

**Climate Change Working Paper Series
No. 4**

Review of Environmental Policy and Institutions

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C O N T E N T S

	<i>Page</i>
1. Introduction	1
2. Institutional Evolution	2
3. Policy Review	6
3.1. National Environmental Policy (2005)	6
3.2. National Climate Change Policy 2012	11
4. Review of Institutions Relevant to Mitigating Climate Change Impacts	15
4.1. Review of Research and Teaching Institutions	15
4.2. Review of Disaster Management Institutions	27
5. Summary and Conclusion	29
Appendices	32
References	64

1. INTRODUCTION

Climate change has surfaced as a critical development, economic and investment challenge during the last quarter of the past century due to its potential impacts on life, integrity of ecosystems and national and global economies [Madzwamuze (2010); Hulme (2005)]. It has been argued that the poor countries as well as the poor people shall be affected the most from the negative impacts of the climate change because of their lack of institutional, financial and technology capacities to deal with the threat [Madzwamuze (2010); OECD (2009)]. The civic, public, and private institutions play very crucial roles in combating the effects of climate change through their support functions including information gathering, dissemination, resource mobilisation, skill development, leadership and linkage with other decision makers and institutions. These institutions can help transform the existing coping capacity of communities into longer term adaptive capacity whilst they can also rationalise some.

The main institutions involved in climate change related functions in Pakistan include local norms, beliefs, and customs based community institutions as well as organisations working in private or public sectors. The formal institutions include associations of growers, NGOs, rural development programmes, rural credit institutions, extension system, research institutes, educational institutions, disaster management bodies, federal ministries, and provincial departments. Among the informal community level institutions are clan system, sardari systems, punchyat system, farmers. associations, and village committees etc.

The local community level institutions work at the grassroots level exercising certain operational modalities and play a crucial role in devising mechanism to combat climatic risks and are usefully involved during relief and rehabilitation phases of calamities. The national rural support programmes develop community groups and link these groups with the formal public sector institutions for capacity building and implementation of development activities. The government had mandated the public sector research and extension system to support rural communities for sharing new knowledge and technologies. Designing and implementing policies regarding climate change is the responsibility of federal and provincial level ministries and departments. Several universities working in the private and public sectors are offering graduate and post-graduate degree programmes in environmental sciences, environmental engineering, and environment economics.

In the pretext of more frequent occurrence of adverse climate events, the importance of these institutions will become very crucial in terms of their capacity to respond to such events. The strengthening of institutional capacity is imperative for effective coping and mitigation strategies to respond to climate and other environmental threats [Tudela (2003)]. The assessment of various policies implemented in this regard and review of different institutions performing important support functions to combat adverse impacts of climate change could be quite useful in fine-tuning the strengthening efforts. This report aims at presenting such an evaluation. The more specific objective of this exercise is to review and evaluate existing policies and support functions of various institutions/organisations mandated to provide support for reducing adverse impacts of climate change, improving food security, and managing disaster.

The review report comprises of five sections. The second section presents a brief history of evolution of institutions dealing with environment/climate change policies and disaster management. The third section provides assessment of the National Environment Policy 2005 and National Climate Change Policy 2012. The fourth section reviews institutions relevant to mitigating climate change impacts including research and educational institutions and those involved in disaster management activities. The last section concludes.

2. INSTITUTIONAL EVOLUTION

Pakistan has been prone to hydro-meteorological and geological hazards and such incidences are forecasted to further increase in coming years. Historically, Pakistan has dealt with disasters in an arbitrary and response oriented manner. The Calamity Act of 1958 included provisions for organising emergency response in case of disasters. A system of relief commissioners at the district, provincial and national level was established in this regard. An Emergency Relief Cell (ERC) in the Cabinet secretariat was responsible for organising disaster response work of the federal government in case of catastrophic events. The awareness of policy makers, media, civil society, NGOs, UN agencies and other stakeholders was low about issues of disaster risk reduction. No preparedness plans existed at local, provincial or national levels. Only isolated efforts were being undertaken by a few NGOs and government departments in hazard prone areas of the country.

In early 1970s, many developing countries with limited carrying capacity including Pakistan faced the challenge of sustainability. Initial step in this regard was seen worldwide soon after the 1972 s Stockholm declaration¹ proclaiming the need for a common outlook and for common principles to

¹First international conference held on integrated issues of sustainable economic development and climate degradation under the umbrella of United Nations in 1972 at Stockholm.

inspire and guide the peoples of the world in the preservation and enhancement of the human environment . The major initiatives undertaken in Pakistan after the 1972 s Stockholm declaration included the establishment of Federal Ministry of Environment in 1975 and enforcement of Environmental Protection Ordinance (EPO) of 1983. Under this ordinance various Environment Protection Agencies were created at the federal as well as at provincial level and Pakistan Environmental Protection Council was established in 1984 to act as a supreme body for formulation and implementation of the national environmental policy and programmes.

Report of the World Commission on Environment and Development [UN (1987)] proposed global agenda for change . The report was quite comprehensive and one of its basic objectives was to propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond. This report became the basis of the 1992 Earth Summit also known as United Nations Conference on Environment & Development (UNCED). Pakistan was part of the 1992 Earth Summit held at Rio de Janeiro (Brazil). The basic theme of the conference was sustainable economic development keeping in view the environmental dilapidation. Pakistan signed the United Nation Framework Convention on Climate Change (UNFCCC) in 1992, which was subsequently ratified by Federal Cabinet in 1994. The objective of the UNFCCC is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system .² In the follow up action, Government of Pakistan formed Cabinet Committee on Climate Change in 1995 to provide a policy coordination forum to deal with climate change.

Also in 1992, Pakistan s National Conservation Strategy Report (Pakistan and IUCN (1992)] endeavoured to redress the earlier inattentiveness to the nation s escalating environmental problem. This report highlighted the existing state of environmental health and identified feasible programme alternatives for the future. The report focused on conservation of natural resources, sustainable development, and improved efficiency in the use and management of resources.

The NCS identified different priority areas including maintaining soils in croplands; amplifying effectiveness of irrigation; protecting watersheds; supporting forestry and plantations; restoring rangelands and improving livestock; protecting water bodies and sustaining fisheries; conserving biodiversity; increasing energy efficiency; developing and deploying renewable resources; preventing or limiting pollution; managing urban wastes; supporting institutions to manage common resources; integrating population and environmental programmes; and preserving the cultural heritage. These were the huge milestones formulated by the NCS and subsequently reflected in the eight

²The United Nations Framework Convention on Climate Change.

fifth year plan (1993-98) of Pakistan. On the implementation side, the important achievements included formulation of provincial and district conservation strategies; establishment of federal and provincial Environment Protection Agencies, Environment Section (in federal Planning and Development Division), and Sustainable Development Policy Institute; and greater reflection of environment in Five-Year Plans.

The Government of Pakistan took more than a decade to get the Pakistan Environmental Protection Ordinance 1983 passed from National Assembly on 6th December, 1997 when it became the Pakistan Environmental Protection Act 1997 —shortly referred as, the PEPA 1997 Act. The basic purpose of this Act was conservation of renewable resources, establishment of environmental tribunals and appointment of environmental magistrates, initial environmental examination (IEE), and environmental impact assessment (EIA). The federal government established environmental tribunals and environmental magistrates in each province. However, lack of specialised human resources severely hindered proper implementations of IEE and EIA.

The Cabinet Committee on Climate Change of 1995 formed as a follow up of the UNFCCC rectification, established the Global Change Impact Study Centre (GCISC) in May 2002. The major objectives of GCISC include: to assess the current and future trends of climate change and to analyse the direct as well as indirect impacts of climate change on water, energy, food, sea level rise, land erosion, marine life, and glacier retreat.

The Cabinet Committee on Climate Change of 1995 was later turned into Prime Minister s Committee on Climate Change in 2004. The committee was chaired by the Prime Minister of Pakistan and included the ministers of federal ministries of Water and Power, Food and Agriculture, Science and Technology, Environment, Deputy Chairman of the Planning Commission and Special Advisor to the Prime Minister. The basic objective of this high level Inter-Ministerial Platform is to forge linkages and consistency between climatic change challenges and the risks that climate change poses to national development and planning. It is compulsory for the body to meet annually to note significant climate change related developments taking place at global as well as at national level. Although, the coordination among the committee members at national and even at global level remained minimal, however it helped in enhancing awareness about environmental and climatic issues which helped in formulation of the National Environmental Policy 2005 [Pakistan (2005).

The National Environmental Policy 2005 provided an overarching framework which covered sectoral guidelines like water supply and management; air quality and noise; waste management; forestry; biodiversity and protected areas; climate change and ozone depletion; energy efficiency and renewables; and agriculture and livestock. The cross-sectoral guidelines

included poverty and environment; population and environment; gender and environment; health and environment; trade and environment; environment and local governance; and natural disaster management. Similarly, the environmental policy provided policy instruments and elaborated proper implementation and monitoring mechanism.

The Planning Commission of Pakistan established a Task Force on Climate Change (TFCC) in October 2008 with the view to take stock of country's situation in relation to climate change and to devise a comprehensive climate change policy and suggest proper strategies for sustained economic growth and ensuring food, water and energy security; control country's GHG emission; increase forest area; establish new institutions and build capacity of existing institutions for effectively addressing climate change; and identify needs for international cooperation and support for addressing issues of climate change in Pakistan.

The report identified expected major climate change related concerns including increased variability of monsoon, rapid recession of glaciers, higher probability of floods and droughts, increased siltation of major dams, water and heat stress leading to reduction in agricultural productivity and power generation, increased upstream intrusion of saline water in the Indus delta, and sea level rise. These concerns lead to possible threats to country's food, water, and energy security; deforestation; loss of biodiversity; and increased health risks (heat strokes, pneumonia, malaria, dengue fever, and other vector-borne diseases). The report forwarded adaptation and mitigations recommendations regarding energy, water, forests, agriculture and livestock. The report emphasised the need for and recommended measures to improve organisational structure, institutional capacity building, promotion of clean development mechanism, raise Pakistan's stance regarding climate change more effectively in various international forums, and enhancement of education and awareness regarding the subject.

The report of Task Force on Climate Change is considered as a hallmark achievement in at least suggesting the adequate adaptation and mitigation strategies for various sectors.

The Ministry of Environment was devolved to the provinces as a result of the 18th Amendment to the Constitution of 1973 and the Government of Pakistan created the new Ministry of Disaster Management in 2011 which was renamed as Ministry of Climate Change in 2012. This ministry drafted the National Climate Change Policy 2012 which aims to ensure that climate change is mainstreamed in the economically and socially vulnerable sectors of the economy and to steer Pakistan towards climate resilient development .

The national climate change policy is very comprehensive document that provides a framework for addressing climate change related issues in Pakistan. The policy adequately addresses climate change adaptation and mitigation

concerns. It also proposes a federal and provincial implementation and coordination mechanism through National Climate Change Implementation Committee and provincial Climate Change Implementation Committees. The National Climate Change Policy 2012 has been approved by the cabinet but still need rectification by the National Assembly and Senate of Pakistan to become a fully endorsed document.

3. POLICY REVIEW

The primary purpose of the policy review exercise is to assess various policies forwarded and implemented in Pakistan addressing environmental and climate change issues faced by the country. This section presents review of the National Environment Policy 2005 and National Climate Change Policy 2012 in terms of scope, goals and achievements. The assessment of other initiatives has been discussed in the previous section.

3.1. National Environmental Policy (2005)

The environmental policy review intends to evaluate the performance of the environmental policy against its goals, objectives and targets and identify the required adjustments in the prevailing policy. The overall goal of the National Environmental Policy (2005) is to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development. The main objectives of the national environmental policy are:

- Conservation, restoration and efficient management of environmental resources;
- Integration of environmental considerations in policy making and planning process;
- Capacity building of government agencies and other stakeholders at all levels for better environmental management;
- Meeting international obligations effectively in line with national aspirations; and
- Creation of demand for environment through mass awareness and community mobilisation.

The policy document forwarded sectoral as well as cross sectoral guidelines for federal, provincial, and local governments in order to address environmental concerns and ensure effective management of their environmental resources. These authorities were encouraged to devise their own plan and programmes in pursuit of the policy. The sectoral policy directions covered issues related to water supply and management; air quality and noise; waste management; forestry; biodiversity and protected areas; climate change

and ozone depletion; energy efficiency and renewables; agriculture and livestock; and multilateral environmental agreements. The cross sectoral guidelines encompassed the issues related to poverty and environment; population and environment; gender and environment; health and environment; trade and environment, environment and local governance; and natural disaster management.

3.1.1. Climate Change and Ozone Depletion

In order to address climate change issues and protect the ozone layer, the policy document recommends that the government may:

- Devise and implement national climate change policy and action plan.
- Establish National Clean Developmental Mechanism (CDM) Authority;
- Develop and implement policy, and operational framework for effective management of CDM process;
- Promote the use of ozone friendly technologies; and
- Phase out the use of ozone depleting substances in line with the provision of Montreal Protocol.

The environmental policy 2005 also suggested six instruments for achievement of required objectives. These instruments included integration of environment into development planning; legislation and regulatory framework; capacity development; economic and market based instruments; public awareness and education; and public-private-civil society partnership.

The achievements made under this sector depict a mixed view—National Climate Change Policy 2012 has been devised, National Clean Developmental Mechanism Cell has been established, and certain efforts have been made in developing and implementing the operational framework for effective management of CDM process however, little progress have been made in promotion of green technologies or ozone friendly technologies.

Another setback to achieve the overall objectives of national environmental policy was with abolition of legislative concurrent list under 18th Amendment to the Constitution of 1973. With this effect the Ministry of Environment devolved to the provinces along with their projects. The newly established provincial ministries lacked capacity in term of skilled manpower and financial resources to run their activities. These provincial ministries were never provided (needed) supports promised by the federal government at time of devolution.

The national climate change policy has been devised and approved in 2012, but at the same time, analysts are viewing the shortcomings especially on the implementation front, and no action plan so far has been devised, which may cause a setback to realisation of objectives of the climate change policy.

After the devolution the Ministry of Environment, the CDM Cell remained affiliated with National Energy Conservation Centre (ENERCON) before its transfer to newly formed Ministry of Climate Change in 2011. The transition period of about one and half year adversely affected the working of the CDM Cell.

Furthermore, the national environmental policy is silent about the proper mechanism for promoting and developing ozone friendly or green technologies. This policy does not explicitly mention the needed local and international efforts for development of technologies and innovative practices. In addition, no domestic efforts are highlighted to attract the technology transfer.

3.1.2. Agriculture and Livestock

The national environmental policy recommended that in order to achieve sustainable development in agriculture and livestock the government may:

- Ensure protection and preservation of prime agricultural land from conversion to other uses through introducing land use planning and zoning;
- Promote organic farming;
- Prevent soil degradation and restore and improve degraded lands;
- Promote integrated pest management and discourage indiscriminate use of agrochemicals;
- Develop strategies and programmes to tackle desertification in line with the National Action Plan to combat desertification and droughts;
- Establish National Desertification Control Funds;
- Encourage ecologically compatible cropping systems;
- Enhance existing livestock production, through development of new technologies, scientific method of farming, and improved management interventions;
- Promote recycling of agricultural products associated with livestock production and use of livestock sector as an outlet for recycling of appropriate urban wastes;
- Encourage highly productive breeds of livestock; and
- Introduce adequate animal waste management system in peri-urban dairy colonies.

While environmental policy contained adequate guidelines for agriculture and livestock sector, it failed to explicitly address food security issues. With the 18th Amendment in the constitution, the federal Ministry of Agriculture and Livestock also stands devolved and a new Ministry of National Food Security and Research has been established at the federal level. But so far, no national food security policy has been framed.

On the implementation side, the proposed National Desertification Control Fund has not been established and little progress has been made in conserving arable lands. The arable lands are being diverted from agriculture to urban and industrial uses at quite higher rates. There is no comprehensive plan for improvement of degraded land. Some programmes were initiated to prevent soil degradation and restore and improve degraded lands in the country including Sustainable Land Management Programme (SLMP) and Saline Agriculture Development Programme. The former programme (initiated by defunct federal Ministry of Food and Agriculture but currently underway in Ministry of Climate Change) was for improvement of land management practices to prevent soil degradation. The later was conducted by National Institute of Agriculture and Biology (NIAB)³, Faisalabad using participatory approach to reclaim 5,000 hectares of saline land. Later, this programme was expanded to 25,000 hectares of saline lands in the four provinces of the country under National Bio-Saline Agriculture Programme .

Sustainable Land Management Programme (SLMP) mentioned above was a step towards developing strategies and programmes to tackle desertification in line with the National Action Plan to combat desertification and droughts. In addition, certain institutions including Arid Zone Research Institutes at Bahawalpur (Punjab), D. I. Khan (KP) and Umer Kot (Sindh), and Cholistan Institute of Desert Studies conducted research on problems related to dry lands. However, no ecologically compatible cropping system has been developed so far.

Similarly, awareness programme for organic farming could not make any substantial achievement in terms of adoption on a noticeable scale. The indiscriminate use of chemicals on crops, vegetables, and fruits is still unchecked. The official statistics [Pakistan (1993, 2009 and 2011)] show that fertiliser use in Pakistan increased from 92 Kg in 1990-91 to 183 Kg per hectare in 2011. Similarly, use of pesticides in Pakistan increased from 0.93 Kg in 1990-91 to 3.15 Kg per cropped hectare in 2010-11. The use of chemicals is alarmingly high especially on farms involved in off season vegetable production.

The University of Agriculture, Faisalabad (UAF) developed Effective Microorganism Technology (commonly known as EM Technology) to be used to grow crops through application of useful microorganism without application of fertilisers or pesticides. However, this technology failed to gain popularity among farmers.

In order to promote integrated pest management and discourage use of agrochemicals, certain bio-control programmes for insects and pests were

³NIAB, Faisalabad is a research institute working under Pakistan Atomic Energy Commission.

initiated by Pakistan Atomic Energy Commission (PACE) including a programme on fruit fly control (in guava in Sindh) using pheromones as an attractants for male annihilation and a programme for mass rearing of predators and parasites (such as *Chrysopa*, *Trigogramma*) of harmful pests. Similarly, rearing labs for some pests and predators are being maintained by Agriculture Department of Punjab in Sheikhpura district and by some other institutes and organisations. However, such technologies could not achieve any noticeable scale of adoption.

3.1.3. National Disaster Management

In this regard, recommendations forwarded in the national environmental policy 2005 emphasised that government may:

- Develop and implement a national disaster management strategy; and
- Establish disaster management institutions at federal and provincial level.

This is one of the important components of National Environmental Policy where national disaster management objectives were achieved more than what were proposed at the policy level. After the unfortunate Earthquake in 2005, the proposal for establishing comprehensive disaster management system was approved in February 2006 and thereof a National Disaster Management Ordinance 2006 was promulgated. This ordinance led to the establishment of National Disaster Management Commission (NDMC) and National Disaster Management Authority (NDMA) at Federal level in February 2007. Consequently, the provincial governments established the Provincial Department Management Commissions (PDMCs) and Provincial Disaster Management Authorities (PDMAs), and Districts Disaster Management Authorities (DDMAs).

The NDMC is the apex policy forum primarily having the mandate to approve national disaster management plan, formulate policies on disaster management, arrange and allocate funds for disaster management. The National Disaster Management Authority (NDMA) serves as the implementing, coordinating and monitoring body for disaster management. One of the functions of the NDMA is to prepare National (Disaster Management) Plan. The Authority consists of three wings namely operational wing, disaster risk reduction wing, and support and services wing. The main responsibility of the operational wing is to plan, monitor, and coordinate rehabilitation initiatives. The operational wing further consists of three sections namely response section, recovery & rehabilitation section and logistic section. The disaster risk reduction wing's main responsibility is to develop a national plan with consultation of all stakeholders. Finally, the support and services wing is responsible for efficient management of human and financial resources. On the implementation front, the

National Disaster Management Authority (NDMA) in addition to providing technical support to PDMAAs, have effectively monitored and coordinated disaster management in terms of prevention, preparedness, mitigation, and restructuring and rehabilitation programmes.

In terms of implementation, the national environmental policy objectives regarding disaster management have been more than achieved. However, the NDMA faces challenges like, lack of political commitments at provincial level, lack of capacity and financial resources, lack of understanding about the role of NDMA, lack of cooperation amongst federal and provincial ministries and departments, lacking in integration of disaster management in national policies and the most important is the strategic shift after the 18th Amendment in the constitution which would affect and need to redefine the relationship of PDMAAs and NDMA.

In summary, the National Environmental Policy (2005) successfully described the sectoral and cross-sectoral targets, goals and objectives. It also developed a proper implementation plan of action to achieve the targets, goals and objectives. This policy induced formulation of Task Force on Climate Change at planning commission of Pakistan in 2008. The report of the Task Force on Climate Change later provided the foundation block for the National Climate Change Policy 2012. However, the objectives of the National Environmental Policy 2005 were only partially achieved as Pakistan faced multifaceted challenges which scaled up and influenced realisation of the policy objectives. More specifically the lack of financial resources with the concerned ministries, divisions, and organisation; the 18th amendment in the constitution; and failure to attract needed political will and get due priority for addressing environmental issues were the prime reasons that affected achievement of the environmental policy objectives.

3.2. National Climate Change Policy 2012

The goal of Climate Change Policy is to make Pakistan climate change resilient economy through mainstreaming climate change in the vulnerable sectors of the country. The objectives discussed in the policy document are sustainable economic growth, food security, availability of water and sufficient energy for this region. In addition to assess the impact of climate change and strengthening the inter-departmental coordination at national level on the climate change. Furthermore, the objective of this policy document is to actively participate in international conferences and engage with international institutions on the said issues and to avail any opportunity of international aid; and also to encourage the public and private sector investments in this field. Finally, to create awareness among general public and institutions and stakeholders about the possible devastating results related to the climate change.

The policy objectives are: pursuance of sustainable economic growth by addressing the climate change threats; integration of national climate change policy with other policies; enhancement of Pakistan's role as a responsible member of the international community in addressing the climate change challenges; promotion of pro-poor and gender sensitive adaptation in cost effective manners; ensure national water, food, and energy security; minimise risks arising from floods, droughts, and storms etc.; development of strong inter-departmental and inter-provincial decision making and coordination mechanism on climate change; effective usage of the available international opportunities to address the issue; encouragement of public and private sector investment in adaptation and mitigation measures; enhancement of the awareness, skill and institutional capacity of the stakeholders; and promotion of conservation of natural resources and long term sustainability [Pakistan (2012)].

The policy document also highlights the important climate change factors that threaten country's water, food, and energy security. The major climate change threats include: increase in extreme weather events and erratic monsoon rains; melting of glaciers; increased siltation of dams; increase in temperature causing reduction in agricultural productivity; decline in forest cover; intrusion of saline water in Indus delta resulting in damage to coastal agriculture, mangroves and fish breeding; rise in sea level and higher sea surface temperature threatening coastal areas; water shortages and increased tensions between regions for water sharing; and increased health risks.

The Policy 2012 suggests a number of adaptation measures to ensure national security in water, food, and energy as well as to minimise impact of climate change on human life, health, and property. The suggested adaptation measures relate to water resources, agriculture and livestock, human health, forestry, biodiversity, and other vulnerable ecosystems. In addition, policy measures are included suggestions for disaster preparedness and socioeconomic measures.

The policy measures suggested for water resources encompass managing of supply side as well as demand side aspects e.g. construction of new reservoirs and upgrading existing setup; adoption of water conservation strategies; better water resource management; and legislation to check water pollution, efficient use of underground water reservoirs, and protect glaciers. For agricultural and livestock, the suggested adaptation measures include developing of digital simulation models for assessment of climate change impacts, development of new varieties of crops and improved breeds of livestock that are tolerant to climate related stresses, promoting biotechnology, developing proper risk management system.

The human health related adaptation measures proposed in the policy cover assessment of health vulnerability of communities; inclusion of health issues related to climate change in national health policy; and enhancement of

awareness about climate change related health issues and building capacity of disease outbreak monitoring and forecasting system etc. The proposed policy measures for forestry sector, emphasise on increasing awareness among communities about environmental and forest protection; encouraging empirical research on adaptation of forests biodiversity and forest management system to climate change; reforms in governance of forests; control forest fires and other damages; and arresting soil erosion in forest lands.

The proposed adaptation measures to protect biodiversity in Pakistan include: encouragement of research on flora and fauna response to climate changes; conserve biodiversity of valuable species; and encouragement of participation of local communities in conservation and sustainable use of biodiversity. The adaptations recommended for vulnerable ecosystems include measures suggested for mountain areas, rangelands and pastures, arid areas, coastal and marine ecosystems and wetlands.

In order to combat disasters more effectively, several adaptation measures are proposed including: allocation of adequate resources to NDMA; development of coordination mechanism among concerned departments; installation of advanced disaster alert systems; and redesigning and up-gradation of storm drainage capacity in major cities.

The policy considers that the poor and the women are expected to be affected disproportionately by climate change and suggests adaptations measures for addressing these aspects of vulnerability from climate change. The important policy measures proposed in this regard include actions to check population growth; enhancement of access of the vulnerable segments of society (poor and women) to adaptation technologies; study of gender-differentiated impacts of climate change; and greater involvement of women and female gender experts in decision making and actions related to climate change.

The policy measures proposed for climate change mitigation focus on main contributors to greenhouse gas (GHG) emissions in the country including energy, agriculture and livestock, industry, and forestry sectors. The mitigation policy measures related to energy sector include promotion of hydropower generation and expansion of nuclear power generation capacity; development of renewable energy resources and technologies; acquiring of clean coal technologies for power generation; import of natural gas, liquefied natural gas, and liquefied petroleum gas; promotion of energy efficient and environment friendly transport technologies; provision of fuel efficient public transport systems; enforcement of vehicle emission standards; encouraging carbon taxation; improvements in town planning and building systems.

Agriculture and livestock is recognised as the second largest contributor to total GHGs emissions in Pakistan. The mitigation policy measures regarding this sector include: promotion of improved management practices that lead to reduction in use of chemicals and conservation of water; promotion of green

manure and improved methods of manure storage and management; promotion of no-till farming for methane abatement; developing high yield cattle breeds that have lower methane production; promotion of agro-forestry: better water management for rice crop to control the release of methane gas; and development of rice varieties having low water requirements.

The mitigation policies proposed for forestry sector emphasise on expansion of area under forest; stopping illegal forest cutting and conversion of forest land to other uses; providing alternative energy to the forestry dependent inhabitants; encouraging farm level agroforestry; improving institutional framework and collaboration with international institutions; and preparing strategy for Reducing Emission from Deforestation and Forest Degradation (REDD) strategy and its implementation.

The other important mitigation measures suggested in the policy include: capacity building and strengthening of institutions; awareness enhancing; encouraging collaborative research on the subject and achieving higher international and regional cooperation; and benefiting from various international funds related to climate change and transfer of adaptation and mitigation technologies from development nations to Pakistan.

The policy also suggests policy implementation mechanism through establishing the Climate Change Policy Implementation Committees at provincial and federal levels with a mandated task of upgrading climate change policy after intervals of five years.

On the whole, the National Climate Change Policy 2012 is a very comprehensive document that provides a framework for addressing climate change related issues in Pakistan. The policy adequately encapsulates the climate change adaptation and mitigation concerns, capacity building and institutional strengthening, awareness raising, international and regional cooperation, finance and technology transfer. It also proposes a federal and provincial implementation and coordination mechanism through National Climate Change Implementation Committee and provincial Climate Change Implementation Committees. These committees are required to meet biannually and the provincial committees would report to the national committee and the national committee on regular basis would report to the Prime Minister's Committee on Climate Change .

The formulation of suggested Action Plans by federal, provincial and local governments for implementation of the Climate Change Policy will take time especially in view of limited financial capacities and lack of human resources trained in the relevant disciplines. The review of the implantation of National Climate Change Policy 2012 is too early an exercise. However, some concerns are being raised about the policy. For example, the policy recommends establishment of new institutions for an effective implementation which is feared to end up just adding few more to already a long list of institutions as

recommendations are not based on proper institutional analysis. There are also concerns about inclusion of recommendations regarding agriculture & livestock, education, and health which are provincial subjects. The suggested actions may not be welcomed by the provinces. Without proper implementation mechanism and serious efforts in this regard, it is feared that the policy will end up being merely a long wish list.

4. REVIEW OF INSTITUTIONS RELEVANT TO MITIGATING CLIMATE CHANGE IMPACTS

This section involves review of various institutions/organisations mandated to provide support for reducing adverse impacts of climate change, improving food security, and managing disaster. Over the years, various institutions and organisation have been evolved to tackle climate change and disaster related issues in Pakistan. Such institutions can be categorised as non-government and government institutions based on their management and source of funding and these include NGOs, private institutions, and provincial and federal level public institutions. However, for the review purpose, we have classified institutions into three broad categories based on functions these institutions are mandated with and the services they render in relation to climate change. The categories include: (i) policy designing and implementing institutions; (ii) academic institutions (research and teaching institutions); and (iii) disaster management institutions. The evolution of policy designing and implementation institutions has been discussed in the second section. The review of the remaining categories of the institutions is presented in the following subsections.

4.1. Review of Research and Teaching Institutions

Pakistan is among the most vulnerable countries facing threats of climate change but education and research regarding the subject remained generally neglected in the past. Greater realisation overtime about importance of the role that quality education and research can play to combat climate change has stimulated some efforts in this regard. These initiatives include restructuring and strengthening of existing institutions, re-prioritising of research focus, and establishment of new institutions. Presently, there are several institutions and ministries involved in research and educational activities related to climate change (see list of such organisations in Appendix-I and Appendix-II). A few of these institutions have specialised mandate of conducting research on climate change issues while most of these have general mandates of undertaking research/teaching but may have specific research wings/sections or have some subsidiary institutions to undertake research and/or teaching/training activities.

On the whole, these organisations have competency to undertake research and teaching tasks. However, as the climate change phenomenon drew attention

only very recently in Pakistan, the research and educational programmes related to the subject are not fully developed, generally deficient in skills about new techniques, often inadequately financed, usually lack autonomy, and poorly linked with other national and international organisations. The purpose of this section is to present an inventory of major institutions, review their research efforts regarding climate change, and report various constraints faced by these institutions.

Global Change Impact Studies Centre (GCISC) and Pakistan Meteorological Department (PMD) are the institutions which have direct mention of research on climate change issues in respective mandates. GCISC was established in May, 2002 and seed money for this purpose was provided by Ministry of Science and Technology. Later, it was supported for some time by Planning Commission and Ministry of Environment. Since devolution of the Ministry of Environment (following the 18th amendment in the Constitution of Pakistan), the Centre is working under Ministry of Climate Change. GCISC consists of four technical sections (Climate, Water, Agriculture, and Environment) and an administration and finance section. The objectives of GCISC include monitoring of trends of global change (climate as well as technological change); analysing their impact on important sectors of Pakistan's economy; providing science based advice to planners on appropriate strategies to cope with adverse impacts; building national capacity for research related to the subject; and enhancing public awareness about global change related issues.

The Centre has developed its capacity to utilise simulation modelling⁴ techniques and have used various models to study climate change and its impact under local conditions. The simulation models currently in use at the Centre include (a) Regional Climate Models; (b) Crop Simulation Models; (c) Watershed Models; (d) Meso-scale Meteorological Model; and (e) Air Pollution Transport Models.

The research conducted at the Centre has focused on designing of crop growth and watershed simulation models; assessment of the impact of trans-boundary air pollution on the climatic changes in Pakistan; development of indicators and indices for extreme climate change events in the South-Asia; projections of frequency and intensity patterns of extreme climate events in Pakistan; study of the temporal changes in physical dimensions and volume of the main glaciers feeding the Indus River System and assessment of the impacts of projected climate change on water flow in main rivers of Pakistan. The research showed that warming will result in rapid melting of glaciers which will have serious consequences for river-flows in Pakistan—more water will be available in the first few decades causing floods and severe droughts afterwards [Sheikh, *et al.* (2011)].

⁴GCISC has acquired and validated diverse mathematical simulation models developed by various world renowned organisations to study different aspects of climate change in Pakistan.

The GCISC has also imparted simulation modelling skills to scientists working in other organisations. The Centre is relatively well linked with other national institutions working on issues of climate change including PMD, WAPDA, NARC, PCRWR, SUPARCO, and University of Agriculture, Faisalabad and University of Arid Agriculture, Rawalpindi. However, the lack of or limited access of the Centre to base data on growth of various crops is constraining its research on agriculture. The centre has not developed any technology that could be adapted by the farmers or rural population mainly involved in agriculture to mitigate or cope with the detrimental effects the climate change. The work could be of national benefit, more comprehensive and tangible, if strong coordination and data sharing is developed between GCISC and other agricultural research institutes working at federal and provincial level.

The Pakistan Meteorological Department (PMD) provides meteorological service and deals with Agro-meteorology, Hydrology, Astronomy and Astrophysics (including solar physics), Seismology, Geomagnetism, Atmospheric Electricity and studies of the Ionosphere and Cosmic Rays. The department collects and processes the raw data and issues meteorological forecasts and warnings for various users. The main focus of research has been to investigate the factors responsible for global warming, climate change impact assessment and adaptation strategies in various sectors of the country. The development of climate change indicators [Zaman, *et al.* (2009)] and assessment of impact of global warming on main glaciers [Rasul, *et al.* (2008)] are important research contributions of the department. Among other achievements of PMD include introduction of modern flood forecasting system; earthquake and nuclear explosion detection system; artificial rain making, ground water detection, ozone measurements, solar energy, wind power potential, oceanographic and space research. The PMD has contributed significantly to build capacity of other institutions and to enhance awareness regarding climate change threats and its impact on hydrological resources, agriculture and overall ecology of the Pakistan. The department faces the constraint of computer (processing) power and lack of skills in numerical modelling and climate system dynamics [Rasul (2010)].

Pakistan Agricultural Research Council (PARC), Pakistan Council of Research in Water Resources (PCRWR), and Pakistan Atomic Energy Commission are the other federal level institutions involved in agricultural research. Presently, Pakistan has sizeable National Agricultural Research System (NARS) consisting of federal and provincial research institutions. None of the agricultural research institutions have established a separate section on climate change. However, research undertaken at these institutions has addressed climate change issues.

Pakistan Agricultural Research Council (PARC) established in 1981 as an autonomous organisation is the apex research body mandated to undertake, aid,

promote, and coordinate agricultural research at federal and provincial levels in the country. Presently, it works under newly created Ministry of National Food Security and Research after devolution of Ministry of Food and Agriculture. The council has established a wide network of its substations and research institutes located in all provinces and important agro-ecological regions of the country. Three of these have the mandate to undertake research in dry and desert ecologies. The National Agricultural Research Centre (NARC) of PARC is the largest and the most resourceful research institution and employs the largest number of PhDs in the country.

PARC has developed Agro-Ecological Zones Atlas of Pakistan [Roohi, *et al.* (2002)] for dissemination of information on agriculture and natural resources for research and planning purposes. The scientists of PARC have developed Glacier Inventory of Pakistan using Remote Sensing and GIS [Mool, *et al.* (2003)]. This inventory describes the nature of certain glaciers in Northern Pakistan and provides a baseline about the glacial ice reserves. The study also identifies number of glacial lakes that may cause Lake Outburst Flooding (GLOF). The crop scientists in wheat programme of NARC have conducted research on genotype, environment, and management (GEM) interaction using simulation model [Asim, *et al.* (2011)]; tested wheat genotypes for salinity tolerance [Jalal-ud-Din, *et al.* (2008)]; evaluated wheat, rice, and canola genotypes for drought tolerance [Jalal-ud-Din, *et al.* (2012, 2011, and 2010)]; and screened wheat varieties for heat tolerance. The climate change related research and development activities initiated at rice programme of NARC include development of water efficient and drought and salinity tolerant rice cultivars; raised bed planting and direct seeding of rice. Also dry planting of rice is time saving and environment friendly with no emission of gases. In addition, NARC also undertook research in the field of bio-saline agriculture and to develop water and soil conservation technologies.

Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) is operationally utilising space technology for socio-economic development of the country. The commission provides real time images data of state of affairs due to climate change in flood or drought scenarios. It has developed technology for land cover classification, remote sensing, early warning and flood forecast, climate change impact assessment and also in monitoring of agriculture and timely availability of crop forecast and yield estimates and has created awareness among the stakeholders.

Pakistan Council of Research in Water Resources (PCRWR) works under Ministry of Science and Technology. The council has played its role as a national research organisation by undertaking and promoting applied as well as basic research in various disciplines of water sector especially in the areas of desertification, water management, and water quality. The research and development (R&D) activities in area of desertification covers rainwater

harvesting, desertification control through sand dune fixation and stabilisation, dune-land afforestation, grassland development, and saline agriculture etc. The R&D initiatives dealing with water management relate to surface and groundwater management as well as development of water management tools. Major contributions of the council in this regard include grafting of glacier, introduction of low delta crops, water conserving farm practices, and development of empirical model for characterising snowmelt regime of Upper Swat River Basin and forecasting seasonal flow. The activities regarding water quality monitoring and management comprise of water quality monitoring; establishment of water quality testing laboratories and provision of water quality testing services; and development of water testing and water treatment technologies.

Pakistan Forest Institute (PFI) is based at University of Peshawar. The institute has conducted climate change related research in collaboration with WWF (on fauna) and Global Change Impact Study Centre (GCISC), Islamabad on simulation analysis scenarios on climate change and growth of important tree species. The seasonal temperature and rainfall changes have been studied using (50x50 km) grid-wise data.

Pakistan Atomic Energy Commission (PACE) runs four agricultural research institutes namely Nuclear Institute of Agriculture and Biology (NIAB), Faisalabad; National Institute of Biotechnology and Genetic Engineering (NIBGE), Faisalabad; Nuclear Institute of Agriculture (NIA), Tandojam; and Nuclear Institute for Food and Agriculture (NIFA), Peshawar.

The NIAB has screened a large number of plants for salt-tolerance and have selected several plants having an economic value as food, forage, timber or fire wood that can be grown profitably in salt-affected soils irrigated with brackish water. Sarwar, *et al.* (2006) induced salt tolerance in chickpea cultivar CM98 using simple and safe chemicals and found the cultivar as most salt tolerant. Bibi, *et al.* (2009) analysed the response of four chickpea genotypes to water stress at germination stage and CM-94/99 was identified as a drought tolerant chickpea cultivar. The institute has also developed cold tolerant and short duration variety namely Kashmir Basmati, salt tolerant cultivars of rice (NIAB-IRRI 9) cotton (NIAB-999) and wheat (Sarsabz). The other research related to climate change include establishment of mechanism of stress tolerance (heat and drought) in various crops (cotton, wheat, sorghum, rice, guar, and grasses) and identification of physiological and biochemical markers for stress tolerance.

The NIBGE has developed a critical level of expertise to make use of modern techniques of biotechnology. The Agricultural Biotechnology Division of NIBGE has developed bio-fertilisers and achieved expertise in first generation GM crops by introducing single gene traits for resistance against abiotic stresses such as salt, drought and heat tolerance. Work on improvement

of basmati rice for biotic and abiotic stresses and development of salt/drought tolerant wheat, cotton, potato, sugarcane and tomato is in progress.

The Nuclear Institute of Agriculture (NIA), Tandojam has conducted studies on climate change and its impact on productivity of various crops. The results show that high temperature stress reduces yield of wheat crop. The institute has been involved in evaluation of crop (wheat and rice) varieties for resistant/tolerant to abiotic (high temperature, drought & salinity) stresses. A study conducted at NIA evaluated twenty advance genotypes of wheat under different temperature regimes. The results indicated that the late sown wheat crop (in January) experienced terminal heat stress during grain development period. This study identified six genotypes [DH-12/1, NIA-8/7, NIA-Amber, MASR-7, NIA-10/8, and NIA-9/5] as promising lines showing early maturity and exhibiting high yield under heat stress [Laghari, *et al.* (2012)]. The researchers at NIFA have focused on development of cold tolerant sugarcane cultivar and wheat varieties resistant to biotic and abiotic stresses. Researcher at NIFA has also evaluated wheat cultivar NRL 2017 (selected from germplasm from ICARDA) and released as commercial wheat variety tolerant to drought [Farooq-i-Azam, *et al.* (2007)].

The provincial agricultural research institutions (ARIs) also have their network of research stations and institutes in different ecologies of respective provinces. Ayub Agricultural Research Institute (AARI), Faisalabad; Agricultural Research Institute (ARI), Tandojam; and Agricultural Research Institute (ARI), Quetta have the general mandates taking research to address agricultural issues respectively in Punjab, Sindh, and Balochistan province. The agricultural research institutions in Khyber Pakhtunkhwa (KP) work under Director (Research) KP Agricultural University, Peshawar.

The provincial agricultural research institutes (ARIs) have specialised institutions working under them to address issues of specific crop or a group of crops or agricultural issues in a specific ecology or a particular agriculture or natural resource related problem. For example, Wheat Research Institute(s), Cotton Research Institute(s), and Rice Research Institute(s), Tobacco Research Station, Potato Research Centre; Cereal Crops Research Institute, Maize and Millet Research Institute, Sugar Crops Research Institute, and Horticultural Research Institutes; Barani Agricultural Research Institute and Arid Zone Research Institute(s); Soil & Water Conservation Research Institute; and Soil Salinity Research Institute, etc. The ARIs have not established any separate section or division to deal with the issues of climate change however certain aspects of climate change research are addressed as a part of their routine research activities.

Ayub Agricultural Research Institute (AARI), Faisalabad was established in 1962. It works under Agriculture Department, Government of Punjab and has played an important role in conducting research and development of agriculture

in the province. The climate change related research conducted by scientists of AARI located at various stations focused on: wheat breeding for heat, drought and salinity tolerance; developing short duration varieties of rice, testing of cultivars for salinity and drought tolerance; water harvesting, erosion control, and soil moisture improvement; reclamation of salt affected lands; introduction of drip irrigation system and bubbler irrigation system; breeding of pulses for heat, drought and cold/frost tolerance; development of high yielding, drought tolerant and disease resistant crop varieties of oilseeds (Brassica) and fodders (sorghum and millets); tunnel technology (off-season vegetables); enhancing drought tolerance in wheat through use of growth hormones; and comparative water saving efficacy of various sowing methods of wheat.

A study conducted at Barani Agricultural Research Institute (BARI), Chakwal found three wheat varieties; 4C030, Chakwal-86 and 2C021 heat tolerant [Mian, *et al.* (2007)]. Wheat Research Institute, AARI, Faisalabad screened 442 wheat varieties/lines for heat tolerance during 2004-05 and 2005-06 and identified three entries CB-367, CB-333, and CB-335 showing maximum grain development and survival and can be utilised in breeding programmes for development of wheat varieties having heat tolerance at terminal growth stage [Aziz-ur-Rehman, *et al.* (2009)]. Another study examined impact of temperature on development and formation of grain in ten selected wheat cultivars and found that wheat variety AS-2002 showed heat tolerance while Inqilab-91, 00125, 00180, and 00183 were better yielder under normal conditions [Riaz-Ud-Din, *et al.* (2010)]. The study conducted by Bibi, *et al.* (2012) screened twenty different accessions of sorghum in Faisalabad area and the most promising drought tolerant accessions (80353, 80365, 80199, 80204 and 80319) were identified through multivariate scoring index.

Provincial Agricultural Research System in Sindh consists of five institutes. Agricultural Research Institute (ARI), Tandojam is the leading research institution and mainly focuses on development of improved varieties and development of production technologies for all field crops except rice and wheat. Research on rice and wheat is carried out at Rice Research Institute, Dokri and Wheat Research Institute, Sakrand.

The climate change related agricultural research in various institutions of Sindh has focused on breeding for high yielding; heat- and cold tolerant; drought resistant; and short duration varieties. In addition, technologies for reclamation of saline and water-logged soils have also been developed. The water conserving technologies like drip irrigation, sprinkler, and precision levelling etc. are being promoted in the province. Recently, ARI, Tandojam has established environmental change section to enhance awareness and address the climate change issues more effectively. A study conducted in experimental area of Pulse Crops Research Section, ARI, Tandojam, Khan, *et al.* (2011) evaluated impact of temperature and relative humidity on population of thrips, mites, and field

cricket on mung bean. This research concluded that temperature had a negative and high correlation with thrips population and a positive and high correlation with mites and field cricket. The relative humidity was positively correlated with thrips population and negatively correlated with population of mites and field cricket.

The provincial Agricultural Research System of Khyber Pakhtunkhwa (KP) works under Director (Research) located in KP (formerly NWFP) Agricultural University, Peshawar. It consists of 13 research stations located in different agro-ecological zones of the province to undertake research and development activities for various crops, fruits and vegetables. The climate change related research in KP includes development of varieties of wheat, maize and barley that suits for early, mid, and late-sowing; development of high yielding drought and heat tolerant varieties of wheat, maize, and barley; and short duration wheat varieties. A study conducted by researcher of NWFP Agricultural University at ARI, Tarnab examined the impact of sowing method on canola yield planted in a saline field. It is concluded that highest grain yield was recorded in case of ridge sowing method due to movement of salt away from seed into ridges [Khan, *et al.* (2000)].

Another study screened 11 genotypes of wheat for salinity tolerance at various locations of KP and found that maximum biological and grain yield, maximum shoot K⁺, and minimum Na⁺ concentration (3, 6 and 9 weeks after emergence) were recorded in genotype SR-40 followed by genotype SR-23 [Shafi, *et al.* (2010)]. Effect of temperature on seed quality of soybean was tested by Khalil, *et al.* (2001). They found that the seed matured at higher temperature produce heavier seed but have lower germination and higher infection with seed borne pathogens.

A number of agricultural, engineering, and general universities in Pakistan have initiated climate change/environment related research and/or teaching programmes (please see list in Appendix I). Three provinces (Punjab, Sindh, and KP) have agricultural universities where applied and basic research is a vital part of their academic activities. These universities are financed by federal government through Higher Education Commission (HEC) but work under administrative control of provincial government.

Most of the institutions offer graduate and/or post graduate level degree programmes in environmental sciences. A few institutions offer degree programmes in other disciplines related to environment including graduate and/or post graduate degree programmes in environmental engineering, environmental law, environmental economics, and other disciplines dealing with environment. Relatively more rigorous teaching programmes in environment related fields are offered by COMSATS Institute of Information Technology, Abbottabad; Institute of Soil & Environmental Sciences, University of Agriculture, Faisalabad; Department of Environmental Sciences, University of

Peshawar; Department of Environmental Sciences, International Islamic University, Islamabad; College of Earth and Environmental Sciences, University of Punjab, Lahore; Institute of Environmental Studies, University of Karachi; Fatima Jinnah Women University, Rawalpindi; and Bahria University, Islamabad.

The Institute of Environmental Studies, University of Karachi runs a self-financed programme in Environmental Sciences offering BS and MS leading to PhD degrees with yearly intake of 25 and 5 students respectively. The institute had completed or initiated a number of projects on climate change related problems in coastal areas. Under the project collaborated by Italy, European Union, and China an online Masters Programme on Climate Change has been started. The other important projects undertaken or underway at the institute include a project on Climate Change Vulnerability in the Coastal Areas of Sindh; a project addressing siltation issue in Hub Dam; a British project on Unprotected Coastal Sites addressing impact of unavailability of fresh water on biodiversity; and a project on Climate Change and Conflict. The Department of Geography, University of Karachi has examined effect of rise in temperature on quality of human by relating incidence of malaria and dengue to climate change using data for the period 1980-2010. The other important studies conducted at the department deal with the effect of climate change on plants and hatchability of turtle eggs.

The University of Agriculture, Faisalabad (UAF) is the oldest institution imparting education in various disciplines and undertakes research related to issues of agriculture. The university has established an Agro-climatology Laboratory to teach climatology at graduate and post graduate levels as well as conduct research on various aspects of climatology including climate change. The researchers have studied the impact of climate change on productivity of various crops and cropping patterns in various cropping zones of the Punjab province. The historical environmental data (1961-90) have been analysed in relation to soil and crop management data using crop simulation modelling technique. The studies have provided information about the potential of CSM-CERES model as a component of Decision Support System for Agro-technology Transfer (DSSAT) to simulate productivity of wheat, rice and maize in response to changing climate conditions in the Punjab. Some studies suggested crop management practices in relation to climate change as a strategy to mitigate adverse impact of climate on crops. However, the pace of development of tangible technology for the farmers to utilise resources and adopt better crop husbandry in relation to climate change can hardly be termed as satisfactory.

A study conducted at UAF used CSM-CERES-Maize model run with weather series representing the present and changed climate conditions. The results showed that increase in temperature shortened the crop duration from planting to physiological maturity, retarded growth and decreased yield as

compared to current conditions [Khaliq (2008)]. Qadir, *et al.* (1996) studied four forage plant species for biomass production on saline-sodic field and soil reclamation. *Sesbania* was identified to be the most suitable species for cultivation on saline-sodic soils to produce good quality forage and reduce soil salinisation and sodication process.

In certain studies researchers have used materials like Salicylic Acid (SA), Glycinebetaine (GB), and *Rhizobacteria* for improving drought resistance in various crops. The use of SA and GB for improving drought tolerance in sunflower showed that water stress reduced achene- and oil yields however, application of GB and SA improved yield under the same stress [Hussain, *et al.* (2008)]. The study also showed that application of GB at flowering stage was more effective. Farooq, *et al.* (2008) examined the impact of Glycinebetaine (GB) application on drought tolerance of super basmati rice. It was concluded that drought stress affected growth adversely and application of GB at foliar stage improved growth more effectively than seed treatment. Shakir, *et al.* (2012) screened thirty *Rhizobacteria* for their potential to confer drought tolerance in wheat. The enzyme ACC-deaminase was considered to be responsible for mitigating impact of drought stress enabling utilisation of soil moisture of lower profiles through more proliferated roots.

A number of studies tested different genotypes of various crops for their tolerance to drought and salinity. The research conducted by Ahmad, *et al.* (2009) evaluated six sunflower lines for drought stress tolerance at germination and seedling growth stages and found hybrid G-101 and 64-A-93 to be drought tolerant. Abbasi, *et al.* (2012) screened maize hybrids for salt tolerance at seedling (2-leaf) stage and concluded that the maize hybrid 26204 exhibited salt tolerance at all levels of salinity experimented.

The University of Arid Agriculture, Rawalpindi (UAAR) offers teaching programme in environmental sciences. The research activities are mainly focused on studying the impact of climate change and increase in temperature using crop simulation modelling technique. However, the work conducted is in isolation without establishing professional linkages with various other organisations working on climate change impact studies in the rainfed areas. The climate change related research at PMAS Arid Agriculture University, Rawalpindi (PMAS-AAUR) concentrated on crop improvement for characters like resistance/tolerance to abiotic stresses and evaluation of high yielding cultivars for tolerance/resistance to stresses like drought, heat, and salinity under rainfed conditions. The other related research include water and soil conservation technology including efficient micro irrigation techniques, water harvesting, moisture management, green manuring, gully plugging, check damming, and production of bio-fertilisers etc.

The university has close coordination with CIMMYT, ICARDA, BARI (Chakwal), and NARC (Islamabad) for conducting evaluation and screening of

local and exotic germplasm. Studies have evaluated different genotypes of various crops for their tolerance to biotic and abiotic stresses. In a study, researchers evaluated fifteen genotypes of wheat and found that the plant tolerate drought stress at the cost of yield suggesting that the coping strategy to minimise yield losses. Among the tested genotype MARGALLA-99 and AS-2002 exhibited drought tolerance and can be used in wheat breeding for crop improvement under low moisture conditions [Ahmad, *et al.* (2006)]. A survey based study conducted in arid region (Rawalpindi Division) used Ricardian approach to examine the impact of climate change on agriculture production and concluded that temperature increase has significant negative impact on agriculture production [Shakoor, *et al.* (2011)].

The Quaid-i-Azam University (QAU), Islamabad undertakes research on impact of climate change on geological aspects. Main techniques used in research are remote sensing and geodesy technique to check the effects of global warming on the environment. Department of earth sciences from QAU is working on various risk assessment and adaptation measures regarding climatic change.

Pakistan Institute of Development Economics (PIDE) has established the Centre for Environmental Economics and Climate Change (CEECC) to study the problems related to climate change. It also runs an MPhil programme in environmental economics and has established a data bank on environmental indicators. The Centre is in the developing stage and lacks financial autonomy and is understaffed.

The Department of Environmental Sciences, University of Peshawar runs very rigorous B.S, MS and PhD programmes in environmental sciences. The department is also involved in conducting training and research in public health, applications of remote sensing to environmental monitoring and hazard mapping, and uses of Geographic Information System (RS/GIS) for Planning/Management of Natural Resources. The department has 12 qualified teaching staff and most of them hold PhD degrees. Three Professors are directly involved in research on issues related to climate change while the others are involved indirectly. The faculty actively takes part in workshops, seminars, and conferences etc. However, the department is weakly linked with various provincial government departments as well as with other research/educational institutions including national and international organisations.

Forman Christian College University (FCCU), Lahore runs a BS Programme in Environmental Economics and offers courses in environmental economics in MPhil (Economics). Dr Uzma (a faculty member at FCCU) recently completed her PhD thesis and used Ricardian Approach to analyse impact of climate change on agriculture and applied spatial econometric techniques using survey data regarding various districts of Punjab.

In summary, the research activities related to subject widely differ across institutions in terms of scope, methodologies, and applicability of results. The research conducted in national institutions focused on analysis of trends of changing climate, case studies of glacier melting and its impact on river flows, crop modelling incorporating temperature and rainfall changes etc. The other area of interest in research has been the analysis of impact of climate change on health, poverty, food security, and other socio-economic aspects.

Validation of diverse mathematical simulation models developed by various renowned world organisations has been an important aspect of research undertaken in Pakistan to study various aspects of climate change and its impact under local conditions. The Global Change Impact Studies Centre (GCISC), Pakistan Meteorological Department (PMD), National Agricultural Research Centre (NARC), University Arid Agriculture, Rawalpindi (UAAR) and University of Agriculture, Faisalabad (UAF) and several other institutions have used simulation techniques to study (i) temporal changes in physical dimensions and volume of the main glaciers and water flow in main rivers of the country and (ii) productivity of various agricultural crops in response to changing climate conditions. The other notable aspects of research on climate change issues include research on crop management/farm operations, water and soil conservation, and to a lesser extent use of modern techniques of biotechnologies in development of varieties and other technologies. Development of Agro-environmental Atlas of Pakistan by (PARC) and Climate Chang Indicators of Pakistan by PMD are other useful efforts.

On the whole, research on issues related to climate change was successful in drawing attention of the researchers on a variety of topics. However, these studies in general and those on agriculture in particular, depict that various organisations working in Pakistan lack coordination and mostly working in isolation. In most of the cases, the studies being carried out are the regular activities of the respective institute and have been tilted towards climate change without considering or understanding the fundamental/basic factors associated with climate change. The approach to study climate change scenario in agriculture sector including crops and livestock is mostly not intended to generate tangible research outcomes. It lacks the quantifiable risk mitigation strategies and fails to develop technologies for the stakeholders to adapt and mitigate the negative impacts of climate change. Most of the research studies have narrow scope for application, lack rigor, and are published in national/local journals. The researchers are often found hesitant to share information, data, and research findings.

Majority of the research and educational institutions get insufficient financing; lack human resources with adequate skills in the subject; are poorly linked with national and international institutions; have limited autonomy; and face political interference in institutions. The federal government and provincial

governments attach very low priority for budget allocations to education and agricultural research. A large chunk of research undertaken on the subject in Pakistan is donor driven.

It is crucial to strengthen research as well as education programmes related to climate changes in Pakistan. The potential of new techniques of biotechnology needs to be realised in order to increase crop and livestock productivity, improve nutritional quality, and enhance crop tolerance against biotic and abiotic stresses. Pakistan must introduce a more knowledge-intensive agricultural research system with more focus on technological innovations and having access to modern biological sciences. It is very important to redesign research plans focusing more sharply on climate change risk assessment, adaptation and mitigation strategies and bringing all the stakeholders under a more coordinated research and management system to deal with climate change issues more effectively.

4.2. Review of Disaster Management Institutions

The changing climatic conditions have resulted in frequent occurrence of extreme weather events in Pakistan. The intensity of these events varied in different parts of the country. A large number of its people are exposed to floods which occur normally due to tropical monsoon depression from July to September. The floods and incidence of droughts affect most part of the country but comparatively extreme drought situations usually hit the rainfed areas of Balochistan, Punjab, KP and Sindh. The flood events of 1950, 1992, 1998 and 2010 caused many deaths and huge losses to infrastructure, properties, crops, and livestock. According to official sources, floods in Pakistan during the decade spanning 1991 to 2001 caused an estimated damage to property of over Rs.78 billion.

Historically, Pakistan has dealt with disasters in an arbitrary and response oriented manner. The calamity Act of 1958 included provisions for organising emergency response in case of disasters. A system of relief commissioners at the district, provincial and national level was established in this regard. An Emergency Relief Cell (ERC) in the Cabinet secretariat was responsible for organising disaster response work of the federal government in case of catastrophic events. The awareness of policy makers, media, civil society, NGOs, UN agencies and other stakeholders was low about issues of disaster risk reduction. No preparedness plans existed at local, provincial or national levels. Only isolated efforts were undertaken by few NGOs and government departments.

The heavy damages brought about by the floods in the last half of twentieth century and later huge losses caused by earthquake in 2005 led Pakistan to initiate national efforts in developing a structure for disaster management focusing on prevention, mitigation and integration of responses by

conducting a review of traditional disaster management systems and policies on emergency response. As a result, National Disaster Management Ordinance 2006 was promulgated. This ordinance led to the establishment of National Disaster Management Commission (NDMC) and National Disaster Management Authority (NDMA) at Federal level in February 2007. Consequently, the provincial governments established the Provincial Department Management Commissions (PDMCs), Provincial Disaster Management Authorities (PDMAs), and Districts Disaster Management Authorities (DDMAs). The federal Ministry of Disaster Management was established in 2011 after devolution of Ministry of Environment to the provinces as a result of the 18th amendment in the Constitution of 1973. The Ministry of Disaster Management was later renamed as Ministry of Climate Change in 2012.

The National Disaster Management authority (NDMA) is the most important institution working under the National Disaster Management Commission and serves as implementing, coordinating and monitoring body for disaster management. The Authority provides technical guidelines to national and provincial level organisations about formulation of plans, strategies and programmes for disaster risk management. The NDMA has also formulated a comprehensive pre- and post-disaster management action plan and for the implementation of this plan various national institutions and organisations have been assigned important roles (Appendix III). In addition, various national and international donor agencies, welfare organisations, and NGOs are actively involved in disaster related activities in Pakistan and perform in pre-disaster, emergency response, and rehabilitation and reconstruction phases (Appendix IV).

The post-disaster management activities are extremely important to provide urgent relief, rehabilitation and reconstruction under calamity situations. The post-disaster situation needs an integrated and coordinated mechanism to provide immediate relief and ensure rehabilitation of affected communities. However, the experience shows that 2005 earthquake and flash floods of 2008, 2010, and 2011 resulted in colossal damages which reflect lack of institutional capacity and poor coordination among the institutions as a response mechanism. As a result, the relief measures and utilisation of financial resources made available for rehabilitation remained less effective.

During the recent disasters, the interventions introduced for relief and rehabilitation of respective communities were not well conceived and planned. The lack of information on requirements at various stages of relief efforts was the main missing link. However, the electronic media played a significant role in enhancing awareness, fund raising, and streamlining relief and rehabilitation activities. The Health Departments and health professionals extended useful services to address health and nutrition related sufferings of the affected communities. Similarly, ministry of defense and its allied institutions played

important role in evacuation of the flood and earthquake effected communities. The NDMA played very crucial role during relief and recovery phases.

The national and international donor agencies and non-governmental organisations (NGOs) have also contributed significantly to disaster management related efforts undertaken in Pakistan. The main purpose of these organisations is to improve the socioeconomic conditions, civic facilities and to address health related issues. Pakistan was extended very useful support by such organisations—among them Oxfam, ActionAid, WWF, IUCN, FAO, UNDP, USAID, and Agha Khan Foundation etc. being the most prominent ones. Their support and participation in various phases of disasters of 2005 earthquake and floods of 2008, 2010, and 2011 proved to be excellent help. Still these organisations are actively contributing and helping rural communities in refining their socioeconomic conditions and improving natural as well as human resources. Even some of them have their own five year climate change plan and they are implementing their plan in different ecologies of Pakistan.

5. SUMMARY AND CONCLUSION

In Pakistan, the evolution of formal institutions for addressing environmental issues and disaster management has mainly been in pursuance of international obligation and more of a compulsion. Presently, an array of institutions with overlapping functions helps shaping the response to climate change in the country. This review exercise categorised these institutions in three categories based on mandated functions of these institutions and the services they render in relation to climate change. The categories include: (i) policy designing and implementing institutions; (ii) academic institutions (research and teaching institutions); and (iii) disaster management institutions.

Designing and executing policies to mitigate and combat the climate change impacts, relying hugely on institutional set up, is responsibility of federal and provincial level ministries and departments. National Conservation Strategy Report (1992), Pakistan Environmental Protection Act 1997 and creation of various establishments, formulation of National Environment Policy 2005, Final Report of the Task Force on Climate Change (2010), and National Climate Change Policy 2012 are the important milestones in this regard. Though some important areas have been ignored, on the whole policy documents are quite comprehensive describing sectoral and cross-sectoral targets, and objectives. On the implementation side and realisation of the policy goals only partial success has been met mainly due to lack of financial resources, 18th amendment in the constitution, and failure to attract due political will to address the environmental issues and climate change threats.

Pakistan has sizeable systems of research and education in agriculture and in other disciplines responsible for generation and dissemination of new knowledge to address the issues of import. Only a few of these institutions have

specialised mandate of conducting research on climate change issues while most of these have general mandates of undertaking research/teaching activities and may have specific research wings/sections or some subsidiary institutions to undertake research and/or teaching/training activities. However, in Pakistan education and research regarding the issues of climate change remained generally neglected in the past.

Greater realisation overtime about importance of the role that quality education and research can play to combat climate change has stimulated certain initiatives aiming at restructuring and strengthening of existing institutions, re-prioritising of research focus, and establishment of new institutions in the country. However, as the climate change phenomenon drew attentions only very recently in Pakistan, the research and educational programmes related to the subject are not fully developed and are generally deficient in skills about new techniques, often inadequately financed, usually lack autonomy, and poorly linked with other national and international organisations. The federal and provincial governments attach very low priority for budget allocations to education and agricultural research. A large chunk of research undertaken on climate change in Pakistan remains donor driven.

The research activities related to climate change undertaken in the country widely differ across institutions in terms of scope, methodologies, and applicability of the results. The research conducted in national institutions had mainly focused on analysis of trends of changing climate, case studies of glacier melting and its impact on river flows, crop modelling incorporating temperature and rainfall changes, and development of soil and water conservation technologies/practices etc. The other area of interest in research on the subject has been the analysis of impact of climate change on health, poverty, food security, and other socio-economic aspects.

A few universities and teaching institutions offer graduate and post graduate level degree programmes in disciplines of environmental sciences, environmental engineering, environmental economics, and other disciplines dealing with environment. Only a small number of degree programmes have included courses on climate change in the curriculums. However, none of the universities offers a degree programme in Climate Change.

It is crucial to strengthen research as well as education programmes related to climate changes in Pakistan. The potential of new techniques of biotechnology needs to be realised in order to increase crop and livestock productivity, improve nutritional quality, and enhance crop tolerance against biotic and abiotic stresses. Pakistan must introduce a more knowledge-intensive agricultural research system that focus on technological innovations and has access to modern biological sciences. It is very important to redesign research plans focusing more sharply on climate change risk assessment, adaptation and mitigation strategies and bringing all the stakeholders under a more coordinated research and management system to deal with climate change issues more effectively.

The National Disaster Management authority (NDMA) is the most important institution that serves as implementing, coordinating and monitoring body for disaster management. The NDMA has formulated a comprehensive pre- and post-disaster management action plan and for the implementation of this plan various national institutions and organisations have been assigned important roles. During the recent disasters in the country, the interventions introduced for relief and rehabilitation reflected lack of institutional capacity and poor coordination among the institutions as a response mechanism. The lack of information on requirements at various stages of relief efforts was the main missing link. The electronic media, health professional, ministry of defense and its allied institutions, national and international donor agencies, and non-governmental organisations (NGOs) have played very important roles during relief and recovery phases.

Appendix-I

List of National Institutions Involved in Teaching/Research Activities Regarding Climate Change

S. No.	Institution	Location	Program	Degrees Offered	PhD Staff	Non PhDs
1	Quaid-i-Azam University	Islamabad	Environmental Sciences	MSc, MPhil, PhD	1	2
2	Pakistan Institute of Development Economics (PIDE)	Islamabad	Environmental Economics	MS	1	0
3	PMAS, Arid Agriculture University	Rawalpindi	Environmental Sciences	MSc, MPhil, PhD	4	2
4	Department of Environmental Sciences, International Islamic University	Islamabad	Environmental Sciences	BS, MSc, MS, PhD	11	16
5	Department of Environmental Science, National University of Science and Technology (NUST)	Islamabad	Environmental Sciences	MS, PhD	1	0
6	School of Civil and Environmental Engineering (SCEE), National University of Science and Technology (NUST)	Islamabad	Environmental Engineering	BE, MS, PhD	1	0
7	Institute of Environmental Studies, University of Karachi	Karachi	Environmental Sciences	MSc, MS, PhD	5	2
8	F.C. University	Lahore	Environmental Sciences	BSc (Hons)	1	0
9	College of Earth and Environmental Sciences, University of Punjab	Lahore	Environmental Sciences	BS, MS	7	1
10	Government College University	Lahore	Environmental Sciences	Diploma, MSc, PhD	5	3
11	Department of Environmental Sciences, University of Peshawar	Peshawar	Environmental Sciences	BS, MSc, MPhil, PhD	9	3
12	Institute of Soil & Environmental Sciences, University of Agriculture, Faisalabad	Faisalabad		B.S, MPhil, PhD	12	8
13	Center for Environmental Management and Policy, Baluchistan University of Information Technology and Management Sciences	Quetta	Environmental Management Policy	MS, PhD	2	6
14	COMSATS Institute of Information Technology	Abbottabad Campus	Environmental Sciences	BS, MS, PhD	19	14
15	Department of Environmental Engineering, NED University of Engineering and Technology	Karachi	Environmental Engineering	MSc	3	6

List of National Institutions Involved in Teaching/Research Activities Regarding Climate Change (continued)

S. No.	Institution	Location	Program	Degrees Offered	PhD Staff	Non PhDs
16	Department of Environmental Science, Allama Iqbal, Open University	Islamabad	Environment & Sustainable Development	Post Graduate Diploma	2	0
17	Dr. Pervaz Hassan Center for Environmental Law, Punjab University	Lahore	Environmental Law	Post Graduate Diploma	1	2
18	Environmental Science Department, Lahore College for Women University	Lahore	Environmental Sciences	BS, MS, PhD	4	11
19	Fatima Jinnah Women University	Rawalpindi	Environmental Sciences	BS, MS	9	5
20	Institute of Environmental Engineering and Research, University of Engineering and Technology	Lahore	Environmental Engineering	MSc	---	---
21	Kinnaird College for Women	Lahore	Environmental Sciences	BSc, MA	---	---
22	Department of Environmental Sciences, Bahauddin Zakariya University	Multan	Environmental Sciences	BS	1	1
23	Superior Group of Colleges	Various Cities	Environment, Health and Safety Management	MSc	---	---
24	Bahria University	Islamabad	Environmental Sciences	BS, MS	4	12
25	The University of Lahore	Lahore	Environmental Sciences	MPhil	3	1
26	Federal Urdu University of Arts, Science and Technology	Islamabad	Environmental sciences	No intake at present		
27	Karakoram International University	Gilgit	Environmental Sciences	MPhil, PhD	2	1
28	National College of Business Administration and Management Sciences	Lahore	Environmental Management	BS, MS, PhD	---	--
29	The University of Poonch	Rawalakot	Soil and Environmental Sciences	MSc (Hons)	---	---

List of National Institutions and their Mandates Related to Climate Change

Organization Name	Mandate	Mandate related to Climate Change
Ministry of Climate Change (MoCC)	<ul style="list-style-type: none"> • Environment • Environment related agreements and their monitoring and implementation • Global environment facilities 	<ul style="list-style-type: none"> • Climate Change Division is the focal point for national policy, legislation, plans, strategies and programmers with regard to disaster management. • Climate change including environmental protection and preservation • UNFCC, CDM strategy, and forestry sequestration projects
Ministry of National Food Security and Research	<ul style="list-style-type: none"> • Policies and regulation related to national food security and research. 	<ul style="list-style-type: none"> • Participates in climate change related dialogues • Climate change and food security • Agricultural research including research for technology development related to climate change
Planning Commission of Pakistan	<ul style="list-style-type: none"> • Planning • Analysis of Projects • Approval of Projects 	<ul style="list-style-type: none"> • No specific mandate relating to climate change • The planning commission environment section has a focal person who participates in the meetings on climate change in the MoCC
Ministry of Water and Power	<ul style="list-style-type: none"> • Policy and regulation related to water and power • Water and power support to agriculture sector 	<ul style="list-style-type: none"> • No specific mandate related to climate change
Ministry of Science and Technology (MoST)	<ul style="list-style-type: none"> • Suggests new technologies in the fields of industry, renewable energy and rural development to the government. • Promotion and coordination of research related to technology 	<ul style="list-style-type: none"> • Not specifically related to climate change • Organized an international conference on climate change: opportunities and challenges
Ministry of Industry and Production (MoIP)	<ul style="list-style-type: none"> • National industrial planning and policy formulation. • To create conducive environment for industries and provide technical assistance to industries 	<ul style="list-style-type: none"> • No specific mandate related to climate change. • Work on adaptation strategy to cope the sugarcane production with climate change
Pakistan Metrological Department (PMD)	<ul style="list-style-type: none"> • Works under Ministry of Defense • Weather forecast and monitoring, seismology, geomagnetism, maintaining record of historical data pertain to climate 	<ul style="list-style-type: none"> • Member of world metrological organization • Early warning system against disasters • Research on climate change related issues

Water and Power Development Authority (WAPDA)	<p>Works under Ministry of Water and Power.</p> <ul style="list-style-type: none"> • Generation, transmission and distribution of power. • Irrigation, water supply and drainage. • Prevention of water logging and reclamation of waterlogged and saline lands. • Flood management and inland navigation • Provide technical assistance on different water resources and hydroelectric projects 	<ul style="list-style-type: none"> • Planning to check the impact of climate change on water availability in different reservoirs • Forecasting long term water availability • Monitoring upper Indus basin glaciers
Indus River System Authority (IRSA)	<ul style="list-style-type: none"> • Settlement of disputes, allocation and distribution of water among provinces • Coordinate and regulate the activities of WAPDA 	<ul style="list-style-type: none"> • No specific mandate related to climate change • Observe the water flow in rivers
Pakistan Environment Protection Agency (Pak. EPA)	<p>Worked under MoCC (ministry stands devolved)</p> <ul style="list-style-type: none"> • Development and implementation of environmental regulation • Protection, conservation and rehabilitation of environment. • Prevent and control of pollution 	<ul style="list-style-type: none"> • Active participation in climate change related dialogues • Regulation of Clean Development Mechanism (CDM) projects
Pakistan Agricultural Research council / National Agricultural Research Centre	<ul style="list-style-type: none"> • Works under the ministry of National Food Security and Research • Coordinate and conduct agricultural research 	<ul style="list-style-type: none"> • Partially directing research efforts to develop technologies related to climate change impacts
Space and Upper Atmosphere Research Commission (SUPARCO)	<ul style="list-style-type: none"> • Monitoring of environment • Natural resource surveying • Acquisition of data • Develop and introduce new technologies • Conduct research and develop indigenous capabilities in space technology 	<p>Engaged with climate change issue to check:</p> <ul style="list-style-type: none"> • Ozone depletion • Aerosol optical thickness
Pakistan Atomic Energy Commission (PAEC)	<ul style="list-style-type: none"> • To develop nuclear power facility • Generation of electric power • Research in agriculture, medicine and industry field 	<p>Regarding the climate change, it is working on the following projects</p> <ul style="list-style-type: none"> • Mitigation of greenhouse gases emission • Greenhouse gases emission inventories • Sustainable energy development and climate change
Pakistan Council of Science and Technology (PCST)	<ul style="list-style-type: none"> • Advising the government on science & technology policies and plans. • Strategic planning and promotion of R&D 	<ul style="list-style-type: none"> • No specific mandate on climate change up-till now • Organized an international conference on climate change: opportunities and challenges

Pakistan Council of Scientific and Industrial Research (PCSIR)	<ul style="list-style-type: none"> • Development of technology on local resources • R&D on issues related to industries 	Up to now, there is no research on climate change related issues
Committee on Scientific Technological Cooperation (COMSTECH)	<ul style="list-style-type: none"> • Formulate policies and assist member countries in technological development • Assessment of human and material resource of member countries. • Promotion and cooperation of science and technology among the member countries • Enable members to utilize science & technology as a major contributor towards development 	<p>Actively involved in enhancing awareness about climate change related issues</p> <p>Organizing workshops to create awareness about the danger of climate change such as:</p> <ul style="list-style-type: none"> • High altitude ecosystem and climate change • Water quantity and quality issues • Adaptation of natural hazards in changing global climate scenario
Pakistan Council of Research in Water Resources (PCRWR)	Research on water resources in Pakistan	Research regarding water related projects which have direct relevance to climate change
National Disaster Management Authority (NDMA)	<p>Works under the ministry of Climate Change</p> <ul style="list-style-type: none"> • Disaster risk management policies • Capacity enhancement including relief and recovery coordination 	Focus only on disaster risk management
National Institute of Oceanography (NIO)	<ul style="list-style-type: none"> • Ocean related research • Modeling to predict environmental impact 	Coordinate with Pakistan Metrological Department on early warning system
World Water Forum	<ul style="list-style-type: none"> • Create awareness on water related issues • Contribute to improve access on water supply and sanitation • Provide opportunities to develop shared vision on water issues 	<ul style="list-style-type: none"> • Climate change and water availability • Suggesting water adaptation techniques in consequence of climate change • Formulating policies on climate change and water availability
Alternate Energy Development Board (AEDB)	<p>Works under Ministry of Water and Power</p> <ul style="list-style-type: none"> • Develop and promote renewable energy 	Participates in climate change related discussion in Ministry of Climate Change
Pakistan Council of Renewable Energy Technology (PCRET)	<p>Works under Ministry of Science and Technology</p> <ul style="list-style-type: none"> • Research regarding generation of renewable energy technology 	Not specifically related with climate change issues but the new sort of technology can mitigate adverse impacts related to climate change
Energy Conservation Centre (ENERCON)	<ul style="list-style-type: none"> • Energy conservation and efficiency improvement 	<ul style="list-style-type: none"> • Participation in dialogs held under MoCC • MD heads Clean Development Mechanism committee on energy

Sustainable Development Policy Institute (SDPI)	<ul style="list-style-type: none"> Promote the ideas and research on environment and sustainable development 	<ul style="list-style-type: none"> Developing a team for research on climate change
Global Change Impact Studies Centre (GCISC)	<ul style="list-style-type: none"> Research dealing with climate change related issues (agriculture, climate, water, and environment) 	<ul style="list-style-type: none"> Using past and present data on General Circulation Models (GCMs), Regional Circulation Models and MM5 to construct plausible climate change scenario for Pakistan Develop monitoring system and predict the extreme climate events
Pakistan Institute of Environmental Development and Research (PIEDAR)	<ul style="list-style-type: none"> Involve in the sustainable development practices Influence government policy and program in favor of less privileged Establish sustainable network of civil society 	<ul style="list-style-type: none"> Formulation of policies related to environment Involve in number of projects relating to irrigation and waste management
NUST Institute of Environmental Sciences and Engineering	<ul style="list-style-type: none"> Education in Environmental Sciences Research addressing water and air pollution control, recycling, waste disposal, and public health issues. 	<ul style="list-style-type: none"> Involve in organizing climate change conferences Teach mathematical and computational tools to students enrolled in Environmental Sciences degree programmes
Quaid-i-Azam University	<ul style="list-style-type: none"> Education in Environmental Sciences Conduct basic and applied research on the environmental issues. Produce skill person in order to address the environmental challenges 	Climate change, global environmental issues, water resource management are some courses of the degree.
Pakistan Institute of Development Economics (PIDE)	<p>Autonomous research and educational institute established by the government of Pakistan.</p> <ul style="list-style-type: none"> Research and teaching Economics and related Social Sciences 	<ul style="list-style-type: none"> Conduct Research on Climate Change Issue A number of socio-economic studies relating to climate change issues Established data bank on environmental indicators. Set up academic program on environmental economics.
Pakistan Agricultural Research Council (PARC)	<p>The apex agricultural research organization at the national level.</p> <ul style="list-style-type: none"> Conduct, aid, promote and coordinate agri. research at the federal and provincial levels 	<ul style="list-style-type: none"> Presently, no mandate specifically related with climate change research. Plan to establish climate change section/cell Have a number of contributions towards research related to climate change

Agricultural Research Institute (ARI), Quetta	<p>Apex organization in provincial agricultural research system of Balochistan</p> <ul style="list-style-type: none"> • Develop appropriate technology for each agro-ecological zone of the province • Identify various production constraints hindering the agricultural development • Develop high yielding varieties • Develop soil and water conserving, harvesting, and storage technologies 	<ul style="list-style-type: none"> • No mandate specifically related with climate change. • Little research addressing issues related to climate change
Agricultural Research Institute (ARI), Tandojam	<p>Institution belongs to provincial agricultural research system of Sindh</p> <ul style="list-style-type: none"> • Development of improved varieties and production technologies of field crops except rice and wheat. • Evolve insect, pest and disease resistant varieties. 	<ul style="list-style-type: none"> • No mandate specifically related with climate change • Some studies address issues related to climate change
Ayub Agricultural Research Institute (AARI), Faisalabad	<p>Apex organization in provincial agricultural research system of Punjab</p> <ul style="list-style-type: none"> • Genetic improvement of crop varieties for yield, quality and tolerance against biotic and abiotic stresses • Develop production technology - to protect crops from diseases and insects/pests using both chemical and non-chemical means • Introduce new industrial/food plants (flowers, essential oils and medicinal plants) • Develop post-harvest technology of fruit and vegetable crops 	<p>A number of studies related to climate change issues</p>

List of National Institution and their Role in Disaster Management Related Activities

NDMA	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plans. 2) Prepare multi hazards and disaster specific contingency plans. 3) Establish communication mechanisms for early warning system with PDMAs, DDMA's and concerned ministries/departments. 4) Share contingency plans with NDMC, relevant federal ministries, authorities, departments, commissions, PDMAs, DDMA's, I/NGOs, armed forces, media, voluntary and charity organizations. 5) Provide technical assistance for preparing disaster preparedness and response plans for each province including AJK, Northern Area & FATA. 6) Develop hazard specific maps and provide to PDMAs, DDMA's and also, make available on NDMA/PDMA website. 7) Set up national emergency operation centre and maintain state of readiness with all equipment in working order. Orient and train personnel of EOC. 8) Develop national search and rescue, emergency response and early recovery operation teams. 9) Set up national level I/NGOs, UN coordination committee for sharing of resources and coordination for preparedness and emergency response. 10) Prepare and update inventory of personnel, suppliers, material and equipment. 11) Prepare communication and transportation plan for potential disaster response. 12) Develop a communication strategy which clearly indicates the communication mechanisms with relevant federal ministries, departments, provincial departments, PDMAs, DDMA's and district level administration & departments, I/NGOs, Civil Society organizations, media and communities. 13) Prepare security guidelines for humanitarian organizations working in the disaster affected areas (in case of insecure areas where conflict and kidnappings are common).
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Activate NEOC 2) Organize initial and subsequent assessment of disaster affected areas and determine the extent of loss damage and volume and relief required. 3) Coordinate and inform all concerned departments to prepare for emergency response. Keep informed print and electronic media on regular basis. 4) Coordinate with Armed Forces through JS HQ and Service HQ. 5) Prepare detailed plans for the resources required for full relief operation.

	<ol style="list-style-type: none"> 6) Coordinate with I/NGOs, UN bodies and philanthropists organizations for resource mobilization. 7) Mobilize and deploy resources e.g. search and rescue medical teams in the affected areas. 8) Supply of food, drinking water, medical supplies and non-food items to the affected population. 9) Organize details assessment for the early recovery programme and prepare proposal and circulate it to the NMDC, multi and bilateral donors, UN, I/NGOs and philanthropists. 10) Prepare a transition plan from relief to recovery programme. 11) Organize regular media and public information briefings. 12) Prepare situation Report (SITREP) on daily and weekly basis and circulate to the Prime Minister, NDMC members, PDMC members, PDMA's, Armed Forces etc.
PDMA	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness and hazard specific contingency plan. 2) Lay down communication mechanisms for early warning system with DDMA and concerned departments. 3) Assist and provide information to the NDMA to develop hazard specific maps. 4) Set up provincial emergency operations centre and maintain state of readiness with all equipment in working order. Orient and train personnel of EOC and its operations. 5) Develop provincial search and rescue, emergency response and early recovery operation teams. 6) Establish provincial/equivalent level I/NGOs, UN coordination committee for sharing of resources and coordination for preparedness and emergency response. 7) Identify high risk areas, population and prepare vulnerability profiles and contingency plans accordingly. 8) Ensure that each district has prepared multi hazard and disaster/agency specific contingency plan to deal with the potential disaster. 9) Provide technical, financial and human resources support to districts for disaster preparedness and emergency response activities. 10) Carry out survey of public buildings for using as shelter and relief centers during disaster times; make sure that these buildings have basic facilities e.g. water/sanitation etc. 11) Set up provincial level EOC and maintain state of readiness with all equipment in working order. Orient and train personnel of EOC and its operations. 12) Organize trainings for DDMA teams, volunteers, civil defense to cover first aid, dissemination of warnings, search and rescue, relief and recovery. 13) Conduct trainings on disaster preparedness and emergency response for the district, taluka/tehsil level government officials, elected councilors, etc. 14) Develop a communication strategy which clearly indicates the interaction mechanism with key provincial departments, district level administration, NDMA, concerned departments at federal level, I/NGOs, Civil Society organizations, media and communities.

	15) Prepare security guidelines for humanitarian organizations working in affected areas (in case of insecure areas where conflict and kidnappings are common).
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Activate PEOC. 2) Disseminate early warning information to all stakeholders. 3) Conduct rapid assessment and launch quick response. 4) Prepare plans for the resource requirement for relief operation and send to the PDMC for approval. 5) Provide food, drinking water, medical supplies, and nonfood items to the affected population. 6) Keep NEOC abreast of latest situation. 7) Warn all concerned departments to prepare for emergency response. 8) Coordinate with NDMA, Armed Forces and keep them informed about the situation and resource mobilization. 9) Keep print and electronic media updated on regular basis. 10) Liaise with I/NGOs, UN bodies and philanthropists organizations for resource mobilizations for emergency response. 11) Organize regular media and public information briefings. 12) Forward Situation Report (SITREP) on daily and weekly basis to Chief Minister, Governor, PDMC/Equivalent Members, NDMA, Armed Forces etc. 13) Organize initial and subsequent assessment of disaster affected areas and determine the extent of loss damage and volume and relief required. 14) Organize detailed assessment for the early recovery programme and prepare proposal and circulate it to the PMDC, NDMA, UN and I/NGOs.
DDMA	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Finalize emergency preparedness plan. 2) Prepare hazard specific contingency plan. 3) Develop search and rescue, evacuation and emergency response teams at district level. 4) Identify high risk geographical areas, communities and prepare vulnerability resource profile. 5) Conduct survey of public buildings to be used as shelter and relief centers during disaster times. Ensure that these buildings have basic facilities e.g. water/sanitation etc. 6) Maintain updated inventory of personnel, volunteers, material and equipment at UC, tehsil/taluka and district levels. 7) Organize and facilitate community level trainings and awareness programme on disaster preparedness and emergency response. 8) Develop communication system for disseminating early warning information to the end user. 9) Stock pile rescue and relief material or ensure preparedness to make such material available at short notice.

	<ul style="list-style-type: none"> 10) Encourage participation of non-governmental organizations and voluntary social welfare organizations and communities in different aspects of preparedness and emergency response. 11) Promote indigenous system and practices on disaster preparedness and emergency response. 12) Conduct drills and trainings on disaster preparedness and emergency response for the government officials, elected councilors, communities, volunteers, CBOs/NGOs etc.
	<p>Emergency Response Phase</p> <ul style="list-style-type: none"> 1) Activate DEOC. 2) Warn all district level departments to get ready for emergency response. 3) Inform PEOC and NEOC about the situation. 4) Organize evacuation on priority basis. 5) Conduct initial and subsequent assessment of disaster affected areas and determine the extent of loss and damage. 6) Prepare detailed plan for the resources requirement for relief operation and share it with the PDMA and NDMA. 7) Provide food, drinking water, medical supplies, and nonfood items to the affected population. 8) Deploy medical, search and rescue and emergency response teams immediately. 9) Set up relief camps and provide relief in the camps. 10) Coordinate with PDMA and NDMA to deploy resources for emergency response. 11) Liaise with I/NGOs, UN bodies and philanthropist organizations for resource mobilizations for response 12) Develop complaint mechanism system and set up complaint mechanism cell in the DEOC and sub district level. 13) Hold regular media and public information briefings. 14) Arrange detailed assessment for the early recovery programme and prepare proposal and submit to PDMA and N DMA. 15) Forward Situation Report (SITREP) on daily and weekly basis to the PDMA, NDMA and Armed Forces etc
Ministry of Defense	<p>Pre-Disaster Phase</p> <ul style="list-style-type: none"> 1) Prepare emergency preparedness plans. 2) Allocate resources for preparedness and emergency response activities. 3) Prepare resource inventory including human resources, helicopters, airplanes, vehicles, heavy machinery etc and share it with NDMA. 4) Organize drills on disaster preparedness and response. 5) Prepare search and rescue guidelines and share it with NDMA. 6) Enhance DRM capacities of Cantonment Boards specially firefighting, casualty, evacuation, and search and rescue. 7) Prepare training modules on search and rescue, evacuation, logistics and facilitate trainings for civilians at federal, provincial and district level with the collaboration of NDMA, PDMAs, and DDMA as a part of disaster preparedness.

	<p>8) Prepare plans for utilizing Armed Forces pensioners (liable to recall) for disaster response, featuring reasonable financial compensation.</p> <p>9) Support civilian authorities to maintain the traffic and law & order in disaster affected areas.</p>
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative in NEOC, PEOCs and DEOCs (as applicable). 2) Conduct survey in affected areas and assess requirements of relief and recovery needs. 3) Provide helicopters, aircrafts, ships etc for assessment, search and rescue and evacuation in complex emergencies, when required. 4) Support NDMA, PDMA, DDMA in emergency response e.g. search and rescue, evacuation, distribution of food, non-food items, tent village, medical camps, debris clearance, transportation of injured and dead bodies etc. 5) Deploy professional teams e.g. medical doctors (for health services) and engineers to restore the communication and infrastructure network, breach filling) and manpower (to clear roads, lift debris, control traffic on main roads, maintain law and order, help in the camp site management, provision of drinking water supply etc). 6) Close coordination with NDMA, PDMA during emergency response.
Ministry of Education	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan on education sector and share it with provincial education departments, NDMA and PDMA. 2) Prepare a roster of volunteer teachers and students that can be deployed as volunteers in emergency response. 3) Develop education assessment checklist, monitoring and evaluation formats for emergency response programme. 4) Develop a model of mobile school for emergency situation and develop emergency education teaching kit which can be used in emergency situation. 5) Prepare a list of ICT-based government schools and colleges that may be used for relief camps and prepare a list of suppliers for stationery, school text books, school bags, uniforms and share it with NDMA. 6) Organize orientation programme to raise awareness of education authorities and professors, teachers about emergency response and role of education. 7) Coordinate with NDMA for emergency response planning
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National Emergency Operations Centre. 2) Make arrangements to deploy teachers and students for voluntary assistance in assessment and distribution of relief goods in the affected areas. 3) Provide support to PDMA in education sector assessment. 4) Support PDMA and provincial education authorities to run emergency mobile schools and provide teaching material to continue education during the emergency.

	<ol style="list-style-type: none"> 5) Determine the extent of loss in educational institutions and prepare plans for their rehabilitation. 6) Prepare a report on the experience and share it with provincial education departments, PDMAs and NEOC. 7) Document the lessons learnt from the response experiences and incorporate the same in future planning.
Ministry of Environment	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Develop technical capacities of the staff of ministry to undertake disaster risk assessment and disaster risk reduction activities in the environment sector; 2) Undertake assessment of vulnerability of natural resources (forest, lakes, streams, mangroves, coral reefs, protected areas, coastal areas) to natural and human induced hazards; 3) Implement programmes for conservation and rehabilitation of natural resources in order to reduce risks of natural hazards; e.g. reforestation, mangrove plantation, combating desertification, conservation of special natural resources; e.g. wetlands, lakes, reefs, mangroves, and coastal areas; 4) Develop mechanisms for assessment of environmental losses and damages in the aftermath of disasters and their rehabilitation
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Provide space of schools colleges, universities, and other educational buildings located near affected areas by disasters.
Ministry of Finance and Revenue	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Coordinate with NDMA about needs for financial resources to promote disaster risk management programmes in hazard-prone areas; 2) Allocate financial resources to NDMA and other line ministries and departments for implementation of disaster risk management activities as part of their development plans; 3) Allocate funds for the establishment of a National Disaster Management Fund, which could be utilized to organize mitigation, emergency relief and to monetize the affected areas; 4) Monitor and evaluate utilization of funds by relevant authorities and ministries on disaster risk management; 5) Encourage financial service sectors and local capital markets to develop schemes for financing disaster risk reduction measures by families and CBOs; 6) Incorporate provisions in micro-finance schemes to have flexible repayment schedules for recipients who have been affected by a disaster;
Ministry of National Food Security and Research	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Allocate resources for preparedness and response activities. 3) Prepare emergency preparedness plan on agriculture and livestock sector and share it with provincial agriculture and livestock departments, NDMA, and PDMAs.

	<ol style="list-style-type: none"> 4) Develop agriculture and livestock assessment checklist. 5) Develop indicators for drought early warning system and share it with provincial agriculture departments, NDMA and PDMA's etc. 6) Develop IEC material on emergency response for extension, community workers and farmers. 7) In collaboration with WFP, identify food insecure areas of disaster prone districts in Pakistan. 8) Establish enough livestock feed manufacturing units in disaster prone districts so that people can access livestock feed in disaster times. 9) Create awareness on livestock feed and promote it through agriculture extension workers and livestock field assistants in disaster prone districts. 10) Create awareness on livestock feed among livestock owners and promote production of livestock feed. 11) Ensure that all provinces maintain reserve quota for essential vaccine in disaster prone districts to deal with any outbreak disease in animals. 12) Develop guidelines and minimum standards for cattle camps and share it with provincial livestock departments, NDMA, PDMA's and DDMA's. 13) Prepare an inventory of equipment, vehicles, agriculture input and animal vaccine and medicine suppliers. Update inventory on six monthly bases and share it with NDMA.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National Emergency Operations Centre. 2) Conduct initial rapid assessment to assess the damage to crops and livestock. 3) Provide agricultural machinery and necessary tools to the farmers to protect their crop during flood season. 4) Prepare and release messages and advices for farmer community through NEOC, PEOCs, provincial agriculture departments, print and electronic media to protect standing crops. 5) Vigilant about pest attack on the crop and take effective measures. 6) Provide technical advice to the farmer community to protect standing crop during heavy rains, wind storm, flood and cyclone situations. 7) Support provincial livestock department, for the provision of fodder, de-worming medicines and vaccine for animals during the drought period. 8) Coordinate with Federal Flood Commission and NDMA regarding emergency response. 9) Develop plan for agriculture sector for early recovery phase if needed. 10) Prepare a detailed report and disseminate it to all stakeholders. Document the lessons learnt from the response experiences and incorporate the same in future planning.

Ministry of Foreign Affairs	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plans. 2) Develop guidelines and procedures to receive relief goods from foreign countries in case of major disaster and share it with NDMA. 3) Develop procedures to facilitate arrival of foreign humanitarian workers to support disaster response initiatives and to expedite visa renewals, if required. 4) Prepare inventory of embassies/other aid giving organizations focal points in order to quickly organize requests for assistance 5) Coordinate with international technical organizations and relevant UN agencies to receive technical and financial assistance for disaster risk reduction and preparedness. 6) Maintain liaison with NDMA in order to ensure collaborative efforts for disaster preparedness
	<p>Rehabilitation & Reconstruction Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National EOC, if and when required. 2) Work as focal point for the deployment of aid workers in the region, in case of major disaster, and coordinate support given by the Government of Pakistan. 3) Facilitate issue of visas to foreign humanitarian relief workers so that they can promptly access the affected areas. 4) Coordinate with foreign countries to obtain aid in case of major disaster. 5) Coordinate with NDMA on issue of foreign humanitarian aid.
Ministry of Health	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan on health sector and share it with Provincial health departments, NDMA, and PDMAs. 2) Prepare protocols and guidelines to address public health issues as part of preparedness, response and recovery plans. 3) Develop minimum standards in health services in emergency situations and share with NDMA, PDMAs and provincial health departments. 4) Develop health assessment checklist, health monitoring and evaluation formats for emergency response programme. 5) Develop roster of medical and paramedics to be deployed in case of any major disaster in any part of the country including AJK. 6) Build effective linkages and coordination with all national, regional and international health agencies working in the emergencies. 7) Prepare a list of surgical, hospital equipment, and medicine suppliers and share it with NDMA and PDMA. 8) Prepare mass causality management plans for different hazards. 9) Develop MOU with various medical and pharmaceutical associations for the provision of assistance in emergencies. 10) Prepare an inventory of equipment, human resources, vehicles, ambulances, medicine stocks, and hospitals that come under the federal ministry of health and update this list on six monthly bases and share it with PDMAs.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative in National Emergency Operations Centre during the emergency period.

	<ol style="list-style-type: none"> 2) Deploy medical teams and paramedical staff in the affected areas for rapid assessment and emergency response. 3) Exercise vigilance about possibility of any epidemic /outbreak and take effective measures against it. 4) Provide technical support to PDMA including Gilgit-Baltistan and AJK in carrying out smooth health services in emergency response. 5) Ensure that WHO protocols on quality and Sphere Minimum Standards are followed by medical professionals in the field. 6) Coordinate and facilitate with WHO/UNICEF and other humanitarian organizations working in health sector in affected areas. 7) Monitor health situation in the affected areas. 8) Document the lessons learnt from the response experiences and incorporate the same in future planning.
Ministry of Housing and Works	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Allocate resources for preparedness and response activities. 2) Prepare emergency preparedness plan and share it with NDMA and PDMA. 3) Develop guidelines and standards on building codes for safer construction of houses, public & private buildings in hazard prone areas. 4) Ensure compliance with local building laws and the required prescribed standards under national and provincial building codes. 5) Develop guidelines and training courses for builders/contractors for safer construction. 6) Prepare inventory of heavy construction equipment at federal level. Review it on six monthly basis and share with NDMA.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National EOC. 2) Carry out detailed technical assessment of damaged public infrastructure. 3) Support provincial governments in conducting of damage and loss assessment to infrastructure and housing. 4) Coordinate with FWO/Armed Forces to get their help in clearing land slides, removing road blocks and restoration of infrastructure e.g. bridges. 5) Provision of heavy machinery to the district administrations for clearing roads, debris etc.
Ministry of Industries, Production and Special Initiatives	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Develop system of incentives and disincentives for industry to promote application of disaster safety measures; 2) Implement awareness raising programmes for industrial sector including Chambers of Commerce and Industry (CCI) on integrating disaster risk assessment and vulnerability reduction in project planning and implementation stages; 3) Prepare inventories of industries based upon the type of chemicals and raw materials used in their products and the dangers posed by various types of industries; 4) Initiate demonstration programmes on industrial disaster preparedness; 5) Develop safety codes for industry to reduce risks of industrial and chemical hazards and to ensure vulnerability reduction from natural hazards;

	6) Develop physical capability to manage all types of likely industrial disasters including chemical disasters; 7) Monitor and encourage implementation of safety codes in industry;
Ministry of Information and Broadcasting	Pre-Disaster Phase <ol style="list-style-type: none"> 1) Formulate communication strategy and guidelines for public and private broadcasters in relation to reporting on emergency response. 2) Ensure that public and private broadcasters broadcast responsible and factually correct information in electronic and print media. 3) Take proper and adequate steps for the protection of own installations and property. 4) Prepare inventory of public and private radio/TV stations and local TV cable operators and national daily news papers along with their detailed addresses. 5) Organize training programmes on reporting on emergency response for media journalists and relevant government departments.
	Emergency Response Phase <ol style="list-style-type: none"> 1) Ensure that the news-items relating to disaster reflect accurate picture and do not create undue panic. 2) Take steps for due projection of news directives relating to the situation issued by the Federal Government s agencies concerned with response, including NDMA 3) Disseminate information about measures initiated by different ministries and departments for relief and rehabilitation of affected people. 4) Curtail normal programmes to broadcast essential information on disaster, if requested by the Chairman, NMDA. 5) Arrange comprehensive media rebuttal in events of any distorted news projections by any segment of local or foreign media, in concert with NDMA.
Ministry of Information Technology	Pre-Disaster Phase <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Allocate resource for preparedness and emergency response. 3) Prepare plan to provide IT support to NDMA, PDMAs and DDMA's in disaster situation and share it with NDMA, PDMAs and DDMA's. 4) Coordinate with NDMA and the National Emergency Operations Centre (NEOC) to ensure the provision of IT support during disaster. 5) Train a team of technical people within the ministry to provide IT support in disaster situation. 6) Ensure that private telecommunication service providers develop SOPs to engage in disaster situation and share those SOPs with NDMA and PDMAs. 7) Develop guidelines for private sector telecommunication for preparing of contingency plan for disaster situations. 8) Organize orientation training for IT staff on emergency response.

	<p>9) Maintain through the National Telecommunication Corporation (NTC) a pool of telecom equipment preferably satellite/wireless based for provision and establishment of emergency telecom network.</p> <p>10) Work with NDMA to have a robust communication infrastructure for efficient use in disaster times</p>
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National EOC. 2) Ensure that IT and telecommunication system functions well during disaster times for effective emergency response. 3) Engage private sector IT firms to provide support during disaster. 4) Deploy technical staff to support EOCs and PDMA in disaster situation. 5) Monitor situation and ensure that communication and IT System functions smoothly to carry out emergency response. 6) Document the lessons learnt from the response experiences and incorporate the same in future planning
Ministry of Interior	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Prepare guidelines for evacuation in different disaster situations. 3) Develop security management guidelines for international humanitarian organizations, donors community, UN and diplomatic missions for their visits to affected areas
	<ol style="list-style-type: none"> 1) Emergency Response Phase 2) Carry out search and rescue with the help of Armed Forces. 3) Support district administration to evacuate affected people and transport them to camp sites. 4) Protect life and property. 5) Maintain law and order situation in relief centers and shelter sites. 6) Provide security in relief centers, shelter sites and warehouses established by the government in disaster affected areas. 7) Arrange security for government property and installations damaged in disaster. 8) Provide security to the foreign dignitaries, donors, UN agencies, and humanitarian organization visiting and taking part in relief operations. 9) Keep close watch for any criminal and anti-state activity in the affected area. 10) Manage traffic during disaster situation in the affected area.
Ministry of Law, Justice and Human Rights	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Develop appropriate laws and regulations to ensure the provision of relief and recovery packages to disaster survivors; 2) Monitor the situation of human rights in affected areas and taking action on human rights violations of disaster survivors; e.g. denial of aid, capturing of property, kidnapping of children or women, and harm to elderly; 3) Work with relevant UN agencies; e.g. Inter-Agency Standing Committee (IASC) and the IOM to ensure the human rights of affected people;

	<ul style="list-style-type: none"> 4) Prepare reports about potential bottlenecks that may hinder certain vulnerable groups of disaster survivors from receiving relief and rehabilitation packages; 5) Implement programmes to raise awareness of the staff of ministry on human rights and disasters
Ministry of Local Government and Rural Development	<p>Pre-Disaster Phase</p> <ul style="list-style-type: none"> 1) Prepare emergency preparedness plan and share it with NDMA and PDMA. 2) Allocate resources for preparedness and emergency response activities. 3) Develop guidelines on water and sanitation in emergency situation and share it with NDMA, PDMA and provincial/ local government and rural development departments. 4) Create awareness among LG&RD staff on Sphere Project Minimum Standards on water and sanitation and promote it in provincial LG&RD Department. 5) Develop assessment checklist on water/sanitation. 6) Devise community participation strategies and involve communities in water and sanitation schemes. 7) Prepare inventory of resources and share it with NDMA and PDMA. 8) Prepare list of suppliers on water technologies and sanitation material
	<p>Emergency Response Phase</p> <ul style="list-style-type: none"> 1) Designate a representative to the National EOC. 2) Conduct damage assessment of the water/sanitation and rural infrastructure schemes damages within jurisdiction. 3) Support NDMA and PDMA in assessment and provide technical support for water/sanitation activities in emergency response. 4) Ensure that Sphere Project Minimum Standards are followed in water and sanitation schemes in emergency response. 5) Introduce simple and cost effective water purification technology in emergencies. 6) Promote indigenous water purification methods. 7) Coordinate with NDMA, PDMA and provincial LG&RD Department
Ministry of Petroleum and Natural Resources	<p>Pre-Disaster Phase</p> <ul style="list-style-type: none"> 1) Develop guidelines for safety in oil/gas, fire and mining sectors; 2) Integrate risk assessment and risk reduction in planning and implementation of projects in the above sectors; 3) Implement awareness raising programmes for staff in the oil, gas, fire and mining sectors; 4) Develop SOPs for emergency response to disasters in the above sectors; 5) With assistance from the Geological Survey of Pakistan (GSP) conducting research on hazard mapping and produce user friendly maps

Ministry of Planning and Development	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Base planning upon hazard risk maps available with the NDMA and technical agencies; e.g. PMD, FFC, WAPDA, SUPARCO and circulate these to all development ministries and departments; 2) Organize orientations for line ministries about the guidelines on risk assessment; 3) Issue policy directive to all line ministries about incorporating disaster risk assessment (and vulnerability analysis) in project design and planning; 4) Make mandatory the inclusion of vulnerability reduction measures in implementation of development projects, if located in hazard-prone areas; 5) Monitor the progress on implementation of vulnerability reduction measures in all development projects in hazard-prone areas; 6) Obtain and maintain data on public sector infrastructure in hazard-prone areas in order to plan vulnerability reduction initiatives and organize reconstruction operations; 7) Assist the NDMA in evaluation of losses and damages
Ministry of Population Welfare (The ministry stands devolved to provinces)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Conduct research on population growth, settlement trends and vulnerability patterns in hazard-prone areas; 2) Consult with NDMA and technical organizations to identify strategies to influence patterns of settlement and population growth in hazard prone areas; 3) In collaboration with relevant stakeholders, launch programmes for awareness raising of people about linkages between population density, growth and vulnerability to disasters
Ministry of Ports and Shipping, Ministry of Communications	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Assess vulnerability of port facilities, infrastructure and services to Tsunami. 2) Integrate vulnerability reduction methods in construction of new infrastructure at ports; 3) Implement vulnerability reduction strategies for existing infrastructure, facilities and services; 4) Conduct training and drills for staff and management of the ministry and ports and shipping about disaster preparedness
Ministry of Railways	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Prepare duty roster for railway staff in emergency situation and organize training for them. 3) Prepare inventory of Railway ware houses including size and storage capacity and railway stations at district level and share it with NDMA. Revise inventory after six months and share it with NDMA. 4) Develop contingency plan to deal with degradation of railway moveable/static assets due to natural/industrial disasters and take preventative measure for it. 5) Develop IEC material for travelers in case of disaster and install fire extinguisher in the railway bogies to deal with the fire incident.

	<ol style="list-style-type: none"> 6) Train railway staff in firefighting, bomb-disposal and search and rescue skills. 7) Stock stores including emergency bridging equipment at selected nodal points to enable early restoration of service in case of failure of bridge due to disaster.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a focal person in National EOC if and when needed. 2) Transport relief material from ports and airports to the disaster affected areas. 3) Monitor the situation of railway tracks and update NDMA on regular basis particularly in earthquake, floods and cyclone situations.
Ministry of Science and Technology	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Assess vulnerability of infrastructure and facilities of the Ministry in hazard-prone areas; 2) Implement strategies to reduce vulnerabilities of infrastructure and facilities to disasters; 3) Develop awareness of the staff of the ministry on the role of science and technology in disaster risk management; 4) Undertake research to explore the role of ministry in promoting disaster risk management; 5) Develop technologies for better disaster preparedness and disaster response; e.g. emergency communications technologies in case of damage to the mainstream communication infrastructure;
Ministry of Social Welfare and Special Education	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Allocate funds in the annual budget of the ministry for disaster preparedness activities for most vulnerable social groups; 2) Develop awareness and capacity of the ministry staff 3) Conduct research to identify most vulnerable social groups in hazard-prone areas; 4) Implement awareness raising, and preparedness programmes with most vulnerable social groups; 5) Prepare inventories of potential post disaster needs of most vulnerable social groups through conducting assessments in hazard prone areas;
	<p>Rehabilitation and Reconstruction Phase</p> <ol style="list-style-type: none"> 1) Make institutional (establishment of a committee, establishment of outreach offices during disasters, legislation if needed etc) arrangements for provision of relief and recovery assistance to most vulnerable social groups; 2) Manage post-hospitalization care, recovery and rehabilitation of poor and vulnerable ; 3) Coordinate efforts with NDMA and the Ministry of Law, Justice and Human Rights to ensure that needs of most vulnerable social groups are addressed during disasters;
Ministry of Tourism (The ministry stands devolved to provinces)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Coordinate with the NDMA and other scientific agencies to gather information about hazards and risks prevalent in tourist areas; 2) Enhance awareness of tour operators, hotel management, transporters and other stakeholders in tourism industry about high risk areas and the need for disaster preparedness strategies in tourism industry;

	<ol style="list-style-type: none"> 3) Publish materials for tourists about seasonality of hazards and risks in areas of attraction and print details of agencies that could provide help; 4) Put up evacuation route maps in tourist areas and in hotels in case of a disaster; 5) Encourage management of hotels and guest houses to organize evacuation drills for their staff; 6) Link the tourism industry with the mainstream early warning systems; e.g. PMD, FFC; 7) Encourage business owners to formulate preparedness plans for their businesses; 8) Build capacity of the staff of ministry on disaster preparedness in tourism sector
Ministry of Youth Affairs	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Allocate resources for preparedness and emergency response activities. 3) Prepare SOPs for youth volunteers and their role in emergency response. 4) Organize awareness programmes in schools, colleges and universities on the role of youth volunteers in emergency response. 5) Prepare a data base of volunteers to assist in emergency response. 6) Develop IEC material on emergency response for youth volunteers and share it with NDMA and PDMA.
Ministry of Water and Power	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Monitor and manage dams and reservoirs for irrigation releases from the point of view of specific hazard peculiar to that area; 2) Assess disaster vulnerability of existing dams, reservoirs and power sector infrastructure in hazard-prone areas; 3) Prepare updates on flood protection bunds, canal systems and share it with NDMA, PDMA.
Ministry of Women Development	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Raise awareness of decision makers and staff at the ministry about special vulnerabilities and capacities of women with relation to disasters; 2) Make institutional arrangements for involvement of women in disaster risk management; 3) Promote awareness amongst women in hazard-prone areas about disaster risks and disaster preparedness; 4) Develop capacities of women's organizations on disaster risk management; 5) Ensure that needs of women survivors are addressed in post disaster situations during the relief, rehabilitation and reconstruction phases;
	<p>Rehabilitation and Reconstruction Phase</p> <ol style="list-style-type: none"> 1) Facilitate participation of women in the management of relief, rehabilitation and reconstruction activities; 2) Support post-disaster rehabilitation of livelihoods of women survivors, who mostly work in the informal sector and are ignored;

National Crises Management Cell (NCCM) Ministry of Interior	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Manage a round the clock Operational Control Room; 2) Collect information on emergencies of all sorts in the country; 3) Coordinate with Provincial Crisis Management Cells (PCMCs); 4) Coordinate with other agencies to gather relevant information; e.g. casualty figures etc 5) Coordinate plans for emergency response in case of crisis situations;
WAPDA Dams Safety Council	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Carry out periodic inspections of dams and advise WAPDA and provincial governments regarding repairs and maintenance of dams and reservoirs; 2) Review the plans of new dams to ensure adequate safety of structures; 3) Review the plans and specifications for enlargement, modifications, major repairs, revival or abandoning of dams / reservoirs; 4) Keep close liaison with International Commission on Large Dams based in Paris; 5) Enhance the glacier and glacial Lake observation not only for water resource but also for GLOF with climate change
Civil Defense	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Allocate resources for preparedness and emergency response activities. 3) Develop training modules and organize training on fire prevention/fighting, rescue, casualty handling, bomb reconnaissance/disposal 4) Organize/conduct refresher courses and simulation exercises for volunteers in above mentioned areas. 5) Compile data base of volunteers at district headquarters, tehsil and UC levels and organize trainings on rescue and first aid. 6) Draw up a list of trained government officials in different types of trainings as mentioned above and share it with NDMA. 7) Organize trainings on fire fighting for government staff and volunteers at district and below district level. 8) Create community awareness on public safety departments and youth in colleges and universities. 9) Prepare inventory of equipment, Civil Defense offices, human resources and volunteers in each office and share this with NDMA and PDMA in each district.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the NEOC/PEOCs/DEOCs (as applicable). 2) Assist NDMA, PDMA, DDMA in search and rescue and evacuation in different kinds of disasters. 3) Divide potential affected sites in various zones. Each zone to be controlled by designated appointment in case of major disaster.
Coast Guards	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan.

	<ol style="list-style-type: none"> 2) Develop contingency plan especially for the coastal areas of Pakistan. 3) Jointly organize training programmes with DDMA for the coastal communities on first aid, evacuation etc. 4) Prepare inventory of equipment and buildings and share it with NDMA, PDMA and DDMA. 5) Disseminate warnings to the coastal communities for potential disaster. 6) Coordinate with Maritime Security Agency (MSA) and Pakistan Navy about any ocean related natural and man-made hazards.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative in NEOC/PEOCs/DEOCs particularly in cyclone season and monsoon period. 2) Assist DDMA in relief operation. 3) Assist DDMA in assessment of damage and losses of the coastal public property and prepare a report and share it with DDMA, PDMA, and NDMA. 4) Assist DDMA, PDMA and NDMA to evacuate communities from the coastal areas in case of cyclone or any other sea related hazard. 5) Coordinate and closely work with NDMA, PDMA, DDMA in case of any coastal area disaster
Emergency Relief Cell (Cabinet Division)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Stock tents, medicines, blankets, clothing plastic sheets and tarpaulins. 2) Share this information with NDMA on fortnightly basis. 3) Prepare inventory of emergency relief item suppliers and share it with NDMA. 4) Prepare a list of relief items suppliers those who can supply relief goods on short notices. Share it with NDMA. 5) Develop guidelines and mechanisms for release of relief goods from warehouse. 6) Maintain record of receiving and dispatching relief goods from/to foreign and local agencies in the event of disaster. 7) Prepare procurement plans of relief stores in concert with NDMA.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National EOC. 2) Immediately release relief goods in case of disaster. 3) Coordinate international relief assistance in case of major catastrophe in consultation with NDMA. 4) Closely work and coordinate with NDMA.
Fire Services	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare contingency plans with different scenarios for residential areas in urban and slum areas in big cities. 2) Prepare contingency plan for industrial areas with particular focus on chemical industry. 3) Purchase firefighting equipment and establish fire stations according to size and population of each city in Pakistan. 4) Develop IEC material in national/local languages on preventive measure from the fire.

	<ol style="list-style-type: none"> 5) Organize awareness programmes on fire control for school teachers, students, workers in formal/informal industrial sector, gas stations, commercial markets etc. 6) Identify fire prone locations in the city and prepare contingency plan accordingly. 7) Develop fire risk monitoring system in urban localities. 8) Conduct firefighting drills on regular basis. 9) Keep all fire brigade vehicles in order and ready to deploy any time anywhere
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Deploy fire-fighting teams and rescue people. 2) Coordinate with NDMA/PDMAs/DDMAs.
Federal Flood Commission (FFC)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Make flood protection plans for the country. 3) Review flood protection work and prepare plans for restoration and reconstruction work. 4) Compile resource inventory e.g. machinery, manpower, vehicles, and update it on six monthly basis. Share it with NDMA and PDMAs. 5) Draft list of stone suppliers and contractors. 6) Update NDMA and Armed Forces on situation on protection embankments particularly in flood season.
National Logistics Cell (NLC)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Prepare contingency plan for transportation of relief goods in case of major disaster. 3) Prepare inventory of NLC vehicles and share it with NDMA. 4) Identify and prepare an inventory of private transport companies which can be engaged in national major disaster. 5) delivery of adequate quantity of POL supplies at designated areas in event of disruption of the POL market supply chain
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the National EOC, if and when needed. 2) Provide vehicles to transport relief goods. 3) Act as coordinator of road transport agencies during disaster. 4) Ensure smooth transportation of relief goods in the affected areas. 5) Support government in technical appraisal of projects/programmes pertaining to roads, road transport, railways, ports and shipping. 6) Liaise with private transport agencies on behalf of NDMA if needed.

Provincial Irrigation Departments	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Finalize emergency preparedness plan. 2) Prepare a flood contingency plan and review it every year. Allocate resources for preparedness and emergency response activities. 3) Devise a communication strategy for flood season on water flow in the river, canals and its sub distributaries. 4) Draw up a list of embankments. Identify weak points and get them repaired before the flood season. 5) Promote community participation in embankment management before, during and after any disaster. 6) Plant trees on both sides of the canal and its distributaries 7) Provide technical support to the district irrigation department to prepare contingency plan for the flood season. 8) Compile an inventory of equipment e.g. machinery, human resources, vehicles, and a list of suppliers of stones. Update this list on six monthly bases and share it with the PDMA and NDMA. 9) Organize de-siltation of irrigation canals and its distributaries every year. 10) Maintain canals and distributaries properly to avert breaches. Also arrange upkeep of surface drainage system to cope with flood water
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Designate a representative to the PEOC. 2) Monitor embankment situation during floods and set up camp of irrigation officials on sensitive points of the embankment. 3) Monitor water flows in canal and its distributaries during the flood season and update EOC on river and canal water flow in monsoon period on daily basis. 4) Update communities on river and canal water flows through PDMA, DDMA (as applicable), print and electronic media. 5) Issue early warning of potential floods or canal breach through media, T.V cable operators, police wireless network etc. 6) Monitor alert and be ready to face any situation e.g. breach of canal/sub distributaries etc. 7) Coordinate with Armed Forces and indigenous breach filling experts for canal breach filling.
Pakistan Meteorological Department (PMD)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Develop communication strategy of disseminating early warning information so that the information reaches to the end user. 2) Develop people-centered early warning system. 3) Prepare a plan for issuing weather forecasts data on regular basis through electronic and print media. 4) Prepare list of rain gauge data collection stations and other ways of data collection in the country and share it with NDMA, PDMA, and DDMA. Maintain the satellite system.

	<p>5) Take measures to increase the capacity of the PMD in relation to the Tsunami forecast and earthquake related information.</p> <p>6) Coordinate with GSP, SUPARCO, FFC, FWC and other organization in collecting data which helps to forecast any hazard in the country</p>
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Inform public on the weather forecast and issuing warning in case of potential threat. 2) Disseminate flood information to the provinces and districts heads by phone and fax on daily basis during flood season. 3) Share weather forecasts and early warning information with NDMA, PDMA on regular basis in the monsoon period. 4) Coordinate with Federal Flood Commission, Flood Warning Centre in monsoon period. 5) Collect rain data on regular basis, consolidate it and share it with NDMA.
Space and Upper Atmosphere	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare satellite image maps of natural disasters in the country and share it with NDMA. 2) Monitor drought conditions in Pakistan. Share imagery maps with NDMA, PMD and Pakistan Agriculture Research Council. 3) Develop procedures and mechanism to access the remote sensing images and satellite maps by humanitarian organizations for emergency preparedness and response. 4) Provide remote sensing and satellite maps for hazard risk zones for planning and response. 5) Coordinate and facilitate with NDMA, PDMA on regular basis in provision of satellite images for emergency preparedness and planning purposes.
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Provide remote sensing and satellite maps. 2) Prepare post disaster imagery maps
Banks	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Undertake analysis to identify high risk areas for the banking sector lending programmes; 2) Develop insurance and lending services against natural hazard risks for housing, industrial and infrastructure sectors 3) Coordinate with relevant city authorities or NDMA to receive guidelines
Insurance Sector	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Undertake analysis to identify high risk areas for the insurance sector; 2) Develop insurance services against natural hazard risks for housing, industrial and infrastructure sectors; 3) Coordinate with relevant city authorities or NDMA to receive guidelines for construction in high risk areas

Media	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare communication strategy on emergency response. 2) Document and broadcast good practices on emergency response. 3) Develop awareness strategy for public during emergency response period. 4) Broadcast public messages on disaster related issues. 5) Allocate air time for emergency response programmes. 6) Organize awareness programmes for journalists in relation to media's role in emergency response. 7) Conduct annual conference on role of media in disaster management
	<p>Emergency Response Phase</p> <ol style="list-style-type: none"> 1) Provide timely and factual information to public during emergency response. 2) Influence decision makers to take immediate and appropriate actions for emergency response. 3) Relay public awareness messages on health and other issues which help to reduce the human losses. 4) Highlight needs and issues of survivors during the disaster time. 5) Curtail normal programme to broadcast essential information on emergency response.
	<p>Rehabilitation and Reconstruction Phase</p> <ol style="list-style-type: none"> 1) Appeal for assistance from all parties to meet the needs of survivors; 2) Communicate about rehabilitation and reconstruction plans of authorities, UN and NGOs, and others in the affected areas; 3) Encourage survivor participation in recovery through conducting surveys and ; 4) Influence for integrating risk reduction in rehabilitation and reconstruction programmes;
Pakistan Red Crescent Society (PRCS)	<p>Pre-Disaster Phase</p> <ol style="list-style-type: none"> 1) Prepare emergency preparedness plan. 2) Ensure that all PRCS branches have developed preparedness plan at district level with close coordination of local government. 3) Provide financial and technical support to branches for preparedness activities. 4) Compile inventory of resources for emergency response. 5) Develop capacity of PRCS district level branches in disaster preparedness and response. 6) Conduct trainings to promote Humanitarian Charter and Sphere Minimum Standards in Disaster Response in PRCS branches. 7) Conduct trainings for volunteers in first aid, evacuation, and emergency response.

	8) Hold community based disaster preparedness and emergency response training workshops. 9) Formulate development plans in concert with NDMA. 10) Develop a roster of blood donor volunteers at branch and HQ level and share it with DDMA, PDMA and NDMA
	Emergency Response Phase 1) Designate a representative to the NEOC, PEOCs and DEOCs. 2) Assist DDMA in evacuation process in the affected area. 3) Provide ambulance for rescue and transporting injured people. 4) Provide medical services to the affected population. 5) Coordination with NDMA, PDMA, DDMA, NGOs, INGOs, relief agencies for emergency response. 6) Coordinate operations of national and international components of Red Cross/Red Crescent Movements, operating in disaster affected areas. 7) Coordinate with DM authorities and UN agencies for post disaster relief work.
Private Sector	1) Undertake hazard and risk analysis during design and planning stages of new infrastructure and industry; 2) Identify and implement alternative options in order to reduce risks of natural hazards to infrastructure and industry; e.g. change location 3) Implement vulnerability reduction measures in case of construction of infrastructure and industry in high risk areas; catastrophic events. 4) Develop disaster preparedness and response plans for industrial units and industrial zones; 5) Undertake drills at industrial unit level in order to prepare for any disaster

Source: National Disaster Management Plan (2010), National Disaster Management Authority (NDMA) and Japan International Cooperation Agency (JICA).

Appendix-IV

List of National and International NGOs Participating in Climate Change and Disaster Related Activities in Pakistan

Institution/ NGO	Mandate/ Aims	Working Experience	Location of Activity in Pakistan	Year of Activities	Type of Disaster	Interventions Introduced	Comments
Oxfam Pakistan	An international relief and development organization that creates lasting solutions to poverty, hunger, and injustice.	Since 1973	AJK and all Province of Pakistan	2005, 2008, & 2010	Flood & Earthquake	Supply of Food and Agricultural Inputs	Organization having its own five year climate change plan
ActionAid Pakistan	Supporting communities who are trying to cope with the disastrous effects of climate change.	Since 1992	AJK and all Province of Pakistan	2005, 2008, & 2010	Flood & Earthquake	Damage assessment and input supply	Working in the climate change affected countries and dealing with the impact of climate change
WWF Pakistan	Conserve nature and ecological processes by preserving genetic, species and ecosystem diversity	Since 1970	AJK and all Province of Pakistan	2005, & 2010	Flood & Earthquake	Food supplies, agricultural Inputs, & training of farmers	The largest environmental conservation organization working on climate change related projects
IUCN	Influence, encourage and assists societies to conserve the integrity and diversity of nature to ensure use of natural resources is equitable and ecologically sustainable	Since 1985	AJK and all Province of Pakistan	2005, 2010	Earthquake Flood	Conservation strategy, awareness about climate change, water run-off control practices, conservation education	Conservation strategies, community education, and land and water conservation
FAO	Food security	Since 1951	AJK and all Province of Pakistan	2005, 2007, 2008, 2010, 2011	Flood, Drought, & Earthquake	Distribution of food, feed, seeds and fertilizer; rainwater harvesting structures; and training of farmers	Important organization in terms of damage assessment, relief and rehabilitation measures, financing and capacity building.
UNDP	Social progress, better life, advances economic, social and technical development-capacity building facilitation in policy development	Since 1960	All province of Pakistan	2011, 2005, 1999, 2000	Floods & earthquake, Drought	Repairing infrastructure, job creation, clean water, food supplies, agri inputs, Improved tillage, water harvesting	Natural resource management, biodiversity and climate change policy & initiated first UNFCCC adaptation fund. Also Worked as Focal point on climate change

National Rural Support Programme	Poverty Alleviation by development activities in rural areas	Since 1991	AJK, Punjab, KP, Sindh, Balochistan,	2005	Earthquake, flood, drought	Infrastructure development, agricultural technologies and inputs	Participating and organizing workshops and seminars on climate change issues
BRAC	Aim to achieve large scale, positive changes through economic and social programmes that enable men and women to realize their potential	Since 2007	KP	2008	Flood		B A s Disaster, Environment Climate Change (DECC) Programme was created in 2008 as a result of the Cyclone Sidr, which hit Bangladesh in November 2007.
Save the Children Pakistan	Relief, recovery, and development have nurtured the seeds of hope for millions of children and their families.	1979	AJK & KP	2005	Earthquake	Healthcare, education , shelter kits and food	Actively involved in problematic regions of Pakistan
Islamic Relief Pakistan	Assisting individuals, groups and institutions to develop safe and caring communities		AJK, KP, Balochistan	2009, 2010	Flood & Earthquake	Food, clean drinking water, healthcare	Actively involved in disastrous areas in Pakistan
Concern Worldwide	Focus is on improving livelihoods, improving access to water and sanitation and responding to emergency situations.	Since 2001	AJK, Punjab, KP, Sindh, & Balochistan,	2008, 2010, 2011	Flood	Healthcare and wind-milled powered water pumps for clean water	Working with both rural and urban communities in Pakistan
Inter Cooperation Pakistan	Working in development cooperation across four continents with an aim to alleviate poverty in rural areas.	Since 1982	KP: Eight districts	2007	Change and disaster	Agriculture, livestock, forestry and informal education,	Consistently involved in activities related to climate change and related disaster risk reduction.
Caritas International Pakistan	An international charity recognized by the Vatican dedicated to human advancement and development	Since 1998	Punjab		Community Development		
Relief International Pakistan	Focuses on serving people who have not received due attention, and in several large-scale crises	Since 2005	KP, AJK, Balochistan and Punjab	2005, 2010	Earthquake & Flood	Clean water, food, shelter, hygiene kits, emergency medical supplies and health services	Mainly working for poor communities in Pakistan

Church World Service Pakistan	An international NGO which implements humanitarian & development activities across Pakistan and Afghanistan.	Since 1954	Balochistan		Earthquake & Flood	Capacity building, disaster management, and social development	
CBM International	Focus on long-term rehabilitation of flood survivors.	Since 1968	KP, AJK, and Punjab		Earthquake & Flood	food, water, medical care, equipment and shelter	
Catholic Relief Services	Focus on water and sanitation, education, refugee protection, and emergency preparedness & response.	Since 1954	KP, Sindh and Punjab	2005, 2010	Earthquake and Flood	Schools and irrigation systems.	Well known in relief activities in Pakistan
International Medical Corps	OFDA-funded program seeks to meet emergency healthcare needs	Since 1984	KP, Sindh and Punjab	2005, 2010	Earthquake and Flood	Health clinics, water, sanitation and hygiene-related services	Having experience in the disastrous area to provide healthcare services
Mercy Corps	Improve health, sanitation, and socioeconomic conditions	Since 1986	Sindh, AJK, and KP	2005, 2010	Earthquake and flood	Safe drinking water, health units, latrines & bathrooms	Experienced in relief work
Lead Pakistan	NGO to provide leadership on sustainable development.	Since 1995	KP, AJK	2005, 2010	Earthquake and Flood		Plan to designing a multi-year program to help Pakistan tackle the challenge of Climate Change

REFERENCES

- A. Bibi, H. A. Sadaqat, M. H. N. Tahir, and H. M. Akram (2012) Screening of Sorghum (*sorghum bicolor* var moench) for Drought Tolerance at Seedling Stage in Polyethylene Glycol. *The Journal of Animal and Plant Sciences* 22:3, 671 678.
- Abbasi, G. H., A. Javid, M. Anwar-ul-Haq, and Nazir Ahmad (2012) Screening of Maize hybrids for Salt Tolerance at Seedling Stage under Hydroponic Condition. *Soil Environment* 31:1, 83 90.
- Ahmad, Munir, Zahid Akram, Muhammad Munir, and Muhammad Rauf (2006) Physio-morphic Response of Wheat Genotypes under Rainfed Conditions. *Pakistan Journal of Botany* 38:5, 1697 1702.
- Ahmad, S., A. Rahid, M. Y. Ashraf, M. Ashraf, and Ejaz A. Waraich (2009) Sunflower (*Helianthus Annuus L.*) Response to Drought Stress at Germination and Seedling Growth Stages. *Pakistan Journal of Botany* 41:2, 647 654.
- Asim, M., M. Aslam, and Asghari Bano (2011) Climate Variability and Wheat Productivity: Analysis for Sustainability VDM Verlag Dr. Müller GmbH and Co. KG. Dudweiler Landstr. 9966123 Saarbrücken, Germany. ISBN: 978-3639-32201-9.
- Aziz-Ur-Rehman, Imran Habib, Nadeem Ahmad, Mumtaz Hussain, M. Arif Khan, Jehanzeb Farooq, and Muammad Amjad Ali (2009) Screening Wheat Germplasm for Heat Tolerance at Terminal Growth Stage. *Plant Omics Journal* 2:1, 9 19.
- Bibi, N., A. Hameed, H. Ali, N. Iqbal, M. A. Haq, B. M. Atta, T. M. Shah, and S. S. Alam (2009) Water Stress Induced Variations in Protein Profiles of Germinating Cotyledons from Seedlings of Chickpea Genotypes. *Pak. J. Bot.* 41:2, 731 736.
- Farooq, M., S. M. A. Basra, A. Wahid, Z. A. Cheema, M. A. Cheema, A. Khaliq (2008) Physiological Role of Exogenously Applied Glycinebetaine to Improve Drought Tolerance in Fine Grain Aromatic Rice (*Oryza sativa L.*). *Journal of Agronomy and Crop Science* 194, 325 333.
- Farooq-i-Azam, Abdul Jabbar Khan, Akhtar Ali and Muhammad Tariq (2007) NRL 2017: A High Yielding Drought Tolerant Wheat Strain for Rainfed Areas of NWFP. *Sarhad Journal of Agriculture* 23:4, 895 898.
- Hulme, P. E. (2005) Adapting to Climate Change: Is There Scope for Ecological Management in the Face of a Global Threat? *Journal of Applied Ecology* 42, 784 794.
- Hussain, M., M. A. Malik, M. Farooq, M. Y. Ashraf, and M. A. Cheema (2008) Improving Drought Tolerance by Exogenous Application of Glycinebetaine and Salicylic Acid in Sunflower. *Journal of Agronomy and Crop Science* 194, 193 199.

- Jalal ud Din, S. U. Khan, and A. R. Gurmani (2012) Physiological and Biochemical Constituents are Predictive for Selection of Drought Tolerance Cultivars in Wheat (*Triticum aestivum* L.). *Journal of Chemical Society of Pakistan* 34:1, 151-155.
- Jalal ud Din, S. U. Khan, I. Ali, and A. R. Gurmani (2011) Physiological and Agronomic Response of Canola Varieties to Drought Stress. *Journal of Animal and Plant Sciences* 21:1, 79-83.
- Jalal-ud-Din, S. U. Khan, and I. Ali (2008) Physiological response of wheat (*Triticum aestivum* L.) Varieties as Influenced by Salinity Stress. *Journal of Animal and Plant Sciences* 18:4, 125-129.
- Jalal-ud-Din, Sami Ullah Khan and Ali Raza Gurmani (2010) Salt Tolerance Evaluation of Rice (*Oryza Sativa* L.) Genotypes Based on Physiological Characters Contributing to Salinity Resistances. *Pakistan J of Sci. and Ind. Res.* 53:1, 37-41.
- Khalil, Shad K., John G. Mexal, and Leigh H. Murray (2001) Soybean Seed Matured on Different Dates Affect Seed Quality. *Pakistan Journal of Biological Sciences* 4:3, 365-370.
- Khalique, Tassneem (2008) Modeling the Impact of Climate Change on Maize (*Zea mays* L.) Productivity in the Punjab. [PhD thesis] Faculty of Agriculture, University of Agriculture, Faisalabad, Pakistan.
- Khan, M. Jamal, Riaz A. Khattak, and M. Asim Khan (2000) Influence of Sowing Method on the Productivity of Canola Grown in Saline Field. *Pakistan Journal of Biological Sciences* 3:4, 687-691.
- Khan, Y. Ahmed, Wajad Nazeer, Asifa Hameed, Jehanzeb Farooq, and M. Rafiq Shahid (2011) Impacts of Abiotic Factors on Population Fluctuation of Insect Fauna of *Vigna Radiata* and *Tetranychus urticae* Koch in Sindh, Pakistan. *Frontiers of Agriculture in China* 5:2, 231-236.
- Laghari, K. A., Mahboob Ali Sial, and M. A. Arain (2012) Effect of high Temperature Stress on Grain Yield and Yield Components of Wheat (*Triticum aestivum* L.). *Science, Technology and Development* 31:2, 83-90.
- Madzwamuze, M. (2010) Climate Governance in Africa: Adaptation Strategies and Institutions (A Synthesis Report). Heinrich Boll Stiftung.
- Mian, M. A., A. Mahmood, M. Ihsan, and N. M. Cheema (2007) Response of Different Wheat Genotypes to Post Anthesis Temperature Stress. *Journal of Agricultural Research* 45:4, 269-275.
- Mool, P., S. Bajracharya, R. Roohi, A. Ashraf, and R. Naz (2003) Inventory of Glaciers, Glacial lakes and the Identification of Potential Glacial lake Outburst Floods Affected by Global Warming in the Mountains of Himalyan Region, Astor basin, Pakistan. ICIMOD, Nepal & PARC, Pakistan (CD).
- OECD (2009) *Integrating Climate Change into Development Cooperation: Policy Guidance*. Environment Directorate.
-

- Pakistan, Government of (1993, 2009 and 2011) *Agricultural Statistics of Pakistan (1992-93, 2008-09, and 2010-11)*. Islamabad: Ministry of Food and Agriculture, Economic Wing.
- Pakistan, Government of (2005) *National Environmental Policy, 2005*. Islamabad: Ministry of Environment.
- Pakistan, Government of (2012) *National Climate Change Policy, 2012*. Islamabad: Ministry of Climate Change.
- Pakistan, Government of and IUCN (1992) National Conservation Strategy Report. Environment and Urban Affairs Division (EUAD), Government of Pakistan.
- Qadir, M., R. H. Qureshi, N. Ahmad, and M. Ilyas (1996) Salt-tolerant Forage Cultivation on a Saline-sodic Field for Biomass Production and Soil Reclamation. *Land Degradation and Development* 7, 11-18.
- Rasul, G., Qin Dahe and Chaudhry Qamar-uz-Zaman (2008) Global Warming and Melting Glaciers along Southern Slopes of HKH Range. *Pakistan Journal of Meteorology* 6:11, 63-76.
- Rasul, Ghulam (2010) An Analysis of Knowledge Gaps in Climate Change. *Pakistan Journal of Meteorology* 7:13, 1-9.
- Riaz-Ud-Din, Ghulam Mahboob Subhani, Naeem Ahmad, Makhdoom Hussain, and Aziz Ur Rehman (2010) Effect of Temperature on Development and Grain Formation in Spring Wheat. *Pakistan Journal of Botany* 42:2, 899-906.
- Roohi, R., S. Ahmed, and A. Ashraf (2002) Characterisation and Classification of Agro-climates of Pakistan. *Pakistan Journal of Agriculture Research* 17, 245-254.
- Sarwar, Nighat, Sumaira Yousaf, and Farhat F. Jamil (2006) Induction of Salt Tolerance in Chickpea by Using Simple and Safe Chemicals. *Pakistan Journal of Botany* 38:2, 325-329.
- Shafi, M., Jehan Bakht, M. Javed Khan, M. Aman Khan, and Shazma Anwar (2010) Effect of Salinity on Yield and Ion Accumulation of Wheat Genotypes. *Pakistan Journal of Botany* 42:6, 4113-4121.
- Shakir, M. A., Asghari Bano, and M. Arshad (2012) Rhizosphere Bacteria Containing ACC-deaminase Conferred Drought Tolerance in Wheat Grown under Semi-arid Climate. *Soil Environment* 31:1, 108-112.
- Shakoor, Usman, Abdul Saboor, Ikram Ali, and A. Q. Mohsin (2011) Impact of Climate Change on Agriculture: Empirical Evidence from Arid Region. *Pakistan Journal of Agricultural Sciences* 48:4, 327-333.
- Sheikh, M. M., M. Mohsin Iqbal, Ghazanfar Ali, and Arshad M. Khan (2011) Global Warming in the Context of Pakistan: Major Concerns and Remedial Strategies. Symposium on Changing Environmental Pattern and its impact with Special Focus on Pakistan held at Lahore, Pakistan.
-

- Tudela, F. (2003) Institutional Capacity for Climate Change Mitigation in Mexico. In *Institutional Capacity and Climate Actions (Edn)*. OECD Environment Directorate, International Energy Agency.
- United Nations (1987) *Our Common Future*.
- Zaman, Q., Arif Mahmood, Ghulam Rasul, and Muhammad Afzal (2009) Climate Change Indicators of Pakistan. Pakistan Meteorological Department. (Technical Report No. PMD-22/2009).
-