

# Framework for Implementation of Climate Change Policy

(2014 - 2030)



**Government of Pakistan**  
**CLIMATE CHANGE DIVISION**  
Islamabad, Pakistan  
November 2013

## Acknowledgements

The Climate Change Division, Government of Pakistan acknowledge the efforts of Dr. Qamar uz Zaman Chaudhry (Lead Author) and Mr. Muhammed Sohail (Co-author) for developing this framework document, and to the steering committee experts which includes Mr. Jawed Ali Khan, Mr. Irfan Tariq, Dr. Aurangzeb Khan, Dr. Arshad M. Khan, Syed Mujataba Hussain and Mr. Amanullah Khan for providing significant guidance to the authors in developing the policy document.

Valuable support and input of Federal Ministries, particularly Planning & Development Division, Ministry of Water & Power, Ministry of Food Security, Ministry of Industries, Ministry of Foreign Affairs and other Government Agencies and Institutions which include NDMA, WAPDA, PMD, FFC, GCISC, ENERCON, EPA-Pak through their experts is also deeply acknowledged.

My special thanks to the Provincial Governments of Sindh, Punjab, Baluchistan, Khyber Pakhtunkhwa, Governments of AJK and Gilgit-Baltistan and their departments for their very useful feedback in formulation of Pakistan's Framework for Implementation of Climate Change Polciy is also deeply appreciated.

The invaluable input provided by NGOs and Civil Society Organizations particularly by IUCN, CDKN-Lead-Pakistan, Oxfam-Novib, and WWF-Pakistan is also deeply appreciated.

The support of the United Nations Development Program (UNDP) is also greatly appreciated, which provided necessary funding, through the One-UN Joint Program on Environment for the formulation of this framework document.

(Raja Hasan Abbas)  
Secretary  
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## Abbreviations and acronyms

CDM	Clean Development Mechanism
CSR	Corporate Social Responsibility
ENERCON	National Energy Conservation Centre
GCISC	Global Change Impact Studies Centre
GHG	Green House Gases
ICAO	International Civil Aviation Organisation
IPCC	Intergovernmental Panel on Climate Change
IRS	Indus River System
IRSA	Indus River System Authority
NESPAK	National Engineering Services of Pakistan
PEPA	Pakistan Environmental Protection Agency
PFI	Pakistan Forest Institute
PMD	Pakistan Meteorological Department
RAMSAR	Convention on Wetlands of International Significance
REDD	Reducing Emissions from Deforestation and Forest Degradation in developing countries
NCCP	National Climate Change Policy-Pakistan
SAARC	South Asian Association for Regional Cooperation
SUPARCO	Space & Upper Atmosphere Research Commission
UNFCCC	United Nation Framework Convention on Climate Change
WMO	World Meteorological Organization



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## INTRODUCTION

An overwhelming majority of scientists, experts, and professional scientific organizations related to earth sciences agree that evidences are sufficient that climate change is real. Some may still deny this overwhelming judgment of science, but none can deny the devastating impact of increase in frequency and intensity of climate extremes. Further, most of the experts agree that the major cause is human activities, which include a complex interaction with the natural environment coupled with social and economic changes, that are increasing the heat trapping CO<sub>2</sub> and other greenhouse gases (GHG) in the atmosphere, which are increasing global temperature and in turn causing climate change.

The climate system is a highly complex system consisting of the atmosphere, the hydrosphere, the Cryosphere, the land surface and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcings. (Source: IPCC). These interactions operate over a large span of spatial and temporal scales. Because of this complexity our understanding of climate change will always be limited.

For Pakistani's, Climate Change is no longer a distant threat-we are already feeling and experiencing its impacts across the country and the region. The country experienced devastating floods during the last three years. These changes come with far reaching consequences and real economic costs. Losses in the 2010 floods alone exceed US\$ 9.6 billion.

The development of this Framework for Implementation of NCCP is a follow-up of the National Climate Change Policy (NCCP), the parent document providing broader framework concerning how to adapt to the changing impacts of climate and how to play a role in its mitigation. This

Framework for Implementation of NCCP is developed keeping in view the current and future anticipated climate change threats to Pakistan's various sectors.

In view of Pakistan's high vulnerability to the adverse impacts of climate change, in particular extreme events, like the policy document adaptation effort is the focus of this Framework for Implementation of NCCP document too. The vulnerabilities of various sectors to climate change have been highlighted and appropriate adaptation actions spelled out. These cover actions to address issues in various sectors such as water, agriculture, forestry, coastal areas, biodiversity, health and other vulnerable ecosystems. Notwithstanding the fact that Pakistan's contribution to global greenhouse gas (GHG) emissions is very small, its role as a responsible member of the global community in combating climate change has been highlighted by giving due importance to mitigation efforts in sectors such as energy, forestry, transport, industries, urban planning, agriculture and livestock.

Furthermore, appropriate actions relating to disaster preparedness, capacity building, institutional strengthening; and awareness raising in relevant sectors has also been part of this document.

This Framework for Implementation of NCCP has been developed not as an end in itself, but rather a catalyst for mainstreaming climate change concerns into decision making that will create enabling conditions for integrated climate compatible development processes. It is therefore not a stand-alone document, but rather an integral and synergistic complement to future planning in the country.

Further, this Framework for Implementation of NCCP is designed as a 'living document'. This is because we are still uncertain about the timing and exact magnitude of many of the likely impacts of climate change. We will continue to deepen our understanding of the phenomenon, as we continue to implement our adaptation and mitigation programmes. We will also keep ourselves informed of the latest developments in the science of Climate Change and from experiences in other parts of the world, including through our participation in the process of UNFCCC and related fora.

Therefore, we anticipate periodical revision and updating of this Framework for Implementation of NCCPdocument to address emerging concepts and issues in the ever-evolving science of climate change.

It is also expected that this document will be used to prepare the detailed provincial and local adaptation action plans. In addition it will also provide a basis and form the building block that will lead to the development of a National Adaptation Plan(NAP), National Appropriate Mitigation Action(NAMAs) Framework and the preparation of the Second National Communication to UNFCCC.

## 2.0. BACKGROUND AND CONTEXT

### 2.1. Geography and Climate

Pakistan is situated at the junction of three major regions of Asia: Middle East to the west, Central Asia to the north and the Indian Subcontinent to the east and southeast. The country is located in sub-tropics and partially in temperate regions and has a long latitudinal extent stretching from the Arabian Sea in the south to the Himalayan mountain range in the north.

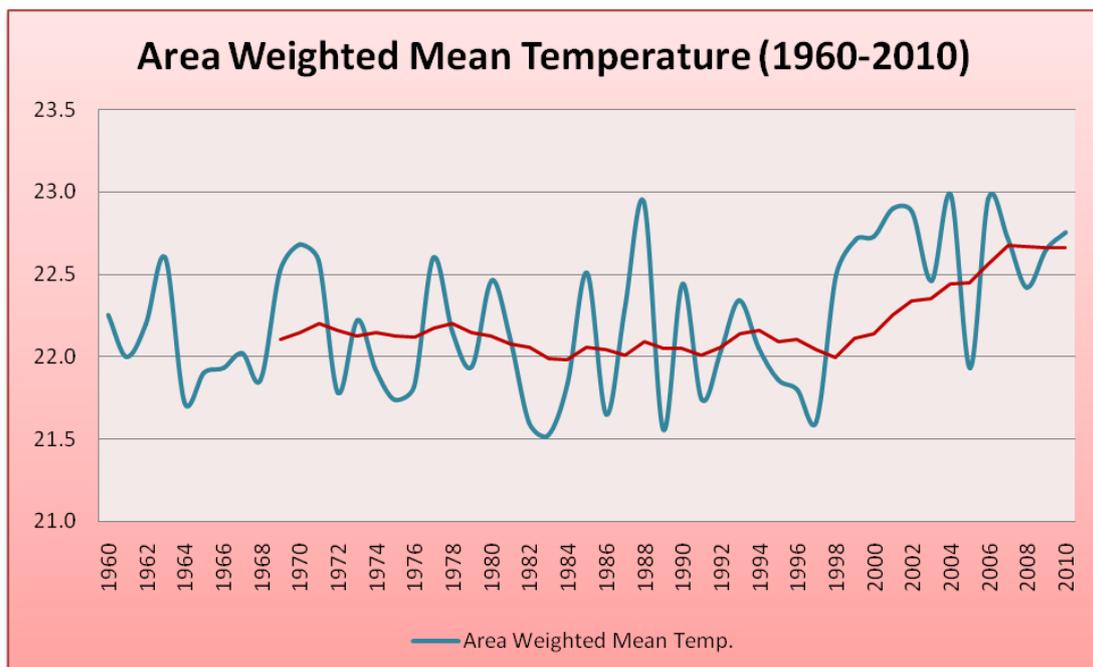
Mountains in the northern areas comprise Himalayan-Karakoram ranges and part of the Hindukush range. The large area of Karakoram range is covered with glaciers. The coast-line stretches from the Iranian border along the Makran coast to Karachi and then along Sindh coast, including the Indus Delta to the Indian border. Physically the Indus river and its tributaries run through the whole country.

Most parts of Pakistan are arid to semi-arid with significant spatial and temporal variability in climatic parameters. However, areas in the northern half of the country above 31°N are semi-arid to humid with a sub-humid belt running along the southern slopes of mountain ranges. Southern half of the country below 31°N is mostly arid and hyper-arid.

## 3.0. CLIMATE CHANGE IN PAKISTAN

### 3.1. Observational facts and trends

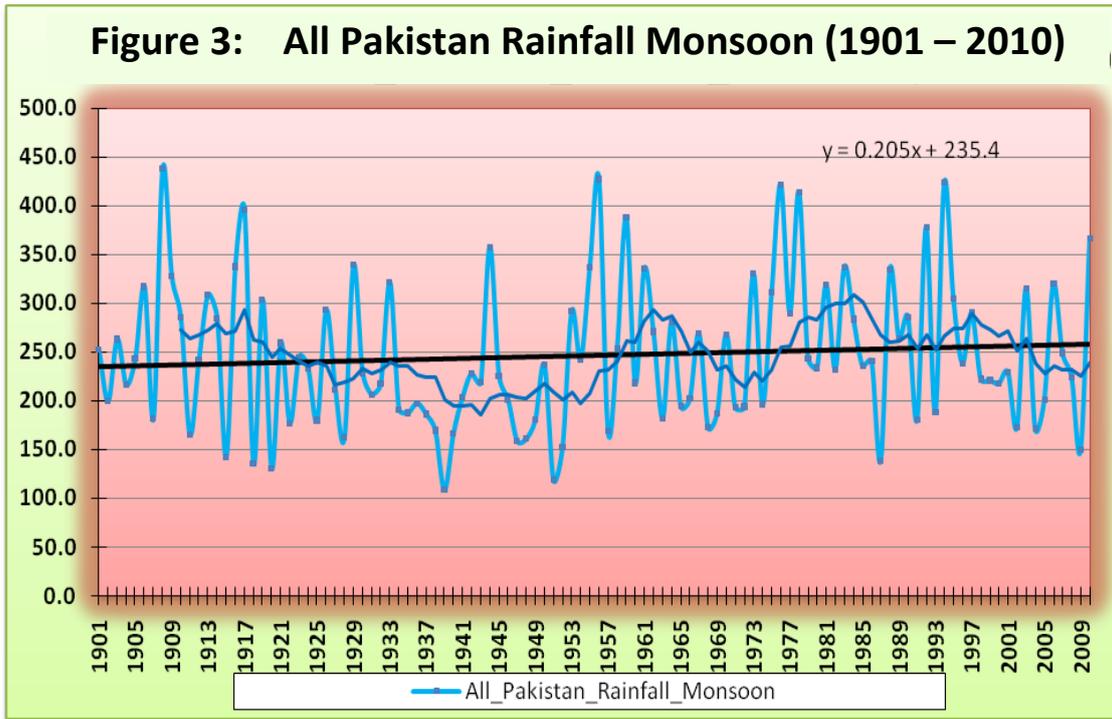
Observed air temperature trends in Pakistan go along with the global trends. The latest observed temperature data obtained from Pakistan Meteorological Department shows that the mean surface air temperature in Pakistan has risen at the rate of 0.099 °C per decade from 1960-2010 resulting in total change of 0.47 °C, which is statistically significant at the 95% level. The warmest year in Pakistan recorded by PMD was 2005 and the second warmest was 2007. Drastic rise in temperature in the last decade has been observed, which made it the warmest decade on record in Pakistan.



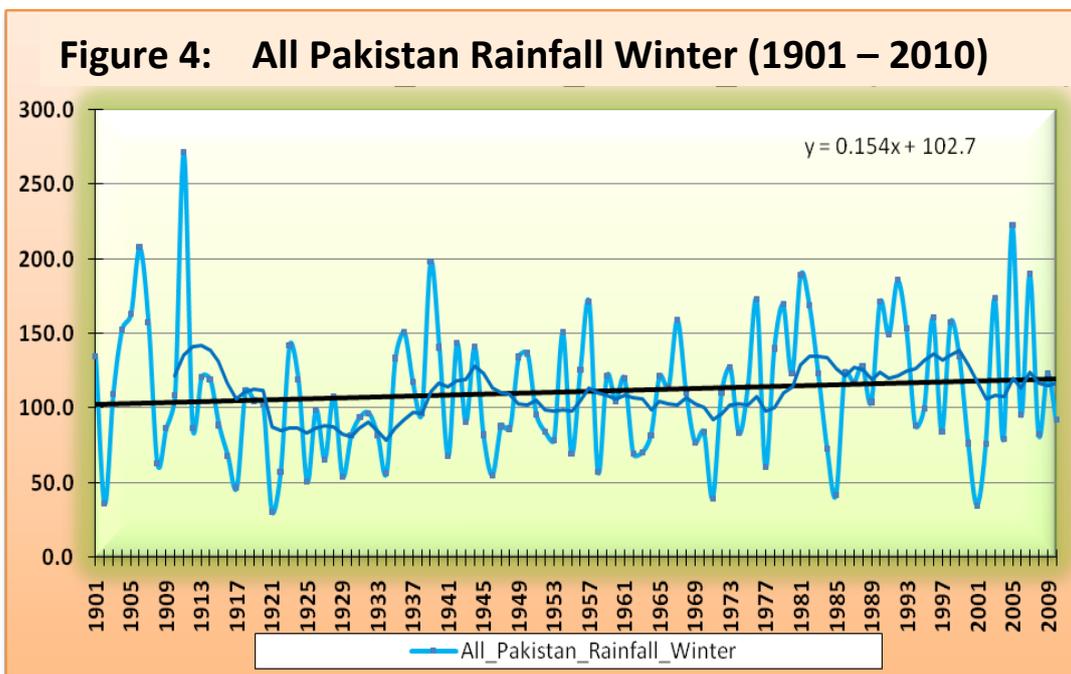
### 3.2. Seasonal Precipitation

The monsoon rainfall time-series shown in figure.3 depicts an increase of 22.6 mm over the data period (1901-2010), which is not very significant statistically. Moving average of ten years period has also been displayed. This decadal

analysis clearly indicates inter-decadal variability of 20-30 years cycles. Rainfall started decreasing from the second decade of the 20th century and this trend lasted up to the fifth decade. Then there is an increasing trend up to 1962 and followed by decrease in rainfall for next ten years. After that, small variations continued until decreasing trend set in again in 1997, which continued until 2009.



Pakistan’s winter rainfall 1901-2010 shown in fig.4 indicates an increasing trend. The rainfall has increased by 1.95 mm per decade with total increase of 20.8 mm over the period. The change is not significant statistically. Moving average of ten years period shows random variations in the time series. Floods in last ten years in Pakistan has been shown in Annex-III.



### 3.3. Pakistan's Climate Projections

Global Change Impact Studies Centre (GCISC) and Pakistan Meteorological Department (PMD) jointly carried out a study and developed future climate change scenarios for Pakistan. The study revealed that almost all the temperature indices show significant changes over the region. Trend in temperature indices reflect an increase in both maximum and minimum temperature. There is a much larger percentage of land area showing significant change in minimum temperature (5°C) than maximum temperature. Percentile based spatial change shows that the daily minimum temperature will become warmer as compared to the increase of daily maximum temperature in summer, whereas, in winter the change in maximum threshold temperature is high (GCISC & PMD and joint report on climate change 2007).

The climate change scenarios are based on IPCC Special Report Emission Scenarios (SRES). The SRES scenarios cover a wide range of the main driving forces of future emissions from demographic to technological and economic developments. Among them A2, A1B and B1, emission scenarios were chosen for interpolation on 1° x 1° grid resolution using multi-model ensemble output. Monthly data sets were used by 17-model ensemble to construct A2 and A1B scenario but daily data were used for ECHAM-5 (Max Planck Institute for Meteorology's 5th generation atmospheric circulation model) output to produce B1 scenario. Statistical downscaling of multi-model GCMS output by using NCC-RCM (Regional Climate Model of National Climate Centre Beijing) produced final scenarios. Future climate projections of Pakistan have been calculated keeping in view the above-mentioned scenarios. The rate of change of precipitation and temperature in different future scenarios has been displayed in Tables 1 & 2.

**3.3.1. Table 1: All Pakistan Climate Projections (2011- 2050)**

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

**3.3.2. Table 2: Regional Climate Projections (2011- 2050)**

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 KPK	+6.1	+3.8	-0.5	+0.01	-0.34	-0.01
Central / Southern Punjab & Lower KPK	-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

It can be seen in the above table that most regions in Pakistan are showing a positive trend in temperature for the period mentioned. Maximum rise is expected in Northern Areas of the country and Central-Southern Punjab and Lower KPK. However, there are mixed trends of increase and decrease of precipitation in different regions.

### 3.3.3. Table-3. IPCC Projected Climate Change Impacts

Impacts (IPCC Group II Summary for Policy Makers)	Likelihood (based on SRES) Scenarios	Project Sectoral Vulnerabilities to Climate Change in Pakistan
Over most land areas, fewer cold days / nights, warmer and more frequent hot days / nights.	Virtually Certain	<b>Water:</b> Increased water demand due to frequent heat waves; widespread stress on water availability during drought; higher temperature may adversely affect HKH glaciers reserves, which are the main source of water supply in Indus river system (IRS); increased salt water intrusion in Indus delta. <b>Agriculture:</b> Warmer temperatures in some areas may result in higher yields, but higher evapotranspiration and water deficit may affect crop yield in other areas. Warmer environment would increase the incidence of pest and disease. Increased extreme weather events would cause crop losses and land erosion in floods and reduced crop yields in droughts.
Warm spells/ heat waves, frequency increase over most areas.	Very likely	<b>Energy:</b> Increased energy demand because of higher temperatures. Decreased hydropower potential due to reduced water availability in long term.
Heavy precipitation events, frequency increased over most areas.	Very likely	<b>Human Health:</b> Increased risk of vector-borne disease (e.g. malaria, dengue) and heat related mortality due to warmer temperatures. Increased risk of deaths and injuries from extreme weather events and diarrheal out break due to reduced access to clean drinking water.
Areas affected by drought increase.	Likely	<b>Ecosystem:</b> Increased risk of extinction of many species due to the synergistic effects of climate change and habitat fragmentation: Increased threat to the stability of wetlands, mangroves and coral reefs.
Increased incidence of extreme high sea level.	Likely	

### 3.4. Pakistan's Vulnerability to Climate Change Threats

The important climate change threats to Pakistan are:

1. Considerable increase in the frequency and intensity of extreme weather events, coupled with erratic monsoon rains causing frequent and intense floods and droughts;
2. Projected recession of the Hindu Kush-Karakoram-Himalayan (HKH) glaciers due to global warming and carbon soot deposits from trans-boundary pollution sources, threatening water inflows into the Indus River System (IRS);
3. Increased siltation of major dams caused by more frequent and intense floods;
4. Rising temperatures resulting in enhanced heat and water-stressed conditions, particularly in arid and semi-arid regions, leading to reduced agricultural 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 the 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 in relation to sharing of water resources;
9. Increased health risks and climate change induced migration.

The above threats lead to major survival concerns for Pakistan, particularly in relation to the country's water security, food security and energy security.

### ***3.5. Climate Compatible Development & Climate Finance***

Government of Pakistan is fully cognizant of the fact that for Pakistan, climate change threats are not just limited to environmental issues, but more precisely these are economic and developmental challenges. As such the Framework for Implementation of NCCP document has been designed to promote effective institutional framework to mainstream climate change concerns into overall national planning and to promote climate compatible development with clear sets of roles and responsibilities at the federal and provincial levels. The success of this framework for supporting progress towards climate compatible development also depends on the interest and actions taken by other line ministries, departments, provincial governments, private sector and civil society which are mostly outside the Climate Change Division. As such a strengthened institutional role of the Climate Change Division has been envisioned that is able to lead and manage climate change programmes and concerns from a federal perspective along with line-ministries, while encouraging actions at the provincial level.

A major challenge for Pakistan in this area to date has been the lack of donor' interest in environment and climate change issues; in reality however, Pakistan has a strong case for such assistance, given its extreme vulnerability to climate variability and change. This has been further exhibited by the significant cost, both financial and human, of recent extreme climate disasters in the country. On a broader canvas, Pakistans Climate vulnerability and its direct impact on the socio economic conditions of its population transcends onto broader issues of security and governance at the regional and global levels.

The newly announced establishment of the Green Climate Fund (GCF) would hopefully provide a regular and reliable source of much needed financing to the developing countries for their climate change programmes. Besides the GCF there are many other climate financing windows internationally available, such as ICF, GEF, Adaptation Fund and multilateral banks etc. Pakistan has so far been able to register 29 projects with UNFCCC under Clean Development Mechanism (CDM) while around 67 such projects are in the pipeline. For Pakistan to successfully attract a significant share of GCF or other available Climate financing, the institutional capacity at federal and provincial level needs to be enhanced significantly to design and prepare effective and saleable programmes by the line ministries and other stakeholders.

Further, involvement of the private sector in Pakistan also needs to be explored by indentifying their role in appropriate climate change actions where both can have a win-win situation. In this regard best practices from other countries may need to be studied and adopted. Another important enabling factor for the success of this framework includes building high-level political support, beside enhancing donor community interest and attracting international climate financing.

### ***3.6. Gender Dimensions of Climate Risk & Resilience***

The recent studies and literature on gender and climate change adaptation clearly show that gender differentials are critical to the success of any adaptation programme. This is precisely because of the unequal power relations between men and women in our society. While a large number of women in rural areas depend on climate-sensitive resources for survival and their livelihoods, they do not enjoy equal authority, decision-making power and resources needed to adapt to climate change.

As such, impacts of climate change could prove particularly severe for women. With climate change, there would be increasing scarcity of water, reduction in agriculture, and increased risks to human health with children and women becoming more vulnerable. Increasingly, evidential experience also confirms that the impacts of climate change are not gender neutral. Women and men experience climate change differently and their capacity to cope with it also varies. Pakistan's experiences in recent climate disasters also clearly suggest that climate change is amplifying and exacerbating existing patterns of gender disadvantage. Thus, women's historic disadvantage, their limited access and control over decision-making and economic resources, and their restricted rights, make them more vulnerable to climate change.

Therefore, women's vulnerability to climate change differs from men and climate change interventions that are not gender-responsive often result in deepening the existing gender divide.

The Government of Pakistan is fully cognizant of this critical issue and is determined to support gender integration into various efforts to address climate change. This would be achieved by countering the disproportionate burden of climate change on women by ensuring their empowerment and recognition of their critical role in the management of climate change plans and strategies

# FRAMEWORK FOR IMPLEMENTATION

## SCHEDULE

**Implementation of each action proposed has been designed into following four time frames.**

**Priority Actions (PA) : within 2-years**

**Short term Actions (SA): within 5-years**

**Medium term Actions (MA): within 10 years**

**Long term Actions (LA): within 20-years**

## 4.0 WATER SECTOR: ADAPTATION ACTIONS

Pakistan is an agricultural country. Therefore water is an essential resource for sustained economic growth as well as human survival. Water, which is one of the most important national resource is increasingly becoming a scarce natural resource. Presently agriculture sector is using 93%, domestic sector 5% and industrial sector 2% of water resources. The domestic and industrial sector water uses are projected to increase to 15% by 2025. Agriculture sector is the major user of water, but its share is expected to decrease because of competing non-agricultural demands. Our Indus Basin Irrigation System (IBIS) is the world's largest contiguous irrigation system. It comprised three large dams, 85 small dams, 19 barrages, 12 inter-river link canals and 45 canal commands. This irrigation network is the biggest infrastructure asset of Pakistan worth approximately US\$ 300 billion of investment (source: Ministry of Water & Power).



**Mangla Dam (Source: WAPDA)**

Water resources are inextricably linked with climate; hence, the projected climate change has serious implications for Pakistan's water resources. The freshwater resources in Pakistan are mainly based on snow and glacier melt and monsoon rains, both being highly sensitive to climate change. The average annual flow of IRS is around 142 million acre-feet of which 104 MAF is diverted to the canal network, while major portion of the remaining balance of around 35 MAF outflows to the sea. Fortunately Pakistan has a large useable groundwater aquifer, God gifted natural reservoir, which is largely recharged from the surface flows and rains. This resource is being exploited heavily and particularly in some hyper-arid areas to the extent of criminality.

Pakistan has moved from a water affluent country to water stressed country. In 1947, per capita water availability was 5000 cubic meter, which has currently decreased to around 1000 cubic meter, and projected to decrease to 800 cubic meter per capita by the year 2025.

Proper management and use of water resources, keeping in view its economic value, is essential for sustainable development. Its scarcity affects health, sanitation, disaster risk reduction, poverty alleviation, environmental conservation and cuts across all eight Millennium Development Goals (MDG). Furthermore, vulnerability from extreme weather events is growing due to the ever increasing population, climate change, socio-economic issues and environmental degradation.

The country-specific climate projections strongly suggest the following future trends in Pakistan: decrease in the glacier volume and snow cover leading to alterations in the seasonal flow pattern of IRS; increase in the formation

and burst of glacial lakes; higher frequency and intensity of extreme climate events coupled with irregular monsoon rains causing frequent floods and droughts; greater demand of water due to increased evapotranspiration rates at elevated temperatures.

These trends will have a large and significant impact on the spatial and temporal distribution of water resources on an annual and inter-annual basis in the country. This will further exasperate the already difficult situation of a water stressed-country facing demand increases due to population growth and increasing economic activity. In these scenarios, Integrated Water Resources Management (IWRM) can play an important role in addressing these needs and challenges. As the water is managed locally, IWRM needs to be implemented on a river basin level, by involving downstream and upstream stakeholders in planning and decision-making processes and by integrating their issues of water quality and quantity, for achieving long-term social, economic and environmental benefits.

Climate change sometimes is not perceived as a fundamental water challenge, but it definitely can exacerbate existing water management practices. In order to adapt to these climate change impacts, it is even more essential to revisit existing water management practices across all relevant sectors. To address the impact of climate change on water resources and to help in enhancing water security, the following plan of action is suggested.

#### 4.1.0. Objective 1: To conserve water by adopting appropriate techniques and measures.

Strategy	1.1	Providing incentives for adoption of more efficient irrigation techniques.	
<b>Actions</b>	1.1,1	Promote the preparation of provincial water conservation strategies.	<i>Priority</i>
	1.1.2	Improving water conservation through reduction in irrigation system losses and Update and rationalize country's gross water availability estimates.	<i>Short Term</i>
	1.1.3	Identify and implement most efficient irrigation techniques such as sprinklers and trickle irrigation etc.	<i>Short Term</i>
	1.1.4	Enhance capacity of line departments and private sector to develop indigenously low cost energy and water efficient devices such as trickle and sprinkle irrigation system.	<i>Short Term</i>
	1.1.5	Ongoing canal lining be completed on priority to reduce irrigation losses.	<i>Short Term</i>
	1.1.6	Revisit the existing cropping pattern to conserve maximum water.	<i>Short Term</i>
	1.1.7	Allocate sufficient resources in the ADP for implementing climate change related actions.	<i>Short Term</i>
	1.1.8	Promote laser land levelling of agriculture fields to reduce water losses.	<i>Short Term</i>
	1.1.9	Enhance capacity of relevant departments for silt and salt management in Indus Basin.	<i>Short Term</i>
	1.1.10	Introduce and improve agricultural drainage system in Sindh	<i>Short Term</i>
	1.1.11	Promote reuse of drain water in rural and urban areas of Sindh.	<i>Short Term</i>
	1.1.12	Undertake periodic proper de-siltation of the canal system.	<i>Short Term</i>
	1.1.13	Facilitate technology transfer to small farmers by giving them incentives through subsidies etc.	<i>Short Term</i>

1.1.14	Take appropriate measures for construction of additional storage capacity while ensuring minimum base flows in all rivers.	<i>Medium Term</i>
1.1.15	Organize integrated command area development for the existing and planned dams.	<i>Med.Term</i>
1.1.16	Design and implement projects (e.g. afforestation, gabion's structures etc) that reduce land erosion and avoid silting of dams.	<i>Medium Term</i>
1.1.7	Explore the option of fixing the irrigation water pricing for generating the financial resources for the regular sustainability of irrigation infrastructure.	<i>Medium Term</i>

Strategy	1.2	Developing local rainwater harvesting measures.	
<b>Actions</b>	1.2.1	Estimate rainwater capturing potential of areas near villages and agricultural farms.	<i>Priority</i>
	1.2.2	Promote rain harvesting both in rural and in urban areas as well as at household level.	<i>Priority</i>
	1.2.3	Strengthen community capacity in rainwater harvesting practises at house hold / village / local level.	<i>Short Term</i>
	1.2.4	Identify areas for building new rainwater harvesting infrastructure for irrigation and household use (e.g. in Balochistan: Rakshan river, Zhob river, Pishin lora basin, Nari river, Panjgur river, Anambar river, Barkhan district, Musakhel district).	<i>Short Term</i>
	1.2.5	Initiate programmes aimed at promoting the use of flood water for irrigation in Balochistan.	<i>Short Term</i>
	1.2.6	Plant tree species in watersheds that are not negatively affecting the water table.	<i>Short Term</i>
	1.2.7	Incorporate rain water harvesting systems in building bye-laws.	<i>Med. Term</i>

### Implementing Institutions:

Provincial/ State Irrigation Departments, Provincial/ State Agriculture Departments, Local Govt. & Rural Development Departments, Education Department, National and Provincial Highways Authorities, Environmental Protection Agencies, CDA, LDA, KDA, PDA, City Municipalities.

### 4.1.2. Objective 2: To increase awareness to adapt to changing water resource situation due to climate change.

Strategy	2.1	Enhancing public awareness to underscore the importance of conservation and sustainable use of water resources.	
<b>Actions</b>	1.2.1	Plan regular media campaigns and hold seminars and workshops to highlight importance of conservation and sustainable use of water resources at all levels.	<i>Priority</i>

1.2.2	Support the NGOs and Civil Society organizations to highlight conservation and judicious use of water resources.	Priority
1.2.3	Initiate joint ventures, involving the line departments, civil society, academia as well as print and electronic media, to create mass awareness among the general public regarding water conservation, water availability, drainage system and other water related issues.	Priority
1.2.4	Facilitate and provide guidelines to NGOs for adopting right policies that directly benefit the communities.	Short Term
1.2.5	The importance of conservation and sustainable use of water resources be added to schools and madaras curriculum.	Short Term

### Implementing Institutions:

Ministry of Water and Power, Ministry of Education, Planning and Housing Departments, Hydro-Electric Board, National/ Provincial/ State EPAs, Academia, Civil Society, Water Conservation Campaign Groups, and Electronic and Print Media.

#### 4.1.3. Objective 3: To develop and implement integrated water resource management.

Strategy	3.1	Ensuring that water allocations are made according to changes in sectoral demands caused by climate change.	
Actions	3.1.1	Undertake a study to estimate the impacts of climate change on sectoral demands for water.	Priority
	3.1.2	Identify the medium and long term future water needs of each sector.	Short Term
	3.1.3	Assess the vulnerability of water sector and estimate the changes in the gross national water availability due to climate change.	Short Term
	3.1.4	Re-adjust water allocation according to future projected water demand for each sector of the economy.	Short Term
	3.1.5	Strengthen IRSA for integrated water resource management and its allocation as per demand for each sector.	Priority
	3.1.6	Establish water resources database for knowledge management and dissemination of necessary information through advanced information and communication technology (ICT).	Short Term
	3.1.7	Encourage community participation and empowerment in planning, implementation, monitoring and operation & maintenance of water supply systems.	Short Term
	3.1.8	Water allocation for drinking purposes will be given priority over other uses.	Short Term

Strategy	3.2	Protecting groundwater through management and technical measures like regulatory frameworks, water licensing, artificial recharge especially for threatened aquifers.	
Actions	3.2.1	Identify the locations, quality and quantity of groundwater resources available in the country.	Short Term
	3.2.2	Prepare a groundwater integrated water resources management plan for each aquifer by location at district and tehsil of each province.	Short Term

3.2.3	Develop regulatory frameworks and water licensing to control groundwater depletion and degradation and to ensure its rational exploitation.	<i>Priority</i>
3.2.4	Develop technical measures like artificial recharge, particularly, for threatened aquifers.	<i>Medium Term</i>
3.2.5	Streamline and include watershed management as an essential component of all water sector development schemes.	<i>Short Term</i>
3.2.6	Construct delayed action and check dams for groundwater recharging particularly in AJK and Balochistan.	<i>Medium Term</i>
3.2.7	Promote and standardized water-saving plumbing equipment and water efficient techniques and appliances.	<i>Short Term</i>

<b>Strategy 3.3 Developing wastewater recycling and its reuse in agriculture, artificial wetlands and groundwater recharge.</b>			
<b>Actions</b>	3.3.1	Identify the sources and estimate the amount of wastewater available for recycling in the country including AJK.	<i>Short Term</i>
	3.3.2	Design the technology and estimate the cost of proper treatment of wastewater.	<i>Short Term</i>
	3.3.3	Categorize the potential of reuse and estimate the cost of proper treatment, particularly, of wastewaters from industrial sector.	<i>Short Term</i>
	3.3.4	Pilot testing of reusing wastewater in potential agricultural areas.	<i>Priority</i>
	3.3.5	Undertake an experimental pilot study to test the recharging of groundwater aquifers with treated wastewater.	<i>Short Term</i>
	3.3.6	Install waste water treatment plants at all the urban sewerage system.	<i>Short Term</i>
	3.3.7	Provide the necessary financial resources to maintain the existing combined affluent treatment plants to keep them functional and operational with their full capacity.	<i>Short Term</i>
	3.3.8	Introduce biological treatment of waste water.	<i>Short Term</i>
	3.3.9	Promote reuse of drain water in rural and urban areas.	<i>Short Term</i>

<b>Strategy 3.4 Protecting and conserving water 'catchment' areas, and reservoirs from degradation, silting and irrigation system contamination.</b>			
<b>Actions</b>	3.4.1	Engage local community organizations and line-departments to identify the processes and sources of contamination and degradation in the catchment areas, reservoirs and irrigation systems in each province.	<i>Short Term</i>
	3.4.2	Design a water quality conservation and protection plan for these areas.	<i>Short Term</i>
	3.4.3	Identify local community leaders to support and implement a regional water quality plan.	<i>Short Term</i>
	3.4.4	Provide incentives to local population living in watershed areas to ensure plantation and sustainability through their concrete participation.	<i>Priority</i>

<b>Strategy</b>	<b>3.5</b>	<b>Encouraging active participation of farmers in water management along with line-departments.</b>	
<b>Actions</b>	3.5.1	Identify the line departments and civil society organizations that could train and mobilize the farmer's community to participate in management and distribution of irrigation water.	<i>Priority</i>
	3.5.2	Build efficient communication between irrigation department and farmer's communities regarding distribution and management of irrigation water.	<i>Short Term</i>
	3.5.3	Undertake stakeholders' consultations with water managers and users on the integrated management of water resources vulnerable to climate change.	<i>Priority</i>
	3.5.4	Promote public-private partnership for enhancing access of safe drinking water and sustainable operation & maintenance of water supply systems.	<i>Short Term</i>

<b>Strategy</b>	<b>3.6</b>	<b>Distributing water among provinces as far as possible according to crop sowing timing.</b>	
<b>Actions</b>	3.6.1	Estimate the water available and crops water requirements during sowing and planting season.	<i>Short Term</i>
	3.6.2	Decide in consultation with each province, their allocated water share for crop sowing according to their planting season.	<i>Short Term</i>
	3.6.3	Transfer the seasonal water shortages, as far as possible, according to the agreed provincial share.	<i>Short Term</i>
	3.6.4	Revisit the 1991- Inter-Provincial Water Apportionment Accord in the light of present realities and climate change scenarios.	<i>Short Term</i>
	3.6.5	Allocate, on priority, water required for drinking and industrial use in each province including the northern part of AJK.	<i>Priority</i>

<b>Strategy</b>	<b>3.7</b>	<b>Addressing sea water intrusion into Indus deltaic region by allocating required water flow downstream Kotri, and taking measures to preserve the ecology of dry-river reaches of Eastern Rivers.</b>	
<b>Actions</b>	3.7.1	Make allocation of water from the existing gross national water availability to minimum environmental river flow, downstream of Kotri.	<i>Priority</i>
	3.7.2	Identify the methods to preserve the ecology of dry-river reaches of Eastern Rivers.	<i>Priority</i>
	3.7.3	Undertake project to study the changes in aquatic ecology of western rivers in the wake of climate change.	<i>Short Term</i>
	3.7.4	Ensure proper allocation of water down stream of any hydraulic engineering structure to cater for minimum environmental regime.	<i>Priority</i>
	3.7.5	Mobilize local community to modify agricultural practices based on depleting irrigation water availability in the dry-river ecology.	<i>Short Term</i>

<b>Strategy</b>	<b>3.8</b>	<b>Developing contingency plans for short-term measures to adapt to water shortages that could help to mitigate drought.</b>	
<b>Actions</b>	3.8.1	Identify the areas that could be severely affected from seasonal or prolonged drought.	<i>Priority</i>

	3.8.2	Identify water storage capacity of that region.	<i>Short Term</i>
	3.8.3	Allocate water from existing gross national water availability to water storages that could help mitigate drought in these affected areas.	<i>Short Term</i>

<b>Strategy</b>	<b>3.9</b>	<b>Exploring the possibility of trans-boundary joint watershed management of catchment areas with neighboring countries.</b>	
<b>Actions</b>	3.9.1	Undertake a study to identify the potential environmental threats to the watershed and catchment areas of the rivers flowing into Pakistan.	<i>Short Term</i>
	3.9.2	Setup a regional river waters study group to assess the environmental impacts on trans-boundary watershed and catchment areas.	<i>Short Term</i>
	3.9.3	SAARC or Indus Water Commission forum be used to set up Joint Environment Management Group for joint water shed management through appropriate agreement.	<i>Short Term</i>

<b>Strategy</b>	<b>3.10</b>	<b>Safeguarding Pakistan's rights on trans-boundary water inflows according to international norms and conventions.</b>	
<b>Actions</b>	3.10.1	Identify the amount of water that could be diverted from existing river resource by regional nations due to increasing local demand.	<i>Medium Term</i>
	3.10.2	Identify the economic cost of such water diversion by neighbouring countries.	<i>Medium Term</i>
	3.10.3	Setup a task force on water, comprising relevant experts to study all relevant issues including international laws and convention to develop strategy to safeguard Pakistan's rights on trans-boundary water.	<i>Short Term</i>
	3.10.4	Setup a mutual interest council to identify the possibilities of water treaty between Afghanistan and Pakistan to ensure continued and sustained water availability in River Kabul.	<i>Medium Term</i>
	3.10.5	Setup another mutual interest council to identify and handle issues of post Indus Basin water Treaty (IBWT) between India and Pakistan in the light of emerging environmental and climate change concerns.	<i>Short Term</i>

<b>Strategy</b>	<b>3.11</b>	<b>Promoting integrated watershed management practices in uphill watersheds.</b>	
<b>Actions</b>	3.11.1	To identify the environmental threats to the uphill watershed and catchment areas of the rivers flowing in the plain regions of Pakistan.	<i>Short Term</i>
	3.11.2	Identify the technical possibilities like artificial glacial recharge to improve water quantity and quality.	<i>Short Term</i>
	3.11.3	Provide training to local community to identify sites and to manage artificial glacial recharge.	<i>Short Term</i>
	3.11.4	Ensure that the basic norms of watershed management are followed to protect erosion.	<i>Short Term</i>

### Implementing Institutions:

Ministry of Water and Power, Ministry of Food and Agriculture, Provincial/ State Irrigation Departments, Provincial/ State Agriculture Departments, Provincial water regulatory authorities, Indus River System Authority, Water & Power Development Authority, Pak.EPA/ Provincial EPAs, Urban Water Supply Departments, Town planning departments,

Municipal Authorities, Agriculture land management departments, Provincial/ State Livestock Departments, Forestry, rangeland and pastures departments, Fisheries departments, Pakistan Indus Water Commission, Ministry of Foreign Affairs, Provincial Social Welfare Departments.

**4.1.4. Objective 4: To develop and enforce required legislative and regulatory framework to protect water resources from climate change related vulnerabilities.**

Strategy	4.1	Legislating and Enforcing laws and regulations required for efficient water resource management, conservation and groundwater regulatory framework.	
Actions	4.1.1	Review all relevant existing legislation to identify deficiencies in relation to water conservation and management.	Priority
	4.1.2	Amend and enact new laws, wherever needed, to achieve effective water resources management in agriculture, domestic and industrial sectors.	Priority
	4.1.3	Ensure strict enforcement of laws regulating the groundwater exploitation.	Short Term
	4.1.4	Cap the subsidy given to agriculture tube wells and ban installation of new in most threatened aquifers in Balochistan.	Priority
	4.1.5	Effectively enforce all environmental laws, concerning water conservation and water protection, through provincial/ state EPAs.	Short Term
	4.1.6	Constitute environmental tribunals at district level covering water related issues.	Short Term
	4.1.7	Conduct review and harmonize existing legislations, polices and plans in water sector to include climate change adaptation and mitigation measures.	Short Term
	4.1.8	Bring all individual Water concerning laws in different sectors into a single section, called "Water Laws".	Medium Term

Strategy	4.2	Legislating and implementing the draft National Water Policy to address the water related vulnerabilities induced by climate change.	
Actions	4.2.1	Ensure that water related vulnerabilities induced by climate change are part of 'National Water Policy'.	Priority
	4.2.2	Ensure the expeditious approval of draft ' National Water Policy' and its implementation.	Priority

Strategy	4.3	Legislating and enforcing laws related to industrial and domestic waste management.	
Actions	4.3.1	Review the existing laws related to industrial and domestic waste management practices and update if needed to protect environment, in particular, water resources from further degradation.	Priority
	4.3.2	Identify Government Departments and Private Sector Organizations that will process solid and liquid industrial waste before it is mixed with existing water resources like lakes, rivers and aquifers.	Priority
	4.3.3	Identify local line departments that will legislate and enforce proper solid and liquid waste management laws.	Short Term
	4.3.4	Amend the relevant clauses of Pakistan Environment Protection Act regarding environmental degradation in the light of climate change realities.	Short Term

<b>Strategy</b>	<b>4.4</b>	<b>Declaring glaciated areas as ‘protected areas’ to protect HKH Glaciers.</b>	
<b>Actions</b>	4.4.1	Identifying the glaciated areas which are still not part of protected areas and ensure their inclusion.	<i>Priority</i>
	4.4.2	The National and Provincial line-departments to ensure proper management of Himalayan Glaciers by strictly enforcing the regulations meant for protected areas.	<i>Short Term</i>

### Implementing Institutions:

Ministry of Water and Power, Cabinet Division, Ministry of Law and Justice, Provincial Irrigation Department, Federal Flood Commission, AJK&GB Forest Department, Ministry of Food and Agriculture, Provincial Irrigation Departments, Provincial Agriculture Departments, Provincial water regulatory authorities, Indus River System Authority, Pak.EPA/ Provincial EPAs, Urban Water Supply Departments, Town planning departments, Agriculture land management departments, Provincial Livestock Departments, Forestry, rangeland and pastures departments, Fisheries departments, Municipal Authorities, City Development Authorities; KDA, CDA, LDA, PDA, WASA, Private sector waste transport and disposal contractors.

#### 4.1.5. Objective 5: To enhance capacity to manage the country’s hydrological system.

<b>Strategy</b>	<b>5.1</b>	<b>Preparing a comprehensive inventory of all water resources, including surface and ground water, in order to support an efficient water management system in the country.</b>	
<b>Actions</b>	5.1.1	Design provincial and regional plans for undertaking scientific studies for preparation of comprehensive inventory of all water resources in Pakistan to support an efficient water management system in the country.	<i>Priority</i>
	5.1.2	Prepare Water Statistics Handbook for Pakistan.	<i>Short Term</i>
	5.1.3	Ensure the availability and use of technologically advanced equipment and measurement techniques for preparation of comprehensive inventory of country’s surface and ground water resources, as the accuracy of this inventory is vital for future planning.	<i>Priority</i>
	5.1.4	Update the Indus Drainage Basin Atlas-2005 prepared by WAPDA and includes vulnerable water resources in the wake of climate change.	<i>Priority</i>

<b>Strategy</b>	<b>5.2</b>	<b>Strengthening the present hydrological network to monitor river flows and flood warning systems.</b>	
<b>Actions</b>	5.2.1	Initiate a complete assessment of the hydrological network to highlight any shortcomings in the monitoring of river flow changes and flood warning.	<i>Priority</i>
	5.2.2	Plan enhancement for the hydrological network monitoring system, based on this assessment.	<i>Short Term</i>
	5.2.3	Examine the options of trans-boundary hydrological data sharing on real time basis using WMO and UNESCO forums.	<i>Short Term</i>
	5.2.4	Upgrade the WAPDA’s snowmelt forecast system incorporating remote sensing and snowmelt modelling.	<i>Short Term</i>

<b>Strategy</b>	<b>5.3</b>	<b>Ensuring effective planning and management of irrigation water.</b>	
<b>Actions</b>	5.3.1	Strengthen the country wide river and stream gauges network for provision of real time water availability reading for the irrigation system to IRSA.	<i>Priority</i>
	5.3.2	Ensure to use this information for effective and transparent distribution of irrigation water among different provinces according to their share.	<i>Short Term</i>

<b>Strategy</b>	<b>5.4</b>	<b>Developing and extending technologies and techniques of domestic and drinking water saving as well as sea water utilization.</b>	
<b>Actions</b>	5.4.1	Introduce and popularize domestic and drinking water conservation techniques and technologies.	<i>Priority</i>
	5.4.2	The government line departments will ensure that new technologies and techniques for domestic water saving are made available in a cost effective way in all urban areas.	<i>Short Term</i>
	5.4.3	Setup institutional arrangements for developing and installing local sea water de-salinization plants in coastal urban areas to ensure ample water supply.	<i>Short Term</i>
	5.4.4	Promote installation of water meters to check the indiscriminate use of drinking water supplies.	<i>Short Term</i>
	5.4.5	Enforcement of the National Drinking Water Quality Standard.	<i>Short Term</i>
	5.4.6	Promote cost effective and appropriate technologies options for water supply systems	<i>Short Term</i>

<b>Strategy</b>	<b>5.5</b>	<b>Enhancing national capacities for monitoring temporal changes in glaciers, snow cover, and meteorological parameters.</b>	
<b>Actions</b>	5.5.1	Set-up and expand high-altitude meteorological observing stations to monitor the changing climatic parameters.	<i>Short Term</i>
	5.5.2	Strengthen remote sensing and GIS capabilities of SUPARCO, Pakistan Meteorological Department and WAPDA for monitoring temporal changes in glaciers and snow cover.	<i>Priority</i>
	5.5.3	Undertake study to prepare detailed and comprehensive inventory of glaciers in Pakistan using satellite imageries and develop institutional capacity for its regular updates.	<i>Priority</i>
	5.5.4	Carry out comprehensive mass balance studies of UIB glaciers.	<i>Priority</i>

### **Implementing Institutions:**

Provincial /State EPA, P&D Department AJK (Land Use Planning section) Ministry of Water and Power, IRSA, City Development Authorities, Municipal Authorities, Federal Flood Commission, Pakistan Meteorological Department, WAPDA, SUPARCO.

#### 4.1.6. Objective 6: To develop climate change resilient water infrastructure in the country and strengthen it according to the needs.

Strategy	6.1	Enhancing country's water storages capacities.	
<b>Actions</b>	6.1.1	Take measures to enhance the life of existing water storage particularly, Mangla and Tarbela dams.	Short Term
	6.1.2	Identify new potential dam sites in the country including AJK.	Short Term
	6.1.3	Undertake detailed seismic survey of these potential dam sites.	Short Term
	6.1.4	Ensure that these sites are not used for construction projects other than agriculture and forestry, to keep options open to develop new dams, should they be needed.	Short Term
	6.1.5	Undertake detail study to assess the country's need for additional water storage for irrigation and hydropower generation.	Priority
	6.1.6	Undertake detailed feasibility and design studies with cost estimates of the proposed new dams.	Short Term
	6.1.7	Identify the source of funding and ensure its availability to WAPDA for expeditious completion of on-going and future dam projects.	Priority

Strategy	6.2	Ensuring the early rehabilitation, remodeling and up-gradation of existing irrigation infrastructure in the country, which can sustain the climate change related expected extreme weather events.	
<b>Actions</b>	6.2.1	Assess the possibilities and range of expected extreme weather events.	Priority
	6.2.2	Assess the range and potential of the existing irrigation infrastructure to sustain these extreme events.	Short Term
	6.2.3	Re-model and up-grade existing irrigation infrastructures to the projected range of expected extreme weather events.	Medium Term
	6.2.4	Identify the sources of funding required for upgrading these infrastructures.	Priority
	6.2.5	Ensure the early rehabilitation of irrigation infrastructure in the country damaged during the floods in 2010.	Priority

Strategy	6.3	Developing infrastructure to harness the hill torrents potential.	
<b>Actions</b>	6.3.1	Identify the potential hill torrents sites and estimate the amount of hill torrents water that can be harnessed at each potential site.	Priority
	6.3.2	Undertake detailed analysis of socio-economic cost of constructing such infrastructure.	Short Term
	6.3.3	Identify the sources of funding and its timely availability for constructing infrastructure to harness the full potential of hill torrents.	Priority

#### Implementing Institutions:

Ministry of Water and Power, Hydel Board AJK, Water Resource Management Authority, Provincial Irrigation Departments, NESPAK, WAPDA.

## 5.0 AGRICULTURE AND LIVESTOCK: ADAPTATION ACTIONS

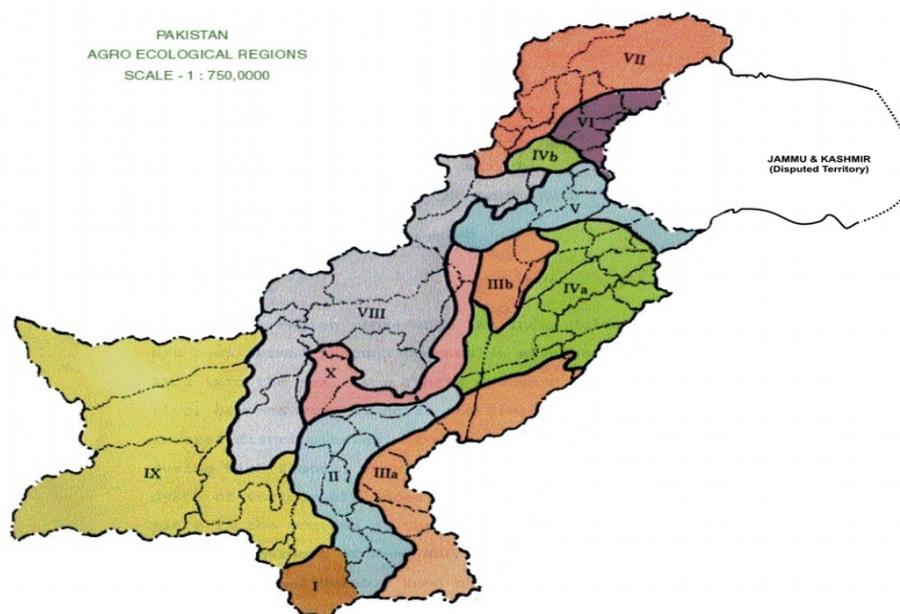
Agriculture is central to human survival and is probably the single human enterprise most vulnerable to change in climate. Agriculture sector is the life line and the single largest sector of Pakistan's economy. It contributes 21% to the GDP, employs 45% of the labour force and contributes about 70 % to the export earnings. Agriculture in Pakistan is greatly affected by short term climate variability and could be harmed significantly by long-term climate change.

### 5.1 Agro-Ecological Zones

Pakistan is a land of diverse ecologies. Starting with high mountains in the north, moving southwards there is the Pothwar plateau followed by the fertile Indus Plain. The western parts of the country mainly comprise Balochistan Plateau having high to low mountains. There are two sandy deserts; Thal desert and Thar Desert in the Indus Basin. The southernmost part of the country, Rann of Kutch is a marshy area.

The country is broadly divided into 10 agro-ecological zones based on physiographic, climate, soil type and agricultural land use (source PARC modified GCISC).

These regions are depicted in the map below:



(Source: NARC PARC, Islamabad)

I. Indus delta; II. Southern Irrigated plain; III. Sandy desert; IV. Northern irrigated Plain V. Barani( Rain feed areas); VI. Wet Mountains ; VII. Northern dry mountains; VIII. Western dry mountains; IX. Dry western Plateau; X. Sulaiman Piedmont.

Climatic parameters that influence agriculture include: temperature, rainfall, solar radiation, wind, soil & air moisture and carbon dioxide. Understanding of the functions of these parameters help us to appreciate the impact of climate change on agriculture and to devise appropriate adaptation and mitigation actions to reduce negative impacts.

### 5.2. Major Climate Change Concerns for Agriculture

It has been increasingly realized that climate change is the most important factor that is likely to affect productive resources and ultimately the agriculture production in a number of ways. These impacts include:

### 5.2.1. Shortening length of growing period:

The duration of crop growth cycle is related to temperature; an increase in temperature will speed up crop growth and shorten the duration between sowing and harvesting. This shortening could have an adverse effect on productivity of crops and fodder for livestock.

### 5.2.2. Changes in river flows:

The Indus River System gets about 80% water from the Hindu-Kush-Himalaya glaciers. Increasing atmospheric temperatures are expected to increase glacier melt. IPCC (2007) projected that glacier melt in Himalayas would cause increased rivers flows during the next few decades and then followed by decreased river flows, as the glaciers recede.

### 5.2.3. Increased crop evapotranspiration:

Increased atmospheric temperature would cause higher water evaporation from soil and from plant leaves. These higher evapotranspiration losses would mean that plants would need more water to maintain optimum growth.

### 5.2.4. Land Degradation:

The deterioration of productive agricultural land areas due to water logging and salinity is causing major threat to food security in the country. Soil erosion due to water and wind is universally recognised as a serious threat to productive agriculture land areas. Water and wind erosion is the direct consequence of climatic parameters of high-intensity rainfall, wind-velocity and higher temperatures. The northern mountainous region suffers from unfavourable soil and moisture regime, thereby causing soil erosion. Similarly arid regions of Punjab (Cholistan), Sindh (Tharparker) and Balochistan (Chaghi Desert and sandy coastal areas) are affected by wind-erosion.

### 5.2.5. Extreme Weather Events:

According to IPCC (2007), the frequency and intensity of extreme weather events, such as floods, heavy precipitation events, droughts, cyclones etc are expected to increase in future. Such extreme events can also affect food security.

### 5.2.6. Livestock Sector:

In Pakistan, livestock is an important sub-sector of agriculture and its share in the total agriculture GDP has shown a slow and gradual increase during last two decades. Currently, it contributes 12.0 percent to the total national GDP and 53.2 percent of agriculture value added. The role of livestock in the rural economy may be gauged from the fact that 30-35 million rural population is engaged in livestock raising and derive 37-40 percent of their income from it (Economic Survey 2009-10). Fishery is a sub-sector of livestock that also plays a significant role in the national economy and towards achieving food security.

Since the agriculture & livestock sector are heavily dependent on the vagaries of nature, it is highly vulnerable to climate change phenomena. Climate change will impact food security of the country mainly through reduced crop productivity, adverse impact on livestock health and increased agricultural production losses because of extreme weather events. This will necessitate the agriculture and livestock sectors, particularly in rain-fed areas, to adapt to these climatic changes. Since the agriculture sector is heavily dependent on the water sector, a number of adaptation actions identified in the preceding section are equally applicable to the agriculture sector and will generally not be repeated.

### 5.3.0. Objective 1: To build climate change resilience into Pakistan's agricultural system.

<b>Strategy</b>	<b>1.1</b>	<b>Developing a risk management system to safeguard against crop failures due to extreme climatic events e.g. floods and droughts.</b>	
<b>Actions</b>	<b>1.1.1</b>	Setup agricultural production surveillance system in various arid, semi arid and other vulnerable areas to categorize them according to their vulnerability to extreme climate change events.	<i>Priority</i>

1.1.2	Involve corporate sector, comprising of public and private insurance firms to build an agricultural production insurance system for agriculture sector of Pakistan, particularly focused on climate change related crop failures.	<i>Short Term</i>
1.1.3	Involve the farming community to manage the local risk identification process and the safeguard methods.	<i>Priority</i>
1.1.4	Develop and introduce research based drought resistance crop varieties.	<i>Short Term</i>
1.1.5	Set-up a programme for reclamation of denuded agriculture land.	<i>Medium Term</i>
1.1.6	Develop and provide quality seeds and planting material to farmers in Gilgit-Baltistan.	<i>Short Term</i>

<b>Strategy</b>	<b>1.2</b>	<b>Discouraging conversion of fertile agriculture land for purposes other than agriculture.</b>	
<b>Actions</b>	1.2.1	Make viable legislation to discourage the indiscriminate conversion of agriculture land for town planning.	<i>Short Term</i>
	1.2.2	Organize awareness campaign for the farmers and other relevant stakeholders regarding safe and efficient use of agriculture land.	<i>Priority</i>

<b>Strategy</b>	<b>1.3</b>	<b>Encouraging farmers, particularly in rain-fed areas, to avoid monoculture and plant a variety of heat and drought resistant crops, to reduce the risk of crop failure.</b>	
<b>Actions</b>	1.3.1	Identify vulnerable areas within the rain-fed agriculture systems that are prone to increasing heat and drought related failures of crops.	<i>Priority</i>
	1.3.2	Support agriculture research system to identify the cropping mix package that would be most suited to that area under new vulnerabilities.	<i>Short Term</i>
	1.3.3	Modify the local market and agriculture extension system to absorb the change in cropping patterns in the rain-fed areas.	<i>Short Term</i>
	1.3.4	Identify additional skills for farmers to supplement their incomes, reduced due to abandoning the monoculture planting systems.	<i>Short Term</i>
	1.3.5	Develop and introduce Short rotation crops and Hybrid maize.	<i>Short Term</i>
	1.3.6	Adopt integrated cropping method to avoid monoculture and to have varieties of crops particularly in Balochistan.	<i>Priority</i>
	1.3.7	Develop and introduce climate resilience late crop varieties in Balochistan	<i>Short Term</i>
	1.3.8	Introduce low delta crops, at large scale, in Balochistan.	<i>Short Term</i>

<b>Strategy</b>	<b>1.4</b>	<b>Encouraging farmers to adopt agriculture drought management practices as part of highly variable climate, rather than as unusual natural disaster.</b>	
<b>Actions</b>	1.4.1	Identify the drought vulnerable agricultural areas.	<i>Priority</i>
	1.4.2	Develop and introduce drought resistant crops.	<i>Short Term</i>

1.4.3	Develop localized plans for water storage and rain water harvesting for drought management.	<i>Short Term</i>
1.4.4	Involve the farming community to manage the reoccurring drought due to climatic variations.	<i>Medium Term</i>
1.4.5	Involve line departments to transfer innovative technologies for agricultural drought management to the vulnerable areas on pilot basis.	<i>Short Term</i>
1.4.6	Provide incentives for reuse of domestic and sewage water for kitchen gardening.	<i>Short Term</i>
1.4.7	Initiate a programme of land levelling and preparation of land sites for agriculture purposes in Balochistan.	<i>Priority</i>

<b>Strategy</b>	<b>1.5</b>	<b>Ensure the enabling financial environment to farmers to invest in and adopt the relevant technologies to overcome the climate related stresses.</b>	
<b>Actions</b>	1.5.1	Enhance the existing financial services for the farming community to cater to the technological innovation needed due to impending climate change related droughts.	<i>Medium Term</i>
	1.5.2	Make innovative technologies in agricultural irrigation readily available in the country and also financially viable.	<i>Short Term</i>
	1.5.3	Establish institutions that provide information to the farmers regarding finances available for technologies, equipments and new crops that will be needed in their regions due to climate change conditions.	<i>Short Term</i>
	1.5.4	Establish special financial grant mechanism for farmer's community in Balochistan.	<i>Priority</i>
	1.5.5	PTV may consider launching an "Agricultural TV channel" to transfer information and agriculture technology to farmers.	<i>Short Term</i>

<b>Strategy</b>	<b>1.6</b>	<b>Ensure availability of quality feed and fodder to livestock to supplement their grazing in the rangelands.</b>	
<b>Actions</b>	1.6.1	Classify the quality of fodder production and potential of rangelands for grazing in each of the provinces.	<i>Short Term</i>
	1.6.2	Provide information regarding the products that could supplement feed and fodder in these grazing lands for the livestock.	<i>Priority</i>
	1.6.3	Develop efficient transport system from feedstock locations to farm areas to provide these livestock feed and fodder supplement products.	<i>Short Term</i>
	1.6.4	Minimise livestock impact on vegetation and crops in view of climate change projected stresses.	<i>Short Term</i>
	1.6.5	Encourage farmers to grow mod gross and oats as fodder crops in mountainous areas of AJK & Gilgit-Baltistan.	<i>Priority</i>

### Implementing Institutions:

Pakistan Agriculture Research Council, National Agriculture Research Centre, Arid Agriculture University Rawalpindi, Provincial Agriculture Extension Department, Arid Agriculture Departments, Agriculture universities in all provinces,

Central Cotton Research Institute, Multan, Veterinary and Livestock Research Departments, Provincial Agriculture Research Institutions, Provincial Crops, Forestry, Livestock, Dairy Development, Fisheries and Irrigation Departments.

### 5.3.1. Objective 2: To enhance crop productivity through improved irrigation & land management techniques.

Strategy	2.1	Improving crop productivity by increasing the efficiency of various agricultural inputs, in particular the input of irrigation water.	
Actions	2.1.1	Research on innovative techniques in cropping patterns to enhance agricultural productivity under reduced water conditions.	Short Term
	2.1.2	Training of farmer community to promote water conservation techniques in drought prone areas.	Priority
	2.1.3	Promote contour farming in mountain areas.	Short Term
	2.1.4	Set-up pilot project for demonstration and introduction of high yielding crop varieties in Balochistan.	Priority
	2.1.5	Set-up pilot project for demonstration of water conservation techniques to the farmers of Balochistan.	Short Term
	2.1.6	Promote sustainable management of Irrigation water and rehabilitation of field water-courses through community participation.	Short Term
	2.1.7	Rehabilitation of salinity drainage infrastructure to reduce water logging and salinity etc.	Med Term
	2.1.8	Discourage traditional flood irrigation practices.	Med.Term

Strategy	2.2	Promoting energy efficient farm mechanization to increase yield, while conserving water and saving labor.	
Actions	2.2.1	Ensure systematic mechanization of farming production processes that are based on energy efficient equipment.	Medium Term
	2.2.2	Increase yields while conserving water, train farmers to adapt innovative techniques and equipments that are locally adjustable.	Short Term
	2.2.3	Invest in tools and equipments that increase yields while saving labour to convert to processing and other farming activities.	Medium Term
	2.2.4	Light weight agriculture machinery be developed and promoted in AJ&K and Gilgit-Baltistan.	Short Term

Strategy	2.3	Improving farm practices by adopting modern techniques.	
Actions	2.3.1	Research and introduction of modern and innovative techniques for farming systems.	Medium Term
	2.3.2	Ensure improvement in cropping patterns and crop diversification with optimized planting dates and laser land levelling for reduced irrigation water consumption.	Short Term

	2.3.3	Introduce inter cropping system (ally cropping) and soil conservation techniques.	<i>Short Term</i>
	2.3.4	Provide incentives to Gilgit-Balochistan's farmer for development of water channels, dairy sheds and market linkages.	<i>Short Term</i>
<b>Strategy</b>	<b>2.4</b>	<b>Promoting biotechnology in terms of more carbon responsive crops, improving breeds and production of livestock through genetic engineering and other relevant fields.</b>	
<b>Actions</b>	2.4.1	Enhance infrastructure to absorb biotechnology and genetic engineering for both crops and livestock to improve varieties and breeds, making them drought resistant.	<i>Medium Term</i>
	2.4.2	Genetically modified crops that are more carbon responsive to enhance productivity under increased GHGs conditions.	<i>Short Term</i>
	2.4.2	Establish Bio-technology Labs in live stock and crop sectors.	<i>Short Term</i>
	2.4.2	Undertake capacity development of concerned provincial institutions for introduction of carbon responses plants and crops.	<i>Short Term</i>
	2.4.2	Strengthen and undertake research in KPK through Agriculture University Peshawar, agriculture & environmental research institutions of KPK.	<i>Priority</i>

<b>Strategy</b>	<b>2.5</b>	<b>Promoting horizontal expansion of cultivated lands through development of wastelands and rainwater harvesting through involvement of local communities.</b>	
<b>Actions</b>	2.5.1	Develop scientific skills to identify cultivable wastelands in each province.	<i>Short Term</i>
	2.5.2	Train local communities to harvest rainwater in small ponds and dams.	<i>Priority</i>
	2.5.3	Raise financial sources for irrigation and rainwater dam infrastructure development.	<i>Medium Term</i>
	2.5.4	Involve local and international corporate sector in these cultivation land expansion projects.	<i>Short Term</i>
	2.5.5	Develop effective land use planning for agriculture sector in Punjab.	<i>Priority</i>
	2.5.6	Develop necessary legislations to discourage conversion of agricultural lands into non-agricultural purposes.	<i>Priority</i>

### **Implementing Institutions:**

Provincial Agriculture Extension Department, Pakistan Agriculture Research Council, National Agriculture Research Centre, Agriculture universities in all provinces, Provincial Irrigation Departments, Provincial Agricultural Departments, IRSA.

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

<b>Strategy</b>	<b>3.1</b>	<b>Developing models for assessment of climate change impacts on agricultural production systems in all agro-ecological zones.</b>	
<b>Actions</b>	3.1.1	Strengthen capacities of institutions to prepare digital simulation models of climate change impacting present and future agriculture production.	<i>Short Term</i>

3.1.2	Undertake assessment of climate change impacts on physical, chemical, nutritional and biological aspects of agricultural production systems in all agro-ecological zones.	<i>Priority</i>
3.1.3	Design detailed financial assessments of each of the physical, chemical and biological aspects of change in the agricultural production systems in all agro-ecological zones due to climate change.	<i>Short Term</i>
3.1.4	Undertake detailed study of existing agriculture product system and develop recommendations for productivity enhancement.	<i>Priority</i>
3.1.5	Undertake further strengthening of Plant Protection Department (PPD) particularly its activities in Balochistan.	<i>Short Term</i>
3.1.6	Support the relevant agriculture and livestock research projects of relevant research institutions and universities of KPK.	<i>Short Term</i>
3.1.7	Transform the Agriculture University Rawlakot into a Mountain Area Agriculture University with up-dated curriculum and research activities.	<i>Med. Term</i>

<b>Strategy</b>	<b>3.2</b>	<b>Developing new varieties of crops which are high yielding, and resistant to the anticipated impacts of climate change.</b>	
<b>Actions</b>	3.2.	Undertake research on crops that expected to be adversely affected by the climate change in various parts of Pakistan.	<i>Short Term</i>
	3.2.1	Initiate research to develop new varieties of crops that are less vulnerable to heat stress and are drought resistant.	<i>Priority</i>
	3.2.2	Develop new and hybrid climate change resistant crops that could survive both changes in temperature and precipitation, and still be high yielding, resistant to heat stress, drought tolerant, less vulnerable to heavy spells of rains, and less prone to insect-pests.	<i>Short Term</i>

<b>Strategy</b>	<b>3.3</b>	<b>Developing and introducing better breeds of livestock which have higher productivity and are less prone to the unavoidable impacts of climate change.</b>	
<b>Actions</b>	3.3.1	Develop livestock research capabilities of research institutions and universities based on projected changes in climatic conditions.	<i>Short Term</i>
	3.3.2	Improve veterinary facilities at grass root level to prepare for any livestock epidemics.	<i>Priority</i>
	3.3.3	Initiate research on developing new breeds of livestock that are less prone to heat stress and more droughts tolerant.	<i>Medium Term</i>
	3.3.4	Initiate research on local livestock species-breed improvements especially of sheep, and introduction of new foreign breeds either should be discouraged or linked to stringent tests and trials.	<i>Medium Term</i>
	3.3.5	Establish agriculture, livestock and poultry research institute in AJ&K.	<i>Short Term</i>
	3.3.6	Develop capacity to use "Embryo Transfer Technology" to enhance livestock reproduction.	<i>Priority</i>

3.3.7	Develop improved livestock breeds suitable for mountainous areas of Gilgit-Baltistan, KPK and provide incentives to local communities for its adaptation.	<i>Short Term</i>
3.3.8	Develop and introduce disease resistant fish species and promote public-private partnership for development of new fish farms in Gilgit-Baltistan.	<i>Short Term</i>

<b>Strategy</b>	<b>3.4</b>	<b>Developing quality datasets on crop, soil and climate-related parameters to facilitate research work on climate change impact assessment and productivity projection studies.</b>	
<b>Actions</b>	3.4.1	Develop capacities of Bureau of Statistics, PARC, PMD and other database institutions to compile information on crop, soil and climate related parameters for different aspects of agricultural production systems in all agro-ecological zones.	<i>Short Term</i>
	3.4.2	Strengthen research facilities at selected agriculture research institutions on climate change impact assessment and agricultural productivity projection studies.	<i>Short Term</i>
	3.4.3	Undertake detail soil and ground water quality studies in AJK.	<i>Priority</i>
	3.4.4	Enhance the present limited capacity of institutions in Balochistan to promote tissue culture.	<i>Short Term</i>

<b>Strategy</b>	<b>3.5</b>	<b>Enhancing research capacity of relevant organizations to make reliable climate change projections to assess the corresponding likely impacts on various agriculture products and develop appropriate adaptation measures.</b>	
<b>Actions</b>	3.5.1	Develop reliable high resolution local level climate change scenarios.	<i>Priority</i>
	3.5.2	Develop adaptation measures well suited for each agro-ecological zone and for all agricultural production systems based on above scenarios.	<i>Short Term</i>
	3.5.3	Establish close coordination mechanism among concerned agricultural organizations and meteorological department at district level for benefiting from reliable weather and climate predictions.	<i>Priority</i>
	3.5.4	Set-up climate change adaption and mitigation cells in the departments of agriculture, livestock and EPA of the AJK.	<i>Short Term</i>
	3.5.5	Establish close collaboration between academic and research organizations/institutions in Balochistan particularly dealing in agricultural areas.	<i>Short Term</i>

<b>Strategy</b>	<b>3.6</b>	<b>Developing “Remote Sensing and GIS techniques” capacity to assess temporal land cover changes.</b>	
<b>Actions</b>	3.6.1	Develop remote sensing and GIS related capacities of agriculture research institutions and universities.	<i>Priority</i>
	3.6.2	Undertake research to identify major temporal changes that have been taking place in all agro-ecological zones of Pakistan.	<i>Priority</i>
	3.6.3	Upgrade the GIS laboratories of planning & development and forestry departments; and set-up such facilities in crops and livestock departments in AJK.	<i>Short Term</i>

3.6.4	Undertake remote sensing mapping of existing and future land use planning in Balochistan.	Short Term
3.6.5	Establish GIS laboratory for relevant sectors in Balochistan.	Short Term

Strategy	3.7	Improving nutritional quality of livestock feed.	
<b>Actions</b>	3.7.1	At the farm level improve livestock feed quality by preparing supplements of Multi-Nutrient Blocks (MNB) prepared from urea, molasses, vitamins and minerals.	Priority
	3.7.2	Design program to involve local communities and corporate sector to develop MNB locally or as near the rangelands as possible.	Short Term
	3.7.3	Provincial agriculture research organization and universities to supervise livestock feed and fodder production enhancement activities.	Short Term
	3.7.4	Encourage and assist farmers to develop cost-effective livestock feed through "Silage Making" techniques and by using "Urea Treatment" from maize, rice and wheat low quality roughages.	Priority
	3.7.5	Develop and improve rangelands through community participation.	Short Term

### Implementing Institutions:

PARC, NARC, PMD, Arid Agriculture University Rawalpindi, Agriculture University Peshawar, Arid Agriculture Departments, Agriculture universities in all provinces, Central Cotton Research Institute, Multan, Veterinary and Livestock Research Departments, Bureau of Statistics and other data collection agencies, Provincial Agriculture Research Institutions, Provincial Crops, Forestry, Livestock, Dairy Development, Fisheries and Irrigation Departments, Provincial EPAs and GCISC.

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

Strategy	4.1	Establishing Climate Change units in agriculture research organizations to devise adaptive strategies for projected impacts of climate change on agriculture.	
<b>Actions</b>	4.1.1	Establish climate change units or centres at agriculture research organizations.	Short Term
	4.1.2	Establish meteorological and cropping information hubs at provincial level.	Priority
	4.1.3	Streamline information flow through agriculture extension services for climatic conditions and related cropping from these organizations.	Priority
	4.1.4	Undertake awareness campaign among all stakeholders to give due importance to climate change's impact on agriculture.	Short Term
	4.1.5	Involve farmers in policy formulation and strategic dialogues.	Priority
	4.1.6	Conduct review and harmonize existing legislations, polices and plans in agriculture sector to include climate change adaptation and mitigation measures.	Priority

<b>Strategy</b>	<b>4.2</b>	<b>Promoting feed conservation techniques and fodder banks in the arable areas.</b>	
<b>Actions</b>	4.2.1	Introduce innovative technologies to enhance livestock production in the arable areas in each province.	<i>Medium Term</i>
	4.2.2	Involve corporate sector in promotion of feed conservation techniques and fodder banks for the dairy and poultry sectors.	<i>Short Term</i>
	4.2.3	Set-up poultry feed production unit in AJ&K.	<i>Priority</i>

<b>Strategy</b>	<b>4.3</b>	<b>Enhancing the capacity of the farming community to take advantage of scientific findings of the relevant research organizations.</b>	
<b>Actions</b>	4.3.1	Establish community organizations at village/ town levels to ensure imparting them scientific knowledge.	<i>Short Term</i>
	4.3.2	Build a process to communicate the scientific findings to the farming community in easy to understand mode.	<i>Priority</i>
	4.3.3	Arrange awareness material, campaigns and exposure workshops in all provinces particularly in Balochistan for Information dissemination to farmers about climate change threats.	<i>Priority</i>
	4.3.4	Undertake awareness raising and capacity building of farmer's communities to understand the natural phenomenon of climate change.	<i>Priority</i>

<b>Strategy</b>	<b>4.4</b>	<b>Improving the extension system to allow effective and timely communication of weather, climatic predictions and corresponding agro advices.</b>	
<b>Actions</b>	4.4.1	Develop communication hubs for translation of weather and climatic information in local language for the farming community at village and Tehsil level.	<i>Priority</i>
	4.4.2	Develop efficient agriculture extension system for establishing an effective communication among farmers and relevant government departments.	<i>Short Term</i>
	4.4.3	Develop effective communication strategy for dissemination of timely weather information to farmers through electronic and print media.	<i>Priority</i>

### **Implementing Institutions:**

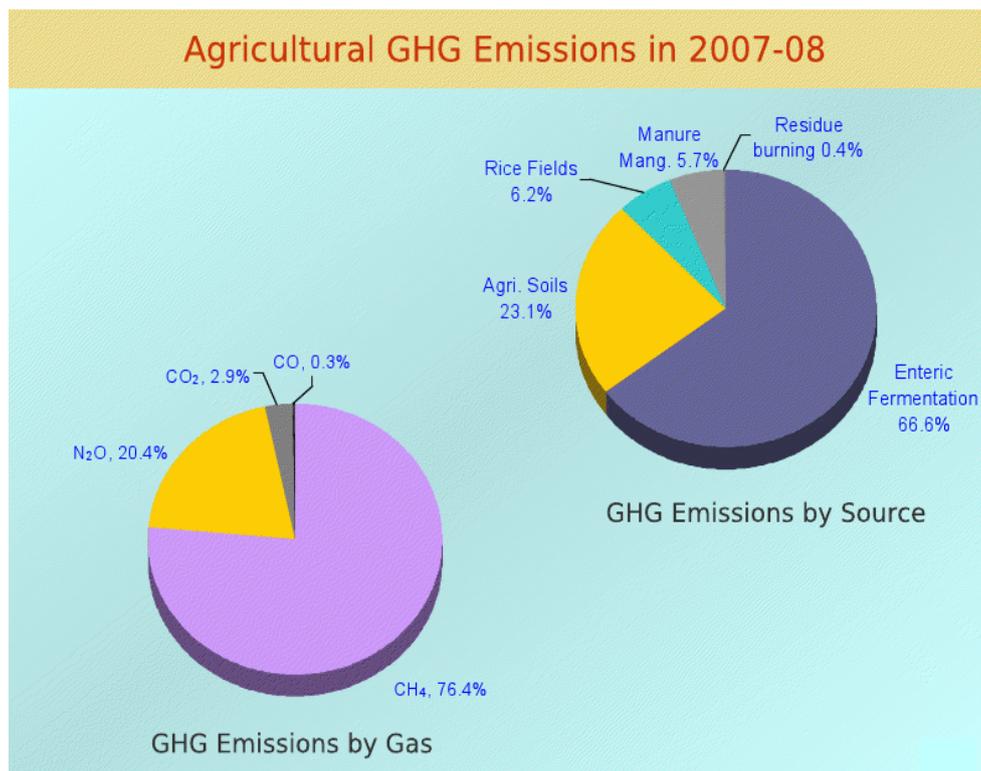
Provincial Agriculture Extension Department, PMD, PTV, PID, Radio Pakistan, Electronic & Print Media, PARC, GCISC, Agriculture universities in all provinces, National Agriculture Research Centre, Central Cotton Research Institute, Multan, Veterinary and Livestock Research Departments, Provincial Agriculture Research Institutions, Provincial Crops, Forestry, Livestock, Dairy Development, Fisheries and Irrigation Departments, Agriculture Research & Extension Services Management Academy.

## 6.0. AGRICULTURE & LIVESTOCK: MITIGATION ACTIONS

### 6.1. GHG Emissions from Agriculture & Livestock:

GHG emissions from agriculture and livestock sectors accounted for about 39% of Pakistan’s total GHG emissions in 2008. These emissions are essentially all Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O), 79%, and 21% respectively and originated mainly from four sub-sectors: 1) Enteric fermentation in cattle (all in the form of Methane), 2) Rice cultivation, 3) Releases of Nitrous Oxide from agricultural soils/ Nitrous Fertilizer, and 4) Manure management.

During 1994-2008 GHG emissions from agriculture and livestock in Pakistan grew at the rate of about 3% per annum (source: National GHG inventory 2008). There is a pressing need to find ways to contain these emissions or at least to slow down their growth rate. These efforts will require technological innovations and financial resources and for that Pakistan would need the support of the International community. To mitigate and minimize GHG emissions from agriculture and livestock sectors the Framework for Implementation of NCCP prescribes many measures.



(Source: National GHG Inventory 2008)

#### 6.1.1. Objective 1: To reduce greenhouse gas emissions from agriculture and livestock sector.

Strategy	1.1	Reducing greenhouse gas emissions through improved management and techniques in agriculture and livestock sector.	
Actions	1.1.1	Develop and promote best management practices for methane and nitrogen management in agriculture and livestock sector.	Priority
	1.1.2	Promote optimum use of chemical fertilizer and pesticides for achieving mitigation goals.	Short Term
	1.1.3	Arrange pest management training programmes for farmers.	Short Term
	1.1.4	Develop best practices of tillage and soil management that improve soil carbon storage.	Short Term

	1.1.5	Develop and introduce improved water management in rice paddy to control release of methane from agriculture soils.	Medium Term
	1.1.6	Introduce low water dependent rice varieties.	Priority
	1.1.7	Promote use of green manure in agriculture.	Priority
	1.1.8	Identify and promote better manure storage & management practices.	Priority
	1.1.9	Set-up system to control the illegal import of pesticides and for applying quarantine measures at dry/ sea ports particularly in Balochistan.	Short Term
	1.1.10	Proper disposal of obsolete pesticides/chemicals in Balochistan be ensured.	Priority
	1.1.11	Improve energy use efficiency in agriculture sector to reduce carbon emissions.	Short Term
	1.1.12	Develop and introduces low water dependent rice varieties.	Medium Term
	1.1.13	Develop efficient bio-gas and manure digester for methane reduction and energy production.	Short Term
	1.1.14	Undertake extensive review of existing research about mitigation option in agricultural sector to assess the value of investment in these programs.	Priority
	1.1.15	Under take detailed study to assess the possible threat of cultivation of bio-fuel crops on country's food security.	Short Term
	1.1.16	Initiate cultivation of bio-fuel crops on limited pilot scale to assess its viability.	Priority
	1.1.17	Develop and introduce appropriate feedstock mixes and additives to reduce methane production from enteric fermentation/ digestion in cattle.	Short Term
<b>Strategy</b>	<b>2.2</b>	<b>Develop climate model to predict climate change impact on agricultural activities at local scale.</b>	
<b>Actions</b>	2.2.1	Develop Institutional capacity of GCISC and other relevant organisations to run climate models for developing future climate projections.	Priority
	2.2.2	Down scale the output of regional climate models to the scale relevant to farmers and local planners.	Short Term
	2.2.3	Use these climate change scenarios for informed decision making in agriculture and livestock sector.	Priority
	2.2.4	Set-up Climate Change Research Department in Agriculture University Rawlakot.	Short Term

### Implementing Institutions:

Provincial Agriculture Extension Department, Pakistan Meteorological department, PTV, PID, Radio Pakistan, FM Radio stations, Electronic & Print Media, Arid Agriculture University Rawalpindi, Agriculture University Peshawar, Arid Agriculture Departments, Pakistan Agriculture Research Council, National Agriculture Research Centre, Islamabad, Agriculture universities in all provinces, Central Cotton Research Institute, Multan, Veterinary and Livestock Research Departments, Bureau of Statistics and other data collection agencies, Provincial Agriculture Research Institutions, Provincial Crops, Forestry, Livestock, Dairy Development, Fisheries and Irrigation Departments, Agriculture Research & Extension Services Management Academy.

## 7.0. FORESTRY SECTOR: ADAPTATION ACTIONS

Pakistan is a country with one of the lowest forest cover in the world, which is mainly due to the arid and semi-arid climate in most parts of the country. It has 0.03 ha of forest per capita compared to the global average of one ha (FSMP). According to the Forestry Sector Master Plan (FSMP-1992), natural forests in the country consisted of 4.2 million ha (4.8%), irrigated plantations occupied 103,000 ha (0.11%) while rangelands covered 28.50 million ha (32.40%) out of the total land area (87.98 million ha) of Pakistan. Unfortunately, no recent studies or surveys have been undertaken so as to exactly determine the current forest cover in the country. Detailed studies however of the Food & Agriculture Organization of the United Nations (FAO) in 2007 recorded that the total area under forests in the country was 4.34 million ha (5%) out of which 3.44 million ha were state owned while the tree cover on farmlands and in private forests was 0.78 million ha (0.88%). Furthered by the increased rate of deforestation, the country's forest cover is alarmingly on the verge of disappearance. FAO in 2007 indicated that on average an area of 31,658 ha (-0.75%) of natural forests is cleared or deforested each year in Pakistan.

The forests of Pakistan reflect great physiographic, climatic and edaphic contrasts in the country. Most of the literatures including the 'Asia-Pacific Forestry Sector Outlook Study Working Paper' (Pakistan's Country Report by FAO) explain the following main forest types found in the country.

### **7.0.1. Littoral And Swamp Forests:**

These are more or less gregarious forests which means they grow in open clusters or colonies of low height. They occur in the Arabian Sea around the coast of Karachi and Pasni in Balochistan. According to latest estimates, these forests cover an area of 207,000 ha.

### **7.0.2. Tropical Dry Deciduous Forests:**

These are forests of low or moderate height consisting almost entirely of deciduous species. These types of forests do not occur extensively in Pakistan but are limited to areas in the Rawalpindi foothills.

### **7.0.3. Tropical Thorn Forests:**

These are low, open and pronouncedly xerophytic forests in which thorny leguminous species predominate. This type occupies the whole of the Indus plain in Pakistan except the driest parts. Characteristic pioneer vegetation is developed on inland sand dunes and the semi-deserts of the areas of least rainfall. On the basis of climax vegetation, the whole Indus basin plain with the exception of parts of the districts of Sialkot, Gujrat and Jehlum, consists of tropical thorn forests. Prior to development of irrigation, agriculture and urbanization, the area extended from the foothills of the Himalayas and low-hills in the south-west Punjab plains and Balochistan to the Arabian Sea. They grow on a wide range of soil textures, from flat deep alluvial soils to heavy clays, loams and sandy loams. The climate varies from semi-arid (250 to 750 mm rainfall) to arid (less than 250 mm rainfall). The summer temperature in this tract is as high as 50°C. Unlike in the past, these forests now grow in the form of patches over an area of 173,000 ha. Irrigated agriculture is carried over 18.668 million ha and irrigated tree plantations over an area of 103,000 ha in this tract.

### **7.0.4. Sub-tropical Broad-leaved Evergreen Forests:**

These are xerophytic forests of thorny and small leafed evergreen species. This type occurs on the foothills and lower slopes of the Himalayas, the Salt Range, Kalachitta and the Sulaiman Range. Total area of these forests is estimated to be 1,191,000 ha.

### **7.0.5. Sub-tropical Pine Forests:**

These types of forests are open and very prone to fires with a dry evergreen shrub layer and little underwood. This type consists of Chir pine (*Pinus roxburghii*) forests found between 900 m and 1700 m elevation in the Western Himalaya within the range of the south-west summer monsoon. It is the only pine of these forests though there is a small overlap with *Pinus wallichiana* (Kail, Biar) at the upper limit. Mountainous areas of Swat, Dir, Chitral and Murree hills are mostly (at its specific elevation) occupied by these types of forests.

### **7.0.6. Himalayan Moist Temperate Forests:**

These forests occur between 1500 m and 3000 m elevation in the Western Himalayas except where rainfall fall is below 1000 mm in the inner ranges, especially in the extreme north-west. These forests are divided into a lower and an upper zone each with particular tree type species. There may be pockets of deciduous broad-leaved trees, mainly edaphically conditioned, in both the zones.

### **7.0.7. Himalayan Dry Temperate Forests:**

These are open evergreen forest with open scrub undergrowth. Both coniferous and broad-leaved species are present. They are found in the inner ranges throughout their length and are mainly represented in the north-west. This type is mostly represented in dry parts of Balochistan and Gilgit.

### **7.0.8. Sub-alpine Forests:**

This type consists mainly of evergreen conifers and evergreen broad-leaved trees. The type occurs throughout the Himalayas from about 3,350 m to the timber limit (above which no woody vegetation is found).

### **7.0.9. Alpine Scrub:**

Vegetation under this type includes shrubs of 1-2 m height extending 150 m or more above the sub-alpine forests. They are mostly found in the alpine pastures of Khyber Pukhtoonkhwa and AJK.

## **7.1. Threats of climate change to the forests in Pakistan**

Generally most of the forests in Pakistan are prone to the threats of changing climate in the form of changes in species composition, disease and insect attacks, more frequent forest fires, and shifting habitats due to unfavorable climatic conditions. Further research is required to investigate the real and specific climate change threats to each forest type so as to undertake realistic adaptation measures.

The Framework for Implementation of NCCP for forestry sector in Pakistan outlines a coordinated response to the threats of climate change. The Framework for Implementation of NCCP for adaptation identifies strategies for direct actions and partnerships that is sought to increase the resilience and reduce vulnerability of the forestry sector and the forest communities in the country. The Framework for Implementation is designed to complement the National Climate Change Policy with the following objectives and strategies:

### **7.1.1. Objective 1: To improve the understanding of forests and climate relationship through enhanced scientific research.**

Strategy	1.1	Addressing the essential knowledge gap about climate change impact on Pakistan's forests through research on forest adaptation.	
Actions	1.1.1	Initiate immediate collaboration with national and international research institutions (such as CIFOR <sup>1</sup> , IIASA <sup>2</sup> and other renown international research bodies); and organize research projects on species vulnerable to climate change in all natural forests located in various ecological zones of Pakistan.	Short Term
	1.1.2	Undertake 'forest ecosystem' based research and map out ecosystems of high and low resilience to climate change.	Short Term
	1.1.3	Commence research on species and climate change interactions in the most vulnerable forest types.	Short Term

<sup>1</sup> CIFOR: Centre for International Forest Research, Indonesia.

<sup>2</sup> IIASA: International Institute for Applied Systems Analysis, Austria.

1.1.4	Organize research projects on response of various forest types to increased temperature and drought spells.	<i>Short Term</i>
1.1.5	Undertake research on forest pathology and entomology in the vulnerable forest types/ areas to control insect and disease outbreaks.	<i>Short Term</i>
1.1.6	Initiate studies on forest management systems to explore new tools and adaptation options for managing forest areas in wake of climate change.	<i>Medium Term</i>
1.1.7	Include forest pathology, entomology, water management, watershed management, flood risk management, soil conservation and other interrelated disciplines as integrated part of forestry research programs depending on the research objective(s).	<i>Medium Term</i>
1.1.8	Develop an appropriate 'Risk Management Framework' and include the research findings into it and good practice guidance.	<i>Medium Term</i>

### Implementing Institutions:

Pakistan Forest Institute, Provincial Wildlife Departments, Provincial Planning and Development Departments, Relevant Education & Research Institutions, Office of the Inspector General of Forests (IGF), Provincial Environment Ministries/ EPAs, Proposed Federal Commission on Climate Change, Provincial Forest Departments, Academia

### 7.1.2. Objective 2: To minimize the damages and to increase resilience of forest ecosystems

Strategy	2.1	Taking appropriate measures to adapt to the projected adverse impacts of climate change and increase ecological resilience of forest ecosystems.	
<b>Actions</b>	2.1.1	Based on conservancy approach, identify important forest fragments and connect them to provide natural migration corridors for plant and wildlife species for important ecosystem functions.	<i>Short to Med. Term</i>
	2.1.2	Take Forest protection measures to reduce the damage from forest fires.	<i>Priority</i>
	2.1.3	Promote the use of indigenous and locally adapted plants.	<i>Priority</i>
	2.1.4	Identify appropriate forest management practices to address the likely impacts of climate change based on scientific research.	<i>Medium Term</i>
	2.1.5	Initiate demonstration projects, in line with the research findings, on area and species specific appropriate silvicultural systems to minimize damages caused by forest pathogens and insect pests.	<i>Short to Med. Term</i>
	2.1.6	On the pattern of forest landscape restoration approach, design and implement soil conservation and slope stabilization programs for fragile watershed areas by applying bioengineering and biological techniques.	<i>Priority</i>
	2.1.7	Enhance forest cover on uphill watershed areas through rapid afforestation and reforestation measures on account of increased intensity of rainfall and flood risks.	<i>Priority</i>
	2.1.8	Measures to adopt forestry practices in wake of increased temperature and droughts in accordance with the research findings.	<i>Short Term</i>
	2.1.9	Promote the role of GIS/ RS techniques in mapping climate change prone forests, monitoring and implementation of ecosystem based adaptation.	<i>Priority</i>

### Implementing Institutions:

Provincial Forest Departments, Provincial Planning and Development Departments, Provincial Wildlife Departments, Provincial Departments, EPAs, Pakistan Forest Institute,

### 7.1.3 Objective 3: To improve governance and management of forests in Pakistan to acclimatize to the impact of the changing climate.

Strategy	3.1	Promoting best practices of Sustainable Forest Management (SFM) via setting appropriate Criteria and Indicators (C&I) to ensure the social and environmental values and services from forests.	
Actions	3.1.1	Develop and implement criteria and indicators to clearly define SFM; prepare manuals and guidelines to monitor progress towards it.	Short Term
	3.1.2	Develop and put into practice appropriate forest legislation, regulation and incentives to promote sustainable management of forests.	Medium Term
	3.1.3	Seek policy advice from experts and international bodies (such as FAO) through institutional and technical capacity building.	Priority
	3.1.4	Set up pilot projects, with participation of the forest dependent communities, to demonstrate and compile best practices of SFM in all forest types of Pakistan.	Priority
	3.1.5	Facilitate dissemination of best practices and exchange of experiences particularly with the forest communities and civil society organizations through networking, workshops, seminars, exposure visits.	Priority
	3.1.6	Capacity building of the relevant institutions for preparedness to address emergency situations in forests caused by natural disasters or adverse effects of human activities, e.g. forest fires, pathogens and storms.	Short Term
	3.1.7	Initiate specific projects and programs to promote sustainable use of non timber forest produce (NTFP) with greater participation of the local communities with particular focus on livelihood improvement.	Priority
	3.1.8	Bring all forest areas, either state owned or community owned, under certain management regime based on the principles of SFM.	Short Term
	3.1.9	Integrate land use planning and community participation in managing forest lands.	Priority
	3.1.10	Recognize the role of indigenous knowledge and give it due consideration while managing forest and other natural resources with participation of the local communities.	Short Term
	3.1.11	Institutional strengthening and re-organization of provincial forest departments to form manageable forest management units.	Medium Term
	3.1.12	Organize refresher courses for lower staff of the forest departments to pace with the recent developments.	Priority
	3.1.13	Take appropriate measures to stop encroachment of the forest areas in the country.	Priority
	3.1.14	Minimize revenue generation focus from the existing forests and put more focus on ecological values.	Priority
	3.1.15	Define jurisdiction for <i>shamilat</i> and <i>guzara</i> forests and manage them involving the local communities to restore the depleted forest fragments.	Short Term

3.1.16	Put emphasis on 'self sustenance' use of forest resources for the local communities.	Short Term
3.1.17	Ensure in time 'sanctioned water' availability to the irrigated plantation.	Priority
3.1.18	Provide economic incentives for forest guards, foresters and RFOs.	Priority

### Implementing Institutions:

Provincial Forest Departments, Provincial Wildlife Departments, Provincial Environment Departments, EPAs, Pakistan Forest Institute, Office of the Inspector General of Forests (IGF), Proposed Federal Commission on Climate Change, Civil Society Organizations, Community Based Organizations.

### ***7.1.4. Objective 4: To intensify mass awareness and build capacities of institutions and professionals on climate change adaptation.***

Strategy	4.1	Raising awareness among general public, forest communities and enhancing capacities of forest professionals on forestry and climate change adaptation.	
<b>Actions</b>	4.1.1	Develop joint programs in partnership with civil society to show up the role of forests particularly among the forest dependent communities and students in tackling climate change.	Priority
	4.1.2	Launch nationwide campaign for sensitization of the general public via print and electronic media to highlight the importance of forest ecosystem and biological diversity.	Priority
	4.1.3	Establish 'Communication' wings in the relevant ministries at national, provincial and local levels.	Short Term
	4.1.4	Enhance dissemination of appropriate information on forestry and climate change in Pakistan through the proposed 'Information Communication' wings.	Short Term
	4.1.5	Develop curricula on forest ecosystem, biodiversity and their relevance to climate change and introduce them at all levels of schooling.	Short Term
	4.1.6	Regularly monitor the public awareness of forestry's role in helping combat climate change through public opinion's surveys.	Short Term
	4.1.7	Develop and promote 'Forest and Climate' expert groups at national and provincial levels to deliver newer ideas and information to public, forest communities and professional foresters based on latest research in forestry and climate change.	Short Term
	4.1.8	Arrange workshops and seminars for forest professionals and managers to widen up their professional horizons on green issues related climate change.	Priority
	4.1.9	Organize capacity building and educational opportunities for forest professionals on interconnectedness of forestry and climate change.	Short Term
	4.1.10	Promote forestry's role in tackling climate change through engagement with appropriate government, sectoral and cross-sectoral forums.	Priority
	4.1.11	Sensitize politicians and provide advice to Parliamentarians (ministers, senators, members of national and provincial assemblies) and other key government personnel on forestry-related aspects of the National Climate Change Policy.	Priority

### Implementing Institutions:

P&D Departments (Federal/ Provincial), Proposed Federal Commission on Climate Change, Provincial Forest Departments, Provincial Wildlife Departments, Education Departments, Ministry of Science and Technology, Pakistan Centre of Philanthropy, Pakistan Forest Institute, Planning Commission of Pakistan, Ministry of Environment (Federal/ Provincial), Ministry of Information and Telecommunication, Ministry of Education (Federal/ Provincial), Federal and Provincial text book boards, Non Government Organizations, Print and Electronic Media.

## 8.0 FORESTRY SECTOR: MITIGATION ACTIONS

Climate change and forests are essentially linked with each other. According to the Food and Agriculture Organization of the United Nations (FAO), better forest management can play a key role in dealing with climate change. Forest trees trap and store carbon dioxide, playing a major role in mitigating climate change. Contrarily, when these forests are cut down or destroyed and burned, they can become sources of carbon dioxide (CO<sub>2</sub>), the major greenhouse gas considerably responsible for climate change. Forests could be better used in combating climate change. This can be achieved by preventing forests from being cut down and through afforestation and reforestation of non-forested forested lands. The FAO and other experts have estimated that global carbon retention that could result from reduced deforestation, increased forest re-growth and more agro-forestry and plantations could make up for about 15 percent of carbon emissions from fossil fuels over the next 50 years.

Pakistan’s forests, if not cut down and managed sustainably, can equally contribute to combat climate change by absorbing enormous amounts of CO<sub>2</sub>. Such objectives can be achieved through devising appropriate strategies and frameworks with assistance from the international community. Reducing Emissions from Deforestation and Forest Degradation in developing countries (REDD) is an opportunity offered by the UNFCCC platform providing incentives to developing nations for saving their forests and use them as ‘sinks’ to absorb atmospheric CO<sub>2</sub>. This document suggests actions to plan a framework, sketch REDD strategy and work out the CDM (A/R) to effectively shape the process and programming of the mentioned mechanisms in Pakistan.

### 8.1. Objective 1: To build institutional and professional capacities for development and implementation of REDD plus and A/R CDM mechanisms.

<b>Strategy</b>	<b>1.1</b>	<b>Building capacities of national institutions, provincial forest departments and other stakeholders for effective development and implementation of innovative mechanisms aiming at avoiding deforestation and enhancing forest carbon stocks.</b>	
<b>Actions</b>	1.1.1	Designate national and provincial focal institutions for steering, coordination and implementation of the REDD plus mechanisms and CDM processes.	<i>Priority</i>
	1.1.2	Develop strategy for establishing regulatory, governance and law enforcement framework for REDD mechanisms in consultation with all stakeholders including communities depending on forests for their livelihoods.	<i>Short Term</i>
	1.1.3	Establish linkages with national and international entities, (especially the UN-REDD program, World Bank’s Forest Carbon Partnership Fund- FCPF, Forest Investment Program- FIP; Australia’s International Forest Carbon Initiative; and Norway’s International Climate and Forest Initiative) for technical and financial assistance to initiate programs and pilot projects on CDM and REDD plus in various phases.	<i>Priority</i>
	1.1.4	Make institutional and legislative arrangements to clearly define the rights on carbon stored in the forests.	<i>Short Term</i>

1.1.5	Organize training workshops and seminars for forest professionals and forest dependent communities on “Free, Prior and Informed Consent” (FPIC) taking on board all the relevant stakeholders to avoid future conflicts and disagreements.	Priority
1.1.6	Develop and enhance national capacity for assessing existing forest carbon stocks, monitoring and accounting capacity in accordance with globally accepted Monitoring, Reporting and Verification (MRV) system for REDD plus projects.	Priority
1.1.7	Build capacities of provincial forest department personnel in ‘Reduced Impact Logging’ (RIL) to minimize damages to forest trees and soil thus so as to save the future carbon stocks.	Short Term
1.1.8	Organize training events to enhance national capacity on taking a lead role in the negotiation processes under UNFCCC to include incentives for REDD plus in post-2012 legally binding climate change agreement in the national interest.	Priority
1.1.9	Provide trainings to professional foresters and staff of provincial forest departments on developing documentation for CDM and REDD plus projects.	Priority
1.1.10	Develop and disseminate manuals and guidelines for target audience including forest dependent communities and civil society on REDD plus and CDM projects.	Priority
1.1.11	Integrate climate change as a compulsory part of forestry education system with particular emphasis on understanding the concepts of REDD plus and CDM mechanisms.	Short Term

### Implementing Institutions:

Planning Commission of Pakistan, Office of the Inspector General of Forests (IGF), Proposed Federal Commission on Climate Change, Ministry of Foreign Affairs, Federal Ministry of Disaster Management, Provincial Forest Departments, Provincial Environment Departments, Pakistan Forest Institute, Civil Society Organizations.

### 8.2. Objective 2: To restore, conserve and enhance forest carbon sinks and minimize carbon loss from the existing forests.

Strategy	2.1	Developing and implementing mechanisms to avoid deforestation, reduce carbon emissions and enhance forests’ capability to sequester more emissions from the atmosphere.	
Actions	2.1.1	Pursue massive afforestation and reforestation programs for enhancing the country’s forest cover and establishing forest areas as effective carbon sinks.	Priority
	2.1.2	Launch ‘Reduced Impact Logging’ (RIL) techniques in commercial forests to minimize damages during forest operations to save the future carbon stocks and avoid soil disturbance and erosion risks.	Short Term
	2.1.3	Develop forest cover assessment at district level through GIS/ RS in decision making and forest carbon accounting system to assess changes in carbon stocks in forest areas.	Short Term
	2.1.4	Develop effective mechanisms to avoid illicit cutting of forests and strictly enforce such measures in all forest types of Pakistan.	Medium Term
	2.1.5	Intensively encourage farm forestry and agro-forestry practices through plantation of multipurpose and fast growing tree species to meet the demands of local population for fuel, timber and fodder for cattle.	Priority

2.1.6	Initiate projects and programs to provide alternative fuel and livelihood options for forest dependent communities to compensate avoiding deforestation (e.g. improved livelihoods through conservation and sustainable use of NTFPs, providing fuel efficient stoves and provision micro-hydel energy etc).	<i>Priority</i>
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**Implementing Institutions:**

Provincial Forest Departments, Proposed Federal Commission on Climate Change, Provincial Environment Departments, EPAs, Pakistan Forest Institute, Civil Society Organizations, Community Based Organizations.

**8.3. Objective 3: To monitor and evaluate the progress**

<b>Strategy</b>	<b>3.1</b>	<b>Developing effective mechanisms to gauge the progress from the onset and during implementation of the proposed actions.</b>	
<b>Actions</b>	3.1.1	Develop and maintain an appropriate climate change and forestry monitoring framework for the forestry sector.	<i>Short term</i>
	3.1.2	Verify the proposed MRV system after certain intervals of time if the emission reductions, as part of the REDD process, are progressing.	<i>Medium Term</i>
	3.1.3	Publish annual progress reports and make them publicly available.	<i>Short Term</i>

**Implementing Institutions:**

Proposed Federal Commission on Climate Change, Provincial Environment Departments, Provincial Forest Departments, and Provincial Wildlife Departments.

**9.0. DISASTER PREPAREDNESS: ADAPTATION ACTIONS**

Pakistan is highly vulnerable, in varying degrees, to a large number of climate related natural disasters. Large part of the areas along rivers are prone to floods and river erosion, the coastline is prone to tropical cyclones and tsunamis, arid and semi-arid areas of the country are vulnerable to drought and hilly areas are at risk from hill-torrent’s flash floods, landslides etc. Heightened vulnerabilities to disaster risks are due to expanding population, urbanization and development within high-risk zones, environmental degradation and above all from climate change.

As far as human vulnerability to disasters is concerned, the economically and socially weaker segment of the population is the one that is most seriously affected. Within the vulnerable groups, elderly persons, children and especially women are exposed to higher risks and require special attention during disasters.

Climate change is likely to increase climate-related natural disasters with a projected increase in the frequency and intensity of extreme climate events, including floods, droughts, cyclones, landslides triggered by heavy rains and urban flooding due to congestion on storm drainage. Climate change projections are scenario based, hence, contain some degree of uncertainties. In spite of this, there are strong indications that in South Asia, particularly in Pakistan, climate change is intensifying the above mentioned hazards. Pakistan is already experiencing climate change impacts that are too visible to ignore.

Most natural hazards like floods, droughts, cyclones etc cannot be avoided or prevented. However, with appropriate adaptive and preparedness measures, along with proper climate-resilient development work in risk prone areas, these hazards turning into disasters can be prevented or their impact minimised. To address disaster management and risk reduction in a holistic manner, the following strategy and Framework for Implementation has been developed.



(Source: AP Photo-Khalid Tanveer)

## 9.1. Critical Infrastructure

It is vital that critical infrastructure like dams, barrages, irrigation network, roads, bridges, railway lines, power stations, and river embankments are constantly monitored for safety standards and strengthened where deficient. Building bye-laws and structural safety features need to be revisited periodically to identify gaps and for suitable modifications.

### 9.1.1. Corporate Social Responsibility

Historically in our culture, well to do individuals the corporate sector, civil society organizations, and individual citizens have been supporting disaster relief and rehabilitation activities. Public Private Partnership between government and private sector needs to be encouraged, strengthen and formalize so that they can play an effective role in disaster management.

### 9.2.0 Objective 1: To increase awareness of climate change related natural disaster's impact and our capacity to respond.

Strategy	1.1	Improving awareness of issues related to mitigation of climate change induced disasters through public participation.	
Actions	1.1.1	Make the decision makers aware of the likely increase in the frequency and intensity of natural disasters due to climate change and the proposed mitigation strategy;	Priority
	1.1.2	Develop mechanism to formalise and promote strong sectoral coordination among sectors responsible for DRM;	Priority
	1.1.3	Conduct special emergency handling situation training programmes for NGOs and volunteer organizations;	Short Term
	1.1.4	Conduct special awareness campaigns for different segments of society and particularly for those communities living in vulnerable areas, through radio, TV, print media and participatory workshops;	Priority
	1.1.5	Develop an integrated information system to manage temporal and spatial information on climate change and disaster risk reduction;	Short Term

1.1.6	Include disaster management as a discipline in the curriculum of universities;	<i>Short Term</i>
1.1.7	Develop flood adaptability of the communities' living in riverine flood plains;	<i>Short Term</i>
1.1.8	Enhance the institutional capacities of all agencies involved in disaster management related activities (NDMA, PDMA, SDMA Provincial Irrigation Departments, PMD, FFC, WAPDA and Emergency Relief Cells Civil Defence, Health Deptt, Education Dept, Hydel Board, Highways Deptt, CBO, Academia);	<i>Medium Term</i>
1.1.9	Develop drought adaptability of the communities living in county's drought prone areas particularly in Balochistan.	<i>Short Term</i>

### Implementing Institutions:

NDMA, PDMA, GCISC, PMD, WAPDA, FFC, and Ministry of Information and Broadcasting.

### 9.2.1 Objective 2: To improve our understanding of the processes that produce natural hazards.

Strategy	2.1	Addressing the important gaps in our knowledge of the natural processes that cause hazards.	
<b>Actions</b>	2.1.1	Develop remote-sensing and in situ techniques to monitor temperature & moisture contents of the atmosphere at different levels using satellite and weather radars etc.	<i>Medium Term</i>
	2.1.2	Develop data assimilation techniques for running high resolution Numerical Weather Prediction (NWP) models to predict precise weather conditions for 7 to 10 days.	<i>Priority</i>
	2.1.3	Establish a dedicated Monsoon Research Unit in PMD to study the climate change induced changes in monsoon rainfall patterns.	<i>Priority</i>
	2.1.4	Develop capacity of predicting quantitative precipitation.	<i>Short Term</i>
	2.1.5	Improve numerical weather models and visualization techniques to provide accurate and timely products more usable by forecasters and researchers.	<i>Short Term</i>
	2.1.6	Develop methods for validity the output of these models.	<i>Short Term</i>
	2.1.7	Analysis and document details of gaps and weakness and strong points in handling each natural disaster to learn lessons.	<i>Priority</i>
	2.1.8	Improve knowledge and understanding of available technologies for disaster reduction among professional engineers, building contractors etc.	<i>Priority</i>
	2.1.9	Enhance stake holders understanding of disaster process through training seminars and workshops.	<i>Priority</i>

### Implementing Institutions:

NDMA, PDMA, and Federal Flood Commission.

### 9.2.2 Objective 3: To develop integrated hazard mitigation strategies.

Strategy	3.1	Developing hazard zoning and mitigation strategies through management, formulation and enforcement of regulation and laws.	
<b>Actions</b>	3.1.1	Prepare an integrated natural hazard zoning map of Pakistan including AJK.	<i>Short Term</i>
	3.1.2	Identify the vulnerable areas at local level and develop mitigation strategies against those vulnerable areas and communities.	<i>Short Term</i>
	3.1.3	Identify low floods risk areas for future land use planning.	<i>Short Term</i>
	3.1.4	Identify the avalanches and landslides vulnerable mountain areas.	<i>Medium Term</i>
	3.1.5	Identify safe areas for evacuation of people and livestock in each vulnerable locality.	<i>Priority</i>
	3.1.6	Encourage resettlement/ relocation of villages outside the flood plains;	<i>Short Term</i>
	3.1.7	Develop collection points for livestock during disaster.	<i>Priority</i>
	3.1.8	Develop evacuation plans with the consent and participation of local communities and also provide training to them.	<i>Priority</i>
	3.1.9	Incorporate water, food hygiene, and sanitation management in disaster preparedness and evacuation plans.	<i>Short Term</i>
	3.1.10	Set-up system where old, children and disabled get particular focus during evacuation.	<i>Priority</i>
	3.1.11	Develop waste management strategies for post disaster situations.	<i>Priority</i>
	3.1.12	Integrate hazard zoning into land use and urban development through zoning regulation.	<i>Short Term</i>
	3.1.13	Undertake formulation and enforcement of "River Flood Plain" regulations and laws.	<i>Short Term</i>
	3.1.14	Update river laws to protect Streams, rivers banks and its flood plain areas from encroachments.	<i>Short Term</i>
	3.1.15	Develop and provide incentives to encourage disaster resistant construction, particularly in rural areas.	<i>Priority</i>
	3.1.16	Develop efficient rescues mechanism, relief and rehabilitation options and their implementation strategies before a disaster happened.	<i>Priority</i>
	3.1.17	Set-up a system to ensure that policy and regulatory framework is implemented and enforced.	<i>Short Term</i>
	3.1.18	Identify the drought vulnerable areas in Balochistan and develop mitigation strategies for vulnerable communities.	<i>Short Term</i>
	3.1.19	Undertake risk mapping of all vulnerable areas in Balochistan.	<i>Short Term</i>
	3.1.20	Update the flood plain maps for 100 years return period.	<i>Priority</i>

#### Implementing Institutions:

NDMA, PDMA, Pakistan Meteorological Department, Provincial Irrigation Departments, WAPDA (Dams Safety Commission), Ministry of Water & Power, Emergency Relief Cell (Cabinet Division), SUPARCO, IRSA, Maritime Security Agency, and Pakistan Red Crescent Society.

### 9.2.3 Objective 4: To assess future likely flood levels in Indus River System against future climate change scenarios.

Strategy	4.1	Investigating and undertaking detailed studies through hydrological and climate modeling future flood behavior of Indus River System.	
Actions	4.1.1	Undertake GIS mapping of all existing irrigation infrastructure specially flood embankments for effective monitoring and flood management.	Priority
	4.1.2	Identify the flood retarding basins and escape channels for managing flood peaks.	Priority
	4.1.3	Undertake comprehensive dam break studies to analyze flood routing etc.	Short Term
	4.1.4	Use the existing dams particularly Tarbela and Mangla dams for managing flood peaks through integrated water management at these dams.	Priority
	4.1.5	Demarcate the flood vulnerable areas according to different flood return periods of 10 to 100 years.	Priority
	4.1.6	Identify the most vulnerable public areas and buildings.	Priority
	4.1.7	Undertake detailed flood routing studies.	Short Term

#### Implementing Institutions:

Ministry of Water and Power, Pakistan Meteorological Department, Federal Flood Commission, National Disaster Management Authority, and GCISC.

### 9.2.4 Objective 5: To provide reliable natural disaster's information and early warning where and when it is needed.

Strategy	5.1	Developing and strengthening natural hazard early warning system for providing the reliable warnings to the users.	
Actions	5.1.1	Improve real-time meteorological and hydrological data collection and processing for better understanding of natural processes and evolving disasters.	Short Term
	5.1.2	Upgrade and expand weather monitoring station network in the country.	Medium Term
	5.1.3	Strengthen natural disaster's early warning system for making it more efficient and linked it with improved mitigation measures and actions.	Short Term
	5.1.4	Develop improved early warning dissemination system using radio, TV, SMS, and mosque loudspeakers etc.	Priority
	5.1.5	Develop standard operating procedures, clearly defining the role and responsibilities of each concerned department during natural disasters.	Priority
	5.1.6	Establish the local flash flood warning centres in vulnerable mountain areas.	Medium Term
	5.1.7	Improve and strengthen flash flood response mechanism of local & district disaster managers to minimize the damages keeping in view generally rapid on-set of flash floods with short warning lead-time.	Short Term

5.1.8	Establish regional flood forecasting and warning centres in each province and sub-regional centres at each vulnerable district.	<i>Medium Term</i>
5.1.9	Strengthen linkages with media, particularly with electronic media, for timely dissemination of early warning in easy to understand local languages.	<i>Priority</i>
5.1.10	Set-up remote-sensing and ground-base mechanism to monitor the development of Glacial Lakes Outburst Floods (GLOF).	<i>Priority</i>
5.1.11	Develop evacuation strategies in case of GLOF for vulnerable areas.	<i>Priority</i>
5.1.12	Develop universally adopted standards for sharing and storing hazard-related data for easy analysis and integration with other data sets.	<i>Short Term</i>
5.1.13	Set-up a national data centre for easy sharing of all climate, water and disaster related data.	<i>Short Term</i>
5.1.14	Upgrade & install Flood Early Warning System (FEWS) model in PMD, Mangla Dam and Tarbela Dam with proper staff training.	<i>Priority</i>

### **Implementing Institutions:**

Pakistan Meteorological Department, Global Change Impacts Studies Centre, Federal Flood Commission, NDMAs, PDMAAs and DDMAAs.

### **9.2.5 Objective 6: To develop climate change resilient Infrastructure.**

<b>Strategy</b>	<b>6.1</b>	<b>Developing and strengthening the infrastructure which is resilient to climate change, particularly to the extreme weather events.</b>	
<b>Actions</b>	6.1.1	Undertake detailed studies to assess the requirements of flood embankments, dykes and protective bunds to protect vulnerable areas particularly urban areas with large population in light of likely flood level.	<i>Priority</i>
	6.1.2	Strengthen the existing flood embankments and dykes and protective bunds.	<i>Short Term</i>
	6.1.3	Rehabilitate the 2010 flood damaged embankments, bunds and irrigation infrastructure on priority.	<i>Priority</i>
	6.1.4	Enhance, restore and strengthen the capacity of Barrages.	<i>Medium Term</i>
	6.1.5	Strengthen telecommunication, power, utilities, and transport infrastructure to with stand climate change induced extreme weather events.	<i>Medium Term</i>
	6.1.6	Construct cyclone shelters in vulnerable coastal areas.	<i>Short Term</i>
	6.1.7	Redesign and construct disaster resilience multipurpose school buildings to be used as shelters during natural calamities.	<i>Short Term</i>
	6.1.8	Ensure regular periodic maintenance of irrigation and other related infrastructure to enhance its sustenance and minimizing its damage during natural disasters.	<i>Medium Term</i>
	6.1.9	Redesign and upgrade storm drainage capacity of major cities especially Karachi and Lahore keeping in view climate change related likely increase in short duration intense rainfall events.	<i>Medium Term</i>
	6.1.10	Redesign and upgrade Left Bank Outfall Drain (LBOD) capacity, particularly in southern Sindh, keeping in view the experience gained during climate change related short duration intense rainfall events in Southern Sindh during July, 2003 & Aug, 2010.	<i>Short Term</i>

6.1.11	Construct escape structures at suitable places along the existing flood embankments, dykes and protective bunds, and identify suitable places that could be used for recharging depleting aquifers from surplus flood water.	<i>Medium Term</i>
6.1.12	Water supply systems be designed and constructed with due consideration to natural disasters and emergencies.	<i>Med. Term</i>
6.1.13	National, Provincial, District and local emergency preparedness and response plans may be developed for ensuring provision of safe water to the people affected by emergencies such as floods, earthquakes, droughts and conflicts, in line with Sphere Standards.	<i>Med. Term</i>
6.1.14	Policies may be formulated to prevent threats of pollution and risks to water bodies and underground water for providing safe sanitation to communities affected by disasters like floods and earthquakes.	<i>Med. Term</i>

### **Implementing Institutions:**

NDMA, Ministry of Water & Power, FFC, WAPDA, Provincial Irrigation Departments, Planning & Development Division

## **10.0 OTHER VULNERABLE ECOSYSTEMS**

### ***10.1. Biodiversity: Adaptation Actions***

Pakistan covers a significant number of the world's ecological regions that support a rich variety of species contributing to the overall biodiversity of the country. These valuable resources, however, are continuously depleting due to many factors including unsustainable use whereas some species of important ecological functions are already on the verge of extinction. The loss, fragmentation and degradation of natural habitats are further declining which is affecting biodiversity in the rangelands, forests, deserts, freshwater and marine ecosystems. Deterioration of natural habitats has been taking place for years however the present decline of these habitats in Pakistan has alarmingly increased. It is feared that the anticipated effects of climate change on biodiversity will further worsen. This continuous loss of biodiversity calls for immediate response and solid action towards conservation of these resources in the country.

The importance of conserving biological diversity, in the wake of climate change, has been repeatedly outlined in various policies, strategies, plans and programs in Pakistan; no concrete actions, however, have been taken so far. The Ministry of Environment, Government of Pakistan in collaboration with WWF- Pakistan and IUCN- Pakistan in 2000 has already prepared a comprehensive Biodiversity Action Plan (BAP) for Pakistan. The BAP provides a brief assessment of the status and trend of the existing biodiversity in Pakistan outlining strategic goals and objectives. It also identifies the plan of action including coordination arrangements and implementation measures. The Biodiversity Action Plan for Pakistan was prepared in consultation with and participation of stakeholders including government, academia and civil society. The BAP is made up of 13 components corresponding to the specific Articles of Convention on Biological Diversity (CBD), which, under Article 6, requires parties (member countries) to develop national plans, strategies and programs for conservation and sustainable use. Article 6 also implores to integrate such plans and strategies into relevant sectoral plans.

This Climate Change Adaptation Action Plan supports and recommends implementation of the already formulated Biodiversity Action Plan for Pakistan. Additional measures, however, in wake of the latest knowledge and research in the context of climate change, are recommended to shore up the efforts already sketched out in Pakistan's BAP.

**10.1.1. Objective 1: To strengthen legal and institutional set up to materialize efforts towards biodiversity conservation.**

Strategy	1.1	Strengthening institutions and implementing the existing measures taken so far to enhance biodiversity conservation in Pakistan.	
Actions	1.1.1	Boost national and provincial institutional capacities in terms of finance and political as well as public support to enhance biodiversity conservation activities;	Short Term
	1.1.2	Concrete measures to put into practice the already prepared Biodiversity Action Plan for Pakistan;	Priority
	1.1.3	Set up provincial focal points and steering committees in all provinces to draw up Biodiversity Conservation Plans at provincial/ local levels and make sure its practical implementation;	Priority
	1.1.4	Establish central body at national level to look after the conservation activities at provincial/ local levels;	Short Term
	1.1.5	Promote public and political sensitization activities to put biodiversity conservation as one of the top priority agendas;	Short Term
	1.1.6	Review and update the existing plans periodically based on the lessons learnt during practical implementation phases.	Short Term

**Implementing institutions:**

Federal Ministry of Disaster Management, Planning Commission of Pakistan, Planning and Development Departments of all provinces including AJK and GB.

**10.1.2. Objective 2: To enhance scientific research on and practice of biodiversity conservation.**

Strategy	2.1	Promoting and conducting latest research in the field of biodiversity with its relevance to the effects of climate change to fill the knowledge gap between policy and practice.	
Actions	2.1.1	Enhance capabilities of research institutions and academia to explore and promote sustainable use of natural resources and the associated biological diversity in the country;	Short Term
	2.1.2	Initiate meaningful applied research on biodiversity conservation in the wake of climate change at national and provincial levels;	Short Term
	2.1.3	Document and integrate indigenous knowledge into the latest scientific findings/ information for use in conservation planning and activities;	Short Term
	2.1.4	Commence joint partnerships with international research institutions and make the best use of their collaboration in terms of technical assistance and the use of latest technologies in conservation efforts;	Priority
	2.1.5	Extend conservation practices in joint collaboration with the local communities making use of their knowledge in local perspective;	Short Term
	2.1.6	Integrate biodiversity conservation practices into all relevant disciplines such as forestry, wildlife, marine and agriculture;	
	2.1.7	Promote in-situ as well as ex-situ conservation of valuable species for research and other purposes in biodiversity rich regions.	Medium Term

**Implementing Institutions:**

Provincial Agriculture Research Departments, Biodiversity Research Institutions, Universities & Research Centers, and Pakistan Forest Institute.

**10.1.3. Objective 3: To enhance national and provincial capacities to identify, conserve and monitor conservation processes.**

Strategy	3.1	Enhancing capacities of the existing and yet to be established monitoring centers at national and provincial levels	
<b>Actions</b>	3.1.1	Establish resource bases at national and provincial levels to collect, share and monitor information and monitoring activities of biodiversity conservation;	<i>Short Term</i>
	3.1.2	Strengthen institutions and organizations that are involved in various activities (e.g. data collection, information dissemination, and conservation) pertaining to conservation of flora and fauna in Pakistan;	<i>Short Term</i>
	3.1.3	Identify and classify national priorities to conserve various threatened ecosystems and the associated biodiversity in each province in accordance with the Biodiversity Action Plan for Pakistan;	<i>Priority</i>
	3.1.4	Enhance capacities of research institutions, government departments, civil society and local communities to monitor activities pertaining to conservation of biodiversity;	<i>Short Term</i>
	3.1.5	Promote knowledge and information sharing among relevant stakeholders preferably among the local communities and sensitize them towards importance of conserving valuable species of flora and fauna through various programs.	<i>Short Term</i>

**Implementing Institutions:**

Federal Ministry of Disaster Management, Planning Commission of Pakistan; Provincial Environment, Forest and Wildlife Departments and Pakistan Forest Institute.

**10.2. Mountain Areas: Adaptation Actions**

The most likely climate change risks to the mountain areas of Pakistan are: Increase in frequency and intensity of precipitation, resulting in more frequent flash floods and landslides; Increase in intensity of wind storms and lightening, resulting in top soil erosion and forest fires; Increase in temperature, resulting in rapid glacier melting and glacial lake outburst floods (GLOFs) and changes in cropping patterns. To safeguard against most likely climate change impacts on mountain areas and to protect their ecosystems and livelihoods of mountain communities, the Government shall take the following measures:

**10.2.1 Objective 1: To map out vulnerability of ecosystems to climate change in mountainous areas and prepare action plans for its mitigation.**

Strategy	1.1	Conducting detailed scientific research in mountain areas to identify the most fragile and resilient ecosystems to the adverse impacts of climate change and addressing the identified issues with concrete measures.	
<b>Actions</b>	1.1.1	Establish a coordination mechanism and plan of operation for the entities carrying out scientific studies to map out the ecological resilience of mountainous areas.	<i>Short Term</i>
	1.1.2	Establish a research centre exclusively coordinating and disseminating scientific information on mountain areas ecosystems.	<i>Short Term</i>
	1.1.3	Initiate focused research on plant phenology; trends in precipitation and temperature; changes in the soil carbon and biomass of mountainous ecology.	<i>Priority</i>

1.1.4	Investigate the effects of climate change on mountain biodiversity and the role of science integrated with indigenous knowledge for its preservations.	<i>Medium Term</i>
1.1.5	Publish reports of the scientific findings and recommendations for preserving mountain ecology to adapt to the adverse impacts of climate change.	<i>Priority</i>
1.1.6	Launch integrated watershed management projects at sub-catchment basis to reduce run off and soil erosion mitigating flood intensities.	<i>Short Term</i>
1.1.7	Launch reforestation programs in the mountain areas to stabilize slopes and reduce the flood intensities.	<i>Priority</i>
1.1.8	Establish network of small multi-purpose dams in mountain areas to reduce the flood intensities, generate power and serve irrigation purposes.	<i>Priority</i>
1.1.9	Launch slope stabilization and river bank protection programs by applying engineering, soil bio-engineering and biological measures.	<i>Short Term</i>

### Implementing Institutions:

Global Change Impacts Study Centre, Pakistan Forest Institute, and Provincial Agriculture Research Departments.

### 10.2.2. Objective 2: To sustain food security from agriculture crops and livestock production in mountain areas of Pakistan.

Strategy	2.1	Ensuring agriculture crops adapting to the changing climatic conditions at high altitudes.	
<b>Actions</b>	2.1.1	Conduct studies to identify crops particularly vulnerable to sudden climatic changes; develop programs to prevent crop damages due to unexpected weather changes.	<i>Medium Term</i>
	2.1.2	Undertake experiments on short duration, heat and drought resistant crops in mountain areas.	<i>Short Term</i>
	2.1.3	Introduce cold and drought resistant short duration cereal crops suited for high altitudes based on tested experimental results.	<i>Short Term</i>
	2.1.4	Designate responsible agriculture research entities to systematically and continuously carry on research on crop production in mountain areas and recommend actions accordingly.	<i>Priority</i>
	2.1.5	Implement the recommended measures in close collaboration with the local communities. For instance, replace the vulnerable crops with those resistant to cold and droughts.	<i>Priority</i>
	2.1.6	Establish a forum of agricultural research institutions to research on, design and introduce technologies suited for high altitudes.	<i>Short Term</i>
	2.1.7	Introduce new feedstock varieties and technologies to maintain it as forage areas for cattle.	<i>Priority</i>
	2.1.8	Encourage perennial crops (fruit orchards) and fodder trees to produce fodder and food during droughts.	<i>Short Term</i>

### Implementing Institutions:

Pakistan Agriculture Research Centre and Provincial Agriculture Research Departments.

**10.2.3. Objective 3: To sustain and protect mountain ecology and plain areas from degradation and pollution.**

Strategy	3.1	Discouraging activities that contribute to depletion of mountain ecology while encouraging those that help in rejuvenating feasible climate at higher altitudes.	
<b>Actions</b>	3.1.1	Develop conservation partnerships with China, Afghanistan and other Central Asian countries to protect the mountain ecology of Northern Areas of Pakistan;	<i>Medium Term</i>
	3.1.2	Conduct GLOF related research and accordingly develop projects to conserve the glaciers of northern regions, especially Gilgit Baltistan;	<i>Priority</i>
	3.1.3	Promote ecotourism and devise mechanisms to avoid accumulation of solid waste, trash and other unwanted material in hill stations and popular tourist destinations;	<i>Short Term</i>
	3.1.4	Sensitize and take on board the local communities for promoting ecotourism;	<i>Priority</i>
	3.1.5	Actions to remove and further avoid accumulation of unwanted biomass in areas of higher altitudes so as to prevent clogging of mountain water channels;	<i>Short Term</i>
	3.1.6	Develop special engineering projects to build check dams and other barriers to control solid waste, trash, biomass, and soil erosion from reaching plain areas;	<i>Short Term</i>
	3.1.7	Organize localized programs for removal and disposal of solid waste from the mountain areas;	<i>Short Term</i>
	3.1.8	Promote growing natural shrubby barriers on slopes to avoid soil erosion, windstorm, hailstorm and snowstorm related damages;	<i>Medium Term</i>
	3.1.9	Introduce and encourage the use of bio-degradable products.	<i>Short Term</i>

**Implementing Institutions:**

Local Municipal Committees, Provincial Forest Departments, Pakistan Agriculture Research Center, Provincial Wildlife Departments, Livestock and Veterinary Research Institutions, Natural Science Departments of Universities, Irrigation and Water Engineering institutions, Pakistan Tourism Development Corporation.

**10.3. Coastal & Marine Ecosystems: Adaptation Actions**

Coastal areas in Pakistan are already exposed to a number of natural hazards due to climate change. Tropical cyclones, severe storms, floods, shoreline erosion and other hazards all impact our coastal areas, causing loss of life and damage to property and infrastructure. Further possible impacts of projected sea level rise in Pakistan could be erosion of beaches, flooding and inundation of wetlands and lowlands, salinization of ground and surface waters, and increased intrusion of sea water into the Indus deltaic region (IDR) as well as the increased risk of cyclones originating in the Arabian Sea. Similarly, Pakistan’s marine coastal ecosystems are likely to be severely impacted by climate change: change in sea water temperature and acidification; cyclones; relocation and movement of marine fish and mammals; and heat induced drying of deltaic areas. To safeguard the Coastal areas and Marine ecosystem from the likely climate change impacts, the Government of Pakistan shall take the following measures:

### 10.3.1. Objective 1: To develop adaptation to climate change impacts on Coastal and Marine Ecosystems.

<b>Strategy</b>	<b>1.1</b>	<b>Building natural plantation barriers along coastal areas to control sand and soil erosion and to minimize the disastrous impacts of cyclones and tsunamis.</b>	
<b>Actions</b>	1.1.1	Identify coastal habitats that are most vulnerable to sand and soil erosion.	<i>Priority</i>
	1.1.2	Involve agricultural research institutions to identify the vegetation, shrub and trees most suited for the coastal areas.	<i>Priority</i>
	1.1.3	Designate plantation areas for vegetation recovery and regeneration in the coastal areas.	<i>Short Term</i>
	1.1.4	Initiate campaigns to plant mangroves, coastal palm and other trees suitable for coastal areas to control sand and soil erosion.	<i>Priority</i>
	1.1.5	Get local community organizations involved in building and maintaining vegetative barriers in the coastal areas.	<i>Short Term</i>

<b>Strategy</b>	<b>1.2</b>	<b>Constructing structural barriers to safeguard low lying coastal human clusters against rising sea level, cyclones and tsunamis.</b>	
<b>Actions</b>	1.2.1	Undertake environmental socio-economic profiling of coastal areas.	<i>Priority</i>
	1.2.2	Identify areas that are within the hazards-belt and need engineering structures as safeguards against coastal cyclone and tsunami activities.	<i>Short Term</i>
	1.2.3	Design appropriate engineering structures that can with stand moisture corrosion and other extreme weather fatigue.	<i>Medium Term</i>
	1.2.4	Entrust Provincial Irrigation Department to build and maintain such structures.	

<b>Strategy</b>	<b>1.3</b>	<b>Developing salinity tolerant crops for coastal areas.</b>	
<b>Actions</b>	1.3.1	Identify agricultural research institutions to develop locally adaptable salinity tolerant cereal crop cultivars.	<i>Priority</i>
	1.3.2	Conduct economic valuation of marine ecosystems and coastal biodiversity resources.	<i>Short Term</i>
	1.3.3	Involve local community to develop experimentation agricultural plots near the seashore and in coastal areas to see the adaptability of salinity crops to local environment.	<i>Short Term</i>

<b>Strategy</b>	<b>1.4</b>	<b>Maintain optimal river water flow for continuation of sediment and nutrient transfer to the marine ecosystem.</b>	
<b>Actions</b>	1.4.1	Identify the minimum amount of water inflows required downstream kotri to maintain marine ecosystem.	<i>Priority</i>

1.4.2	Provide required fresh water inflows downstream kotri to maintain coastal marine ecosystems and fish habitats in good health.	<i>Short Term</i>
1.4.3	Develop linkage between upstream and downstream ecosystems and their sustainable uses.	<i>Med. Term</i>

Strategy	1.5	Reduce and control solid and liquid waste disposal in the bay areas.	
<b>Actions</b>	1.5.1	Identify the bay area's being effected by waste disposal.	<i>Priority</i>
	1.5.2	Identify alternative processes and locations for disposal of solid and liquid waste from coastal towns and cities.	<i>Short Term</i>
	1.5.3	Involve local coastal communities for controlling bay area's degradation from waste disposal.	<i>Short Term</i>
	1.5.4	Develop coastal water quality monitoring stations.	<i>MediumTerm</i>

Strategy	1.6	Maintain marine ecosystems and fish habitats for healthy fisheries sector.	
<b>Actions</b>	1.6.1	Institutional strengthening and capacity enhancement of R&D and other relevant institutions for conducting research to determine the impact of climate change on fisheries and marine ecosystems.	<i>Priority</i>
	1.6.2	Design special coastal areas biodiversity and habitat preservation program that have direct implications for fisheries in the region.	<i>Short Term</i>
	1.6.3	Train local fisherman and coastal area inhabitants to monitor and inform the concerned line departments of any changes in sea currents and fish stock movement.	<i>Medium Term</i>
	1.6.4	Conduct studies to monitor any sea surface temperature change and the consequent movement of fish and other marine life.	<i>Short Term</i>

### Implementing Institutions:

National Institute of Oceanography, Provincial Coastal Development Authorities, Geological Survey, Provincial Forest, Wildlife and Fisheries Departments, Civil Society Organizations, EPAs, WWF, IUCN.

## 10.4. Rangelands & Pastures: Adaptation Actions

Rangelands historically are a livelihood contributor, particularly in mountains regions where livestock shares more than 70 percent of annual rural household income and animals derive as high as 90 percent of their feed from rangelands.

The total land area of Pakistan, including Azad Kashmir, is about 803,940 square kilometres. About 60 percent is classified as unsuitable for forestry or agriculture, and consists mostly of deserts, mountain slopes, rangeland and urban settlements. The estimates for grazing land or pastures in Pakistan vary widely, between 10 percent and 70 percent of the total area. A broad interpretation, for example, categorizes almost all of arid Balochistan as rangeland for foraging livestock.

The National Rangeland Policy provides a detailed sketch for rangelands development in Pakistan. The role of rangelands in environmental conservation is vital and important, their existence and health would remain critical for conserving biodiversity in Pakistan. Degradation of rangelands results in gradual loss of flora and fauna. Climate change impacts that could affect rangelands and pastures in Pakistan are: reduced precipitation, increased heat, stronger wind, increased soil erosion and abrupt weather changes in mountain pasture areas. To ensure food security, based on livestock and pasture management, and ecosystem maintenance in the light of impending climate change impacts, the Government of Pakistan shall take the following policy measures.

**10.4.1. Objective 1: To develop climate change adaptation strategy for rangelands and pastures.**

Strategy	1.1	Safeguarding the soil against erosion through vegetative barriers and maintaining optimal livestock densities.	
<b>Actions</b>	1.1.1	Devise vegetative barriers for rangelands that are particularly vulnerable to erratic precipitation, strong winds and increased soil erosion;	<i>Short Term</i>
	1.1.2	Develop community based programs to plant shrubs and trees most suited for these rangelands and pasture;	<i>Short Term</i>
	1.1.3	Design and implement programs to ensure optimal livestock densities according to the rangelands' carrying capacities;	<i>Medium Term</i>
	1.1.4	Organize awareness raising and training programs for local shepherds and farmers so as to maintain the 'rangeland ecosystem';	<i>Short Term</i>
	1.1.5	Build communication channels among the local communities and the livestock research institutions to stay informed about the latest innovations in field of livestock research;	<i>Short Term</i>
	1.1.6	Use native and hybrid soil nutrient fixing vegetation for improving soil quality;	<i>Short Term</i>
	1.1.7	Develop close coordination among forest and livestock departments for efficient management of rangelands.	<i>Priority</i>
Strategy	1.2	Promoting grazing system, in line with the research findings, to facilitate regeneration of rangeland grasses and to increase the livestock production.	
<b>Actions</b>	1.2.1	Conduct research to identify 'fragile' and 'resilient' rangelands and pastures in each province;	<i>Priority</i>
	1.2.2	Discretely calculate, through extensive research, the carrying capacities for both fragile and resilient rangelands and pastures in each province according to their local climatic conditions;	<i>Short Term</i>
	1.2.3	Design rotational program for periodic movement of livestock from fragile to resilient rangelands and pastures to restore the fodder quality grass and shrubs according to the local conditions;	<i>Medium Term</i>
	1.2.4	Conduct research involving expert institutions to change the herd composition that increases productivity with reduced ecosystem impact in the fragile rangelands and pastures;	<i>Priority</i>

1.2.5	Develop close links between local communities, veterinary services and livestock market for efficient livestock turnover;	<i>Short Term</i>
1.2.6	Establish experimental plots of native, hybrid and adapted vegetation species for increased fodder availability and improved rangeland and pasture management;	<i>Medium Term</i>
1.2.7	Designate alternative pastures and passages, in case of earlier or later than usual weather change.	<i>Priority</i>

### Implementing Institutions:

Pakistan Agriculture Research Council (PARC), Provincial Agriculture Research Departments, Livestock and Veterinary Institutions, Provincial Forest and Wildlife Departments, Dairy and livestock Departments, Academia.

## 10.5. Wetlands: Adaptation Actions

Pakistan's wetlands play an important role in maintaining and sustaining regional ecological processes that support globally important biodiversity such as bird migration routes and wintering grounds. A significant fraction of Pakistan's wetlands-dependent biodiversity, however, is classified as endemic threatened and vulnerable. There has been a dramatic change in the ecosystem of the wetlands in Pakistan in the last ten years, affecting its ability to function as a habitat for waterfowl, shorebirds, and migratory birds. To protect, sustain and enhance the wetlands in Pakistan, the Government in collaboration with the relevant entities shall take the following actions:

### 10.5.1. Objective 1: To protect the habitat of birds and biodiversity including fish in Wetlands Ecosystem.

Strategy	1.1	Researching the causes of depletion of wetlands' ecosystem in Pakistan.	
<b>Actions</b>	1.1.1	Establish research bodies to monitor the immediate and lasting climate change impacts on the wetlands in Pakistan.	<i>Medium Term</i>
	1.1.2	Extend the research possibilities to recognize and enhance the roles played by wetlands in natural disaster protection.	<i>Short Term</i>
	1.1.3	Take measures to protect the associated biodiversity of the wetlands in Pakistan.	<i>Priority</i>
	1.1.4	Design appropriate management plans to maintain and safeguard the wetlands of Pakistan in light of the adverse impacts researched.	<i>Short Term</i>
	1.1.5	Control the use of pesticides and fertilizers in the immediate surroundings of the wetlands.	<i>Priority</i>
	1.1.6	Encourage the use of biological control for disease and weed control in agricultural crops.	<i>Priority</i>
	1.1.7	Establish a "Centre of Excellence" to conduct comprehensive climate change related research on the conservation of wetlands in connection with associated biodiversity, forestry and related disciplines.	<i>Medium Term</i>

### Implementing Institutions:

Federal and Provincial Environmental Protection Agencies, Research Institutions and Universities, provincial Forest, Wildlife and Fisheries Departments, and Civil Society Organizations.

**10.5.2. Objective 2: To provide the necessary inputs to ensure sustainability of wetlands ecosystem in Pakistan.**

Strategy	2.1	Supplying the necessary contribution to the wetlands by efficient management of the resources.	
<b>Actions</b>	2.1.1	Ensure adequate water supply allowing ecologically necessary water flows to estuaries, peat lands, rivers, streams and lake marshes, mudflats and inter-tidal areas.	<i>Short Term</i>
	2.1.2	Establish an institutional setup to responsibly monitor changes in quality of waters coming to the wetlands.	<i>Medium Term</i>
	2.1.3	Take immediate measures to conserve the wetlands, particularly those that are part of the RAMSAR convention.	<i>Priority</i>
	2.1.4	Design proper monitoring and evaluation procedures for the existing conservation activities in Pakistan's wetlands and the report be made publicly available.	<i>Short Term</i>
	2.1.5	Undertake joint programs with provinces to plan and set allocations for ecosystem maintenance water levels.	<i>Short Term</i>
	2.1.6	Develop adaptation mechanisms for wetlands and communities dependent on them threatened by climate change.	<i>Short Term</i>
	2.1.7	Concretely address the 'multi-management' and 'multi-ownership' issues of wetlands and bringing their management under a single authority.	<i>Priority</i>
	2.1.8	Ensure design and implementation of sustainable, participatory management plans for independent demonstration sites, representing of broad eco-regions in Pakistan.	<i>Short Term</i>

Strategy	2.2	Taking remedial measures to reduce siltation of the wetlands.	
<b>Actions</b>	2.2.1	Ensure control of siltation of wetlands by reducing deforestation and felling of timber in the catchments areas.	<i>Priority</i>
	2.2.2	Conduct research to identify further the causes of siltation in the wetlands and take remedial measures accordingly.	<i>Medium Term</i>
	2.2.3	Develop wetlands maintenance programs to control siltation and other debris with efficient participation of the local communities.	<i>Short Term</i>

Strategy	2.3	Devise legal procedures concurrent with scientific findings to control organic and inorganic pollution of wetlands.	
<b>Actions</b>	2.3.1	Undertake comprehensive survey of the wetlands catchment areas for any intensive input agricultural.	<i>Medium Term</i>
	2.3.2	Check water quality in all drainage systems to wetlands for excessive fertilizer and pesticide contamination.	<i>Priority</i>
	2.3.3	Put in place monitoring and control system to keep wetlands from receiving excessive chemicals.	<i>Short Term</i>
	2.3.4	Incorporate the role of local communities in management procedures.	<i>Short Term</i>

## Implementing Institutions:

National Institute of Oceanography, Federal and Provincial Environmental Protection Agencies, Provincial Wildlife, Forest and Fisheries Departments, Wetlands and Agriculture Research Institutions, Provincial Irrigation and Water Management Departments, Community based Organization and Training Institutions.

## 10.6. Arid, Hyper-Arid Areas: Adaptation Actions

Pakistan is mainly a dry land country, where 68 million hectares, which is about 80 percent of the total geographical area of the country is arid and semi-arid. Out of this 41 million hectares falls under arid and 11 million hectares under deserts, where climate is hyper-arid (Kahlowan & Majeed 2004). The main hyper-arid areas in Pakistan are: Thar (4.3 Mha), Cholistan ( 2.6 Mha), Thal (2.3 Mha) and Chagi-Kharan (1.8Mha).

### 10.6.1. Thar Desert

The Thar Desert is the world's seventh largest desert and one of the most inhospitable eco-region. However, in the past this area supported one of the world's oldest civilizations, Monhenjo Daro and Harappa (Chaudhry, 1997). The climate of Thar is extreme: in summer the temperature range more than 50 °C and in winter it drops to near-freezing. Rainfall mostly in south-west monsoon is between 100-500mm (Source: PMD). About 10 % of the desert is composed of sand dunes, and 90% of craggy rock forms (Grewal 1992).



(Source: Virginmedia.com Thar desert)

Despite the extreme climate, several species and sparse vegetation have evolved to survive in the harsh environment. Vegetation in Thar mostly consists of grassland and low tree scrubs. It is one of the most densely populated deserts in the world. People's livelihood depends on grazing of livestock, mostly sheep and goats. The intense grazing is affecting soil fertility and destroying native vegetation. These pressures combined with climate changes are likely to degrade and destroy the already fragile desert eco-systems. The livelihood patterns in the future may change in the area as work on the exploration of Thar Coal deposit picks up.

### 10.6.2 Cholistan Desert

The sandy landscape of the Cholistan Desert (locally known as Rohi) starts some 30 kilometres from Bahawalpur and is spread over an area of some 16,000 square kilometres and extends up to the Thar Desert in the Sindh province. The Cholistan Desert has an average rainfall of 166 mm a year and temperature in summer ranges above 50 °C. The Desert consists of sand dunes, sandy soil, loamy soil, and saline-sodic clay soil. Cholistan Desert is inhabited by about 110,000 semi-nomads living in the desert, and livestock population is nearly 2.0 million. The inhabitants are mostly camel and goat herders. In the dry season they cluster in temporary villages around the more reliable water resources. The

underground water is mostly saline and unfit for human and livestock drinking. Because of these limiting factors, the local population remains in search of water and fodder for their animals.



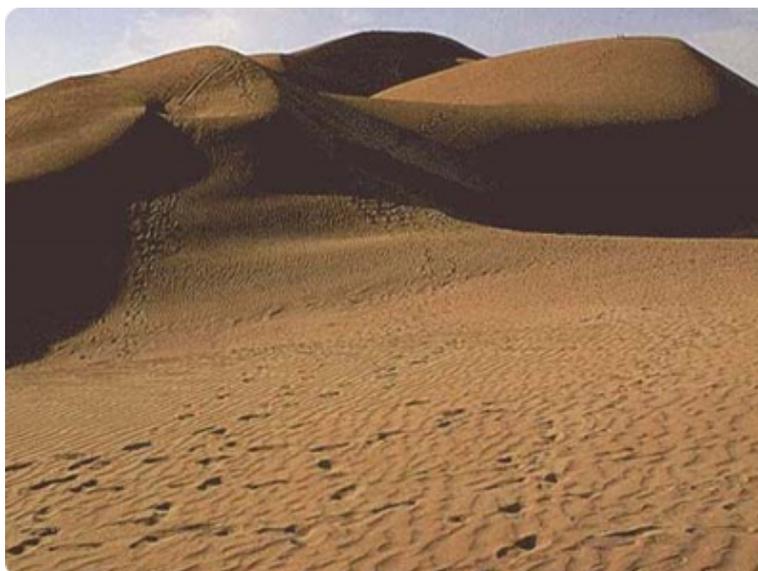
(Source: National Geographic- Cholistan Desert)

### **10.6.3 The Kharan Desert (Balochistan)**

The Kharan Desert, also known locally as the "Sandy Desert", is located in northwest Balochistan. The Kharan Desert area consists of shifting sand dunes with an underlying pebble-conglomerate floor. The moving dunes reach heights of between 15 and 30 meters. Level areas between the dunes are a hard-topped pan when dry and a sandy-clay mush when wet. The barren wastes that occupy almost half of Iran, with its continuation into Kharan in Pakistan, form a continuous stretch of absolute barrenness from the alluvial fans of the Alborz Mountains in the north to the edge of the plateau in Balochistan, more than 1,200 kilometres to the southeast. Average annual rainfall throughout these deserts is well under 100 mm. The surface of the Hamun-i-Mashkel, which is some 85 kilometres long and 35 kilometres wide, is littered with sun-cracked clay, oxidized pebbles, salty marshes and crescent-shaped moving sand dunes.

### **10.6.4 Thal Desert**

This desert is mainly situated between the Jhelum and Sindh Rivers near the Pothohar plateau. It covers an area of 300 km from north to south and 110km maximum and 30 km minimum breadth. The locals of Thal mostly speak 'seraiki' and their main activity is cattle rearing. In some areas limited agriculture is done, where canal water is made available through some reclamation projects.



**Sand dunes in Thal desert**

These desert dwelling and habitats are highly fragile and are likely to be more vulnerable in the wake of climate change. These fragile arid and hyper-arid ecosystems in Pakistan are in urgent need of integrated conservation approaches for adaptation to climate change that can contribute significantly to prevent and reduce the widespread land degradation and desertification processes, such as drought, overgrazing and erosion. In addition to this, there is a need to establish alternative land use and conservation management strategies for these areas. Based on close participation of scientists with stakeholder groups in the arid and hyper-arid areas in Pakistan, the adaptation strategy should ensure both the acceptability and feasibility of conservation methods, and a solid scientific basis for its effectiveness at various levels.

The communities of the vulnerable ecosystems usually are the marginalized people living in ecologically vulnerable areas, experiencing extreme water and energy resource shortage. This reduces their food security, due to failing of crops, loss of livestock and relocation of dwellings due to water and energy resource stress. The ecological changes in these areas due to climate change increases their resource constraints and vulnerability.

Desertification indicator sets for areas with active desertification and soil degradation need to be designed to harmonize information systems that may help organize socio-economic and soil information to identify climate change impacts and adaptive strategies.

Climate Change Impacts that could affect the arid and hyper-arid areas in Pakistan are: Reduced precipitation, Increased temperature, stronger wind, and Increased sand storms. For ecosystem maintenance, innovative crops and livestock management in these arid and hyper-arid areas in light of impending climate change impacts, the Government of Pakistan shall implement the following action plan

**10.6.5 Objective 1: To develop and manage scarce water resources in a sustainable manner.**

<b>Strategy</b>	<b>1.1</b>	<b>Seeking innovative fodder shrubs and crops irrigation techniques and technologies designed for water conservation.</b>	
<b>Actions</b>	1.1.1	Establish 'Knowledge Management' and 'Information Extension' cells at village and town levels to extend information regarding water conservation and its techniques to the local farmers.	<i>Medium Term</i>
	1.1.2	Drive 'farmers' awareness' campaigns to sensitize local farmers regarding importance of water conservation measure.	<i>Short Term</i>

	1.1.3	Devise appropriate training programs for local communities to adopt and maintain technologically advanced equipments for drip irrigation.	<i>Medium Term</i>
	1.1.4	Develop experimentation plots for local and hybrid vegetation cover with least usage and maximum utilization of water.	<i>Medium Term</i>

<b>Strategy</b>	<b>1.2</b>	<b>Find technological breakthrough for irrigation systems, to raise vegetative cover in extremely difficult and harsh areas of arid zone.</b>	
<b>Actions</b>	1.2.1	Identify irrigation equipment and technology most suited for arid and desert areas;	<i>Short Term</i>
	1.2.2	Design appropriate training programs for local communities to maintain technologically advance equipments for drip irrigation and alternative (solar and wind) electricity source systems for tube-wells;	<i>Medium Term</i>
	1.2.3	Built local community linkages with irrigation and agriculture research institutions for most appropriate technology for arid areas with decreasing water resource.	<i>Short Term</i>

<b>Strategy</b>	<b>1.3</b>	<b>Encouraging development of technological innovations for improved water efficiency for crops, efficient equipments for the rehabilitation of Karez irrigation system including artificial groundwater recharge.</b>	
<b>Actions</b>	1.3.1	Ensure irrigation technological innovations that are most suited for arid areas with hot climate to maintain crop cover;	<i>Medium Term</i>
	1.3.2	For artificial ground water recharge, involve institutes that apply engineering innovations to irrigation techniques, particularly, suited for arid and hyper-arid agriculture;	<i>Medium Term</i>
	1.3.3	Involve irrigation research institute with a focus on arid areas to develop technologies and equipments to improve the traditional Karez irrigation system;	<i>Short Term</i>
	1.3.4	Provide training to local farmers to develop Karez irrigation system by using artificial.	<i>Short Term</i>

### **10.6.6 Objective 2: To combat land degradation and desertification.**

<b>Strategy</b>	<b>2.1</b>	<b>Ensure building vegetative barriers for safeguarding against sand storms near human habitats.</b>	
<b>Actions</b>	2.1.1	Identify human habitats that are most vulnerable to sand storms.	<i>Priority</i>
	2.1.2	Involve arid area agricultural research institutions to identify appropriate vegetation for these vulnerable areas.	<i>Short Term</i>
	2.1.3	Engage local communities to build and maintain these vegetative barriers near desert area villages.	<i>Short Term</i>

<b>Strategy</b>	<b>2.2</b>	<b>Developing Kharan Desert as a rangeland.</b>	
<b>Actions</b>	2.2.1	Develop a local pastures and livestock development plan in consultation with the local communities and nomadic tribes.	<i>Short Term</i>

2.2.2	Develop a small dam projects for local rivers in the closed valley of the Kharan water catchment area.	<i>Medium Term</i>
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### 10.6.7 Objective 3: To introduce low delta crops and dry land trees & livestock

<b>Strategy</b>	<b>3.1</b>	<b>Researching on and promotion of “low delta crops” as well as drought and pest resistant crops.</b>	
<b>Actions</b>	3.1.1	Ensure development of low delta and drought resistant, high-yield crop varieties for arid and hyper-arid areas in Pakistan.	<i>Short Term</i>
	3.1.2	Develop special programs for pest resistant crops or integrated pest management to safeguard crop productivity.	<i>Short Term</i>

<b>Strategy</b>	<b>3.2</b>	<b>Undertake development of drought resistant shrubs, fodder crops and grasses for pastures and oasis for livestock.</b>	
<b>Actions</b>	3.2.1	Explore research opportunities to improve feed and fodder in arid areas;	<i>Short Term</i>
	3.2.2	Involve local communities and nomadic tribes to develop experimental plots of improved grasses and shrubs for livestock.	<i>Medium Term</i>

#### Implementing Institutions:

Arid Agriculture Universities Provincial Agriculture Research Departments, Livestock and Veterinary Institutions, Provincial Forest and Wildlife Departments, Dairy and livestock Departments, Academia.

### 10.7. Health Sector: Adaptation Actions

It is now widely recognized that climate change induced increased frequency and intensity of extreme events such as heat and cold waves, heavy or too little precipitation, strong winds and cyclones have serious implications for human health. For example, floods and storms not only increase the risk of death and injuries, they also have implications for other health effects such as diarrheal diseases because of insufficient clean drinking water, water for personal hygiene or for washing food; they may also cause severe psychological problems among the affected population (e.g. mental health effects such as depression have been observed in the aftermath of the 2010 disastrous floods). Similarly, incidence of many vector borne diseases such as malaria and dengue fever, which are sensitive to temperature and rainfall, may increase with the expected changes in climate. In order to address the impacts of climate change on human health, the following actions are required to be taken:



Source: Wateen Net Services.

### 10.7.1 Objective 1: To address the Impact of climate change on human health

Strategy	1.1	Assessing and reducing health vulnerabilities to climate change.	
<b>Actions</b>	1.1.1	Assess the country's vulnerability including identifying those populations and regions that are most vulnerable to vector borne diseases.	<i>Priority</i>
	1.1.2	Identify the vulnerable population groups with each urban and rural locality that might be directly affected by natural calamities like floods and cyclones.	<i>Priority</i>
	1.1.3	Establish baseline conditions of human health risk of current climate variability and recent climate change.	<i>Short term</i>
	1.1.4	Design health systems out-reach programs that could reach the designated areas for quick emergency health services.	<i>Priority</i>
	1.1.5	Built effective infrastructures and means of communications to quickly counter any epidemic spreading due to climate change induced natural hazard.	<i>Short Term</i>

Strategy	1.2	Ensuring that appropriate measures to address health related climate change issues are incorporated into national health plans.	
<b>Actions</b>	1.2.1	Identify financial resources and personnel training facilities within new national health plans, particularly, focused on climate change related health hazard requirements.	<i>Priority</i>
	1.2.2	Estimate the possible additional burden of adverse health issues (future risk) likely to change over the coming decades due to climate change.	<i>Short Term</i>
	1.2.3	Assess the current capacity of health and other sectors to manage the risks of climate sensitive health outcomes.	<i>Short Trem</i>
	1.2.4	Design health plans that not only have out-reach components, but able to provide first aid medical help to a large number of injured and sick during a natural disaster.	<i>Priority</i>

Strategy	1.3	Educating and sensitizing health personnel and the public about climate change related health issues.	
<b>Actions</b>	1.3.1	Design communication strategies to inform the general public of climate change related health hazard and its geographical span, particularly, alerting health personnel in the vicinity.	<i>Priority</i>
	1.3.2	Use media and civil society organizations to educate and sensitize public as well as health personal to the climate change related health issues particularly arising during the natural disasters.	<i>Priority</i>
	1.3.3	Conduct assessments on the impacts of climate change on vector/waterborne and nutritional diseases.	<i>Short Term</i>

<b>Strategy</b>	<b>1.4</b>	<b>Ensuring that the medications and clean drinking water are available to the general public easily and cost effectively particularly during climate related extreme events.</b>	
<b>Actions</b>	1.4.1	Design and built emergency vaccines and medication storage facilities near each DCO's office to be used in case of injuries and epidemics due to natural hazard.	<i>Priority</i>
	1.4.2	Keep mobile water purification facilities ready to be shifted to disaster stricken areas at short notice.	<i>Short Term</i>
	1.4.3	Develop and promote household water treatment options.	<i>Short Term</i>

<b>Strategy</b>	<b>1.5</b>	<b>Upgrading and extending disease outbreaks monitoring and forecasting systems to counteract the possible climate change health impacts.</b>	
<b>Actions</b>	1.5.1	Strengthen disease monitoring and forecasting systems for prior planning and timely effective interventions.	<i>Priority</i>
	1.5.2	Develop effective intervention strategies in national health plans to build and design climate change related health impacts control system.	<i>Short Term</i>
	1.5.3	Develop an effective response system to deal with any vector borne diseases like malaria and dengue epidemics, which are expected to rise in changing climate patterns.	<i>Short Term</i>

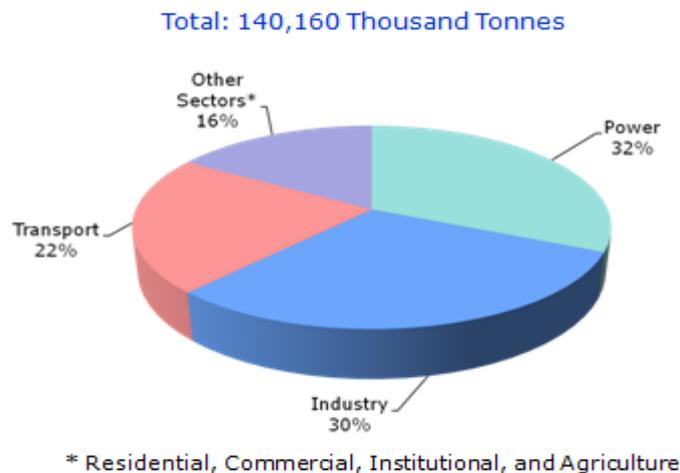
### **Implementing Institutions:**

Federal Health Authorities, National Institute of Health, Provincial Health Departments. WHO, Red Crescent Society of Pakistan, IUCN, Oxfam Novib, NGO & Civil Society Organisations.

## 11.0. ENERGY SECTOR: MITIGATION ACTIONS

Pakistan's Green House Gas (GHG) emissions are low compared to international standards. In 2008 Pakistan's total GHG emissions were 310 million tonnes of CO<sub>2</sub> equivalent. These comprised: CO<sub>2</sub> 54%; Methane (CH<sub>4</sub>) 36%; Nitrous Oxide (N<sub>2</sub>O) 9%; Carbon Monoxide (CO) 0.7%; and Non-Methane Volatile Organic Compounds 0.3%. (Source: National GHG inventory 2008).

### CO<sub>2</sub> Emissions of Energy Sector for the Year 2008



Source: National GHG Inventory 2008

The energy sector is the single largest source of GHG emission in Pakistan; it contributes nearly 51% of these emissions and is followed by the Agriculture sector (39%), Industrial processes (6%), Land Use, Land Use Change and Forestry (3%) emissions and wastes (1%) (Source: National GHG inventory 2008). As such, the most important targets for mitigation effort involving reduction of GHG emission are the Energy and Agriculture sectors. In the energy sector, integration of climate change and energy policy objectives is particularly important as today's investment will "lock in" the infrastructure, fuel and technologies to be used for decades to come. Similarly, building and transport infrastructure put in place today should meet the design needs of the future. Therefore, greater attention must be paid to the energy efficiency requirements in building codes and long term transport planning.

Pakistan's energy sector has, besides furnace oil, high reliance on natural gas (the fossil fuel with the lowest Carbon intensity), and very low reliance on coal (the fossil fuel with the highest Carbon intensity) in utter contrast to the patterns of primary energy consumption and electricity generation worldwide. It is largely for this reason that the CO<sub>2</sub> emissions per unit of energy consumption in Pakistan are among the lowest in the world.

With this consumption pattern, Pakistan's natural gas reserves have depleted to such an extent that it will be difficult to maintain the present level of production for long. Similarly local oil resources are dismally low too. The only sizable fossil fuel resource available in Pakistan is coal with an estimated resource base of 185 billion tonnes. To meet an increasingly large fraction of its future energy needs, Pakistan has no alternative but to seek meeting an increasingly large fraction of its future energy needs through the use of its practically unutilized vast coal resources. As such, clean coal technologies are expected to be part of the energy mix for the medium term future.

To find solutions to the present energy needs and future energy requirements, a creative and sustainable energy policy framework is necessary that may help in reducing the green house gas (GHG) emissions. This framework would facilitate the transition towards low carbon emissions for sustainable development. We may also need to realize the full potential of the country's renewable capacity, beside developing and enhancing clean sources and other

efficiency measures towards a low carbon economy in the energy sector. As such the change in energy mix, the development of renewable energy resources and the increase of nuclear and hydroelectric share provides an opportunity to achieve the above mentioned objectives of reduction in carbon emissions in the energy sector in Pakistan. The Government of Pakistan shall take the following measures for mitigating its GHG emissions.

**11.0.1. Objective 1: To develop and enhance renewable energy sources and uses to achieve green growth in the energy sector.**

Strategy	1.1	Giving preferential status to development and promotion of hydropower generation.	
Actions	1.1.1	Develop provincial consensus on promotion and development of hydropower generation in the country.	Short Term
	1.1.2	Undertake pre-feasibilities on potential hydel power projects sites.	Priority
	1.1.3	Develop and promote run-of-river hydel power projects on rivers and canals on massive scale.	Short Term
	1.1.4	Strengthen engineering and design capacities of relevant institutions for preparation of feasibilities and later to supervise the development of hydel power projects.	Medium Term
	1.1.5	Create a mechanism to ensure stable funding for new hydro-power projects through international financial lending institutions.	Short Term
	1.1.6	Incorporate policies in line with the procedures followed by other countries/international norms where hydel power projects are undertaken.	Priority
	1.1.7	Undertake survey of water resources in provinces including AJK and GB to assess, and accordingly, enhance their potential in generating energy.	Short Term
	1.1.8	A uniformed tariff, as set for other provinces, is recommended for AJK in the form of subsidy.	Short Term
	1.1.9	Ensure that rights of local population are protected wherever the hydro power projects are launched.	Short Term
	1.1.10	Constitute a framework to legislate the water usage and water rights involving all stakeholders at provincial/ state level.	Short Term
	1.1.11	Develop consensus at national level to divert funds to Gilgit Baltistan so that hydel projects be initiated that will equally benefit communities of other provinces of the country.	Short Term
	1.1.12	Improve recovery procedures from individuals/departments that are not paying utility bills and thus eliminate mismanagement from government part and introduce strict monitoring system to generate revenue.	Priority
	1.1.13	Build capacities of all concerned departments to develop project proposals on need assessment and actual understanding of problems at governance level.	Short Term
	1.1.14	Construct small dams as abundant water is available in Gilgit Baltistan for power generation and supply to other parts of the country.	Short Term

1.1.15	Develop projects for energy generation by diverting river into energy production units.	<i>Medium Term</i>
1.1.16	Develop and promote hydropower projects through dams in Khyber Pukhtunkhwa (KPK).	<i>Short Term</i>
1.1.17	Develop mechanism to support the Public Private Partnership in mobilizing, financing and enabling investments in hydel-power projects and make sure its implementation through proper legislation.	<i>Short Term</i>
1.1.18	Promote updated energy technologies.	<i>Priority</i>
1.1.19	Ensure construction of hydropower structures at appropriate sites in Punjab to cover its power shortfall.	<i>Short Term</i>
1.1.20	Identify appropriate sites as well as financial resources for establishing wind mills and hydro turbines in Punjab.	<i>Short Term</i>
1.1.21	Explore possibilities for generating solar energy in Punjab.	<i>Short Term</i>
1.1.22	Promote simplistic lifestyle of low energy consumption (and discourage that of intensive energy consumption).	<i>Short Term</i>
1.1.23	Utilize the link canal water in Punjab for generation of hydro-power.	<i>Priority</i>

<b>Strategy</b>	<b>1.2</b>	<b>Promoting development of renewable energy resources and technologies such as solar, wind, geothermal, small-hydropower and bio-fuel energy.</b>	
<b>Actions</b>	1.2.1	Undertake extensive survey to map country's wind and solar power potential.	<i>Short Term</i>
	1.2.2	Identify potential wind corridor in different parts of Balochistan for installing wind power projects.	<i>Short Term</i>
	1.2.3	Identify potential sites for installation of small hydro-power projects in mountain areas as well as along major irrigation canals.	<i>Short Term</i>
	1.2.4	Strengthen capacities of scientific and engineering technology public sector institutions and universities to develop and design renewable energy technologies for solar, wind, geothermal, small-hydropower and bio-fuel energy sources.	<i>Short Term</i>
	1.2.5	Provide incentives for introducing solar water heaters in the country.	<i>Priority</i>
	1.2.6	Introduce investment friendly incentives to attract private sector interest in renewable energy projects.	<i>Short Term</i>
	1.2.7	Develop mechanism to support the private sector in mobilizing, financing and enabling public sector investment in renewable energy projects independent of government.	<i>Medium Term</i>
	1.2.8	Create clean energy disciplines in universities to raise awareness and promote use of clean energy alternate resources.	<i>Short Term</i>

1.2.9	Constitute a team of technical experts to develop methods of alternate energy resources; enhance their capacities and provide them incentives in terms of scholarship etc.	<i>Short Term</i>
1.2.10	Promote local manufacturing of power generation equipments.	<i>Medium Term</i>
1.2.11	Create power development board reorganized into with sub-sections of hydro power unit, wind power unit, solar power unit, biomass unit and geothermal unit under the relevant ministry (i.e. Ministry of Water & Power).	<i>Short Term</i>
1.2.12	Established a database including experts from all sector related to energy.	<i>Short Term</i>
1.2.13	Promote public private partnership for power sector projects.	<i>Short Term</i>
1.2.14	Develop and encourage indigenous low cost technology (renewable energy) through research and development (R&D) activities.	<i>Medium Term</i>
1.2.15	Arrange renewable energy exhibitions in the country to get low carbon emission ideas and techniques.	<i>Short Term</i>

<b>Strategy</b>	<b>1.3</b>	<b>Promoting buildings design with solar panels for energy self sufficiency, especially in public sector buildings.</b>	
<b>Actions</b>	1.3.1	Identify and introduce energy efficient building materials, designs and technologies;	<i>Short Term</i>
	1.3.2	Initiate wind energy projects in GB as it has a lot of potential and there are areas where these projects shall prove fruitful for energy generation;	<i>Short Term</i>
	1.3.3	Promote enterprises to produce energy efficient products and ensure availability of the same in the local market;	<i>Short Term</i>
	1.3.4	Increase awareness at every level for promoting best practices of energy conservations;	<i>Priority</i>
	1.3.5	Adopt strategy to promote and install solar panels in both public and private sector buildings to conserve energy;	<i>Priority</i>
	1.3.6	Set appropriate building construction criteria/ codes according to climatic conditions for energy conservation.	<i>Short Term</i>

<b>Strategy</b>	<b>1.4</b>	<b>Planning the necessary expansion of nuclear power for Pakistan's energy security.</b>	
<b>Actions</b>	1.4.1	Plan expansion of nuclear power in the country to reduce its dependences on imported fossil fuels;	<i>Long Term</i>
	1.4.2	Revisit the safety standards on our present nuclear facilities to ensure that they are foolproof;	<i>Short Term</i>
	1.4.3	Strengthen capacities of local relevant scientific institutions to design and operate nuclear power reactors;	<i>Short Term</i>
	1.4.4	Develop plans and recommend safety measures in case of any emergency nuclear accidents; build capacities of the local governments to mitigate such calamities through trainings and awareness programs;	<i>Short Term</i>

1.4.5	Develop standards for proper disposal of nuclear waste.	Priority
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**11.0.2. Objective 2: To develop and obtain clean energy technologies and uses to achieve low carbon growth in the energy sector.**

Strategy	2.1	Obtaining technological know-how and its transfer for installing the Near-Zero Emission clean coal technologies.	
<b>Actions</b>	2.1.1	Develop and obtain technological know-how and its transfer for installing the Near-Zero Emission Technology (NZET) for utilization of vast coal reserves in Pakistan;	Short Term
	2.1.2	Strengthen capacities of local scientific institutions to develop pulverized coal Integrated Gasification Combined Cycle (IGCC) systems;	Priority
	2.1.3	Ensure that new coal-fired power stations perform at high-efficiency level and are designed in such a way that they can be easily retro-fitted for carbon capture and storage;	Medium Term
	2.1.4	Develop strategies to utilize all fossil fuels, including coal, at highly efficient and low emission levels;	Short Term
	2.1.5	Strengthen technological and scientific capacities of relevant institutions to develop and operate coal-fired power stations with carbon capture and store facility;	Long Term
	2.1.6	Develop indigenous capacity to technologies such as Waste Heat Recovery and Co-generation; Coal Bed Methane Capture; coal fluidized bed combustion; and Combined Cycle Power Generation;	Medium Term
	2.1.7	Promote Clean Development Mechanism (CDM) projects in Khyber Pukhtunkhwa and in other provinces.	Short Term

Strategy	2.2	Installing plants to generate power from municipal waste.	
<b>Actions</b>	2.2.1	Strengthen capacities of all municipal agencies to install waste-to-heat conversion plants;	Short Term
	2.2.2	Involve local and provincial energy providers to ensure efficiency of energy supply transmission from these plants;	Short Term
	2.2.3	Undertake research on waste conversion into energy; develop major units in provinces to generate power through waste so as to promote alternate energy practices;	Priority
	2.2.4	Encourage private sector to install waste to energy conversion plants at local, district and provincial levels;	Short Term
	2.2.5	Restrict and discourage import of sub-standard technology used for conversion of waste into energy;	Priority
	2.2.6	Encourage the use of low carbon and low sulphur fuel.	Priority

Strategy	2.3	Promoting and providing incentives for activities required for energy-mix and fuel-switching program to low-carbon fuels.	
Actions	2.3.1	Design economic incentives and feasible options for energy-mix and fuel-switching program to low-carbon fossil fuels and other sources, ensuring flexible, reliable innovative strategies and technologies that reduce emissions;	Medium Term
	2.3.2	Equip local universities and research institutions so that they design and develop indigenous and hybrid technology for CO2 capture and storage;	Medium Term
	2.3.3	Develop plans and install infrastructure to turn waste into heat by all municipalities;	Short Term
	2.3.4	Develop coal bed methane capture technology locally for future energy needs.	Long Term

### 11.0.3. Objective 3: To reduce total energy demand through conservation and efficiency.

Strategy	3.1	Conserving energy and improving energy efficiency.	
Actions	3.1.1	Design energy audit methods to improve energy efficiency during transmission;	Priority
	3.1.2	Provide economic incentives to conserve energy in the form of replacing high energy consuming machineries with energy efficient machineries in the industrial sector;	Medium Term
	3.1.3	Develop new strategies for the transport sector to encourage both fuel conservation and fuel efficiency;	Short Term
	3.1.4	Provide subsidy for promotion of low energy consuming devices for house hold and commercial uses such as energy saver lights;	Priority
	3.1.5	Ensure proper maintenance of energy generating material, e.g. power plants.	Short Term

Strategy	3.2	Introducing “Green Fiscal Reforms” in different sectors of economy, including energy, water, waste/sewage etc to achieve carbon emission reductions objective.	
Actions	3.2.1	Design financial incentives for carbon emission reduction plans by improving efficiency of the carbon fuel based machines and engines.	Short Term
	3.2.2	Develop Green Fiscal Reforms for introduction of polluter pays/carbon tax;	Medium Term
	3.2.3	Plan Green Fiscal Reforms for providing subsidies for: renewable technology transfer; local innovations of renewable technology; efficiency improvement for carbon fossil fuel based technologies;	Medium Term
	3.2.4	Strengthen fiscal reforms and incentives for green technologies in water and waste water sector;	Short Term
	3.2.5	Develop fiscal reforms for the introduction of carbon credit market.	Short Term
	3.2.6	Develop GHG emissions “Monitoring, Reporting and Verification System”(MRV) capacity.	Short Term

Strategy	3.3	Enacting and enforcing energy conservation legislation and audit standards.	
<b>Actions</b>	3.3.1	Design energy conservation legislation by enacting energy sector specific laws that ensure to control the energy wastage;	<i>Priority</i>
	3.3.2	Strengthen the existing legal system that ensures energy efficiency audits and energy conservation;	<i>Priority</i>
	3.3.3	Provide market based incentives, such as emission trading credits to private energy producers to help reduced carbon emissions;	<i>Short Term</i>
	3.3.4	Ensure proper implementation of policy and legislation at each level with identified checks and balances.	<i>Short Term</i>

Strategy	3.4	Ensuring quality management of energy production and supply, including reduction in transmission and distribution losses.	
<b>Actions</b>	3.4.1	Design auditing of energy supply and transmission system to control distribution losses;	<i>Short Term</i>
	3.4.2	Strengthen quality management system of energy production to improve efficiency.	<i>Priority</i>

Strategy	3.5	Improving energy efficiency in building and use of energy efficient electric appliances.	
<b>Actions</b>	3.5.1	Improve energy efficiency in buildings through standardize building and construction codes;	<i>Short Term</i>
	3.5.2	Develop plans for legislating/creating incentives for retrofiting;	<i>Priority</i>
	3.5.3	Encourage modification of building design for better insulation;	<i>Priority</i>
	3.5.4	Encourage design and manufacturing of energy efficient boilers and appliances;	<i>Short Term</i>
	3.5.5	Design energy efficient ground water pumping units for agricultural, industrial and domestic uses;	<i>Short Term</i>
	3.5.6	Introduce incentives for energy efficient products which often cost more than the less-efficient versions, especially when they are first introduced to the markets;	<i>Priority</i>
	3.5.7	Strengthen public awareness programs relating to energy efficiency.	<i>Priority</i>

### **Implementing Institutions:**

Ministry of Water & Power, Water & Power Development Authority, Alternate Energy Development Board, PCRET Ministry of S&T, PAEC, ENERCON, Pakistan Electric Power Company, OGDC, Sindh Coal Authority, Provincial Minerals Departments.

## 12.0. TRANSPORT SECTOR: MITIGATION ACTIONS

Transport sector has shown the highest emission growth rate of all sectors and accounts for about a quarter of carbon dioxide emissions in Pakistan (source: National GHG Inventory, 2008). Thus managing or slowing the growth of emissions in transport sector presents one of the most significant challenges to overall mitigation efforts and is crucial for tackling climate change. What makes the task of reducing emissions in transport difficult is the fact that the scope for technical improvement is limited, at least, in the short run and that transport volumes are closely linked to economic growth. Similarly, emissions from aviation sector are also a matter of concern. In fact emissions of aircraft which are injected directly into the upper atmosphere are much more harmful than similar emissions at surface level because of their longer residence time in upper troposphere. However, despite difficulties, some options are available to reduce emissions in road and air transport, therefore, the following action plan is proposed for that purpose.

### 12.1 Road Transport



(Source: Dawn Newspaper-Traffic jams at M.A.Jinnah Road in Karachi.)

#### 12.1.1. Objective 1: To minimize GHG emissions from transport sector.

<b>Strategy</b>	<b>1.1</b>	<b>Sensitizing public to the importance of proper vehicle maintenance for fuel efficiency enhancement and reduction of emissions.</b>	
<b>Actions</b>	1.1.1	Initiate media campaigns to create public awareness that how proper maintenance of vehicles can contribute to the fuel efficiency and reduction of emissions.	<i>Priority</i>
	1.1.2	Involve civil society and the corporate sector to join in the campaign for emission reduction and fuel efficiency by proper vehicle maintenance.	<i>Priority</i>
	1.1.3	Arrange regular vehicle maintenance technician courses in all urban centres of the country.	<i>Short Term</i>
	1.1.4	Setup vehicle maintenance service centres in all urban areas.	<i>Short Term</i>
<b>Strategy</b>	<b>1.2</b>	<b>Ensuring the provision of efficient public transport (Buses) system in the country.</b>	
<b>Actions</b>	1.2.1	Develop and provide quality efficient public transport system in the country to encourage people to slowly move from the use of private cars to the public transport system.	<i>Medium Term</i>

	1.2.2	Encourage foreign investment to start and maintain high quality public transport in all major urban areas of Pakistan.	<i>Short Term</i>
	1.2.3	Develop public private partnership for the provision of fuel efficient local transport.	<i>Short Term</i>

<b>Strategy</b>	<b>1.3</b>	<b>Setting-up and enforcing vehicle emission standards.</b>	
<b>Actions</b>	1.3.1	Set-up state-of-the art vehicle emission testing stations in all districts of KPK.	<i>Priority</i>
	1.3.2	Update and strictly enforce vehicle emission standards.	<i>Priority</i>
	1.3.3	Develop a law enforcement system with a clear mandate to enforce vehicle emission standards.	<i>Priority</i>

<b>Strategy</b>	<b>1.4</b>	<b>Examine and implement actions required for the use of bio-fuel for local transport.</b>	
<b>Actions</b>	1.4.1	Identify the bio-fuels that can be used in conjunction with fossil fuels in Pakistan.	<i>Short Term</i>
	1.4.2	Make these bio-fuels available at least in important urban centres of Pakistan.	<i>Medium Term</i>
	1.4.3	Develop technology to modify the existing vehicles to run on a mixture of gasoline and bio-fuels.	<i>Medium Term</i>

<b>Strategy</b>	<b>1.5</b>	<b>Planning and developing mass transit system in metropolitan cities.</b>	
<b>Actions</b>	1.5.1	Undertake detailed feasibility studies through foreign consultants to develop an efficient mass transit system in all metropolitan cities of Pakistan.	<i>Priority</i>
	1.5.2	Explore the possibility to fund the development of these mass transit systems through Green Climate Fund.	<i>Priority</i>
	1.5.3	Complete some of these projects through public-private partnership.	<i>Short Term</i>
	1.5.4	Apply subsidized price or cost control for customers, to popularize mass transit system over the use of individual cars.	<i>Short Term</i>

<b>Strategy</b>	<b>1.6</b>	<b>Supporting the private transport sector through incentives for reducing emissions and environmental friendly transport services.</b>	
<b>Actions</b>	1.6.1	Identify and design financial incentives for the private commercial transport systems to reduce emissions.	<i>Short Term</i>
	1.6.2	Identify financial resources to fund systematic replacement of all public transport vehicles with technologically advance reduced emission engines.	<i>Medium Term</i>
	1.6.3	Promote the use of Low Rolling Resistance (LRR) tires.	<i>Short Term</i>
	1.6.4	Create public awareness that improperly inflated tires decrease fuel efficiency and result in greater emissions.	<i>Priority</i>
	1.6.5	Promote proper inflation of tires to improve mileage and reduce emissions.	<i>Priority</i>

<b>Strategy</b>	<b>1.7</b>	<b>Promoting the development and adoption of environmental-friendly transportation technologies.</b>	
<b>Actions</b>	1.7.1	Identify funding resources to develop environmental friendly transportation technologies.	<i>Short Term</i>
	1.7.2	Promote awareness raising in collaboration with civil society and corporate sector to adopt environmental friendly technologies.	<i>Short Term</i>

<b>Strategy</b>	<b>1.8</b>	<b>Securing financing for technology innovations for urban planning and the transportation sector, specifically to address the mitigation issues.</b>	
<b>Actions</b>	1.8.1	Use CDM and other funding sources to develop and adopt emission control technology for the transport sector.	<i>Short Term</i>
	1.8.2	Utilize CSR to involve the corporate sector in fund raising for transport technology innovation in the country.	<i>Short Term</i>
	1.8.3	A special fund needs to be set aside for technology innovations that have direct impacts on human health like emission control, water quality.	<i>Short Term</i>

<b>Strategy</b>	<b>1.10</b>	<b>Developing a pipeline for efficient transportation of oil in the country.</b>	
<b>Actions</b>	1.9.1	Undertake a detailed study to assess the cost effectiveness of transporting oil from sea port to up country through pipeline instead of road transportation.	<i>Short Term</i>
	1.9.2	Train and enhance technician's capacity to build and maintain fuel pipelines.	<i>Medium Term</i>

## **12.2. Aviation**

The emissions from aviation sector are a matter of concern, as aircraft emissions, which are injected directly into upper atmosphere are much more harmful than similar emissions at surface because of their longer residence time in the upper troposphere.

### **12.2.1. Objective 2: To minimize the adverse effects of aviation's emission on the environment in the context of climate change.**

<b>Strategy</b>	<b>2.1</b>	<b>Encouraging national and other local airline to give due consideration to the fuel efficient new technologies aircrafts, causing minimum carbon emissions, while planning new fleet.</b>	
<b>Actions</b>	2.1.1	Keep close track of new emerging fuel efficient aircraft engine technologies for adaptation at the right time.	<i>Priority</i>
	2.1.2	Assess the financial needs of the national airline for introducing new aircrafts with innovative fuel efficient technologies.	<i>Short Term</i>
	2.1.3	Identify the funding sources for technology development to improve efficiency in aviations.	<i>Short Term</i>
	2.1.4	Keep a close watch on the results of recent experiments of 50-50 bio-fuel blend use in aviation sector for aviation emissions reduction.	<i>Short Term</i>

<b>Strategy</b>	<b>2.2</b>	<b>Supporting International Civil Aviation Organization's (ICAO's) initiative for carbon emission reduction through improved air traffic management.</b>	
<b>Actions</b>	2.2.1	Enhance coordinate with International Civil Aviation Organization's (ICAO's) initiative for carbon emission reduction through improved air traffic management.	<i>Priority</i>
	2.2.2	Undertake a detailed study to assess the benefits of improved weather services and free flight air routes instead of defined routes for reduced flight time and thus fuel consumption.	<i>Short Term</i>

<b>Strategy</b>	<b>2.3</b>	<b>Participating actively in ICAO's activities and initiatives for ensuring that new strategies and policies of ICAO may not hurt the economic interests of developing countries' aviation industry.</b>	
<b>Actions</b>	2.3.1	Undertake study to assess the financial implications for the national airline if in the future some carbon tax is imposed on old generation fuel inefficient aircrafts.	<i>Priority</i>
	2.3.2	Develop a dedicated expert team to actively participate in ICAO's initiatives to minimize carbon emissions from the aviation sector.	<i>Priority</i>

### 12.3. Railway

Road transport sector has shown the highest emission growth rate of all sectors in Pakistan. To counter this, railway system needs to be developed to be fast and efficient in carrying cargo and passengers with least amount of carbon emissions. The advantage of railway over road travel in terms of carbon emissions is well recognized internationally.

#### 12.3.1. Objective 3: To upgrade, expand and modernize the railway network in the country.

<b>Strategy</b>	<b>3.1</b>	<b>Ensuring the provision of efficient railway system in the country.</b>	
<b>Actions</b>	3.1.1	Assess the amount of cargo and passengers that have been shifted to road transport in the country during the last ten years and develop the strategy to change this trend.	<i>Short Term</i>
	3.1.2	Develop a railway efficiency plan to improve the quality of service for systematic shift of cargo and passengers back from road to rail transport.	<i>Short Term</i>
	3.1.3	Arrange sufficient financial resources for purchase of new trains engines and cabins to make rail journey efficient and comfortable.	<i>Priority</i>

<b>Strategy</b>	<b>3.2</b>	<b>Upgrading and expanding the railway network in the country.</b>	
<b>Actions</b>	3.2.1	Identify fuels efficient engines for trains.	<i>Priority</i>
	3.2.2	Build infrastructure to improve the quality of train services.	<i>Medium Term</i>
	3.2.3	Identify new routes and build rail lines connecting areas that are not easily accessible.	<i>Long Term</i>
	3.2.4	Build rail lines parallel to roads to reduce the cargo load and emission control.	<i>Long Term</i>

## Implementing Institutions:

Ministry of Communication, Ministry of Defence, National Highway Authority, Civil Aviation Authority, Pakistan International Airlines, Pakistan Meteorological Department

Ministry of Railway, Pakistan Railway.

## 13.0. INDUSTRIES: MITIGATION ACTIONS

The major industries in Pakistan include textile, fertilizer, sugar factories, cement, steel and large petro-chemical plants. These industries contribute about 6% to the total GHG emissions of the country due to the industrial processes in use, in addition to being responsible for more than a quarter of the emissions attributed to the energy sector.



(Source: Pakistan Textile Association. Textile mill in Faisalabad)

### 13.1. Objective 1: To reduce carbon dioxide emissions from the industrial processes used in Pakistan's major industries.

<b>Strategy</b>	<b>1.1</b>	<b>Incorporating economic incentives to promote emission reduction by upgrading the industrial processes and technologies.</b>	
<b>Actions</b>	1.1.1	Undertake initial survey to identify the industries that need technological improvement for emission reduction;	<i>Priority</i>
	1.1.2	Design financial incentive schemes for those particular industries to purchase or develop technological innovation for reduction in emission/liquid effluents.	<i>Short Term</i>
<b>Strategy</b>	<b>1.2</b>	<b>Preparing voluntary Corporate Social Responsibility (CSR) guidelines and encouraging corporate sector to create CSR-fund to cover carbon emission reductions efforts in industrial sector.</b>	
<b>Actions</b>	1.2.1	Identify the industries that need emission reduction technology in Pakistan;	<i>Priority</i>

	1.2.2	Encourage the corporate sector to design CSR specifically for reducing emission in the industrial sector in Pakistan;	<i>Medium Term</i>
	1.2.3	Appoint an expert for drafting CSR guidelines.	<i>Priority</i>

<b>Strategy</b>	<b>1.3</b>	<b>Promoting the integrated “Cleaner Production” strategy in the Industrial sector by making more efficient use of inputs such as energy, water, raw material etc.</b>	
<b>Actions</b>	1.3.1	Identify the industrial processes that cause the most emission;	<i>Priority</i>
	1.3.2	Identify the technologies that could replace these processes, inputs and raw materials to reduce emissions;	<i>Short Term</i>
	1.3.3	Identify the financial resources for this technology innovation and replacement of machineries and equipments;	<i>Short Term</i>
	1.3.4	ENERCON may hold periodical workshops for private sector management for creating awareness about efficient use of inputs such as energy, water and other raw material;	<i>Priority</i>
	1.3.5	Similar workshops may also be arranged for introducing latest energy efficient technologies available in the market for replacement of outdated/obsolete technologies to save precious inputs	<i>Short Term</i>

<b>Strategy</b>	<b>1.4</b>	<b>Promoting the use of energy efficient motors in the industries sector.</b>	
<b>Actions</b>	1.4.1	Identify the quality of machinery and motors use in the industrial sector in Pakistan;	<i>Priority</i>
	1.4.2	Develop energy efficient motors and generator and promote their use in Industrial sector;	<i>Short Term</i>
	1.4.3	Provide financial incentives to encourage industries to voluntarily adopt energy efficient motors.	<i>Short Term</i>

<b>Strategy</b>	<b>1.5</b>	<b>Encouraging the industrial sector to have periodical “Energy Efficiency Audit”.</b>	
<b>Actions</b>	1.5.1	Design voluntary energy efficiency audits to coincide with emission audits for industrial corporate sector;	<i>Priority</i>
	1.5.2	The Financial incentives be provided to the industrial and corporate sector to complete energy efficiency audits;	<i>Medium Term</i>
	1.5.3	Provide expert services to industrial sector for carrying out periodical “energy efficiency audit” of small and large industries.	<i>Short Term</i>

<b>Strategy</b>	<b>1.6</b>	<b>Developing capacity to monitor and estimate emissions locally for each industry.</b>	
<b>Actions</b>	1.6.1	Develop and install instrumentation to estimate emissions from the industrial sector of Pakistan;	<i>Priority</i>
	1.6.2	Train technicians to operate and maintain emission monitoring instruments;	<i>Short Term</i>

1.6.3	Industries may initially be encouraged to submit periodical reports of emissions from their industrial processes.	Short Term
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<b>Strategy</b>	<b>1.7</b>	<b>Ensuring that technology transfer is accelerated for the industries like cement manufacturing to control emissions without hampering the production process.</b>	
<b>Actions</b>	1.7.1	Identify the technology that reduces emissions for industries like cement manufacturing;	Short Term
	1.7.2	Identify the financial needs to transfer these technologies into Pakistan;	Short Term
	1.7.3	Train technicians to adapt these technologies successfully into Pakistan production system and hire foreign experts if required.	Short Term

**Implementing Institutions:** Ministry of Industries, ENERCON

## 14.0 URBAN PLANNING: ADAPTATION & MITIGATION ACTIONS

Climate change presents a range of socio-economic implications for urban planning. Town/ urban planning is a process by which adaptation to climate change impacts is possible in the urban areas. The effects of climate change and the process of urbanization has a complex inter-linkages. It is expected that extreme events as well as gradual changes will, in many cases, contribute to the increasing level of climate change vulnerability in the urban areas-particularly because of inadequate institutions and a lack of infrastructure in high population density locations. In particular, rural to urban migrants often have no choice but to live on land that is already densely populated or in a location that is particularly prone to disasters.

The extent to which a particular urban centre is vulnerable to climate change is influenced by different factors. The location of the town affects the types of climate hazards to which they are exposed, and whether they are prone to be affected by high temperatures, erratic precipitation patterns, sea level rise or more frequent or intense extreme events. However, more importantly, vulnerability of an area and its residents depends upon its social and economic circumstances and the adaptive capacity of stakeholders and institutions to address the challenges of climate change.

Moreover, urban areas influence the level of emissions produced by human settlements by changing fuel and energy consumption patterns.

To adapt to the impacts of climate change, there is a need to introduce changes in town planning and building systems. We can make our cities climate resilient and GHG friendly, by taking advantage of advanced technologies and approaches for using land, water and energy resources.

### **14.1. Objective 1: To introduce innovations in town planning to adapt and mitigate the impact of climate change.**

<b>Strategy</b>	<b>1.1</b>	<b>Updating town planning design principles for lower carbon foot prints.</b>	
<b>Actions</b>	1.1.1	Undertake studies to determine the future expansion needs of the existing towns;	Short Term
	1.1.2	Estimate the fuel and energy needs of these expanding cities;	Short Term
	1.1.3	Undertake emission profile of major urban centres:	Short Term

1.1.4	Provide alternative and low-emission fuels for heating and energy in these new settlements and suburbs;	<i>Medium Term</i>
1.1.5	Convert tall buildings to solar radiation receptors, where possible, by installing solar panels and making them energy self-sufficient;	<i>Medium Term</i>
1.1.6	Design transport corridors for fast and efficient urban transportation;	<i>Medium Term</i>
1.1.7	Encourage communal living in the suburbs with self-sufficient food produce and vegetable gardens;	<i>Medium Term</i>
1.1.8	Amend building laws to ensure that all new buildings are constructed using designs appropriate to local climate;	<i>Priority</i>
1.1.9	Upgrade existing public sector building to reduce energy demand and encourage private house owners to follow;	<i>Short Term</i>
1.1.10	Promote lifestyles, adaptation, and choices, through civil society organizations, that require less energy;	<i>Priority</i>
1.1.11	Enhance capacity of urban planning professionals and facilitate researching in low cost energy efficient construction.	<i>Short Term</i>

<b>Strategy</b>	<b>1.2</b>	<b>Developing infrastructure and support facilities in smaller agro-based towns and periphery urban areas to check rural-to-urban migration.</b>	
<b>Actions</b>	1.2.1	Develop small agro-based towns with modern amenities in rural areas to discourage rural to urban migration;	<i>Short Term</i>
	1.2.2	Develop industrial estates and large-scale agricultural farms to provide job opportunities to rural population near their homes;	<i>Medium Term</i>
	1.2.3	Provide necessary infrastructure and services to remote agricultural settlements to encourage movement of goods rather than labor out of there.	<i>Medium Term</i>

<b>Strategy</b>	<b>1.3</b>	<b>Promoting proper “Land Use Planning” and vertical instead of horizontal expansion of urban housing projects.</b>	
<b>Actions</b>	1.3.1	Increase density of town centres and suburbs near popular business and shopping areas;	<i>Medium Term</i>
	1.3.2	Build planned high density townships near parks, gardens and natural reserves;	<i>Medium Term</i>
	1.3.3	Build planned labour high density colonies near factory areas to curtail shanty towns and large slum areas.	<i>Medium Term</i>

<b>Strategy</b>	<b>1.4</b>	<b>Undertaking hazard mapping and zoning of areas before construction.</b>	
<b>Actions</b>	1.4.1	Geological and seismic surveys of any new township location should be made mandatory;	<i>Short Term</i>
	1.4.2	Control expansion of existing towns and construction in ecologically fragile areas.	<i>Short Term</i>

1.4.3	Development of Vulnerability-Index of urban areas of the country.	<i>Short Term</i>
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<b>Strategy</b>	<b>1.5</b>	<b>Constructing climate resilient rural housing particularly in natural hazard zones.</b>	
<b>Actions</b>	1.5.1	Identify technological innovation and reinforcements for reconstruction of houses in cyclone or storm prone areas and also for landslide and avalanche prone areas;	<i>Short Term</i>
	1.5.2	Design special shelters in flood prone areas near the rivers and sea storm shelters where applicable.	<i>Short Term</i>

<b>Strategy</b>	<b>1.6</b>	<b>Limiting the industries in large urban cities to the designated areas.</b>	
<b>Actions</b>	1.6.1	Design segregated areas for industries adjacent to towns and cities, keeping in view the wind and storm directions;	<i>Priority</i>
	1.6.2	Build vegetative barriers and nature reserve areas as buffers between cities and industrial areas;	<i>Short Term</i>
	1.6.3	Organize regular transport between housing suburbs and industrial areas to ease commute and traffic congestion.	<i>Short Term</i>

<b>Strategy</b>	<b>1.7</b>	<b>Installing solar water heaters in large commercial and public buildings.</b>	
<b>Actions</b>	1.7.1	Assess the availability of solar radiation in selected cities and start a pilot project of replacing fuel based water heaters with solar water heaters in government/public buildings;	<i>Priority</i>
	1.7.2	In the commercial areas and shopping malls, encourage the corporate sector to build a public private partnership for replacing fuel based water heating and energy needs with solar energy.	<i>Short Term</i>

<b>Strategy</b>	<b>1.8</b>	<b>Installing wastewater treatment plants as an integral part of all sewerage schemes.</b>	
<b>Actions</b>	1.8.1	Design central sewerage schemes for all large metropolitan areas;	<i>Short Term</i>
	1.8.2	Link sewerage schemes with wastewater treatment plans;	<i>Short Term</i>
	1.8.3	Designate rivers, lakes and estuaries where this treated water will be deposited;	<i>Short Term</i>
	1.8.4	Ensure systematic installation so that all wastewater is treated;	<i>Short Term</i>
	1.8.5	Install water quality measurement equipments near all water reserves to ensure water safety.	<i>Priority</i>
	1.8.6	Development of strategies for integrated management of municipal, industrial, hazardous and hospital wastes.	<i>Short Term</i>
	1.8.7	Appropriate solid and liquid waste treatment facilities be made an integral part of all development projects.	<i>Med. Term</i>

Strategy	1.9	Arranging separate collection, disposal and re-use of recyclable, composite and biodegradable waste.	
<b>Actions</b>	1.9.1	Ensure separate collection of non-biodegradable solid waste for disposal and re-cycling;	<i>Priority</i>
	1.9.2	Encourage each locality to segregate glass, metal, paper and plastic in separate containers;	<i>Priority</i>
	1.9.3	Formalize solid waste collection by scavengers into a regular and efficient system;	<i>Short Term</i>
	1.9.4	Ensure collection of the biodegradable waste preferably at source for composite and waste-to-fuel process;	<i>Short Term</i>
	1.9.5	Encourage public private partnership for waste-to-fuel enterprise ventures.	<i>Short Term</i>
	1.9.6	Encourage recycling of all recyclable waste to reduce the demand on natural resources and save landfill space.	<i>Medium Term</i>

### **Implementing Institutions:**

Capital and City Development Authorities, ENERCON, City Municipal Authorities, Provincial Town Planning Departments, Higher Education Commission.

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## Annex-I

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1.	Dr. Ishfaq Ahmad	Advisor S&T Planning Commission
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## **Annex –II**

### ***Consultation & Development Process of Framework for Implementation of National Climate Change Policy(2013-2030)***

Extensive consultation meetings were undertaken with all relevant stakeholders including Federal Ministries and Departments, Provincial Governments & their line-departments, and Civil Society Organizations for drafting of the National Climate Change Policy and Framework for Implementation.

#### ***Provincial Consultation Process***

Consultation meetings with all Provincial Governments, including Gilgit-Baltistan and AJK, were held and all the relevant stakeholders including civil society organization were taken on board while formulating the draft policy & Framework for Implementation documents. A brief about the provincial consultation is given below.

#### ***Consultative Meeting Balochistan***

The first consultative meeting was held on 11th January, 2011 at Provincial Secretariat, Quetta. It was attended by 24 senior officials from the Govt. of Balochistan and local NGOs. The meeting was chaired by the Secretary P&D. The second consultation meeting at Quetta was held on 10th May, 2011 and was attended by senior provincial government and line department officials and experts. Extensive consultation took place among the participants and they provided useful input to the policy & Framework for Implementation documents. The Govt. of Balochistan assured endorsement and full support to the efforts of the Ministry and One-UN Joint Programme on Environment (JPE) to formulate a National Climate Change Policy and Pakistan's Framework for Implementation of NCCP

#### ***Consultative Meeting Punjab***

The first Punjab consultative meeting took place at Avari Hotel in Lahore on 15th January, 2011. The consultation process was attended by 47 participants from various sectors including senior Punjab Govt. officials, academia, researchers, policy experts, NGOs, students and journalists. The second Punjab provincial consultation meeting was held on 18th May, 2011 in Lahore which was attended by more than a hundred senior Punjab government and line department officials and experts. Both the meetings resulted in very useful comments and feedback.

#### ***Consultative Meeting Sindh***

The first consultation with the line departments of Sindh Government and other NGOs based in the province was held on 25th January, 2011 at the office of the Environmental Protection Agency in Karachi. The meeting was chaired by the secretary Environment and attended by 24 provincial government officials, academia, and representatives from industries etc. The second provincial consultation meeting in Sindh was held on 12th May, 2011 at Avari Hotel Karachi and was attended by more than 75 participants. Extensive consultation during the two meetings provided very useful comments & suggestions for formulation of the draft policy and development of the Framework for Implementation of NCCP.

#### ***Consultative Meeting Khyber Pakhtunkhwa (KPK)***

Two consultative meetings with the Govt. of Khyber Pakhtunkhwa were held in Peshawar Secretariat and University of Peshawar on January 28th and February 26, 2011 respectively. The diverse number of participants from various walks of life included Govt. officials from line departments, academia and NGOs who actively took part in the consultation process. The third provincial consultation meeting in KPK was held on 14th July, 2011 at Pearl-Continental Hotel Peshawar, which was chaired by the Provincial Minister for Environment and was attended by a large number of participants. They provided very useful suggestions for the development of the Framework for Implementation.

### ***Consultative Meeting Gilgit-Baltistan***

Realizing the importance of Gilgit Baltistan and AJK in the wake of recent climate change, the consultation process was further extended to the above mentioned areas. The first consultative meeting with Govt. officials and NGOs of Gilgit-Baltistan was held at Gilgit Serena Hotel on March 19, 2011. The meeting was attended by 19 participants from various disciplines including Govt. officials, academia, IUCN, UNDP, WWF and AKRSP. The second meeting was held in Gilgit on 24th May, 2011 which was also attended by a large number of relevant officials and experts. The extensive consultation resulted in very useful feedback.

### ***Consultative Meeting Azad Jammu & Kashmir***

The first consultation process with the AJK government was held in Muzaffarabd on 31st March, 2011. The second consultation meeting was again held in Muzaffarabad on 16th May, 2011. Both of these meetings were chaired by Additional Chief Secretary AJK and attended by a large number of participants which included AJ&K Govt. officials, researchers, academia, journalists and representatives from non-government organizations. Extensive consultations resulted in useful feedback from the participants. Most of the feedback was incorporated in the policy document.

## Annex-III

**Table 4: Serious Floods during last 40-years in Pakistan**

Events	Impact
Floods-1973	3 million homes were destroyed and 160 persons lost their lives
Floods-1976	Flood demolished over 10 million homes while 425 lives were lost. With losses amounting to Rupees six billions.
Floods-1988	An unprecedented flood occurred towards the end of September inflicting Rs. 17 billion worth of damages to the country.
Floods-1992	Super flood of 1992 surpassed all previous records with damages estimated at Rs. 50 billion
Floods-1997	Very heavy rainfall in the last week of August, 1997 caused devastating floods in Punjab and Sindh that resulted villages affected 5891, person affected 2 millions, houses damaged 130,000 and area affected 3.3 million acres.
Floods-2001	On 23 <sup>rd</sup> July, 2001 an unprecedented and the highest ever recorded 24 hours rainfall of 624 mm occurred in Islamabad-Rawalpindi resulting flash flooding in Lai-Nullah Rawalpindi with death of 74 people and which damaged 3000 homes.
Floods-2003	July August 2003 heavy monsoon rains caused the worst flooding for a decade in Sindh that resulted in 230 deaths, one million people affected, tens of thousands of houses destroyed, 45,000 acres of crops damaged and 20,000 cattle killed.
Floods-2010	In July & August 2010 abnormal monsoon rains resulted into countywide unprecedented flash & riverine flooding. Population affected 20.25 million, death 1985, houses damaged 1.89 million, and area affected 132,000 Sq Km. Economic losses were to the tune of US \$ 9.5 billion.
Floods-2011	Highest ever recorded four-week monsoon rainfall in Sindh caused devastating floods. The rainfall was more than five years average rainfall of the area. Persons affected 9.72 million, houses damaged 1.5 million, person died 456, cattle perished 1.15 million, and crop area damaged 6.6 million.
Floods-2012	Late September monsoon rains caused devastating floods in parts of Punjab, Sindh and Baluchistan. Villages affected were 14,370, crops damaged over 1.1 million acres, houses destroyed were 2,75,023 and resulted loss of 9651 cattle livestock.

(Source: NDMA & Flood Forecasting Division – Pakistan Meteorological Department)

## Box-1

## Climate Change Terms

**Weather** is the day-to-day atmospheric conditions at a particular place in terms of air temperature, pressure, humidity, wind speed and precipitation.

**Climate** is defined as the average weather conditions, at a particular place, over time (typically, 30 years).

**Climate Variability** refers to short term (daily, seasonal, annual, inter-annual) variations in the mean state of climate on all temporal and spatial scales beyond that of individual events.

**Climate Change** refers to any significant change in the mean state of climate (such as temperature, precipitation or wind), persisting for an extended period (decades or longer). Climate change may be due to natural factors or due to persistent anthropogenic changes in the composition of the atmosphere (e.g. through burning fossil fuels) or in land use changes (e.g. deforestation, urbanization etc).

**Vulnerability** to climate change is defined as a function of a system's exposure and sensitivity to adapt to their (adverse) effects (IPCC 2007).

**Adaptation** to climate change is a response that seeks to reduce the vulnerability of natural and human systems or take advantage of expected changes in climatic conditions.

**Mitigation** to climate change is another policy response that aims to reduce greenhouse gases emissions or enhance the removal of these gases from the atmosphere.

**Intergovernmental Panel on Climate Change (IPCC)** is the global scientific body established by the WMO and the UNEP. It produces Assessment Reports and most recent is the Fourth Assessment Report in 2007. These reports summarize the state of knowledge on climate change and allow informed policy makers to see the consequences of alternate decisions.

**United Nation Framework Convention on Climate Change (UNFCCC)** provides the global legislative framework for reducing global warming and responding to climate change. It convenes annual meetings, known as **Conference of Parties or COP** for negotiating emission reduction and adaptation financing.



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