

PUNJAB CLIMATE CHANGE POLICY (Internal Draft)

Not for Circulation



2017

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List of Abbreviations

AR5	Fifth Assessment Report of IPCC
CCD	Climate Compatible Development
CO2	Carbon Dioxide
CSOs	Civil Society Organizations
DRR	Disaster Risk Reduction
EPD	Environmental Protection Department Punjab
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GoPunjab	Government of Punjab
Ha	Hectares
IPCC	Intergovernmental Panel on Climate Change
NCCP	National Climate Change Policy
NDMA	National Disaster Management Authority
NGOs	Non-Governmental Organizations
NTFP	Non Timber Forests Produce
P&D	Planning and Development Department Punjab
PCCP	Punjab Climate Change Policy 2016
PDMA	Provincial Disaster Management Authority
PGS	Punjab Growth Strategy 2018
UNFCCC	United Nations Framework Convention on Climate Change

1 Goal¹

To ensure that climate action is mainstreamed in the development planning and especially in the economically and socially vulnerable sectors of the economy; and to steer Punjab towards economic growth² and *climate compatible development*³.

2 Policy Objectives

- This policy proposes measures which address Punjab specific climate change impacts and is in line with National Climate Change Policy (2012) and its Framework for Implementation (2013).
- Enhance awareness of the impacts of climate change among all stakeholders for necessary appropriate measures to combat and minimize these impacts.
- Mainstream climate change in long term development planning as a vehicle for the implementation of the provincial *Punjab Growth Strategy (PGS)*.
- Integrate climate compatible development paradigm through climate resilient, low carbon, and water-energy-food nexus related measures into key relevant sectors' policies, strategies, and plan.
- Facilitate climate action in Punjab on climate resilience, low carbon, and water-energy-food nexus related themes, while promoting long term sustainability in urban and rural areas.
- Enhance interdepartmental coordination and cooperation for effective climate action.
- Ensure water, food, and energy security for Punjab province in the face of a changing climate.
- Address climate change risks particularly those arising from climate induced disasters.
- Ensure interests of vulnerable groups and gender aspects are adequately addressed in climate development strategies and planning.
- Develop bases to secure sufficient financial and technological support, and strengthen institutional and human resource capacities to achieve policy objectives; and to be able to tap financial and technological opportunities available internationally.

3 Introduction to Climate change

The exchange of gases between the earth's atmosphere and air, land and water influence the earth's climate and average weather. This exchange is what keeps the earth at an optimum global average to sustain life. Without this natural balance, or *Greenhouse Effect*, the earth will freeze over, similarly an

Greenhouse Effect

The greenhouse effect is a natural process by which radiation from the atmosphere warms the surface of the earth, to an optimum temperature for the sustenance of life on earth.

¹ This policy goal has been stated so as to be completely in line with the National Climate Change Policy.

² As envisioned by the Government of Punjab. See chapter 5 for elaboration and details.

³ **Climate compatible development:** While climate resilient development increases adaptive capacity against climate impacts it does not necessarily cater to the mitigation aspects. Climate compatible development, on the other hand, is a holistic approach that minimizes the harm caused by climate impacts, while maximizing human development opportunities presented by a low emission and resilient future. See chapter 10 for more comprehensive explanation.

alteration in this natural balance can have dire impacts on all organisms which live off the earth's natural resources.

Increase in carbon emissions and warming of the earth's atmosphere has been exponential after 1950s. With yearly temperature records reaching never seen before Fahrenheit's. According to the latest Intergovernmental Panel on Climate Change (IPCC) report, the last three decades have been warmer than the previous. Oceans are getting warmer, sea level is rising and glaciers are melting. It is predicted that there will be an average increase in global temperatures from 0.3-4.8 degrees by 2100 under business as usual.

The stability of the climate is very important for natural ecological systems to survive. Humans depend greatly on these services, if they are thrown off balance due to anthropogenic activities, the detrimental impacts arising from their depletion will be faced by all of mankind. The issue of Climate Change adaptation and mitigation has a global impact but through low carbon, climate resilient, and water-energy-food nexus related measures at a country, district and community level the global threat of Climate Change be tackled.

Geographic location, dense population and poverty has made countries of South Asia, e.g. Pakistan highly vulnerable to Climate Change. Pakistan experienced damages worth an estimated 10 billion US dollars as a result of the floods of 2010 (World Bank and Asia Development Bank, 2010). Not only have such recurring weather events become more frequent, their impacts on human health, livelihoods and economic development have stretched in magnitude and extent.

Therefore, each province needs to step forward to make their rural and urban areas more resilient to Climate Change. So that, monetary and human life loss can be controlled in event of natural disasters and extreme weather events.

How can Climate Change impacts be reduced?

Climate Change impacts can be reduced or tackled by adopting mitigation and adaptation strategies best suited for the geographic location, terrain, availability of resources and potential natural disasters prone to that area.

Adaptation- is a process, or set of initiatives and measures, to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Adaptation can also be thought of as learning how to live with the consequences of climate change.

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

Table 3-1: Key aspects of climate change policy

Policy Response		Objectives and Targets
United Framework Convention Climate (UNFCCC)	Nation on Change	UNFCCC seeks to reduce international GHG emissions by setting National level targets based on the concept of 'common but differentiated responsibility'. This means that nations which emit majority of GHGs need to reduce GHGs at a greater rate.
UNFCCC's Protocol	Kyoto	Under the UNFCCC's Kyoto Protocol, developed countries agreed to reduce their overall emissions of a basket of GHG by 5.2 percent below 1990 levels over the period 2008-2012.
National Change Policy 2012	Climate	It supports the shift to a resource-efficient, low-carbon economy to achieve sustainable growth. It provides a long-term framework for action to factor in resource efficiency in a balanced manner in many policy areas, including

4 Climate Change challenges in Punjab

Punjab is the second most urbanized and the most populous province of the country. It is known as the breadbasket of Pakistan. The region is arid to semi-arid and mostly plain. The semi-arid region of Punjab is punctuated by five rivers, which are the reason why Punjab has a significant contribution to agricultural outputs. There are some hilly areas in the North-west, bordered by the Potohar Plateau which transitions predominantly into alluvial agricultural plains and eventually into a desert belt known as Cholistan.

The climate of Punjab ranges from extremely hot summers to mild foggy winters. The land is hydrated by summer monsoons and by the five rivers which run longitudinally through the province, namely, Indus, Jehlum, Chenab, Ravi, and Sutlej. Summers are hot from May to July, followed by monsoon rainfall from the Bay of Bengal from August to September which breaks the heat spell. These bring precipitation to the northern parts of the province. The Southern parts of the province receive rainfall from southwest winds from over the Arabian Sea.

4.1 Punjab – a Zonal Distribution

According to Pakistan Agriculture Research Council, Punjab is divided into four agro-ecological zones based on water availability to the land. This zonal distribution is summarized below:

Table 4-1 Agro-ecological zones of Punjab with major districts

Zone	Description of Land	Major districts
A	Irrigated Plains: Cotton zone, Central mixed zone, Rice Zone	Rajanpur, Rahimyar Khan, Bawalnagar, Lahore, Sheikhpura, Gujranwala, Kasur
B	Barani Region: High rainfall, low rainfall	Rawalpindi, Attock, Chakwal
C	Irrigated zone, arid zone	Layyah, Bhakkar, Mianwali, Khushab
D	Suleiman Mnts, Rud-I-Kohi, Cholistan	Dera Ghazi Khan, Bahawalpur, Rahimyar Khan

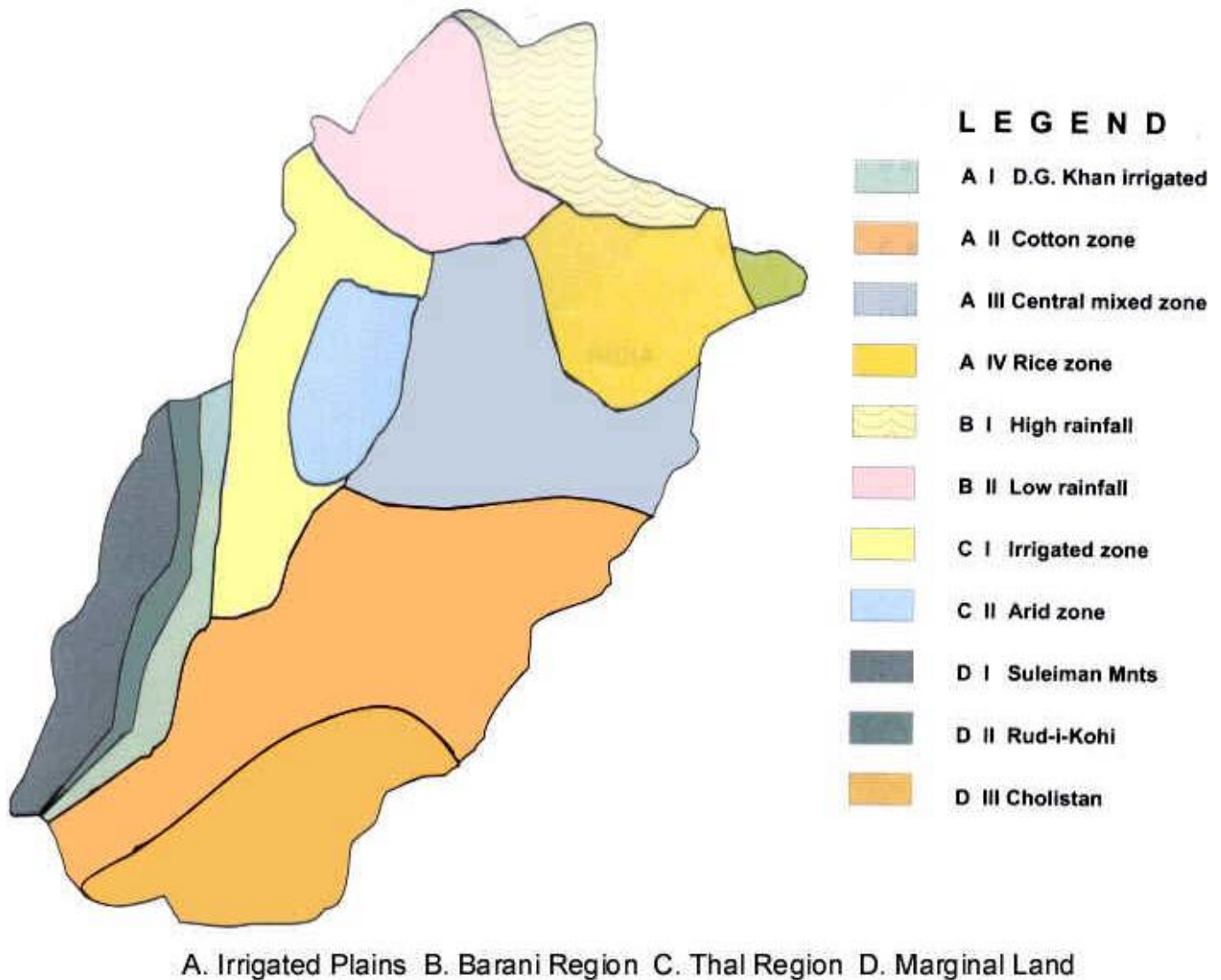


Figure 4-1 Agro-ecological zone distribution of Punjab (PARC. (.n.d).)

Climate change impacts vary with topography, usual weather patterns and land use. Each zone will have different intensity of impacts depending on these properties and unique land cover such as Zone A, irrigated plains; Zone B, barani region; Zone C, Thal region; and Zone D, marginal land.

4.2 Climate Hazards in Punjab

The impacts of climate change are evident in many parts of the world. In the latest report by the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 5 (AR5) 2014, the linkage between climate change and its impacts on natural and human systems has been given strong recognition. Moreover, there is more strong evidence that climate change is responsible for the disruption of weather patterns catalyzing melting of glaciers, alterations in hydrological systems, species diversity by changes in migration pathways, changes to crop production and yield threatening existing food production patterns. The report states that the frequency of heat waves in Asia is expected to increase and stay for longer periods of time. The number of cold days and nights will decrease and warm days and nights will increase. Therefore, irrespective of what is causing climate change, there are evidences from past events all over the world that climate change is threatening the natural balance of nature and proving the dependence and sensitivity of human on nature (IPCC, 2014) (IPCC, 2014a).

Over the past decade, impacts of climate change have been experienced in the form of warming of the atmosphere and ocean, rise in sea level and increase in concentration of greenhouse gases. Therefore, there is no ambiguity related to the evidence that climate change is happening. Impacts of climate change also make the destruction caused by natural hazards even worse. When events of heavy precipitation increase and with rise in average surface temperature of the earth altering the natural weather patterns, natural hazards become more intense and dangerous to communities especially in vulnerable areas. Natural hazards are defined as naturally occurring events which are potentially dangerous to communities in difficult and disaster prone terrains. Earthquakes, landslides, floods, droughts, hurricanes and volcanic eruptions can be classified as naturally occurring hazards. Without proper risk reduction, mitigation and adaptation methods, these natural hazards can turn into catastrophic disasters.

Punjab lies in the mid-latitude region of the globe where all four seasons are witnessed along with regular interruptions of the northeastern monsoon and westerly precipitation. The weather throughout the year changes considerably which gives Punjab diversity in agriculture and ecology.

The North West part of the province experiences high to low rainfall during the monsoon season, the upper parts of the province lies on the foothills of the Himalayan range. The rest of the province is mostly semi-arid and plain which receives considerably less rainfall throughout the year. The southern parts of the province is predominantly dry arid land, with deserts in the extreme south bordering India and Sindh.

Zone A, is irrigated by the five river system of Punjab and the land is heavily used for cotton, rice and wheat cultivation. Cotton is grown more in the lower lying parts of zone A where temperatures are high, whereas rice is cultivated in cooler climates in the upper parts of zone A.

Zone B, is higher up north and receives more rainfall due to the monsoon influence, which comes in originally from the Bay of Bengal but is deflected by the Himalayan Range. Therefore this zone is predominantly *Barani*.

Zone C, is irrigated to arid land on the west of the province, making the Thal region. The Thal desert is located between Jhelum and Sindh River and is comprised of Layyah, Bhakkar, Khushab, Muzaffargarh and Mianwali districts. The Indus and Jhelum run longitudinally through this zone providing water for the cultivation of Wheat and Maize.

Zone D, is dry land and is also known as Cholistan. Cholistan Desert is located in the South bordering India and covers majority of the area allocated to zone D. The Indus River runs on its outskirts.

According to the distribution of land cover described above in each zone, it is evident that climate change impacts will range from the north to south. These impacts can be in the form of slow changes to food production patterns and weather patterns or abrupt catastrophic weather events such as flash floods due to cloud bursts, drought due to water stress and scarcity and heat waves. The climate hazards which are most likely:

4.2.1 Flood Zone

Floods have been the most frequent and damaging climate hazards to not just Punjab but to most parts of Pakistan, creating negative impacts on the country's economy. Frequent and extreme weather patterns over a shorter period of time has started becoming a yearly norm for many parts of Punjab, especially to the South. According to the National Monsoon Contingency Plan 2013, the main monsoon hazards suffered by Punjab are:

1. **Riverine floods:** These occur in the flood plains of the Indus River and its tributaries
2. **Flash Floods:** These are mostly downstream flood which occur in the foot plains of mountainous regions of Khyber Pakhtunkhwa, Gilgit Baltistan, the Indus River Basin, Kashmir, Baluchistan and ultimately South Punjab. These have been frequent events over the past few years and have

caused catastrophic loss of agriculture land, livestock, settlements and displaced millions of vulnerable communities.

3. **Hill torrents:** These occur in the southwestern mountain range of Punjab known as the Suleiman Range.
4. **Urban floods:** These floods occur most frequently after intense precipitation incidents or cyclones in many cities of Pakistan, such as Lahore and Rawalpindi in Punjab.

Floods have occurred repeatedly over the past few years in different parts of Punjab due to different meteorological reasons. The super floods in 2010, were riverine floods which impacted 78 districts of Pakistan including a large area of Punjab. In 2012, hill torrents and heavy rainfall subdued parts of southern Punjab into flood waters. Heavy monsoon rainfall in 2013 brought with it extreme floods which almost engulfed most parts of the country including central Punjab. However, the damage caused by these floods is not completely due to heavy monsoon rainfall or hill torrents. In fact, many social vulnerabilities turn these meteorological events into disasters. Increase in population has caused the encroachment of settlements onto flood plains. As the rivers dry up due to increasing temperatures, people settle closer to the thinning rivers to sustain their livelihood. Homes are made out of natural material which are washed away by floods. Rampant environmental degradation has reduced the water absorption capacity of the land, moreover there are no barriers to stop the flood water from entering downstream settlements making them highly vulnerable. Moreover, glacial melting in the north causing uncertain river flows in Indus have also been a major cause of downstream flooding. The map generated by the PDMA shows the most vulnerable districts in Punjab.

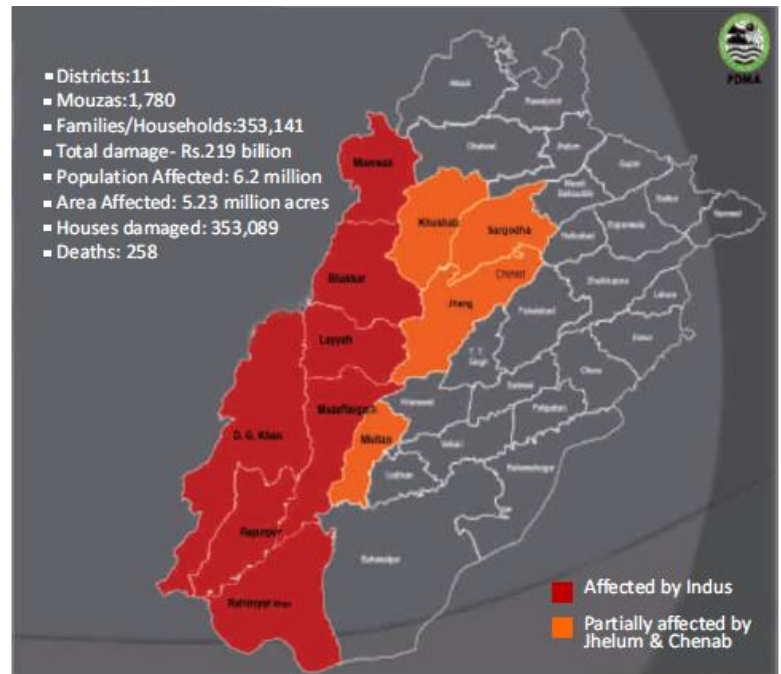


Figure 4-2 Districts Vulnerable to Floods in Punjab

Flooding events are not going to decrease in the future with heavy and unexpected rainfall patterns becoming a norm. Where riverine flooding might decrease over the next ten years, incidents of flash floods and hill torrents is going to increase. According to the IPCC report, Asia is vulnerable to increase in urban flooding and flashfloods which will lead to widespread damage to infrastructure, livelihoods and settlements. Keeping this in mind, Punjab needs to adapt effective climate resilient strategies to minimize damage to infrastructure, settlements and agricultural fields. As depicted by the map above, many parts of Punjab are currently high risk zones of floods. With western parts of zone D, C and a few parts of zone A being highly prone to hill torrents and downstream flash floods. The eastern parts of zone A are industrial and populated cities, which are at a risk of urban flooding due to poor storm drainage systems.

4.2.2 Drought Zone

As most of the regions of Pakistan are arid to semi-arid especially in Punjab, the susceptibility of droughts in these areas is very high. Although droughts are natural occurring, the risk and damage caused by them is directly proportional to the exposure and vulnerability of the society. The IPCC has stated in the latest annual report of 2014, that Asian regions will experience an increase in drought incidents and drought related food and water storage problems. Droughts unlike floods span over a larger geographical area, therefore have wide ranging and longer impacts.

Punjab experiences dry spells and high temperatures during the summers which are a cause of droughts in the region. The southern parts of Punjab are most prone to droughts, mainly in lower parts of zone A and marginal lands of zone D with India. These zones are dependent on cultivation of cotton and wheat and grazing of livestock for their livelihood. Droughts can have serious negative effects on these. Droughts can cause famine, death of livestock, decrease in crop yield, decline in groundwater tables and drinking water availability, spread of diseases such as malnutrition, environmental degradation and desertification.

With the global increase in average temperatures and shifting weather patterns due to Climate Change, Punjab is most likely going to face extremely hot and long summers which will increase the chances of droughts in many districts along with heat waves. Although the incidents of droughts have been low in Punjab and droughts have been considerably less severe as compared to Sindh and Baluchistan, the duration of droughts have been long and have impacted children the most. The chances of drought are the highest during the season of low rainfall and high temperatures.

4.2.3 Earthquake Zone

Although earthquakes are not caused by Climate Change, they have severe impacts on communities and can alter natural ecosystems. Moreover, they can be the cause of many other natural hazards such as landslides, floods (due to cracks in dams, altering of river pathways), infrastructure damage which can pose as a challenge for rehabilitation efforts.

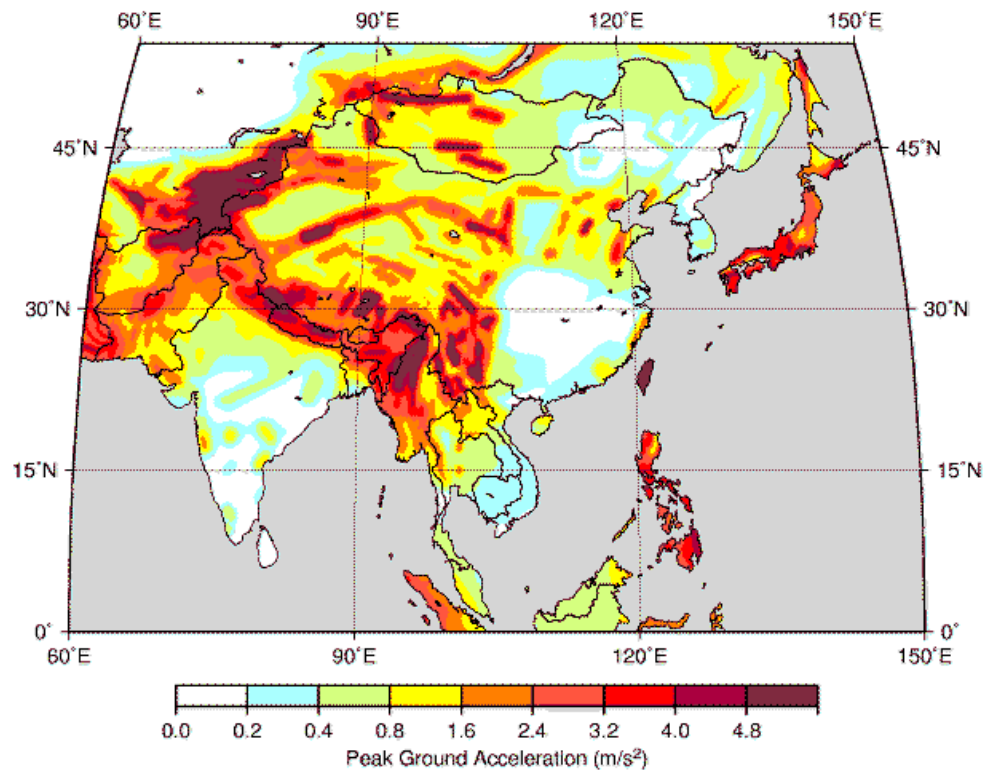


Figure 4-3 Map representing the red zones for earthquakes of South Asia (GSHP, 2000)

Pakistan is located on two major tectonic plates, Eurasian and Indian Plate. This makes Pakistan at high risk from high magnitude earthquakes. This is evident by the red to orange color given to Northern part of Pakistan in the map above. The Northern regions, especially Punjab are at higher risk compared to the other parts of the country and have experienced devastating earthquakes before. The Hindukush and Himalayan range are usually determined as the epicenters of earthquakes which affect this region. Therefore, disaster risk reduction and climate compatible development is of utmost importance in Punjab to prevent loss of lives and infrastructure and create communities which are able to reduce as much damage as they can through safe buildings and better preparation through capacity building and access to rescue equipment.

Some of the main climate change impacts that Punjab is most likely to face can be summarized as below:

Increase in surface temperature-The IPCC AR5 has reported that almost all of the globe has experienced surface warming. This will result in hotter, longer summers and shorter and milder winters having significant impacts on cropping patterns of Punjab. Moreover, incidences of heat waves will also increase in the lower parts of Punjab which already are considerably hot during summers. Higher temperatures will also mean that monsoon rainfall will be more severe (due to more evaporation of water in the atmosphere causing a higher moisture content which will create extreme weather conditions) increasing risks of flooding downstream in the lower parts of Zone A (cotton zone), and in major parts of Zone C (irrigated and arid zone) and D (particularly, Rud-i-Koh and Suleiman Mnts).

Increase in precipitation- More intense rainfall over a shorter period of time will cause flash flooding with large volumes of water coming from the upper areas of Punjab in the monsoon season will impact all western parts of the zones, while the floodplains downstream - the main centers of population and agricultural activity due to alluvial soil - will be affected by riverine floods. Intense rainfall can cause soil erosion and strips soil of nutrients. Moreover, shortage of rainfall in drier areas higher parts of zone D and lower parts of Zone A (such as the central mixed zone, cotton zone) will result in drought effecting crop yield.

Changes in food production- This impact is most significant to Punjab where majority of the agricultural activity occurs. As weather patterns shift, temperatures fluctuate and rainfall becomes more erratic, changes in the type of crop and amount of crop produced will occur. Farmers will have to struggle with depleting water supplies and extreme temperatures unsuitable for a healthy crop. Moreover, they will have to deal with frequent insect infestation due to favorable warmer humid climate for insects. In the north with an increase in temperature, more crops will be able to be cultivated, such as cotton, wheat, maize, rice etc., whereas in the Central Valley Plain, which is currently the main region for agriculture, and also the Southern Piedmont region, will face water shortage due to decrease in rainfall, causing a decrease in crop production. These changes along with natural hazards such as floods and droughts (which completely destroy agricultural fields and ready to harvest crops) will cause food security issues in the province.

Shifting weather patterns- Changing weather patterns such as higher temperatures and more rainfall can have serious impacts on flora, fauna and people living in the province of Punjab. Higher temperatures and shorter winters allow insect forests to thrive thus weakening trees. Droughts can have the same weakening effects. Higher temperatures also provide more bacteria and viruses to thrive and can cause health issues to people, especially those who consume contaminated water. Moreover, flooding and droughts can cause shortage of potable drinking water.

Loss of species diversity- Climate change is a threat to species diversity. Changes in temperature and precipitation are the basis for changes in ecosystems which are abode to many mammal, bird, forest and insect species. Most plant species cannot shift their geographic ranges or adapt to the rapid changes in climate. Mammals and other species will not be able to do either. Moreover, changes in ecosystems means changes in feeding patterns which can weaken animal species and lead to their extinction (IPCC, 2014).

People and society- Climate change and its implication on society means that people will have to change the way they live. They will have to adopt techniques which can help minimize impacts of climate change and the rate of climate change itself. Extreme weather patterns caused by the changing climate will cause a stress on human health, infrastructure, livelihoods and culture. Climate change will increase the displacement and the need for resettlement of people who are subjected to extreme weather patterns, especially in developing countries.

5 Punjab Growth Strategy and Climate Compatible Development

5.1 Setting the scene: National Climate Change Policy and Framework for Implementation

The National Climate Change Policy (NCCP) is comprehensive document which covers the adaptation and mitigation related policy measures for sectors relevant to Pakistan. It serves as a reference points for policy implementers in all provinces. The NCCP Framework for Implementation was developed by the Government of Pakistan as a follow-up of the NCCP document. It outlines strategies and actions to meet the objectives laid out in the NCCP by following the approach of *climate compatible development*. The NCCP Framework for Implementation stresses the need for preparation of detailed provincial policy and action plans. Hence the preparation of a detailed provincial climate change policy based on the principles of climate compatible development, followed by action plans is imperative for the province of Punjab.

5.2 Punjab Growth Strategy 2018

Over the past year, the GoPunjab has been very active in starting initiatives to reduce Climate Change by taking a step towards developing a Punjab Climate Change Policy and showing active participation in various stakeholder policy dialogues and capacity building events to signify their commitment in reducing further impacts of climate change on the people of Punjab.

In an endeavor to resolve Punjab's growth challenges, the GoPunjab has started giving priority focus on key sectors such as industrial development, cities and urban development, agriculture, livestock, skills, education, demography and health within The PGS. The Growth strategy demarks focus areas and recommendations for these sectors to accomplish an economic growth of 8% by 2018, 1 million quality jobs, and increasing exports by 15%, simultaneously achieving all Sustainable Development Goals by 2018.

The Growth Strategy proposes many policy measures to achieve their targets through sector specific interventions through investing public investments in core public goods and inducing private capital in promoting industrial development, resolving electrical shortage, increasing skills and human capital, enhancing performance of cities, improving agriculture and market access for exports, prioritizing livestock and dairy, education, population planning and building a healthier Punjab through better health facilities. The infographic below summarizes the key messages in the PGS.



Punjab Growth Strategy 2014-2018

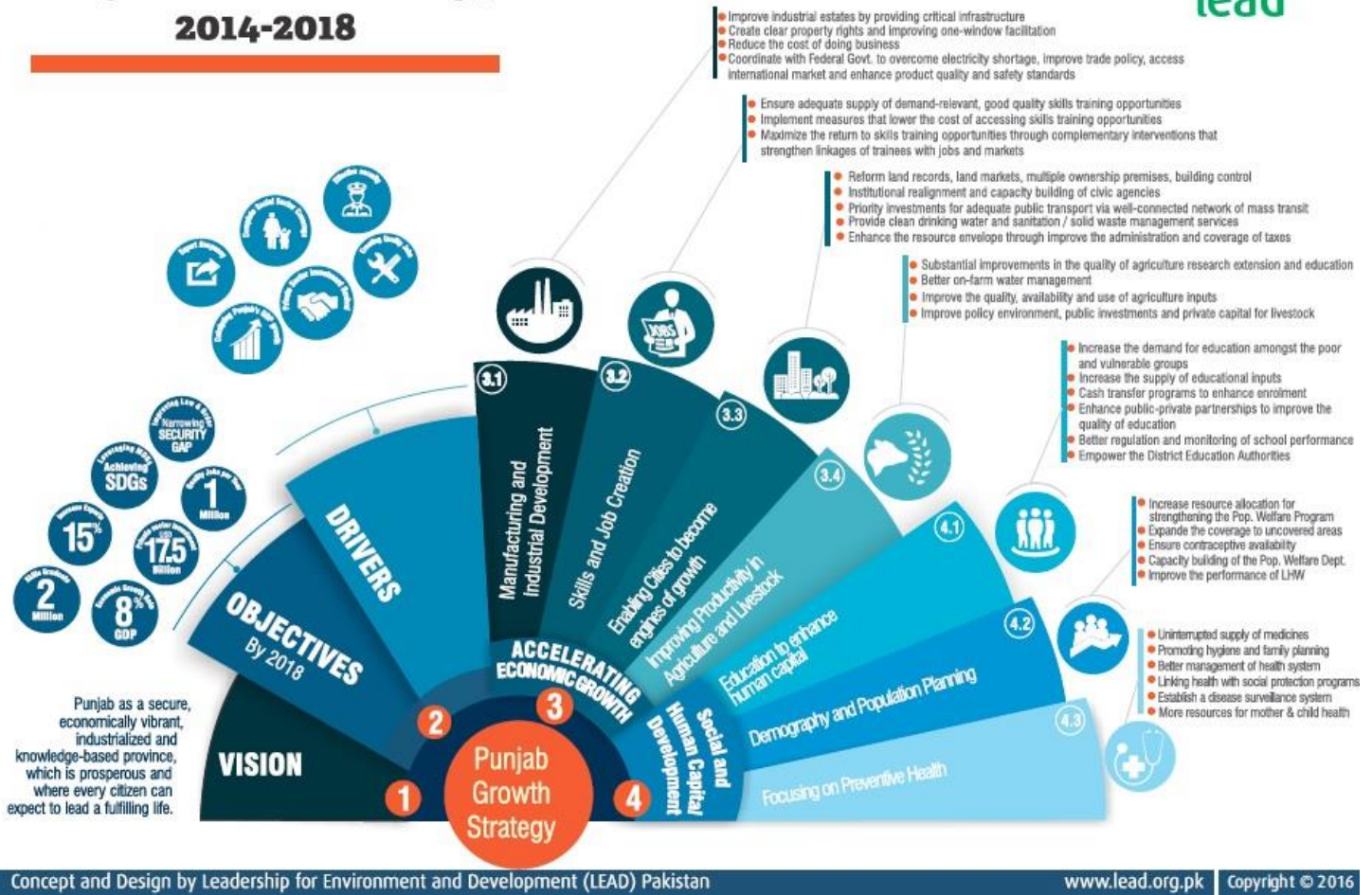
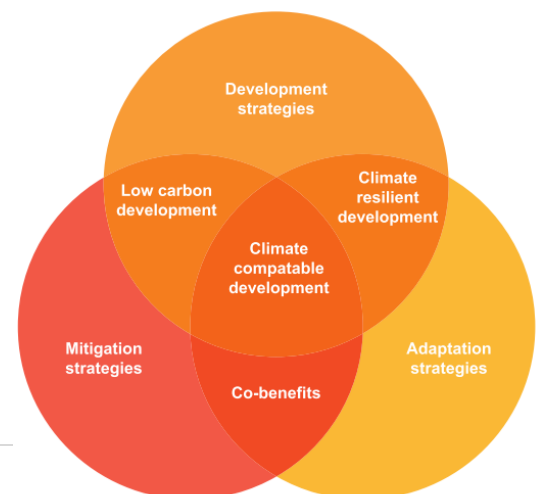


Figure 5-1 Infographic PGS

5.3 Towards a Climate Compatible Paradigm

Punjab has burgeoning environmental problems which are a hindrance to its road to sustainable development. This has been recognized by many government departments who are ready to take on necessary roles and responsibilities needed to make Punjab more climate compatible. In light of series of frequently occurring natural hazards, strategies to improve Punjab’s growth and economy and linkages has been a regular topic of debate at various national forums in the public and private sector. It has become evident that Punjab needs to move towards sustainable development with priority focus on climate change issues.

Being one of the largest and most lucrative provinces of Pakistan, Punjab’s growth and development is pivotal for Pakistan’s economic stability. Over the past few decades, unsustainable development has increased the vulnerability of Punjab. Without climate smart interventions and solutions to all growth needs, especially in infrastructure, urban development, energy and power generation, agriculture and water sectors, the growth of Punjab will be in peril. There is a need to shift towards climate compatible development to prevent further economic and social capital loss from future climate events. Therefore, climate compatible development, to reduce future risks from disasters (such as extreme weather patterns, disease outbreaks,



unexpected increase in temperatures which can ruin crop yields, etc.) needs to be made an essential and critical part of the development agenda.

Figure 5 Climate Compatible Development Paradigm (CKDN)

5.4 Punjab on the 'Triple Win' Pathway

In an effort to catapult Punjab a level further into the CCD paradigm it is imperative to the province that Climate Change Policy incorporate the 'Triple Win' strategies offered by the paradigm which looks at Low Carbon Development, Climate Resilient Development, and the arising Co-benefits of adaptation and mitigation efforts [Figure 4-3]. Within Climate Resilient Development a special focus has been laid upon making cities sustainable, as according to the PGS cities need to be treated engines of growth. A thorough analysis of the climate change impacts on different sectors of Punjab it can be stipulated that the highest co-benefits from adaptation and mitigation efforts should trickle down into strengthening the linkages between the Water-Energy-Food Nexus.

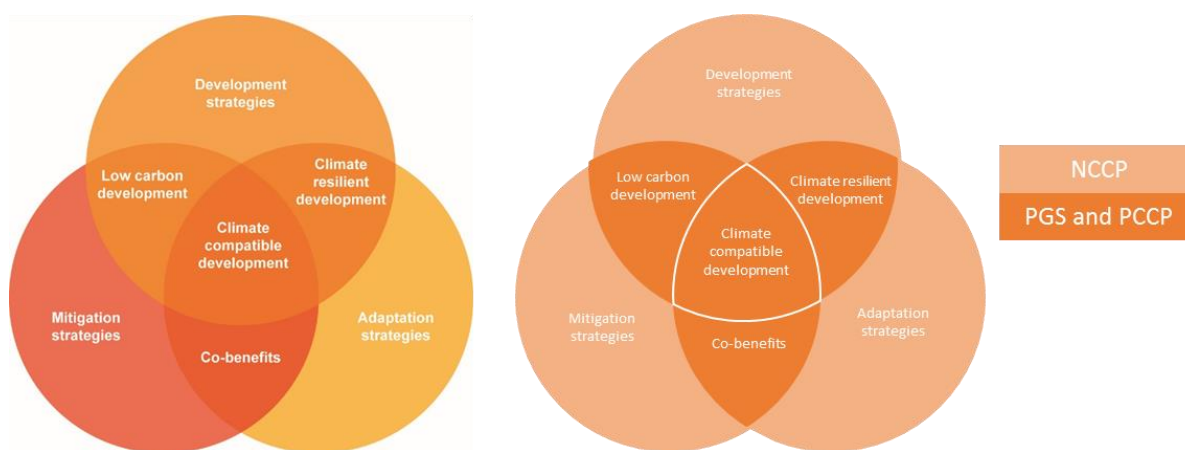


Figure 5-3 CCD, PCCP, PGS, and NCCP

In order for Punjab to move towards a sustainable economy, climate compatible development needs to be encouraged in every sector to reduce carbon emissions, enhance climate resilience, create better linkages between Water-Energy-Food Nexus, and make cities sustainable in order to reduce the severity of predicted climate change events. Climate Change is already posing as a threat to the national economy, with billions of dollars going into post disaster rehabilitation efforts and loss in infrastructure. With the increasing probability of extreme weather events such as floods and droughts in Punjab, the cost of damage will only be exasperated.

The PGS, through its sectoral focus which cover the 'Triple Win' strategies of the CCD paradigm, already sets the precedence for Punjab Climate Change Policy. At this secondary level of CCD as it relies heavily on the three strategies of Low Carbon Development, Climate Resilient Development (Sustainable Cities), and Co-Benefits (Water-Energy-Food Nexus). The paragraphs to follow will attempt to demonstrate how key components of the 'Triple Win' strategies have already been discussed by the PGS and therefore make a suitable starting point for the PCCP. The PCCP measures have been drafted using the three lenses of Low Carbon Development, Climate Resilient Development, and Co-benefits.

5.5 Low Carbon Development

Carbon is an emblem of industrial development and is a major contributor towards warming of the earth's atmosphere. Low Carbon Development aims at reducing the amount of carbon released into the atmosphere and is a major part of mitigation efforts in reducing the severity of climate change impacts

(pwc, 2014). Measures proposed for low carbon development can help decarbonized economy, increase natural resource efficiency, and improve energy security for Punjab.

Initiatives proposed by the PGS can be enhanced by branching out into various sectors and creating an enabling environment for its implementation. The PGS can incorporate deeper understanding of climate compatible development by focusing on climate friendly measures within the priority sectors underlined in the growth strategy. To overcome electricity shortage, the strategy proposes energy efficiency and conservation measures such as renewable power plants, including solar and hydel power plants. Coal based power plants have also been proposed in the strategy but in order to make them in line with climate compatible development strategies, reduction in carbon emission through pollution control technologies need to be adhered to. The industrial sector should focus on strictly abiding by national environmental quality standards to curb land and air pollution and not just production quality standards. PCCP takes a holistic approach to incorporating low carbon development options across the sixteen sectors, where it proposes measures pertaining to mitigation and development for each.

5.6 Climate Resilient Development

The Intergovernmental Panel on Climate Change (IPCC) defined Resilience as “the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change”. This definition of Resilience when applied to the ‘triple win’ strategies of the CCD paradigm would lead to development which can enhance the ability of the system to absorb climate shocks and mitigate stresses, ultimately leading to climate resilient development.

In order to accelerate economic growth, the PGS prioritizes skills & job creation, enhancing social outcomes, improving human capital, and treats cities as engines of growth. The measures proposed for improving the performance of these sectors, when made climate compatible, can enhance sustainability and resilience of urban and rural areas.

Climate compatible development emphasizes on human capital development, as access to quality education and health facilities is important to sensitize people and help them cope with the changing climate with a broader understanding of the impacts. Participatory planning in policies and development plans of citizens will influence the success of adaptation strategies, simultaneously bridging the gap between culture and adaptation methods and enhancing climate resilience.

Increase in quality and quantity employment opportunities, urban and rural areas, is one of the challenges that Punjab is currently facing. The PGS proposes to increase skilled labor and quality jobs for men and women in urban as well as rural areas. Such interventions would contribute to poverty reduction and reduce the vulnerability of marginalized communities to climate shocks and stresses.

5.6.1 Sustainable Cities

Cities are at the forefront of the battle against climate change, they are major drivers of climate change and are highly vulnerable to its impacts⁴. Unplanned urbanization and unclear policies in Punjab, where 40% of the population resides in urban areas, have created hurdles for cities in reaching their full economic potential. These factors have also exacerbated the impacts of climate change in the urban areas of the province where extreme weather events are impacting cities, paralyzing transportation, sewerage systems, and stagnating economic activity are an impediment to utilize this untapped potential.

⁴ <http://www.ghgprotocol.org/city-accounting>

The PGS sees cities as engines of economic growth and places urban development at the heart of the strategy. Improvement in urban management, infrastructure investment, and urban investments will need to be climate compatible if Punjab is to win its battle against climate change. Introducing climate resilient land-use planning will not only help utilizing unproductive land, but will also reduce the vulnerability of informal settlements in the wake of climate induced extreme events. Low carbon and pro-poor transport needs to be promoted so that mitigation and development strategies could be implemented. Access to clean water and environment can improve health and enhance resilience, especially during extreme events such as heat waves the incidence of which is likely to mount in cities. In order to create better linkages between the PGS a special focus, within this policy, has been laid upon making Sustainable Cities within the Climate Resilient Development of CCD.

5.7 Co-Benefits

While planning adaptation and mitigation actions there are opportunities for achieving co-benefits. Climate-resilient mitigation actions and low emission adaptation options would lead to the emergence of co-benefits. Hence when both adaptation and mitigation objectives are being achieved through an action, they are known as co-benefits.

5.7.1 Water-Energy-Food Nexus

Water, Energy, and Food are imperative to sustaining life. Climate change impacts affect the availability of water, and food, while efforts to reduce these impacts have direct impact on energy security (Wakeford *et al.*, 2015). According to the reports of the Climate Change Commission, availability of water in Punjab is plummeting. With increasing demand and chronic energy shortage faced by the breadbasket of the country, food security is likely to be the next victim. GoPunjab is diverting all its efforts to prevent this from happening by promoting the optimum utilization of the nexus in the PGS. The PGS aims at resolving energy shortages, improving agricultural productivity & market access, livestock & dairy development, health, and education. The Water-Energy-Food nexus approach will enable the realization of co-benefits across the different sectors.

5.8 Linkages with Sustainable Development Goals

With 17 goals and 169 targets to achieve these goals by 2030, Pakistan must now shape its development agenda with a more inclusive approach; climate change and environment components now constitute a greater number of goals and targets than before. SDGs and the Climate Compatible PCCP promote climate action, development in harmony with nature, sustainable ecosystem management, and economically sound environmental technologies. Out of the 17 SDGs Goal 13: Climate Action, is dedicated to reducing the impact of climate change. PCCP measures propose sustainability, reduction in environment degradation, and mitigation of climate change drivers. This brings about indirect benefits and helps in meeting other SDG goals.



5.9 Way Forward

Shifting development goals and plans towards climate compatible development is a challenge, however it is a step towards sustained development over a longer period of time. Its vitality cannot be ignored, therefore shifting towards development which does not compromise the climate and conserves the natural environment along with maximum economic growth is a step towards fulfillment of not just sustainable development goals but all future development objectives.

6 Climate Change Policy Measures

In the grid below find the policy measures proposed for the sixteen sectors relevant to Punjab. The first 7 sectors namely Water Resources, Agriculture, livestock, Forestry, Land and Vulnerable Ecosystem, Biodiversity, and Disaster Preparedness are priority sectors as identified by the Climate Change Commission. The remaining sectors namely fisheries, human health, socio-economic measures, energy, industry, transport, waste, and urban planning follow suit. The sectors are completely aligned to the sectors identified by the NCCP. Find below a table which shows how the PCCP sectors are linked to the NCCP chapters. This Table (6-1) should be used to implement adaptation and mitigation measures from the NCCP along with the climate resilient, low carbon, and co-benefits (water-energy-food nexus) of the PCCP.

Table 6-1 PCCP, NCCP, NCCP Implementation Framework, and SDGs

	PCCP Sectors	NCCP Chapter	NCCP Framework for Implementation	Relevant SDG
6.1	Water Resources	5.1	4.1	Goal 6
6.2	Agriculture	5.2; 6.5	5.3	Goal 2
6.3	Livestock	5.2; 6.5	9.2, 6.1, 5.3.2, 5.3.3	Goal 2, Goal 14, & Goal 14
6.4	Forestry	5.4; 6.6	7.1,8.1	Goal 15
6.5	Land and Vulnerable Ecosystems	5.6	10.2, 10.4, 0.6	Goal 15
6.6	Biodiversity	5.5	10.1	Goal 15
6.7	Disaster Preparedness	5.7	9.2	Goal 13
6.8	Fisheries	*	5.3,10.3, 10.5	Goal 2 & Goal 14
6.9	Human Health	5.3	10.7	Goal 3
6.10	Socio-economic measures	5.8	*	Goal 1 & Goal 5
6.11	Energy (Generation & Distribution)	6.1	11.0	Goal 7
6.12	Energy (Efficiency & Conservation)	6.2	11.0.3	Goal 7
6.13	Industry	6.5	13.1	Goal 9
6.14	Transport	6.3	12.1, 12.2, 12.3	Goal 11
6.15	Waste	*	14.1, 10.2.3, 4.1.3	Goal 11 & Goal 12
6.16	Urban Planning	6.4	14.1	Goal 11

* Additional Sectors included in the PCCP and not a part of the NCCP/Framework.

Priority sectors (6.1 to 6.7, mentioned in bold) are aligned with the implementation committees of the Climate Change Commission in Punjab.

Priority Sectors ⁵	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-Benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
6.1 Water Resources	<p>Punjab water resources are used in agriculture, households, industries and power generation. Surface water is found in the form of springs, precipitation, lakes streams and rivers. Ground water can be found aquifers and alluvial deposits. Agriculture is the mainstay of the province and it uses more than 95% of the countries freshwater resources (ADB, 2007). 74.1% of the total irrigated land of Pakistan is in Punjab and the province supplies more than 50% of Pakistan's total agriculture output (Punjab Development Statistics, 2014). According to the reports of the Climate Change Commission water levels in the Punjab are continuously dropping and the dwindling water resources will have far reaching impacts on water use especially for agriculture.</p> <p>Punjab is the breadbasket of Pakistan and climate change can reduce the agricultural output of the province and increase the scarcity of water. Water resources are threatened by flooding, deterioration in water quality, and increase in intensity and frequency of extreme weather events. The absence of proper drainage choked the Indus Basin's massive irrigation structure through water logging and salinity (Qureshi <i>et al.</i>, 2008). Adding to the problem, our largely inefficient irrigation practices caused extensive usage of groundwater to supplement surface water supplies, thus up-coning saline groundwater (Shah, 2007). Some of the challenges to policy implementation in Punjab are lack of historical data, lack of coordination, lack of storage capacity to conserve water, and technical human resource.</p>	Promote investment through public - private partnerships in urban water supply and introduce water pricing;	Improve water-use practices in agriculture (Enhance water efficiency and productivity, Incentivize use of efficient devices, incentivize & expand drip irrigation technology deployment, deploy rain water harvesting systems; rehabilitate irrigation infrastructure, removing sedimentation, constructing breeches, and upgrade the distribution system);	Assess and address the need for additional water storages, continue efforts to construct small dams, water storage tanks, carry-over reservoirs to improve water storage capacity and where possible generation of clean energy;	Prepare a comprehensive inventory of all water resources, including surface and groundwater, in order to support an efficient water management system in the country;
		Ensure that surface and groundwater resources are developed and utilized sustainably and conjunctively and that water is considered as an economic and social resource; Promote public awareness campaigns to underscore the importance of conservation and sustainable use of water resources;	Develop and implement water conservation and water demand management strategy including financial incentives and fiscal instruments to promote water use efficiency especially in agriculture and industry sectors;	Promote rainwater harvesting and recycling of wastewater through proper treatment especially in the industrial sector;	Make centralized provincial water policy for the next 5 years which takes into account variation in water availability and quality due to climate change impacts;
		Increase capacity of local governments to reduce and re-use waste water;	Develop measures to adapt to water shortages, especially in water stressed areas, and surpluses that could help to mitigate the impact of droughts and floods;		Improve irrigation and drainage systems in water logged and salinized areas;
6.2 Agriculture	<p>Punjab contributes to around 50% of its agricultural produce (Punjab Development Statistics, 2014). The Punjab province has 57% of the total cultivated and 69% of the total cropped area of Pakistan. It constitutes a major share in the agricultural economy of the country by providing about 83% of cotton, 80% of wheat, 97% fine aromatic rice, 63% of sugarcane and 51% of maize to the national food production. Among fruits, mango accounts for 66%, citrus more than 95%, guava 82% and dates 34% of total national production of these fruits (www.agripunjab.gov.pk).</p> <p>A decrease in the share of agriculture sector in the provincial output, 31% to 20% is linked to decreasing agricultural productivity, crop failure, and inefficient use of agricultural inputs, water scarcity, environmental, and land degradation, all of which can be attributed to the impacts of climate change (PGS, 2015). In Punjab, the most dominant form of agriculture practiced is by utilizing the river basins, harnessing hill torrents and canal farming in some areas, all of which will be at threat from climate change impacts.</p> <p>Agriculture is energy intensive which releases large amounts</p>	Reduce migration to urban areas by providing farmers and communities localized livelihood diversification options;	Take measures to reduce crop failures, and improve crop health by reducing disease outbreak and impact of extreme events;	Encourage and incentivize the use of renewable energy and low carbon emitting technologies for on-farm activities;;	Promote water efficient farming techniques, especially in low rainfall areas, such as precision farming, laser levelling, and nutrient management etc.;
		Improve demand forecasting, access to farm produce, market structures and supply chains, and value-addition of produce;	Improve physical access to markets, and access to market information, especially for small and landless farmers.	Establish climate change units or centres at agriculture research organizations in the province to categorize areas according to their vulnerability to extreme climate events, climate resilient crop varieties, modern farming techniques;	Increase self-reliance on crops & agricultural inputs, and improve food security;
		Through viable legislation and land-use planning ensure that fertile land is prioritized for agricultural use and discourage conversion of this land for housing, industrial, or other non-agricultural purposes.	Promote and enable use of climate resilient and high yielding inputs, and sustainable agricultural practices;	Periodically update agro-ecological zones based on current climate, soil condition, and land cover data.	Introduce climate-smart water and energy use into agriculture extension programmes and increase number of female farmers targeted;
		Develop appropriate digital simulation models for assessment of climate change impacts on physical, chemical, biological and financial aspects of agricultural production systems in various agro-ecological zones;	Initiate campaigns in collaboration with Punjab Commission on the Status of Women, to highlight the contribution of women to agricultural GDP, environmental and land stewardship, conservation, and climate	Reduce the soil degradation caused by water logging, and salinity through crop rotation techniques, water efficiency, and rainwater harvesting;	

⁵ As per the Climate Change Commission of Punjab

Priority Sectors ⁵	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-Benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
	of GHG into the atmosphere. Deforestation for agricultural use is also a rising trend, and this can reduce the potential for soil carbon sequestration. Rapid urbanization is detrimental to the availability of fertile land for agriculture. As urban areas expand they use fertile land, which could be employed by the agricultural sector, is used for housing, and industrial activity. This sector has huge potential to sequester carbon and reduce GHGs into the atmosphere.			resilience, and women's vulnerability to climate change.	
6.3 Livestock	Livestock in Punjab contributes to two third of the milk production in the country. Pakistan has an estimated livestock population of 125 million, as reported in 2006, a large portion of this population is in Punjab. It is also a large source of livelihood for 75% of the rural population (Planning and Development Department, 2015). Livestock department is a potential sector for growth, around three-quarter of the provinces population is involved in the sector. Its growth rate is 4% more than agriculture and industries. While agriculture contributes 22% to GDP, 55% of that is due to livestock. Although its GDP growth has been increasing every year, the budget allocation has been reducing annually. Only 7% of total budget is given to livestock department. 85% of livestock farming is in Punjab and 64 mega industries depend on bi-products of animals such as gelatine, tannery, milk, meat. Livestock is critical for food security and ensuring food safety and quality of livestock can reduce health bills by 71%. In Punjab, livestock is used as farm help, dairy products, meat, manure, and for transportation. The main typed of livestock found in Punjab are cattle, buffalo, sheep, goats, poultry, camels, horses, mules, and donkeys (PGS, 2015). The GoPunjab has made significant achievement in the Livestock department over the past two years by focusing on mass vaccination campaigns, cross sectional disease surveys, mass education and training of farmers, breeders, butchers, and traders (Livestock and Dairy Department, 2015). However, there are still various challenges, especially climate change impacts, which need to be overcome in order to increase livestock productivity (Planning and Development Department, 2015).	Improve the functioning of livestock markets and regulatory regimes;	Promote local high pedigree & drought-resistant varieties of livestock and poultry; Introduce climate and disaster-resilience into fodder harvesting and storage practices;	Improve productivity of livestock through genetic breeding so less livestock count is required for production of the same amount of milk/meat;	Research on climate change impacts on poultry and livestock diseases, prevention, transmission, cure and facilitate transfer of technology to farmers;
		Increase direct link of corporate sector and livestock farmers helping the latter to move up the value-chain;	Diversify incomes in the livestock sector by incorporating asset-management practices into livestock management, utilizing animal by-products as fuel, and recognizing their role in poverty reduction, resilience building, and food security;	Develop and promote best management practices for methane and nitrogen management in livestock sector;	Improve livestock feeding by increasing the quality and quantity of pastures and rangelands, providing nutritious and economic feedstock, safe drinking water, and livestock feed enrichment techniques;
		Update veterinary best practices to address impact of extreme temperatures on livestock health and productivity;	Arrange livestock management training programmes for farmers, including women, especially during disasters;	Research to further improve bio-gas technology and develop biogas related projects;	Devise and implement management plans (heat wave, floods, and droughts) and quality control plans (animal by-products dairy, meat, and leather etc.);
		Promote public-private partnership in livestock sector for research, training, climate resilient shelters, transportation etc.;	Develop a framework for connecting small and medium livestock farmers to corporations and markets in a just and equitable way. In the status quo, small livestock farmers lack bargaining power and are subject to exploitation		
6.4 Forestry	In Punjab the forested cover is around 3.26% of the total area of the province, out of which the major forest types found in the province are Irrigated Plantation (25.6%), Riverine Forest (10.6%), Scrub Forest (40.7%), Range Lands (12.2%) and Coniferous Forest (6.8%). Although each province has made efforts in its own jurisdiction, the National Forest Policy (2015) urges provinces to expand forest covers, integrate economies with forestry, curb deforestation, and encourage conservation (Ministry of Climate Change, 2016). Forest cover in Punjab is threatened by land grabbing groups, timbre mafia and deforestation. Although the Government has initiated a number of afforestation campaigns in many areas of the province such as the central zone, riparian forest of the central zone, margalla foothills, Chung and Mohlanwal forest along the Ravi River. The	Initiate projects and programs to promote sustainable use of non-timber forest produce (NTFP), and improve market access to NTFP (plant and animal);	Improve lives and livelihood of forest dependent communities by providing alternative options; Encourage communal management of forests and introduce modifications in property laws to facilitate it;	Improve and adhere to regulations on tree cutting and compensatory plantation;	Research and develop the use of indigenous knowledge in forest management and locally adapted plants;
		Discourage unsustainable use of forests as fuel and firewood for domestic uses in urban and rural areas;	Improve forest health by studying forest pathology, entomology, water management, watershed management, flood risk management, soil conservation and other interrelated disciplines as integrated part of forestry research programs to enhance the resilience of forests;	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;	Pursue afforestation and reforestation programs for enhancing the forest cover;
		Coordinate with urban planning and horticulture institutions to curb growth of Invasive Alien Species (IAS) that threaten biodiversity;			

Priority Sectors ⁵	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-Benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
	<p>Punjab forest department has taken a number of initiatives to improve forest cover in the province, some of which are listed below:</p> <ul style="list-style-type: none"> Punjab Forest Department on an average, carries out afforestation over 4000 acres annually through its development and non-development budget. The Department has initiated development projects for rehabilitation of seven major irrigated plantation in Punjab, through afforestation of 2000 acres of blank areas. In the historic Lal Suhanra Plantation 100 acres was planted this year. Continues program is being implemented to plant up small portion of blank areas in Murree Forest Division Department has launched a program for planting private farmlands by trees through 70% subsidy over an area of 3000 acres Green Pakistan Programme has been launched as a special initiative of Prime Minister of Pakistan to plant 10000 acres of blank area over next five years, with 50% cost sharing by the Federal Government 	<p>Improve Land use planning and land zoning to conserve, protect, and increase tree cover;</p>	<p>Develop criteria for sustainable forest management in protected areas and public spaces;</p>	<p>Strive to reach zero net emissions through forests as carbon sinks;</p>	<p>Encourage farm forestry and agro-forestry practices through plantation of multipurpose and fast growing tree species which also improve degraded land and promote animal nutrition;</p>
6.5 Land and Vulnerable Ecosystems	<p>Punjab does not consist of extreme mountainous ranges, in fact it is largely considered as the Indus Plain, nonetheless has a variety of ecosystems within it. Punjab has three protected wetlands sites under the Ramsar Convention of 1971; Chashma Barrage in Mianwali, Taunsa Barrage in Muzaffargarh and Uchhali Complex in Khushab.</p>	<p>Promote eco-tourism to ensure maintenance and improvement of vulnerable ecosystems;</p>	<p>Identify vulnerable ecosystems and take measures to increase their resilience in a changing climate and Integrate ecosystem conservation into development policies and planning;</p>	<p>Design adequate procedures to control organic and inorganic pollution of wetlands that includes flow of agricultural chemicals and pesticides into the wetlands;</p>	<p>Ensure close coordination among forest and livestock departments for efficient management of rangelands and other resources while ensuring the rights of the indigenous people;</p>
	<p>Towards in the South eastern border with Sindh, the Cholistan desert is situated, covering the Punjab districts of Bahawalpur, Bahwalnagar and Rahimyar Khan. The Thal desert, the second largest desert in Pakistan is also located in Punjab, boarded by the Indus and Jehlum River, covering the districts of Bhakkar, Khushab, Mianwali, Jhang, Layyah, and Muzaffargarh. These two deserts support communities, which depend on tube wells and canals to cultivate the land. However, these people are poor and vulnerable living off the natural ecosystems for their livelihood.</p>	<p>Revive threatened ecosystems, such as rangelands and enhance ecosystems by creating artificial wetlands and increasing grasslands in water logged areas;</p>	<p>Arrange joint watershed management of trans-boundary catchment areas with neighbouring provinces;</p>	<p>Develop inventories of assimilative capacities of different locales and align local development strategies accordingly;</p>	<p>Maintain soil and sub-soil moisture and vegetative cover to safeguard arid and semi-arid land from desertification;</p>
	<p>Such dependence of people on natural ecosystems, in the Indus plains, deserts and surrounding areas of wetlands means that the impacts of Climate Change will pose a great threat on food security, livelihood and health of poor people.</p>	<p>Discourage conversion of land use (rangeland to agriculture, agriculture to urban spread etc.);</p>	<p>Promote integrated watershed management including ecological Conservation practices in uphill watersheds;</p>		<p>Increase vegetative cover in extremely difficult and harsh areas of arid zone through technological advancements;</p>

Priority Sectors ⁵	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-Benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
6.6 Biodiversity	<p>Each ecological zone of Pakistan has biodiversity unique to climate, geographical location and habitat. Punjab, mainly a plateau forms the major part of the Indus Plain. Moreover, it forms the Tropical Thorn Forests of low density. This area is largely used for cultivation because of alluvial soils and the eastern tributaries, namely, Ravi, Sutlej, Chenab and Jehlum, which has contributed to low forest cover. The biodiversity of the region may not be as rich as the northern areas or on the coastlines of Pakistan but it is home to some of the most special and endangered species on earth such as the Indus River Dolphin (Bhulan) and the Waterfowl population which migrates to natural wetlands of Pakistan during the winter season. Biodiversity in Punjab faces many threats. The demand for more land and lack of natural resources has exploited the natural habitats of many species. Conversion of forest lands into agricultural fields, over grazing, soil erosion, non-sustainable agriculture practices, hunting, commercial forestry and fishery, growing industrial pollution, expanding settlements and encroachment are some of the threats faced by mammal and bird species in Punjab. One of the prominent National Parks in Punjab is located in the Cholistan desert named "Lal Suhanra National Park" which has been declared a biosphere reserve by IUCN. Other national parks which have been created for the conservation of endangered species and recreation are; Jallo Forest and Wildlife Park, Gatwala Forest and Wildlife Park, Bansra Gali Wildlife Park, Bahawalnagar Wildlife Park, Bhagat Wildlife Park, Kamalia Wildlife Park, Lohi Bher Wildlife Park, Pirowal Wildlife Park and Rahim Yar Khan Wildlife Park Game reserves, areas where hunting and shooting of wild animals and birds is allowed under certain circumstances, are also found in different districts of Punjab.</p>	<p>Establish nature reserves, botanical gardens, and gene banks in all districts;</p>	<p>Facilitate ecosystem based adaptation of biodiversity to climate change by increasing resilience of, in particular, the protected areas to ensure sustainable benefits ensuring complementary schemes to mitigate adverse impacts on livelihood of local communities;</p>	<p>Engage corporate and private sectors including energy providers, manufacturing, and industry to contribute in protection of biological diversity by including it in corporate and private sector responsibility;</p>	<p>Encourage the use of biological control for disease and weed control in agricultural crops;</p>
		<p>Develop capacity and give training within responsible institutions on addressing climate change in wildlife management and conservation;</p>	<p>Establish natural migration corridors in areas that are rich in biodiversity to preserve their existence as well as assist in migration;</p>		<p>Research and establish links between impacts of climate change on biodiversity and the water-energy-food nexus;</p>
			<p>Prevent and protect endangered species as per obligations under international agreements;</p>		<p>Monitor and improve understanding of the Climate Change impacts on biodiversity, including through application of modelling techniques to assess vulnerability of priority species particularly Indus Dolphins and the Waterfowl population;</p>
6.7 Disaster Preparedness	<p>Natural and human induced disasters are frequent occurrences in Punjab. Almost every year, the province faces catastrophic floods and droughts which claim hundreds of lives and displaces millions. The Disaster Risk Management Plan published in November 2008 by the Provincial Disaster Management Authority states that the most commonly occurring natural hazards in Punjab are floods, heat waves, storms, earthquakes, and droughts, whereas the human induced disasters include fires, civil unrest, terrorism, industrial accidents sectarian violence, rail, road and air accidents and health epidemics. Climate Change will only exacerbate these hazards as the frequency of natural disasters increasing with changes in weather patterns and extreme weather events. The unexpected floods in the summer of 2010 along the Indus River Plain affected 21 million out of which 8.6 million were children. 2 million homes and 8.4 million acres of crop were damaged due to the flood. The damages were so severe that many are still trying to salvage from the loss. With frequent extreme weather events predicted due to Climate Change, it will be impossible for the rural population to permanently recover from the loss. These hazards have serious repercussions on Punjab's sustainable development and economic growth.</p>	<p>Develop strategies for disaster risk management (including evacuation plans, local flood forecasting & early warning system, drought monitoring, strengthening and enhancement of barrages capacity, retarding basins and providing escape channels etc.);</p> <p>Clearly define roles and responsibilities of each concerned government department during natural disasters to strengthen coordination;</p>	<p>Prepare an integrated natural hazard zoning map of the province, including layers of physical, biological, social, and demographic vulnerabilities;</p> <p>Create inventory of illegal encroachments in floodplains;</p>	<p>Promote non-grid renewable energy to reduce vulnerability during natural disasters;</p>	<p>Research and development, and collaboration with researchers/academics to gather baseline information on crops, buildings, infrastructure, livelihoods, populations etc. before a disaster strikes;</p>
		<p>Introduce measures to reduce the risk of urban flooding through better spatial planning and land use; Improve and strengthen flash flood response mechanism of local & district disaster managers to minimize the damages;</p>	<p>Develop an 'assessment and compensation mechanism' including insurance of losses and damages in the aftermath of disasters and measures for rehabilitation, with tailor made packages for poor and vulnerable segments;</p>	<p>Develop disaster safe and energy efficient building codes based on the vulnerability assessments;</p>	<p>Global discourses and agreements on disaster risk reduction should feed into annual planning and policies;</p>

Priority Sectors ⁵	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-Benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
		Through timely provision of relief and rehabilitation reduce climate induced displacement and migration; Create inventory of informal or illegal construction and/or encroachment in disaster vulnerable urban areas;	Redesign, construct and upgrade disaster resilience multipurpose buildings to be used as shelter during natural calamities;	Ensure that infrastructure, including water supply, food, telecommunication, power, utilities and transport are climate resilient;	Proactive storage of relief goods in disaster prone areas;

Sectors	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
6.8 Fisheries	<p>Although fish farming is not widely practiced in Punjab but it can have a sizable impact on the economy of the province. Fish products are widely traded goods having implications for export. Its potential implications on food security and livelihood are substantial.</p> <p>Indus River and its tributaries are a source of fresh water fish in Punjab. The Indus River is the main inland fish catchment area. The major natural resources are Rivers, Canals, Reservoirs, Lakes, and Water Logged Areas etc. covering a total area of about 3 million hectares (7.5 million acres) (GoPunjab). In Punjab, fish farms are located in irrigated areas or regions which receive ample rainfall, such as Khanawal, Multan and Muzafargarh (FDB, 2015). Involvement of the private sector in fish farming activities has increased considerably in the last two decades; it now contributes 50% of fish production from the province (Brander, 2007; GoPunjab). The Department of Fisheries in Punjab, ensures the enforcement of the Punjab Fisheries Ordinance of 1961 for the conservation and management of marine life in the province and promote aquaculture. The Fisheries Department of Punjab is striving to expand local fish farming. One of the largest fish farms is recently underway in Rajanpur, whereas a hatchery for saltwater fish is in progress in Bahawalpur. Better technology and training programmes for fish farmers is also one of the top priorities for the Department of fisheries in Punjab (The Express Tribune, 2016).</p>	<p>Training programs and skill development, especially for women, on catching fish, mending equipment and related paraphernalia to be delivered for small scale farmers;</p>	<p>Adopt integrated ecosystem approach with three main pillars: managing fisheries and aquaculture; adapting to climate change; and reducing risk from natural disasters;</p>	<p>Promote use of low energy intensive technologies which increase heat recovery in refrigeration and encourage the use of solar water heating on fish farms;</p>	<p>Fill critical gaps in knowledge to assess the vulnerability of fisheries and aquaculture to climate change, especially on small scale farmers;</p>
		<p>Formalize fish farms and aquaculture as an industry;</p>	<p>Promote and develop to climate resilient, fast growing, indigenous, and high yielding fish varieties;</p>	<p>Protect the habitat of fish by reduced release of harmful chemicals from industrial practices which release toxins into the rivers and lakes;</p>	<p>Improve lives and livelihoods of fisherman through efficient use of fish and its by-products to increase food security;</p>
		<p>Improve regulatory and administrative regime for fish farmers and fishermen;</p>	<p>Introduce sustainable fishing zones and improve fishing supply chains;</p>	<p>Promote uptake fish and related products in daily diets through awareness raising;</p>	<p>Promote applied research in fisheries by supporting public universities in the development and promotion of relevant programmes and courses.</p>
6.9 Human Health	<p>Punjab being one of the largest provinces in Pakistan, is densely populated. Although there are considerable health facilities in the province, due to a large population they do not suffice. 70% of the population of Punjab resides in rural areas, whereas the remaining 30% lives in Urban areas (Health Department, 2016). Poor water quality and sanitation services are responsible for prevalence of many diseases in Punjab. The province is behind on meeting with MDG goals for reducing child mortality rates, improvement in maternal health, and combating HIV/AIDS, malaria and other diseases. Disease detected and treatment remains poor (PGS, 2015). Dwindling and deteriorating supplies of water can exacerbate the spread of disease. According to the Punjab Health Department, malnutrition is one of the biggest problems that plagues the province, especially in children. Lack of education especially in women who are the main care takers of households, adequate health facilities, poverty and low budget allocation towards health initiatives are the main factors outlined by the health department as the cause of poor health standards in the province. These conditions will only be exaggerated due to Climate Change and without prior investment in health facilities, the cost of recovery will be even higher. Punjab's current situation coupled with impacts of climate change on health can have deleterious impacts on people.</p> <p>The GoPunjab has started many health centre upgradation, human resource training institutes and disease control programs (for AIDS, Tuberculosis) in many districts of Punjab. To improve life expectancy and health, the GoPunjab drafted a comprehensive health strategy in 2012. Moreover, a Health</p>	<p>Encourage and promote less sedentary lifestyles through awareness raising and better coordination between health department and urban planning;</p>	<p>Draft, prioritize, and implement district-wise health, heat and disaster management plans which help reduce risks to human health from climate induced disasters and diseases (dengue);</p>	<p>Improve industrial and municipal environmental management;</p>	<p>Counter the prevalence of malnutrition and stunted growth by ensuring access to food and clean water;</p>
		<p>Ensure just and equitable access to health insurance, especially for the poor;</p>	<p>Conduct Needs Assessment of the health sector, identifying infrastructure, human resource and financial resources required by sub-urban and rural health facilities to equip them to handle climate induced diseases and disasters;</p>	<p>Promote consumption of low carbon food items;</p>	<p>Ensure availability and access to sufficient, safe and nutritious food to meet the dietary needs;</p>
		<p>Improve geographical spread of health facilities between urban and rural areas and between south and north;</p>	<p>Take measures to reduce water-borne diseases and insure access to safe clean drinking water;</p>	<p>Promote low carbon and climate resilient building designs which improve insulation, provide adequate ventilation, and green space;</p>	<p>Promote research on the nexus of climate change and health (spread, prevalence, and incidence of disease; food security; water security; indoor air etc.);</p>

Sectors	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
	Care Commission has also been set up. Other programmes to improve health include Health Sector Reform Programme, Chief Minister's Initiative of Primary Health Care, Punjab Devolved Social Services Programme, and Punjab Resource Management Programme (GoPunjab, 2013).				
6.10 Socio-economic measures	The growth of a country is measured by its economic growth influenced by many determining social factors prevalent in the society, such as level of poverty, literacy, gender etc. Punjab although being a densely populated province has less incidences of poverty as compared to Baluchistan, Sindh and Khyber Pakhtunkhwa (SDPI, 2012). 58.7 million People in Pakistan are living below the poverty line and 19% of them are in Punjab. The occurrence of poverty in Punjab is more concentrated in the Southern districts of the province, such as Rajanpur, Muzaffargarh, Layyah, Lodhran, Pakpattan, DG Khan and Bahawalpur. For Punjab to build its resilience to Climate Change, it is vital to eradicate poverty in these regions. Women in Pakistan generally continue to be at disadvantage, for they have limited access to resources and opportunities compared to their male counterparts. This holds true in case of Punjab, where 21% of female population have below primary level education, as against 18% in men. Likewise, 0.8% female are able to attain master's degree compared to 1.2 % of men. Overall literacy rate for male and female population in Punjab is estimated at 57.2% and 35.1% respectively. Similarly, 60% of men are part of labour force in the province as against 2% of women (Pakistan Bureau of Statistics, 1998). Majority of these women work as farm labourer in agricultural fields, for their livelihoods.	Increase job opportunities to reduce unemployment through both supply and demand side policies;	Strengthen community participation in vulnerability assessment studies and management plans to provide useful climate-poverty information and to assist in preparing them for enhanced and efficient natural resources management;	Develop green jobs and increase technical knowledge of low carbon technologies across all sectors using socially inclusive and gender sensitive pathways;	Improve access of poor communities to appropriate technologies for crop production, integrated pest management and credit facilities for agricultural development;
		Mainstream climate-poverty nexus in provincial planning, such as poverty reduction strategies, strategies & programs, and annual budgets;	Increase benefits to the poor through support programs (mother and child health care and welfare programs);	Hire technical and policy expertise on low carbon development strategies to ensure provincial climate change policy is integrated in development of projects;	Evaluate gender-differentiated impacts of climate change to reduce the vulnerability of women to climate change impacts, particularly in relation to their critical roles in rural areas in provisioning of water, food, and energy;
		Promote gender equality in education, especially in hazard awareness, early warning systems and climate change impact studies;	Ensure equitable development in all districts of the province;	Ensure social, resource, and climate synergies in industrial development;	
6.11 Energy (Generation & Distribution)	In Punjab, at present, there is a demand-supply gap of about 4000 MW which is increasing at a rate of 6% per annum. Punjab consumes 68% of the generated power and gas, therefore is worst affected by this gap and has to endure both power and gas load shedding leading to adverse social and economic consequences (GoPunjab Energy Department). The current energy mix of the country is expensive and inefficient. The government is investing in solar and wind power projects in order to improve the energy mix. Energy department has taken a number of initiatives for increasing the share of renewable energy and clean sources of Energy Generation like hydropower projects under REDSIP, Quaid e Azam solar, mini hydropower projects and projects under "Access to Clean Energy investment Project" etc. In compliance of The National Power Generation policy, 2015, Energy department is heading towards reduction in reliance on coal and is in position to claim Carbon Credits under Clean Development Mechanism (CDM). Furthermore, the recommendations in 6.11 of this policy should be taken in conjunction with the National Energy Policy 2015, and Punjab Provincial Energy Policy 2009.	Develop an investment attraction strategy for foreign and domestic investors including PPPs, using carbon markets, applying for international climate funds and/or looking at opportunities for partnerships etc.;	Develop a provincial vision for energy mix based on strategic assessments (coal, other traditional, and renewable energy) and extensive consultations (technical, financial, economic, environmental, and social experts);	Conduct applied research to increase the insight and knowledge about possible carbon reduction by the introduction of low carbon energy and renewable technologies, as well as on the feasibility and cost-effectiveness of these measures from a carbon mitigation perspective;	Ensure high quality management of energy production and supply, including reduction in transmission and distribution losses;
		Promote decentralized/off-grid renewable energy generation in industrial, commercial, and residential areas by introduce smart metering, and smart grids to increase electricity supplies;	Review and upgrade the Punjab Power Generation Policy 2009 which promotes the use of indigenous resources;	Develop a GHG inventory of energy consumption and production in Punjab to provide the energy and environment department with key information on which they should base their annual planning;	Ensure clean, regular, and sustainable energy supply (electricity & gas) to households;
		Harmonize provincial Vocational Education and Training plans with energy and climate change themes;	Ensure that all new infrastructure is climate resilient and transform existing infrastructure gradually into climate resilient;	Review and update curriculum of universities to include various aspects of renewable energy technology;	Remove regulatory gaps and create enabling conditions for renewable energy, including supply chain, financing, customs and regulatory regime, and logistics; Increase knowledge and information on renewable energy options and their cost effectiveness;

Sectors	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
	Bridging the demand and supply gap of the energy needs is problematic due to financial constraints, low involvement of private sector, lack of capacity within of government officials and weak regulation. Weak fiscal and regulatory frameworks to incentivize renewable energy, lack of data on links between energy and climate change, and ineffective environmental impact assessments are also some of the barriers to policy implementation faced by Punjab energy department.				
6.12 Energy (Efficiency & Conservation)	Energy efficiency has a large potential to reduce GHG emissions at low cost and reduce the demand for energy ensuring sufficient energy supply is diverted to achieving economic development. Economically efficient use of energy causes less environmental impacts required for electricity generation, better health from improved heating or cooling and energy security protecting access to energy resources. Limited experience and expertise on energy efficiency and energy conservation is a barrier to policy implementation. Punjab Energy Efficiency and Conservation Agency is geared towards reducing carbon footprint of the activities of public and private sectors.	Improve energy storage capacity for households, industries, and businesses;	Improve access to financing and provide incentives for energy efficiency measures by coordination within government and the financial sector;	Provide market incentives for carbon reduction through energy efficient practices and projects;	Promote and support higher efficiencies in conveyance of irrigation water, prioritize farmer education, encourage recycling, equitable delivery and reuse of water and other demand management techniques;
		Raise awareness on energy savings options for households, and industrial consumers through mass awareness campaigns;	Promote and gradually make it mandatory to specify the energy efficiency/fuel consumption rates of energy using equipment and devices of common use;	Promote and strengthen research on appropriate energy efficiency technologies particularly for industries;	Enact and enforce energy conservation legislation and audit standards;
		Establish SMART targets for each district in updated Punjab Power Policy;	Prioritize energy efficiency and conservation capacity building to areas prone to high climate risk;	Continue efforts to develop guidelines and rules on energy efficiency and conservation, and energy efficiency codes for buildings and electronic products;	Coordinate with agricultural department to test energy crops as part of cash crops without disturbing food crop cultivation;
6.13 Industry	The industrial sector of Punjab employs around 23% of the province's labour force and contributes 24% to the provincial GDP. Punjab has more than 48,000 industrial units with several large industrial concentrations. Almost 90% of private enterprises are small and medium in size, which employ 78% of the non-agricultural workforce in Punjab. On the whole, the province has around 39,000 small and cottage size industrial units (Go Punjab, Industries Department).	Develop climate resilient, low carbon, and sustainable industrial estates in the province for small, large, and cottage industries;	Prepare industry profiles and vulnerability scenarios of small, large and cottage industries;	Develop economic incentives like tax cuts of tax exemptions to promote emission reduction and low carbon development by upgrading the industrial processes and technologies for heavy polluters;	Promote and incentivize the usage of locally available and ecologically sustainable raw materials;
		Develop and implement environmental management systems and secure international accreditation;	Align political priorities to favour integrated decision making and introduce industrial synergy as a mandatory design element for all new industrial zones, and promote it in the existing developed zones;	Generate data to study the impact of climate change on manufacturing industry;	Develop and implement low emissions climate resilient development scenarios which increase food security, reduce water scarcity, and are energy efficient;
		Draft a framework for technology transfer to industries to control and cap emissions;	Enhance resilience through socially inclusive, and human rights based measures including local employment, voluntary Corporate Social Responsibility (CSR) and encourage voluntary emission reductions;	Undertake technical studies to determine environmental footprint (water footprint, carbon footprint, ecological footprint, etc.) of industrial value-chains. And use this to make informed decisions about which industries to promote and incentivize	Strengthen regulatory framework on Industrial carbon emissions, integrating with existing and new regulations including the industries policy;
			Develop and promote integrated "Cleaner Production" strategy in the Industrial sector for more efficient use of inputs and cleaner production processes;		

Sectors	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
6.14 Transport	<p>In Punjab the demand for motorized urban transport is increasing rapidly, so is the amount of GHG emissions. Government has undertaken a number of projects to improve the availability and quality of public transport, mostly in urban centres. On the other hand, there are other initiatives e.g. Rozgar scheme putting more vehicles on the road and increasing the GHG emissions. Improved road infrastructure also reduces the GHG by ensuring smooth traffic flow, but also indirectly encourages use of private vehicles. According to the PGS, 2014 inadequate supply of public transport in rapidly expanding cities of Punjab has increased the pressure on private transport providers. Punjab's transport department is working on sustainable transport one way or the other, without consciously registering its climate related upside.</p> <p>In order to ensure climate-resilient transport vehicle emissions standards need to be updated. Knowledge of low-carbon transport options, their cost effectiveness, climate risk planning, strengthening regulatory framework, and promoting a cleaner fuel mix will help make transport sustainable and reduce GHG emissions from this sector.</p>	Set aside annual budget for technical capacity development required for implementation of sustainable transport related projects;	Integrate climate risk planning in transport strategies and develop climate resilient plans for road transport, aviation, and rail;	Encourage private sector investment in increasing access to low GHG emission, clean, affordable, and sustainable transport;	Increase access to agricultural inputs and outputs through improvements in freight traffic, vehicle efficiency, electrification, and logistics;
		Reduce passenger travel demand and time through land-use planning;	Rationalize competing priorities of livelihood creation (rozgar scheme) and mass transit (GHG reduction);	Increase energy efficiency standards for both new and used vehicle;	Promote water ways as a transport means;
		Promote non-motorized modes of transport;	Improve traffic management and sustainable transport through education, public awareness, and regulatory monitoring;	Investments in efficient transport, transit systems and infrastructure;	
6.15 Waste	<p>Quality and coverage of waste management services in Punjab are inadequate. Municipal solid waste is not disposed of properly and ends up in streets and public spaces. This creates a host of problems including environmental degradation, pollution of water, exposure to toxins and air pollution. Wastewater from households, commercial and industrial activity is discharged untreated, degrading the soil, fresh water and ground water. Industrial activity releases harmful fumes into the atmosphere which cause air pollution.</p> <p>Weak management and increasing urban sprawl has exacerbated the waste management issues already faced by Punjab. Lack of funds, technical capacity and low public sector investments hinder the maintenance of waste management networks in the province.</p>	Promote the concept of 3 Rs to increase sustainable waste management;	Create jobs in waste management and recovery through research and creating partnerships between different stakeholders;	Develop provincial solid waste standards for waste storage, collection, transport, treatment and disposal, in line with air and water quality standards;	Promote energy-from-waste projects;
		Improve municipal solid waste management;	Rationalize environmental quality standards in view of assimilation capacities of receiving environment;	Encourage treatment, and re-use of waste water from manufacturing, commercial, and industrial processes;	Promote waste management technologies which provide co-benefits (e.g. anaerobic digestion);
		Ensure proper labelling, handling and prevent illegal dumping of hazardous waste;		Engage stakeholders and create partnerships for waste management;	
6.16 Urban Planning	<p>Punjab is the second most urbanized province in the country with half of the provinces population concentrated in five major cities namely, Lahore, Faisalabad, Gujranwala, Rawalpindi and Multan (PGS, 2015). A large part of the provinces population lives in informal settlements, where the availability of municipal services is minimal. Urban areas have a huge potential of enabling economic growth, as a result the rate of rural to urban migration is very high. The migrants typically settle in informal settlements or slums. Over populated urban areas and resultant urban sprawl causes a deterioration in air and water quality. In search of low-cost accommodation migrants settle in insecure locations (waste dumps, barani canals, and illegal land). This not only puts them at risk of eviction but may eventually leave them more vulnerable, there is lack of basic services (hospitals, schools, etc.) in these areas.</p>	Entrepreneurship and specialization clusters must be developed to get benefit from the innovation potential of cities;	Conduct comprehensive climate risk assessment for all districts;	Replace non-porous surfaces in urban areas with green space to create more areas for absorption of excess water, flood abatement and groundwater recharge;	Critical gaps in urban infrastructure and basic services need to be catered to by improving the efficiency of urban markets through better regulation;
		Develop and implement affordable housing programs in collaboration with private sector, capital markets and financial institutions;	Allocate budget to increase urban resilience based on climate risk assessments;	Promote renewable energy options, especially solar panels, for heating and cooling of buildings and other domestic purposes;	Promote sustainable water management strategies, especially in urban areas;

Sectors	Situation Analysis	Climate Resilient Development		Low Carbon Development	Co-benefits: Water-Energy-Food Nexus
		Sustainable Cities	Other CRD Measures		
	Urban planning is of paramount importance to Punjab as the rate of migration, rural to urban, is expected to rise. Spatial planning and management of urban land can help reduce the number of environmental problems caused. Water supply, sewage & sanitation, drainage, vehicular emissions and solid waste management are amongst the top priority measures for urban planning for GoPunjab. Unplanned urban development is likely to increase the environmental concerns in urban centres. It can increase water scarcity, exacerbate energy crisis and increase air pollution. Environmental impact assessments need to be conducted before the construction of road networks, spatial planning and management of urban land.	Improve municipal service delivery;	Introduce slums alleviation program to increase resilience of the most vulnerable segments of the urban population;	Implement climate resilient, energy and water efficient building codes and laws in residential and commercial buildings sector;	Develop master plans for all major cities considering water-energy-food nexus and including sub-urban areas.

7 Climate Innovation: Developing Capacity, Capability, and Competence

Climate Change will affect many different sectors of Punjab and many new skill sets may be required to respond to threats posed by the changing climate. Table (7-1) shows some of the skills that will be required. It must be recognised that some of these skills may already be available though not all reside in the relevant organisations. Nevertheless, the following areas for capacity, capability, and competence building will be required for effective implementation of this policy.

- Institutional capacity-building as initiated by establishment of policy implementation focal points in all line departments;
- Individual technical competences on:
 - Vulnerability and adaptation assessments
 - Research and systematic observation, including meteorological, hydrological and climatological services;
 - Development and transfer of technology;
 - Provincial climate change programmes and projects
 - GHG inventories, emissions database management, and systems for data collection, analysis and management;
 - Accessing and delivering finance for climate action;
- Capacity-building of relevant stakeholder groups for implementation of low carbon, climate resilient, and Water-Energy-Food nexus related measures;
- Improved decision making, including contribution to national position in international negotiations;
- Clean development mechanism and new carbon market under Paris Climate Agreement 2015;
- Education, training, and public awareness;
- Information and networking, including the establishment of databases.

The policy measures recommended below are necessary to achieve maximum impact of this policy. These measures do not repeat but are complementary to sector-specific capacity and training related recommendations provided in above chapters.

7.1 Capacity Building

- Conduct a capacity (human count), competences (relevant expertise) and capability (enabling environment/process) needs assessment exercise with representatives from key sector authorities (provincial and district level) and key implementers in communities (farmers, local leaders, consumers, industrialists, private companies etc.);
- Create platforms that provide ease of access to weather and climate data for government departments, educational institutions, policymakers, and researchers;
- Prepare a comprehensive action plan focused on capacity building that will identify follow-up projects, overall goals, specific objectives to be achieved and course of action for each sector;
- Build partnerships, work closely with, and strengthen technical capacities among agencies and groups that are involved in addressing climate impacts in order to leverage resources (human, technological and financial);
- Deliver capacity-building programs and incorporate climate change into existing training programmes provided by academic institutes and technical training institutes such as Technical Education & Vocational Training Authority (TEVTA), In-Service Agriculture Training Institutes (IATI), Water Management Training and Research Institute (WMT&RI), Fisheries Research and Training Institute;
- Develop and improve capacity at all levels and for all sectors to design and implement climate responsive development policies, strategies and programs.

Table 7-1 Skill Sets Required for Climate Policy Implementation

Area of competences	Relevant Climate Impacts			Relevant Sector(s)	Priority Requisite Capability
	Economic	Physical	Social		
Environmental Science	X	X	X	All	Assessment of scientific impact to environment
Policy Analysis and Engagement	X	X	X	All	Policy and planning to respond to climate impacts
Environmental Economics	X			All	Assessment of economic impacts
Resource management	X			All	Assessment of climate impacts and management of
Hydrology		X		Water resources	Monitoring and predicting availability of water resources
Agro-climatology		X		Agriculture, livestock	Long term and short term climate modelling of impact on crops and livestock
Geology		X		All	Assessment of vulnerabilities of natural resources like aquifers
Anthropology			X	All	Assessment of impacts on culture and populations
Sociology	X		X	All	Assessment of socioeconomic impacts
Sustainable Development	X	X	X	All	Planning to respond to climate impacts
Carbon Management	X	X	X	All mitigation related	Planning and implementation of climate mitigation activities
Disaster Risk Reduction		X	X	All	Assessment of vulnerability to climate induced disasters and planning of mitigating options

7.2
Technical
Capability

Establish additional weather observatories, especially in rural areas, coupled with mechanisms to share high spatial resolution weather data which is site specific,

with relevant institutions;

- Develop capacity of selected individuals in key public sectors such as agriculture, water resources, energy, urban housing and development, etc., to interpret and analyze climate data;
- Develop provincial action plans for low carbon, climate resilient, and water-energy-food nexus related measures;
- Under provincial action plans, develop Local Adaptation Plans of Action (LAPAs) for sub-provincial implementation;
- Establish a mechanism for development, analysis, management, monitoring and reporting of a provincial GHG database;
- Develop climate models to allow for better analysis and understanding of the climatic processes in Punjab, particularly for major sectors of agriculture, water resources, energy and land-use planning (urban areas);

- Develop and update hazard maps for climate induced hazards;
- Review the design criteria and building codes to include climate change concerns;
- Conduct financial planning to access, deliver, monitor, report and verify flows of finances required to uptake climate low carbon, climate resilient, and water-energy-food nexus related;
- Develop expertise of young professionals on climate services to provide research, technical assistance, policy and planning, and knowledge management related support to GoPunjab;
- Collect and archive baseline data to inform the specific studies and analysis that will be required for the vulnerability assessments.

8 Climate Finance: Resourcing Finances and Technology for Policy Implementation

8.1 Financing policy implementation

Punjab requires substantial additional resources from both public and private sources to respond effectively to climate impacts. A mix of public and private, international and domestic sources will have to be explored to ensure a coordinated approach that reinforces existing practices in national planning and public financial management. Public spending on the environment (as extension of climate change) is less than 0.01 per cent of the government budget⁶. Climate compatible development in all the sectors is necessary to ensure public spending spent for each sector ensures sustainability and longevity.

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

Recommended Policy Measures:

- Assess financial needs of Punjab to address low carbon, climate resilient, and water-energy-food nexus related measures in all the sectors and develop investment plans for each sector;
- Take a pro-active approach in exploring and accessing international funding for low carbon, climate resilient, and water-energy-food nexus related measures through Global Climate Fund (GCF), Clean Development Mechanism (CDM), Adaptation Fund (AF), Global Environmental Facility (GEF), World Bank's Forest Carbon Partnership Facility (FCPF) etc.;
- Mobilize domestic (public and private) resources, integrate climate change in budget allocation and develop new approaches for climate proofing as a tool to support project selection and budget allocation from public spending;
- Explore potential to participate in international carbon markets and REDD+ (Emissions from Deforestation and Forest Degradation) system particularly for tree plantation programmes planned by Government;
- Establish a provincial climate change trust fund for financing climate change related projects;
- Tracking Climate change public expenditures, by establishing a revised chart of accounts (CoA). This revised CoA would identify the unified budgetary heads for climate change in all the relevant departments. This will make easier to track the allocations, utilization, and efficiency around climate change related work in the province⁷;
- Enhance the capacity of organizations which can implement and execute climate projects from climate investment.

⁶Government of Punjab, 2014. Annual budget statement for 2014-2015.

⁷ The Ministry of Finance in partnership with the United Nations Development Programme is currently developing and testing a sophisticated tool for tracking public and institutional expenditure on climate change. This policy recommends that such tools be studied, modified, and adopted to suit the requirements of Punjab

8.2 Technology transfer and development

Technology development, demonstration, transfer, deployment and diffusion are required to avoid the adverse effects of climate change. Uptake of modern technology can support coping with climate variability, paving the way for low carbon climate resilient development in the future. Renewable energy resources and related technology can reduce dependence on 'carbon-intensive' fossil fuels and hydropower (which is becoming unreliable with increasing water stress).

Currently, following are the main constraints for technology transfer and uptake in Punjab:

- Lack of resources (human and financial) for technology transfer and research;
- Lack of enabling environment for modern technology uptake (high taxation and customs);
- Lack of specialized staff on technology in the public sector;
- Insufficient information available on different (domestic and international) technological options; and
- Limited expertise in modern technology maintenance and development

Recommended Policy Measures:

- Assess technology needs for low carbon, climate resilient, and water-energy-food nexus related measures in Punjab for each sector including current gaps, challenges, weaknesses and opportunities, and associate capacity building of technicians;
- Develop favorable business environment for investment on technology adoption to support low carbon, climate resilient, and water-energy-food nexus related actions proposed in this policy by foreign investment, international trade and international cooperation;
- Explore international mechanisms and forums that provide support on technology development and uptake such as UNFCCC's Climate Technology Centre & Network (CTCN) to access funds for technology uptake;
- Build relations with developing countries in Asia to promote exchange of knowledge, information and experiences on low carbon technology;
- Develop platforms for technology development, transfer and diffusion at technical institutes, engineering colleges and universities;
- Exploit opportunities for innovation in research and engineering to refine traditional and indigenous technology and develop modern technology to respond to climate change threats.

9 Learning and Knowledge Management

Learning and knowledge management of climate change Raising awareness of both government and general public with respect to implications of climatic change to socioeconomic development can improve buy-in. Policy-supporting research and awareness campaigns accompany the implementation of adaptation and mitigation measures (using low carbon development, water-energy-food nexus, resilience, and sustainable cities), and target all relevant stakeholders including communities and the private sector. The media can play a key role in disseminating important and timely information to public regarding Climate Change impacts. Well-designed educational climate change programs are imperative in providing requisite human resources and expertise to address climate change challenges and opportunities in Punjab.

9.1 Communication

- Design and implement a public awareness program on climate change issues (global discourse and domestic trends) targeting audiences at several levels of the society with emphasis on utilizing the media and other available effective communication tools to raise awareness among stakeholders in different agro-ecological zones.
- Conduct policy sensitization workshops with relevant stakeholder groups to raise awareness on climate issues, low carbon, climate resilient, and water-energy-food nexus related measures to counteract them;
- Strengthen dialogue, information exchange and cooperation among all relevant stakeholders including governmental, non-governmental, academic, and private sectors;
- Develop interprovincial learning sessions for peer to peer exchange of knowledge and information on low carbon, climate resilient, and water-energy-food nexus related activities for each sector;
- Support Non-government organizations (NGOs) and community based organizations (CBOs) in their efforts to raise awareness in different community groups. The role of media should be taken into consideration in awareness raising activities;
- Provide climate change related information to general public targeting behavior change to switch to low carbon lifestyles;
- Ensure the effective flow of information to end-users about climate change impacts.

9.2 Research

- Create a provincial repository of research material by undertaking a meta-study of existing Punjab-specific climate change research;
- Establish and expand research exchange programmes between national researchers with internationally known and recognized climate research and academic institutes;
- Develop research capacities of students, practitioners and technical human resources in public sector so climate impacts can be gauged with scientific precision;
- Increase involvement of Pakistani researchers in international scientific community, including IPCC, by generating research which uses authentic data, its analysis and interpretation in the provincial context;
- Promote policy supporting research to bridge gap between researchers and policy makers, establish coordination and cooperation mechanisms between research institutions and policy making institutions;
- Highlight priority research areas and communicate such research needs of policy makers to academic institutes and researchers;
- Support research-oriented programmes and projects on low carbon, climate resilient, and water-energy-food nexus related impacts on all affected sectors, on climate change impacts (economic, physical and social) on all affected sectors, including interactions between sectors;

- Provide platforms and participate in knowledge and information sharing forums on climate change to encourage research and development.
- Increase collaboration between government departments, research institutions, and academia to enhance climate action.

9.3 Education

- Integrate climate change science and information into curriculum and academic frameworks of different grade levels of schools, colleges and universities with emphasis on special departments teaching environmental sciences and management and issues related to climate change;
- Reflect training and education on low carbon, climate resilient, and water-energy-food nexus related issues for policy makers and practitioners alike in curriculum of vocation training and higher education;
- Encourage and support initiatives aiming at improving climate change related education especially those led by NGOs, academia and the private sector by facilitating all efforts to securing the required financing and providing technical information available.

10 Policy Implementation: Sustainability, Governance and Mechanisms

10.1 Sustainability

Long term and sustained efforts are required to adapt to Climate Change, to mitigate GHG emissions, and to achieve considerable impacts on both. Paris Climate Agreement put forth by UNFCCC in 2015 requires countries to take these actions on a proposed timeline from year 2020 to 2025. Continued and collective action by governments will be required to ensure average global surface temperature rise does not cross 2 degree Celsius. It is, therefore, essential that Climate Change policy is sustainable in itself. Sustainability of the policy can be ensured by:

- Anchoring Climate Change in legal frameworks and integrating in provincial and sector policies and planning;
- Supporting federal government in meeting obligations under multilateral environmental agreement (MEAs) and other international agreements;
- Enhance the role of local governments in ensuring climate action;
- Raising awareness on climate change and the benefit of early action;
- Rigorous reporting, monitoring and verification of implementation of policy measures;
- Continuous research to improve knowledge and information on Climate Change impacts;
- Sustained multi-stakeholder involvement and participation to ensure multi-sectoral approach to decision making;
- Revising and updating the policy every 5 years (or as necessary) to reflect increasing knowledge on climate impacts and provincial circumstances
- Projects that are climate sensitive shall be given priority in implementation by the government

10.2 Governance and Coordination

Coherent and cooperative governance is required for climate adaption and mitigation decision making and implementation. This goes beyond the policy circle to include the private sector, non-governmental organizations, Parliamentarians, communities and other key stakeholders.

A governance structure is proposed in Figure (10-2) below that enhances coordination, has clear mandates and roles for the different stakeholders. This governance structure can be translated into an implementation committee as proposed in the National Climate Change Policy. The task of this committee

will be to meet bi annually to discuss strategic plan for implementation, to oversee all climate-related policy areas and coordinate activities to minimize duplication and maximize synergies particularly with existing institutions and programmes. Initially, the Planning and Development Department, through the climate change cell, will be the custodian department of this policy while the Environment Protection Department is undergoing restructuring and capacity building. In the medium to long-term, the EPD will serve as the custodian of this and subsequent climate change policies.

The composition as put forth in National Climate Change Policy for the Provincial Climate Change Policy Implementation Committee is as below⁸:

1. Provincial Minister for Environment (Chairperson)
2. Chairman/Additional Chief Secretaries Planning and Development Department;
3. Secretaries Environment/Agriculture/Forest/Irrigation/Local Government/ Public Health Departments;
4. DGs PDMA and PMD
5. Three representatives from corporate sector/Chambers of Commerce and industries;
6. Three representatives from Civil Society Organizations;
7. Three eminent experts from the field;
8. Director General Environmental Protection Agency, member/ Secretary.

In addition to these, it is recommended that the following be included in the Provincial Climate Change Policy Implementation Committee:

9. Provincial Minister for Finance
10. Three Members of Provincial Assembly (MPAs), one each from the treasury benches and opposition benches.

10.1 Mechanisms: Monitoring, Reporting, and Verification

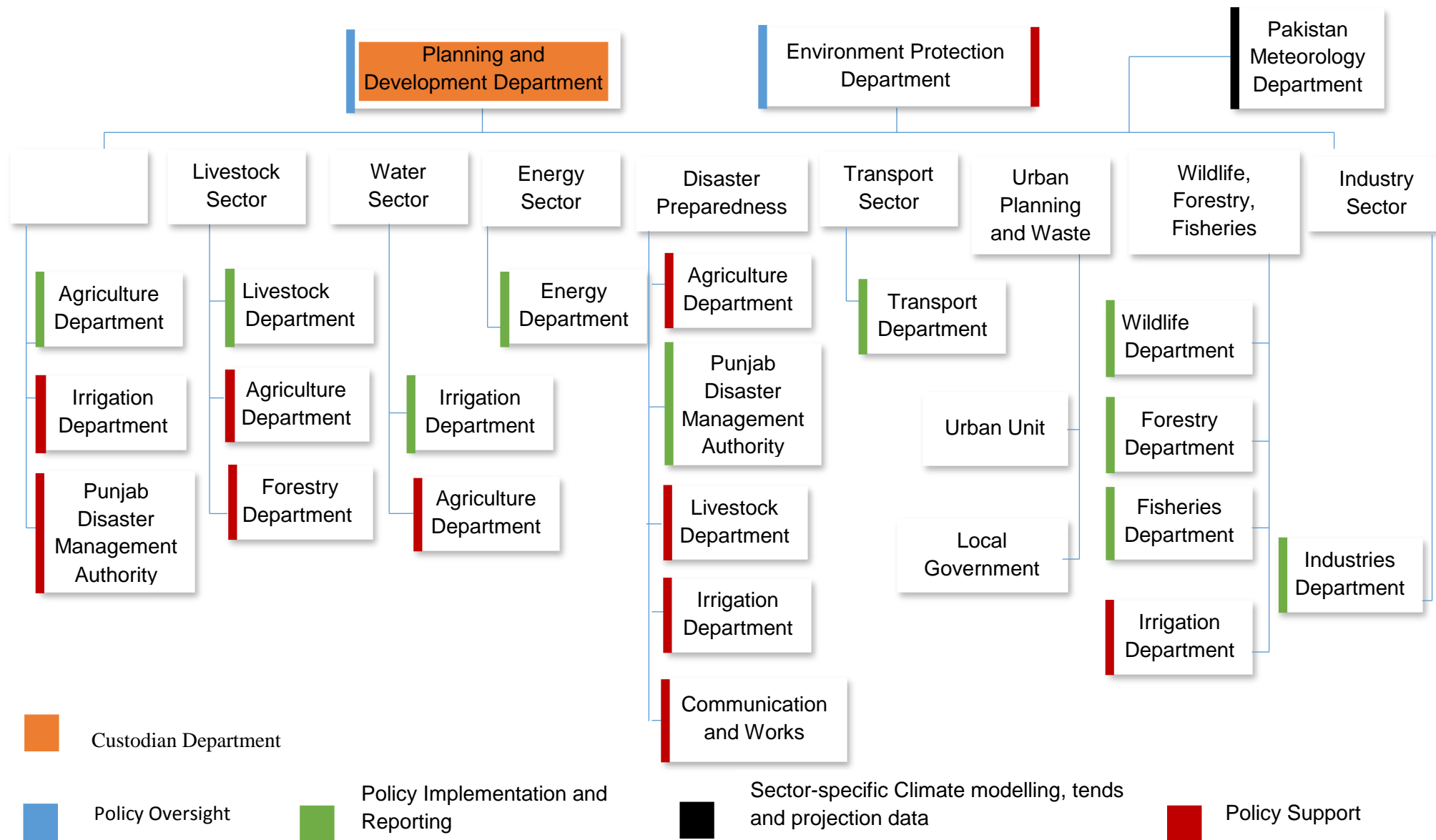
Monitoring, reporting, and verification are essential to ensure the effectiveness and accountability of climate change actions for development in Punjab.

Initially, P&D will monitor the progress in the implementation of the Climate Change Policy on the provincial level through the climate change cell. In addition, the climate change cell will keep track of development of policies and strategies by other provincial departments and ministries to ensure that the Punjab Climate Change Policy is referenced, and that the respective policies are cognizant of the commitments made to climate resilience and climate-compatible development. This role will later be handed over to EPD after its restructuring and capacity building is done. Verification and implementation of the sector-specific objectives of the Policy will be the responsibility of the sector's line department (refer to Figure 10-2). Progress in each sector at division, district and Tehsil level will be monitored by each line department.

Each line department would report to P&D who will report to the Provincial committee. The provincial committee will then report to the National Committee, who will provide a progress report to the Prime Minister's Committee on Climate Change. The focal persons nominated by P&D and EPD during the development stage of the policy will continue implementation of the policy in their respective departments.

⁸ This proposed mechanism is to be finalized by Government of Punjab

Figure 10-2: Climate Governance in Punjab



Acknowledgements

The policy document is produced by the Planning and Development Department and Environment Protection Department in consultation with the line departments, Academia, and NGO/CSOs. Oxfam Novib provided the necessary funding for the formulation of the policy.

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