instruments which are pre-requisites for effective implementation of policy.

4.4. Institutional Development at Governmental Level:

Institutional development is an integral component for overcoming climate change dilemma. In 1995 Pakistan's first institution i.e. Cabinet Committee on Climate change was formulated which was transformed into Prime minister Committee on Climate change (PMCCC) in 2005. The purpose of its formulation was to develop strong inter-linkages between ministries and promoting initiative of entry into global carbon market. The major shift in the institutional sector of climate change took place after the 18th amendment in 2010 as it leads to formation of ministry of climate change because of federal devolution to provincial level. Ministry of climate change maintained its strong commitment to implement international agreements or treaties and even national climate change policy even after devolution by a continuance clause in the 18th amendment. The understanding of climate change issue by the provinces is a huge challenge and is very weak at the moment affecting their role and responsibility towards it. (CPEIR,2015)

In 2013 Ministry of climate change was transformed into climate change division facing a 62 percent budget cut but was reversed back to full fledged ministry again in 2015. MCC works on national environmental policies including sanitation, drinking water, forests and resettlement and PEPA policies. Ministry of climate change has done limited work in the case of CDM or NAMAs on climate change. Finance section of climate change institutions is also a big concern for the ministry. A plan for tracking national climate related expenditures is under consideration and also formulation of an Accrediting National Implementing Entity (ANIE). This entity aims for direct access to international climate funds and to address adaptation and vulnerability. (CPEIR, 2015)

4.5. Institutional Setup at provincial level:

Provincial institutional setup has undergone a lot of transitions after the 18th amendment. A new set of roles and responsibilities have been designed to provincial departments. This devolution aims to help in synthesizing sources of policy and regulatory regimes and in effective policy implementation. All four provinces have their own working bodies named as Environment Protection Agencies (EPA).”The EPA in Punjab and KP is under the administrative control of the Environment Department; in Balochistan it is under the administrative control of Environment, Sports and Youth Affairs; and in Sindh it is under the control of the Environment and Energy Development Board. In AJK, it is under the control of the Planning and Development Department (P&DD) and in GB under the Forest, Wildlife and Environment Department.” (CPEIR,2015 pg 37)

4.6. Critical View and Findings of the Institutional Setup of Pakistan:

After the 18th amendment, the devolution from federal to provincial level has many critical impacts. The climatic response by the governmental Institutions and their system had undergone a substantial amendments and a huge drift. Provincial level also encountered a lot of hurdles. Clarity of the designated responsibilities of the different tiers of Government in regulation, legislation and enforcement is key for implementing climate change policy in an effective way. Government at federal level should pay heed to valuable inputs and discussions on climate issues that are overlapping in many sectors. The Institutional set up still have many gaps and is facing many challenges. Creating an awareness and highlighting the issues aims to pinpoint the weaknesses for the betterment of the setup.

Delivering economic growth in a period of changing climate requires the policy setting and formulation of a governmental institutional setup that can deliver these policy objectives. Pakistan has been making both policy and institutional arrangements, i.e. the development of a national policy for CC (in 2012) and the establishment of the MCC in 2015. However, Climate change issue cannot be addressed by a single ministry and the current institutional and policy developments have not reached a level that they make climate change as fundamental part of policy debate and doesn't find it's place in the budget and planning paradigm of many cross sector ministries.

4.7. Lack of Vulnerability Assessment in the Contextual way:

Although National climate change policy formulation is a country's baseline for setting an orientation to overcome impacts of climate change, but it has some serious flaws like many other policies related to environment had been gone through. itself seeing climate change as the main focal point or the ultimate threat to the exposure unit which in other terms considering vulnerability as the measurable outcome of climate change. Moreover current adaptation practices are focusing more on technological one which infact is missing out a lot of underlying contextual social issues related to it. Assessment of climate variability and adaptation strategies are lacking the political, economic and social context of the area for which the policy is being made and be implemented. Moreover, as in the case of contextual vulnerability the major stakeholder is local community as their involvement is vital for achieving sustainable adaptive or mitigative strategies. Development of the policy lacks this important consultation and involvement of the local people that could be done in the form of community surveys or using the local NGO's or development agencies knowledge that have worked on the relevant themes in the area. Development of national policy can't overcome the institutional and socio-economic barriers faced by local people. Lack of full contextual knowledge might make the local people even more vulnerable as the coping strategies might not be able to solve the grass-root social issues. There is a need of vulnerability assessment based on the contextual knowledge rather than focusing on outcome vulnerability. As contextual vulnerability analysis focuses on affected communities and their whole linkage of social and economic process which is key for adapting to climate change. Policy changes should not only be focusing on the technological adaptations but also addressing the local constraints to response as people will be adapting to some new livelihoods or practices. However the provincial setup has aimed to develop Closer links between local vulnerabilities and site-specific adaptation activities With increased clarity in Climate Change-response directions and increased discretionary expenditure, the provinces can improve the fit between budget expenditures and local needs, over time. Provincial discretion in setting budget expenditures is likely to improve the linkage between vulnerability and expenditure.

4.8.Provincial ownership and delivery:

After the devolution process the provinces have gained much of their own take on the climate change adaptation and mitigation. The main gap and challenge lies that with the increased autonomy of the provinces there is a high risk of linking their objectives with National Climate Change Policy. As the gap find it's ground in the political differences between some of the provincial governments and federal government as they are headed by different political leaders and parties. It can lead to a disruption in provincial policy ownership, effectiveness and it's implementation. Although the provincial climate change policy is a milestone to highlight provincial climate change issues, mitigation and adaptation. But until and unless the process and mechanism is not fully revealed, the provincial policy delivery can be quite uncertain and variable. The positive aspect of the devolution is that provinces can take national climate policy as a robust starting point and can work in their own provincial context. As long as the objectives of the NCCP are being kept in focus the result of the devolution can be effective.

4.9. Need of an inter-provincial commission:

The formation of an inter-provincial commission can be helpful in synergizing the efforts of the institutions in a single direction. It can provide a platform for an effective communication and assessment of the work to ensure the compliance with the national climate change policy and international agreements and conventions. A technical panel should also be supporting in data provision for decision making process. The NCCP has already made some to establish such a commission. The IPC Ministry could also serve as a useful forum for clarifying roles and responsibilities.

4.10. Coordination and facilitation:

The ministry of Climate Change has been taking a lead role in the coordination between climate change agenda and national climate change policy. The international collaboration with UNFCCC, CDM and REDD is also being done by MCC. The implementation and effectiveness of the climate policy relies on the response by the provincial governments in each particular vulnerable sector. There is a huge gap on the information flow between the MCC and provincial ones which is key for effective coordination in response to climate change. It is crucial for the MCC to orientate the

federal and provincial efforts in a unidirectional way which can be done through monitoring and assessment of the provincial work. Such information needs a degree of consistency between the provinces in order to furnish the MCC with a unified perspective. A lack of information will undermine the MCC's ability to effectively coordinate, orientate and prioritize the response.

4.11. Unclear division of responsibilities between the federal and provincial levels:

Although the devolution process has aimed to share the responsibility and be more effective in achieving the NCCP goals but it has emerged with a new set of complexities that is unclarity on the roles and responsibilities. There needs to be a lot of work done on the assignation of the responsibilities at both federal and provincial level for an effective outcome. The federation is responsible for the international Agreements which can be highly impacted if the federal and provincial level failed to collaborate to achieve the desired goals and objectives of the NCCP which is set to meet International legislation. Therefore there is a need of complete set of process for a comprehensive and harmonized federal-provincial system for effective Climate change response.

The lack of a policy framework and capacity within provinces:

TAs there had been no development of provincial climate change policy before 2010 so the provincial sector's capacity to assess the policy framework, setting the whole objectives and climate change related expenditures is quite low. As the devolvement to the provinces places this responsibility in a historical vacuum in terms of capacity and a policy framework. The lack of policy leadership and capacity in provinces undermines some of the benefits of devolution.

4.12. Other significant Governmental Challenges:

The most serious and alarmingly risky challenge that Pakistan is currently facing is the war against terrorism. Government's huge budget is being investing in overcoming security issues. The second big challenge is of energy crisis. Energy shortage has hampered the whole economic growth as

almost all the industries facing a huge loss because of energy crisis. The Pakistani Government's priorities as other developing countries are being affected because of domestic issues. The implementation of the Climate Change policy requires a lot of financial investments for making institutions that can build capacity and resilience of communities against disasters.

Chapter five:

Policy and Institutional setup for Disaster risk reduction in Pakistan:

Pakistan due to its diverse topographic and demographic settings is vulnerable to a host of natural and human-induced hazards. The predominant and conventional approach of emergency response remained in practice until the Earthquake-2005 that struck Pakistan and caused massive destruction in the northern part of Pakistan. Following the earthquake, the debate for a paradigm shift from emergency response under the calamity act of 1958 based mainly on reactive approach to Disaster Risk Management (DRM) got momentum, which subsequently yielded into the promulgation of National Disaster Management Ordinance in December 2006 (now NDM Act 2010) which serves as the primary law of the land in the field of disaster management. A closely tied network of governmental agencies responsible for disaster management in the country are Federal Flood Commission, Provincial Irrigation departments, the Dams Safety Council, the Water and Power Development Authority, Civil Defence, the Pakistan Red Crescent Society, the Emergency Relief Cell, fire services, the National Crises Management Cell (NCCM), the Pakistan Meteorology Department(PMD), the Space and Upper Atmospheric Research Commission, the Earth-quake Reconstruction and Rehabilitation Authority, the armed forces, the police and the National Volunteer Movement. (NDMA,2010)

Three tier heierarchical
framework

National Disaster Management Commission(NDMC)

Headed by: Prime Minister

Members:All provincial chief ministers,the key federal cabinet ministers such as finance,defence,foreign affairs, communications, health and interior,a member of civil society and some other members(Section3)

Purpose: To act as national disaster management policy making in the country

National disaster Management Authority (NDMA)

Headed by : Director General

Provincial disaster Managment authority(PDMA)
and district disaster Managment authority(DDMA)

5.1.National Disaster Management Authority

National Disaster Management Authority (NDMA), is the lead agency at the Federal level to deal with whole spectrum of Disaster Management Activities. It is the executive arm of the National Disaster Management Commission (NDMC), which has been established under the Chairmanship of the Prime Minister, as the apex policy making body in the field of Disaster. In the event of a disaster all stakeholders, including Government Ministries/Departments/Organizations, Armed Forces, INGOs, NGOs, UN Agencies work through and from part of the NDMA to conduct one window operation.(NDMA,2010)

The National Disaster Risk Management Framework (NDRMF) is the major policy document in the field of DRM. DRM, being a cross cutting issue requires the involvement of all stakeholders including the Federal Ministries/Organizations, Provincial Departments, humanitarian organizations, communities and media. Accordingly, the Framework defines roles and responsibilities of the key stakeholders in implementation of disaster management policies. It essentially revolves around the objectives of the Hyogo Framework for Action (2005-2015) and highlights the following nine priority areas for the development of a robust DRM system in Pakistan:

1. Institutional and Legal arrangements;
2. National Hazard and Vulnerability Assessment;
3. Training , Education and Awareness;
4. Promoting Disaster Risk Management Planning;
5. Community and Local level Risk Reduction Programming;
6. Multi-hazard Early Warning System;
7. Mainstreaming disaster Risk Reduction into Development;

8. Emergency Response System; and
9. Capacity development for Post disaster Recovery.

Institutional and Legal Arrangements

- Promulgation of National Disaster Management Ordinance (2006) / National Disaster Management Act, (2010);
- Development and approval of the National Disaster Risk Management Framework (NDRMF);
- Provincial/Regional Disaster Management Authorities (PDMA's) have been established in all provinces including AJK, FATA, and Gilgit-Baltistan;
- District Disaster Management Authorities (DDMA's) have also been notified throughout Pakistan and efforts are being made to make them fully functional;
- Establishment of National Disaster Management Fund to ensure availability of dedicated resources for DRR and disaster management. (NDMA,2010)

5.2.Critical review of DRR and DRM in Pakistan:

The purpose of the national disaster management act is to formulate institutions aimed for effective disaster management system in the country however there is a need of an integrated system which is key for it's effectiveness. The scope of the act is narrowed down by utilizing the definition of two term i.e. disaster and disaster management. Disaster management has been defined as as "managing the complete disaster spectrum, including- preparedness; response; recovery and rehabilitation; and reconstruction" (Section 2c,PDMA 2010). This definition indicates that action would be taken when either the disaster has struck or the occurrence of the disaster is highly probable. It shows a reactive approach towards dealing a disaster. According to the UN/ISDR, the term 'mitigation measures' means 'the lessening or limitation of the adverse impacts of hazards and related disasters'(UNISDR,2004) however in the NDMA 'mitigation' refers to actions taken for avoiding a 'second disaster' after the initial disaster has struck, for instance, the spread of diseases in the relief camps. In addition, the National Plan (Section 10), refers to a number of measures for the prevention of disasters; integration of mitigation measures in the development plans; preparedness and capacity building to effectively respond to any threatening disaster situation or disaster. Inclusion of these terms in the Act thus indicates anticipatory and corrective approaches in the national plan. However, according to the UN-ISDR, 'prevention' means 'the outright avoidance of adverse impacts of hazards and related disasters'.(UNISDR,2004)

Therefore, the effectiveness of the Act depends upon not only formulation and implementation of the national plans but also on the availability of the funds. The Act suggests establishment of disaster management funds at both the national level (Section 29) and provincial levels (Section 30); however, there is no mention of such funds at the district level and there are no directions with regard to amount of funds that would be reserved in the

annual budget for the disaster management activities at the national, provincial and district levels.

There is a need of check and balance system as the current act gives protection to officials from legal action against malpractices in DRR and DRM in the country. The failure of DRM practices was observed at the time of the 2005 earthquake, when there were no DRM related legal and institutional frameworks in the country and even now after its formation the practices were flawed. Thus, nothing had changed on the ground with regard to the DRM because of PNDMA 2010, apart from the establishment of more bureaucratic strata.

Chapter Six:

Climatic Funding at Governmental and private sector:

This chapter aimed to give an overview of how the climate budget process is done at the federal government level. A report on climate public expenditure and institutional review done by United nation development program (UNDP) Pakistan has highlighted the climate budgeting process. It has assessed that climate relevant projects are being undertaken by different ministries and percent of them vary widely within each governmental institution every year. Governmental budget on adaptation and mitigation projects vary widely as it had been 25 to 60 percent on adaptation and 30 to 71 percent across the four year from 2010 to 2014. ministry of climate change, the water and power division have most climate relevant projects. This chapter helps to understand that governmental budget on climate related projects can be a milestone towards combating impacts of climate change.

6.1.Process of Climatic Funding at Governmental and private sector:

The climate budget is complicated and not just a percent of national budget related to climate change response in terms of mitigation and adaptation. Linking climate budget to national climate policy's objectives requires a strong involvement of institutions at all levels. Climate budget disaggregation to sub-budgets given to governmental sectors concerned with mitigation and adaptation is key to achieve climate policy objectives.

A three phase process takes place for budget within each governmental institute related to climatic response.

6.2. Identifying Climate Change expenditure:

Identification of budget lines with climate- related expenditures followed the definition of two key elements of Climate Change: Adaptation and Mitigation. The identified projects are aimed to increase the resilience against climate change impacts. The mitigation and adaptation projects are based mainly on technological change, substitution and carbon sequestration which aimed to reduce GHG emissions. Other projects that can protect resources and infrastructure includes renewable energy conservation, efficient ways of energy usage, alternative use of fossil fuels and carbon capturing. Projects involving local communities, capacity building and agricultural reforms i.e. climate resilient varieties are also included.

6.3. Classifying Climate Change expenditure:

Budget lines are classified into one intervention type from a pre-determined list of intervention types linked to National Climate change policy objectives. Some projects have both adaptation and mitigation components A/B. These projects can be of huge gain as they create an opportunity for mutual adaptation and mitigative approaches.

Example of such tasks include (theoretically):

- “Renewable energy development (mitigation) in a remote village primarily to provide electricity for groundwater pumping to maintain subsistence agricultural production (adaptation).
- The development of urban public mass transport systems (mitigation) in riverine or coastal areas on raised platforms to maintain functionality during times of floods or inundation events (adaptation).
- The development of drought-resilient fodder crops for livestock husbandry (adaptation) specifically bred to reduce GHG gas emissions from livestock digestion processes (mitigation)” (CPEIR,2015 pg).

The tasks and activities were divided into four themes: adaptation, mitigation, A/M and supporting areas. The supporting areas theme was included as there are many activities that

relate to Climate Change and the creation of a governance and delivery platform. These in themselves do not deliver direct adaptation or mitigation benefits.

6.4. Assessing climate relevance: The proportion of the expenditure of the budget line that is related to Climate change outcomes is determined.”

“The third phase of the expenditure line analysis determined the climate relevance of expenditures, which was expressed as a percentage of the total expenditure attributed to CC. Very few climate-relevant projects identified in phase I are completely directed at CC outcomes. This is a consequence of the situation that much of the climate response sits within business-as-usual activities (e.g., irrigation, hydropower schemes) which have sector-related objectives (e.g., agricultural production, power generation) as well as climate benefits (e.g., drought-resistant crops, low-carbon/renewable energy production). The creation of a climate budget must try to include climate-related components, but exclude non-climate-related components.

Similar to many previous CPEIRs, categories related to expenditure were ranked from highly-relevant (75 percent+ of expenditure line item predicated on CC) to marginally relevant (< 25 percent) items. A rationale for the high, medium-low and marginal categories was established, and possible examples of the types of expenditures were placed in each category.

Phase III provided the percentage climate-related component of each budget line which then formed the base data for collation to ministry, theme/task/ activity or policy objective. Some projects are fully focused on CC whereas others may have small or indirect CC benefits. Table 5.2 provides a rationale for each category of CC relevance with examples.”(CPEIR,2015 pg)

6.5. Federal CLIMATE PROGRAMMES AND BUDGETS:

The overall federal budget of Pakistan is estimated to increase from PKR 2,559 million in 2010/11 to PKR 4,057 million in 2013/14, which shows that there is an increase of indicating an average annual growth of 11.5 percent. Pakistan currently has to pay a lot of interest on domestic and foreign debt. Government is spending almost 20% of the expenditures on security and defence which demands a significant portion as it is critical for the terrorism attacks in Pakistan. Like wise disasters like floods have hit hard on the economy of Pakistan as a lot of expenditure has been done on the infrastructure re-building and it has affected the budget of other development projects as PSDP share has declined in the last four years.

Pakistan has become a recipient of World Bank because of PRSP programme. An accounting system has been held to monitor and track the funding in different sectors. Pakistan’s tax GDP ratio is quite less as compared to other income developing countries which make it a resource-constrained economy. Pakistan has remained dependant on external resources that is foreign funding, loans and aid or grants. . At a time when developing and developed countries across the globe are investing heavily in adaptation to and countering climate change, Pakistan has not only dissolved it’s climate change ministry but also slashed its development budget by more than 60 percent in 2013. The government allocated a total of Rs58.8 million to combat climate change in the Public Sector Development Program (PSDP) for 2013-14 as compared to Rs168.1 million allocated to the climate change ministry in 2012-13. (CPEIR,2015)

In 2013-2014 Federal Government has allocated almost 6 percent of the total budget to the climate related activities and mitigative projects constitute over half of those funding as shown in the figure 8. This indicates that during 2013-14 the government has focused more on mitigation instead of adaptation as different ministries have different prioritized projects. Based on the national climate change policy each of the public sector development project has been analyzed in the broad category of four themes.)

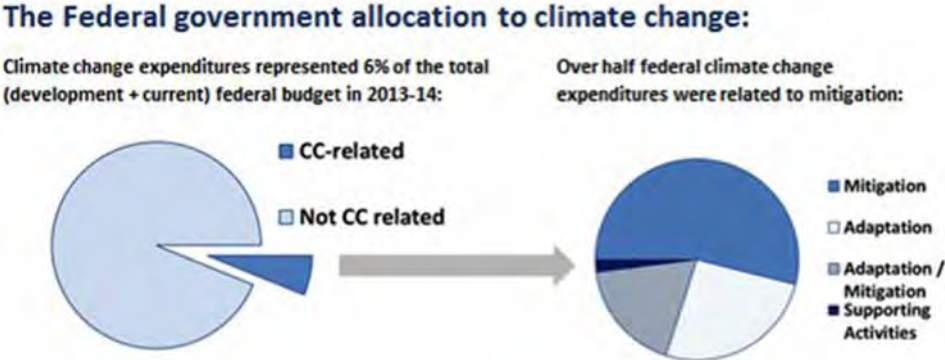


Figure 8: Federal government allocation of funds in the year 2013-1014(CPEIR,2015)

The projects that have been taken by different ministries in the year from 2010-2014.

Federal ministries	2010/11			2011/12			2012/13			2013/14		
	No. of projects (CGA+ PSDP)	No. of CC-related projects	%	No. of project (CGA+ PSDP)	No. of CC-related projects	%	No. of projects (CGA+ PSDP)	No. of CC-related projects	%	No. of projects (CGA+ PSDP)	No. of CC-related projects	%
Cabinet Secretariat/ AEC	173	165	95.4%	266	75	28.2%	58	31	53.4%	112	67	59.8%
Communication/ NHA Div.	119	112	94.1%	124	116	93.5%	81	78	96.3%	98	95	96.9%
Defence Div. and SUPARCO	65	32	49.2%	39	23	59.0%	24	16	66.7%	22	12	54.5%
Federal Education and Professional Training	95	80	84.2%	8	5	62.5%	10	7	70.0%	11	2	18.2%
MCC	36	36	100.0%	8	8	100.0%	6	6	100.0%	6	6	100.0%
Finance, Rev, Privatization	336	156	46.4%	383	181	47.3%	252	174	69.0%	232	100	43.1%
Interior and Control/Ministry of Population Welfare	257	55	21.4%	172	45	26.2%	105	27	25.7%	134	51	38.1%
Kashmir Affairs and Gilgit-Baltistan Div.	15	12	80.0%	20	17	85.0%	14	10	71.4%	11	7	63.6%
Science and Technological Research Div.	108	41	38.0%	56	34	60.7%	66	29	43.9%	55	38	69.1%
Water and Power Div. (Water and Power Sector)	162	105	64.8%	153	92	60.1%	185	84	45.4%	134	107	79.9%
Railways Div.	29	24	82.8%	29	19	65.5%	37	21	56.8%	35	26	74.3%
Housing and Work Div.	105	92	87.6%	49	14	28.6%	56	22	39.3%	74	18	24.3%
HEC	1	1	100.0%	1	1	100.0%	1	1	100.0%	1	1	100.0%

Soucre(CPEIR,2015 pg 71)

Different ministries has undertaken projects that has strong relevance to climate change as compared to other ones depending on the budget they get each year. There is no specific increasing or decreasing trend has been seen in the climate related projects during the 2010-2014. However Ministry of Communications have contributed to almost 97% of climate related projects during the year of 2013-2014 while the education sector contributed the least during the same year. The reason of variability in the climate related projects having relevance to separate ministry is because of the administrative change as the new party came in and set up a new agenda and priorities across all the ministries and divisions. It has led to unequal investment in various projects under some ministries and also availability of funds

play a crucial role in the number of climate related projects each year.

“Even in the absence of governmental transition there still is a uncertain fluctuation in the average relevance weight across time and across ministries. This four year period also indicates that government and ministries main focus has been on other areas such as countering terrorism. Generalizing the four- year trend, the water and power sector showed up as a ministry which has taken up the projects which has strongest climate relevance, followed by the Ministry of climate change. Science and Technology Research and Kashmir and Gilgit-Baltistan Divisions has shown greater variability across the four years as these areas has been a victim of climate change impacts and different projects has been taken up showing strong to moderate climatic relevance across the four years. Similarly different ministries have different level of climatic relevance but it’s a matter of worry that none of the projects showed a relevance of more than 50 percent. In addition, average relevance is one element that gives a highlight of the difference in the investments by the ministries.”(CPEIR,2015 pg, 72)

The Ministry of Wapda and Cabinet division which includes atomic energy commission accounts for almost 60 and 80 percent of the total climate- related actual investment expenditure during the four years. The share of each of the three ministries in total climate-related investments (Communications, NHA, Finance and Railways) ranges between 0.8 and 9.4 percent. The corresponding share of the remaining eight ministries is less than 1 percent.

The analysis based on the CPEIR report indicates that energy represents the dominant climate related expenditure while the important task areas are transport (19 percent of PSDP CC expenditure), health and social services (9 percent) and water resources.

four themes: mitigation, adaptation, A/M or supporting activities which are CC response enablers. The 2013/14 climate-related federal CC expenditures were related mainly to the mitigation theme, with supporting activities making up just 2 percent (Figure 9,10,11).

“The allocation of expenditures to tasks within each theme demonstrates further detail about climate-related expenditures (Figures 9,10,11). Within mitigation (54 percent of total federal CC expenditure,) a majority (86 percent) is made up of the energy task area. The remainder

is contributed by transport. Energy is thus dominant in the climate budget, making up 60 percent of the total PSDP CC budget in 2013/14. Adaptation has a more varied selection of CC- related tasks, but with three tasks making up over 98 percent of the adaptation expenditure; health and social services, water resources and disaster preparedness. The supporting areas theme represents just 2 percent of the CC budget and is dominated mainly by the awareness raising and education task. A majority of the expenditure was within the energy sector for mitigation purposes (57 percent, 2013/14 data). Further significant contributions were from the transport category (19 percent, predominantly mitigation), health and social services (9 percent, adaptation), water resources (8 percent, adaptation) and disaster preparedness (5 percent, adaptation.”(CPEIR,2015 pg 74)

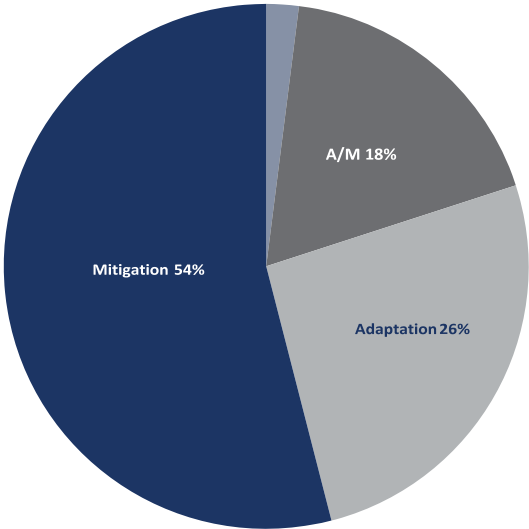


Figure 9

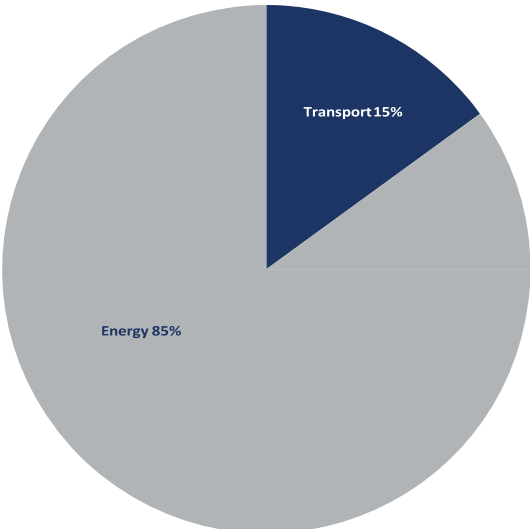


Figure 10

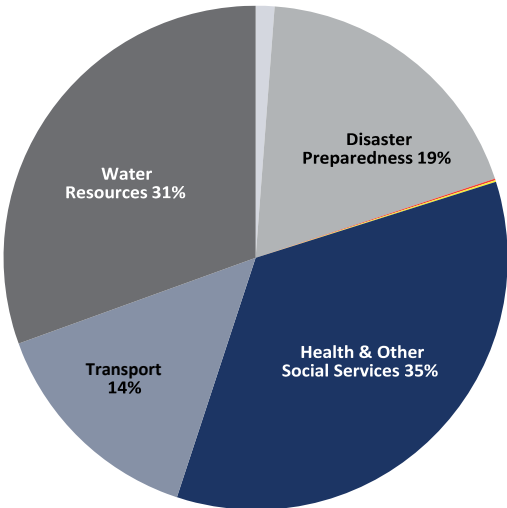


Figure 11 soucre(CPEIR,2015)

Chapter Seven :

This chapter gives a brief details about the organizations and institutions that are working on climatic data collection, processing and research. As these organizational climatic work is key for the climatic policy makers to make adaptive or mitigative policies according to the severity of the climate change presented in the collected data. These organizations also face many challenges that highly damages the effectiveness of their institutional capacity. These issues can be lack of financial resource or technical one and can be overcome with the help of governmental or private funding as these organizations are key for creating a baseline for the whole institutional setup for overcoming the climatic change potential impacts in Pakistan.

7.1.Climatic data Collection and its challenges and gaps:

There are several organizations that are involved in climatic data collection, it's processing and research as well. Some of the main organizations are mentioned below.

GCISC, PMD, Water & Power Development Authority (WAPDA), NIO, National Agricultural Research Centre /Pakistan Agricultural Research Council (NARC /PARC), Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan Institute of Development Economics (PIDE), Pakistan Atomic Energy Commission (PAEC), COMSATS Institute of Information Technology (CIIT), National University of Computer and Emerging Sciences (FAST), Hydrocarbon Development Institute of Pakistan (HDIP), Pakistan Forest Institute (PFI).

In the beginning the most prominent and determined organizations of Pakistan working on climatic change data collection ,it's impact assessment and adaptation measures were

Pakistan Metrological Department (PMD), Pakistan Agriculture Research Council (PARC), Pakistan Council of Research in Water Resources (PCRWR), and Pakistan Forest Institute (PFI), etc. Later as the issue was getting more graved many new organizations were set up to envisage on this issue dedicatedly. For instance, Global Change Impact Study Centre (GCISC), Water and Power Development Authority (WAPDA), Pakistan Institute of Nuclear Science and Technology (PINSTECH), and Pakistan Institute of Engineering and Applied Sciences (PIEAS) and Pakistan Atomic Energy Commission (PAES).

These all organizations were also contributing much in collecting a handful information about climatic data and also have limited set up for addressing issues of climate change and global warming by utilizing the information in productive research. A brief details about these organizational work have been highlighted and had been collected by visiting and interviewing the head of these departments.

7.2. Pakistan Metrological Department:

The Pakistan Meteorological Department (PMD) is both a scientific and a service department, and functions under the Ministry of Defence, Pakistan. It is responsible for providing meteorological service , climate change indicators and related adaptation or mitigative measures in different sectors. PMD provides weather information to public and private sector for various purposes. It also has to fulfil it's obligations towards certain international agreements. Apart from metreorology, the department is also concerned with Agro-metrology, Hydrology, Astronomy and Astrophysics (including solar physics), Seismology, Geomagnetism, Atmospheric Electricity and studies of the Ionosphere and Cosmic Rays. Pakistan Meteorological Department has different sections and departments to investigate the climatic indicators, climate change impacts and possible adaptation measures aswell to the governmental policy makers. In recent years PMD has given considerable consideration to the research department to find out more on the impacts of climate change on Pakistan. A detailed study is conducted regarding Climate Change Indicators that briefs the degree of variation in climate in twentieth century (Zaman. Q, Mahmood. A, Rasul. G, Afzal..M., 2009). Furthermore, investigations are being carried out to identify the impact of global warming on glaciers of Himalaya, Karakorum and Hindukush (HKH) ranges (Rasul G , Qin Dahe and Chaudhry Q. Z. 2008), and in recent years PMD teams are regularly visiting Glaciers like

Baltoro, Biafo, Hinarchi, Passu and Batura to monitor impact on climate change on glaciated regime of Northern Pakistan (Chaudhry, Q. Z. and Rasul G. 2004)

The major achievements of the Department are introduction of modern flood forecasting system, earthquake and nuclear explosion detection system, radar, satellite, computer technology, flight safety consultancy services in seismic design of dams, buildings and other development and disaster relief schemes.

Different instruments and methods are being used to collect data on the temperature, precipitation and various other related indicators. Four main divisions headed by Chief metrologist are Centre for drought monitoring, Research and development division, Flood forecasting division, and National seismic and tsunami warning centre. (PMD,2009)

7.3.Data collection, integration and coordination:

Climatic Data collection process is an integral part of the climatic research and findings. Several national and International organizations are playing their key role in archiving quality scientific climatic information. Currently almost every organization is running it's own network but the main concern is of data sharing and collaboration among organizations. Pakistan metrological department is the largest network throughout the country and has close connections with WAPDA and Ev-K2-CNR but the communication is not that high. Winiger's network operates in Mountainous terrain of HKH but is not being shared or given access to any of the national or governmental organization. There is a weak communication, sharing and integration of data among the organizations working on climate change. There is a need of cohesive mechanism or a system which gives a platform for effective sharing of data and to avoid duplication of the work being already done which will ultimately save national resources. There is an urgent need of a central data bank where all sort of climatic data and research can be archived conveniently. It can lead to a progress in making valuable policy uptakes and mitigation strategies. (. (Rasul, G., 2010.))

7.4.Lack of Technical Capacity:

PMD, WAPDA, PCRWR, SUPARCO, NARC and GCISC are the main organizations working on different aspects of Climate change and impact assessment. One of the key

method to predict the changes is done by modelling which involves oceans, land and atmospheric relationships and cycles. Modeling helps to formulate the scientific data in both qualitative and quantitative ways. The circulation models are well recognized for the assessment of the circulation of planetary atmosphere or ocean and involve equations that involve thermodynamic concepts. These equations are the basis of simulation of the atmosphere or ocean done by the complex scientific programs and software. In Pakistan organizations like PMD and GCISC use global models results and then deduce or downscale it into regional climate modelling but because of lack of technical capacity and computational limitation barrier they have to go for the rough resolution. But, due to their computational limitations they are bound to either choose a limited domain or make a choice of coarse resolution so that the computer could sustain the load of heavy processing. Presently PMD has been using a 16 nodes blade server for running HRM, RegCM3, SDSM and PRECIS models whereas GCISC is using 16 PCs cluster. Each run takes months to be completed in a limited domain and at a larger time step. Computer power has to be significantly enhanced to work in regional domain to reduce the bias at finer time steps for making more realistic assessments in shortest possible time. With enhanced computer capacity dynamical downscaling can also be exercised along with statistical downscaling.(Rasul, G., 2010.)

7.5.An Organized Approach :

The contributions towards an integrated approach to climatic data has been remarkable by many scientists at institutional and individual level but there is a lack of an organized and systematic approach towards handling and collection of the climatic data. Modeling of the Indus basin is a crucial process which is quite demanding and requires research groups working collaboratively at one platform using outputs of GCMs to stream flow models. The result of this modelling can be interpreted into economic, social and environmental impacts which opens up ways for adaptation and mitigation to climate change in a sustainable way. The involvement of the key institutions at organizational level, private sector and academia can orient their work by making a platform to share and organize the data which result in better results.

7.6.Lack of Trained Manpower:

There is an acute shortage of well trained staff in national organizations which knows the climate change science and dynamics of the climate system because none of the national universities offer such courses at graduate or post-graduate level. Only PMD impart basic training to fresh intakes having post-graduate degrees in Mathematics, Physics or Computer Sciences. Climate change science demands high level of professional proficiency in theory and practice. In addition to that knowledge and expertise in numerical modeling is high desirable to work on a model in commanding way.

There is a dire need to train the staff of PMD, GCISC and NARC on numerical modeling and climate system dynamics at International organizations that are playing a leading role in climate change science.

Coordination among Research Groups Different organizations and research groups are working on different aspects of climate change and its impact on various sectors.

There is a great probability of duplication of research efforts so there is a need of an apex body due to the lack of communication among the groups. Especially in cryospheric research many groups and individuals are involved to investigate changes in glaciers size and mass through remote sensing and at many occasions duplication appeared. .(Rasul, G., 2010.)

Chapter Eight:

Role of Academia:

DCCE in its present form is comparatively a new concept in Pakistan which leads to lack of awareness, being the major challenge exists in government and education departments. As predicted in the disaster management Framework, the lack of awareness together with lack of expertise in the relevant government departments hinder implementation of national plan and strategy for integrating DCCE in school, college and higher education curricula. Similarly, 18th Amendment in the Constitution of Pakistan in 2011 reflected a task of mainstreaming DCCE as a subject in the curricula at school, college and university level, in which the education sector was decentralized to provinces (NDMA 2013). Since education is a decentralized sector and provinces are empowered and responsible to enhance the capacity of young generation in DCCE and introduce it as a compulsory subject in school, college and university system. If NDMA works in collaborations with PDMA's with

respective provinces in designing uniform standard curricula for all levels, this process will be more productive.

8.1.DCCE at University Level

Peshawar Climate Change Centre:

Peshawar climate change centre is a case study of how academics can play a leading role in highlighting and implementing better adaptation practices and creating an awareness about mitigation and sustainable adaptation.

University of agriculture, Peshawar is located in Khyber-Pakhtunkhwa which is sheltering a population of more than 20 million people. Farming especially crop production, horticulture and livestock production are the main livelihoods of the inhabitants as majority lives in rural areas. Exposure of climate change is expected to affect hydrological patterns resulting in food insecurity. Climate centre is working to help farmers devise new methods of adaptation and resilience against climate change. Climate centre Peshawar sees vulnerability of the local people in a contextual way that is to overcome the main livelihood barrier that is water shortage. Farmers are in an ultimate need of a system to access the climate change research and similarly the policy makers should be aware of the challenges faced by the farming community. Climate Change Centre is providing a system to help farmers accessing the relevant information and also to record their observations of the climate change and possible adaptive strategies as the local knowledge can be key to devise new resilient techniques. Climate centre has a plan to provide a platform where all the data of the region that is Peshawar can be accessed easily by all the researchers at the private sector. Climate Change Centre aimed to be service centre for adaptation to climate change. Inter-corporation is a Swiss NGO which is providing technical and financial support through their SDC funded livelihoods programme Hindukush.

9. Conclusion:

This study concludes that although there have been a huge effort in institutionalizing climate change at governmental and local level how ever there are some big flaws and drawbacks at the policy making level and also at institutional level. Policy making doesn't involves any of the local community as a case study to figure out their contextual vulnerability. It has affected the outcome of adaptation and mitigative strategies. Institutions also have differing values and interest which has lead to unsustainable adaptation practices. There is a lot of work needed to be done to improve the knowledge about vulnerability and adaptation both at governmental an local level.

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