

A STUDY ON PAKISTAN'S CLIMATE CHANGE POLICY AND THE CHALLENGES IT WILL IN FUTURE RAPID CLIMATE CHANGE

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ABSTRACT--

There is growing global consensus that climate change is the greatest upcoming global threat to humankind in modern times and is likely to have serious consequences for socio-economic sectors such as health, food production, energy consumption, security and natural resource management in near future. Pakistan is a developing country that has been severely hit by climate change affects in some last year's Although Pakistan contribute very little to global greenhouse gas emissions. To face a potential impacts of climate change in near future, a strong policy and institutional setup should be Developed. So This research aims to study the possible knowledge that policy makers and the government officials should focus on so that they can prepare themselves in the near future.

Focusing on future vulnerability is the key feature for the achievement of Sustainable development. Government officials and policy makers face many challenges for Effective implementation of strategies to face the possible climate change affects, but the main gap lies in lack of participation of different affective communities at any level of policy-making. According to present and past circumstances effective measures should be needed to address climate change phenomena in Pakistan. It is essential that the government strongly recognize potential future climate risks and protect the environment.

Index Terms—climate change, future challenges, policy making, sustainable development, future threats. Increasing awareness, green house gasses, adaptation measures

1.INRODUCTION

As we know Climate change is a serious upcoming global challenge in near future. Climate change effects appear in the form of natural disasters and catastrophes, which have a negative impact on the lives of people throughout the world. Deforestation, melting of glaciers, rising sea level and rapid urbanization contribute to serious global climate change. There is no doubt that pollution; industrialization and deforestation have added to the climatic problems that produce large amounts of greenhouse gas emissions into the environment which are the serious threat to future development of the world. Pakistan's role in climate change has become increasingly important as Pakistan cannot ignore its contribution to this problem. The latest scientific assessment by the Intergovernmental Panel on Climate Change (IPCC) estimates that the Earth's average surface temperature will increased by 1 to 3.5 degrees Celsius (about 2 to 6 degrees Fahrenheit) by 2100, and also sea level will increased from 15 to 95 cm (about 6 to 37 inches).

Raising awareness about climate change at the local and government level is critical to Pakistan as the effects of climate change intensify the extent of disasters in the recent years. According to A recently published index, Pakistan ranked 12th in the list of countries that are maximum exposed to the impacts of climate change .Climate change is a broad term and has been widely discussed in many disciplines. However the main focus of climate change research was usually Scientific analysis and its effects. The research on climate change about Awareness and adaptation in developing countries is still in its initials stages.

An increasing awareness on disaster risk reduction in Pakistan can help increase preparedness through early warning development evacuation and forecasting Systems. In

a survey climatic change experts believes that both natural and manmade causes are responsible for climate change issues in Pakistan .About 30 percent of the respondents believes that it due to manmade cause which further indicates the lack of Knowledge about climatic issues. However, the federal government must be aware that such initiatives require dedication to achieve fruitful results in the long term time. If policies remain on paper and are not implemented, they will serve no purpose. As Developing countries are the least responsible for climate change. However, the geographical location and socio-economic vulnerability of most developing countries make them more vulnerable to the environmental, social and economic impacts of climate. Moreover, people living in poverty around the world will be most affected by climate change.

2.MAIN GOALS AND OBJECTIVES

As we know that Pakistan is facing The worst climate-related disasters in Pakistan but there are still a short amount Information and knowledge on how actors can achieve this goal in practice. There is therefore a need to study how to implement current initiatives against climate change, which aims to analyze Pakistan's vulnerability to climate change, and the key challenges in achieving sustainable adaptation practices. There are some sub search questions that are useful in Achieve the main research objective.

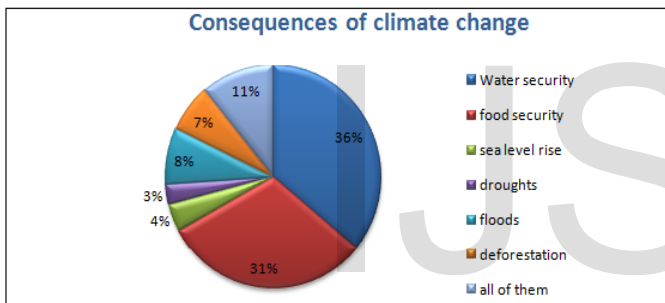
- 1.What is the current climate change situation in Pakistan and what are its future challenges?
2. What are the key steps by which we can control the impacts of climate change in the future?
3. What is the institutional setting at the government level and the role of institutes to deal with Climate change , and

what are the main challenges and gaps that we are facing at a government level?

3. CONSEQUENCES OF CLIMATE CHANGE

According to the National Climate Assessment, human impacts are the primary cause of global warming, in particular the carbon pollution caused by the burning of fossil fuels and contamination from pollution through forest destruction. But if human activities continue to cause carbon dioxide in the atmosphere at current rates, scientists will have to dig deeper into the past for a similar period. Climate models predict that global warming will lead to major changes in climate patterns around the world in near future. These changes are likely to include major shifts in wind patterns, annual precipitation and seasonal variations in temperature.

As climate change affects various sectors Ecosystems such as food, water, energy, forests and Also the occurrence and severity of climate-related risks such as floods And drought. In a survey According to different government officials and climatic change experts there are different Consequences of climate change in Pakistan.



3.1 Climate change as Global perspective

Climate models predict that the global average temperature of land will rise in the future. Over the next two decades the temperature is expected to be about 0.2 ° C. During the 21st century various computer models predict that the average temperature of the Earth will rise between 1.8 degrees and 4.0 degrees Celsius (3.2 degrees and 7.2 degrees Fahrenheit). According to the Environmental Protection Agency Global sea levels have risen by about 8 inches since 1870 and the rate of increase is expected to accelerate in the coming years. By 2100, models predict that sea level will rise between 20 and 50 cm (8 to 20 inches) above the late twentieth century level. By 2100, our oceans are estimated to be above one to four feet, threatening coastal systems and lowlands including entire island nations and the world's largest cities.

3.2 Climate change as Pakistan perspective

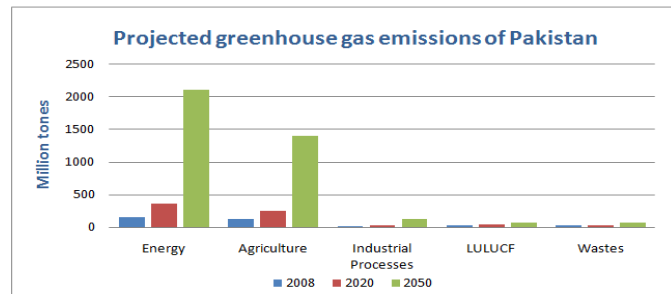
Pakistan contains Asia's most spectacular landscapes as it stretches from Arabian Sea to its southern border and to the world's magnificent mountain ranges in the north. Geography varies across the country, forming a great variation in the

country's climate. Preliminary studies indicate that Pakistan's 49.6 per cent of the population is at risk from the impact of climate change. Temperature and rainfall trends vary widely in Pakistan. Temperatures increases Up to 52 ° C in the middle arid plains and falls below to -26 ° C in the north Mountains areas. Major cities in Pakistan are suffering from High population growth rate, continuous degradation of agricultural land, potential Water shortages and uneven distribution of resources. Current population Temperatures have risen from 0.6 to 1 ° C In coastal areas of Pakistan since 1900s. Below Table shows a climate risks for South Asian countries in which Pakistan could face severe challenges of climatic issues in near future.

Climate change Ricks comparing to south asian countries

	Afghanistan	Bangladesh	Bhutan	India	Nepal	Pakistan	Maldives	Sri Lanka
Sea Level Rise	-	High	-	Modest	-	Modest	High	High
Glacier Retreat	High	High	High	High	High	High	-	-
Temperature Increase	-	High	High	High	High	High	Modest	High
Floods more Frequent	-	-	Likely	High	High	Likely	High	-
Drought more Frequent	Likely	High some areas	High	High	-	Likely	-	-

Pakistan's greenhouse gas emissions are expected to increase significantly as the country climbs the development ladder and strives to provide sufficient energy to support its growing social and economic development needs. Although Pakistan is a small emitter of greenhouse gases it contributes only about 0.8% of the total global greenhouse gases Emissions but On a per capita basis, Pakistan's greenhouse gas emissions are 1.9 tones which is At a level equivalent to about a one third of the global average. In a recent global study on greenhouse gas emissions in 2011-2015, Pakistan ranked 137th, contributing only 0.47 per cent of global GHG emissions but due to its climate conditions Pakistan will have most drastic effects of change in climate. It is estimated that in Pakistan carbon emissions are increased by 76 million tons in 1994 to 200 million tons in 2012. It is estimated that CO2 emissions will be increased at a average rate of 6.7% annually that will result in 484 million Tons by 2020. [4]



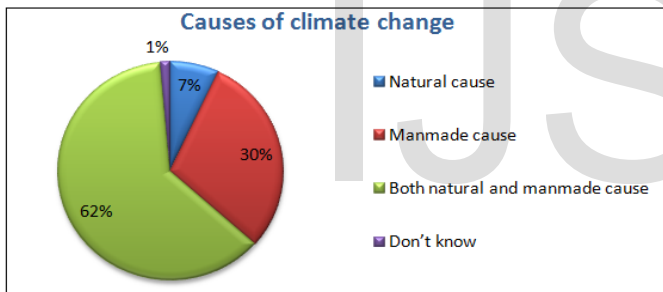
The last 10 years are terrible years for Pakistan as coastal salinity, deadly heat waves, mangrove depletion, serious hurricanes and floods have a devastating consequences of climate change in the country. In Karachi alone, more than 1,200 people were killed by the deadly heat wave last year. According to the National Oceanographic Institute as

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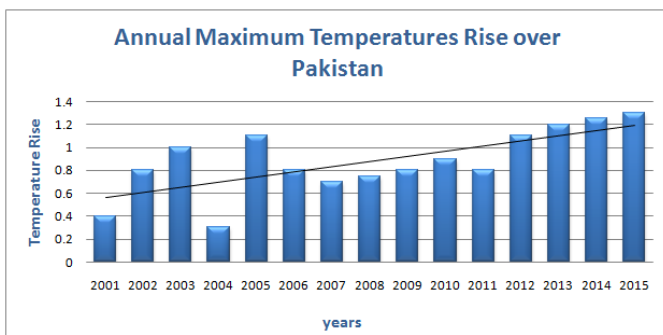
temperatures rise across the country there is a apparent danger that Karachi would sink into the next 35-45 years. According to experts, if climate change was not taken seriously, the resulting damage would be irreversible and inconceivable to the country in the coming years.

3.3 causes of climate change

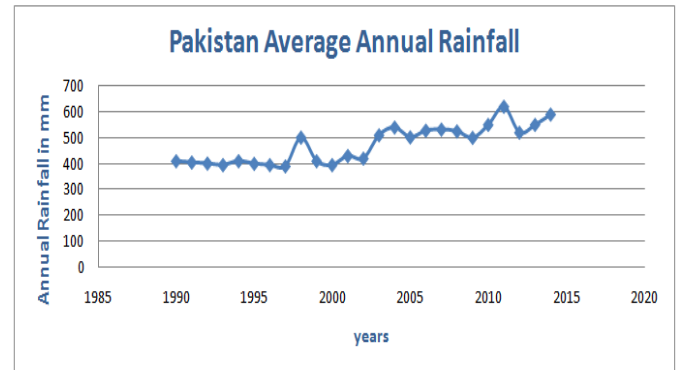
Pakistan is still self-sufficient in agriculture sector , but due to large no of rains in recent years the country has witnessed unprecedented deadly floods that wipes out millions of acres of key agricultural land. According to reports 715,000 people in Pakistan are affected by floods each year, resulting in an annual loss of approximately 1 per cent of the country's gross domestic product, which translates to US \$ 2.7 billion. According to climate change experts the main cause of recent floods is the melting of glaciers at a faster rate as and rain cannot be responsible for the recent floods alone. It is expected that 4/5 of all glaciers in the Himalayas will melt very soon, reducing river water levels and affecting the lives of about 500 million people. According to World Resources Institute 2.7 million people could be affected annually by the river floods in Pakistan by 2030. A study done on the precipitation of rainfall in Pakistan from 1985 - 2015 shows that An increasing trend has been observed for the annual average rainfall over Pakistan .



According to the Temperature data obtained from (2000-2015) for Punjab Province shows that average maximum and minimum temperature of 0.96°C and 0.93°C respectively rise from 1960-1988 and from 1988-2015 the average maximum and minimum temperature increased from 1.21°C to 1.03°C. The average maximum temperature increased in Sialkot, Meri and wazirabad regions are (3.09°C, 2.38°C, 2.23°C), respectively.



Pakistan is one of the country's which is most affected by climate change. Pakistan has also experienced the worst historic floods in the last 10 years, and at the same time, severe droughts have been experienced in the vast scattered Thar Desert and some parts of Balochistan. Moreover, Pakistan is now experiencing an extended summer due to changing weather patterns. However, sea level rise is the worst case in comparison to other climate change outcomes.



3.4 Government efforts regarding flood challenges:

to prevent future flooding, the Pakistani government has begun to develop its own plan to reduce the risk of flooding. National engineering services in Pakistan have developed a fourth national plan for flood prevention (2015-2025), with the assistance of the Institute of Deltares in the Netherlands and after nearly two years of consultation with various stakeholders. This plan could represent a significant break with Pakistan's current flood management approach. For the first time, the national strategy emphasizes integrated flood management and soft measures such as mapping of floodplains and restoration of watersheds and forests on the high rivers. The draft plan also includes the establishment of large reservoirs in the areas already identified, including the dams of Kalabag, Daimar Pasha, Acharwi, Munda, Shinjut and Kuram Tanji, and the upgrading of the early warning system for floods. [16]

The Federal Flood Commission of the Ministry of Water and Energy is responsible for flood management planning and will supervise the implementation of the new plan. It has members from various government agencies that are supposed to coordinate the management of the Rivers - including the Water and Energy Development Authority, provincial irrigation departments, the military and the provincial environmental protection agencies.

3.5 Role of forests in preventing floods:

Climate change has been significantly affected by the depletion of ozone in recent decades. We have developed a large amount of chlorofluorocarbons (CFCs), which attract oxygen from the ozone layer. In addition, we lose forests that supply pure oxygen to the atmosphere.

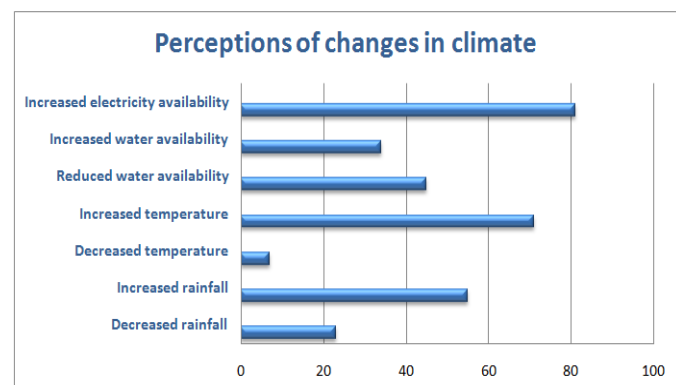
Forests are also one of the largest carbon observers in the world, absorbing 2.4 billion tons of carbon dioxide a year and

storing billions more. Some scientists have warned in the report that deforestation should be reduced by 50% in 2020 to get the best opportunity to achieve this goal. Forests have the capacity to absorb about one-tenth of the expected global carbon emissions for the first half of this century in biomass, soil and products and store them.

Pakistan is relatively poor in forests. According to experts, the area under forests should be at least 25 to 30 per cent of the country's total area. In Pakistan, forest area is only 4.5 per cent. Pakistan Annual wood requirements are about 22 million cubic feet in the form of timber, but our country produces only 11 million cubic feet.. It is estimated that if we want to increase the forest according to our needs, it takes 100 years to raise the current situation. According to the 2015 report of the Food and Agriculture Organization of the United Nations (FAO), Pakistan's forest cover has been reduced to less than 2 per cent of its land area that is one of the lowest in the region. But the major concern is that country is losing about 27,000 hectares annually and this downward trend of deforestation has exposed the country importance towards the issues of climate change. In Pakistan mountainous areas about 40% forest consists of conifers and scrub forests.

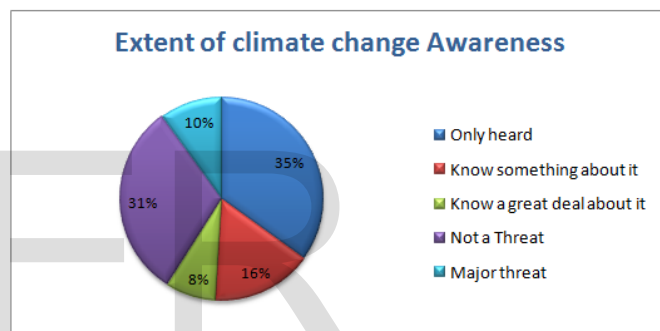
3.6 Disaster history of Pakistan:

Pakistan ranks 7th on the list of countries most vulnerable to climate change according to the German World Climate Risk Index. We are placed in a group of countries facing extreme climatic events every year. This time, fortunately, Pakistan is not among the top 10 climate-affected countries in the short-term index, ranking 11, losing \$ 907.122 million and 0.0974 per cent of GDP. However, in the long-term climate risk index (1996-2015) Pakistan ranked seventh losing \$ 3.8 billion and 0.6 per cent of GDP. It is important to note that in the long-term climate risk index (1995-2014) Pakistan was ranked eighth losing \$ 3.9 billion and 0.7 per cent of GDP, highlighting that Pakistan's vulnerability has been increasing for a long time. Running. The German World Climate Risk Index placed Pakistan, which is frequently affected by disasters and is ranked among the most affected countries in both short and long terms over the past six years. According to survey these are the perceptions that are observed by the people of Punjab in last few years.



4. OBSERVATIONS AND RESULTS

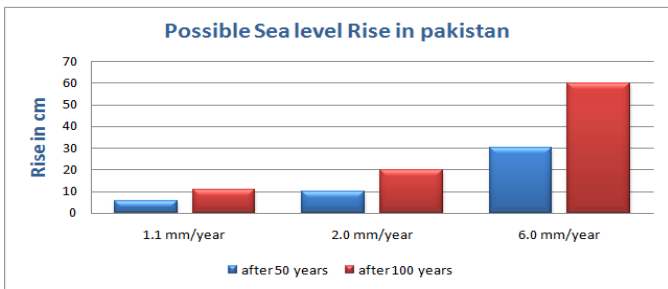
There should now growing awareness in Pakistan of understanding the climate change issues. Not only the area of experts, national planners, decision-makers alone, but also in General people also needs to learn about the impacts of climate change and also its possible Adaptation and mitigation. According to Article 6 of the United Nations Framework Convention on Climate Change also requires Parties to promote education, training and public awareness programs within their respective capacities And resources. There should be Support for research Institutions and universities to conduct needs-based research in a priority environment and also organize scientific conferences, seminars on the environment. Climate change awareness should be an integral part of all this education, research and public awareness Activities. According to survey 35 percent of the people are unaware of the climatic issues and 31 percent not consider as a major threat. It shows the level of awareness about climate change issues among the local population.



The Ministry of Environment, in partnership with key stakeholders, is spearheading efforts Aims to integrate the concepts of environmental education into school curricula. At the same time, both public and private sector institutions heavily involved in the planning and development of programs and communicating climate change-related information. There should be sufficient Efforts required at a organization level to target workshops at the expert level Important international days such as Earth Day, World Environment Day, World Water Day, World Forest Day etc. Use effectively electronic media (radio and television) to transmit the message to a Aa larger audience by organizing discussion groups on selected climate change themes And also use of print media (newspapers and magazines) to disseminate similar information Through the diffusion of both semi-technical materials and that can easily understand on popular materials

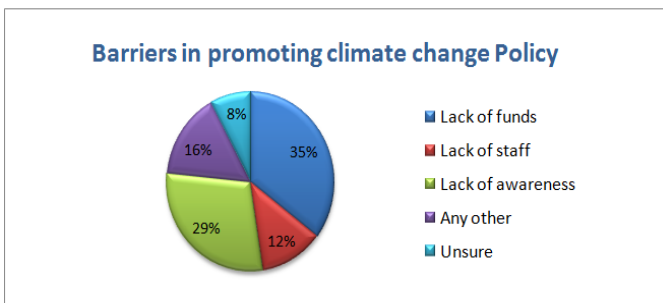
Train the scientists in reputable institutions and also organize intensive training efforts within the country with the help of foreign experts or through a combination of both Approaches. These professionals scientists will then serve as trainers to transport them Climate change education and training for other professionals, scientists and educators and work in various educational organizations and institutions.

Pakistan has more than 10% of its population living in the vicinity of the coastal zone, more than 20% of Pakistan's coastal areas are relatively developed, and 40% of the industry is located on or near the coast. Sea level rise of a few mm per year, although not a threat but the direct and indirect impact of this rise will have a profound impact on coastal resources for the sustainable management of coastal areas. In addition to sea level, the rise in global warming will increase the frequency of tropical cyclones and increase the tragedies of coastal States. Current information and data on SLR in the archives of the National Institute of Oceanography in Karachi are consistent with the global average of sea level rise. The rate of sea level rise in the Pakistani coastal region has been classified to approximately 6 mm per year. Below figure shows the annually rise in sea level at a Gwadar coast.



4.1 Government role in implementing climate change policy:

Pakistan has played a leading role in the adoption of the United Nations Framework Convention on Climate Change. The Climate Change Task Force that was established in October 2008 has Comprehensive assessment of all aspects of climate change, including its implications for the economy and the proposed options of Mitigation and adoption. National climate change Policy was approved in 2012 and its framework Implementation has approved in 2013. Its Medium-term policy Vision 2025, adopted in 2014 has a number of objectives in response to deep challenges posed by climate change. According to survey various government officials and climatic change experts there are different Barriers in implementing climate change policy.



The Pakistan Council on Climate Change will be headed by the Prime Minister and will include relevant federal ministers, the provincial environment ministers and the senior secretaries of the AGK and Gilgit Baltistan, as many as 30 others, including 20 non-officials, representing chambers of

commerce and industry, non-governmental organizations, scientists, researchers and experts Technicians, and educators. The Council would be the supreme policy-making body. The Council was also informed that it may also direct any Government agency to develop and implement projects and also mitigate the adverse effects of climate change, to promote climate-resilient development and to be resilient the climate sustainability research in any aspect of climate change. The Authority will also advise the Government on appropriate legislative, policy and operational measures. The Authority will manage the Funds and would be used properly for the expenses incurred by the Authority in the performance of its functions and for financial assistance for adaptation and mitigation projects for the sustainable development of resources and research

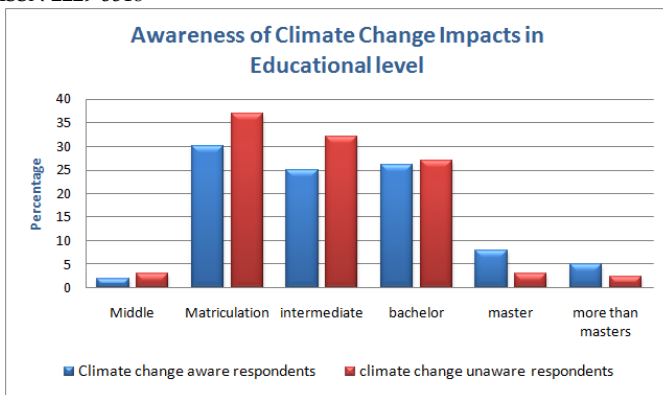
4.2 Integration and coordination of Data collection:

The Federal Ministry of Climate Change should be restructured On the basis of a review of its internal and external responsibilities. Coordination between Governments at the national and sub national levels is a prerequisite for the success of climate change Activities.

A national climate change committee should staffed by technically qualified personnel. There is a need to review on performance of various legal bodies responsible for implementing the climate change including those developed under the framework of Climate change policy and other federal ministries. These include Center for the Study of the Impact of Global Change and the Pakistani environment Protection Agency as well as alternative energy Development Board, Energy Conservation Center And water-related constitutions such as water and energy Development Authority and its numerous research centers, Sindh River System Authority (ERSA), National Flood Commission ,Pakistan Agricultural Research Council (PARK), University Of agriculture in Faisalabad, the oceanographic institution in Karachi, and the Forestry Institutes in Peshawar and Jamshoro. There should be proper system in federal and provincial ministries in order to do so and enhance their performance. Other key ministries related to climate change are Ministry of Development Planning and Reform, Ministry of Water The Ministry of Food Security and Research. There should be need for a coherent mechanism or a system that provides an effective exchange platform to future climatic effects.

4.3 Need of professional climate change experts:

The government should consider the establishment of national Multi-stakeholder task forces led by ministries working groups that could prepare inputs for national plans for climate change mitigation and adaptation. According to survey there are both aware and unaware Respondents that's belong to low educational level as compare to Masters and Phd level . This problem Explains the low level of literacy and education in Pakistan.



There is a severe lack of well-trained staff in national organizations that know Climate change importance and climate system dynamics because no one is national University in the country is offering such courses at postgraduate or graduate level. The science of climate change requires a high level of professionalism in theory and practice and also a experience in high numerical modeling. So there should be a urgent need to train PDM staff so that they can understand The dynamics of the climate system in international organizations that play a leading role into face the challenges of future Climate Change.

There should be proper Coordination between research groups and Different organizations so that they can work on various aspects of climate change and its impact on different sectors. There is a great potential for duplication of research efforts so a summit on climate change can highlight the awareness of climate change in public .

4.4 Need of funds for implementing climate change policy:

The Pakistan Climate Change Council is a supreme policy-making body headed by the prime minister of Pakistan. To addresses the extreme climate change impacts in future Pakistan has developed comprehensive policies and plans that include adaptation and mitigation measures. However adequate funding is the key issue. According to a study commissioned by the Government to prepare our specific national planned contributions to the UNFCCC secretariat 1 Pakistan requires \$40 billion by 2030 and for mitigation measures to reduce projected greenhouse gas emissions by 20% requires US \$ 14 Billion annually to face the effects of climate change. So we can hope that the financial commitments in the Paris Agreement on the availability of at least US \$ 100 billion annually by 2020 will be fulfilled.

The summary budget is one of the most important policy documents for the Government of Pakistan. It is a summary of the federal budget and sets the principles of financial management of the government for next year. The summary budget for the period 2016-2017 now includes a separate chapter on climate change budgeting, which is an important milestone in UNDP work with the Ministries of Finance and Climate Change to include climate change at every stage of government planning and budgeting, which needs to be

prepared for Pakistan's severe vulnerability to Effects of climate change.A climate change bill has been passed in Pakistan after years of resistance by the government to adopt measures to solve the global warming issues. The of Ministry Climate change establishes a Climate Change Policy Council and a Climate Change Panel to prepare and oversee climate change project for their implementation .The climate change council also hopes to accelerate action and implement climate projects in future.

5.RECOMMENDATIONS:

As the effects of climate change are likely to be more severe due to resource constraints and infrastructure so there should a need to Develop and implement progressive adaptive strategies and policies for facing future climate challenges in Pakistan. The first comprehensive strategy involves rapid and sustainable development Which will increase income levels, education and technical skills and improved disaster management system, and health care systems .The second strategy is a micro-strategy that involves management Sectors that are most sensitive to climate change. This means the development of new institutions And modifying existing systems to promote adaptation of climate change. This will also include modification of climate s infrastructure that are already planned and implement Long-term decisions that are climate sensitive. Monitoring and analysis of changing trends that are related to climate change.

Weather prediction systems in the region must be improved for the Implementation of land-use planning reforms. New techniques should be adopt to face the Regional climate change issues and extreme events. Climate change adaptation activities should be coordinated among the countries of the region. Public should be aware and involved in Planning, adaptation, and mitigation strategies of climate change issues.

6. CONCLUSION

Climate change is one of the most serious challenge face by the humankind in this present era. As the study concludes that The impact of climate change in Pakistan is worsening day by day So To deal with this There should be an imminent need for collaborative efforts by national and international organizations. So This study concludes that despite the considerable efforts are made institutionalize the climate Change at the government and local level But there are still some major flaws in the Level of policy-making and as well as at the institutional level. Institutions also have different values And benefits that led to unsustainable adaptation practices. There is a lot of work Must be done to improve the knowledge about both vulnerability and adaptation of climate change issues at Government and local level . sufficient efforts should be made for need of data integration, Training of skilled manpower and also fulfill the demand of technical capacity. In this regard We should train the workforce working on climate change and adopt various strategies that should be implemented on a emergency level.

7. REFERENCES

1. http://www.lead.org.pk/cc/basicguide_climate_change
2. <http://www.worldbank.org/en/topic/climatechange>
3. <https://climate.nasa.gov/>
4. **Sadiq, N. and M. S. Qureshi, 2010:** Climatic Variability and Linear Trend Models for the Five Major Cities of Pakistan. *Journal of Geography and Geology*:83-92.
5. **Syed, F. S., W. Iqbal, S. A. A. Bukhari, and G. Rasul, 2013:** Uncertainties in the regional climate models simulations of South-Asian summer monsoon and climate change. *ClimDyn* 42: 2079-2097.
6. **Chou, C., C. A. Chen, P. H. Tan, K. T. Chen, 2012:** Mechanisms for global warming impacts on precipitation frequency and intensity. *Journal of Climate* 25: 3291-3306
7. **Montzka, S. A., Dlugokencky, E. J., & Butler, J. H., 2011:** Non-CO2 greenhouse gases and climate change. *Nature*, 476(7358): 43-50.
8. **Rasul, G., 2010:** An analysis of knowledge gaps in climate change research, *Pakistan Journal of Meteorology*, 7(13): 1-9.
9. **Hussain, Mumtaz; Mumtaz, Saniea, (2014):** Climate change and managing water crisis: Pakistan's perspective, *Reviews on environmental health*, Volume: 29 (1-2): 71-7
10. **Haroon, M. A. & Rasul, G., 2009:** Principal Component Analysis of Summer Rainfall and Outgoing Long-Wave Radiation over Pakistan. *Pakistan Journal of Meteorology*, Vol.5 (10):7-9.
11. **Mahmood, T. and G. Rasul, 2012:** Predictability of Summer Monsoon Rainfall by using High Resolution Regional Model (HRM). *Pakistan Journal of Meteorology* Vol. 9 (17):8-9
12. <https://www.theatlantic.com/international/archive/2010/08/5-long-term-effects-of-pakistan-floods/344374/>
13. **Latif, M., F. S. Syed, and A. Hannachi, 2016:** Rainfall trends in the South Asian summer monsoon and its related large-scale dynamics with focus over Pakistan. *Climate Dynamics*: 1-17.
14. **Loo, Y. Y., L. Billa, and A. Singh, 2015:** Effect of climate change on seasonal monsoon in Asia and its impact on the variability of monsoon rainfall in Southeast Asia. *Geoscience Frontiers*, 6(6), :817-823.
15. **Turner, A.G., and H. Annamalai, 2012:** Climate change and the South Asian summer monsoon. *Nature Climate Change*, 2(8):587-595.
16. **Ali, G., T. Mahmood, W. Iqbal, S. A. A. Bukhari, F. S. Syed, G. Rasul, 2014:** Heavy Rainfall Forecast by High Resolution Regional Model (HRM) and its Validation over Pakistan. *Pakistan Journal of Meteorology*, 11(21): 31-37.
17. **Ghazala, N. and G. Rasul, 2011:** Investigation of Rainfall Variability for Pakistan. *Pakistan Journal of Meteorology*, Vol.7(14):25-32.
18. **Kazmi, D.H, Rasul. G, Tong. J, Ali. G, Cheema. S.B, 2010:** Statistical downscaling and future scenario generation of air temperature, for Pakistan:6-8
19. **Gadiwala, M. S., and N. Sadiq., 2008:** The apparent temperature analysis of Pakistan using biometeorological indices. *Pakistan Journal of Meteorology*, Vol 4 (8):15 -26.
20. **Shah, S.M. 2008:** Impact of climate change on minimum temperature trends of Pakistan:6-9
21. **Cheema, S. B., G. Rasul and D. H. Kazmi, 2010:** Evaluation of Projected Minimum Temperature for Northern Pakistan:4-6
22. **Dr. Qamar-uz-Zaman Ch, Arif Mahmood, Dr. Ghulam Rasul, and Muhammad Afzal.(2009):**
23. *Climate Change Indicators of Pakistan*, Technical Report No. PMD-22/2009, Pakistan Meteorological Department:7-9
24. **Pakistan Meteorological Department & Global Change Impact Studies Center:** joint project report on climate change and its impacts, June 2007
25. **Hsu, P. C., T. Li, H. Murakami, and A. Kitoh, 2013:** Future change of the global monsoon revealed from 19 CMIP5 models. *Journal of Geophysical Research: Atmospheres*, 118(3) :1247-1260
26. **Hussain, M. S., and S. Lee, 2013:** The regional and the seasonal variability of extreme precipitation trends in Pakistan. *Asia-Pacific Journal of Atmospheric Sciences*, 49(4) :421-441
27. **Iqbal, W., and M. Zahid, 2014:** Historical and Future Trends of Summer Mean Air Temperature over South Asia. *Pakistan Journal of Meteorology* Vol, 10(20):10-20
28. **Trenberth, K. E., and J. T. Fasullo, 2013:** An apparent hiatus in global warming? *Earth's Future*, 1(1), :19-32.
29. **CPEIR,2015:** Pakistan Climate Public expenditure and Institutional Review ,United nations development programme (UNDP) Islamabad retrieved online from
30. **Economic survey of Pakistan for the Period 2007 – 08:** Ministry of Finance, Government of Pakistan.
31. <http://www.wwfpak.org/floodinpakistan/index.php>
32. **Task Force on Climate Change, February 2010:** Final Report, Planning Commission, Government of Pakistan.
33. **IPCC, 2001:** Summary for policymakers, A report of working group of the IPCC.
34. **IPCC(2010):**<http://www.ipcc.ch/pdf/presentations/himalaya-statement-20january2010.pdf>
35. <https://www.adaptation-fund.org/project/reducing-risks-and-vulnerabilities-from-glacier-lake-outburst-floods-in-northern-pakistan/>
36. <https://www.adaptation-fund.org/>