Technical Report

Climate Change Impacts and Adaptation in Balochistan

Awarding Agency:

Global Change Impact Studies Centre (GCISC)

Executing Agency:

Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS), Quetta

Future Drought Risk and Adaptive Capacity in Balochistan including the role of 100 dams and CPEC in Balochistan

Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS), Quetta

&

Global Change Impact Studies Centre (GCISC), Islamabad

(August, 2019)

Table of Contents

Concepts used in this study

Anticipatory or planned adaptation: are proactive adaptation measures that are taken to lessen the impact of perceived stress from the future events (Fankhauser et al., 1999). Important lessons can be applied from previous experiences in considering anticipatory adaptations. For the implementation of sustainable adaptations, the adaptive capacity of a system is important.

Autonomous agronomic adaptation: Autonomous agronomic adaptation ameliorates temperate crop yield loss and improves gain in most cases. With autonomous agronomic adaptation, it is established with medium confidence that crop yields in the tropics tend to be less adversely affected by climate change than without adaptation, but they still tend to remain below baseline levels. Research on agricultural adaptation to climate change also has made important advances. Inexpensive, farm level (autonomous) agronomic adaptations such as altering of planting dates and cultivar selections have been simulated in crop models extensively.

Climate-related stimuli: include all the climate change elements i.e., mean climate characteristics, climate variability, and the frequency and magnitude of extremes. They may effect directly, for e.g., a change in crop yield in response to variability of temperature or indirectly for e.g., damages caused by an increase in the frequency of coastal flooding due to rise in the sea-level.

Sensitivity: the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli.

Vulnerability: the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

1. Introduction

The emerging key determinants of future impacts and vulnerability of climate change are the potential changes in the frequency, intensity, and persistence of climate extremes such as heat waves, heavy precipitation, and drought) and in climate variability such as El Niño Southern Oscillation (ENSO) (IPCC, 2001). There are preliminary indications that Some Human Systems and social and economic systems have been affected by recent increases in floods and droughts in some areas, however, such systems are also affected by changes in socioeconomic factors such as demographic shifts and land-use changes (IPCC, 2001).

Occurrence of natural disasters such as floods and droughts has been causing considerable socio-economic damage especially in the absence of skills and means to handle such situations and mitigate the impact of these disasters. This has resulted in inadequate responses required for mitigating the impacts of such extreme events (Halcrow, 2008)

Floods and droughts also have significant social impacts, again affecting women and children the most (Young et al., 2019). During the extended drought in Sindh of 2014–17, more than 1,000 children died and 22,000 were hospitalized with drought-related diseases in the Tharparkar district alone (ACAPS 2016). During droughts in rural Pakistan, girls are most at risk of malnutrition, because they receive less food when resources are stretched given the common preference toward sons (Mansuri 2006). The economic costs to Pakistan from poor water and sanitation, floods, and droughts are conservatively estimated to be 4 percent of GDP, or around US$12 billion per year (Young et al., 2019)

Drought is a natural but temporary imbalance of water availability, consisting of a persistent lower than average precipitation of uncertain frequency, duration and severity, resulting in diminished water resources availability, and reduced carrying capacity of the ecosystem (Pereira et al. 2002) Drought is a common feature and is cyclic in nature, which occurs almost within every 10 years of period. The dry spells and droughts are also variable as the previous drought persisted for almost seven years (1998-2004). The drought years usually reoccur mostly after every 5–7 years, which substantially add to the risk of farming operations. Therefore, cropping intensities are low in Sailaba and very low in Khushkaba areas occurring in the PLB. (Halcrow, 2008) Balochistan is an arid region with frequent spells of drought. According to a study carried out by Mr Wirasatullah Khan the recurrence interval of mild, moderate and severe droughts is 7, 11 and 14 years, respectively. Moreover frequent and severe droughts and floods arising from climate change will have serious management implications for water resource users (Halcrow, 2008).

A UNDP-BUITEMS (2016) study reveals that the likelihood of different types of drought prevail in Balochistan during 2013-2016. These include meteorological drought, which is caused by less than average precipitation, triggers other types of drought, including agricultural drought, hydrological drought, and socio-economic drought. Through a generic analysis, the study reveals that the districts of Loralai, Mashtung and Pishin experiences a moderate drought, while Nushki and Lasbella experiences a mild and moderate drought. The impacts of drought were food insecurity, low agriculture productivity, livestock losses and depletion of groundwater, malnutrition and decline in health quality, increase in crime rate, forced sale of land and household assets (UNDP-BUITEMS, 2016).

Short-term migration during droughts can alleviate resource constraints, but gender gaps in development outcomes are often exacerbated by drought. A lack of resilience, especially to search for work or in response to water-related shocks, and women from higher socioeconomic groups don’t leave their villages unless it’s a drought year (Sattar 2014). The links between water and migration are complex because migration choices reflect many economic, political, and demographic issues. Droughts and floods, especially in Balochistan and Sindh have been a cause of longterm migration (Ashraf, Routray, and Saeed 2014).

Many factors such as population growth, resource depletion, and poverty are also affecting many communities and regions that are also vulnerable to climate change. Policies are needed to lessen pressures on resources, improve management of environmental risks, and increase the welfare of the poorest members of society. Moreover, to minimize the effect of climate and other stresses these policies can also help in the attainment of sustainable development and equity, reduce vulnerability and enhance the adaptive capacity (IPCC, 2010).

IPCC (2010) reported that due to thermal and water stress, sea-level rise, floods and droughts, and tropical cyclones can cause decreases in agricultural productivity and aquaculture that could diminish food security in many countries of arid, tropical, and temperate Asia.

Extreme events such as floods, droughts, forest fires, and tropical cyclones have increased in temperate and tropical Asia whereas the adaptive capacity of human systems is low and vulnerability is high in the developing countries of Asia. The developed countries of Asia are less vulnerable and more able to adapt (IPCC (need rephrase).

Adaptive capacity is the ability of a system to adjust its characteristics or behavior in order to expand its coping range under existing climate variability or future climate conditions (FAO, 2007). The adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation (FAO, 2007).

Due to lesser adaptive capacity the effects of climate change are expected to be greatest in developing countries in terms of loss of life and relative effects on investment and the economy. For example, the relative percentage damages to GDP from climate extremes have been substantially greater in developing countries than in developed countries (IPCC, 2010). Moreover, the projected distribution of economic impacts is such that it would increase the disparity in well-being between the developing and the developed countries.

Some adaptation strategies have been implemented in Balochistan by government and other national and international agencies are related to livestock, agriculture, water management, cold storage for fruits, improved packaging material, construction of water tanks, water courses and provision of delivery pipes, development and construction of check-and delay action dams, perennial and flood irrigation schemes and rehabilitation of natural resources such as Karezes and Springs (UNDP & BUITEMS, 2016). But the existing drought adaptation and mitigation strategies in Balochistan are inhabited by many weaknesses such as response to drought and other disasters in a reactive mode and lack of funding resources.

The assessment of the future drought risk and adaptive capacity is important so the necessary precautionary measures may be taken to avoid the colossal losses. Moreover, the role of CPEC and 100 dams project is also important to know the effect of these projects on the strengthening the drought coping and adaptive capacity.

To increase the adaptation capacity of rural masses and increase groundwater recharge the construction of dams has been among the policy initiative for more than 15 years. In this regard, the Government of Balochistan constructed about 292 DADs (Appendix-C) with a gross storage capacity of 276 MCM (223,556 Acre ft) (Halcrow, 2008). These dams would also help in flood control and damage minimization; control of sediment loads and the socio economic uplift of the people.

The specific objectives of this assessment study are as follow:

- To examine the drought risk and adaptive capacity of Balochistan
- To evaluate the role of CPEC and 100 dams project on the enhancing the drought risk and adaptive capacity of Balochistan
- To provide recommendations for good governance on enhancing drought risk reduction and management capacity of the province

2. Literature Review

Overview of drought in Balochistan

Balochistan which constitute 44% of the geographical area inhabits around 5% of population on a vast area administratively divided into 32 districts. The province due to occasional and scanty rainfall (average around 200 mm) is classified as arid zone. The rural dwellers mainly rely on agriculture and livestock for livelihood. The miseries of rural inhabitants increase when the occurrence of rains fall short of the average rainfall over an extended period of time and/or don't occur at the proper time- such situation is termed as drought in the literature (UNDP & BUITEMS, 2016).

Droughts have been observed to occur every four out of ten years in Pakistan (Anjum et al., 2012). Balochistan is among the most drought prone regions of Pakistan where the severe droughts have been recorded in 1967-1969, 1971, 1973-1975, 1994, 1998-2002, and 2009-2015 (Ahmed et al., 2015). The 1998-2002 drought reduced rain-fed crop yield by 60-80%, irrigated crop yield by 15-20%, and led to the deaths of approximately 2.0 million animals (FAO/WFP, 2002; Sarwar, 2008).

The degree of (2013-15) drought that affected the population of Killa Saifullah, Zhob, Sherani, Kohlu, Lasbela, Gawader and Kech districts was estimated to be 30-55%. Meanwhile, in Noshki, Chagai, Kharan, Quetta, Ziarat, Sibi, Nasirabad, Jaffarabad, Bolan, Dera Bugti, Musa Khal, Barkhan and Jhal Magsi districts 40-65% of the population are at risk due to different types and degrees of drought (UNDP-BUITEMS, 2016).

Ahmed et al., (2015) conducted a study on the characterization of seasonal droughts in Balochistan and found that early winter droughts were frequent in the north of Balochistan, where the return periods of moderate, severe, and extreme droughts were 7, 21, and 55 years, respectively. The same study also revealed that severe and extreme late winter droughts were more frequent in the upper north, with return periods of 16 and 35 years, respectively. Early summer droughts occur more frequently in the east, returning every 8, 20, and 60 years; late summer droughts occur in the northeast, with moderate, severe, and extreme droughts returning every 8, 22, and 65 years, respectively (Ahmed et al., 2015). These seasonal droughts were found to be positively correlated with variations in the seasonal rainfall throughout the study area (Ahmed et al., 2015).

Droughts occur almost in every region of the world but it is the least understood and most damaging natural hazard (Pulwarty and Sivakumar, 2014). Droughts affect the agricultural sector of the economy the most because of its dependency on water resources which creates vulnerability to drought conditions. Droughts history shows that rural communities of Balochistan that have been devastated by droughts, faced great difficulties to return to normal once the drought period passes due to the dependence of their livelihood on agriculture.

Drought is a multivariate phenomenon characterized by its frequency and severity (Reddy and Ganguli, 2013). The frequency and severity of drought have increased in Asian countries in recent years (Wang et al., 2012). According to the Intergovernmental Panel on Climate Change (IPCC), the production of rice, maize and wheat has declined in many parts of Asia over recent decades due to increasing water stress attributed to a combination of increasing temperatures, the increasing events of El Nino events and a reduction in the number of rainy days (Bates et al., 2008).

There is growing concern about the increasing frequency and severity of droughts in Pakistan (Ahmed et al., 2015). A significant increase in the frequency of heat waves, an indicator of forthcoming drought, has been reported (Zahid and Rasul, 2012).

Drought severity does not necessarily mean destruction unless it coincides with crop growing seasons. Among the severe droughts occurred in the United States in 1930s and 1950s, the 1988 drought was the costliest one to date because it occurred during the crop growing season (Mishra and Cherkauer, 2010). This emphasizes the need of drought characterization during crop growing season (Ahmed et al., 2015).

An overview of the 100 dams project in Balochistan

The project aims at the appropriate conservation of the flood flow with the help of storage / Delay action dams. These dams would serve the dual purpose of protection of cultivated land and settlements against frequent flood damages and would also help to augment the growth of agriculture, besides recharge of groundwater underground aquifers.
More specifically the project aims at the Conservation of Run-off, Agriculture Extension, ground

water recharge, flood mitigation, control of soil erosion, poverty reduction promote tourism, and employment generation (http://100-dams.org/package1.htm).

. **Table 1: Division of project on the basis of packages for implementation**

Package No	Number of dams	Period of work	Time of completion (Years)	Progress
I	20	2008-09 to 2011-12	3	Completed
II	26	2011-12 to 2012-13	3	Completed
III	50	2012-13 to 2018-19	5	In progress
IV	50	2018-19 to 2023-24	5	PC-! Stage
V	48	2023-24 to 2028-29	5	PC-1 stage

Source: http://100-dams.org/package1.htm

Adaptive capacity

Adaptive capacity or adaptability is the ability to adapt or the ability of a system to prepare for drought or stresses and prepare itself in advance or adjust and respond to the effects caused by the drought or stresses (Smit et al., 2001). Adaptive capacity is also defined as the ability of a system to adjust itself to climate change in the form of moderating potential damages, taking advantage of opportunities, or coping with the consequences. Brooks and Adger defined the adaptive capacity of a system as its ability to adjust its characteristics to cope with the current and future climate change or in practical terms, adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the hazards due to climate change. When a system is flexible enough to adjust its characteristics to increase its coping range under climate change is called Adaptive capacity (Brooks & Adger). The adaptive capacity inherent in a system represents the set of resources that includes natural, financial, institutional or human available for adaptation and the ability or capacity of that system to use these resources effectively in the quest for adaptation. Practically, the ability to design and implement effective adaptation strategies in order to reduce the likelihood of the harmful outcomes of hazards and stresses resulting from climate related hazards. Additionally, access to ecosystems, information, expertise, and social networks may also be needed (Brooks and Adger). In the situation of a uncertainty, adaptive capacity describes the ability to mobilize scarce resources to anticipate or respond to perceived or current stresses or drought (Adger et al., 2009). Importantly, governance, management and institutions strongly influence the adaptive capacity (Nathan L. Engle, 2011). Nathan L. Engle, 2011 added that adaptive capacity depends on the ability of a society to act collectively, and to resolve conflicts between its members. Strong adaptive capacity help the system to manage varying degree of climate impacts both in advance or after the climate events have been occurred.

Adaptive capacity is a common thread between vulnerability and resilience framework and is a positive system attribute and it is highly influenced by management, governance, and institutions (Nathan L. Engle, 2011). There is a limited vulnerability research that considers both the biophysical and the social aspects that make a system vulnerable (Clark et al., 1998). For example, in the perspective of drought event, vulnerability assessments might include the stress (the drought itself), the biophysical factors (soil, plant, and hydrologic responses) the demographic factors (dependence on surface water), and social factors (the political, economic, and institutional factors that led to the dependence on surface water) (Nathan L. Engle, 2011).

Both human and the system within which they live adapt to or adjust to the environment in reactive and anticipatory way and this is what the scholars conceptualize adaptation (Smit et al., 2000). Adaptive capacity or adaptability is an important concept in both the vulnerability and resilience literatures that bridges the gap between the two. Resilience is achieving the desirable status in the case of a change (Folk, 2006). As with the vulnerability framework, resilience scholars identify governance and institutions as critical variables affecting adaptive capacity.

Nathan L.Engle (2011) studied the adaptive capacity and its assessment. He concluded that adaptive capacity although is central but an ignored concept with both vulnerability and resilience frameworks. The benefits of both vulnerability and resilience research help in the assessment of adaptive capacity and can serve to advance theory and application in the field of sustainability research. Moreover, assessment of adaptive capacity can be improved by examining the response of governance, institutions and management to recent climatic events.

Determinants of adaptive capacity

The Intergovernmental Panel on Climate Change (IPCC, 2010) describes the determinants of adaptive capacity as economic resources, technology, information and skills. Adger (2003) suggests that from political economy and geography perspective, social capital, trust, and organizations greatly influence the capability of communities to act collectively to adapt. Moreover, to adapt to climate change, an effective economic structure, institutions, governance, and management is needed (Brooks et al., 2005). Haddad, (2005) suggested that the adaptive capacity to climate change is also associated with poverty, social justice, lack of resources and institutions to mobilize the resources.

Key Components of adaptive capacity

Adaptive capacity, depends on the ability of a society to act collectively, and to resolve conflicts between its members. Viable adaptation strategies can be designed by having information on climatic hazards faced by a society, socioeconomic systems and their past and future evolution, cultural and political contexts. Moreover, the adaptation and capacity development strategies must also be acceptable and realistic. For the successful implementation of adaptation strategies, the following resources are required: i. Strong institutions, transparent decision-making systems, formal and informal networks that promote collective action, ii. human resources (e.g., labour, skills, knowledge and expertise) and iii. natural resources (e.g., land, water, raw materials, biodiversity). Adaptive capacity of a system is strongly related to health, literacy and governance at the national level (Brooks et al.,2004).

Adaption Policy Framework (APF)

Since enhancing adaptive capacity is a process that cuts across all adaptation activities. The process of enhancing adaptive capacity will be relevant to all projects, regardless of the approach. Brook and Adger concluded that the involvement of stakeholders at all stages is need for an adaptive capacity to be equitable successful. Further, the distinguishing feature of the Adaption Policy Framework is its focus on adaptive capacity that should be considered at all the following stages of the adaptation process (Brook & Adger, 2005).

APF components provide guidance to assess and enhance the capacity of a system to adapt to natural hazards. It is important that adaptive capacity is considered at all stages of the adaptation process. Adaptive capacity is enhanced by the availability of information on the nature and evolution of the climate hazards. Further, both historical and scenarios based climate change data is needed. To design viable adaptation strategies, information on the past and future evolution of socioeconomic systems is required.

Component 1: Designing and scoping an adaptation project for a particular system in terms of its capacity to adapt to specific types of hazards. The question of "who adapts and to what?" is explored through component 1. This question should also address the design of any adaptation strategy.

Components 2 and 3: To assess the current vulnerability and assess the future climate risks: The assessments of vulnerability must form the basis for strategies to enhance adaptive capacity. The nature of hazards to which a system much adapt partially determine the nature of adaptive capacity and appropriate adaptation strategies. The important determinants of adaptive capacity are relating to development, economic well-being, health and education status.

Component 4, Formulating an adaptation strategy: The essential prerequisites for designing and developing strategies for enhancing capacity is to identify existing adaptive capacity.

Component 5, Continuing the adaptation process: To maintain the level of adaptive capacity, the processes of reviewing, monitoring and evaluating are important in order to collectively identify the success or failure of capacity development.

Barnet et al. (2010) reported that the United Kindom climate impacts programme (UKCIP) encourages the local authorities to ask themselves the following questions in adapting to climate change: Do you know how climate change could impact your area? Do your current policies, strategies and plans include provisions for the impacts of climate change? Can you identify and assess the risks from climate change to your services? Are developments with a lifetime of more than 20 years required to factor in climate change? Does your Emergency Planning Service take into account climate change? Are you addressing climate change in your local community strategy or community plan? Have you briefed your elected members on any key risks arising from climate variability and long-term climate change? It is expected that addressing the above questions will significantly enhance institutional adaptive capacity at the local level (Barnet et al. 2010).

Adaptation as a strategy

At all scales adaptation is a necessary strategy to complement climate change mitigation efforts (IPCC, 2010). Adaptation can reduce the adverse climate change and to enhance its beneficial impacts. Human and natural systems will to some degree adapt autonomously to climate change. Moreover, planned adaptation can supplement autonomous adaptation. In order to develop appropriate strategies for adapting to anticipated climate change, experience with adaptation to climate variability and extremes can be used. Adaptation to current climate change produces benefits as well as forming a basis for coping with future climate change. However, experience also shows that there are constraints to achieving the full measure of potential adaptation.

Why adaptation is important

Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts (Lasage et al. 2007). For successful adaptation process the capacity to cope with current climate change and the ability to learn from previous experiences for future climate changes is required (Brook & Adgar). The vulnerability or susceptibility to harm and resilience or achieving desirable status frameworks have given shape to the majority of adaptation research (Eakin and Luers, 2006; Folke, 2006 reported by Nathan L. Engle, 2011).

Need for adaptation to climate change

Pittock and Jones suggested that adaptation is inevitable in response to some anthropogenic climate change to maximize benefits and minimize losses. In this connection the understanding regarding the effect of climate change and adaptation is underway. In developing countries and tropical regions, the focus should be on risk assessments magnitude and frequency instead of mere predictions. Further, thresholds to impacted sectors and ecosystems should be identified with the stakeholders. Moreover, to identify the dangerous levels of green houses gases beyond which adaptation become expensive or ineffective, the adaptation limits needs to be defined Pittock and Jones).

Adaptation to drought through the construction of sand dams

Lasage et al. (2007), studied the adaptation to drought through a local water harvesting project i.e., the construction of small scale water storage sand dams by communities. Socio-economic vulnerability indicators were used to measure the impact of changes in water management. In ten years time, the dams had great impact through increasing farmers access to water resulting in higher yields and as a result farmers incomes rose by 60%.

Climate change risk assessment for improvement in adaptation policy

Howartha et al., (2018) studied the use and perceived usefulness of the 2012 and 2017 United Kingdom Climate Change Risk Assessment (CCRA) reports to identify potential areas of improvement for UK adaptation policy. Interviews were conducted with key stakeholders. CCRAs were analyzed in the context of objective, audience, budget, frame, key findings, dissemination, and how they informed policy. The results showed that stakeholders used the CCRA in three main ways: (i) to make a business case for their work; (ii) to shape direction of policy or work; and (iii) practical applications. Based on findings they suggest that the way in which both CCRAs have been operationalized are symptomatic of the UK state reinforcing scientific reductionism in adaptation assessments for policymaking. Recommendations from interviews for future CCRAs included (i) adopting 5263more innovative methodological approaches, (ii) developing more effective mechanisms for operationalisation of the CCRAs, and (iii) improving communication of the CCRAs, their risks and recommendations

Maladaptation

Maladaptation happen in situations when promoting development in risk-prone locations, decisions based on short-term considerations, neglect of known climatic variability, imperfect foresight, insufficient information, and over-reliance on insurance mechanisms. (IPCC, 2010).

Relief programs have inadvertently fostered complacency and maladaptation by inducing development in at-risk areas such as U.S. flood plains and coastal zones. (IPCC, 2010)

Factors determining the capacity to adapt

Most vulnerable people are those having the capacity to adapt due to least resources. The ability of human systems to adapt to and cope with the vulnerabilities of climate change depends on wealth, technology, education, information, skills, infrastructure, access to resources, and management capabilities. Populations and communities of least developed countries are highly poorest in this regard and have the least capacity to adapt and are more vulnerable to climate change damages and to other stresses (IPCC, 2010). Adaptation to climate change presents complex challenges, but also opportunities, to the sector. Public- and private-sector actors also support adaptation by promoting disaster preparedness, loss-prevention programs, building codes, and improved land use planning

Adaptation to climate change in Asian countries and what needs to be done

IPCC (2010) suggested that adaptation to climate change in Asian countries depends on the affordability of adaptive measures, access to technology, and biophysical constraints such as land and water resource availability, soil characteristics, genetic diversity for crop breeding (e.g., crucial development of heat-resistant rice cultivars), and topography. Most developing countries of Asia are faced with increasing population, spread of urbanization, lack of adequate water resources, and environmental pollution, which hinder socioeconomic activities. These countries will have to individually and collectively evaluate the tradeoffs between climate change actions and nearer term needs (such as hunger, air and water pollution, energy demand). Coping strategies would have to be developed for three crucial sectors: land resources, water resources, and food productivity. Adaptation measures that are designed to anticipate the potential effects of climate change can help offset many of the negative effects (IPCC, 2010).

Improving Assessments of Impacts, Vulnerabilities, and Adaptation

Advances have been made since previous IPCC assessments in the detection of change in biotic and physical systems, and steps have been taken to improve the understanding of adaptive capacity, vulnerability to climate extremes, and other critical impact related issues. These advances indicate a need for initiatives to begin designing adaptation strategies and building adaptive capacities. Further research is required, however, to strengthen future assessments and to reduce uncertainties in order to assure that sufficient information is available for policymaking about responses to possible consequences of climate change, including research in and by developing countries. Development of approaches to adaptation responses, estimation of the effectiveness and costs of adaptation options, and identification of differences in opportunities for and obstacles to adaptation in different regions, nations, and populations (IPCC, 2010.

Assessment of opportunities to include scientific information on impacts, vulnerability, and adaptation in decision making processes, risk management, and sustainable development initiatives. Improvement of systems and methods for long-term monitoring and understanding the consequences of climate change and other stresses on human and natural systems.

Cutting across these foci are special needs associated with strengthening international cooperation and coordination for regional assessment of impacts, vulnerability, and adaptation, including capacity-building and training for monitoring, assessment, and data gathering, especially in and for developing countries (particularly in relation to the items identified above). (Need rephrasing)

Projected Changes in Climate Extremes could have Major Consequences

According to IPCC (2010) the vulnerability of human societies and natural systems to climate extremes is demonstrated by the damage, hardship, and death caused by events such as droughts, floods, heat waves, avalanches, and windstorms.

In Asia Adaptive capacity of human systems is low and vulnerability is high in the developing countries of Asia; the developed countries of Asia are more able to adapt and less vulnerable. Extreme events have increased in temperate and tropical Asia, including floods, droughts, forest fires, and tropical cyclones (IPCC, 2010).

Climate Change Effect on Adaptation

Fahad and Wang (2018) studied the effect of climate variability on farm households' vulnerability and related risks and farmers perceptions about risks associated with climate change and adaptation to it. Farm households reported that that droughts, floods maximum temperature, variation in precipitation are the major risks associated with climate change adversely affected the farming sector specially the small subsistence farmers. They also perceived variation in climate might as a great threat to agriculture sector in future.

Adaptation techniques and constraints

Fahad and Wang (2018) revealed that the farm households adapted to climate by making change in fertilizer, quality of seeds and changes in crop varieties. They reported that major constraints in adapting to climate change were lack of access to credit facilities, lack of access to extension services, lack of information or knowledge and lack of irrigation.

What to do to increase farmers adaptability to climate change

Fahad and Wang (2018) suggested that it was very crucial to increase the farmers awareness about climate change vulnerabilities and provide them adequate facilities to enable them to adopt adaptation measures.

Government responsibilities

Fahad and Wang (2018) that government should implement certain policies to facilitate farm households to adopt the advanced adaptation strategies at their farm level.

3. Methodology

This study is primarily survey based. Both primary and secondary data were collected. The primary data was collected from the relevant stakeholders, while the secondary data was collected from the libraries, government departments, etc.

Primary data

Primary data is also collected from some 20 Key informants in Pishin, 10 in Quetta and 10 in Nasirabad district of Balochistan. A semi structured questionnaire was used for the purpose (appendix-A). Moreover, to see the impact of dams in drought risk minimization and drought adaptation, four delay actions dams in Balochistan (constructed under the 100 dams project) and 5 local people from each dam vicinity were interviewed using an interview schedule (Appendix-B. The details of these dams are given below:

Table 2: Details of Delay Action Dams Visited

Dam	Coordinates	Location	Storage capacity	Catchment area	Benefits
Spezandi Delay Action Dam	30° 33' 14.2" N, 67° 39' 4.4" E	District Ziarat	1.570 MCM	8.44 Sq. KM.	About 1000 Acre of land will be irrigated/brought under cultivation
Manzari Delay Action Dam	30° 48' 20" N, 67° 02' 05" E	District Pishin	0.617 MCM	20.02 Sq. KM	Not provided
Bostan delay action dam	30° 26' 59" N, 67° 2' 0.0" E	District Pishin	0.720 MCM	507.37 Sq. KM.	About 500 Acres of land will be irrigated/brought under cultivation.
Arambi delay action dam	30° 50' 3.0" N, 66° 47' 46.2" E	District Killa Abdullah	. 0.773 MCM	42.99 Sq. KM	About 500 Acres of land will be irrigated/brought under cultivation

Source: http://100-dams.org/package1.htm

For the survey, teams of researchers from BUITEMS Quetta visited the area during May-June 2019 to collect data from the relevant stakeholders (farmers of area where dams are constructed, irrigation, Agriculture, and others) through interviews. The data enumerators will be properly briefed and trained prior to field work and data collection. For dams survey the team members included 2 researchers from BUITEMS, a researcher rom GCISC, and an engineer from irrigation department. The visits were made during June 2019.

Secondary data Sources

The following sources were used for secondary data

- Existing assessment reports (i.e. drought assessment carried out by UNDP & BUITEMS and other international organizations, PDMA in support with district authorities, analysis carried out by irrigation department, NGO assessment reports).
- Government of Pakistan and Government of Balochsitan websites
- Previous UN project reports (all agencies)
- District profiles (UNICEF Atlas, IUCN integrated district development vision, Balochistan conservation strategy, etc.)
- The Food Security Analysis of Pakistan and IPC reports.
- Reports on the previous droughts in the province.
- Development plans and investment figures; risk assessment reports

Data analysis techniques

The quantitative is analyzed by using different descriptive statistics (such as measures of central tendency, measures of dispersion, frequency percentages etc.) and inferential statistics such as (student's t test, chi square test etc., correlation analysis, regression analysis etc.).. GIS techniques is used for preparation of maps.

Table 3: Team members and their job description

S.No	Name	Designation
1	Dr. S.M.Khair	Professor, Economics department, FMS, BUITEMS.
2	Mr Alamgir Khan.	Assistant Professor, Economics department, FMS, BUITEMS.
3	Mr Muhammad Jawad Khan	Assistant Professor, Economics department, FMS, BUITEMS.
4	Mr. Aziz Ahmad	Assistant Professor, Economics department, FMS, BUITEMS.
5	Mr. Abdul Rashid	Deputy Director, Agriculture Extension Department, Quetta.

Appendix-A: Stakeholders Questionnaire

Future Drought Risk and Adaptive Capacity including the role of 100 dams and CPEC in Balochistan

Enumerator's Name ________________________District __________________ Tehsil ________________

Gender [______] 1. Male 2. Female Occupation___________ Designation_____ Experience________

What are the common disasters in your Town/city? (Drought/Flood/Any other ( )

____
____
____

What are the causes of those disasters?

____
____
____

Why does drought become a phenomenon?

____
____
____

What are the causes of the phenomenon?

____
____
____

Which particular UCs or villages of the administrative unit are being affected the most?

____
____
____
____
____
____

How has the drought been affected the area? Identify the sector wise losses as per following table:

Sector	Extent of losses	Any measures taken to control these losses by the government/NGOs etc
Agriculture		
Livestock		
General health (Mal nutrition and epidemic/other diseases)		
Degradation of Pasteur lands		
Any other		

An estimation of drought effect on agriculture sector

Indicators	Effected of drought (%)
Reduction in crop yield/productivity	
Orchard (destroyed) dried	
Rainfed/Khushkaba/Sailaba farming	
Unemployment	
Any other	

An estimation of drought effect on livestock sector

Indicators	Effected by drought (%)
Livestock mortality	
Excess of diseases (specify)	
Feed insecurity	
Range land degradation	
Abnormal migration	
Force to sale livestock at minimal prices	
Any other	

Adaptation and coping strategies to face drought effect on agriculture

Strategies	Effectiveness on water saving				
	Very Low	Low	Moderate	High	Very High
Diversion from flood irrigation to controlled irrigation method					
Cropping pattern changes (from high delta to low delta crops)					
installation of delivery pipes to supply water to orchards/crops					
Changes in irrigation intervals					
Changes in timing of irrigating the crops					
Reduction in crops area					
Utilization of high efficiency irrigation system (i.e. bubbler, sprinkler, or drip)					

Up rooted the trees (fruit name)					
Mulching					
Any other (specify)					

Adaptation and coping strategies to face drought effect on livestock

Strategies	Effectiveness				
	Very Low	Low	Moderate	High	Very High
Drought resistant breeds					
Abandon livestock rearing					
Rely only on stall feeding					
Decreased the number of animals					
Any other (specify)					

What are vulnerability factors and their susceptibility identified by government?

Factors	Least susceptible	More susceptible	Most susceptible
Rainfall variability			
Drought intensity			
Source of water for irrigation dries up			
Increases defaults on loans in rural sector			
Pasture degradation			
Forced sale of livestock at minimum prices			
Any other			

Have there been any changes occurring in people's livelihood sources due to the drought? (Yes/No)

If yes, then what are the alternate sources of livelihood after drought?

1.____ 2.____

3.____ 4.____

What are the indigenous drought coping and adaptation strategies being taken by local people?

Coping Strategies (immediate and short run) Adaptation strategies (long run)

1.____ 1.____

2.____ 2.____

3.____ 3.____

4.____ 4.____

Have the community members in the respective areas been informed about the drought phenomenon?

1. Yes 2. No

Do you have a specific strategy on drought risk management?

1. Yes 2. No

If yes, then specify

Have you informed other related department in the area of your responsibility on this phenomenon?

1. Yes 2. No

If yes, then specify

What copping and adaptation strategies should be adopted by the government/agencies to overcome the drought risk management?

1.____

2.____

3.____

4.____

Thanks

Appendix-B: **Impact of dams on the drought adapting capacity (Farmers perceptions)**

Date:___/____/____.

Name of interviewer____

Name of respondent____

Name of village____

Profession of respondent____

Location____

Name of the Dam____

Year of completion of dam construction____________________________

Villages receiving benefits of the dam (names)______________________

Benefits of the dam

Item	Response (Yes/No)	Remarks (if any)
Increases drought resilience		
Water Availability for Irrigation		
Water Availability for Domestic Use		
Drinking Water for Livestock		
Increase in Fish Production		
Flood Control		
Increase in Command Area		
Improvement in Socio-Economic Status		
Saving in cost for TW/OSW deepening		
Equitable distribution of Land & water rights		
Use of Silt		
Any changes in biodiversity		

Appendix-C: Summary of completed Delay Action/ Storage Dams in Balochistan till 2008

Basin	**No. of Dams**	**Total Storage (MCM)**
Dasht	18	28
Gaj	3	6
Gawadar	4	76
Hamun-E-Lora	1	0
Hamun-E-Mashkhel	9	21
Hingol	5	4
Hub	7	8
Kachi Plain	11	3
Kadnai	--	0
Kaha	8	4
Kand		0
Kunder	4	0
Mula	5	5
Nari	44	22
Pishin Lora	127	43
Porali	13	16
Rakhshan	4	8
Zhob	29	30
Total	**292**	276

Source: Halcrow (2008)