Climate change adaptation in the agriculture sector: An analysis of governance challenges in two Pakistani provinces
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Tese de doutorado apresentada à Escola de Administração de Empresas de São Paulo da Fundação Getúlio Vargas, como requisito parcial para a obtenção do título de Doutor em Administração Pública e Governo.

Linha de Pesquisa: Governo e Sociedade Civil em Contexto Subnacional

Orientador: Prof. Dr. José A. Puppim de Oliveira

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Abstract

Climate adaptation policies are a key to protect farmers from future climate vulnerability. However, what are the implementation challenges of those policies at the subnational level? This study develops a framework to understand response of subnational governments to climate adaptation policies in the agricultural sector using the case of Pakistan, looking at the province of Punjab and the province of Khyber Pakhtunkhwa.

The analytical components of our proposed framework are: locally driven initiatives, local capable institutions, legally implementable measures, and effectively establishing intergovernmental relations. To develop the framework, critical reading of various literatures on subnational governance and challenges for implementation of climate policies at subnational level are explored. A case study approach is employed to investigate the climate adaptation governance in two Pakistani provinces: Punjab and Khyber Pakhtunkhwa.

Pakistan is one of the most vulnerable countries to climate change and its agriculture sector is highly exposed to the adverse impacts of climate change. The responsibility of implementation of climate change policies and action plans rests with respective provinces. The most important initiative of Punjab government, inter alia, is launching awareness campaign about climate change adaptation by publishing related literature in local languages, establishing a radio station, arranging farmer day, and writing articles in newspapers. One notable initiative by Khyber Pakhtunkhwa government is the development of provincial climate change policy.

Provincial approaches vary in terms of subnational climate policy, research undertaken, and institutional capacity. Khyber Pakhtunkhwa government has developed provincial climate change policy whereas the Punjab government is in the process of formulating its policy. Punjab, however, is leading in terms of carrying out research work and developing institutional capacity.

These differences at planned level adaptation are primarily driven by coordination among the respective departments, engagement with academics, and availability of financial resources. On the other hand autonomous initiatives of two provinces are essentially similar and are majorly driven by the previous experiences of farmers, sustainability in agriculture production, and the knowledge sharing. Moreover, both provincial governments are giving training to farmers for agriculture adaptation. Additionally, the government of Punjab is practically enhancing capacity building by arranging training programs.

The study finds that local farmers are actively involved in autonomous adaptation in the both provinces and the subnational governments also encourage engagement of farmers in climate adaptation policies. Our study identifies the factors that influence the implementation of these autonomous initiatives. These factors include past experiences and knowledge sharing of farmers.

**Keywords**: climate change, adaptation, governance, subnational, agriculture, Pakistan
Resumo

As políticas de adaptação climática são fundamentais para ajudar o setor agrícola, principalmente os pequenos agricultores, a responder à vulnerabilidade climática futura. No entanto, quais são os desafios de implementação dessas políticas no nível subnacional? Este estudo desenvolve um quadro analítico para entender a resposta dos governos subnacionais às políticas de adaptação climática no setor agrícola, usando o caso do Paquistão, considerando a província de Punjab e a província de Khyber Pakhtunkhwa.

Os componentes analíticos do nosso quadro analítico propostos são: iniciativas locais, instituições locais capacitadas, medidas legalmente implementáveis e o estabelecimento efetivo de relações intergovernamentais. Para desenvolver o quadro analítico, a leitura crítica de várias literaturas sobre a governança subnacional e os desafios para a implementação de políticas climáticas em nível subnacional são exploradas. Uma abordagem de estudo de caso é empregada para investigar a governança da adaptação climática em duas províncias paquistanesas: Punjab e Khyber Pakhtunkhwa.

O Paquistão é um dos países mais vulneráveis às mudanças climáticas e seu setor agrícola está altamente exposto aos impactos adversos da mudança climática. A responsabilidade da implementação de políticas e da elaboração de planos de ação sobre mudanças climáticas está nas respectivas províncias. A iniciativa mais importante do governo de Punjab tem sido uma campanha de conscientização sobre a adaptação à mudança climática publicando literatura relacionada em idiomas locais, estabelecendo uma estação de rádio, organizando o dia do agricultor e escrevendo artigos nos jornais. Uma iniciativa notável do governo Khyber Pakhtunkhwa é o desenvolvimento da política provincial de mudança climática.

As abordagens provinciais variam em termos de política climática subnacional, pesquisa realizada e capacidade institucional. O governo de Khyber Pakhtunkhwa desenvolveu uma política provincial de mudança climática enquanto o governo de Punjab está no processo de formulação de sua política. O Punjab, no entanto, está liderando o trabalho de pesquisa e desenvolvendo a capacidade institucional.

Essas diferenças no nível de adaptação planejada são principalmente impulsionadas pela coordenação entre os respectivos departamentos, pelo envolvimento com os especialistas e pela disponibilidade de recursos financeiros. Por outro lado, iniciativas autônomas de duas províncias são essencialmente similares e são majoritariamente impulsionadas pelas experiências anteriores de agricultores, sustentabilidade na produção agrícola e compartilhamento de conhecimento. Além disso, ambos os governos provinciais estão dando treinamento aos agricultores para adaptação agrícola. O governo do Punjab também está melhorando a capacitação e organizando programas de treinamento.

O estudo constata que os agricultores locais estão ativamente envolvidos na adaptação autônoma nas duas províncias e os governos subnacionais também incentivam o engajamento dos agricultores nas políticas de adaptação climática. Nosso estudo identifica os fatores que influenciam a implementação dessas iniciativas autônomas. Esses fatores incluem experiências passadas e compartilhamento de conhecimento dos agricultores.

Palavras-chave: mudança climática, adaptação, governança, subnacional, agricultura, Paquistão
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<td>AARI</td>
<td>Ayub Agricultural Research Institute</td>
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<td>ADB</td>
<td>Asian Development Bank</td>
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<td>AG</td>
<td>Adaptive Governance</td>
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<td>CA</td>
<td>Copenhagen Accord</td>
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<td>CCC</td>
<td>Climate Change Cell</td>
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<td>CCG</td>
<td>Climate Change Governance</td>
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<tr>
<td>CDM</td>
<td>Clean Development Mechanism</td>
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<td>CFA</td>
<td>Climate Smart Agriculture</td>
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<tr>
<td>COP</td>
<td>Conference of Parties</td>
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<tr>
<td>EG</td>
<td>Environmental Governance</td>
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<td>ESG</td>
<td>Earth System Governance</td>
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<td>EU</td>
<td>European Union</td>
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<td>GCs</td>
<td>Green Courts</td>
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<td>GCF</td>
<td>Green Climate Fund</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GHG</td>
<td>Greenhouse Gas</td>
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<tr>
<td>IFNCCP</td>
<td>Implementation framework for National Climate Change Policy</td>
</tr>
<tr>
<td>INDCs</td>
<td>Intended Nationally Determined Contributions</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<tr>
<td>KP</td>
<td>Kyoto Protocol</td>
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<td>KPK</td>
<td>Khyber Pakhtunkhwa</td>
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<tr>
<td>LA</td>
<td>Lima Accord</td>
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<td>MLG</td>
<td>Multi-level Governance</td>
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<td>MoCC</td>
<td>Ministry of Climate Change</td>
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<td>NCCP</td>
<td>National Climate Change Policy</td>
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<tr>
<td>NCS</td>
<td>National Conservative Strategy</td>
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<td>NEAP</td>
<td>National Environmental Action Plan</td>
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<tr>
<td>NECP</td>
<td>National Energy Conservation Policy</td>
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<tr>
<td>NEQS</td>
<td>National Environmental Quality Standard</td>
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<tr>
<td>NGOs</td>
<td>Non-governmental Organizations</td>
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<tr>
<td>PA</td>
<td>Paris Agreement</td>
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<tr>
<td>PC</td>
<td>Planning Commission of Pakistan</td>
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PCCP: Provincial Climate Change Policy

PEPA: Pakistan Environment Protection Agency

PEPC: Pakistan Environmental Protection Council

PG: Participative Governance

PTI: Pakistan Tehreek-e-Insaf

RG: Risk Governance

SESSs: Social-ecological Systems

TFCC: Task Force on Climate Change

UN: United Nations

UNDP: United Nations Development Programme

UNFCCC: United Nations Framework Convention on Climate Change

USA: United States of America

WCS: World Conservation Strategy

WWF: World Wildlife Fund
CHAPTER 1

Introduction
1.1 Background of Research

Climate change is a reality; according to Intergovernmental Panel on Climate Change (IPCC) fifth assessment report humans are responsible for this unsustainable situation. From future climate change perspective, both human and natural systems are at risk (Walk, 2011). There is evidence that climate change will continuously pose threats throughout this century despite taking certain successful steps to curb the greenhouse gas (GHG) emissions (Wilson, 2006).

To face the challenge of climate change many efforts are made in the world. Various climate change policies are devised at international, national, subnational, and local levels to tackle the negative implications of climate change. In order to confront the negative consequences of climate change two fundamental societal response options emerged in the form of mitigation and adaptation (Change, 2001; Füssel, 2007; Kpadonou, Adégbola, & Tovignan, 2012), maintained that adaptation and mitigation are important and complementary strategies. Historically, policy interest remained on mitigation measures to mitigate climatic impacts (Burton, 2001). Traditionally, the focus of such policies remained on mitigation instead of adaptation measures despite urgent requirement for adaptation strategies are emphasized (Biesbroek, Swart, & Van der Knaap, 2009). However, the shift emerged and it became widely accepted that mitigation measures are not sufficient to address climate change (Kurukulasuriya & Rosenthal, 2013; Pielke Jr, 1998).

Presently, the need of adaptation policy is recognized. Governments are being forced to re-think their ways to manage climatic impacts and to focus not only on mitigation but also adaptation (Porter et al., 2014; Rijke et al., 2012). Due to increasing public interests, the adaptation policies have gained space on policy agenda since last decade (Puppim de Oliveira, 2019). The Paris Agreement (PA), 2015 is a notable initiative that recognized adaptation strategies and that too at subnational and local level.

Adaptation strategies to climate change are getting attention in the scientific community and due place in policy debate (McCarthy, Canziani, Leary, Dokken, & White, 2001; UNFCCC, 1997). Adaptation is explained and defined by various scholars and institutions. For instance, Smit, Burton, Klein, & Street, (1999) defines adaptation as “adjustment in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects or impacts”. Adaptation is process in which strategies and mechanisms are established in such a
way to tackle the negative implications posed by climate change. Stern et al., (2006) defines it as “adaptation will be crucial in reducing vulnerability to climate change and is the only way to cope with the impacts that are inevitable over the next few decades”

The important role of adaptation as a policy is recognized and well considered internationally (Smit & Skinner, 2002). For instance United Nations Framework Convention on Climate Change (UNFCCC), (1992) defines that all parties are ‘committed to framed and implement appropriate measures for mitigation and adaptation at national, regional, and local levels’. Likewise, Article 10 of the Kyoto Protocol (KP) also emphasized the promotion of adaptation and incorporation of technological advancements for adaptation to overcome climate change (UNFCCC, 1997). First time the dilemma of adaptation for developing countries was recognized at Conference of the Parties (COP) in 2001 in Morocco (Adger, Huq, Brown, Conway, & Hulme, 2003). Furthermore, in 2007 during the climate change conference in Bali emphasized to enhance actions on adaptation by relevant parties (UNFCCC, 2007). Many countries have set their adaptation strategies to cope with climatic event at various levels of government tiers in the frames of short, medium and long-terms (Selvaraju, Subbiah, Baas, & Juergens, 2006).

Adaptation is considered a key aspect of vulnerability assessment and climatic impacts (Kurukulasuriya & Rosenthal, 2013; Smit & Skinner, 2002). Adaptation is considered a positive response to curb climate change (Smith, 2012). The exposure of poorest societies and developing world to climate change requires urgent adaptation actions (Burton, 2001). Many studies have stressed the need to opt adaptation in addition to mitigation strategies.

It is projected by climate models that there would be more frequent devastating floods, high rainfall events, and heat waves. Therefore, this scenario of climatic impacts itself demands to incorporate adaptation strategies in action. Adaptation is considered a promising step to strengthen local capacity to tackle the forecasted and unexpected climatic conditions (Dessai, Lu, & Risbey, 2005). It is suggested to promote sectoral adaptation actions to curb climate change.

Agriculture sector is considered one of the most vulnerable and sensitive sectors to the climate change (Smit & Skinner, 2002). Adaptation to climate change is an important policy response to deal with climate change in agriculture sector (Mizina, Smith, Gossen, Spiecker,
& Witkowski, 1999; Smit & Skinner, 2002). For agriculture sector the focus is being shifted to adaptation strategies and adaptability considering the assessment climatic impact and vulnerability of agriculture sector. The IPCC emphasized that adaptation to climate change is critical for agriculture sector. The Adaptation Policy Frameworks for Climate Change (UNDP, 2002) and the National Programmes of Action provided guidelines to developing countries that how to adapt with changing climate. They identified priority adaptation actions for handling climate change (UNFCCC, 2007).

Pakistan like any other country recognizes the significance of adaptation to climate change. The policy responses of Pakistan are more focused on adaptation actions (Vij et al., 2017). Agriculture being a backbone of the economy of Pakistan and is considered the major sector for all climate change policies and action plans in the country. Pakistan is an agriculture-dependent country; almost 45% percent of the country’s labour force is attached with this sector (Chaudhary & Verick, 2014). Agriculture sector contributes about 21.4% to the gross domestic product (GDP) in Pakistan. Further, about 60 percent of the country’s exports are dependent on agriculture sector in Pakistan (Javed et al., 2018). It is indicated in various studies that this sector is under threat due to the negative impacts of climate change.

Agriculture sector in Pakistan faces serious challenges due to its high vulnerability and climatic impacts in the form of floods, rising temperatures, yield losses and droughts (Nomman & Schmitz, 2011). Moreover, Janjua, Samad, Khan, & Nasir, (2010) stated that Pakistan’s geographical location is also responsible for its high vulnerability to climate change. The occurrence of floods in Pakistan is happening almost every year due to climate change and this is costing Pakistan about 14 billion dollar per year (TFCC, 2010). Considering the importance of agriculture sector to the rural livelihoods and Pakistan’s economy, the significance adaptation strategies towards climate change is highly important (A. Ali & Erenstein, 2017).

The subnational governments are a key for effective implementation of climate change related policies. To tackle the challenge of climate change, Pakistan took multiple initiatives for climate change adaptation at federal level and at the provincial levels. After 18th constitutional amendment in 2010 in Pakistan, provinces/subnational governments have the responsibility to establish and implement climate change policies. The subnational governments are important to curb climate change due to the proximity to the impacts of
climate change (Puppim de Oliveira, 2009). Subnational governments in Pakistan have taken certain adaptation measures to curb climate change impacts in multiple sectors especially for agriculture sector. Many studies described that subnational governments have important role for effective implementation of climate policies and plans. The role of subnational governments for effective implementation is increasingly recognized worldwide.

During last almost two decades the role of subnational governments for global climate governance has grown significantly (Jörgensen, Jogesh, & Mishra, 2015). They further pointed out that the role of subnational governments has extended as influential actors in international climate change policies. It is normal to find the leading role of subnational governments in climate change policies (Roppongi, Suwa, & Puppim De Oliveira, 2017).

Various studies in the existing literature acknowledge the role of subnational polices in global climate governance. Subnational state policies found to be important for climate and for other related areas (Jörgensen, 2011). He further maintained that subnational levels serve as laboratories of experimentation and it could promote policy change through policy-learning. In recent years, provincial (subnational) and state level activities for climate change have increased significantly (Jänicke, Kunig, & Stitzel, 1999).

Adaptation to climate change poses some key and complex governance challenges and is called as a “wicked problem par excellence” (Davoudi, Crawford, & Mehmood, 2009; Jordan & Huitema, 2014). The wicket problem needs comprehensive and diligent solutions. Adaptation governance faces many difficulties, hindrances and opportunities involved to deal with the wicked problems (Termeer et al., 2011). They further argued that due to novelty and complexity of adaptation governance, a number of fundamental governance dilemmas are needed to be (re)addressed while establishing the adaptation governance towards climate change. For instance, which ministry and agency is dealing with climate policy and specifically adaptation policy? Are delegation of powers and responsibilities are sufficient to tackle the issue of climate adaptation?

It is evident that changing climate is responded by national, subnational and local level along with citizen’s groups and other communities. There is a consensus in adaptation/adaptive capacity literature that there is need to build adaptive capacity in the form of free flow of ideas, knowledge and technology, capable institution and government schemes, and other
policies to effectively respond to climate change (Wise et al., 2014). They further argued that it is significantly unclear that how this adaptive capacity is actually built or enhanced.

To deal with uncertainties in climate change, it is required equally complex solutions. These solutions involve several fields of human activities and various stakeholders such as governments, different companies, multilateral agencies, associations, and other pressure groups to recognize the challenge and show determinations to face the challenge. Multiple stakeholders like civil society, research institutions, universities, private sector have played a promising role to devise responses with governmental representatives to face climate change (Bulkeley et al., 2009). The linkage of subnational/local governments with international networks provides them a great potential for the development of effective policies and actions as responses to climate change (Lindseth, 2004).

Subnational or local level governments have an important governance role to tackle climate change in general and climate change adaptation specifically. It is indicated in adaptation literature Schwalb & Walk, (2007) that there has been relatively little research in area of adaptation policies and climate adaptation governance especially in developing countries. There are limited understandings in scientific literature that how climate policy approaches are being designed and implemented in South Asian countries (Butler & Huybers, 2015). It is suggested that the policy makers and stakeholders need to accelerate to develop adaptation strategies and their implementation to secure for the future (Measham et al., 2011). These developments present a need to study climate adaptation policies so that effective responses can be developed.

In the related literature, we could not come across any framework to analyze climate change adaptation for agriculture sector at subnational level. The relevant literature is accessed on Scopus on 25 February, 2019. This research found that 734 research articles on climate change adaptation for agriculture sector while only 1 article is shown on climate change adaptation governance for agriculture sector at subnational level.

The frameworks are available at national and international level for analyzing climate policies for agriculture sector but lacking at subnational and provincial level. This may be due to limited empirical research work on climate adaptation policies for agriculture sector at the subnational level as the subnational governments in recently years are recognized for
climate policies and actions specifically they got momentum after the PA. Therefore, it is important to advance knowledge for climate adaptation policies at subnational level by establishing a comprehensive framework. This framework is established by exploring the gaps of implementation of climate adaptation policies for agriculture sector at subnational level. The components and sub-components of the framework are basically the challenges of implementation of adaptation policies at the subnational level.

This thesis contributes by developing a framework to analyze sub-national policies for adaptation on agriculture sector at subnational level by using the case of two Pakistani provinces: Punjab and the Khyber Pakhtunkhwa (KPK).

1.2 Research Objective and Questions

In the above section, the point is made that it is relevant to study the climate adaptation governance at subnational level because:

1. A lack of literature on climate adaptation governance at subnational level in agriculture sector as it is comparatively novel area of climate governance.
2. There is a need to understand the effectiveness of the PA as after 2015, subnational governments are the focus of climate actions. Considering the ongoing worldwide focus on subnational governance to address climate change, subnational governments are key to tackle the issue. Therefore, it is important to describe the strengths and weaknesses, and effectiveness of climate governance at subnational level.
3. The case is taken from one of the most vulnerable countries which is an important case. Therefore, it is helpful to understand the overall progress of subnational governments by assessing an important case. To provide some valuable lessons to other developing countries while devising adaptation policies and action plans at subnational levels keeping in view the pluses and negatives of this case.

As stated in the previous section that the literature on climate adaptation governance is being emerged. Scholars from different scientific disciplined are engaged to elaborate the type of climate governance at subnational level. Research is still limited on this subject as one of the reports stated that “most of the literature on climate change adaptation and cities is focusing on what should be done, not on what is being done (because too little is being done)”
(Lazarus, 1993). The empirical studies are being conducted but these studies are not necessarily demonstrated what actually climate governance is happening at subnational levels. This research study contributes to filling this gap by studying climate adaptation governance and to identify the promising aspects of climate governance at subnational. It will also develop a framework to advance the knowledge and understanding of climate adaptation governance at subnational level and it will help to effectively operationalize climate adaptation policies for agriculture sector at subnational level.

Thus the research main objective is:

*To analyze climate adaptation governance at subnational level by developing a framework for agriculture sector. This framework is applied on the case of Pakistan by looking at the province of Punjab and the province of the Khyber Pakhtunkhwa.*

Based on the research objective, our main research question for this study is:

**What are the key governance challenges in implementation of adaptation policies for the agriculture sector at subnational level?**

This research question identifies key implementation challenges of adaptation policies and climate adaptation governance hurdles in the provinces. This question needs further specification. Therefore, following three sub-questions are is formulated to guide the empirical work

Q1. *What are different initiatives are taken at planed level and at autonomous level in the province of Punjab and province of the KPK?*

The aim of this research question is to explore the governance strategies in each province. Planned levels initiatives are the governance initiatives being intervened by the subnational governments. This research question also focuses to dig out the autonomous level governance initiatives in each province. These initiatives are not principally supported by the government rather these are the initiatives of local community/local farmers
Q2. To develop and apply a framework to analyze the climate change adaptation governance in agriculture sector in the province of Punjab and in province of the KPK?

The aim of this research question is to evaluate and analyze the governance initiatives for agriculture sector in both the provinces against the established framework of this study.

1.3 Contribution to the field (conceptual and practical contribution)

This research study advances the literature on the governance of climate change adaptation in the agriculture sector at subnational level in a number of ways. First, it contributes in the area of public policy research at subnational levels by developing a framework to analyze sub-national policies for adaptation on agriculture sector. The proposed framework is a novel framework at subnational level and offers some unique opportunities. For instance, it tells policy makers at subnational levels that how effective and implementable climate adaptation policies can be established. Literature on climate adaptation policies dictates that broader frameworks at national level only focused on ‘what’ needs to be done instead of ‘how’ it can be done.

Secondly, this study and empirical work give clear directions and role of climate adaptation policies at subnational level to address climate change by exploring the strengths and weaknesses of climate adaptation governance at subnational level. Previous research (Butler et al., 2014; Huq and Ayers, 2008), indicated that empirical work on how the harmonization between adaptation and development remain limited.

Climate adaptation governance work in literatures demands to integrate climate adaptation policies with other related policies for effective fight against climate change. Our framework is helpful to provide an effective mechanism for integrating climate change concerns into development policy and plans at subnational level.

Third, this research focus on a country that is extremely vulnerable to climate change. Pakistan is ranked among the top 10 countries that are highly vulnerable to climate change (Dahal, Shrestha, Tuitui, & Ojha, 2019). It is one of the first efforts to study implementation of climate change adaptation policies in agriculture sector at subnational level not only in Pakistan but in the whole South Asian region.
Finally, the finding of the study can bring policy lessons applicable for other developing countries while devising adaptation policies or action plans at subnational levels keeping in view the positive and negative aspects of this study. Additionally, the study will be helpful to identify policy needs and research gaps which will contribute for the understandability and effective implementation of adaptation policies at the subnational level

1.4 Structure of the thesis

The structure of this thesis is as follows. Chapter 1 provides background of research and a rationale (statements of problem), followed by the contributions of this research study. Research objectives, main research question, and sub-questions are explained.

Chapter 2 explains understanding of governance and background of climate governance followed by evolution of climate governance. It also describes the key dimensions of climate change. The impacts of climate change on agriculture sector are explained in this chapter. Moreover, this chapter discusses on adaptation and mitigation strategies towards addressing climate change in agriculture sector and explains the concept of adaptive governance. This chapter highlights the role of subnational governments to address climate change. This chapter also demonstrates climate adaptation strategies and climate governance for agriculture sector. Finally, the proposed framework is explained and each component of the framework is discussed.

Chapter 3 examines background of climate governance and climate change governance structure in Pakistan. It also overviews the impacts of climate change on agriculture sector of Pakistan followed by environmental institutions and legal initiatives taken in Pakistan. Finally, the chapter is sum-up by describing the evolution for climate change policies and climate governance in Pakistan.

In Chapter 4, we discuss the research methodology used for this study. It highlights the background of research methodologies and explains the case study method which is employed for our study. Finally, respondents sections, data collection and analysis of data are described followed by proposing to test our study cases based on proposed framework of the study.
Chapter 5, we discuss results and analysis. It explains the governance dynamics in both the provinces, governance initiatives in each province, and highlights the bureaucratic interaction in each province. Moreover, it also discusses how adaptation measures are being shaped in these provinces. Finally, autonomous initiatives and drivers behind planned and autonomous initiatives are explained.

Chapter 6 discusses the detailed analysis of climate adaptation governance in Punjab and the KPK province by utilizing the proposed frame of the study. The initiatives identified in Chapter 5 in both provinces are evaluated against the four components of our proposed framework.

Chapter 7 summarizes the key finding of the research based on in relation of research goal and objectives. This chapter also proposes some recommendations based on our findings and highlights key lessons in our study based on results and analysis done in Chapter 5 and discussion in Chapter 6. It provides the limitations of this study and proposes some suggestions bas on the findings and results of the study. Finally, our work is concluded by providing a way forward for further research.
CHAPTER 2

Governance responses to climatic impacts on agriculture sector
2.1 Overview

This chapter is organized as follows. Section 2.2 explains the understanding of governance followed by section 2.3 that provides detailed background of the climate change governance (CCG). Climate governance has evolved with emergence of climatic impacts on global societies. Section 2.4 gives evolution of climate governance. Various aspects of climate change have been introduced in climate change literature. It has also identified the impacts of climate change on different sectors. In section 2.5, key dimensions of climate change are explained while section 2.6 discusses the impacts of climate change on agriculture sector. In order to manage the impacts of climate change, different strategies are being in place. Section 2.7 overviews the countermeasures strategies for climate change in the form of adaptation and mitigation. These strategies paved the way to the emergence of multiple governance techniques to deal with climate change at different levels of government. Section 2.8 explains the concept of adaptive governance while section 2.9 describes significance of sub-national governments to address climate and identify some gaps. In section 2.10, climate adaptation policies for agriculture sector are described. Finally, framework of this study is proposed based on existing literature and identified gaps for climate adaptation governance at subnational level.

2.2 Understanding of Governance

It is important to understand what actually is meant by governance? It is important to define governance because it is “dazzling” (Benz, Lütz, Schimank, & Simonis, 2007) and a “acknowledged ambiguous term” (Plaut, Butow, Blumenthal, & Wrigley, 2004). The meaning of the term governance remains unclear in many cases. On one hand in a narrow use of term, it is considered as opposite or antonym of government and qualifies “softer” form of regulations which means it does not totally depend on hierarchical decision making processes rather the societal problems are resolved by involving private stakeholders (Gerber, Henderson, & Makkar, 2013).

On the other hand, in a wider use of term, it is not exactly opposite to the government rather governance defines the entity of “all co-existing forms of collective regulation of societal circumstances: from institutionalized civil society self-regulation through various forms of cooperation between public and private stakeholders to sovereign action by governmental stakeholders” (Mayntz, 2004)). Based on this definition and from analytical point of view
governance is an approach on a complex reality (Benz et al., 2007). This perspective facilitates the concept of multilayered political and social contexts, as they can be observed in the field of mitigation and adaptation to climate change (K. Dietz, 2007).

In many cases, governance is considered the instruments of an arrangement of a system (Zürn, 2008). These instruments mean the available options of the realization for the aims of the society (Jänicke et al., 1999). The state is not the only stakeholder to establish, determine and implement instruments in arrangement of governance but the other stakeholders such as civil society and private sector are equally involved to regulate societal circumstances. Therefore, Governance is a concept of regulatory and non-regulatory instruments that are being proposed and initiated by non-state actors along with state actions (Jordan & Huitema, 2014).

2.3 Background of Climate Governance Literature

Political and public interests in climate change have significantly increased in recent years (Anderegg & Goldsmith, 2014). The IPCC warned the severe consequences of climatic impacts on humanity and natural resources. Various studies have been emphasized to establish proactive adaptation and mitigation strategies so that climate change can be managed. There is a need to take such proactive measures in order to enhance the resilience of the society (Adger & Vincent, 2005; Folke et al., 2002).

It is reported that the magnitude of climate change will affect number of stakeholders and their interests. Therefore, it is required to bring the entire stakeholders on a single platform so that effective climate change policies and action plans can be devised keeping in view the serious threat of climate changes for all sectors. (Srivastava, Mboh, Zhao, Gaiser, & Ewert, 2018). To bring all the stakeholders together is really a complex issue and this complexity of relations among various stakeholder is best classified as “governance” (Benz, 2004). In this situation, the system of governance demands that each stakeholder have to play its role to establish proper coordination mechanisms so that specific and implementable measures can be devised (Benz, 2004; Olsen, 2009).

The main requirement of climate governance is to recognize that climate change is a societal and global environmental challenge (Meadowcroft, 2009). Without complete understanding
the actual nature and structure of the problem by the stakeholders, it is difficult to establish effective solutions in the form of mitigation and adaptation. This shows that the concrete and successful actions can be set only by proper participation and representation of all relevant actors in taking actions to mitigate climate change.

In order to have solutions, climate change requires cross-boundary demands for its governance (Fröhlich & Knieling, 2013). Governance approaches that have impacts across the boundaries are well discussed and articulated in the EG (Jänicke et al., 1999). Various organizational structures and processes are being used as an important instrument of the EG to improve environmental challenges and provide better opportunity for the society to live (Lemos & Agrawal, 2006). For instance, to reduce the negative consequences of environmental impacts on coastal area, it is suggested that coordinated efforts from all stakeholders are required to protect the coastal zone from negative impacts of climate change (Olsen, 2009). The involvement of all stakeholder is very relevant for establishing both mitigation and adaptation actions (Fröhlich & Knieling, 2013).

The impacts of climate change have no border or boundary, it is suggested by many scholars that to meet this challenge, it is needed to bring different kind of regulations and incorporate planning at multi-level. The planning and policies can be framed from global to local level but in a very coordinated manner. These developments gave birth to a new concept of multi-level governance (MLG). The MLG is a system of interdependent and concerted decisions of politically and institutionally different systems (Benz et al., 2007) He further stated that the MLG is not the structure of different organizational levels but it helps to establish proper coordination and relations among these levels. Therefore, the CCG is a complex system of governance which brings all the actors together those who are working at different levels with different interests and approaches (Jänicke et al., 1999).

Climate change has impacts everywhere but local and regional governance structures are extremely important to develop effective mitigation and adaptation initiatives (Adger et al., 2007). Local governance arrangements are critical to ensure the participation of stakeholders to cope the issue of climate change (Schwalb & Walk, 2007). In addition with local level governance, the regional level governance setup also offers prominent role to devise and implement adaptation actions (Eckstein, Vera, & Laura, 2018). The regional level governance
structure is an important mediator among different levels and various sectors (Schmitz, 2005). Apart of different levels, the governance is also extended in different sectors.

The MLG approaches are appropriate to be used to address of cross-sectoral issues. To devise mitigation and adaptation actions for different sectors is an important and central mechanism of climate change governance (Fröhlich & Knieling, 2013). Since early 1970s, it was demanded to integrate environmental issues to other sectors. Presently, same demands are being observed that the sectoral policies should be established keeping in view that climate change as an important element for such policies (Swart & Raes, 2007).

Another important feature of climate change is that there are multiple actors and different set of governance models with different activities. All the governance approaches of climate change are needed to work and coordinate with different interests groups and actors. Different governance strategies such as earth system governance (ESG), the EG, the participative governance (PG), the risk governance (RG), and the adaptive governance (AG) are linked with climate change governance and they all stress for stakeholders cooperation for active management of environmental challenges (Jänicke et al., 1999).

The objective of the ESG is to influence the relations between humanity and environment. It describes different regulations and state activities of traditional hierarchical. It focuses to establish an effective mechanism to promote private and public relations so that a concreate policy can be established to tackle the problems in the society. The ESG ensures the participation of public-private stakeholders and other actors in taking decisions at each level of governance. These actors are different local networks, experts in the area, environmentalists, journalists, multinational organizations, and government’s agencies (Biermann, 2007).

The EG defines that environmental problems are those who are perceived or defined by a society. It stresses that the linkage among science, policy, and media is very important to establish the perception for the environmental problem (Biermann, 2007). To tackle climate change by employing mitigation and adaptation strategies, it requires governance arrangements which are identified by related actors. These should be partners among public, private, and civil society so that there is no conflict between the national and local governmental bodies as this nexus presents the whole society (Nicholson-Cole &
O’Riordan, 2009). This partnership emerges among the differ stakeholders with common objective that is climate change.

The PG approaches stresses on the participation of different civil society groups to handle a societal issue (Alganci et al., 2015) This form of governance is important and suitable to improve the public policies and it helps for effective implementation of such policies. By involving civil society groups in the decision making process, a higher level legitimacy is achieved. To involve private stakeholders, the civil society, and the public sector is important for rational decision making. Participatory form of governance ensures transparency, legitimacy, and adequacy to the problem. However, it is complicated and still unclear that how the legitimacy can be ensured by just involving the related actors (Palumbo, 2010; Zürn, 2008). Nevertheless, the ingredients of this form of governance can be identified for each case and are important for implementable actions.

Furthermore, the RG is an important subset of the CCG. The RG approach aims the characteristics of complexity, uncertainty, and ambiguity (Renn, 2008). Uncertainties can complicate the situation of decision-making process. Therefore, it emphasizes on importance of cooperation between public and private sectors. The RG focuses on collective decision making about risks. This collective decision can be taken through proper interactions among science, politics, management, and society (Renn, 2008). Policy experts and top politicians participate in framing mitigation and adaptation actions and they play an extra role of institutions along with public and private entities so that accepted decisions for all parties can be obtained (Greiving & Fleischhauer, 2008).

One of the influential approaches to reconciling social and ecological aspects of governance emerged in the form of the AG to deal with uncertainty and complexity. The concept of this form of governance gained prominent attention in the scientific community as an alternative form of governance during the last decade (Folke et al., 2002; Rijke et al., 2012) described the AG as a strategy to solve the social issues so that effective management for complex ecosystems can be maintained. (Chaffin, Gosnell, & Cosens, 2014) consider that the AG is a platform for discussion among different key players such actors, networks, organizations, and institutions in order to find common solutions. It emphasizes on flexibility approach and encourages incorporating past experiences and related local and indigenous knowledge (Nelson, Howden, & Smith, 2008; Pahl-Wostl, 2007).
The CCG is not a phenomenon of administrative units but is well structured and presented the concerns of all related geographical regions. A suitable regulatory and system arrangements are established which are based on various landscapes and cultural areas. These system arrangements are made among the different levels of governance structures from international level to the municipalities’ levels. On all these levels, the interactions for adaptation strategies and mitigation measures happen in different sectors in different ways. For instance, these sectors include energy, urban planning, water management, agriculture, and health. The interactions can happen by launching various dialogues, giving some kind of financial support and sometimes even coercion is an option. The final interactions and coordination requirements for involved stakeholders require different kind of regulation and instrument for each level and among the different levels. These regulation and instruments are discussed in table 1 below.

Therefore, climate change actions/policies can be characterized as regulatory mix which consist of local level planning, established procedures for such planning and flexibility techniques to produce a better governance form (Fleischhauer & Bornefeld, 2006).

<table>
<thead>
<tr>
<th>Formal instruments</th>
<th>Economic instruments</th>
<th>Informal instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional development plans</td>
<td>Land use taxes</td>
<td>Development concepts (local, regional)</td>
</tr>
<tr>
<td>Land use plans</td>
<td>Soil sealing charges</td>
<td>Development scenarios</td>
</tr>
<tr>
<td>Zoning plans</td>
<td>Water charges</td>
<td>Mission statements (Leitbilder)</td>
</tr>
<tr>
<td>Urban planning agreements</td>
<td>Tradeable land use rights</td>
<td>Area management (local, regional)</td>
</tr>
<tr>
<td>Plan approval procedures</td>
<td>Certificates</td>
<td>Networks</td>
</tr>
<tr>
<td>Environmental impact assessments</td>
<td>Climate standards</td>
<td>Aggregate liability indices</td>
</tr>
<tr>
<td>Strategic environmental audits</td>
<td>Incentive systems</td>
<td>Climate agencies</td>
</tr>
<tr>
<td></td>
<td>Climate labels</td>
<td>Flood protection associations</td>
</tr>
</tbody>
</table>

Source: (Fröhlich & Knieling, 2013)

### 2.4 Evolution of Climate Governance at the International Level

Today, climate change issue is not only a leading for environmental challenges and it demands considerable reforms for energy-mix in developed world and it also requires changes and reforms to the international system (Akpan and Akpan, 2012). Climate change
attracted attentions globally and it is recognized that international cooperation and collective actions will be instrumental to address climate change. Former UN Secretary-General Ban Ki-Moon (2009) once stated that “climate change is altering the geopolitical landscape,” as posing more intense competition over Arctic resources, increased intra-state and inter-state migration and rising sea levels, it becomes clear that all countries need to work collectively to combat climate change. According to the UNFCCC “If the international community doesn’t get stronger actions, we will get very dangerous climate change.” In 1990s, the establishment of the UNFCCC and the KP replaced the ideological confrontations of cold war which turned climate change from purely scientific topic to an issue that need be addressed with political and development issues (Viola, Franchini, & Ribeiro, 2012). These developments paved the way for climate change to place on global climate governance agenda.

From, 1992 Rio Summit to the PA 2015, it took over two decade when the world leaders gathered and seriously considered climate change as problem and its likely impacts (Gisladottir & Stocking, 2005). Since the inception of the UNFCCC in early 1990s, international climate negotiations are still in progress to discuss climate change and possible solutions for its redressal. Previously, two decades was the difficult time to bring all countries on the same platform due to their diverse national interests. However, during these two decades the processes and negotiations brought climate change as a major focal area for international cooperation and governance.

In 1972, political leaders brought the issue of climate change on the agenda at the UN conference on Human Environment. In 1990s, environmental issues became an important issues especially it was seen in world media (Pereira, 2015). During this period, climate change negotiations and environmental activism was at its peak which can be assessed as between February 1991 and May 1992, five sessions were held by Intergovernmental Negotiating Committee for a Framework Convention on Climate Change. In these sessions, a considerable number of participants from more than 150 countries participated and the focus of the discussions remained on binding commitments, set a timeframe for reduction of the GHG, financial mechanisms, and technology transfer from developed to the developing world (H. Gupta, 2009).

On May 9, 1992, in Rio de Janeiro, Brazil, the UNFCCC was adopted. It opened for signature at the UN Conference on Environment and Development in June 1992 in Rio where it
received 155 signatures. The UNFCCC with universal membership entered into force on March 21, 1994, after receiving the requisite 50 ratifications.

The KP was notable initiative toward climate governance to manage climate change by reducing the GHS emission especially by developed nations (Vihma, 2011). Over 150 nations had adopted the KP by 1997. It was created with the aim to bring the amount of the GHG to 7 percent below the 1990 level. It set the target that the emission will be reduced between the years of 2008 and 2012. The United States of America (USA) committed to reduce seven percent, the European Union (EU) members to jointly assume eight percent, and Japan was to assume six percent.

Another important aspect of dealing climate change was created by arranging annual meeting to discuss the progress on climate change by all countries. In 1995, the first meeting of the COP was scheduled in Germany. A major responsibility of the COP is to assess the submitted national communications and emission inventories by all countries. Based on given information by the individual countries, the COP observes the impacts of the actions taken by the countries and to assess the progress made by these countries.

At the COP in annual meeting in Bali in December 2007, governments from developed and developing world were agreed to expedite their efforts to address climate change by adopting “Bali Road Map”. It was decided to accept the roadmap in order to show that the developing world will accept the mandatory caps. Mandatory caps mean to set a time frame for reducing carbon emission. The developed countries will provide proper assistance for the reduction of carbon emission. Moreover, it is also emphasized that the reduction should be in measurable and veritable.

In 2009, the Copenhagen Accord (CA) was finalized after an extensive sessions. In the CA efforts were made to set an effective future scenario. The CA is unlike to the KP. The CA is a volunteer agreement among the parties and each country’s acceptance and participation is not mandatory. The agreement was on a goodwill basis and it was assumed that each country will live up to their part in saving the climate by reducing GHG emissions.

In 2011, important decisions were taken in Durban conference. Three important achievements were accomplished in this meeting: extension of the KP, to set Durban
Platform for coordinated actions, to discuss global emission scheme after 2020, and the establishment of the green climate fund (GCF). This conference was important one to support the KP as it was the only legal mechanism that was applied on developed world to reduce the GHG emissions. It was decided that all the countries are required to work toward the global climate roadmap after 2020 especially; the EU and 10 other countries who have agreed to keep following the second phase of the KP.

In 2013, during Warsaw Conference, it was decided to prepare Intended Nationally Determined Contributions (INDCs) by all countries (H. Gupta, 2009). It was requested to all parties to provide their individual INDCs and related information about their efforts for tackling climate change. Some important decisions were taken in this conference to keep the international community on the right track for 2015 agreement. For instance, governments were agreed to give their information and ambitions before the conference in Paris in 2015. Similarly, it was also decided that the utilization of the GCF to provide financial assistance for developing will be in 2014. Additionally, governments were willing to work for loss and damage which is caused by long-term climatic impacts.

In 2014, some important achievements were set in the Lima Accord (LA). All countries submitted INDCs plans which were asked in 2013. There INDCs documents of all countries were available for public on UN website. The UNFCCC considered the submission and availability of these INDCs is a significant move for post-2020 when the new agreement will take into effect. According to Executive director of UNFCC, ‘It is positive and good news that various developing countries such as China, the EU, and the USA are here and willing to the scaling up the efforts for proper utilization of the GCF’. However, on the heels of the GCF, the more burdens will come on the shoulders of the developing countries to expedite their actions for climate change that are already fighting against poverty reduction and ensuring sustainable development (Beall & Fox, 2007). The LA was considered a great achievement from the climate negotiation for the year 2014 (Rogelj et al., 2016).

In 2015, an historical agreement emerged in the form of the PA. As per the PA, each country has to establish its programs and plans so that climate change can be managed effectively by cutting GHG emissions. The objective of the PA is to work in coordinated manners so that to limit global warming to 2 degrees Celsius or even less by 2100. Moreover, the PA is focusing on participatory approach by enhancing the capabilities of all countries in the fight against
climate change. The objectives of the PA are to provide financial assistance, technology transference and providing other required assistance and help to developing and most vulnerable countries. The PA encourages transparency for climate actions and it provides more effective transparency framework. The most notable aspect of this agreement is to encourage subnational governments/ local actors, and civil society organizations to play their role to tackle climate change. Moreover, this agreement equally focuses on adaptation measures to climate change.
Table 2. Evolution of Global Climate Negotiations

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>Rio Earth Summit</td>
</tr>
<tr>
<td></td>
<td>Rio signatories over 150 countries to the UNFCCC committed to achieving “stabilization of Greenhouse Gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system.”</td>
</tr>
<tr>
<td>1994</td>
<td>Entry into force of the Climate Convention</td>
</tr>
<tr>
<td>1995</td>
<td>First Conference of the Parties (COP1), Berlin, Germany</td>
</tr>
<tr>
<td></td>
<td>Berlin Mandate, “Common but Differential Responsibilities” for developing country (Group 77 &amp; China)</td>
</tr>
<tr>
<td>1997</td>
<td>COP3, Kyoto</td>
</tr>
<tr>
<td></td>
<td>Over 160 countries sign the Kyoto Protocol. Industrialized signatories commit to binding GHG reductions of a global average of 5.2% below 1990 levels for the period of 2008–2012.</td>
</tr>
<tr>
<td>1998</td>
<td>COP4, Buenos Aires, Argentina</td>
</tr>
<tr>
<td></td>
<td>Parties set deadline to decide on Kyoto rules. The implementation of reducing the GHG in developing countries.</td>
</tr>
<tr>
<td>1999</td>
<td>COP5, Bonn, Germany</td>
</tr>
<tr>
<td></td>
<td>Parties intensify work plan in order to meet COP4 deadlines “Bonn Agreement”.</td>
</tr>
<tr>
<td>2000</td>
<td>COP6, The Hague, Netherlands</td>
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<tr>
<td></td>
<td>Opportunity to close Kyoto loopholes and ensure real GHG reductions.</td>
</tr>
<tr>
<td>2001</td>
<td>COP7, Marrakech</td>
</tr>
<tr>
<td></td>
<td>The 165 nations endorsing the Marrakech consensus adopt guidelines for implementing the Kyoto Protocol. Nations can thus proceed to introduce the necessary domestic legislation to ratify the Kyoto Protocol.</td>
</tr>
<tr>
<td>2002</td>
<td>COP8, New Delhi</td>
</tr>
<tr>
<td></td>
<td>China ratified the Kyoto protocol.</td>
</tr>
<tr>
<td>2005</td>
<td>COP11 and MOP1, Montreal, Canada</td>
</tr>
<tr>
<td></td>
<td>The Kyoto protocol came into effect. The Montreal Action Plan is an agreement to extend the life of the Kyoto Protocol beyond its 2012 expiration date and negotiate deeper cuts in greenhouse-gas emissions.</td>
</tr>
<tr>
<td>2007</td>
<td>COP-13 and MOP-3, Bali, Indonesia</td>
</tr>
<tr>
<td></td>
<td>The negotiation focused on the post-2012 framework on GHG reduction.</td>
</tr>
<tr>
<td>2009</td>
<td>COP-15 and MOP-5, Copenhagen</td>
</tr>
<tr>
<td></td>
<td>Prospective adoption of the post-2012 climate change regime.</td>
</tr>
<tr>
<td>2011</td>
<td>COP-17 and MOP-7, Durban</td>
</tr>
<tr>
<td></td>
<td>Durban Platform for Enhanced Action made all countries at the UN climate change conference confirm to a legal framework toward a new global pact that would bring all major emitters — developed and developing — into its fold.</td>
</tr>
<tr>
<td>2013</td>
<td>COP-19 and MOP-9, Warsaw</td>
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<tr>
<td></td>
<td>Warsaw Consensus reaffirmed the core principle that the deal will be “applicable to all” 195 parties to the UN climate convention, with no differentiation between rich and poor nations as under the Kyoto Protocol.</td>
</tr>
<tr>
<td>2014</td>
<td>COP-20 and MOP-20, Lima</td>
</tr>
<tr>
<td></td>
<td>The Lima Accord requires all countries to submit INDCs that would be posted on a United Nations website.</td>
</tr>
<tr>
<td>2015</td>
<td>COP-21-Paris, France</td>
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<tr>
<td></td>
<td>This focused on adaptation actions and encouraged on bottom-up approaches.</td>
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</tbody>
</table>
2016 COP-22-Marrakech, Morocco
Adoption of the PA and awareness rising remained the focus of this conference.

2017 COP-23- Bonn, Germany
Outcome came to discuss three around three questions – “Where are we? Where do we want to go? How do we get there?”.

2018 COP-24- Katowice, Poland
The Rulebook for the PA was adopted which will enable all countries to implement various aspects of the PA that can measured, reported and verified in a uniform manner.

Source: Yu, H. (2015) and author’s contributions

2.5 Key Dimensions of Climate Governance

The CCG requires actions on adaptation and mitigation fronts. Adaptation aims to adapt with the changing climate. On the other hand mitigation emphasizes the change in existing behaviors which are contributing to further complicate or promote climate change. In this section, we will discuss various dimensions of climate change governance.

2.5.1 Building Strategic Capacity

The CCG demands strategic capacity. This strategic capacity can be well explained by the following four sub-categories:

Effective and Committed Leadership

The engagement of top level political leadership is a key factor to produce successful CCG (Meadowcroft, 2009). In managing climate change, if the leadership is active then the things can move forward. It is indeed the political leadership who influences the minds of officials and other stakeholders. This leadership means not just an individual level rather it is on the institutional front. Examples of initiatives to establish leadership capacity in area of climate change include: to set a cabinet committee on climate change that can oversee the climate change and related critical areas, to give responsibility to a senior minister on climate actions and policies, to establish an administrative agency on climate change, evaluation and monitoring systems on climate change, and to regularly make aware the parliament about the actions taken to curb climate change. Internationally, three different models of developing administrative leadership capacity on climate change are observed (Meadowcroft, 2009).

Firstly, to place the responsibility of climate change policy within environmental or climate change ministry: secondly, to establish independent climate change authority may be linked with Prime Minister’s office: thirdly, to link climate change with other related
ministry/ministries. There can be some other approaches and it is yet to declare that this is the most successful models over the others. However, these models emphasizes that the climate change ministry/agency must have considerable power, top level leadership support, and has proper authority to engage other networks or groups working on climate change.

Knowledge and the Provision of Expert Advice
Relevant knowledge and incorporation of experiences of experts are essential for establishing an effective and implementable policy (Graham et al., 2018). It is evident that complete understandability for climate change and availability of scientific evidences and advice are important for good governance (Meadowcroft, 2009). This can be attained by setting a proper mechanism that can provide authoritative advice to the government on climate change. Based on existing knowledge, it is important to continuously develop the scientific knowledge on climate change, its impacts, and to set and revise the likely responses to the negative consequences of climate change. To monitor the achievements, it is required to ensure the monitoring system across the country at various levels of governance. To develop capacity building is instrumental to deal with climate change (O’Brien, Eriksen, Inderberg, & Sygna, 2015). Therefore, promote capacity building is important in the areas related to climate change such as policy, economic, and social sciences. These fields provide proper backing to formulate a solid and actionable climate change policy.

National Interests and Strategic Policy Frameworks
National governments are responsible to present the country’s interests at domestic and international level. These interests evolve with the passage of time as per requirements of the existing situation. The governments should realize the sensitives of climate change and approach it keeping in mind the national interests (Nightingale, 2017). The governments should set their policies and plans based on vulnerability of climate change and made the decisions for climate actions based on cost and benefits analysis. However, in many countries especially in developing world the policy responses emerge on ad hoc basis in compliance with domestic political circumstances and to the need as per international negotiations. Therefore, such perspectives and national interests lack multi-dimensional approach for long term considerations.
It is important for good governance to establish responses for climate change by considering the long run national interests and associated risks of climate change in future. Climate change is an activity that requires actions for long run even for decades (Gao, Gao, & Zhang, 2017). Therefore, the governments should have to set sophisticated strategic policy framework. This strategic framework should present the overall situation of climate change in a country, adaptation and migration measures with respect to the environment, and presence of institutional body for implementing climate change policy, proper governance structure, involvement of stakeholders, and a mechanism on international cooperation on climate change.

**Building Institutions and Low Carbon Emission Economy**

Carbon emission is one the main reason for climate change (Dodman, 2009). Internationally, it is focused on to lower the carbon emission for effective fight against climate change. There are many institutions and bodies that are working to address climate change but there is a need to establish an independent body that can only focused on low carbon economy. Most of climate change programs operate directly under governmental ministries or bodies (Nightingale, 2017). The advantages of establishing an independent body are: it is free from political interventions, it can operate quickly, it has specialty, and it has credibility in the eyes of public being an independent body. This independent body mainly focuses on research and innovations for low carbon economy, to educate public the linkage of science and policy for climate change, to assess various policy options, encouraging involvement of community to deal with climate change, provide assistance to those who are seeking for low carbon businesses.

**2.5.2 Integration of Climate Change into Development Decision Making**

Sustainable development can only be achieved with sound and practically implementable policies in developed and developing world. The environment and development are interrelated at many points. Therefore, the decision making are obvious and directly linked in case of environment and development (WCED, 1987). Climate policies are successful only if they are prepared by accepting socio-economic realities and goals (Meadowcroft, 2009).

Climate change policies at national, provincial, and local level are needed to integrate into key socio-economic sectors like energy, industry, and transport (Lafferty, 2006). Lafferty
(2004) further emphasized that these climate policies should also be linked and established with respect to the key regions like provinces, cities, and municipalities.

It is important to taking in account the integration of climate change while establishing policy in any related sector (Eckerberg, 2009). For example, while establishing transport policy, mitigation should be considered. Approaches of integration include nomination of individuals and groups those are responsible in each ministry, adaptation and mitigation strategies to be set in national, regional and sectoral plans, inform relevant stakeholders about climate change implications and developments, requiring climate change assessment with respect to adaptation and mitigation implications. An effective CCG requires the integration of climate change into the routine practices of any governmental function so that it can be given a significant important in all institutions and bodies of a government.

2.5.3 Societal Mobilization

To develop social mobilization is a positive response to deal with climate change. The local stakeholders such as families, individuals, business, and communities need to alter their behaviors to effectively respond to climate change (Meadowcroft, 2009). These entities and their behaviors provide innovations on technological and social fronts to limit the GHG emission and to adjust with climate change. One of the main objectives of the CCG is to track approaches that are helpful to mobilize dynamic and active actors in the society who are willing to promote and support climate actions. The important aspect of societal mobilization is to educate to the society about certain behaviors that some are encouraged and some are discouraged. For instance, encourage energy efficiency and discourage the sources that emit more carbon. Secondly, to develop a system of public education about adaptation and mitigation to tackle climate change. For example, to devise new curriculum that include futures and major impacts of climate change for schools, colleges, and universities.

Likewise media plays a positive role to inform public about climate change and its implications. The role of local media is exceptionally important to engage and educate local community who are the real stakeholder in the fight against climate change. Other professional organizations like doctors, professors, scientist, nurses, teachers, and farmers can be utilized for this purpose. Role of cities and localities to address climatic impacts is emphasized in literature. Climate change is always happening at local level so local institutions are key for adaptation and mitigation initiatives (Measham et al., 2011). There is
need to ensure the participation and involvement of all stakeholders from all related sectors such as industry, academics and media. Various studies have suggested developing and applying adaptation and mitigation strategies sector-wise because it promotes for innovation and acceptability in the society.

Finally, informal public discussion is positive aspect of societal mobilization. The CCG is complex in nature and has difficult policy choices. These complex decisions affect welfare of a society in long run and it is too important to consider costs-benefits and its distribution. Therefore, citizens should be involved in such decision-making process and policy discussions as they are more familiar with the situation and they can work collectively for societal burden in adjustment of climate change.

2.5.4 Learning Mechanisms and the Climate Change Governance
Climate change is complex problem; human societies are learning and understanding its complexity. Various institutions and approaches are developing around the world for its effective management (Measham et al., 2011). Although, developments are made to deal with climate change in different forms at various levels of governance but it is important to learn from the existing systems of the CCG. This learning approach is stressed to develop climate policy in interactive manners so that the objectives of the policy can be carefully specified, policy tools can be chosen correctly, and the results are to be critically assessed before the policy is launched for implementation. It is emphasized to devise measurable policy goals, indicators and targets because it is easier to measure the progress of measurable established ingredients.

This learning approach also focuses that there should be a proper monitoring system so that climate related changes and impacts of the policy can be monitored and learnt. Independent organizations have a leading role to assess the progress of climate actions and outcomes of climate policies and action plans.

The learning approach encourages adopting an experimental approach for policy design, technological development, and social innovations. This experimental approach provides new ideas, new experiences, and dig out more or less important innovative initiatives. Governments need to apply this experimental approach for policy options, to promote promising practices, and to apply alternative and advanced technological solutions (Kemp,
Rotmans, & Loorbach, 2007). Although, such experimental approaches are involved with risks and nobody can assess in advance that it will be successful but it is important to get rich lessons even if it is failed.

Transparency is considered an important aspect of the CCG. Through transparency and accountability, the weaknesses and strengths can be uncovered. The policy should be societal reflexivity. It is a process of collective reflection towards social goals and the means of attaining them by involving policy making institutions, political forums, and the public sphere (Grin, 2006).

2.6 Climate Change and Agriculture Sector

Agriculture production depends to choose a right crop that is well suited for the climate of that region (Kim, 2008). Kim, (2008) further stated that this shows that agriculture is bio-industry depends on regional characteristics. Regional characteristics mean the characteristics of the ecosystem that are identified by regional climate. Climate change effects agricultural and the ecosystem related to agriculture sector. These climatic impacts bring changes in agricultural ecosystem due to variation and changes in climate such as temperature rise, increased precipitation, and sunlight. These changes in climatic elements further extend its influence on livestock and hydrology sectors. These climatic impacts on agriculture sector are discussed by many scholars and scientific community. A chart of these impacts on agriculture sector can be summarized in figure 2.1 below.

![Figure 2.1: Climate change impacts on agriculture sector. Source: Kim, Chang-Gil and et al., (2009)](image-url)
The climatic impacts on arable and livestock sector are posed by some biological changes (Richardson et al., 2013). These biological changes include changes for harvesting seasons, change in quality, and changes in area that is suitable for better cultivation. It affects the agriculture ecosystem, changes in bright and pests, a cause of population migration, and alteration in biodiversity. Moreover, it is noted that in this sector, climate change is also influencing the biological changes in the form of fertilizers and breeding in addition with its impacts to disturb pastures patterns.

Climate change brings obvious changes in hydrology sector (Döll et al., 2015). These changes include level of underground water, variations in water temperature, flow of rivers, quality of water quality, precipitation, and soil moister contents. It is in fact a complicated phenomenon to understand the climatic impacts on hydrology sector. These complications can be addressed by statistical and other models like deterministic hydrology model. Climate change is significantly impacting the rural economy. The rural economy includes agricultural productivity, revenues for local farmer community, and asset values. Climate change is also posing negative effects on agricultural infrastructure due to certain changes in water resources.

To calculate and understand various research techniques, simulations and experiments are being carried out in laboratories and fields to assess and uncover the impacts on agriculture sector which are posed by variation in precipitation and rise in temperature (Kim, 2008). It is reported that the impacts of climate change on agriculture sector depends on related variables, therefore, it is not easy to set the generalize results. These impacts on agriculture sector can be positive and can be negative as well. Below in figure shown 2.2 both the aspects:
The positive impacts can be in the form of increase in productivity due to fertilizers effects caused by increased carbon dioxide concentrations in the atmospheres. The productivity is also enhanced due to expansion of area for production of tropical and sub-tropical crops and reduction of damages for winter crops due to low temperature. It is experimented that various new crops are replacing the existing crops which is increasing the overall productivity in agriculture sector. Moreover, it is also noted that the production is increased by reducing heating cost for agricultural crops in protected cultivation areas.

On the other hand negative impacts of climate change on agriculture productivity are noted. These negative impacts are changing quality of crops and reducing the quantity of productivity. These impacts are generally happening due to rise in temperature, bad coloration, and reduction in sugar contents. Likewise, the productivity is negative due weeding, growth of harmful insects in crops, and other diseases such as blights. Other factors that are negatively impacting crops are reduction in fertility of land caused by decomposition of organic substances. Soil erosion and increased and unexpected rainfall are the other major contributors for less agricultural productivity.

Climatic impacts on agriculture sector vary and depend on multiple factors as discussed above. The positive impacts create opportunities to maximize the benefits but there is much
cost and the negative consequences are attached with negative impacts. Therefore, for sustainable agriculture, it is suggested to establish adaptation strategies in a way so that the opportunities can be utilized and threats can be overcome.

2.7 A concept of Adaptive governance

2.7.1 A Framework of Adaptation

Climate change adaptation has many definitions. The IPCC defines adaptation as “adjustment in natural and human systems in response to actual or expected climatic stimuli and their effects.” The UNFCCC defined it as “regulating process of ecological and socioeconomic systems to reduce possible damages from actual and expected climate change, that is, actions taken to help communities and ecosystems cope with changing climate conditions.”

It is indicated that climate change adaptation is important to mitigate climate change. It helps to reduce the negative aspects of climate change and provides opportunities to utilize the changes for positive effects. Adaptation actions are both direct and indirect. It mitigates directly the damages happened due to climate and promotes the adaptive capacity for future actions. Indirect adaptation actions are also taking place to indirectly manage the damages of climate change. It is important to implement the right strategies of adaptation in the right time.

It is important to understand the relation between adaptation and adaptive capacity. Adaptive capacity is an ability of an individual or a community or a system to adjust and adapt with the changing climate and to strengthen its ability for any unexpected and uncertain climate consequences (Grambsch & Menne, 2003). Adaptive capacity or adaptive capability is critical for implementation of adaptation measures. It is strength or capabilities of a certain system that can be regulated and responded, can reduce the expected damages, and can utilize the existing opportunities effectively (IPCC, 2014). It is required to plan properly and execute the planned actions in order to face increasing risks and negative consequences of climate change. It is reported that the adaptive capacity can be enhanced by utilizing the aforementioned conditions for implementation of adaptation actions (Wise et al., 2014). These components for adaptation are interlinked and interdependent.
It is suggested that before establishing adaptation policy, it is better to assess the vulnerability and likely impacts of climate change. This assessment is important to identify the areas of vulnerability of any system. Grambsch & Menne, (2003) suggested that vulnerability assessment should include the estimation for climate change, socioeconomic aspects of climate change, and likely adaptation measures.

There are different types of climate change adaptation. The types of adaptation are classified by some conditions like intention of adaptation, characteristics of a system, and timing of the adaptation in the system (Adger et al., 2007). This system composed of the natural and human system (Kim, 2008). Adaptation to climate change is broadly divided in two parts: autonomous and planned adaptation (Forsyth & Evans, 2013). Autonomous level adaptation is the adaptation which is undertaken by the individual or local community without any external interventions. On the other hand planned adaptation is an adaptation which is principally introduced by external sources such as governments or any other agencies.

The autonomous and planned level adaptation can be further classified into pre-adaptation and post-adaptation which depends on the system and required adaptation (Jannach, Lerche, & Jugovac, 2015). These adaptations can be happened at national, subnational, and even at local levels. Generally, public and private sectors are responsible for implementation of these adaptation actions for climate change. The public sector includes national, subnational, and local governments while private sector depends on the subsector and related enterprises. For instance, in private sector adaptation for agriculture sector, the people responsible for implementing adaptation initiatives are the agricultural people and related enterprises to agriculture. Generally, the private sector is doing adaptation for getting profit whereas the attentions of public sector are to serve public. Below table 3 tells us the adaptation responses with public and private sectors contributions.
Table 3. Adaptation response depending on time and sectors

<table>
<thead>
<tr>
<th>Main sector in charge of response</th>
<th>Response Time</th>
<th>Post-adaptation</th>
</tr>
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<tbody>
<tr>
<td>Private Sector</td>
<td>• Utilization of the private insurance market&lt;br&gt; • Private R&amp;D and investment</td>
<td>• Change of crop cultivation and applicable agricultural techniques&lt;br&gt; • Regulation of the insurance market&lt;br&gt; • Verification of adaptation options of the minimum expense</td>
</tr>
<tr>
<td>Public Sector</td>
<td>• Utilization of Early Warning System&lt;br&gt; • Construction of public infrastructure (irrigation systems)&lt;br&gt; • Communication of risks Utilization of subsidies&lt;br&gt; • Publicly available R&amp;D</td>
<td>• Recovery from the aftermath of disasters&lt;br&gt; • Compensation for the consequences of the impacts&lt;br&gt; • Insurance contract&lt;br&gt; • Compensation system&lt;br&gt; • Subsidies and supports</td>
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</table>

Source: OECD (2006)

Adaptation of every sector depends on the certain conditions, time, and available resources. For example, a system of community can reduce the vulnerability to climate change by promoting its storage capacity, promoting awareness, and set a considerable preparation to face flooding (Kang, Khan, & Ma, 2009). It is also important strategy to change exposure of system to climate change by incorporating Early Warning System. This change of exposure of a system also includes enhancing the resilience of social/ecological system through reservation of resources. Resilience is a concept that focuses to promote the ability of a system and make it prepare for adaptation in case of changing climate (Patel, Rogers, Amlôt, & Rubin, 2017).

2.7.2 Adaptive Governance

One of the influential approaches to reconciling social and ecological aspects of the environmental governance (EG) emerged in the form of the AG to address uncertainty and complexity related to climate change. The AG literature is an emergent form of the EG research that demands to coordinate various dynamic forms of resource management regimes and confront the environmental challenges (Chaffin et al., 2014).

Thus the AG is a form of governance which emerged to tackle the issue of complexity and uncertainty (Folke, Hahn, Olsson, & Norberg, 2005). The concept of the AG gained prominent attention in the scientific community as an alternative form of governance during the last decade (Rijke et al., 2012). (Dietz, Ostrom, & Stern, 2003) firstly introduced the concept of “adaptive governance” in a landmark publication in Science. Folke et al., (2005) described the AG is a strategy who resolve the societal conflict of complex ecosystems.
Chaffin et al., (2014) further defines “adaptive governance as a range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for the Social-ecological Systems (SESs)”.

Governance systems especially the top-down or centralized approach rarely an effective system to face ecological complexity (Cumming, Cumming, & Redman, 2006). National governments by incorporating top-down strategies are failed to bring solid solutions the complex situation of rapid environmental changes. They further argued that the centralized decisions could not bring intended results due to complexity of ecosystems having extended jurisdictional boundaries.

Due to the governance challenges of top-down approach, multiple bottom-up governance strategies are emerged to replace the previous one (Brosius, Tsing, & Zerner, 2005). In this new structure of governance multiple stakeholders were involved like leaders of local community, social networks. These bottom-up approaches or local governance seem quite effective but they also suffer in coordination due to complex geographies (Cosens, Gunderson, Allen, & Benson, 2014).

Chaffin et. al., (2014) pointed that in this system of governance, all the stakeholders especially the representative of the most vulnerable and poor communities are not actually presented. To fix these challenges there is a need to bring new approaches of governance which are capable to handle the governance hurdles and the complexity between the SESs components. The AG is increasingly recognized as a right form of governance to address these challenges and uncertainties (T. Dietz et al., 2003; Folke et al., 2005; Lebel et al., 2006). However, despite certain challenges, the AG is still very important as it focuses to involve local actors, promotes the system of self-governance, and emphasis to learn from existing governance (Rijke et al., 2012).

The learning process is an important component to understand and deal with the complex dynamics and uncertainty associated with such systems (Folke et al., 2005). This learning process is triggered by various networks which emerge due to the interaction between different stakeholders at different levels (Olsson et al., 2006). Such learning facilitates the replication of successful practices from each other and coordination of effective resource utilization. Various international efforts are taking place to utilize different knowledge system
and learning environments for enhancing the capacity building which is dealing with the complex adaptive system (Ludwig, Mangel, & Haddad, 2001).

The AG is essentially involved in devolution of management rights and power sharing in order to promote participation (Folke et al., 2005). This division of rights, responsibilities, and access to heterogeneous local bodies can essentially contribute to the AG (Ostrom, 2005). The presence of multiple communities contributes to accumulate diverse knowledge by interaction which ultimately enhances the adaptive capacity of the community (Davidson-Hunt, 2006). For complex problems, decentralized network that tackle local problems at local scales have been proven to be effective (Bodin, Crona, & Ernstson, 2006). However, leadership for the effective management of such governance mechanisms also plays an important role in organizational effectiveness.

Collaboration and interaction among various networks for good governance requires leadership. Such leadership is important to frame change and reorganize to incorporate innovation and keep flexibility to face complex dynamics of the system (Meadowcroft, 2009). Further, leaders are important for performing the key functions for the AG like trust building, linking actors, compiling and generating knowledge, establishing links among the networks. The visionary leadership always gives directions for positive change and transforming the system of the governance.

Transformability is essentially important to bring innovative systems while the social, political and economic impact remains untenable in existing governance structures. Transformability produces the development of the SESs by incorporating novel components and ways of life from various existing sub-systems to define a new system (Walker, Holling, Carpenter, & Kinzig, 2004). This transformation has four phases: (1) to prepare the system for change (2) to open an opportunity, (3) to navigate and transition and (4) to chart/establish new direction for management to build resilient of the new governance regime.

2.8 Adaptation and Mitigation as Countermeasures Strategies for the Agriculture Sector

It is reported that climate change is happening due to many factor especially the disruption of the energy balance in global climatic system. The scientific analyses tell us that global
warming is a phenomenon as a result from human activities (IPCC, 2007). Agriculture sector can consider as countermeasures to face the challenge of global warming by incorporating effective mitigations and adaptation. Mitigation strategies are established to fight against climate change by reducing and absorbing the GHG emission.

Since the start of climate change discussions at international level, the focus was mostly on mitigation strategies. If we see the early protocols and agreements of climate change are more related to mitigation. However, during last one decade or so the adaptation is well recognized at international level and considered as an important policy response to climate change. Both the strategies have their own dynamics, strengths, and weaknesses.

The mitigation strategies are well suited to the industrialized nations as they are the major GHG emitters (Gerber et al., 2013). Therefore, by incorporating the mitigation strategies, they can reduce the GHG emissions. However, on the other hand, adaptation is a best strategy for the poor and most vulnerable countries as these communities are facing the negative implications of climate change. Therefore, their first priority is to adjust and tackle the existing situation.

Mitigation measures are established to reduce the GHG emissions and to stabilize the level of the GHG in the atmosphere. The main objective of mitigation measures is to control the increasing human interference in climate system by reducing and maintaining the GHG emission. The GHG emissions are the major contributors to threaten the environment and causing climate change. Human activities can play a significant role to control those activities of the GHG emissions which are harmful for climate system.

Adaptation is the other important strategy to deal with climate change. Adapting strategies focus to understand the impacts of climate change, set certain mechanisms to adjust with inevitably climate change, and minimize the damages due to climate change. Adaptation to climate change is equally important to mitigation especially developing and most vulnerable communities have no option rather adaptation. By incorporating mitigation and adaptation strategies, positive results can be achieved to address climate change. Below figure 2.3 presents these counter measures:
Based on scientific calculations and models, the expected negative consequences of climate change are identified or calculated. These consequences can be minimized or eliminated by incorporating the appropriate counter measures in the right time.

Once climate change happens, the climatic systems like atmosphere, hydrosphere, cryosphere are initially disturbed by climate change due to their exposure (Kim, 2008). These climatic systems attempt to adapt by themselves as volunteer approach. However, sometimes due to severity of climatic impacts, the system cannot manage the situation just of volunteer basis; therefore, they require some special and additional measures in the form of planned adaptation. If the impacts still remain after introducing planned adaptation, such situation is called remaining impact. In such scenario, it is difficult for the system to adapt; therefore efforts are placed to reduce the impacts to bring mitigation strategies by reducing the GHS emission and absorption. It is suggested that through mitigation by reducing the GHS emission, certain impacts of climate can be minimized, postponed, and even avoided. Both mitigation and adaptation strategies are very much interconnected and linked. In long term
strategies and perspectives, mitigation actions are a part of adaptation measures (Chappin & van der Lei, 2014). Therefore, adaptation is not an optional measures rather it is compulsory countermeasure against climate change.

2.9 Subnational Governments and Climate Change Strategies

Previously, the focus remained not only on mitigation but also top-down governance approach and the national governments were encouraged to take actions. However, presently the trend has been changed drastically especially after the PA 2015 as the PA strongly encourages subnational/local governments and civil society organizations to act against climate change. The subnational and local governments are getting many attentions in policy debate and they are considered very instrumental to curb climate change.

It is suggested in literature that responses to deal with climate change must be implemented simultaneously at local and global scale undertaken by public and private actors (Puppim de Oliveira, 2009; Setzer, 2009). It is argued that the MLG approach is a promising approach to manage the negative consequences of climate change in major states and cities in developing countries. Subnational governments from all over the world are recognized for effective fight against climate change. It is indicated that 50% to 80% adaptation and mitigation measures will be taken at subnational and local level (Anderton & Setzer, 2018).

Climate change has local impacts; the local responses by individuals and communities are the appropriate form of governance (Adger & Vincent, 2005). The local community or individuals closer to the impacts are suitable to deal with it. The adaptation strategies can play an effective role to address the local challenges (Tanner, Mitchell, Polack, & Guenther, 2009). In this situation when the challenges are local then subnational and local governments actions are more obvious and required (Dawson, 2007).

The literature suggests that the subnational and local governments are key players in implementation of climate policy either alone or coordinating with other actors (Lowe, Foster, & Winkelman, 2009; Storbjörk, 2007). Subnational and local governments are in a right position identify the needs of their societies being closer to the climatic impacts (Barbi & da Costa Ferreira, 2017) for instance in case of flooding or heatwaves local governmental institutions are the best and urgent responder. Subnational governments are well placed to
implement and reinforce national policies (Parry, Echeverria, Dekens, & Maitima, 2012) because they are familiar with the local context and have more acceptability for local actions. These governments are well situated to identify local requirements and to identify the priorities areas for investment and actions (Allain-Dupré, 2011) keeping in view they know the actual crises and requirements at local level. It is argued that they are crucial for climate actions by mobilizing resources at local levels and establishing linkage and coordination among local actors and all sectors (Anton, Cambray, & Dupar, 2014).

Sub-national governments bring policy innovations and to develop better solutions by identifying local requirements (GGBP, 2014), for instance by local experimentations and piloting (IPCC, 2014). Local governments are taking measures and innovative action in their own as per their requirement (Betsill & Bulkeley, 2006). These governments are responsible for enacting laws and framing policies which are directly linked with climate change.

Subnational governments are responsible in many countries for public budget and expenditure, the effective use of these budgets can be helpful for adaptive improvements and adjustments (Barbi & da Costa Ferreira, 2017). In populated and geographical large countries, regional governments or subnational governments have reasonable administrative powers in many areas including sustainable development (Setzer, 2009). For example, in many countries subnational governments are responsible to implement policies like the environment, agriculture, and industry.

Sub-national governments are important to raise awareness, and influence behavior and collaboration (Setzer, 2009). This can be achieved by launching consumer education programs, changing consumption habits, and promotion to use green goods and services (Allain-Dupré, 2011). These are key aspects of adaptation strategies. These governments are effective to bring multiple stakeholders at the same point and to establish better relationships among the stakeholders at local level (Smit & Pilifosova, 2003).

Subnational governments have proved that they can take the responsibility to tackle climate change. For example, they have established networking and collaborations with many other subnational governments for implementing climate policies. They are sharing best practices, focusing and encouraging green technologies, and encouraging transference of low carbon technology. They are determined to tackle climate change and to address economic problems
by turning the challenges into opportunities towards ensuring green economy. These governments are taking effective steps to build more sustainable, less carbon, and low energy intensive communities (Kauffmann & Less, 2010).

It is noted that subnational governments from developed countries have established linkage with same governments in developing countries in order to help them to adapt to climate change by building their capacities (Anderton & Setzer, 2018). This is an important step to enhance the capabilities of subnational governments in developing countries. There are many other mechanisms to prepare subnational governments in developing world through subnational cooperation agreements.

The complete success of subnational and local governments with respect to climate change is yet to predict. However, they are in a better position to deal with the impact of climate change being closer to the problems and most intimate knowledge of their needs. There are very strong views that the subnational/local governments lack institutional and human capacity to deal with climate change. However, after getting recognized at international level, their capacities of subnational governments are being enhanced.

To implement the PA and effective use of global climate fund, it is important to understand the dynamics of subnational institutions and their collaboration with national and local level institutions (Christoplos et al., 2016). These subnational level institutions are key to communicate the policy implementation challenges and opportunities between the national and local level governments. Although, in the PA, the bottom-up approach and role of civil society organization are highlighted but national governments are also an important player by a wide range of motivations such as increasing (economic) damage from climate impacts (European Environment Agency, 2017), pressure from the public and the NGOs (Nulman, 2016), learning through transnational networks (Bauer & Steurer, 2014), and (economic) competition with other countries (Massey, Biesbroek, Huijtema, & Jordan, 2014). Therefore, it is required to have a proper system of coordination for intergovernmental levels and due cooperation with international organization for effective climate adaptation governance at subnational level.

Adaptation is a comparatively a new policy issue but various states have already started to take action in this area, from developing wait-and-see approaches to becoming early
innovators that lead by example (Massey et al., 2014). To implement an adaptation policy with its true spirit, it is suggested in literature to have solid accountability and transparency systems. This accountability and transparency can be ensured by enacting new laws. Therefore, strong legal backing for implementation of climate adaptation is required.

Role of local institutions/bureaucracies are significantly emphasized. The corresponding literature maintained that public bureaucracies constitute barriers to successful adaptation due to red tape (Phuong, Biesbroek, & Wals, 2018). This red-tape prevents the local institutions to take timely actions which in turn routine measures instead of flexible and proactive actions. Consequently, adaptation policies are lacking a certain willingness to initiate innovative measures, and to focus on implementation due to weak institutional capabilities at subnational and local level (Biesbroek et al., 2009). Hence, the capabilities and capability building of local institutional are critical for proper implementation of climate adaptation policies at subnational level.

The adoption of the PA is a shift away from previous efforts under the KP that followed a more top-down, legalistic, and uniform model for climate governance. The emergence of this polycentric governance model under the PA, has created new openings for local governments, non-state actors such as businesses and civil society to actively engage while addressing climate change (Hall & Persson, 2017). Climate change adaptation is an emerging field of policy action involving subnational and local governments Biesbroek et al., 2009). Considering the new field, the implementation of climate adaptation policies at subnational level need to be followed a balanced governance approach.

2.10 Climate Adaptation Strategies for Agriculture Sector at Subnational level

Uncertainties in climate change scenarios make it difficult to determine the precise impacts on future agricultural productivity. However, it is reported that growing food security challenges is increasing and it will be worse situation by 2050 if the proper actions are not taken for sustainable agriculture sector. Various studies in the literature have identified that significant losses in agriculture sector should be expected worldwide (Nelson et al., 2008). It is widely acknowledged that policies need to provide a supportive environment that not only
guides development stakeholders in planning and executing adaptation interventions but also enables farming communities to adapt to climate change (Berman, Quinn, & Paavola, 2015).

Climate change poses negative impacts on agriculture sector and it is destabilizing livelihoods of smallholder and farmers at local level (Below, Artnet, Siebert, & Sieber, 2010). Although, the local farmers communities are adapting their agriculture to the changing climate (Knox, Hess, Daccache, & Wheeler, 2012) but still they are vulnerable to climate change and variability (Alganci et al., 2015). Local knowledge can play a promising role to address the challenges of climate change at local scale for agriculture sector. Local knowledge is based on practice and assists farmers to make informed decisions about how to respond to environmental changes and how to improve the amount and quality of their yield (Newsham & Thomas, 2011).

Although considerable progress has been made in developing governance system for climate change adaptation at local level but there are still implementation challenges due to lack of harmonized sectoral and local planning (Madzwamuse, 2010), there is consensus that local knowledge is an important mean for effective adaptation (Mertz, Mbow, Reenberg, & Diouf, 2009; Mubaya, Njuki, Mutsvangwa, Mugabe, & Nanja, 2012). However, there is lack of evidences in literature to study local knowledge as a reflection of climate variability, its effects and adaptations in agriculture (Ogalleh, Vogl, Eitzinger, & Hauser, 2012). The local knowledge of farmers has proved very useful and important in enhancing their adaptive capacity and designing climate adaptation policies (Ogalleh et al., 2012).

It is recognized by researchers, farmers’ community, and government officials around the world that that adaptation to climate change is an urgent response to climate change (Soubry, 2017). But how can this be done most effectively? Soubry, (2017) states that one of the biggest challenges is the need for climate change adaptation solutions to be context specific. A one size fits all approach to policy does not work. This has led many to the conclusion that focus on local participatory approaches to adaptation planning and building adaptive capacity should be encouraged. Therefore, considering the implications of climate change to the farmers and agriculture sector in the local context is highly recognized. Agriculture has always adapted to climate with regionally specific adapted systems being observed across the world (Ren et al., 2014). It is suggested that the adaptation policies towards agriculture sector are needed to be designed based on how the local farmers understand...
climate related risks and respond to those risks (Menapace, Colson, & Raffaeli, 2014). Some other strategies are proposed to manage the impacts of climate change on agriculture sector.

In order to meet the challenges for agriculture sector effectively, the concept of the Climate Smart Agriculture (CSA) was introduced. The CSA can be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change (Lipper et al., 2014). Food and Agricultural Organization of the United Nations (UN) defines the CSA as “agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals”. (Lipper et al., 2014) identified that productivity, adaptation and mitigations are critical for achieving this goal.

The adaptation in case of CSA is utilized by reducing the exposure of farmers to short-term risks and to strengthen their resilience by building their capacity to adapt and face the long term challenges. Particular attention is given to protecting the ecosystem services which ecosystems provide to farmers and others. These services are essential for maintaining productivity and our ability to adapt to climate changes. Here subnational governments have important role to establish better adaptation policies and action plans to ensure the implementation of the CSA mission.

To scale up the CSA triggered to establish agricultural supportive policies, institutions and financing at different level of governance (Westermann, Thornton, & Förch, 2015). The response to impacts of climate change can be observed at local level. However, these responses depend on the information and socio-economic condition of the local farmers. For example, poor farmers take measures to ensure their survival but wealthier farmers make decisions in order to enhance their productivity and maximize their profits (Ziervogel, Bharwani, & Downing, 2006).

Many other national and subnational governments are taking adaptation actions in many sectors. For instance, Korean government took initiative to promote adaptation in agriculture sector. Their actions are divided in five major areas: Firstly, at technical front, there are 28 measures, in economical fronts 7 measures, thirdly in legal and institutional 7 actions, for public education and awareness 6 measures are introduced, 14 measures are taken for
vulnerability assessment and monitoring (Ziervogel et al., 2006). Literature on adaptation measures to address climate change for agriculture sector dictates that there are diverse initiatives in effect depending on the regional and/or national conditions.

Various conditions are established for implementation of adaptation actions. These conditions are in the form of reasonable financial capacity and proper information system. Applicable technologies are also considered as a contributing aspect for implementation of adaptation measures. Moreover, proper infrastructure, committed institutions, and system of equity are in place for effective adaptation actions. These important aspects for adaptation are considered the components of adaptive capacity. Adaptation literature dictates that sometimes adaptation measures are implemented for free or in low costs (Rojas-Downing, Nejadhashemi, Harrigan, & Woznicki, 2017). However, in most cases for implementation of adaptation measures, it requires some amount of expenses. Our search in the relevant literature shows that there is lack of evidences to explain how climate adaptation policies for agriculture at subnational level are established and how they are actually implemented. The literature only emphasizes the importance of local strategies for climate adaptation but it clearly lacks how it should be done.

Climate change adaptation, especially in agricultural sector, is mainly a local issue (Kassie et al., 2015). They further argued that local government institutions such as province, district, and local municipalities are well aware of the need for adaptation strategies. These local institutions have comparatively better knowledge and ideas to deal with climate crises in all sectors including agriculture sector. However, there are challenges to operationalize effectively climate adaptation policies in agriculture sector at local level. These challenges mainly include weak capacity of institutions, absence of local actors in policy framing, lack of connection in intergovernmental relations, and weak legal system. Keeping in view the related literature and the gaps for implementing climate adaptation policies for agriculture sector at subnational level, we proposed a framework that will ensure an effective implementation of climate adaptation policies at subnational/provincial level.

**2.11 Proposed Framework of the Study**

Climate-related risks and opportunities play a key role in agricultural development and management. Climate change is impacting crop productivity and ability of local farmers for
agricultural produce. It has identified that almost 70 percent of people in developing countries are living in rural areas where agriculture is the main livelihood and agriculture sector is highly at risk due to the adverse impacts of climate change (Vermeulen, Campbell, & Ingram, 2012). Various studies have suggested meeting this challenge of climatic impacts on agriculture sector; it is needed to establish local policies specifically on adaptation front. Effective actions through local and subnational governments can bring significant results to address the challenge of climate change and its impacts on different sectors (Dawson, 2007).

Local adaptation policies for agriculture sector are important because local farmers are in a better position to adjust with changing climate. As the climatic impacts are essentially local, the adequate governance responses are required by the local individuals and communities (Adger et al., 2005). As a result, the process of adaptation is strongly influenced by local contexts, choices and collective actions are impactful if taken by the local actors and institutions (Tanner et al., 2009). International community is focusing on long adaptation strategies, it is important to ensure local adaptation strategies in national development plans and policies (Hardee & Mutunga, 2010). Likewise, Yamin, Rahman, & Huq, (2005) argued that it is needed to identify an operational framework that links locally determined adaptation needs with national and international policy. Local and regional planning and policy can play a major role to develop capacity of local farmers and provide tools to support communities in their endeavors to tackle climate change as per local requirements. However, certain challenges are being faced by subnational governments to effectively implement the adaptation policies at subnational level.

Lack of involvement of local actors is a real challenge for implementation of climate adaptation policies at subnational level. A study on local adaptation planning identifies that local level has not sufficiently involved in adaptation policy planning, thus resulting a challenge for implementation of such policies (Dhungana, Khadka, Bhatta, & Regmi, 2017). Non-consultative policy processes at local scale always poses a serious challenge for effective policy implementation. Therefore, it is important to consider the voices of local actors in policy framing and consider them as a stakeholder in implementation of adaptation policies at subnational level. These local actors and non-state actors are important to implement climate change actions at local level (Bulkeley et al., 2009). Local actors in case of adaptation policies for agriculture sector are important as local farmers and their traditional knowledge is needed to the part of climate policies at subnational level.
Capable institutions are critical for handing climate change impacts at subnational level but in many countries especially the developing countries are lacking effective institutions at subnational level. The Subnational governments often do not have institutional capacity or considerable financial resources that are necessary for implementation of climate change actions especially adaptation measures (Bulkeley et al., 2009; Mukheibir & Ziervogel, 2007). (Tiwari, Rayamajhi, Pokharel, & Balla, 2014) argued that weak local institutional arrangement, lack of infrastructure, scarcity of financial resources, and not properly involving local actors are the major barriers for implementing adaptation activities. This capability of local institutions can be enhanced by involving the local actors while establishing adaptation policies and action plans. The capacity of subnational governments to deal with climate change may be strengthened by the participation of other subnational governments, the NGOs and private sector.

Inadequate institutional coordination is another major challenge for implementation of adaptation policies at subnational level. A study identifies that the weak institutional coordination is a major factor for not effective implementation of climate change issues at local scales (Okolo, Twyman, Ampaire, & Acosta, 2015). Policy makers around the world have now recognized the necessity of integrating adaptive thinking in relevant areas of public policy making across different levels of governance (Urwin & Jordan, 2008). It is suggested that horizontal and vertical coordination and the combination of top down and bottom up approaches are the focus of adaptation policies to attain effective adaptation implementation (Dessai & Hulme, 2004). The weak coordination between the states and local authorities is a contributing factor for inefficient implementation efforts of climate policies at local level (Setzer, 2013).

It is equally important to get facilitation and help from developed countries and international organizations by establishing a regular and proper linkage with them. Climate change is a global challenge and international efforts are in place and developed countries have capability and financial resources to extend their help for developing and most vulnerable communities in the world. Therefore, it is very important for subnational governments to have regular coordination with international organizations and subnational governments in other countries via national government if it is required.
Absence of laws and litigation are another factor contributing a challenge for implementation of policies at local level. Laws and litigation at subnational level are key tools in ensuring that the policies and laws are capable of and are used for delivering intended actions, thus, making subnational policies effective or impactful (Anderton & Setzer, 2018). (Osofsky, 2007) argued that through laws and subnational climate litigation, ‘[states and localities] help to move the dialogue on climate regulation forward’. Legal backing for taking actions makes the institutions and local actors as accountable and more impactful results can be achieved at subnational level, fulfilling the third aspect of Jordan and Termeer et al., (2011) framework. Therefore, legal backing for climate adaptation policies is important prerequisite for implementation of successful policies at subnational level.

Drawing from the literature, broad discussion on climate adaptation policies and identification of certain gaps in existing related work, the framework is developed, and later on applied to two Pakistani provinces. Based on the literature, I identified locally driven, institutionally capable, legally stable, and cooperative in intergovernmental relations as four main components that are necessary for fostering climate change adaptation at the subnational level in the agricultural sector. This framework is developed in order to address the implementation challenges of climate adaptation policies at subnational level and the components of the framework are explained below.

**Locally Driven**

Each policy requires proper policy cycle. However, the implementation of a policy remains unsuccessful until proper mechanism of policy is not follow. Related institutions and governance processes are important components not only for establishing a climate change policy at subnational level but also for its effective implementation (Pervin et al., 2013). The role of local institutions is well identified in our field study. Therefore, the proposed framework focuses that local institutions and local actors are critically for effective climate adaptation governance at subnational level.

Particularly in the agricultural sector, locally driven initiatives are important because agriculture is a local phenomenon and climate change is directly threatened to the local farmers. Therefore, they are the locals who have to act. Why are locally driven initiatives so important for agriculture sector? To involve the local individuals is considered as ethical obligations as they are directly affected by adaptation policy for agriculture sector. Moreover,
local participation especially the role of farmer community allow for a deep understanding of local ecological phenomena, help to frame the policy which is socially acceptable for local community, and of the nuanced links between different adaptation actions and outcomes. Local participation and knowledge to deal with climatic impacts on agriculture sector are vital to make sure adaptation policies are successful on the ground.

Collective efforts are key for good adaptive governance at subnational/local level. Effective stakeholder engagement is necessary to plan climate policies, particularly for collective actions and facilitating social learning (Preston, 2013). Good governance and institutional processes is a motivating factor for stakeholders’ participation in order to establish trust and relationship among stakeholders (Fukuyama, 2001). Adger et al. (2005) suggested that successful adaptation should balance efficiency, effectiveness, equity and legitimacy. Our study finds that involvement of all related stakeholders such as local farmers, local media, agriculture extension departments, academics working on agriculture, and local and international NGOs are important stakeholders for effective adaptive climate governance at local level. Hence, it is an important element proposed in our framework.

Another striking aspect of proposed framework of the study is incorporation of local and indigenous knowledge in climate adaptation policies and implementation framework. The engage the local community is certainly important but to include their successful measures in governmental policies and plans are essentially required. To include their effective strategies not only give them a trust but also contribute positively to address climate crises amicably at local level. For instance, autonomous adaptation and traditional practices of local community and farmers to deal with climate change can be considered as part of subnational climate policies for agriculture sector. Therefore, it is strongly suggested that such adaptation measures should be the part of public policies and action plans.

Monitoring and evaluation for climate adaptation actions at subnational and local levels are necessary. Pradhan, Su, Fu, Zhang, & Yang, (2017) suggested that the effectiveness of a policy is accessed through a proper evaluation mechanism so that any weak aspects can be identified and they can be addressed well in time. In our study, we found that this is positive side to judge the positives and negatives of climate adaptation policies at subnational level. Hence, our framework proposed that monitoring and evaluation of climate adaptation actions are key for effective governance at subnational level. By such monitoring and evaluations,
the policies can be revised in local climatic context. This will help to bring the novelty in climate adaptation action and ultimately it serves for effective climate governance at subnational level.

**Institutionally Capable**

A number of studies have point out that research and innovation is important for good governance. (Ding et al., 2005) argued that scientific research, information networks, and capacity-building are prerequisite for effective climate change adaptation governance. Our framework proposes that the promotion of research and innovation should be encouraged at local level by involving local educational institutions focusing on agricultural education. The involvement of these local institutions are not only helpful to uncover the climatic impacts on various sectors including agriculture sector but it will also provide a novel, implementable, and acceptable solutions at the subnational level. Therefore, research and innovation in localized educational institutions is a harbinger for effective climate adaptation policies and governance at subnational level.

As discussed above that local institutions are critical for implementation of climate adaptation policies. Effective agricultural policies and capable agricultural extension departments are needed for proper implementation of climate adaptation policies at subnational level. However, it has seen that these institutions are generally weak especially in case of developing world to contribute effectively while managing climate change in local context. Capability building is very important for them. This capability building can be improved by given them a task with proper responsibility, establish a proper mechanism of coordination among these local intuitions and sophisticated links with national and international institutions. Allocation of reasonable financial budget for climate actions is urgent for local agriculture institutions. Finances are always required for climate actions. The lack of finances is a challenge for proper planning which requires additional budgets for more climate-resilient development. Climate adaptation actions require a considerable budget for local agriculture institutions.

**Legally Strong**

One of another important aspect of our framework is legally support for implementing climate adaptation policies at subnational level. These laws are important for implementation of climate adaptation policies for agriculture sector keeping in view there are multiple
stakeholders and multisector such as forests sector, energy sector, water sector, revenue and land departments are involved. The relevant laws keep each department and sector to work in its own sphere. Relevant literature dictates that it is challenging to implement any policy in absence of proper legally backing. For example, in absence of laws certain conflicts can emerge among different departments especially when the policy is based on inter-sector approach.

During two decades, legislations have been developed to implementing climate policies around the world (Lachapelle & Paterson, 2013). Laws are important to restrict to do somethings or allow doing something. Laws create institutional arrangements that define responsibilities for actors to act as per mandate (Campbell, 2004). In case of agriculture sector at local level, such laws facilitate the actors to respond as per legal obligations. Climate change laws can also facilitate the integration of climate change into different aspects of regulation and mainstream climate considerations into multiple institutions and policies, inside and outside government.

In many countries including Pakistan especially in area of climate change, the governance structures has shifted to subnational and local governments from the national level. In the environmental and climate contexts, this shift envisions that subnational entities are actors in global governance in their own right (Andonova & Mitchell, 2010). In the area of climate governance, subnational governments can promulgate laws and new regulations in absence of regulation at the national and international levels (Michaelowa & Michaelowa, 2017). For example, many cities and provinces in various countries such as Brazil, Canada and the USA are more active in legislation matters for climate activities than their national governments (Setzer, 2009).

After the PA, the efforts of subnational governments have recognized and they have different options to continue establishing climate-related commitments and engaging internationally (Allain-Dupré, 2011). Such laws by subnational governments and backing to the local policies are considered positive features of polycentric governance (Mearns et al., 2009). Therefore, subnational governments have important mandate to legislate laws in local context so that effective implementation can be ensured.
These laws are not only required for effective implementation of climate policies but they also ensure accountability and transparency while taking climate actions. Creating stable institutions and improving transparency and financial stability not only sets rules of operation but also contributes to developing countries’ access to international climate finance. Moreover, national legislation lends credibility to governments’ commitments, making the implementation of international agreements both more likely and more meaningful (Averchenkova & Bassi, 2016).

Intergovernmental Institutions Relations

Intergovernmental relations are important for implantation of climate adaptation policies at subnational level, as adaptation requires efforts from different levels of governance. There are inconsistencies between national and local adaptation policies and strategies that are needed to be addressed (Zhao & Li, 2015). Local level governments are always required help from the other tiers of governments for better communication and understanding of the situation. For instance, the national government can provide technical and financial support for agricultural extension departments to improve their capabilities. It has been seen that the agricultural departments and related institutions at subnational level especially in developing countries are facing severe challenges while facing climate change. Therefore, it is important to mobilize national level help and facilitation to local agricultural institutions to effectively address the challenge of climate change.

It is identified in adaptation literature that lack of coordination among the government units are the real challenge for weak implementation of climate adaptation policies at subnational level. For instance, if there is no coordination among the national, subnational and local level then it is likely to fail the implementation of climate adaptation policies subnational level. Impacts of climate change are always multisector and it requires coordinated responses. For example, agriculture sector is linked with energy and water sectors; therefore it requires help and proper backing from these sectors. These responses are from national, subnational, and local levels. The intergovernmental relations are critical for implementing public policies especially when multi-sectorial approaches are involved (Urwin & Jordan, 2008). Therefore, we propose that for effective governance for adaptation policies at subnational level for agriculture sector, the coordination among the governmental pillars to be ensured. Moreover, to keep linkage with international organizations is also very helpful especially to capture technical support and secure funds for global adaptation funds. For example,
Food and Agriculture Organization of the UN can help to local level agricultural institutions with the collaboration of a national government.
Locally Driven

- Engagement of local actors
- Research and innovation at Local academic institutions
- Incorporation of hidden adaptation
- Locally Monitoring and Evaluation

Intergovernmental institutions relations

- National, Subnational, and local level institutional linkages
- Incorporation of International efforts

Legally Strong

- Legal backing for implementing policies
- Legally accountability and transparency

Institutionally Capable

- Allocation of financial budget
- Institutional mechanism of coordination
- Local Institutionalization

Climate Adaptation policies at Subnational level
Thus, as explained above that how the implementation of climate adaptation policies for agriculture sector at subnational level can be made effective by employing the right strategies. The framework is established based on the key challenges for implementation of such policies at subnational level. Based on systemic literature review and observations on climate adaptation governance and implementation challenges for implementation of climate adaptation policies for agriculture sector at subnational level, the key implementation challenges are identified. These identified challenges are divided into four core areas which are essentially the four components of this framework. They are divided into four components because we have seen that the identified challenges can be categorized into four main areas. Moreover, the framework is established in such a way to avoid the complexity of the framework and to keep it simple. The sub-components of the framework are placed based on their relevancy to the major four components. The four sub-components are placed under the component of locally driven initiatives while three sub-components are linked with the institutional capable initiative component of the framework due to the characteristics of sub-components linked with the main components. Likewise, two sub-components for each of legally and intergovernmental relations components are attached based their similar nature of these identified challenges. There is no specific reason to allocate these numbers of sub-components linked with each component of the framework rather the identified challenges are divided into four main groups and then established sub-components based on their nature with the main components.

This is an intriguing framework for subnational government while implementing climate adaptation policies especially for agriculture sector at subnational level. The important components of this framework are locally driven initiatives, capable local institutions, legally backing implementation, and proper intergovernmental coordination with other levels of government. These four major components are well explained in the framework by further dividing each component. The framework is explained in Figure 2.4. This framework can be used in other countries for analyzing the climate policies for agriculture sector and governance initiatives at subnational level. We established a criterion that how each
component and subcomponents of the framework can be ranked and evaluated. The detailed criterion is explained in Appendix A.

The following chapter aims to provide an overview of climate change in Pakistan, its impacts on agriculture sector and other related sectors. It also describes environmental institutions and legal initiatives taken in Pakistan. Moreover, the evolution for climate change policies and climate governance in Pakistan are explained.
CHAPTER 3

Background of climate governance and climate governance structure in Pakistan
3.1 Overview
This chapter is organized as follows. In Section 3.2 overviews and discusses the climate of Pakistan. Section 3.3 explains the impacts of climate change on other key sector in Pakistan while in Section 3.4; impacts of climate change on agriculture sector are described. In Section 3.5, environmental institutions and legal initiatives in Pakistan are highlighted. Section 3.6 concludes this chapter by describing the evolution for climate change policies and climate governance in Pakistan.

3.2 Climate of Pakistan
Pakistan is a South Asian country of over 200 million inhabitants. It has Himalayas and Karakorum mountains in its northern region whereas it is bounded by Arabian Sea in the southern part (Khan, 2010). Pakistan is one of the most vulnerable countries to climate change (Brecht et al., 2012). Climate of Pakistan considerably varies across the country. Pakistan is situated at 23°37′ North and 61°76′ East with an area of about 796,096 square kilometers.

![Map of Pakistan](http://www.maps-of-the-world.net/maps-of-asia/maps-of-pakistan/)

Figure 3.1: Map of Pakistan

In Figure 3.1, a map of Pakistan is shown. This map is taken from an Internet website (http://www.maps-of-the-world.net/maps-of-asia/maps-of-pakistan/).

The climate of Pakistan varies, it has hot-summers and cold-winters. The temperature also varies and it depends on the cities and different locations (G Rasul, Afzal, Zahid, & Bukhari,
One of the reports suggested that generally increase an average temperature is higher in the KPK as compared to Punjab (Lim et al., 2009).

Rainfall is an important factor of climate as it causes floods, degradation of land, destructions of crops, infrastructure and landslides (A. Gupta, Pistorius, & Vijge, 2016). Pakistan has suffered a lot due to heavy rains and many devastating floods in recent years (Abbas, Hussain, Ahmad, & AWajid, 2005). Last decade is an evident that increased rainfall has observed in Asia especially in South Asian region (Salma, Shah, & Rehman, 2012). The KPK province gains very limited rainfall in monsoon season but Punjab receives almost 50-75% rains during the same monsoon period (Siddiqui, Oad, Abbasi, & Gandahi, 2009).

### 3.3 Impacts of Climate Change on Key Sectors of Pakistan

Climate change has posed negative impacts on all major sectors in Pakistan. These key sectors include water, environment/ecology, health, and coastal zones. Pakistan faces severe water crises and the demand of water in the country is growing with every passing day (Kongolo, 2011). Agriculture, urban centers, industry and human health are highly dependent on water (Rahim, Hasnain, & Shamsi, 2010). Climate change is an influencing factor for water resources in Pakistan and in other neighboring countries (Lal, Singh, Rathore, Srinivasan, & Saseendran, 1998). Variation in temperature and changes in rainfall pattern have effects on animals and plants as such climatic conditions may disturb the growth of these species and their living place (Qureshi & Ali, 2011). Rise in water level and rapid receding of glaciers in the Himalaya region is severely threatening the species in these areas such as the Markhor and ibex (Nawaz Khan, 2010).

Climate change has a direct and complex relation with health and it is one of the serious health threats for health in current century (Costello et al., 2009). People belonging to developing or have low income like Pakistan are likely to face the adverse impacts climate change on health (Haines, Kovats, Campbell-Lendrum, & Corvalán, 2006). For example rise in temperature and occurrence of heat waves have been increased the risks mortality especially in poor urban area (Malik, 2013). It has seen in Karachi, many people have been died due to heat waves in last few years.
Karachi is the metropolitan city, where almost 10% of the whole population is living and 40% manufacturing units of the country are situated along the coastal zone (Muneer, Maubleu, & Asif, 2006). This rise in sea level has a direct effect on the coastal areas that happened in coastal dynamic processes including the risk of erosion, flooding, and salinization of ground and surface water (Ghulam Rasul & Ahmad, 2012).

Climate change has an impact on socio-economic activities of the country. Climate change induced negative and harsh impacts on economy (Tol, 2009). Task Force on Climate Change (TFCC) of 2008 prepared by the Planning Commission of Pakistan (PC) on climate change asked to identity and quantifies the climatic impacts on various sectors of the economy. The industrial sector or the business community, the energy sector or transportation, there is a critical nexus between them and ultimately all these poses threats on Pakistan economy (G. S. Khan & Afzal, 1990). There are clear evidences that a strong causality relationship exist between climate change and economic growth in Pakistan (Hussain, Irfan Javaid, & Drake, 2012).

3.4 Impacts of Climate Change on Agriculture Sector of Pakistan

Pakistan’s agriculture sector is a major contributor for its economy. It is indicated that agriculture sector contributes about 23.4% of the total GDP in Pakistan (Imran et al., 2018). Most of population lives in rural areas and their livelihood is totally attached with agriculture sector (Hussain et al., 2012). They also indicated that this sector absorbs nearly 45% labor force and around 65% population of Pakistan is directly or indirectly attached with agriculture sector in the country.

There are two major crop seasons in Pakistan namely Rabi and Kharif. Rabi crops season starts from November to April whereas Kharif crops season is between May to October. The performance of agriculture is highly dependent on climate of these two crops seasons. It is indicated that changes in temperature and level of precipitation affects agriculture sector in Pakistan.

For last few decades high temperature is reported in Asia regions. The agriculture sector is more vulnerable in these regions. Asia and the Pacific are responsible for 37 percent of total world’s emissions from agriculture production. Some of the most vulnerable countries in
these regions are: Indonesia, Pakistan, Sri Lanka, and Vietnam (Kreft, Eckstein, Junghans, Kerestan, & Hagen, 2014)). It is also reported that agriculture sector may disturb the climate (Doraiswamy, Akhmedov, Beard, Stern, & Mueller, 2007). The statistics shows that agriculture sector is responsible for 14 percent of nitric oxide and methane while 18 percent is coming due to deforestation activities for agriculture land use.

Location and seasons are described as important factors for the agriculture productivity. For instance, crops in African regions are more sensitive to even minor change temperature and precipitation affects the agricultural productivity. In empirical studies from Africa shows that rise in temperature has positive effects but less rainfall is negatively affecting net revenues. It is found these observations in in South Africa for crops such as wheat, maize, sugarcane, and groundnuts (Gbetibouo & Hassan, 2005). This Study also suggested that growing season of a crop can be changed as per temperature but it is too likely that such action can cause even the total elimination some crops.

It is reported that agriculture sector is threatened by climate change in Pakistan which is a major sector of Pakistan’s economy (Archer, Forsythe, Fowler, & Shah, 2010). Climate change is negatively impacting the agriculture sector and ultimately severely damaging the economy of Pakistan (Shakoor, Saboor, Ali, & Mohsin, 2011). This sector in Pakistan is affected by many factors including rise in temperature, change in rainfall pattern, and water availability (Skuras & Psaltopoulos, 2012). It is projected with 1˚ rise in temperature will cause (6-9) % decline in wheat productivity (Mustafa, 2011). In last 2 years about 14 events related to climate change has happened and had caused a loss of $ 2 million of Pakistan's economy (Malik, 2013).

It is projected that temperatures is likely to increase 3°C by 2040 and it may even rise 5°C by 2100. If this situation of rise in temperature remains same, the wheat productivity in Asia will be lost almost 50 percent (MOE, 2009). Anthropogenic activities is causing rise in temperature and it is negatively effecting the production of wheat (Janjua et al., 2010) (Janjua et al, 2010). Another study by Shakoor et al., (2011) identified that rise in temperature will negatively affect agriculture production but the impacts of rain fall on agriculture production is positively observed. However, overall situation is disturbing that the analyses of various studies revealed that negative impacts of temperature on wheat crop are much greater as compared to positive impacts from rainfall in Pakistan.
It is noted the negative impacts of climate change on agriculture sector, the decline in agriculture yields cannot be even overcome with the advancement of technology (Kang et al., 2009). In Pakistan climate change is directly affecting the productivity of wheat (A. Ahmad et al., 2015). They further highlighted the importance of wheat crop in Pakistan by identifying that almost 55% consumption of wheat is among the poor masses. The International Food Policy Research Institute identified in its report of 2009 that climate change will posed severe impacts on South Asia and due to these climatic impacts the wheat productivity will be deceased 50% by 2050 which is in fact an alarming situation for agriculture in this region.

It is pointed out in literature that climate change is directly linked with food security especially in developing and under-developing countries. Although, during last two decades 200 million people are pulled out of hunger but still over 700 million people in extreme poverty line. Due to interconnectivity among the regions and interdependency of countries on each other make the situation even complex. Pakistan has highly porous border with Afghanistan which is war zone country for last almost 2 decades. Pakistan is bordering with China and India that are the largest emitters of the GHG.

Various studies identified that Pakistan’s agriculture is under stress. Pakistan is an agriculture supplier to neighboring Afghanistan, Middle East, and several central Asian republicans (I. Ali, Greifeneder, Stamenkovic, Neumann, & Notarnicola, 2015). Pakistan needs urgently to opt for climate adaptation measures for agriculture sector that can stabilize agriculture productivity and fulfill the required demands for agriculture production.

3.5 Environmental Institutions and Legal Initiatives in Pakistan

At the international level, the government of Pakistan always showed commitments to address environmental issues and climate change challenges since the UN took the issue on its agenda in 1972 in Stockholm, Sweden. Pakistan took various institutional and legal measures to deal the challenges of environment and climate change.

In 1983, Pakistan Environmental Protection Council (PEPC) was created with the Pakistan Environmental Protection Ordinance, 1983. However, in 1994, an amendment was enacted in
the ordinance and it gave power to the Prime Minister or the nominee who would be the head of the council. The PEPC was an apex statutory body and it was reconstituted with an enactment of Pakistan Environmental Protection Act (PEPA) 1997. The body had representations from various federal ministries and provincial governments.

The Council had representation from outside the government setup such as Non-Governmental Organizations (NGOs), academics, experts in the area, and related journalists. The main objective of the PEPC was to oversee and approved related environmental policies within the parameters of the National Conservation Strategy (NCS). Moreover, the PEPC was established with the aim to control the pollution and preservation of the living environment.

Pakistan Environment Protection Agency (Pak-EPA) was framed in 1983 under the ordinance of 1983. Pak-EPA was primarily responsible for pollution control. However, its responsibilities and functions were enhanced after enactment of 1997 act. After this act, the agency’s role was enhanced logistically and technically so that it can address the environmental challenges effectively. It also became one of the important institutions to support the Ministry of Environment.

In the same way provincial EPAs were established to control and look the pollution issues related to industries and urban centers. These provincial EPAs were created in all provinces: in 1987 in EPA Punjab, EPA Sindh in 1989, EPA KPK in 1992, EPA Baluchistan in 1995, and EPA Azad Jammu and Kashmir in 2005 were established. Each EPA has a special role in its domain, for example they can use local resources, intervene in local economic sector and can work for promotion of sustainable development.

The establishment of NCS was another great effort which was taken place to response to the efforts of the World Conservation Strategy (WCS). In 1992, the NCS was placed with the aim to raise awareness about environmental challenges in masses keeping in view the low awareness in the society. The main objective of the NCS was to launch various environmental awareness programs. Keeping in view the objectives of the NCS various programs was launched such as environmental awareness spots on Radio Pakistan and other media so that people can understand the importance of the NCS and act as per directed.
The National Environmental Quality Standard (NEQS) was established in 1993 to identify the upper and lower limits for industrial emissions. The initial response of industries sector to lower the pollution was not encouraging. The response was discouraging mainly because the industry was not there while setting these emission limits. Moreover, many industries were not even aware of the actual theme of the NEQS. In order to ensure pollution level low, a self-monitoring system was introduced and set dialogues with the industry so that intended results can be achieved.

Pakistan enacted different laws related to Environment in the country. The PEPA enacted in 1997 and it is considered one of the best environmental laws in developing world. This main objective of the PEPA was to protect and preserve the environment and to take steps for ensuring sustainability and sustainable development.

Apex judiciary was played an important role to ensure environmental rights in Pakistan. For example, to clean environment is included in fundamental rights in Article 9 and 14 of the constitutional of Pakistan in compliance with an order of the supreme court of Pakistan. The Supreme Court passed this order during the hearing of a case between Shehla Zia and the water and power development authority of Pakistan (Kessides, 2013)

At international level Pakistan has shown its keen interests in handling climate change by signing different treaties and legal binding. In 1997 Pakistan ratified the KP which implemented in 2005 to restrict its emissions. After signing this protocol Pakistan is benefiting from clean development mechanism (CDM). The CDM encourages promoting clean production and it contributes to lower the carbon emissions of economic activities.

In 2001, the National Environmental Action Plan (NEAP) was established under umbrella of the NCS. The NEAP was created to focus on four core key programs such as clean water, waste management, clean air, and management of ecosystem. In parallel to establishing frameworks Pakistan established various policies to handle the core issue.

The superior courts in Pakistan are actively playing their role in protection of the environment. In March 2012, the Supreme Court of Pakistan held a conference on the environmental justice (EJ) in Bhurban, Pakistan in collaboration of some international organizations such as the Asian Development Bank (ADB). The conference was attended by
Chief Justices and their designees of some other south Asia countries. The outcomes of this conference were the primary reasons to establish of green courts (GCs) in Pakistan.

The GCs and green benches have been established in all high courts in the country and the Supreme Court of Azad Jammu and Kashmir. These courts are functioning in all provinces to hear cases related to the environment and to provide justice at local level. Some of decisions of these courts are exampled internationally for example in 2015 an important climate change decision by the Lahore high Court (LHC) in Ashgar Leghari case. In this case, a farmer Asghar filed a petition in the LHC demanding that his fundamental rights are violated for not implementing the NCCP. An appellate court in Pakistan granted the claims of Ashgar Leghari, had sued the national government failing to implement the NCCP and the Framework for Implementation of Climate Change Policy (2014-2030).

Similarly the NGOs- working in area of climate change are also playing an important role to highlight the issue of climate change and provide some policy suggestions and advocacy to national and provincial governments. These major organizations are Sustainable Development Policy Institute, the Leadership for Environment and Development, the International Union for Conservation of Nature, and World Wildlife Fund (WWF), the United Nations Development Programme (UNDP), the ADB and international center for integrated mountain development. These organizations are contributing their role in managing the issue of climate change in Pakistan. All these organizations are giving their inputs to government for setting policies and actions plans in the form of different reports, advocacy, and conducting seminars on the crucial issue of climate change. Individuals from civil society are also playing their significant role in streamlining such movements.

People working in area of climate change have a vital role to establish and strengthen such movements. Different research scholars and students of universities highlighted climate change and its implications and bring the attention of government and society to address this challenge. Such academic and empirical research work not only has an instrumental role while formulating the policies and action plans but it also raise awareness in the community for dealing the climate change.
3.6 The evolution for Climate Change Policies and Climate Governance in Pakistan

Pakistan government has shown interests to play an effective and important role to mitigate and adapt to climate change by establishing various climate policies at national and subnational level, particularly in its four provinces, Azad Jammu and Kashmir, Gilgit-Baltistan. Pakistan adopts three folds policy strategies that are at local, national and international levels. At local levels different non-organizations are operating in the country. In this section we discuss some of the policy initiatives related to climate change that have happened in Pakistan.

Pakistan has also established climate institutions, enacted climate laws, and signed various international legal bindings and treaties. Many NGOs, civil society organizations, academics, think tanks and other pressure groups related to climate change have emerged in Pakistan. Ministry of Climate Change (MoCC) at federal level is the central body that is responsible to deal all climate change related activities at international level and establish a coordination mechanism among the subnational/provincial governments. It also oversees the implementation progress of the provinces by regularly arranging meetings with them.

According to Pakistan’s MoCC “The ministry also deals with other countries, international agencies and forums for coordination, monitoring and implementation of environmental agreements”. The ministry is backed by the PC. The PC contributes for making and establishing national plans and it has a key role for evaluating and monitoring the developmental projects and programs. Below table 4 shows the history of institutionalization of climate change in Pakistan.
Table 4: History of Institutionalization of Climate Change in Pakistan

<table>
<thead>
<tr>
<th>Year</th>
<th>Accomplishment</th>
<th>Purpose and/or Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>Environment and Urban Affairs Division established at the Federal level</td>
<td>Follow up to Stockholm Declaration June 1972</td>
</tr>
<tr>
<td>1983</td>
<td>Pakistan Environment Protection Ordinance enacted</td>
<td>First comprehensive environment-specific legislation</td>
</tr>
<tr>
<td>1989</td>
<td>Environment and Urban Affairs Division upgraded to Federal Ministry of Environment, Forestry, and Wildlife</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Cabinet Committee on Climate Change established</td>
<td>Acted as policy coordination forum for climate change</td>
</tr>
<tr>
<td>1997</td>
<td>Pakistan Environmental Protection Act enacted</td>
<td>First environmental act of the country</td>
</tr>
<tr>
<td>2002</td>
<td>Global Centre for Impact Studies on Climate Change established</td>
<td>This research center on climate change functioned for 10 years as a development project</td>
</tr>
<tr>
<td>2004-2005</td>
<td>Prime Minister Committee on Climate Change convenes National Environment Policy</td>
<td>Includes Prime Minister, Ministers of Water and Power, Food and Agriculture, Science and Technology, Environment, Planning Commission, Special Advisor to the Prime Minister</td>
</tr>
<tr>
<td>2010</td>
<td>18th Amendment to the 1973 Constitution</td>
<td>Devolution of power to the provinces</td>
</tr>
<tr>
<td>2011</td>
<td>Ministry of Environment ceases to exist New Federal Ministry of Disaster Management established</td>
<td>Functions transferred to the Planning Commission</td>
</tr>
<tr>
<td>2012</td>
<td>Ministry of Disaster Management renamed to the Ministry of Climate Change National Climate Change Policy approved by Federal Cabinet Punjab and Balochistan Environmental Protection Act prepared and enacted “Green Benches” established in all High Courts and Supreme Court of Pakistan by the Chief Justice of Pakistan National Disaster Management Plan approved National Sustainable Development Strategy</td>
<td>Elevate climate change issue to a cabinet level portfolio A dedicated policy on climate change Deals with environmental cases, 2013 decision prioritizes environmental cases in the High Courts</td>
</tr>
<tr>
<td>2013</td>
<td>Ministry of Climate Change downgraded to Division of Climate Change Global Climate Change Impact Studies granted autonomous status National Disaster Risk Reduction Policy approved</td>
<td>Becomes part of Cabinet Secretariat Serves as the secretariat for the Prime Minister Committee through “GCIISC Act 2013”</td>
</tr>
<tr>
<td>2014</td>
<td>Framework for Implementation of Climate Change Policy adopted</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>Division of Climate Change upgraded to the Ministry of Climate Change</td>
<td>Federal focal ministry on all climate change-related issues</td>
</tr>
<tr>
<td>2016</td>
<td>National Forest Policy</td>
<td></td>
</tr>
</tbody>
</table>

2017-18   | Climate Change Act                                                            | Establishment of Climate Change Council Establishment of Climate change Fund Establishment of Climate Change Authority |

At federal level, initial national communication report to the UNFCCC was developed in 2003 by national government in consultation with other stakeholders. It highlights the efforts of Pakistan to confront climate change. Moreover, it envisioned the required policies and plans related to climate change in the country. This document described all the major vulnerable sectors to climate change and proposed measure to overcome the challenges in each sector.

In 2005 national environment policy was set to counter the environmental issues in the country. The policy provided 171 policy guidelines for protecting, conservation restore and effectively manage resources related to environment of the country. It particularly focuses to tackle contamination of clean water, waste management system, deforestation, and others.

In 2006, the national energy conservation policy (NECP) was developed. The NECP was framed to address the energy related challenges in the country and establish a framework so that conversation of energy can be maintained. It took initiatives to not only to overcome the energy crises in Pakistan but also focused on energy efficiency and renewable energy. Based on the NECP, the implementation framework was also established to actually operationalize the policy. In 2008 the PC, formed the TFCC. The TFCC was comprised of different shareholders including climate experts and civil society members, climate researchers, and academics. It issued a comprehensive report stating that the actual impacts of climate change on Pakistan and demanded concrete actions for fix the issue of climate change in Pakistan. It gave a very detailed overview of climate change scenarios in Pakistan and proposed certain recommendations to tackling climate change amicably.

National Climate Change Policy of Pakistan (NCCP) was established in 2012 based of TFCC’s recommendations. The policy attempts to effectively manage the issue of climate change by providing guidelines and required climate actions. The policy measures recommended in the NCCP are related to various sectors including water, agriculture, biodiversity, disaster preparedness, and energy and so on. It was a positive move to establish the NCCP and Pakistan was named as one of the few developing countries that have established climate policy.
Based on the NCCP, the implementation framework for national climate change policy (IFNCCP) is set in 2013. The framework was prepared based on the NCCP and it suggested various adaptation and mitigation measures and actions. It was a good effort by the federal government to prepare such a document but it could not give the intended results for its effective implementations. It is because the provincial governments are the implementers for climate policies and they did not own the framework as it gave directions for whole country.

All the provincial governments are establishing their own climate change policies and action plans as per their requirements. The NCCP and IFNCCP are important for subnational governments to get guidance before establishing their policies at local level. The provincial governments of the KPK and Punjab have already established their own provincial climate change policy (PCCP) in 2018. However, other provinces are still in process of framing their own climate change policies. These are multi-sectoral policies and cover all the related sectors which are affected by climate change. The implementation frameworks for PCCPs are also in progress in the KPK and Punjab.
CHAPTER 4

Research Methodology
4.1 Overview

This chapter is organized as follow. In section 4.2, we discuss background of research methodologies and explained different techniques for conducting research for analyzing the case studies and testing the framework described in the previous chapter. Section 4.3 describes case study method which is the method employed for our study. This section also explains why case study is best suited for our study. Section 4.4 explains data collection methods, respondent section followed by the methodology framework used in this study.

4.2 Background of Research Methodologies

Before explaining case study, the methodology to be used for this study, we provide an overview of research methodologies and their application. Broadly there are three research approaches which are qualitative, quantitative, and comparative (Sung, 2011).

A qualitative approach is a “distinctive research strategy that usually emphasizes words rather than quantification in the collection and analysis of data” (Bell, Bryman, & Harley, 2018). Qualitative research is a process of understanding which explores a social or a human problem based on distinct and methodological traditions of inquiry. In this technique researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants and conducts the study in a natural setting (Soklaridis, 2009). For qualitative analysis or research the data is collected by the researcher and analyzed using appropriate qualitative methods.

On the other hand, quantitative research is a “distinctive research strategy that entails the collection of numerical data and exhibits a view of the relationship between theory and research as deductive” (Dannhauser, 2007). Some of the dominant research methods for a quantitative research are: structured interviews, surveys or questionnaires, and quantitative data analysis using statistics (Sung, 2011).

The third approach is comparative research. This research design is currently recognized as the third major research strategy to understand the comparative cases (Johnson, Onwuegbuzie, & Turner, 2007). This research approach incorporates both quantitative and qualitative data collection and analysis methods (Metcalf, 2009). The concept of mixing methods was first introduced by Todd D. Jick in 1979 as is concerned with different cases to
study the similarities and differences and to analyze how cases are combined or differentiated to get outcomes (Ragin & Amoroso, 2010).

4.3 Research Methodology

The type of methodology adopted by any research depends upon the central research objective and research questions. We employ case study method for this study which is a qualitative research. Case study method is an appropriate approach for this study as the strength of qualitative research is its ability to uncover things that are not apparent. Wagenaar & Babbie, (2005) explains qualitative research as “a hands-on process, which involves going to the scene of the action and checking it out.” It is therefore well suited approach of policy investigation where comprehensive perceptions need to be collected. Finch, (1988) describes that qualitative research has two prime strengths for policy-oriented research, firstly, it provides descriptive insights with a range of evidence and it is complementary to quantitative analysis. The investigation in this study is exploratory by employing case study methods. To study two or more cases in a case study is important to understand and explore the right situation for area of investigation.

In this researcher multiple cases are studied to understand the similarities and the differences between the cases (Baxter & Jack, 2008). It is also indicated that the researchers are in a better position to analyze the data both within and across situations (Yin et al., 2014). Yin (2009) further argued that multiple case studies can be used to either augur contrasting results for expected reasons or either augur similar results in the studies.

By studying diverse perspectives of different cases, a researcher can clarify whether the findings are valuable or not (Eisenhardt, 1991). While comparing the cases, the investigator can identify and can provide the literature with an important influence from the contrasts and similarities (Vannoni, 2015). It is noted that evidence created from a multiple case study is measured strong and reliable (Baxter & Jack, 2008). Other important advantage of analyzing multiple cases is to provide a strong and convincing theory when the suggestions are more intensely grounded in several empirical evidences. Therefore, multiple case studies allow wider exploring of research questions and theoretical evolution (Eisenhardt & Graebner, 2007).
In the case study method, an in-depth investigation is conducted to understand the real-life context of an individual, group, organization, phenomenon or project, relying on multiple sources of evidence (Yin et al., 2014). He further suggests that multiple case studies are preferable, may be only with two cases, to a single case study as they provide substantial analytical benefits. Therefore, we choose the two provinces as our case for understanding the climate adaptation governance for agriculture sector. We choose the targeted provinces mainly due to the following three main reasons.

Firstly, both the provinces are highly dependent on agriculture sector. Secondly, they have shared agro-ecological zones. The agro-ecological zones are established by National Agriculture Research Council of Pakistan and the classification of the zones was set on the base of climate, land use, and water use. Thirdly, it is accessible and more convenient to collect the related data for our study so that we selected these provinces. It is important to select the respondents for interviews.

4.4 Respondents Selection and Data Collection

In social science research respondents can be individuals, groups or communities, depending on the profession they belong to (Kumar, 2005). He further defines respondents are those who can provide information to the researcher to understand the issues being investigated. The scope of this study is two provinces that are Punjab and the KPK. Therefore, the research targets related officials and stakeholders from these two provinces and also some from federal level. These officials and stakeholders include policy experts, government officials, think thanks working in the areas, NGOs, academics, MoCC, environmental protection agencies in the respective provinces, farmer community, civil society, and climate change activists in both the provinces. See details of the respondents in Appendix C.

The selection of policy makers is targeted because they are relevant authority on climate change in Pakistan. They were involved all related policy matters and they are well aware of each development related to climate change at federal level as well as on provincial level. Moreover, they have rich experience of framing climate change policies and action plans in Pakistan.

Government officials in both provinces and in the MoCC are selected as respondents because they are actually involved in the climate governance for agriculture sector in both the
provinces. At federal level, these officials are from the MoCC, it is chosen because the ministry is the major stakeholder of climate change governance in the country. It is the ministry who oversee the international treaties and presents Pakistan.

Think tanks related to climate change in case of Pakistan are important respondents because they are practically involved in climate policy activities, advocacies to the subnational governments, and giving training to other stakeholders. Likewise, related NGOs and civil society organizations are also important because these all are focusing climate change and adaptations.

Since the study addresses the issue of climate governance at subnational level, climate science and policy are much relevant. Therefore, it is important to gain perspectives local academic institutions that have role to play to address climate change being a stakeholder. The selection of academics was based on their relevant specializations. For example, Agriculture University of Faisalabad and Pir Mehr Ali Shah Arid Agriculture University Rawalpindi are from Punjab and agriculture university Peshawar and Environmental sciences department from University of Peshawar are from the KPK. The interviews were conducted with individuals who are actually working on climate change and in related area.

Additionally, all other respondents are also chosen based on their work on climate change and they are key stakeholders in climate adaptation governance in both the provinces. For instance, agriculture extension departments are selected as they are the local main stakeholders and they are very much linked with local farmers.

The respondents are selected using the purposive and snowballing techniques. The respective respondents are approached through the networks of the author. Purposive sampling is most suitable appropriate for this case study research because it allows to collect information from the individuals who have comprehensive work experience in area of climate change and governance and they can share their insights and valuable perspectives. The snowballing approach is also utilized for the study to allow for the selection of additional respondents who were suggested by some of the respondents who are chosen through purposive techniques.

In order to arrange the interviews with respondents, they were contacted by email or by telephone. The purpose and objectives of the study were explained clearly during the initial
contacts. Interviews were only done with the respondents’ full consent, including the consent of their employment supervisors if required. A written form of consent was created so that the respondents can sign and show their agreement for interview (see Appendix B). A written form of consent and ask the respondents to sign it is not cultural norms in Pakistani society. However, verbal consent was there and it is acceptable.

Each interview started with the researcher to explain the interviewee about the objective of the study, the interview process and timing. The confidentiality of the shared information, thoughts and perceptions was guaranteed through verbal agreement as written agreement is not a societal norm. During the interview flexibility was ensured so that additional questions could be asked if necessary according to what was emerging during talk. Wagenaar & Babbie, (2005) argued that qualitative interview is a conversation in which a researcher triggers the conversation with questions on the study topic and ideally does not use more than five per cent of the interview time for asking the questions. Babbie (2005) further highlighted that it is important to adopt and respect the respondents’ beliefs, at least temporarily, in order for the interviewer to be immersed in the investigation. This advice was taken into account during the interview process.

The study was conducted for November, 2016 to April, 2017. In this phase, six exploratory interviews were conducted in Pakistan with government officials and policy experts to understand the broad perspectives of climate change adaptation in the respective provinces. Keeping in view the previous steps, literature reviewed and research question, 36 in-depth semi-structure interviews was conducted with respondents. Each interview lasted for 60 minutes to 90 minutes. Mostly interviews were conducted in English but some interviews were in Urdu especially with farmers. After the interviews were completed, the interview notes and key observations were reviewed and summarized using the interview guide and translated into English if it is in Urdu.

4.5 Proposed Framework and Analysis of the Cases
The framework is established by reviewing the related literature and identifying the gaps and challenges for implementation of climate adaptation policies for agriculture sector at subnational level. The components and subcomponents of the framework are essentially the challenges of implementation of such policies at subnational/provincial level. As such, the
framework is the product of both inductive and deductive reasoning and it is also based on the existing literature on specific observations in the field. The established framework which is explained in chapter 2 is used to test for our cases of Punjab and the KPK provinces. The adaptation governance initiatives in both the provinces are evaluated against the given four components of our proposed framework. Based on this analysis the findings and results of our study are prepared and conclusions are drawn.

**Research Questions**
What are the key governance challenges in implementation of adaptation policies at subnational levels?

1. What are different initiatives are taken at planed level and at autonomous level in the province of Punjab and province of the KPK?
2. To apply the established framework and analyze the governance measures for agriculture sector in the province of Punjab and in province of the KPK?

**Research Objective**
To analyze climate adaptation governance level by developing a framework for agriculture sector at subnational. This framework is applied on the case of Pakistan by looking at the province of Punjab and the province of the Khyber Pakhtunkhwa.

**Research Methodology-Case Studies**
Critical reading of various literatures to establish framework along with specific observations in the field. Embedded case studies from two provinces on climate adaptation governance, engagement of relevant stakeholders for interviews at provinces and federal level.

- Review and analyze collected information in the form of interviews
- Analyze the cases against proposed framework of the study

Figure 4.1 Research Framework
CHAPTER 5

Results and Analysis
5.1 Overview
Pakistan has taken multiple initiatives to govern the issue of climate change at national and provincial levels. After 18th constitutional amendment in 2010, subnational governments became responsible to deal with climate change. However, at the federal level the MoCC is set to oversee the progress on climate change implementation mechanisms in Pakistan, to play a role of bridge among the provinces/subnational level, and to coordinate and present Pakistan at international level. Section 5.2 describes the climate governance structure at federal level and highlights the role of international organizations. Section 5.3 uncovers the climate governance structure in Punjab province while section 5.4 explains the system of climate governance in the KPK. Lastly, the chapter is concluded with discussion local adaptation and drivers behind adaptation in both provinces.

5.2 Climate Change and the Role of Federal Government and International Organizations
The MoCC at the federal level is also a stakeholder with provinces for managing climate change in Pakistan. The ministry at the federal level is also partially involved in the interaction process. Although, it is not the responsibility of national government in Pakistan to formulate and implement aspects of climate change policies and action plans but it oversees the international obligation and legally binding elements of provisions in national laws. A committee composed of all provinces and federal units’ representation arranges a quarterly meeting at the ministry to discuss the overall achievements to curb climate change in the country. So far 15 meetings have been arranged at the ministry since its establishment.

The ministry is not directly involved in implementing climate actions in the country. However, it can give guidance and support to the provinces for effective governance. After 18th constitutional amendment, provinces in Pakistan are responsible for implementing of climate change and other related policies. A detailed organizational analysis of the bureaucracy for addressing climate change in both provinces allows us to understand the interactions, patterns, and outcomes in the form of governance. The governments in the both provinces are still in a new phase of absorbing and understanding the responsibilities and functions of decentralization. The provinces got more autonomy in 2010 when the 18th constitutional amendment was promulgated in Pakistan. To some extent participation from different actors are seen in decision making, establishing a policy, or framing an action plan.
5.3 Climate Governance in Punjab

Punjab is geographically located approximately at 30°000 N, 70°000 E in the semi-arid lowlands zone (Ahmed, Malik, Ramay, Munawwar, & Pervaiz, 2011). It is the second largest and the most populous province in Pakistan. Punjab has fertile agricultural land which holds an extensive irrigation network and plays a leading role in the development of the economy (Abid, Ashfaq, Hassan, & Fatima, 2011). The province accounts for 56.2% of the total cultivated area, 53% of the total agricultural GDP and 74% of the total cereal production in the country (PBS, 2010). Punjab mainly contributes for agricultural sector in Pakistan. It has about 57% share of agricultural land and contributes for 53% of total Pakistan’s agricultural GDP (Hanif, Syed, Ahmad, Malik, & Nasir, 2010). Agriculture sector in Punjab is facing negative impacts of climate change. Adaptation strategies in agriculture sector are an important response to climate change in Punjab province. It has been pointed out that agriculture adaptation measures can reduce losses (Di Falco, 2014). The subnational government of Punjab is taking adaptation steps to tackle climate change.

Punjab is comparatively established province in Pakistan. It has better institutional setup in as comparted to other provinces in the country. Figure 5.1 presents structure of climate governance in Punjab province.

![Figure 5.1: Structure of climate governance in Punjab province. Source: Punjab Climate Change Policy Draft.](image-url)
All the related sectors are presented in the governance structure including agriculture sector which is the most important sector for Punjab province. However, the impacts of climate change are interlinked; therefore every sector has its own importance. The question is why the institutional governance structure is better in Punjab as compared to other provinces? Punjab was an established province even at the time of independence of Pakistan in 1947 due to its economic role and geographical importance. It has major contributions to the economy of Pakistan and is the most populous province in Pakistan. Keeping in view the economic role and industrial contributions, Punjab remains the focus of all the federal governments in Pakistan. Therefore, institutions were established, their capacity was developed, and their weaknesses were addressed with the passage of time. However, this does not mean that Punjab is an exemplary province to deal with climate change but it is institutionally better as compared to other provinces of Pakistan.

### 5.3.1 Planned Level Initiatives in Punjab

The Punjab government has launched an awareness campaign about climate change and agriculture. They have set up a radio station, which gives information to farmers about weather conditions. The station broadcasts multiple programs to increase farmers’ awareness about climate change, its impacts on agriculture sectors and possible strategies to confront the challenge. The impact of this radio station has been positively observed in the province. For example, many farmers are regularly tuning into the radio for information about weather conditions, planting dates, and to know how they will be affected due to climate change. Some of interviewees told us that they are regular listeners of the radio because they get valuable information, such as, climatic conditions, advice about fertilizer use and seeds, and government subsidy schemes for the farmer community. In some programs, climate experts and agro experts among others are invited to discuss climate change, its impacts on agriculture sector and possible solutions. One farmer told us that he regularly follows such programs on Radio because it is helpful to get novel ideas and best practices from agricultural experts.

The government has set up a formal mechanism to give practical training to the farmers. They arrange sessions with the farmers to teach them based on scientific data how climate change is threatening agriculture sector. Agriculture extension departments which work closely with the farmers at local levels collect data from the fields and gives training to the farmers at
local levels. One of our respondents of agriculture extension department from Faisalabad told us that they have trained over 250 local farmers since 2015. Based on these initiatives, the farmers are able to execute what they learned in their farming practices. For instance, they are advised that they should plant seeds which have been tested in scientific labs and shown to have the capabilities to survive severe weather conditions. It is noted that many trained farmers approached the agriculture extension departments to obtain suitable seeds with respect to weather conditions. We were told by the agriculture extension department in Faisalabad that after attending the training programs, the farmers’ community is encouraged to approach the department for more information about climate change, suitable seeds, and solutions for damages due to pests and extreme weather.

Research and innovation have played a key role in the set of actions aimed at promoting adaptation. Research and innovative techniques are already in place for agriculture adaptation in the province, where experiments have been conducted to find the best varieties of seed that can survive extreme weathers. The government is providing the best varieties of seeds which can survive in hot seasons and produce good results. For instance, the Punjab Seed Corporation is established to provide quality seeds to the farmers according to the conditions of climatic zones in various parts of the province. The subnational government is focusing on research and innovative strategies to address the impacts of climate change. At the institutional level, they are giving training to government officials so that they can comprehend the situation more amicably and address the situation scientifically.

Institutional capacity is important for the implementation of any policy, programs or plans. They arrange proper training for the people working in the area of climate change in order to understand the actual scenario, especially the impact assessment of climate change on the agriculture sector in the province. It is very likely that well trained staff will play a key role in bringing positive results for effective handling of climate change. Engagement of other stakeholders, especially academics, is another core agenda of government.

Academics in the province are contributing and conducting studies on climate change and agriculture sector. For example, Agriculture University of Faisalabad has published some work on climate change adaptation and highlighted the importance of adaptation in the province. The university has linkages with international institutions on climate change research. The linkages with international institutions provide opportunities for the professors
and researchers at the university to learn innovative adaptation techniques from other parts of the world. They can put into practice in Pakistan the relevant activities they have learned for climate adaptation towards agriculture sector.

Coordination among relevant line departments is essentially important for the implementation of any policy. The subnational government of Punjab has established a link among the 26 agriculture institutes throughout the province in order to set up comprehension strategies for climate change and the agriculture sector. They regularly arrange meetings among these institutes to discuss the new challenges and the existing strategies to manage the negative impacts of climate change. For instance, the Ayub Agriculture Research Institute (AARI), manages climate change related activities, is well familiar with what is happening in the agriculture extension departments at various levels and vice versa. By being aware of the activities of agriculture extension departments and others, the AARI can disseminate the positive activities among other institutions and set new targets accordingly.

The provision of financial help to farmers can be helpful when they are facing challenges, such as weather irregularity. On the part of the government, it is providing certain subsidies to the farming community. For example, it provides the farmers with the best seeds and best quality fertilizers keeping in view the exposure of fields to climate change at nominal prices. The farmers’ community is also contributing by handling climate change through their adaptation practices.

### 5.3.2 Autonomous Level Initiatives in Punjab

Apart from planned level adaptation, autonomous adaptation is also seen in Punjab province. Farmers in Punjab region were in view that climate change is happening and affecting negatively their crops and livelihoods. The majority of the farmers reported a decrease or uncertainty in crop yields. These negative impacts are due to the consequences of climate change. It has seen that farmers at farm level is adjusting and adapting with the situation.

Changing seeds types, changing sowing dates, looking for new fertilizers and planning shade trees are the key adaptation strategies are observed in this study. However, some farmers do not adopt any measures due to some constraints reported by farmers, such as lack of information, lack of financial assistance and limited resources. Although, there is a
massive level awareness campaigns about climate change in Punjab but still there are localities or rural areas where this information is yet to reach. Therefore, it is required to further extend the awareness system to the local or union council level.

Our study also identified the drivers behind the autonomous adaptation in Punjab. We found that it is the experience; enhance productivity, and knowledge sharing in the farmers’ community which encourages them to opt for these adaptation actions at their farm level.

Impacts of climate change are obvious in the province on crops. It is noted that the farmers were keep experiencing new local techniques to adapt with changing climate. For instance, one of the respondents informed us that he experimented in a season a new type of seeds and it remained a successful as his new crop survived and gave better outcomes as compared to previous crop. He tried to keep changing not only the type of seeds but also crop types. This experience gave him motivation to keep trying new kind of strategy. He further told us that the farmers’ community in his area also arranging adjustment in sowing time as per climatic condition and this is also a helpful strategy. Therefore, this shows that how experience of the farmers’ community is playing a driving role for autonomous adaptation in the province.

It is reported that productively are decreasing with every passing year in the province due to climatic impacts. We have seen during our field trip, the major focus of the local farmers is to maintain and enhance their productivity of crops especially wheat crop. This is one of the main factors which forced the farmers to act against the changing climate. Therefore, enhancement of productivity of crops is a contributing factor for autonomous adaptation in Punjab province.

An important strategy was uncovered that farmers’ community has been sharing their experiences among each other. The other farmers also follow the same successful experience that he learnt or heard from somebody else. For example, in our study it was reported by a farmer that one hears from another local farmer that by changing the type of crop, we can eliminate or reduce the losses that was happening due to high temperature, unexpected rainfall, or/and floods. He tried to change the type of crop in next season and there were no losses rather it was the profitable year for him. This is how the autonomous level adaptation is happening in the province.
5.4 Climate Governance in the KPK

The KPK is formerly named as North West Frontier Province. It has versatile weather and climate of the KPK varies, it is dry rocky and hot sandy plains in the south while snowy peaks and lush green forests in the north. According to climatic variability, the KPK is divided into three ecological zones that are the southern, the central and the northern zones. The KPK is one of the most effected regions due to mega floods back in 2010 in Pakistan.

Agriculture is the major livelihood of the people in the province. Agriculture sector contributes for 48 percent of the total labor force and contributes 40 percent to the GDP of the province (S. A. Khan, 2012). Climate change is posing adverse impacts on agricultural productivity throughout the KPK.

Rise in temperatures, changing rainfall pattern, increased variability of monsoon, changes in availability of irrigation water, severe water-stressed conditions are the few major stresses that are impacting on agriculture sector in the KPK. Moreover, extreme events, such as floods, droughts, heat waves and cold waves are also responsible factors which are creating serious hurdles for agriculture sector in the KPK. To manage the issue of climate change in the KPK is set to establish multiple initiatives in compliance with federal policies and plans. The climate related institutions are emerging and are in line to perform more effectively to manage climate change in the KPK. Figure 5.2, presents climate change related institutions structure in the KPK province.
Figure 5.2: Organizational Chart of the KPK Climate Change Bureaucracy. The lists of members of Advisory Committee and implementation committee are given in Appendix D and Appendix E.

The diagram shows the interaction between various organizational units in the KPK on climate change policy involves extensive consultation and involvement of many stakeholders. An official at the climate change cell (CCC) informed us that the concerns of all the related departments and stakeholders were fully addressed before sending the policy to cabinet – a point which has been validated by stakeholders as well. This clearly shows that the local institutions are getting space in decision making, policy formulation and policy action that allow for more effective adaptive governance in case of climate change shocks. Another
salient aspect of the KPK’s approach is to involve and incorporate local knowledge and practices in action plans to deal with climate change. The government is exploring the adaptation strategies of farmers at local level so that their traditional knowledge and effective local practices can be well utilized for upcoming action plans.

5.4.1 Planned Level Initiatives in the KPK

The subnational government of the KPK is working to tackle the impact of climate change in compliance with set policies and action plans at federal level. It has introduced multiple measures to tackle climate change in various sectors including agriculture sector.

The government established the CCC in the EPA in Peshawar which is responsible to deal all the related matters of climate change in the province. The scope of this cell is quite huge, it works from establishing the climate change policies and action plans at province levels to coordinate to federal level and to someway with international bodies.

In 2018, government of the KPK has framed the PCCP which is considered a prominent initiative for handling climate change in the province. The policy provides a way forward in the fight against climate change in the province. Moreover, some other important measures are taken at adaptation and mitigation fronts in various sectors specifically for agriculture sector.

We found that government has launched some programs for awareness of climate change and agriculture adaptation in the KPK. For example, multiple seminars are arranged in various regions of the KPK to highlighting the impacts of climate change and importance of adaptation strategies for agriculture sector. So far these seminars are arranged in 12 universities throughout the province and still the process is in progress. The rationale behind arranging these seminars with university are not only to disseminate information about climate change but to engage academics for further research and their inputs while framing upcoming adaptation action plans and strategies at the local levels. To engage and educate farmers in this fight is highly important as the farmers’ community is the major victim.

Various seminars and training are arranged with local farmers keeping in view the low knowledge of farmers about climate change and its impacts on agriculture sectors. We noted during our interviews with farmers that the majority of them in the region do not much about
the impacts of climate change. Therefore, such seminars and training are important for them. In the training programs, they are introduced how to confront the likely impacts of climate change on their crops and how they can protect their crops in extreme weather, heatwaves, floods etc. For example, they are informed to follow the planting dates according to the announcements of the local agriculture departments in the province.

In the province, climate change risk assessment, although in nascent stage but already initiated. The impacts of climate change on many sectors especially on agriculture sector is being studied and shared with farmer community. For example, few studies have done so far to analyze the impact of climate change and agriculture sector in the KPK. Climate change related data is collected and shared with related stakeholders. Moreover, local metrological departments are always share the weather forecast so that the farmers can adjust their planning according to weather and climatic conditions.

The subnational government has taken several initiatives to involve academics for managing climate change. It is planned various climate change related courses will be offered in academic institutions. Various universities in the province are already working to highlight climate change. For instance Agriculture University Peshawar is doing and analyzing multiple aspects of climate change and its impacts on agriculture sector. Likewise few other universities and related departments in the universities are engaged in such research. The purpose behind engaging academics in climate change is to get scientific knowledge for formulation of further adaptation action plans in the province. The engagement and contribution of the multiple actors is essentially required for suitable planning and concrete actions.

Certain international and local NGOs are also working in area of climate change adaptation. For instance, climate change research center at Agriculture University Peshawar is a notable research center which is coordinating research activities of climate change, creating linkages with national and international research institutions and to actually train local farmers. One of the important works of this center is to develop district-wise climate scenarios which are very important for establishment of local adaptation action plans. Some other international organizations are also providing assistance for policy research and advocacy for climate change adaptations for agriculture sector in the province. Moreover, the local farmers’ community is also involved in adaptation practices in agriculture sector.
5.4.2 Autonomous Level Initiatives in the KPK

Apart from planned adaptation, autonomous adaptation is also taking place in the province. Although, majority of farmers have very limited or no knowledge of climate change in the KPK but still they opt several adaptation techniques. These practices majorly include changing planting dates, changing crops types, changing fertilizers, and planting shade trees. It is important to know that the drivers behind these autonomous initiatives in the KPK are the past experience and knowledge sharing of effective practices among the farmer community. For example, in one season one of the crops was destroyed in an area called Swabi due to more precipitation, next time they went for another crop and it was successful. This experiment showed them that by changing the crop type, their damages and losses could be minimized or eliminated. To change the seed type and changing fertilizers are seen as very common practices throughout the province. Likewise, some farmers have planted shade trees as another strategy to save their crops.

It is identified that adaptation to climate change for agriculture sector in the KPK is taken place at the planned levels as well as at the autonomous level. Certain actions are initiated by the provincial government in the form of establishment of the PCCP, awareness rising, establishing science linkage with climate change, involvement of other actors, allocation of budget for the climate change. However, the province is lacking capacity at multiple fronts and some other hurdles as well. For example, in terms of carrying out research work, developing human capital and institutional capacity, and lack of coordination among the departments especially at horizontal and vertical level are some of the main challenges in the KPK.

5.5 Local Adaptation and Drivers behind the Actions Taken

In parallel with governmental initiatives, the farmers’ community is also taking steps for climate change adaptation in agriculture sector in both the subnational governments. It is important to point out that local farmers are actively involved in autonomous adaptation in the both provinces and the subnational governments also encourage engagement of farmers in climate adaptation policies. For example, in both the provinces the farmers are changing their planting dates due to heat/rise in temperature or unpattern rainfall.
Some other have changed the variety of crops as the farmers opt for the crops which are heat tolerant and have less damages in case of floods, droughts or heat waves. Changing fertilizers and planting shade trees are other strategies adopted by the farmers’ community. In both provinces more or less the autonomous initiatives are same. Four important elicited autonomous adaptation initiatives are taking place: changing planting dates, changing crops types, changing fertilizers, and planting shade trees.

The deriviers behind the planned and autonomous initiatives in both the provinces are climatic impacts, political will, coordination among the line department, research and innovation, role of academics and the NGOs, and some local pressure groups. It is observed that these adaptation initiatives vary in both provinces and the dominance of each initiatives is driven by certain factors. These differences at planned level adaptation are dominantly driven by commitment and coordination among the respective departments, linkages with the NGOs working in the area, engagement with academics, and availability of financial resources. On the other hand autonomous initiatives of two provinces are essentially similar. These autonomous initiatives are majorly driven by the previous experiences of farmers, sustainability in agriculture production, and the knowledge sharing among the farmer community.

This chapter majorly focused on climate adaptation governance in Punjab and the KPK. We were able to comprehend the initiatives taken either at planned level or autonomous level in both the provinces. In our next chapter, we apply our established framework on the cases to understand the implementation of climate adaptation governance for agriculture sector in Punjab and in the KPK.
CHAPTER 6

Discussion
6.1 Overview

Effective Governance at subnational level has been instrumental for tackling the negative consequences of climate change. In previous chapter, we identified climate change governance initiatives for agriculture sector in the both provinces. This chapter is dedicated for discussion which is mainly focusing on the prominent aspects of climate governance identified in our study. These initiatives taking in both the provinces are analyzed and discussed based on our proposed framework of this study.

6.2 Analysis Based on Proposed Framework of the Study

In this section, our proposed framework is operationalized in our study cases. The framework has four components: locally driven, institutionally capable, legally strong, and effectively better in intergovernmental coordination. These fours components are being tested on our main cases that are Punjab and the KPK. The framework is applicable for assessing climate adaptation governance at subnational level with special focus on agriculture sector.

We are qualitatively assessing the level of achievement against the framework of this study. Some indicators are performing effectively while some are in a better position and others are at the basic level. The indicators of each component of the framework in discussed in Chapter 2. Climate governance aspects and bureaucratic interactions in both provinces and are identified and explained in Chapter 5 which are tested against the framework. We ranked the level of achievements for established components of our framework in high level (√√√), medium level (√√), and low level (√), as defined in Appendix A. High level achievement means the initiative is fully operational and it can be seen by external evaluator. High level measures can also giving some impacts and that impacts can be observed. Medium level achievement means the initiative is partially taken and moving in right direction. These are those initiatives that can be seen but they have yet to give significantly impacts. Low level achievement means the initiative is at a very basic level may be they can be seen on ground or not but certainly these are those where the subnational governments are strongly committed to put them in place. This is the criterion that is being used for the analysis of this study to analyze the adaptation governance in Punjab and the KPK. Below Table-5 summarizes the analysis.
Table-5: Analysis of adaptation governance in Punjab and in the KPK against proposed framework

<table>
<thead>
<tr>
<th>Component of proposed framework</th>
<th>Indicators for the components of proposed framework</th>
<th>Achievements In KPK</th>
<th>Achievements In Punjab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Locally Driven</strong></td>
<td>Engagement of local actors</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Incorporation of hidden adaptation</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Research and innovation at Local academic institutions</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Locally Monitoring and Evaluation</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td><strong>Institutionally Capable</strong></td>
<td>Local Institutionalization</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Institutional mechanism of coordination</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Allocation of financial budget</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td><strong>Legally Strong</strong></td>
<td>Legal backing for implementing policies</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Legally accountability and transparency</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td><strong>Intergovernmental institutions relations</strong></td>
<td>National, Subnational, and local level institutional linkages</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td></td>
<td>Incorporation of International efforts</td>
<td>✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
</tbody>
</table>

6.2.1 Locally Driven

Adaptation to climate change requires the conjoint efforts of individuals, businesses, industries, governments and other actors that are confronted by the impacts of climate change (Crane, Roncoli, & Hoogenboom, 2011). In our study farmers, local media, related local institutions, academics, related NGOs were highly involved in the establishment of adaptation actions and plans for agriculture sector.

Both subnational governments are keen to involve local actors for establishment of adaptation action plans for agriculture sector. For example in Punjab in recent past, the government has launched a very comprehensive awareness campaign about climate change by local media, active involvement of agriculture extension departments, arrangement of various training programs for farmers, establishment of various research centers across the province to measure or to quantify the impacts of climate change on agriculture sector. Likewise in the KPK, it is observed that the subnational government of the KPK is actively involving local stakeholders. For example, it is seen that the farmers’ community, civil society, and
academics were on board while establishing the PCCP in the KPK. The officials in the governments are actually observing the autonomous adaptation initiatives and other kinds of adaptations so that they may include such effective initiatives in upcoming action plans.

Hidden adaptation is an important aspect of local driven initiatives. Hidden adaptations are those which principally are not motivated by climate change adaptation but actually contribute for adaptability to climate change (Grüneis, Penker, & Höferl, 2016). They further explained hidden adaptations are actions which seem not to have any linkage with climate change adaptation and such adaptations are influenced by socio-ecological and economic or any other drivers but eventually it contributes to climate change adaptation.

In our study while conducting interviews with farmers, we saw many farmers especially in the KPK who do not know much about climate change but actually they are adapting with climate change. For instance, in Charsadda district of the KPK, some farmers have changed their crops because their previous crops were facing many issues due to heavy and unseasonal rains, more heat and floods. They are experiencing how new crops will behave. It is also seen that some others construct barriers or change the way for rainy water to protect their fields and crops from erosion in monsoon season. The importance of hidden adaptation is also noted in Punjab province but it is not as much as seen in the KPK.

Subnational governments in cooperation with academic organizations have identified some of the needs and the strengths of their societies in the battle against climate change. Local academic and research institutions are involved to contribute their due share in their respective provinces. For instance, Agriculture University in Faisalabad has produced many research studies on climate change and agriculture sector in Punjab. For example, (A. Ahmad et al., 2015; I. Ahmad, Wajid, Ahmad, Masud Cheema, & Judge, 2018; Imran et al., 2018; Rahman et al., 2018). are some of the studies produced by the university in recent years. It is an important academic research stakeholder in the province. Some other institutions such as the AARI, local agriculture extension departments and Seed Corporation in Punjab are actively involved in production of research and innovative techniques for adapting climate change in Punjab. Similarly, in the KPK, a research center in Agriculture University Peshawar is contributing by establishing a system of information provision on climate adaptation, creating a learning opportunity for locals, and collection of district-wise data on climate adaptation. In Punjab these research institutions are developed and producing more
research on climate change and climate change impacts on agriculture sector while in the KPK research and innovation is observed as medium level and there is a room for improvement.

Climate change adaptation policy has become an important issue for local government. It needs to monitor performance of adaptation objectives for local level policies in order to assess the progress of initiatives taken. This monitoring provides an opportunity for learning new ideas, and promotes local actions at subnational level. Experts in area of climate adaptation agree that leaning is the major goal of monitoring and evaluation of local initiatives (Scott, 2018). Scott further argued that this evaluation gives local authorities an opportunity to act as precursors in this area. The importance of monitoring and evaluation is key to uncover the weaknesses and strength of implementation of a policy. It is suggested the effective monitoring system in the local policies are helpful for revision of policies and action plans (Mumtaz, 2018). In our cases, both the provinces recognized monitoring and evaluation but it appears that no effective mechanism of monitoring and evaluation is in place in both the provinces.

6.2.2 Institutionally Capable

Local institutions have a critical role to implement climate adaptation policies and action plans. As in case of Pakistan, subnational governments are dealing with climate change subject. Therefore, local institutions are in place in both provinces as indicated in above section. However, how capable are these local institutions to deal with climate change and to implement the climate adaptation policies in respective provinces?. The competence and capacity of local governments is emphasized while implementing adaptation strategies (Adger et al., 2003).

The local institutions are there in both provinces. Considering their responsibility, they are working to establish climate change policies and action plans so that climate change can be faced. The KPK have established the PCCP and officially launch in mid, 2018 whereas Punjab is still in the process of framing the PCCP. Punjab is considered a well-established province in the country while the KPK is not as Punjab in term of human capital, specialty, and resources. However, the KPK is also very active to cope the challenge of climate change. It was the political will that drove the KPK to frame the PCCP on priority basis. The KPK was governed by new political party, the Pakistan Tehreek-e-Insaf (PTI) which has the first
ever government in any province. The KPK government and the PTI leadership are motivated and energetic to bring the important issue of climate change and global warming on policy agenda and ultimately the PCCP emerged in the province.

The capacity of local institutions in both provinces is not up to mark as the responsibility of implementation of these policies came on their shoulders in 2010 after 18th constitutional amendment. It may take time to develop the capacity of local institutions in both provinces. Capacity building is important to adapt to climate change. The UNFCCC recognizes and highlights the significance of capacity building for effective adaptation and mitigation to climate change. In climate change adaptation process, capacity building plays a key role. Therefore, it is an important aspect to tackle climate change impacts. In our study, the importance of capacity building is well recognized in both the provinces. However, Punjab is much ahead from the KPK in capacity buildings.

For example, Punjab is regularly giving training not only to farmers but also to their staff working in area of climate change and agriculture. Punjab being the populous province, they bring the capable and specialized people in the field while the KPK is lacking such specialty. It is important to note that Punjab has much focus for enhancing the capacity building while the KPK is behind from Punjab. Both provinces especially the KPK needs to enhance capacity building for effective results. Some international governmental organizations are involved in both provinces for climate change adaptation training, advocacy and capacity building. For example the UNDP arranges various workshops to provide training to concerned people working in area of climate change in these provinces. In our analysis, the institutional capacity is placed at medium level as they further need to enhance their capacities for taking flexible and realistic measures.

Awareness rising also brings positive results for capacity building especially to the farmers are local level. Promotion of awareness about climate change is an important instrument for climate adaptation. It aims to ensure that all relevant regional and sub-regional bodies understand the impacts of, and take action to respond to certain climate impacts (ACBC-, 2017). It is observed both the subnational governments have launched public awareness campaign about climate change in their respective sphere.
In both the provinces, they have achieved the success of public awareness up to a certain level. For example, majority of farmers have basic knowledge of climate change in Punjab. The role of the media is also vital for promotion of awareness and for deliberate policy engagement in the provinces. Both provinces engage regularly with the media to discuss and disseminate information of climate change. Climate change related material is published in multiple languages and distributed among the local communities. Moreover, they have set up a call-in radio station so that climate related information can be shared with the public and the public point of view can be taken into account. Similarly, in the KPK they arrange certain programs with farmers and engage universities to promote the issue of climate change in the society. However, there is need to extend the public awareness campaign even further levels, may be it can go to the union council levels to ensure that the farmers at the basic level also know the phenomenon of climate change and its likely impacts especially on agriculture sector.

The coordination among the local institutions is emphasized for proper implementation of local climate adaptation policies. The relations among the local actors and right decision making are important for effective adaptation governance at local level. The IPCC report described that “a locally-rooted iterative process of learning about changing risks and opportunities, identifying and evaluating options, making decisions, and revising strategies in collaboration with a range of actors” are a key for climate change adaptation at local level. In our study, it is found that the weak coordination is observed in the KPK but this coordination among the local institutions is comparatively better in Punjab. For instance, during our fieldtrip in the KPK, it is noted that our respondents did not know too much about work the other related departments in the province. However, it has seen in Punjab that the respondents are somehow familiar with the work of other related departments in the province. However, overall both provinces are lacking to set a reasonable coordination among these local institutions.

Funds are always important to deal with the challenge of climate change. The allocation of budget for last few years by federal and provincial governments has a small share of total developmental budget in Pakistan. The budget is being allocated to address the issue of climate change as it faces huge impacts like recurrent floods, heat waves, cyclones, drought, desertification, glacial-melt and sea level rise despite its minimal contribution to global warming. At provincial level, the KPK government has allocated a budget for climate
related activities. This is almost 8 percent of total developmental budget of the province. Similarly, in Punjab, in 2015-17, the government allocated 20 percent resources to climate change related projects in its public sector development program. Both the provincial governments have allocated budget related to climate change projects but these budget do not meet the required amount. Nevertheless, allocation of budget is a promising initiative and it should be extended to the required amount so that climate change can be tackled comprehensively. There is need to fairly allocating adaptation resources across all sectors.

6.2.3 Legally Strong

Laws are very important to ensure the implementation of climate adaptation policies at any level of governance. Legal instruments ensure the planning freedom and scope for discretion to maintain that adaptive measures appropriate to the location can be taken. Law is an essential vehicle for implementing adaptation policy across a range of sector and fields (McDonald, 2011). Law confers rights and imposes obligations; provides the architecture for regulating behavior and activities, including the performance of government functions; establishes the framework for public participation in government decision making; and arbitrates and resolves disputes between the state and private individual and between individuals. Legal backing to implement a policy is always essential.

In 2017, Pakistan passed climate change act 2017 and became one of the few countries who have passed same acts. With this act, three important institutions were supposed to be established, the Pakistan Climate Change Council, the Pakistan Climate Change Authority and the Pakistan Climate Change Fund. The provincial governments in Pakistan have to coordinate with this act. However, the subnational governments also need to bring legislation so that effective implementation of the adaptation policies can be ensured at local level. In this regard, the provincial government of Punjab has enacted some laws and acts such as Punjab Environmental Protection Act, 1997 (No. XXXIV of 1997) (Amended 2012) and the Punjab Environmental Protection (Amendment) Act 2017-(Act XIX of 2017). These acts are promulgated so that upcoming climate policies and action plans can be implemented with it true spirit while there is no such law enacted in the KPK in recent past. However, both the provinces need to work better in this area.
Provision of legal backing is important for accountability and transparency for implementing climate adaptation policies because it makes sure to implement the policies as they are intended to be implemented. Both the cases recognize the importance of accountability and transparency. In case of the KPK, the PCCP emphasized on monitoring and evaluations while the draft of the PCCP in Punjab does the same. However, based on emergence of laws in respective provinces, our study put Punjab on medium level but the KPK needs to work even more in this area.

6.2.4 Intergovernmental Institutions Relations

Intergovernmental relations are essential for implantation of climate adaptation policies at subnational level. The coordination among the different level of governance such as national, subnational, and local levels are important. These relations are fundamental to establish effective networks for governance system which are instrumental for implementing public policies especially when multi-sectorial approaches are involved and it requires proper coordination (Meadowcroft, 2009).

In case of Pakistan, effective intergovernmental relations are required so that the climate adaptation policies can be implemented in line with established policy actions. The role of federal government is still there as it is responsible for creating the INDCs and presenting Pakistan at international level. Moreover, federal government has more resources and specialty to deal with climate change keeping in view before 2010; it was federal government in Pakistan responsible for implementation of climate change policies. During last 8 years, the provincial governments in Pakistan have established many institutions and enhancing their effectiveness but still struggling to produce effective and capable institutions to deal with climate change. For effective governance, it is important to build robust institutions for sophisticated intergovernmental relations (Puppim de Oliveira, 2019).

We found that the intergovernmental relations in case of the KPK are weak while Punjab province is somehow performing better in these relations. One of the reasons for not establishing proper relations is differences of political governments. Collaboration and coordination is challenging when different political groups are in power at different levels of government (Puppim de Oliveira, 2019). For example, in last 5 years, federal and the KPK province are governed by two different political parties. They were not on the single page for many issues including climate change. For example, the KPK launched a Billion Tree
Tsunami in 2014 forestation project to plant 1 billion trees to fight deforestation and climate change but this project was not appreciated by the federal government rather it was criticized. However, later this project was evaluated by external evaluators such as the ADB and it was ranked one the most success projects in Asian region to mitigate global warming.

Apart from this, the weak institutional capabilities of the provincial institutions remained a driver for weak intergovernmental institutions relations. There is still confusion about sharing of power between the federal and provincial governments. This confusion even complicated the situation and consequently better relations are yet to be established. However, both the provinces have to work for creating solid intergovernmental coordination for viable implementation of adaptation policies.

Likewise, it is equally important to cooperate and work in line with international efforts to curb climate change. We noticed that it is yet to establish effective relations with international organization in both provinces. For example, Pakistan is failed to catch heavy funds from international donors. Moreover, it could not secure any reasonable fund from international climate adaptation fund despite Pakistan is one of the most vulnerable countries.

The technical support from international partners is essential to improve local capacity including scientific capacity. Pretty, (2003) identifies that effective international institutions are important as a complement to the local institutions to address global environmental challenges like climate change. To effectively strengthen the local capacity, it is important to acknowledge the gaps between local and international experts, i.e. in levels and areas of expertise. The subnational governments of Punjab and the KPK have basic level of cooperation and getting small advantages from international adaptation efforts. Therefore, it is required to work in this area so that a reasonable level of cooperation with international organizations can be achieved and due financial advantages can be attained.

The conceptualization of our framework advances the knowledge on climate adaptation policies at subnational level. With empirical evidences from this research and recent literature, the proposed framework is consolidated and conceptualized as a guiding framework for implementation of climate change policies at subnational level. The components of proposed framework are considered important to effectively facilitate climate change governance at subnational level. The framework proposes to involve local actors such
as local farmer for establishing and implementing climate policies for agriculture sector at subnational level. It also emphasis on enhancing the local institutional capabilities keeping in view the role of local institutions for implementation policies at subnational level. Therefore, institutional arrangement sets a frame in terms of the individuals or organizations that should or will participate, therefore it is considered as one of the key components for mainstreaming climate change at local levels.

Legally backing for implementation of policies at subnational level is another unique aspect of this framework. Proper provision of legal backing to local initiatives not only effective to implement the policy action but it also promotes accountability and transparency within the implementers. This legal aspect is very important especially in developing countries like Pakistan where normally people do not like to do things by their own. Finally, due to weak capacity and scarcity of financial resources at local level, role of intergovernmental relations and international organizations is much emphasized in this framework. By maintaining sound relations with national government and international organizations, this important aspect can be covered which is a key aspect for effective implementation of climate adaptation policies at subnational level. Based on this study, this thesis suggests that this is an appropriate framework for climate policy experts, subnational governments including local people while taking adaptation decision-making.

This analysis tells us that both provinces are not totally in line for implementation of climate adaptation policies. At certain points they are weak but in other cases they are performing better. Both the subnational governments are having strengths in some areas while in others areas, they are weak. Secondly, in both cases we found different level of achievements. For example, in case of involving local stakeholder, Punjab is ahead but KPK is better to incorporate local knowledge and hidden adaptation for agriculture sector in policies and action plans. Similarly, in case of institutionally capability, both are performing at equal level. However, in case of legal backing and litigation, we found that Punjab is better than the KPK. Likewise, for establishing intergovernmental coordination, Punjab is comparatively up while the KPK is lacking to properly coordinate with national government and with international organizations.

The following final chapter summarizes the key findings of the research in relation to the research objectives and goal. It also consolidates the key lessons of this study and provides
some suggestions based on our analysis. It mentions the limitations of this study before giving a way forward.
CHAPTER 7

Conclusion and Recommendation
7.1 Overview
This final chapter is composed of five sections. The second section summarizes the key findings and results from the research according to the research objectives and goal in relation to our proposed framework. The section three identifies distinctive learned lessons for climate change adaptation from this study. Section four aims to provide some recommendations based on key findings of the research. Section five explains the limitations of the study. The final section suggests some areas for further study.

7.2 Summary of the Key Findings and Policy Applications
The aim of this research was to uncover governance challenges for implementation of climate adaptation in agriculture sector at subnational level by developing a framework. The framework is developed and applied it on the cases of Pakistan. The main components of the framework are established for effective climate adaptation policies for agriculture sector at subnational level. These components of the framework are: locally driven initiatives, institutionally capable, legally implementable and sophisticated intergovernmental relations.

Climate change adaptation in agriculture sector is considered a striking strategy to manage the impacts of climate change because it provides an opportunity to effectively manage the impacts of climate change and get benefits from the opportunities by employing suitable adaptation measures. Theoretically, climate change adaptation is a new field and it created a space for experimentation and new forms of governance. On the heels of 18th constitutional amendment in Pakistan in 2010, at multiple fronts the political and institutional powers have delegated to the provinces at subnational level. This devolution of power and decentralization provided a foundation for emergence of climate adaptation governance at subnational level in Pakistan. In this study the climate change adaptation governance for agriculture sector in Punjab and in the KPK is explored and these governance initiatives are evaluated against the established framework.

The study finds that various initiatives have been taken for climate change adaptation for agriculture sector in both the provinces. For instance, establishment of the PCCP in the KPK, institutional capacity enhancement in Punjab, promotion of climate change research, establishment of linkage with academics, enhancement of capacity building, and involvement
of farmers’ community in climate adaptation for agriculture sectors are some of the important steps taken in the provinces.

Multiple stakeholders are being involved in climate change governance at subnational levels. Political leadership is active especially in the KPK to promote sound and sustainable mechanisms to address climate change. The role of academics and voices of civil society are being considered for redressed of climate change in both the provinces.

Local institutions are in place in both provinces as the subnational governments in Pakistan are responsible for implementation of climate change adaptation and other related policies. However, the study found that, the provinces have yet to attain the full capacity of these institutions to properly implement the climate adaptation policies.

Monitoring and evaluation is key to observe the strengths and weaknesses in implementation phase of adaptation policies. At the same time, such evaluations are important for accountability and ensure transparency while implementing the adaptation policies with their true spirit. However, there is no effective mechanism of monitoring and evaluation is observed in both the provinces.

The enactment of laws in respective subnational governments is critical to provide proper backing for implementation of adaptation policies. Some laws are enacted in Punjab provinces and the KPK is lacking to establish and promote these laws. However, both the subnational governments are needed to establish laws to provide proper support for implementation of the policies.

Moreover, intergovernmental cooperation and coordination with international organizations are instrumental. The study found that there is a weak vertical coordination between provinces and the national government. Likewise, the coordination among the provinces is almost absent which is a major setback for the climate governance in Pakistan. Moreover, the study identified that there is weak cooperation not only among the local departments but also with international organizations.

The differences of initiatives in these provinces are manifest in subnational climate change policy differentiation, research capacity and institutional maturity. The KPK government has
developed and officially launched the PCCP, whereas Punjab government is in the process of formulating its policy. Punjab, however, is ahead in terms of carrying out research work and developing institutional capacity. The most important initiative of the Punjab government, inter alia, is launching an awareness campaign about climate change by publishing related literature in local languages, establishing a radio station, arranging farmer day, and writing articles for newspapers.

Moreover, the study identified lack of institutional and human capacity, scarcity of financial resources, lack of research and innovation, and integration of adaptation policy with other related policies are some of major challenges for climate adaptation governance in the respective provinces. There is a room for improvements in order to overcome the weak aspects of the governance in the provinces. The most notable and novel ideas were identified in the form of exploration of hidden adaptations, active political will to manage climate change, massive level awareness campaign, and transfer of adaptation measures from one place to another place.

**7.3 Lessons Learned from the study**

**7.3.1 Exploration of Hidden Adaptation Strategies**

Firstly, one of the important lessons is the exploration of hidden adaptations. Hidden adaptations are those which are not motivated by an external factor nor are they initiated with the motivation of adaptation. In hidden adaptation, most of the times adaptors do not even know about the concept of adaptation. This important phenomenon is taking place in Pakistan. One of the interviewees in the KPK from the CCC mentioned that one of the main objectives of the research center is to visit multiple locations throughout the province and to identify new strategies which are being taken by the local community or farmers. He further told that many farmers are exercising adaptation practices like changing planting dates, changing seeds or fertilizers but at the same time the farmers are not aware about the actual phenomenon of climate change and climate adaptation. For example, he shared an example stating that in one season one of the crops (groundnut) was destroyed in an area of Swabi district due to more precipitation. In next season, the framers did not opt for groundnut but they went for another crop called pearl millet (bajra). This time the bajra crop survived due to precipitation and it was a successful experience of crop replacement. The farmers did so because they knew that in last season the crop of groundnut was damaged badly due to
precipitation and they wanted to try something new to avoid the damages. They were quite successful in this experiment. No governmental agency was involved in this adaptation initiative and it was solely an initiative of local farmers and they do not know much about climate change.

It is needed to incorporate these novel but unknown initiatives in forthcoming adaptation policies and action plans for agriculture sector at subnational level. By incorporating these local and traditional strategies in policies will not only encourage the indigenous actions for climate change adaptation but it ensures the participation of local community in climate change adaptation.

7.3.2 Sharing/Transfer of Adaptation Strategies among Farmers’ Community

The other notable initiative was identified and that can be a lesson for others is the sharing of adaptation actions among the farmers’ community. Local farmers have shared and still sharing best practices among each other which are well adopted by other farmers. Although, the knowledge sharing among stakeholders is identified for effective climate change adaptation but this sharing of information is different in a way as it is communicated only among the farmers’ community by themselves without any governmental interventions.

At many localities there is no involvement of subnational governments or non-governmental organizations to transfer the adaptation strategies from one place to another place. For example, a farmer in the KPK explained us that his wheat productivity was remarkably less and he recognized that it was due to heat. In next season, he brought seeds from Punjab as a strategy by considering that temperature is always high in Punjab region. In this season with new seeds, his productivity was recorded very well. He shared his experience with other farmers in his area and they followed the same as he did. This exercise is an example to tell us that how adaptation and traditional knowledge is being shared among the farmer community at local level.

This sharing of information about new techniques is very important and it can bring positive results for climate change adaptation in agriculture sector. It has seen these farmers are looking for other farmers and they copy the effective strategy wherever they found. It is important to note that this transfer of information travel even from one region/province to another province/region. For example, one of the farmers in the KPK reported that he opted
for other crops because he was informed by someone that in Punjab people are changing their
crops and seeds which are suffering due to rain and heat waves.

It is observed that many farmers are looking for changing the seeds in every season according
to the weather conditions. For example, in an area where temperature was low previously but
now it is up, the farmers of this area are getting the seeds from the farmers where the
temperature was already high. This is one of the generic practices which are following in
almost both the provinces.

7.3.3 Massive Public Awareness Campaigns
Public aware is considered one of the key aspects for climate change adaptation. The
government of Punjab has launched a massive campaign for climate change adaptation in the
provinces. Certainly, it can be an example for others to follow such strategy to create
awareness about climate change in general and specifically for climate change adaptation. It
would be helpful to tackle climate change once the people know that what actually is climate
change and what are its consequences?.

In order to create awareness, the subnational government took practical step by launching a
radio station and publishing of climate related stuff in local language. At radio station various
climate related programs are aired in different local languages so that maximum people can
understand about the phenomenon of climate change and its impacts specifically its impacts
on agriculture.

Furthermore, the Punjab government is arranging farmer day and arrange programs in
multiple locations of the provinces in which many local farmers are invited and provide them
an opportunity not only to give them information about climate change but they can interact
among each other and share their experiences among the farmer’s community.

Moreover, in different programs on radio and during farmer day, many climate change
scientist and academics are invited to discuss and to inform the farmers, civil society, and
others about climate change and its likely impacts and future trend of climate change. These
exercises play an important role not only to aware people especially farmers’ community but
it provides a way for climate change adaptation.
7.3.4 Activism of Political Leadership

Leadership plays a key role in success of climate governance. One of the most important factors which influence the success of climate change governance is the involvement and active interest of the top political leadership (Meadowcroft, 2009). When the political leadership takes keen interest then things can move forward smoothly.

Imran Khan - a renowned politician in Pakistan who is now the Prime Minister has shown concern about the impacts of climate change. He got interested as climate change is a reality for Pakistan and the KPK which is governed by his party is considered the most vulnerable province in Pakistan due to climate change. In 2010 floods the KPK was the major victim of the flood. It was the worst historical floods in Pakistan which destroyed the infrastructures, killed over 1,700 people, damaged the crops and live-stock, and huge economic losses. These are the major drivers for taking actions against climate change in Pakistan.

Recently, he was elected as Prime Minister of Pakistan and his party emerged as the largest political party in Pakistan and his party is ruling the province of the KPK. He discussed at many occasions about climate change and its impacts on Pakistani’s society. In order to fight against climate change in his province he took one of most notable practical steps in the form of launching a reforestation project in 2015 in the KPK. The reforestation project named as ‘Billion Tree Tsunami Project,’ under the green growth initiative, in which 1 billion saplings are being planted. It is believed that the commitment of a political leader to curb climate change is certainly a very important and fruitful driver for effective implementation of climate change and related policies.

7.4 Recommendations

Some recommendations are proposed based on our research study and analysis.

1. For effective implementation of climate adaptation policies in Pakistani provinces, it is needed to establish climate policies on scientific evidences and backing. The actual mandate of respective provinces should have clarify to address the issue of climate change keeping in view there is still confusion of institutional power between federal and provincial governments. Without proper grip over the required institutional authority, it is difficult to attain the desired results.
2. The provinces need to establish dedicated institutions to deal with climate change and to enhance their capacity building. Effective institutions with specialized human resources are instrumental for proper implementation of climate change policies at subnational level. The federal government should help to provinces in order to build effective institutions. Powerful institutions are important to produce integrated and implementable policies.

3. In order to fulfill the lack of human capacity, it is recommended that each provincial government should send a specified number of professionals and students of climate change and its related fields to developed countries so that these professional and students can get academic as well as professional training and experience to confront climate change. These students and professional are highly likely to become asset for Pakistan to effectively manage the issue of climate change in long run. Higher Education Commission, Pakistan can also play a role to set a quota to sponsor Master/PhD fellowship in area of climate change.

4. It is also recommended to establish and strengthen climate related research institutes across Pakistan. Scientific and evidence based inputs are essential to establish implementable climate change policies at subnational level. The provincial governments should set research institutions related to climate change in each district in their respective provinces. The educational institutions can also play a role to enhance research and innovation on climate change by setting degree program in climate change, include climate change as subject in academic curriculum, and encourage and promotion of research activities in these institutions on climate change policies.

5. To implement provincial climate change policies and action plans, it is appropriate to establish specialized committees on provincial levels so as to set and monitor the proper implementation of the policies at local level. It is imperative to strengthen the local bodies to deal with climate change keeping in the view the important role of local governments to adapt climate change.

6. The reforms especially in the legal system are suggested for further delegation of power at community level. Proper evaluation and monitoring system should be in place to enhance adaptation governance and transformation of the adaptation governance in Pakistan.

7. The study found that one of the challenges is weak coordination among the tiers of governments in Pakistan. It is required to establish an effective mechanism for
horizontal and vertical cooperation. The cooperation at horizontal and vertical fronts is essential to manage the negative consequences of climate change. It is important to implement established policies and action plans with concerted and coordinated efforts.

8. Finances have a very important role to tackle climate change. Presently, the provincial governments in Pakistan are unable to set a reasonable climate change related budget. However, in both provinces climate change fund is being established. Moreover, Pakistan can secure funding from international adaptation fund to address the issue of climate change in the country.

7.5 Limitations of the Study

There are different limitations of the case study method. One of the prominent criticisms of the case study method is that it is restricted external validity and reliability (Bell et al., 2018). We choose two cases for our study to address the concerns of external validity. Likewise, to ensure the reliability, we provided list of interviews and the events that we attended for this research. Another criticism is to generalize the findings of the specific cases outside to those cases. We provided justification of using the case study method for our study. The purpose of taken these measures are to ensure if same research is conducted the findings will be in line with results of our study. Nevertheless, the case study method allows to understand the complexity of a case by in-depth investigations.

The major limitation is that the study is focusing mostly on wheat crop not on all crops. The interviews conducted in both provinces especially with farmers who have wheat as their major crop. Although, the other respondents either academics, policy experts, government official are related to agriculture sector not just with wheat crops. This crop is chosen from agriculture sector as almost every framer in both the provinces is directly linked with wheat crop irrespective of field size.

Another limitation was the issue of finance and security issues for the data collection. Overall 36 semi-structured interviews were conducted in both the provinces. These were limited to 36 due to limited financial resources. Secondly, during the field study, the security situation was not good especially in the KPK. Therefore, the interviews were conducted only from security wise better places.
7.6 Way forward

Further research relating to climate adaptation governance is suggested. For example it is important to explore the adaptation measures from other sectors such as industry. To understand the stakeholders’ motivations including local educational institutions and other local governmental bodies so that more productive outcomes can be achieved. Another important area for research is an examination of the needs regarding the alignment between national and subnational climate change adaptation policies and planning. It is of interest to explore ways and role of civil society organizations to bridge the coordination gap among federal, provincial/subnational, and local governments to implement climate adaptation policies in Pakistan. Finally, the proposed framework of this study for establishing effective climate adaptation policies and good adaptive governance at subnational level needs to be tested in other cases and it can be fine-tuned if it is required.
BIBLIOGRAPHY:


Averchenkova, A., & Bassi, S. (2016). Beyond the targets: assessing the political credibility of pledges for the Paris Agreement.


## Appendix A

### Criterion for Analysis

<table>
<thead>
<tr>
<th>Component of proposed framework</th>
<th>Indicators for the components of proposed framework</th>
<th>✓/✓</th>
<th>✓/✓</th>
<th>✓/✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locally Driven</td>
<td>Engagement of local actors</td>
<td></td>
<td></td>
<td>Viable governments’ commitment to involve local actors. This is written in documents or seen by the government people</td>
</tr>
<tr>
<td></td>
<td>Incorporation of hidden adaptation</td>
<td></td>
<td></td>
<td>When the local governments recognized the hidden adaptation but yet to include in their existing plans</td>
</tr>
<tr>
<td></td>
<td>Research and innovation at Local academic institutions</td>
<td></td>
<td></td>
<td>When the importance of research and innovation is recognized by the subnational government</td>
</tr>
<tr>
<td></td>
<td>Locally Monitoring and Evaluation</td>
<td></td>
<td></td>
<td>When the monitoring and evaluation for implementation of subnational policies are emphasized</td>
</tr>
<tr>
<td>Institutionally Capable</td>
<td>Local Institutionalization</td>
<td></td>
<td></td>
<td>When the importance of local institutions are</td>
</tr>
</tbody>
</table>

When there are evidences that all the related local actors are involved and their concerns are taken.

Evidences of involvement of local actors and they are partially satisfied with the actions taken.

When the impact or the hidden adaptation are identified and included in action plans.

When the policy implementation is monitored, evaluated, and used to improve/revise the initiatives.

When partial engagement of local institutions are seen. The
<table>
<thead>
<tr>
<th><strong>Institutional mechanism of coordination</strong></th>
<th>implementation concerns of all relevant departments are not addressed</th>
<th>When the coordination among local institutions are emphasized but yet to take steps to properly involve them</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Allocation of financial budget</strong></td>
<td>When the involvement of all related institutions are there in implementation phase</td>
<td>When the budget is allocated but it is not reasonable amount to address climate change</td>
</tr>
<tr>
<td>Legally Strong</td>
<td>When the involvement of all related institutions are there in implementation phase and some are missing</td>
<td>When there is will and plan to set climate change budget</td>
</tr>
<tr>
<td><strong>Legal backing for implementing policies</strong></td>
<td>When the laws are enacted and implementing actions are taken as per laws.</td>
<td>When some laws are enacted but implementing actions are taken as per laws.</td>
</tr>
<tr>
<td>Legally accountability and transparency</td>
<td>When the proper accountability and transparency system is there. The evidences show that institutions are being accountable for their actions.</td>
<td>When the accountability and transparency system is there but no evidences that institutions are being accountable for their actions.</td>
</tr>
<tr>
<td>Intergovernmental institutions relations</td>
<td>When at the local, subnational, and nation level are at the same page and there is coherence for actions taken at these level</td>
<td>When the linkage among the local, subnational, and nation level is recognized but there is no evidence that how they are taking steps</td>
</tr>
<tr>
<td><strong>Incorporation of International efforts</strong></td>
<td>When there are evidences of involvement of international organization for</td>
<td>When the relations with international organizations are recognized</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>actions taken at subnational level. Securing of reasonable funding from international funds.</td>
<td>for actions taken at subnational level. Limited or no fund is secured from international funds.</td>
<td>but yet to take practical steps</td>
</tr>
</tbody>
</table>
Appendix B

Climate change adaptation in agriculture sector: An analysis of governance challenges in two Pakistani provinces

Participant Informed Consent

I understand that participation in this study is completely voluntary. I can withdraw my participation in this study, the information will be immediately destroyed that I have provided for this study. The data collected for this study is confidential and it will not be given to any person other person and it will not be used accept this study.

I agree to take part in this study as a respondent for his questions. I have read the statement. I am willing to be interviewed by the researcher which will take about 45-60 minutes. I am also willing for follow up correspondence from the researcher for the purpose of validity of his research.

Signed:                                                                                                                Date:
## Appendix C

### Respondents’ Profiles

<table>
<thead>
<tr>
<th>Respondent ID</th>
<th>Respondents' responsibilities/roles</th>
<th>Respondents’ Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inspector General Forests</td>
<td>Ministry of Climate Change</td>
</tr>
<tr>
<td>2</td>
<td>Director General Environment</td>
<td>Ministry of Climate Change</td>
</tr>
<tr>
<td>3</td>
<td>Charmain and member of board of governance</td>
<td>Sustainable Development Policy Institute</td>
</tr>
<tr>
<td>4</td>
<td>Professor of Policy Study and Sustainable Development</td>
<td>Center for Policy Study, COMSATS University, Islamabad</td>
</tr>
<tr>
<td>5</td>
<td>Head of Department</td>
<td>Center for Climate Research and development</td>
</tr>
<tr>
<td>6</td>
<td>Professor of water and climate change</td>
<td>Department of Meteorology, COMSATS University, Islamabad</td>
</tr>
<tr>
<td>7</td>
<td>Senior Researcher for agriculture and climate change</td>
<td>Global Chang Impact Studies Center</td>
</tr>
<tr>
<td>8</td>
<td>Senior Researcher for climate change and head for water section</td>
<td>Global Chang Impact Studies Center</td>
</tr>
<tr>
<td>9</td>
<td>Researcher for climate change and agriculture sector</td>
<td>Pakistan Agriculture Research Council</td>
</tr>
<tr>
<td>10</td>
<td>General Manager and compiling climate change data in Pakistan</td>
<td>Pakistan Space and Upper Atmosphere Research Commission</td>
</tr>
<tr>
<td>11</td>
<td>Director Agronomic and an active member for climate negotiation and policies in Punjab</td>
<td>Ayub Agriculture Research Institute, Faisalabad</td>
</tr>
<tr>
<td>12</td>
<td>PhD student working on climate adaptation and agriculture sector</td>
<td>University of Agriculture, Faisalabad</td>
</tr>
<tr>
<td>13</td>
<td>Regional Director for agriculture extension department</td>
<td>Agriculture Extension Department in Faisalabad</td>
</tr>
<tr>
<td>14</td>
<td>Deputy Director dealing with climate change in Punjab region</td>
<td>Environmental Protection Agency in Lahore, Punjab</td>
</tr>
<tr>
<td>15</td>
<td>Farmer’s community(7 interviews)</td>
<td>Farmers in Punjab</td>
</tr>
<tr>
<td>16</td>
<td>Director working on climate adaptation strategies</td>
<td>Helvetas Swiss Intercooperation organization, Peshawar, Pakistan</td>
</tr>
<tr>
<td>17</td>
<td>Professor of Environmental Sciences</td>
<td>University of Peshawar</td>
</tr>
<tr>
<td>18</td>
<td>Deputy Director and involve in framing climate policy in the KPK</td>
<td>Center for Climate Change, Peshawar</td>
</tr>
<tr>
<td>19</td>
<td>Professor of agriculture and climate change</td>
<td>Agriculture University Peshawar</td>
</tr>
<tr>
<td>20</td>
<td>Manager dealing with agriculture extension in the KPK</td>
<td>Agriculture extension department, Peshawar</td>
</tr>
<tr>
<td>21</td>
<td>Chief Manager for planning in agriculture sector</td>
<td>Establishment Division Peshawar KPK</td>
</tr>
<tr>
<td>22</td>
<td>Climate change policy researcher</td>
<td>Pakistan Forest Institute, Peshawar</td>
</tr>
<tr>
<td>23</td>
<td>Director dealing with floods and rescues</td>
<td>Provincial Disaster Management Authority, KPK</td>
</tr>
<tr>
<td>24</td>
<td>Farmer’s community(7 interviews)</td>
<td>Farmers in the KPK</td>
</tr>
</tbody>
</table>
## Appendix D

### Advisory Committee for the PCCP in the KPK

<table>
<thead>
<tr>
<th>S. No</th>
<th>Departments/Academic Institute</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Directorate of Science &amp; Technology, Govt. of Khyber Pakhtunkhwa, Peshawar</td>
<td>Deputy Director (S&amp;T)</td>
</tr>
<tr>
<td>2</td>
<td>Industries &amp; Commerce Department, Govt. of Khyber Pakhtunkhwa, Peshawar</td>
<td>Additional Director</td>
</tr>
<tr>
<td>3</td>
<td>Wildlife Department, Govt. of Khyber Pakhtunkhwa, Peshawar</td>
<td>Conservator Wildlife, Peshawar</td>
</tr>
<tr>
<td>4</td>
<td>Meteorological Department Govt. of Khyber Pakhtunkhwa, Peshawar</td>
<td>Deputy Director</td>
</tr>
<tr>
<td>5</td>
<td>Agriculture Extension, Govt. of Khyber Pakhtunkhwa, Peshawar.</td>
<td>Deputy Director Horticulture HQ, Peshawar</td>
</tr>
<tr>
<td>6</td>
<td>Department of Geography University of Peshawar.</td>
<td>Assistant Professor</td>
</tr>
<tr>
<td>7</td>
<td>Chief Conservator of Forests, Central Southern Region, Region-I Peshawar</td>
<td>Conservator of Forests, FP&amp;M Circle Peshawar</td>
</tr>
<tr>
<td>8</td>
<td>Irrigation Department, Peshawar</td>
<td>Deputy Director (P)</td>
</tr>
<tr>
<td>9</td>
<td>The Environmental Sciences Department University of Peshawar</td>
<td>Assistant Professor</td>
</tr>
<tr>
<td>10</td>
<td>Agriculture University of Peshawar</td>
<td>Director Climatic Change Center</td>
</tr>
<tr>
<td>11</td>
<td>Department of Geology</td>
<td>Faculty</td>
</tr>
<tr>
<td>12</td>
<td>Department of Botany</td>
<td>Professor /Chairman</td>
</tr>
<tr>
<td>13</td>
<td>Department of Zoology</td>
<td>Lecturer</td>
</tr>
<tr>
<td>14</td>
<td>Pakistan Forest Institute Peshawar</td>
<td>Director General</td>
</tr>
<tr>
<td>15</td>
<td>Energy and Power Department, Peshawar</td>
<td>Managing Director</td>
</tr>
<tr>
<td>16</td>
<td>Economics Department, University of Peshawar</td>
<td>Chairman</td>
</tr>
<tr>
<td>17</td>
<td>Chemistry Department, University of Peshawar</td>
<td>Chairman</td>
</tr>
</tbody>
</table>
# Appendix E

Implementation Committee Members for the PCCP in the KPK

<table>
<thead>
<tr>
<th>S. No</th>
<th>Departments/ Designation</th>
<th>Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa, forestry, environment and wildlife department</td>
<td>Member</td>
</tr>
<tr>
<td>2</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of agriculture department</td>
<td>Member</td>
</tr>
<tr>
<td>3</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa in irrigation department</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of local government</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of transport and mass transit</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of planning and development</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of law</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of finance</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of industries</td>
<td>Member</td>
</tr>
<tr>
<td>10</td>
<td>Secretary to the Govt. of Khyber Pakhtunkhwa of public health engineering</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Director General, Provincial Disaster Management Authority</td>
<td>Member</td>
</tr>
<tr>
<td>12</td>
<td>Director General, Environmental Protection Agency</td>
<td>Member</td>
</tr>
<tr>
<td>13</td>
<td>One representation from chamber of commerce, industries and corporate sector</td>
<td>Member</td>
</tr>
<tr>
<td>14</td>
<td>Chief Executive from Sarhad Rural Support Program(SRSP)-NGO</td>
<td>Member</td>
</tr>
<tr>
<td>15</td>
<td>Director regional metrological center</td>
<td>Member</td>
</tr>
</tbody>
</table>