# Adapting to Climate Change Through Stakeholder Engagement, Innovation, and Knowledge Co-production: The Case of Nepal

by

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ABSTRACT

As one of the countries highly vulnerable to climate change, Nepal has developed climate adaptation policy objectives and integrated risk management strategies to avoid severe impacts from changing climatic conditions. The country has been developing local level adaptation initiatives to create synergy between the policy objectives at the higher levels and location-specific needs of communities. This dissertation analyzes how these initiatives have been shaped by the national and global level discourse on climate adaptation and how they translate into building resilience at the community level. More specifically, using the case of Nepal's flagship adaptation programs - Local Adaptation Plans of Action (LAPA) and Climate Smart Agriculture (CSA) - this dissertation seeks to understand institutional and technological innovations that contributed to the governance of climate adaptation initiatives in Nepal. Methodologically, this dissertation applies a mixed method. Quantitative data was collected by interviewing local level stakeholders using semi-structured questionnaires and from policy documents. The transcripts from the open-ended interviews with the regional and national level stakeholders form the basis for qualitative analysis. Overall, the findings from this dissertation reveal that most of the adaptation activities proposed by local communities were low cost, based on experiential learning, and could be implemented by mobilizing local resources. The case of LAPA shows that community-based adaptation activities are strongly connected to local development goals, revealing the synergy between adaptation policy objectives and development. Likewise, the case of CSA demonstrates how innovations, both technological and institutional, are fostered to co-produce locally specific knowledge

required to adapt to changing climate. The collaborative efforts by different institutions operating at multiple levels for scaling CSA through the Climate Smart Village approach provide justification for working together to address the climate adaptation policy objectives. The findings of this dissertation also reveal that the distinction between local and scientific knowledge makes little sense at the community level as successful climate adaptation requires hybrid approaches. This dissertation makes a strong case to enhance the governance of adaptation initiatives through stronger collaboration between local to national and global actors.

DEDICATION

This dissertation is dedicated to my grandfather and guru Rishi Prasad Sharma

(07/XX/1934 – 12/27/2020)

And

grandmother Haripriya Sharma, father Harihar Sharma Ghimire, mother Gita Ghimire,

wife Arati, and daughter Riva

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# 1. INTRODUCTION

## 1.1 Problem statement

The interactions between changing Himalayan ecosystems and societal welfare have been of concern to scientists and policymakers for almost a half-century. In the mid-1970s, the Theory of Himalayan Environmental Degradation, for example, made a strong case that the mountain region is on the verge of a downward spiral that would reduce the capacity to support human beings (Eckholm, 1975). The chief cause of the dire situation was attributed to the rapid loss of forest in the hills triggering floods and landslides across the Himalayas. Later, scholars unanimously refuted this simple causes and effect relationship at the Himalayan scale. With the restoration of hill forests, it became obvious that blaming poor farmers for cutting trees on fragile hill slopes was limiting (Gyawali & Thompson, 2016; Thompson et al., 2007). Recently climate change is viewed as a risk multiplier that exacerbates a variety of problems that the region is facing. Thus, climate change impacts add a layer of complexity to the already existing multiple stressors that people in and around the Himalayan region are facing. The narrative of climate change has the power to influence action at all scales. Moreover, this issue is often seen as a global problem that can be solved through international and national conventions and initiatives following them. In this context, this dissertation seeks to understand how Nepalese communities have been addressing complex environmental stresses by integrating these powerful narratives with their everyday approaches to managing uncertainties in the Himalayas.

The impacts of climate change are not uniformly distributed across the world. Communities that depend on natural resources for their livelihoods are more likely to bear the brunt of the changing climate (Ribot, 2013). For example, after years of crop loss due to changes in rainfall patterns and degradation of natural resources, some villages in rural Nepal were forced to find alternative sources of livelihood (Masson-Delmotte et al., 2018; Thornton & Comberti, 2017). Climatic stresses and changes are more likely to exacerbate global hunger and catastrophic extreme events causing huge loss of lives, properties, and developmental gains in absence of strong adaptation initiatives. Therefore, the manifestation of climate change in the form of frequency and severity of extreme events should be taken as warnings in order to help vulnerable communities prepare so that they can avoid deleterious effects of such events in the future.

More than three decades of scholarship and practice in climate change adaptation have demonstrated that making effective adaptation policies and successfully implementing them can be a daunting task. As policymaking on complex global issues such as climate change has relied more on global and national actors and/or institutions and higher level policy objectives, this approach has struggled to incorporate voices of affected communities and general people (Chhetri et al., 2020). The top-down approach that relied on expert knowledge has found it difficult to understand the context-based nature of adaptation that is deeply tied to the social and cultural context at the local level (Hulme, 2009). In Nepal, in response to potential threats from climate change, bottom-up approaches to climate adaptation, such as Ecosystem Based Adaptation (EbA), Community Based Adaptation (CBA), and Local Adaptation Plans of Action (LAPA),

have been introduced in recent years. But it has now become clear these bottom-up approaches to climate adaptation may not be sufficient in the absence of technological and institutional support from national and sometimes global levels (Chhetri et al., 2019).

This dissertation analyzes how local level adaptation initiatives are shaped by national and global climate adaptation policy objectives and how these initiatives struggle or succeed in building resilience at the community level. While institutions can be both enablers as well as barriers to adaptation, there is a dearth of research identifying appropriate institutional approaches that facilitate adaptation (Agrawal, 2008; O'Riordan & Jordan, 1999). Thus, recognizing the crucial role of institutions in promoting local level response to climate change this dissertation investigates the role of institutions, operating at multiple levels, in shaping adaptation governance. Further, this study unravels challenges and opportunities of local adaptation initiatives with case studies of LAPA and Climate Smart Agriculture (CSA) initiatives in the Gandaki River Basin, Western Nepal.

Nepal ranks as one of the most vulnerable countries in terms of climate change impacts due to its fragile geology, climate-sensitive ecosystems, and socio-economic circumstances (MoE, 2010). Studies have projected that average and seasonal maximum temperatures will continue rising (Thakuri et al., 2019), with changes in timing and intensity of rainfall in parts of the country (Wester et al., 2019). Nepal's agricultural systems also face a host of challenges, including high dependence on climatic conditions, limited access to irrigation facilities, lack of agricultural inputs when needed, an

increasing trend of land abandonment associated with a high rate of outmigration, and the lack of interest in agriculture.

Agriculture is the main source of livelihood for nearly two-thirds of Nepal's people and contributes about 21% of the National Gross Domestic Product (GDP) (MOALD, 2021). But domestic production falls short of the population's dietary demands and food imports have increased, particularly from neighboring India. For farmers returns form agriculture are constrained due to low productivity of small plots, inadequate infrastructure, and lack of access to markets. Large-scale migration, particularly by young men from rural areas seeking better prospects in urban areas or in other countries, has, in turn, created a shortage of agricultural labor, further amplifying risks among farming communities (Parajuli et al., 2021). This shift has also added to workloads for rural women, who take on additional labor, but for lower returns.

Nepalese agriculture is highly dependent on natural resources, with low levels of irrigation. Climate parameters are becoming unfavorable to agricultural production, as average temperatures rise, and droughts become more frequent (Hamal et al., 2020). Precipitation is becoming erratic, with increasing floods and landslides. Loss of soil fertility further undermines food production and there is a trend to higher doses of pesticides and fertilizers to increase production of cash crops and commercially grown vegetables. Even though the overall use of agrochemicals is generally low, inappropriate and over-use of agrochemicals have resulted in residues in food products, as well as downstream water pollution.

The existence of multiple stressors in Nepalese agricultural systems along with rising climate induced impacts are increasing hardship of farming communities in the country (Xu et al., 2019). The Government of Nepal (GON) has prepared proactive policies at the national level for agricultural development and climate adaptation. These initiatives have targeted improving livelihoods and increasing food security by making the agricultural sector self-reliant and sustainable by adopting appropriate measures to increase productivity and retaining land under cultivation. However, the challenges of agricultural systems in Nepal have persisted and they are not amenable to simple solutions. With the analysis adaptation initiatives focusing on agriculture and local development, this dissertation explores how climate adaptation policy objectives formulated at the higher level and the adaptation activities at the local level are interacting to create conditions to enhance climate resilience at the local levels.

Designed in the form of three independent manuscripts presented in chapters two, three, and four, this dissertation as a whole asks a germane question often raised in adaptation research: *How can appropriate institutional and technological options promote wider stakeholder engagement, innovation, and knowledge co-production for overcoming barriers and increasing wider adoption of promising adaptation options?* This overall question is addressed in subsequent chapters as a set of secondary questions and sub-questions:

1. How does the LAPA initiative contribute to the understanding of the opportunities and challenges of locally led adaptation?

    a. What are the implementation challenges and prospects of bottom-up adaptation initiatives?
    b. How does the case of local adaptation initiative in Nepal contribute to strengthening locally led adaptation as everyday adaptation?
2. How does the climate smart village (CSV) approach enhance the scaling of promising adaptation options through institutional innovation?
    a. How does the institutional model of induced innovation contribute to scaling the adaptation practices and technologies with the CSV approach?
    b. How does the CSV program combine local and global knowledge and engage institutions at multiple levels?
    c. How sustainable is the scaling of CSA through the CSV initiative in Nepal and how aligned is the CSV initiative with domestic and international commitments?
3. How do adaptation practices implemented at the local level promote co-productive imaginaries providing space to multiple knowledge systems?
    a. What adaptation options do local communities prefer and how are these activities engrained in their socio-cultural practice?
    b. How do adaptation practices at the local level promote sociotechnical imaginaries of adaptation with the co-production of local and scientific knowledge?

In addressing these questions, I have used a variety of theoretical and methodological approaches. I draw theoretical insights from fields such as political

science, adaptation research, geography, and science, technology, and society (STS). Likewise, I use qualitative and quantitative research methods that include key informant interviews, policy analysis, and institutional visits. The following sections will explain the theories and methodology that I have used to answer these research questions.

## 1.2 Conceptual background

This section presents the conceptual background of my research to explain how this dissertation contributes to the literature on adaptation. Starting with the historical development in the idea of climate change adaptation, this section explains the role of wider stakeholder engagement in promoting adaptation. Further, this section presents ideas of institutional innovation and knowledge co-production in adaptation.

### *1.2.1 Climate change adaptation*

While the term adaptation has its root in biological sciences where it refers to the autonomous adjustment of organisms to the environment (Smit & Wandel, 2006), in the context of climate change, adaptation has had a delayed entrance as an international policy response. For example, the UNFCCC entered into force in 1994, and the early years were devoted to negotiating the Kyoto Protocol, which has an explicit focus on mitigation. Following the adoption of the Kyoto Protocol in 1997, there was a delay in the negotiations that led to a longer time before finalization of the Protocol. During that time, it was assumed that adaptation objectives can be achieved by transferring of technologies from developed countries to the less developed countries. Towards the end of the 20$^{th}$-century adaptation was politicized as some global leaders mentioned that focusing on adaptation is to surrender, and it can distract from the focus on mitigation

(Pielke et al., 2007). The negotiations of the Kyoto Protocol were intended to be finalized at the Sixth Conference of the Parties (COP-6) in 2000, but due to failure in negotiations and high-level political dispute, it was not until COP-11 in 2005 that the set of rules were adopted (Burton et al., 2006). During the in-between period of the Kyoto Protocols preparation and finalization, adaptation emerged as a policy option and was able to be included into the Marrakesh Accords of 2001 (Adger, Huq, et al., 2003; Schipper, 2006). Figure 1 presents the trajectory of climate change adaptation showing major global milestones, policy outcomes and the emergence of some key concepts.

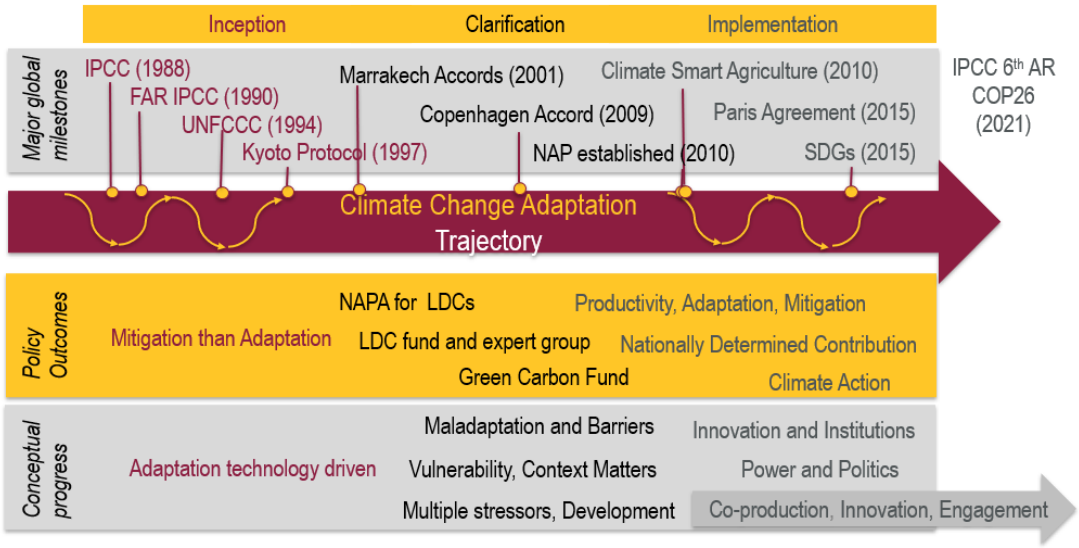


*Figure 1 Trajectory of climate change adaptation*

The failure of negotiations and the ensuing political dispute around mitigation prompted the LDCs to develop a plan of action in response to climate change at COP-6 in 2000 (Schipper, 2006). Accordingly, the Marrakesh Accords (2001) created an

opportunity for adaptation to play a larger role since mitigation was likely to not be effective in subsiding all future climate changes. The formal commitment of the COP to adaptation is in Article 4.1 (b) of the UNFCCC which commits Parties to: "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to … facilitate adequate adaptation to climate change." (UNFCCC, 2006; p. 92) The financing of adaptation measures is addressed in Article 4.3, which states that the developed countries Parties and other developed Parties included in Annex II shall "provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations" (UNFCCC, 2006; p. 254). The articles presented in this paragraph describe the commitments of the COP to adapt to climate change. A more detailed description of international funding arrangements for adaptation can be found in Burton et al. (2002).

The progression of adaptation as a response to climate change laid the groundwork for the National Adaptation Plan of Action (NAPA). The NAPAs are the implementation of Article 4.9 of the UNFCCC, in which the COP established the LDC work program in 2001 (Persson & Klein, 2008). The work program is the response assuming that the LDCs do not have the means to deal with problems associated with climate change on their own. The COP also established a Least Developed Countries Fund (LDCF) to support the preparation and implementation of NAPAs and an LDC Expert Group to provide technical support and advice to the LDCs. As NAPAs are at the forefront of adaptation strategies for developing countries, it is imperative that they meet the needs of communities most vulnerable to climate change.

Several studies also indicated that there are geographic differences in the impacts of climate change (Scherr et al., 2012; Sorte et al., 2011) and that many of the areas with the greatest threat are located in developing countries. Within these countries, those that are the most vulnerable to climate change are those with the least available socio-economic resources. Vulnerability is defined as the propensity or predisposition to be adversely affected by climate risks, and emerges from the intersection of different inequalities, and uneven power structures, and is, therefore, typically socially differentiated (Field et al., 2012). Vulnerability is often high among indigenous populations, women, children, elderly, and disabled people (Eriksen & O'Brien, 2007). People who are poor and vulnerable are also disproportionately affected by climate change (Ribot, 2013). They are also routinely impacted by other ongoing changes as they have the least access to resources and lack the entitlements to acquire them (Adger, Huq, et al., 2003). Thus, it was seen as imperative to see adaptations as local phenomena and intricately connected with overall development and not merely specific stressors (Agrawal, 2010; Lebel, 2013).

In 2009 the Copenhagen Accord established the Green Carbon Fund and adaptation started getting global attention. As adaptation initiatives started around the world, it was noticed that adaptation might not always have intended consequences. This gave rise to ideas such as maladaptation, limits, and barriers (Dow et al., 2013; Jones & Boyd, 2011; Regmi & Bhandari, 2013). Maladaptation refers to an intentional adaptation policy or initiative that increases vulnerability and erodes developmental gains. In general, barriers can be seen as socially constructed norms or obstacles that are

surmountable such as adaptation policies and cultural stigmas (Eisenack et al., 2014). Limits are more related to the physical limit -- an estimated threshold after which adaptation becomes unattainable (Dow et al., 2013). Once a system exceeds a limit the only options left are escalating risk or systems transformation (Kates et al., 2012; Park et al., 2012). In general, transformation is a widespread and radical reorganization of any socio-ecological system once the current ecological, social, or economic conditions become untenable or are undesirable (Nelson et al., 2007; Redman, 2014). Around the same time, scholars started focusing on resilience – ability of a system to resist shock and bounce back to the normal state or another stable state through cross-scale dynamic interactions and integrated systems feedback (Béné et al., 2014).

The literature on climate change impacts, adaptation, and vulnerability has more than doubled from 2005 to 2010 (Field et al., 2012), and it has been increasing persistently. As climate change is expected to bring an increase in the frequency, intensity, spatial extent, and duration of climate and weather extremes (Lavell et al., 2012; Wagner et al., 2014), it has become apparent that adaptation strategies are needed in anticipation of such events. Given that climate change is expected to have dramatic impacts on freshwater resources, terrestrial and inland water systems, coastal systems and low-lying areas, ocean systems, and food security and food production systems (Pachauri et al., 2014), the potential impacts of climate variability and change is, therefore, a cause for concern. While vulnerable communities are struggling for a variety of compounding socio-economic factors such as economic policies, changes in labor markets, population growth, etc., studies continue to reveal that climate change and climate variability worsen

existing poverty and amplify inequalities (Olsson et al., 2014). Climate change, as a risk multiplier, is likely to exacerbate social challenges such as food security, water availability, public health, and sustained economic growth, particularly for populations living in poverty. Due to the multifaceted nature of climate change adaptation, the governance of adaptation has been an arduous task that has relied on international policymaking and the roles of national governments in dealing with these issues.

Governments at all levels play important roles in advancing the adaptive capacity and resilience of diverse stakeholder groups. National governments are integral as they decide many of the funding priorities and tradeoffs, develop regulations, promote institutional structures, and provide policy direction to the district, state, and local governments (Noble et al., 2015). In LDCs, national governments are usually the contact point and initial recipient of international adaptation funding (Noble et al., 2015), therefore, coordination between levels of government can allow for funding to flow more smoothly to local implementers for projects that correlate to national strategies. Governments have the potential to directly reduce the risk and enhance the adaptive capacity of vulnerable areas and populations by developing and implementing locally appropriate regulations and attending to the needs of vulnerable populations through measures such as basic service provision and promotion of equitable policies and plans (Adger, Huq, et al., 2003; Nelson et al., 2007; Noble et al., 2015). While governments have the potential to influence adaptive capacity, local governments often lack the human and technological capacity or mandate to develop and enforce regulations (Noble et al.,

2015). Adaptation will require an approach that devolves relevant decision-making to the levels where the knowledge and capacity for effective adaptation.

While adaptive capacity differs between social, cultural, and economic statuses, the scale of addressing adaptive capacity has important policy components. Addressing adaptive capacity through different scales would most likely present the best approach, as national, regional, and local policies may have different approaches to building adaptive capacity. Additionally, comparing vulnerability and adaptive capacity across countries can identify leverage points in reducing vulnerability to climate change (Brooks et al., 2005). Brooks et al. also mention that sub-national and social differentiation of vulnerabilities and the ways in which the impacts of national-scale processes are mediated by location conditions, should not be overlooked. A study by Vincent (2007) takes a two-pronged approach to adaptive capacity, utilizing a national index for cross-country comparison and a household index for cross-household comparison. Vincent argues that understanding decisions made at both scales illustrates the degree of uncertainty involved when assessing adaptive capacity and that this uncertainty is compounded when additional scales are included. By centralizing adaptation strategies at the national level, country-specific vulnerabilities and guidelines can be disseminated to regional and local governments, so that strategies across scales can be synchronized.

The contemporary approach in adaptation has introduced more interdisciplinary and integrated ideas in adaptation. For example, in 2010 CSA interventions were proposed at the international level that aimed to have triple benefits of food security, mitigation, and adaptation (Palombi & Sessa, 2013). In 2015 a set of 17 SDGs were

adopted that emphasized the integration of efforts and identified climate action as one of the goals. The Paris agreement in 2015 while focusing more on mitigation also encouraged paying attention to adaptation. With the focus on institutional approaches and the role of actors in adaptation, the interest has now focused on the successful implementation of adaptation initiatives. To further that, some scholars proposed adaptation as innovation and innovation as adaptation (Rodima-Taylor et al., 2012) that explained the integrated relationship between innovation and adaptation in the past, present, and future. More recently, scholars have started highlighting that adaptation outcomes in the context of politically unstable and developing countries is shaped by power and politics among the actors (Nightingale, 2017). My work advances these conversations with the case of climate change adaptation in Nepal.

Nepal's case demonstrates that the global climate adaptation discourse and conceptual progress along with the national social, political, and cultural context gave rise to the development of adaptation initiatives. Figure 2 presents the trajectory of climate change adaptation in Nepal showing national context and the progress in adaptation. In 1994 Nepal ratified the UNFCCC and the first communication report was prepared in 2004. This was the time Nepal was undergoing armed conflict that ended with a Comprehensive Peace Agreement signed in 2006. Following that, the country held two Constitution Assembly (CA) elections and the second CA was able to promulgate the Constitution of Nepal 2015. Consequently, Nepal became a federal democratic republic with three tiers of government at federal, provincial, and local levels. Several climate policies were formulated by the GON after 2010, such as NAPA 2010, Climate Change

Policy 2011, and LAPA framework 2011. With this, several initiatives such as LAPA and CSA were implemented at the local levels. The case of Nepal is more interesting with the recent real-time experiment of taking adaptation initiatives more seriously and revising policy objectives in the context of the new administrative structure.

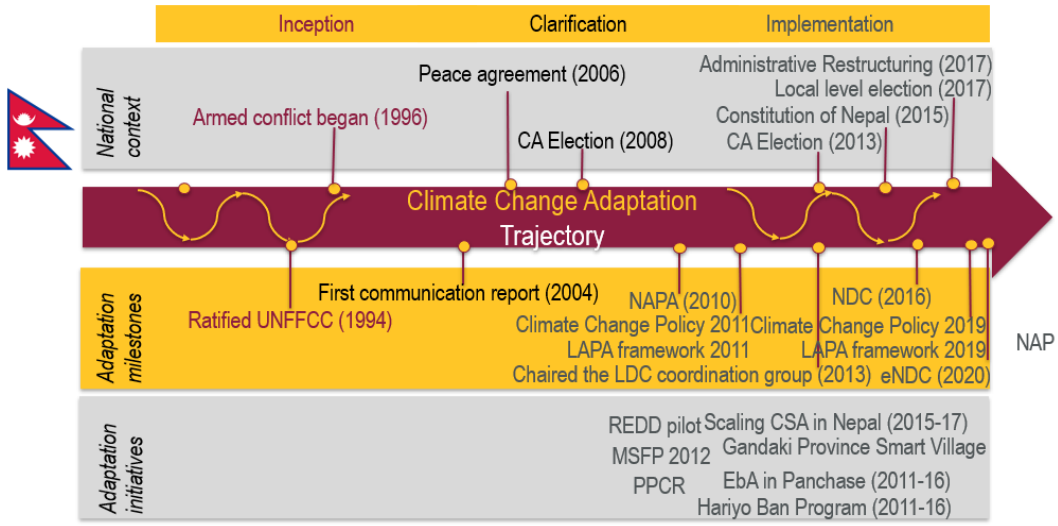


*Figure 2 Trajectory of climate change adaptation in the context of Nepal*

### *1.2.2 Stakeholder engagement*

Effective adaptation requires interactions between public (administrative units), private (business), and civic (NGOs) institutions (Agrawal, 2008) as well as a meaningful engagement among stakeholders that have heterogeneity in terms of scale and operational contexts (Adger, Brown, et al., 2003). In the context that adaptation governance has focused more on high level technical and policy issues (Chhetri et al., 2020; Nightingale et al., 2020), wider stakeholder engagement fosters the leadership of local actors with

continuous coordination and cooperation at multiple levels (Nightingale et al., 2020). The climate change in itself is a boundary concept that is used by multiple stakeholders in their own way. In general, a boundary concept is a loose concept that has a strong cohesive power (Löwy, 1992) and can be helpful for dealing with complex problems (Star, 1989). This vagueness facilitates coordination and communication between multiple actors and to engage with the concept without losing their own identities (Allen, 2009). The concept of boundary work argues that the demarcation between science and nonscience is contingent circumstances and contextual boundaries rather than rigid parameters (Guston, 2001). In the case of climate adaptation, some organizations act as boundary organizations that play a critical role in interpreting highly science-centric and abstract attributes of climate change to meaningful forms (O'Riordan & Jordan, 1999). Such boundary organizations play an instrumental role to foster stakeholder engagement for the implementation of initiatives and achieving adaptation objectives. With cases of LAPA and CSV initiatives in the Gandaki River Basin, I explore how the high-level policy objectives contribute to local adaptation action through the engagement of multiple stakeholders.

### *1.2.3 Innovation in adaptation*

This dissertation recognizes that effective adaptation requires utilizing knowledge, skills, and best practices (Regmi & Bhandari, 2013) as well as technological, institutional, and relational innovation (Rodima-Taylor et al., 2012). In general terms, innovation is widely understood to be the creation of some objects in service of society. In the case of this dissertation, innovation refers to technological, institutional, and wider

cultural and social contexts (Godin, 2008; Mavhunga, 2017). Following Rodima-Taylor et al., (2012), my idea of innovation is based on social innovation through the design and implementation of new solutions that enable individuals and communities to adapt to the changing conditions including a new climate. I recognize that institutions can play a critical role in interpreting highly science-centric and abstract attributes of climate change to meaningful forms (O'Riordan & Jordan, 1999), and in devising location-specific agricultural technologies (Chhetri et al., 2012). Enhancing innovation at farm levels calls for a stronger collaboration between research institutions, extension systems, community-based organizations, and private sectors (Bhatta et al., 2017). Because of their centrality to climate adaptation, institutional context determines the extent to which new technological innovations result in wider adoption (Agrawal, 2010; Chhetri & Easterling, 2010).

Thus, recognizing that institutional innovation remains a critical dimension of agricultural adaptation to climate change, my study contributes to the idea of institutional innovation in adaptation with the case of the CSV approach implemented in Nepal. The CSV approach aims to foster participatory agricultural research and development for designing a package of technological options for addressing climate change impacts working with local farming communities (Aggarwal et al., 2018; Bayala, 2021). The CSV approach comes from the idea of Climate Smart Agriculture (CSA) that was introduced around 2010 to address climate change impacts in the agriculture sector simultaneously reducing its contribution to the greenhouse gas emissions from the sector. A number of CSA practices have been identified, tested, and validated throughout the world, yet these

practices have struggled to be adopted at a larger scale (Neate, 2013). Using the conceptual framework of induced innovation, this dissertation explains how the CSV approach in Nepal has been contributing to agricultural adaptation.

### *1.2.4 Knowledge co-production for adaptation*

The contemporary approach for climate change adaptation is based on technological and science-based ideas that provide little attention to traditional, local, and ecological knowledge. The idea of co-production in adaptation recognizes that knowledge and society cannot exist without each other and cannot be separated (Jasanoff, 2004). Both knowledge and society to whose service the knowledge is created must be constantly in dialectic mode - reinforcing each other for a desired societal outcome. In the case of climate change adaptation, it can be argued that the distinction between scientific and indigenous knowledge is arbitrary (Agrawal, 1995) and blending modern science with local practices strongly connects people and places to respond to the threats posed by climate. In this dissertation, I argue for a more co-productive imaginaries that realize that climate change adaptation is deeply connected to the social, cultural, and everyday reality of a place (Jasanoff & Kim, 2009). Social imaginaries are "collectively imagined forms of social life and social order" (Jasanoff & Kim, 2009, p. 120). For the purpose of this dissertation, I define imaginaries of climate adaptation as collectively held visions of social responses to local climate change attained through and supported by different forms of knowledge including the advancement in science and technology.

To explain the idea of co-production in adaptation, following James Scott (1998), I have used the concepts of *metis* and *techne*, that focus on two different categories of

knowledge systems for adaptation. James C. Scott argues in "Seeing Like a State" that practical and locally derived knowledge known as *metis* has often been ignored in favor of grand narratives and scientific efforts to program development outcomes. On examination, *metis* potentially brings important elements in considering the discourse of climate adaptation notably in the appropriate application of localized knowledge, and the context-specific nature of that knowledge. *Metis* is contextual knowledge situated at the confluence of social and spiritual belief systems as well as the lived experience of a community in question. It refers to place-based and experiential logic focused on solving local issues. The technical knowledge or "*techne*" is a universal and science-based knowledge that can be decomposable, verifiable, and explicit, oriented towards solving specific problems. The *metis*-based approach recognizes adaptation as a socio-natural process where biophysical and sociocultural aspects are coproduced (Jasanoff, 2004) and they are hard to decouple (Nightingale, 2016).

### 1.3 Study Area context

Nepal is a multiethnic and multilingual country situated at the lap of the Himalayas in between India and China. The country of 29 million people is divided into three major ecological zones; the lowland, the midland, and the highland (Regmi et al., 2016). While Nepal is rich in cultural heritage, biodiversity, and biophysical variability, the country is highly vulnerable due to ecological, political, and economic factors along with climatic variability and changes. Climate change continues to be a threat to the lives of the people of Nepal, a majority of whom depend on agriculture for their livelihoods. The changing climate along with other socio-natural causes are responsible for increase

in agricultural pest and diseases decline in water availability and ecosystem services, rising heat related stress, and the increase in climate related disasters such as floods, landslides, drought, and unpredictable rainfall patterns (Xu et al., 2019). Given that the nation's economy and wellbeing is dependent on agriculture and natural resources, potential impacts of climate variability and change is a cause of concern for the country. The overall contribution of agriculture, livestock, forestry, and fishing sectors in the GDP of Nepal in 2019/20 at the current price was 23% out of which the contribution of the agriculture subsector was 75% and the livestock subsector was 15% (MOALD, 2021). Major commodities that have higher share in the agricultural GDP are Paddy and Straw (15.35%), Vegetables (11.92%), Corn and Straw (8.85%), Wheat and Straw (6.34%), and Potatoes (5.96%) (MOALD, 2021).

The issue of climate change is tied to sustainable development and wellbeing of citizens. Though the country has been doing everything to get national and foreign support for increasing the wellbeing of its citizens, these initiatives have not reached everyday lives and decision making in the country. Nepal is often touted in international gatherings for achieving planned development targets in a variety of fields including the increase in girls' education, the decrease in infant and maternal mortality, increase in electricity access, and so on. While the country seems to be doing well on paper, the reality is different compared to the official figures of progress (Gyawali & Thompson, 2016). For example, though electricity access was raised, people have experienced prolonged power cuts and the data on energy access has not been consistent. There are lurking problems and climate change is expected to exacerbate the situation.

As a country highly vulnerable due to climate change impacts, Nepal has been active in preparing plans, programs, and initiatives to address climate change. In 2010, the GON initiated the adaptation planning process by the development of the National Adaptation Program of Action (NAPA), this was followed by Climate Change Policy 2011 and LAPA framework in 2011 along with the initiation of the National Adaptation Plan (NAP). While Nepal's approach to climate adaptation is criticized for being top-down, technocratic, and sectoral (Huq & Khan, 2006; Nightingale, 2015; Ojha et al., 2016), the NAPA provides a clear guideline for the disbursement of at least 80 percent of the adaptation fund at the local level. For this reason, the GON has enacted ambitious adaptation policies and plans focusing on devising local level response strategies. For example, a LAPA framework was proposed by GON in 2011 that intends to implement the priorities of NAPA more effectively through engagement at the local levels and integration of adaptation into sectoral plans and policies. The concept of LAPA emerged during the preparation of NAPA and was taken seriously by the Government of Nepal and its development partners. With the goal of increasing the resilience of local communities through implementing a range of local actions, LAPA has adopted four guiding principles: bottom-up, inclusive, responsive, and flexible (GoN, 2011). Overall, the LAPA framework intends to integrate climate adaptation and resilience into local and national development.

Nepal's LAPA framework aims to make climate adaptation planning inclusive and flexible by allowing local people to make informed decisions on priority actions (Wiseman & Chhetri, 2011). The LAPA also provides a mechanism for mainstreaming

local adaptation needs and capacities into development planning for the effective implementation of the most urgent and immediate adaptation needs. The LAPA framework has identified seven steps for LAPA formulation and implementation: (a) Sensitization (carried out in all steps), (b) Vulnerability and adaptation assessment, (c) Prioritization of adaptation options, (d) Formulation of adaptation plan, (e) Integration of adaptation plan into planning processes, (f) Implementation of adaptation plan, and (g) Progress assessment (carried out in all steps) (GoN, 2011). So far, more than 700 LAPAs have been prepared in Nepal and the LAPA process has gained global recognition and it has been adopted in several other countries (Maharjan, 2019). While this initiative is often touted as a local level initiative, LAPAs are prepared by projects funded by bilateral and multilateral donors together with national NGOs and the local government.

Figure 3 shows the map of Nepal highlighting my study area in the Gandaki River Basin. Around 70 LAPAs were prepared in Chitwan-Annapurna Landscape (CHAL) by the Hariyo Ban Program Phase I. My study has analyzed 65 LAPAs that cover 11 districts. These districts include all three eco-regions: high mountain, mid-mountains/hills, and Terai/Siwalik. Interviews with local level stakeholders include respondents from all districts where LAPAs were prepared. The study area is suitable for the study of climate change impacts, adaptation practices, and the challenges for bottom-up approach in adaptation. The previous studies have based their research in some of these places which gives some basis for comparison with already available literature. The other practical criteria for the selection of these locations were the availability of the

interviewees for virtual interviews. Some of these locations are inside the Annapurna Conservation Area and the buffer zone of Chitwan National Park.

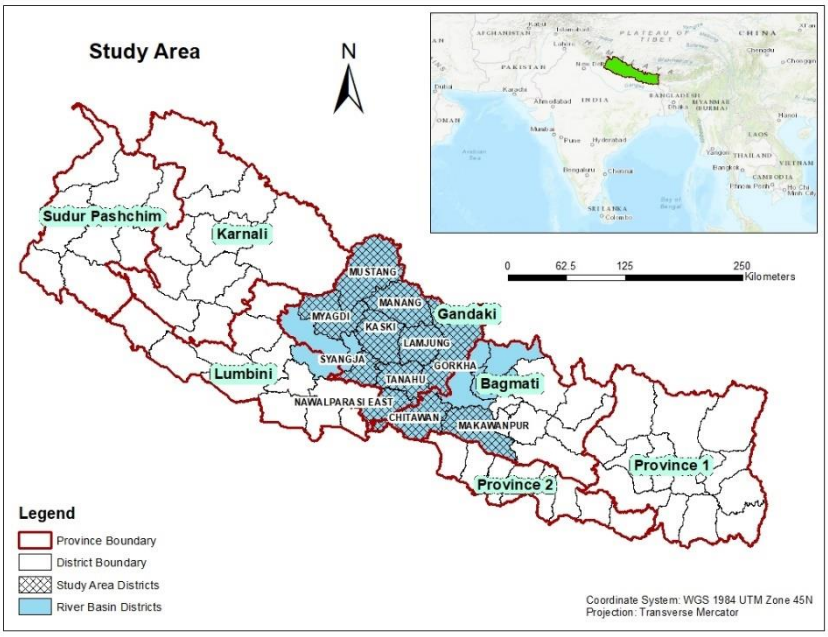


*Figure 3 Map of Nepal and the Study Area*

## 1.4 Research Methodology

This research uses case studies that are organized based on the analysis of documents and stakeholder perceptions. My study draws cases from two of Nepal's flagship adaptation programs – LAPA and CSA. This dissertation applies mixed methods that combines both qualitative and quantitative methods to fully understand a problem (Bloomberg & Volpe, 2018). The quantitative data was collected from policy documents and by interviewing local level stakeholders using semi-structured questionnaires. The transcripts from the open-ended interviews with the regional and national level

policymakers form the basis for qualitative analysis. Figure 4 explains the methods employed for data collection.

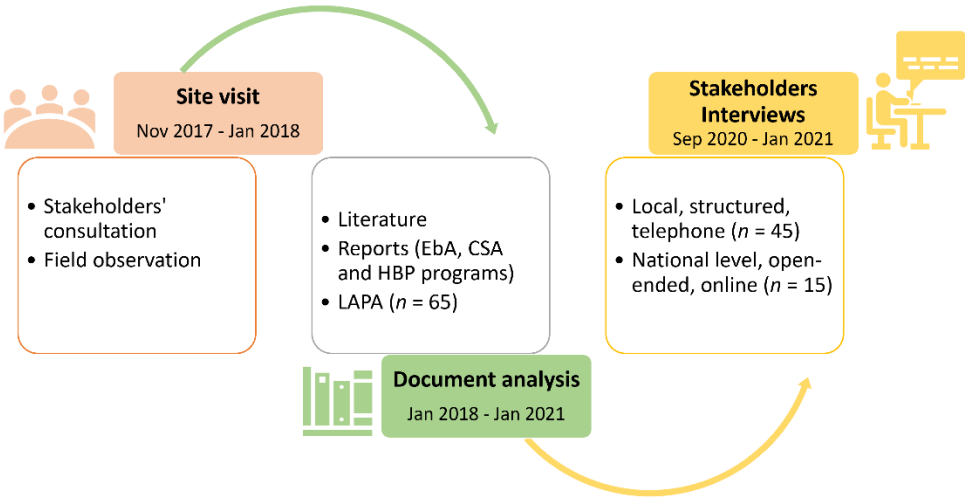


*Figure 4 Data collection methods*

### *1.4.1 Scoping field visit*

First, I conducted a pilot field visit from November 2017 to January 2018 for the scoping of the research. Before initiating the research, I obtained approval from the Institutional Review Board (IRB) of Arizona State University. Using the snowball sampling method, I identified key informants working in climate change adaptation in Nepal and interviewed them. The interviews were not recorded, and these were used as a scoping visit which formed the basis of my dissertation research, but they were not formally analyzed for this dissertation research.

At this point, I focused more on the adaptation initiatives in Nepal and particularly the idea of CSA that is presented in Chapter 3. At the central level, I met

professionals working in CSA-related programs representing different institutions. This was followed by field research at two sites where the GON conducted the CSV program in the fiscal year 2016/2017. The selected sites represent different geographic and socio-economic conditions and consequently have different climate change impacts. First, Bhediya of Surunga Municipality of Saptari district represents plains and Province 2. Second, Bhirpani of Khadadevi Rural Municipality of Ramechhap district represents hills and Province 3. In addition to that, I also visited the CSV program at Bhaktapur district and the resilient mountain village of the International Centre for Integrated Mountain Development (ICIMOD) and Centre for Environment and Agriculture Policy Research, Extension and Development (CEAPRED) at Kavrepalanchowk district.

### *1.4.2 Collection and analysis of reports and secondary information*

After the preliminary field visit, I collected climate change related policies, programs, and documents at the national and local levels. Specifically, I gathered 65 LAPA documents prepared inside the Gandaki River Basin. Data from these documents were collected to understand: a) nature of local hazards; b) proposed adaptation activities in response to these hazards; and c) types of institutions identified to support these activities. For the fourth chapter, I went through reports and publications by Ecosystem Based Adaptation (EbA) program in the Panchase mountain ecological region, CSA and CSV programs, and the Hariyo Ban program. Further, I reviewed, academic papers and policy documents including NAPA, Climate Change Policy 2011 and Climate Change Policy 2019, LAPA framework 2010, LAPA framework 2019, and Nepal's Nationally Determined Contribution submitted to the UNFCCC.

### *1.4.3 Key informants' interviews*

Third, I conducted 45 structured interviews (via. telephone) with local stakeholders responsible for designing and implementing the LAPA. Respondents were affiliated with local government, schools, community forest users' groups, and conservation areas management committees, representing 29 communities from 11 districts where Hariyo Ban Program prepared the LAPA. I used *Qualtrics*, an online platform, to enter the responses directly into the database. The interviews with local stakeholders were used as the primary basis for identifying stakeholder perceptions regarding proposed climate adaptation action in LAPA and their implementation. This is also the basis of quantitative analysis. I followed the snowball sampling method, a non-probability sampling technique where an existing subject provides referrals to identify and recruit samples required for a study (Bernard, 2017). It is important to note that a third of the respondents were women. I also conducted 15 (with 5 women) semi-structured interviews (via. zoom) with policymakers and stakeholders from research institutions, governmental and non-governmental organizations, media houses, and development partners operating at the national and sub-national level. The interviews with these key informants were more exploratory in nature and centered on how local level adaptation plans, policies, and initiatives are connected to the national and international level discourse. It was qualitative in nature. Similar to the first set of interviews with local stakeholders, I used a snowball sampling method, and these respondents were selected based on their knowledge and experience about the issue. These interviews helped to situate the LAPA initiative in the Gandaki River Basin with

the other approaches in climate adaptation happening in Nepal and internationally. Both sets of interviews helped to triangulate the findings of the document review conducted using secondary data. The stakeholder interviews were necessary to learn how the national policy objectives and the local level adaptation activities are linked.

All these interviews were conducted from September 2020 to January 2021 virtually as COVID-19 pandemic restricted travel. All measures were taken to make sure that data collection is reliable, transparent, and strictly following the protocol prepared before the data collection (Noble & Smith, 2015). For example, in addition to securing the approval of the Institutional Review Board of ASU before initiating the data collection, I also obtained permission from the concerned authorities in Nepal such as the Department of National Parks and Wildlife Conservation (DNPWC), and the Annapurna Conservation Area Project (ACAP), and the National Trust for Nature Conservation (NTNC).

### *1.4.4 Analytical framework*

Chapter 3 uses the framework of institutional innovation for agricultural adaptation. Figure 5 shows the conceptual model that integrates institutional and technological innovation in agriculture (Chhetri et al., 2012). The framework suggests that the climate change induced impacts in the resource endowment (e. g. changes in crop growing seasons, change in soil moisture, increase in pest infestation, etc.) provide signals to farmers and their supporting institutions that trigger them to start talking about potential climate change impacts. Farmers' institutions could make adjustments in their social activities, such as changes in crop types that better suit the new environment or

investments in irrigation infrastructure if drier conditions are created due to change in rainfall patterns, to ensure crop growth and development. This conversation spurs some type of institutional innovation that gives rise to technology development or improvement. Since adaptation is a local process, the local organizations, such as farmers groups, exert influence in institutional innovation making cultural components an important part of the conversation.

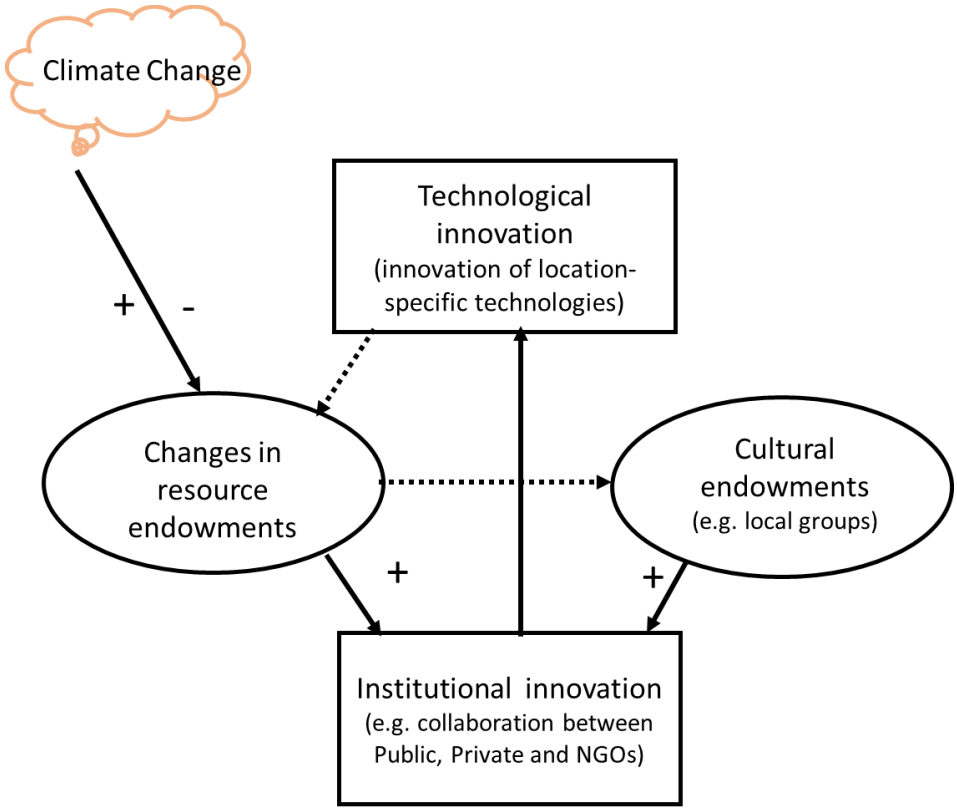


*Figure 5 A conceptual model illustrating the integration between institutional, cultural, and technological innovation (Source: Chhetri et al. 2012)*

### *1.4.5 Data analysis*

I used qualitative and quantitative methods for the analysis of data. The transcripts from open-ended interviews with central and regional level stakeholders were analyzed using the qualitative method. For this, a grounded theory method was used that used inductive analysis focusing on the data to find out themes and patterns. Instead of approaching the data with preconceived theories and concepts, this approach ensures that the researcher looks at the pattern of the data to come up with themes (Ryan & Bernard, 2003). I used the RQDA computer program for analyzing this data. Likewise, the LAPA documents were coded for themes focusing on four relevant sections. These sections are; impacts of climate change on natural resources, list of hazards identified, adaptation activities proposed to adapt to selected hazards, and institutions identified in LAPAs for supporting these activities. Based on the thematic codes, content in LAPAs was sorted (grouped) and entered in an excel sheet.

The semi-structured interviews with local level stakeholders were analyzed quantitatively using excel and SPSS. Likewise, the quantitative data obtained from the analysis of LAPA documents were used to generate quantitative information that was plotted in figures. The semi-structured interview data helped to analyze the public perception regarding climate change impacts, adaptation options, and the implementation of LAPA in the Gandaki River Basin. The descriptive statistics generated analyzing these interviews provided new insights and contributed to a better understanding of the activities proposed in LAPA documents

## 1.5 Chapter overview

This dissertation is structured into five chapters. Besides this introductory chapter and the conclusion chapter, the other three chapters are written as separate journal paper manuscripts. These three chapters are related to the conceptual background presented in this chapter and are designed in such a way that they answer the research questions that I have posed in this dissertation research. As a cohesive whole, these chapters present how adaptation governance can be enhanced through institutional and technological innovation with the case of Nepal. Figure 6 shows the conceptual framework and the structure of this dissertation. Overall, this dissertation argues for a better connection or engagement between higher-level policy objectives and institutions and local-level plans, local development, and institutions. Along with that, this dissertation research calls for co-production between local and indigenous knowledge that communities have and science-based knowledge and technologies. There is a sweet innovation space in the middle with knowledge co-production and wider stakeholders' engagement. This dissertation research investigates these issues in the subsequent three chapters.

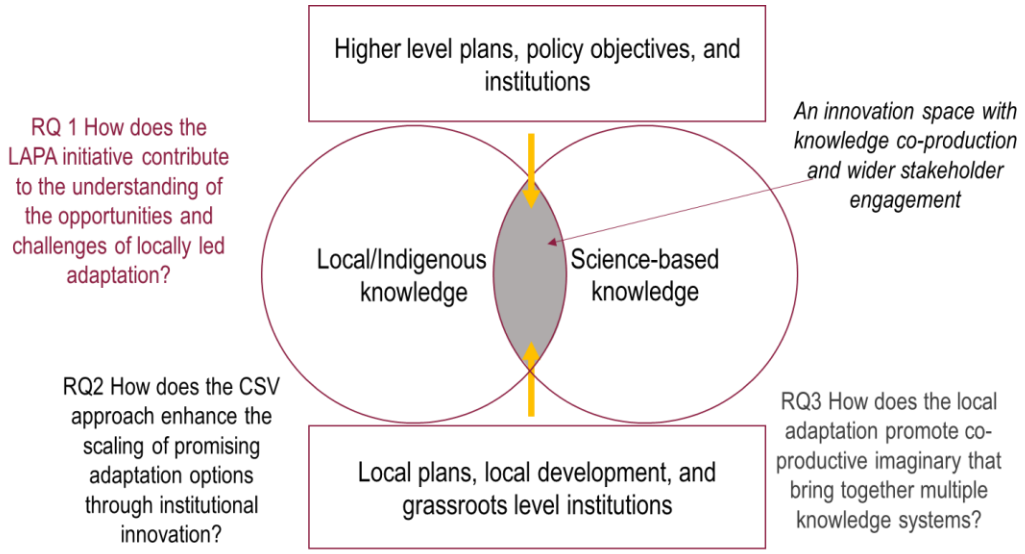


*Figure 6 Conceptual framework and the structure of dissertation*

The second chapter on "Opportunities and challenges of locally led adaptation" focuses on the case study of LAPA in Nepal to examine obstacles that local communities face in promoting local adaptation initiatives. My findings reveal that challenges identified by local level stakeholders are: a) insufficient financial resources, b) lack of support from governmental and non-governmental institutions, c) limited knowledge or awareness, and d) less recognition of local knowledge. Some of these challenges, I argue, can be addressed by building on local knowledge and capacities of the communities. A number of these challenges need support from global and national actors. Finally, this chapter explains how different agents and groups involved in the practices of adaptation have unequal power relationships. While elected local governments and public sector institutions have a crucial role and authority, the voices of women and marginalized groups need special attention.

The third chapter on "Institutional innovation for climate smart agriculture" uses the conceptual framework of induced innovation to analyze the CSV approach in Nepal for the scaling of climate change adaptation practices. Here I investigate opportunities and gaps in scaling up the CSV program through the combination of institutions and technologies. This chapter demonstrates how the CSV approach, introduced by multiple institutions to pilot- and scale locally suitable agricultural technologies and practices, provides a strong basis for the co-production of ideas, institutions, and knowledge systems in agricultural adaptation. Most importantly, this initiative promotes collaboration among public, private, civil society organizations, and communities.

The fourth chapter on "Co-productive imaginaries for adaptation" presents a set of adaptation activities that communities have been using to address climate adaptation challenges. This chapter explores how science-based and traditional adaptation options are being used together at the community level. This chapter reveals that local adaptation practices are a response to a host of other ongoing stresses and are firmly connected to local communities. Further, it demonstrates that most of the adaptation activities proposed by local communities were low cost, based on experiential learning, and could be implemented by mobilizing local resources. Community-based adaptation activities are *metis*-based and strongly connected to local development goals, revealing the synergy between adaptation policy objectives and development. This chapter explains the need of using both traditional and modern knowledge and capacity to enhance the adaptation action at the local level. Further, it explains how the distinction between scientific and traditional knowledge is arbitrary as multiple forms of knowledge come together at the

community level as a response to changing climate. Finally, Chapter 5 presents the key findings from my dissertation and outlines avenues for future research.

### 1.6 Significance

Climate change impacts are severe in mountain environments and particularly for the natural resource-dependent rural populations. By threatening the water, farmlands, and ecosystems that are vital for rural livelihood, climate change along with other socioeconomic changes has created existential risk for people who are already vulnerable. Therefore, the adaptation initiatives in countries such as Nepal are extremely crucial. However, the adaptation governance is driven by top-down and technological ideas that discredit local knowledge, resources, and capabilities.

In this context, this dissertation research contributes to adaptation governance in three ways. First, this research conceives climate change adaptation as an everyday adaptation. This approach reiterates how important it is to see the connection between climatic impacts and adaptation options to communities. This research argues that development and adaptation could be conceived together along the lines of LAPA that aims to integrate adaptation options in local development. While highlighting the need for local knowledge and engagement, this work also explains how the local adaptation cannot happen without continuous top-down support in the form of planning, financing, and implementation. Further, this study has explained how adaptation in the context of developing countries such as Nepal is shaped by power and politics among the actors. Local government and central level authorities have more power compared to local communities, private institutions, and civil society organizations. Most importantly, this

study explains how the voices of women and marginalized groups can get lost during the planning, budgeting, and implementation and how adaptation initiatives can prioritize vulnerable people during all levels of development. Second, this research explains how the focus on institutional aspects can contribute to better adaptation governance while also contributing to larger goals such as achieving Nationally Determined Contributions (NDC) and Sustainable Development Goals (SDGs). This finding is encouraging for institutions promoting CSA interventions as understanding institutional innovation and the role of scientific and local knowledge can contribute to the scaling of climate change adaptation initiatives such as Climate-Smart Agriculture. Third, this research explains how traditional, local, and ecosystem-based knowledge is being used together with science-based measures at the local level. While arguing for a more co-productive approach, this research explains why it is important to use a plethora of adaptation options available for creating resilience at the local level. My research also explains how science-based adaptation options need more connection to be widely adopted by rural farmers.

Since my research draws from STS, political science, geography, and sustainability science, this interdisciplinary research project will be useful to multiple disciplines that are concerned about climate change adaptation research. The methodological approach used in this research can be replicated for understanding the institutional and technological aspects of adaptation. This research will be helpful for international development agencies such as USAID, World Bank, and UNDP to prepare better adaptation plans for vulnerable countries such as Nepal. In addition to that, this

work will be valuable for NGOs and practitioners working in adaptation who are supporting adaptation initiatives on the ground while bridging between international and local levels. This research can also be useful for government agencies to prepare appropriate policy objectives and implement them at local levels working together with multiple actors.

# 2 CHALLENGES AND OPPORTUNITIES OF LOCALLY LED ADAPTATION

## 2.1 Introduction

In the third week of October 2021, an untimely post-monsoon rainfall in South Asia destroyed paddy fields ready for the harvest and killed more than 100 people in Nepal alone. While the variability of Monsoon is a common phenomenon, Monsoon usually withdraws from the Himalayas during the third week of September and farmers start harvesting paddy, a staple crop in the region. Such an intense rain, as much as 200 mm in 24 hours, at this time of the year was unprecedented and devastating. A question many people ask following such disasters is whether it was due to human induced climate change or are such events becoming more frequent. In this dissertation I argue that by associating such events with climate change makes dealing with them more complicated and rigid. Sometimes, climate change can be a distraction for undertaking urgent matters of policy making and public engagement (Pearce et al., 2017). It can also be an excuse or something about which nothing can be done. Rather than debating on less significant matters such as whether climate change is human induced and whether it should be dealt with through a state-led or locally led approach, this study recognizes that the practical approach for solving problems cannot be too rigid, meticulous, and universalist (Lindblom, 1986; Scott, 1998). Don't we need stronger infrastructure and more reliable measures? Don't vulnerable communities need support if we forget about climate change for some time? This article argues to make adaptation an everyday mundane practice in two ways. First, understanding that climate change is nothing more than everyday problems that communities are already facing. Second, the approach of dealing with

climate change does not have to be grand schemes but it can be mundane approaches of learning by doing by communities (Lindblom, 1959). On the other hand, approaches led by external agents can have a hard time forming part and parcel of local life (Scott, 1985, 1989). I view adaptation as everyday practices, and this chapter analyzes challenges and prospects of everyday adaptation with the case of the LAPA initiative in Nepal. With aims to prepare adaptation plans with communities and integrate them in local development planning, LAPA tries to make adaptation a mundane practice in a country that is considered highly vulnerable due to climate change impacts on top of preexisting social, political, and geographical challenges.

In Nepal, climate change is expected to enhance climate variability and extremities such as extended drought and intense rain (Xu et al., 2019). Rural farmers are particularly vulnerable as they depend on smallholder agriculture systems for their livelihoods (Dhungana et al., 2020). As a result, the potential impacts of climate change are seen as key challenges to attaining a number of UN Sustainable Development Goals (UN SDGs), including food security and alleviating poverty. Consequently, the government of Nepal has developed the Local Adaptation Plan of Actions (LAPA) aimed at increasing the resiliency of local communities through implementing a range of locally led adaptation actions. Therefore, adaptation practices led by local communities are increasingly seen as complementing adaptation policy objectives designed at the global and national levels. Rather than seeing adaptation as strictly technical and top-down, Nepal's LAPA can be seen as an ongoing phenomenon that calls for continuous coordination and cooperation at multiple levels (Nightingale, 2015). The operational

approaches of LAPA, therefore, move beyond the structural distinctions between local or community-driven versus external or state-led action.

While potential contributions of LAPA to effective climate change adaptation has been acknowledged in the literature (Chaudhury et al., 2014), lack of knowledge about related governance structure and effectiveness of the current approach to implementing LAPA has hindered its wider application (Nightingale, 2015). Nepal's LAPA is integrally connected to and embedded in the context of everyday life and wider developmental needs of local communities. Successful adaptation policy objectives of LAPA demands that they be connected to institutions operating at multiple scales so that they can benefit in planning activities, budgeting, implementation, and evaluation. Against this background, this study expands knowledge on the role of LAPA in advancing climate adaptation policy objectives in Nepal and its supporting institutions.

For too long solutions for tackling climate change have focused more on high level technical and policy issues (Chhetri et al., 2020; Nightingale et al., 2020). The focus on international and country level intervention has resulted in of formation of policies and programs at the national and international levels. However, the implementation of these national and international plans, policies, and commitments have been struggling to make real impacts at the ground level (Klein et al., 2017). While national level programs and policies are important, it is equally crucial to understand their implementation, and how they translate into the everyday realities of communities who are undergoing multiple challenges whereby climate is one (Funder & Mweemba, 2019). To create synergy between the policy objectives at the higher levels, community-based adaptation

initiatives are proposed that provide more emphasis to the local level. These bottom-up approaches are struggling to garner support from the top-down level for their sustainability and scaling up. Research on the integration of local adaptation planning (e.g. LAPA) to national and global level planning to strengthen local action through multi-level engagement in the implementation is still in its infancy.

The approach of locally led adaptation recognizes that local communities are at the forefront of witnessing climate change impacts and in responding to local changes and calls for more ownership by local actors on adaptation programs, funding, and practices being implemented in their place (Westoby et al., 2020). The World Resources Institute has proposed eight principles for changing the current top-down approaches for adaptation governance to a new model of locally led adaptation that provides more resources to local level actors (Soanes et al., 2021). These principles include devolving decision making to the lowest level, addressing inequality, providing predictable funding, and enhancing local capabilities through a collaborative approach. By 2020 more than 40 international organizations have endorsed the principles of Locally Led Adaptation (Coger et al., 2021). This chapter highlights how locally led adaptation efforts can benefit from recognizing adaptation as everyday adaptation with the case of Nepal.

This chapter analyzes adaptation governance in Nepal, focusing on the Local Adaptation Plans of Action (LAPA) in the Gandaki River Basin. The LAPA program was implemented by the GON in collaboration with several other organizations to provide immediate adaptation services under National Adaptation Program for Action (NAPA) priorities submitted by the country to the United Nations. Following the framework

prepared by the GON, the LAPA aims to develop adaptation plans in consultation with local communities. It is also expected that the LAPAs integrate their plans with the local development goals. So, my goal is to understand and contribute to the growing literature on adaptation governance by examining local level adaptation initiatives in Nepal. I ask: a) what are the implementation challenges and prospects of bottom-up adaptation initiatives? and b) how does the case of local adaptation initiative in Nepal contribute to strengthening locally led adaptation as everyday adaptation?

The remainder of the chapter is divided into six sections. In Section 2.2 I propose my analytical approach and the contribution to climate change adaptation research. Section 2.3 introduces the case of climate change adaptation in Nepal and the LAPA initiative. Following that Section 2.4 presents my research methodology followed by the results of this chapter in Section 2.5. The discussion in Section 5.6 explains how looking through the approach of everyday adaptation can enhance locally led adaptation initiatives. Finally, Section 5.7 reiterates key findings and outlines avenues for future research.

## 2.2 The case of local adaptation

The adaptation research needs to focus on how national and international policies and commitments can translate to the local levels through better implementation of adaptation initiatives. In doing so, it is imperative to understand barriers of adaptation initiatives to enhance complementarities between local and national actions to promote adaptation at all levels. This chapter seeks to fill this pertinent gap by focusing on everyday adaptation. I propose that everyday adaptation can contribute to local level

adaptation planning in three related ways. First, this approach forms part of everyday life and increases ownership of local actors and institutions in adaptation initiatives while connecting adaptation efforts with local development. Second, while building iterative interaction between multiple institutions, this approach bridges the divide between bottom-up and top-down initiatives during planning, financing, and implementation of adaptation initiatives. Finally, by recognizing the political nature of adaptation this approach understands the differential power relationships between actors responsible for adaptation while ensuring that voices of marginalized people are incorporated in adaptation actions at the local level.

First, the idea of everyday adaptation connects to the everyday life and local context in which climate change manifests recognizing how vulnerabilities are produced locally (Ribot, 2013). This approach recognizes multiple stressors and the need to integrate local knowledge to design appropriate adaptation options (Eriksen et al. 2011). This approach concentrates on engaging local communities, empowering grassroots institutions, and integrating contextual knowledge (Chhetri et al., 2012). Further, this idea recognizes that local communities are at the forefront of witnessing climate change impacts and responding to local changes. Local knowledge and lived experience have always been an important part of communities' response to climatic and other stressors. In this view, adaptation is not a new thing as communities have been adapting to changes throughout human history by showing considerable resourcefulness in the face of external change (Lebel 2013). Therefore, for addressing climate change impacts adaptation initiatives needs to understand local cultures, values, and knowledge systems

(Hulme, 2009). Adaptation initiatives can thrive when they connect with local livelihood as seen by the success of farmers' managed irrigation systems (Ostrom, 1990), community forestry institutes, and local cooperatives or microcredits.

The focus on everyday adaptation has the potential to contribute to developmental pathways with meticulous attention to the day-to-day needs of most vulnerable people (Eriksen et al. 2011). This approach connects to adaptation practices in multiple sectors especially for ensuring the availability of food, water, energy, and forestry resources that are vital livelihood resources. Such adaptation initiatives aim to address the everyday development needs of communities such as hunger, malnutrition, lack of education, lack of access to basic needs, and recognition of human rights. In doing so, such initiatives build adaptive capacity to multiple stressors that give rise to vulnerability in addition to contributing to specific stressors such as flood and drought (Eakin et al., 2014). Thus, this approach gives rise to everyday adaptation approaches that might look mundane but are best suited considering the problems local communities are facing.

Second, the idea of everyday adaptation helps to bridge multiple dichotomies and one particularly important in my case is the divide between top-down and bottom-up adaptation initiatives. The local adaptation planning is not merely local, but it needs to consider potential feedback between local and global processes (Eriksen et al. 2011). In practice, both top-down and bottom-up processes work together during planning, budgeting, implementation and monitoring of adaptation governance (Ishtiaque et al., 2021). Local adaptation thrives with the presence of policy and institutional environment for identifying local level units, selecting appropriate interventions, development of

context-specific approaches, adequate funding, effective implementation, and continuous monitoring. For local climate change adaptation approaches to be sustainable adequate institutional support is required (Agrawal, 2010). Thus, the institutional dimension is one of many barriers and enablers for effective climate change adaptation at the local level. In general, barriers can be seen as socially constructed norms such as adaptation policies and cultural stigmas that hamper or prevent adaptation efforts. In most developing countries the contemporary approach to mainstreaming adaptation at the local level is institutionally fragmented (Paudel et al., 2013) that can act as a barrier. However, barriers are surmountable (Eisenack et al., 2014) but are not rigid physical boundaries.

Finally, everyday adaptation explains how adaptation approaches can reinforce existing power differentials and inequities that give rise to vulnerabilities in the first place (Nightingale, 2015). In addition to that, an effective adaptation recognizes that the impact of climate change has been more on vulnerable and natural resource dependent people who lack resources and capacity to adapt to the changes (Ribot, 2013). The differential impacts call for understanding the conflicting sociocultural contexts and societal goals (Engle 2011) and varying values and interests (Eriksen et al. 2011). This approach recognizes that addressing societal vulnerabilities and risks is a social and political challenge rather than a technical one. The voices of marginalized communities and at-risk people are crucial for any adaptation initiative

### 2.3 Climate change adaptation in Nepal and the LAPA initiative

The interactions between social and natural variabilities and changes in Nepal are complex and scholars have been studying these multiple stressors for more than 50 years.

Recently climate change is viewed as a risk multiplier that exacerbates a variety of problems that people in the region are facing. Thus, climate change impacts add a layer of complexity and increase risks to the lives of the people of Nepal, the majority of whom depend on agriculture for their livelihoods. In recent years, evidence of changing climatic conditions, such as the decline in agricultural productivity, water availability, and ecosystem services, and the rise in climate-related disasters such as floods, landslides, drought, and unpredictable rainfall patterns have been well documented in the region (Xu et al., 2019). Given that the nation's economy and wellbeing are dependent on agriculture and natural resources, potential impacts of climate variability and change are causes of concern for the country.

The GON has shown great promise in the governance of climate adaptation. In 2010, the GON initiated the adaptation planning process by the development of the National Adaptation Program of Action (NAPA), this initiative was followed by the Climate Change Policy 2011 and the LAPA framework in 2011 along with the initiation of the National Adaptation Plan (NAP). While Nepal's approach to climate adaptation is criticized for being top-down, technocratic, and sectoral (Huq & Khan, 2006; Nightingale, 2015; Ojha et al., 2016), the NAPA provides clear guidelines for the disbursement of at least 80 percent of the adaptation fund at the local level. For this reason, the GON has enacted ambitious adaptation policies and plans focusing on devising local level response strategies. For example, the LAPA intends to implement the priorities of NAPA more effectively through engagement at the local levels and integration of adaptation into the sectoral plans and policies.

Nepal's LAPA framework aims to make climate adaptation planning an inclusive and flexible process that will allow local people to make an informed decision on priority action (Wiseman & Chhetri, 2011). The LAPA also provides a mechanism for mainstreaming local adaptation needs and capacities into development planning for the effective implementation of the most urgent and immediate adaptation needs which were prioritized in NAPA. Nepal's LAPA process has gained global recognition and as a result, has been adopted in several other countries (Maharjan, 2019). In total, GON with the help of donors has prepared 100 LAPAs in vulnerable districts of mid-western and far-western development regions and at present GON is supporting the implementation of them through National Climate Change Support Program (NCCSP). In addition to LAPAs prepared and implemented by NCCSP, other large-scale programs for preparation and implementation of LAPA were carried out by Multi-stakeholder Forestry Program (MSFP) and Hariyo Ban Project. In general, all LAPAs provide invaluable local information and were produced with a meticulous effort by using the national framework designed by the GON (Silwal et al., 2019). LAPAs in the Gandaki River Basin were prepared by Hariyo Ban Program Phase I, a five-year USAID-funded program with the goal of reducing vulnerability to climate change and threats to biodiversity in Nepal. The phase I program that concluded in December 2016 prepared 90 LAPAs at TeraiArc Landscape (TAL), and the Chitwan Annapurna Landscape (CHAL). Most of these LAPAs were implemented by the program benefiting 288,499 vulnerable people (Gyawali et al., 2017).

## 2.4 Research methodology

The working area for my research is the Gandaki River Basin in Nepal (Figure 7). Among 69 LAPAs prepared inside the CHAL by the Hariyo Ban Program, my study focuses on 65 LAPAs that cover 11 districts. These districts include all three eco-regions: high mountain, mid-mountains/hills, and Terai/Siwalik. Some of these locations are inside the Annapurna Conservation Area and the buffer zone of Chitwan National Park.

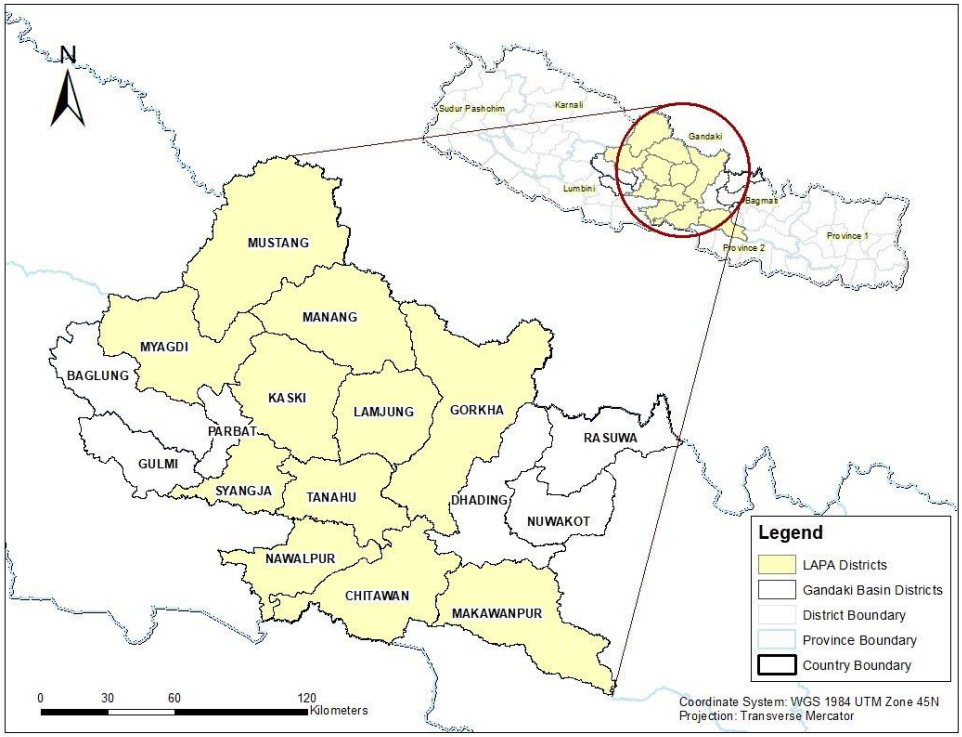


*Figure 7 Map of Nepal showing the study area*

This chapter combines both qualitative and quantitative research methods. Quantitative data was collected by interviewing local level stakeholders using semi-structured questionnaires. The transcripts from the open-ended interviews with the

regional and national level policymakers form the basis for qualitative analysis. Secondary data were collected from LAPA documents that use both methods.

The data collection for this study follows three steps. First, I conducted a pilot field visit from November 2017 to January 2018 for the scoping of the research. Second, climate change related policies, programs, and documents were collected at the national and local levels. Following that I collected LAPA ($n$=65) prepared inside the Gandaki River Basin. Third, I conducted 60 interviews from September 2020 to January 2021 following the snowball sampling method. This includes 45 structured telephone interviews with local stakeholders responsible for designing and implementing the LAPA, and 15 semi-structured online interviews with stakeholders from research institutions, governmental and non-governmental organizations, media houses, and development partners operating at the national and sub-national level. The first set of interviews used *Qualtrics* program for data collection and ensured respondents representing 29 communities from 11 districts where Hariyo Ban Program prepared the LAPA. In both sets of surveys, I ensured the participation of at least a third of women respondents.

The LAPA documents were analyzed focusing on specific sections to understand: a) nature of local hazards; b) proposed adaptation activities in response to these hazards; and c) types of institutions identified to support these activities. Findings of the document review contributed to interviews with stakeholders to explore the link between national policy objectives and the local level adaptation activities. Interviews with local level stakeholders formed the basis of quantitative analysis and helped in identifying

stakeholder perceptions regarding proposed climate adaptation action in LAPA and their implementation. The second set of interviews were more exploratory in nature, so they were analyzed qualitatively. These interviews centered on how local level adaptation plans, policies, and initiatives are connected to the national and international level discourse. To analyze interview transcripts, I used a grounded theory method. This inductive analysis of data focused on the data to find out themes and patterns instead of approaching the data with preconceived theories and concepts. I used computer programs, excel, SPSS, and RQDA for the analysis of data.

## 2.5 Results and discussion

### *2.5.1 Climate change impacts and everyday adaptation*

The impacts of climate change in the Gandaki River Basin are visible in multiple sectors. According to perceived impacts in LAPA documents, the most prevalent changes in the agricultural system have been the increase in pests, decrease in agricultural production, and the loss of traditional seeds and farming systems. In water resources, most LAPA documents mentioned issues such as drying of water sources, lowering of groundwater table, irregular rainfall, and increasing drought. Likewise, the commonly reported impacts in the forest and biodiversity sector are loss of medicinal plants and an increase in wildfire and invasive species. Likewise, LAPAs have documented several hazards (climate-induced and otherwise) prevalent in their place. Figure 8 presents how widespread a given hazard is in the region and what level of severity do communities assign each of them. Hazards reported in most places were landslide, followed by fire,

hail, crop pest/disease, drought, and so on. Among multiple hazards that communities were concerned about drought and landslides are seen as more severe.

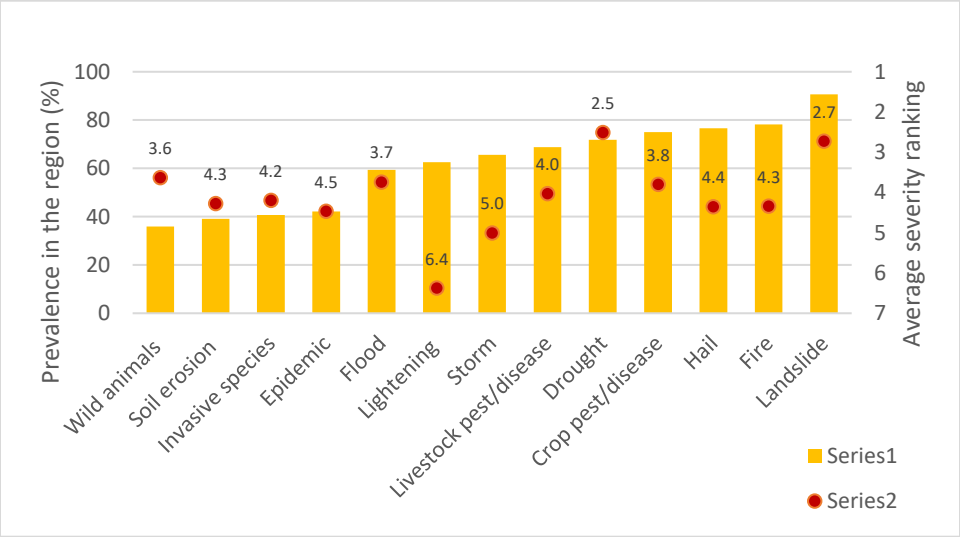


*Figure 8 Prevalence and severity of major hazards in the Gandaki River Basin. [Series 1 shows the prevalence of hazards reported >20% times in all LAPA documents and series 2 is the severity of each hazard where 1 is most severe and 7 is the least severe; Source: LAPA documents Gandaki River Basin]*

My survey with the local stakeholders revealed that respondents are concerned about climate change impacts, and they are enthusiastic about the LAPA initiative in their place. When asked how aware they were of climate change impacts in their place, a significant number (82%) of respondents revealed that they are moderately aware (Figure 9). The impacts they described were similar to the ones reported in LAPA documents. Likewise, when asked how severe the impacts of climate change in their place are, a

significant number of the respondents (73%) reported that their community is severely affected by changing climatic phenomena. In this case, it is most likely that respondents assumed natural climatic variabilities as major impacts of climate change rather than understanding them in connection to various stressors acting on the systems. The awareness regarding these impacts might be high as these respondents were exposed to sensitization regarding climate change organized during the preparation of LAPA. While mentioning the prevalence of climate-induced hazards shown in Figure 8, most respondents revealed that these hazards are getting more severe compared to the time when LAPAs were prepared. Consequently, 98% of the respondents believed that LAPA is extremely important for the overall adaptation initiative in their place. Most of these respondents were very engaged in the preparation of LAPA (44%) and the rest were either moderately or slightly engaged. Among them, more than 80% of respondents mentioned that their engagement made a difference in the preparation of LAPA (Figure 10).

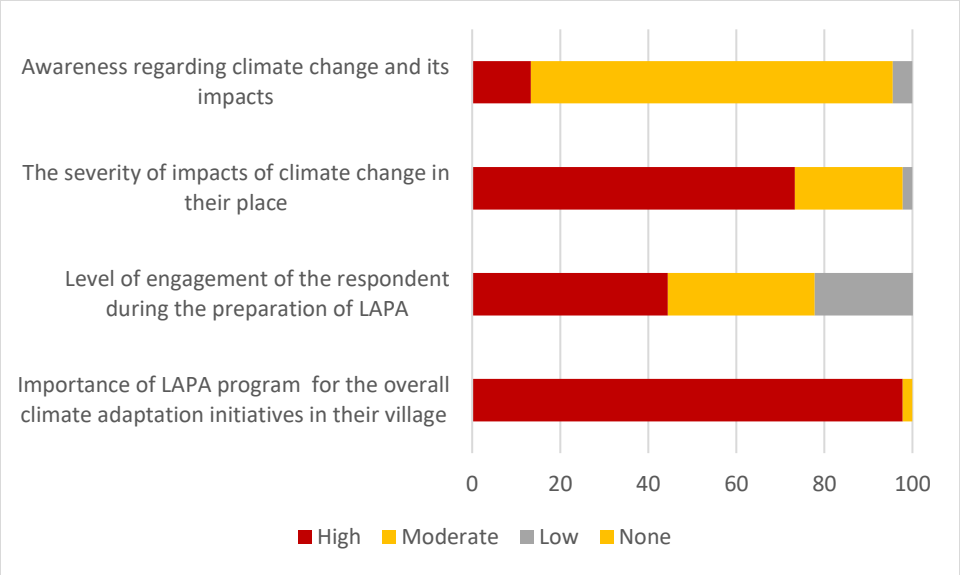


*Figure 9 Stakeholders' views on climate change impacts and LAPA preparation (Source: Interviews with local stakeholders)*

In response to the perceived climatic stress and changes, communities have been implementing several adaptation options and many of them are included in LAPA documents. In the agricultural sector communities have proposed a variety of approaches and the most frequently proposed options are animal husbandry and crop farming training, improvement of irrigation canal, seed distribution, and farming of vegetables or cash crops. Likewise, in the water and energy sectors adaptation options most proposed are supporting improved cooking stoves, water sources conservation, drinking water system maintenance, and the conservation of ponds. The plantation program was identified as an adaptation program in more than 90% of all LAPAs and some other initiatives proposed are construction of fire-line, plantation of non-timber forest products, and awareness regarding forest conservation. Several LAPAs have also mentioned

approaches for building embankments and early warning systems to deal with climate-induced floods and landslides.

In LAPA documents communities have identified several institutions as helpful for supporting their adaptation needs. Among them, civil society and public sector institutions were often recognized, and the market-based institutions were rarely selected. People have identified a variety of public sector institutions including multiple district level offices. The three most important institutions identified for the implementation of LAPAs were the District Development Committee, District Agriculture Development Office, and Village Development Committees. The non-governmental organizations and local level organizations identified include NGOs, women's groups, youth groups, committees, and sub-committees.

Along the same lines, my interviews revealed that local government agencies (Wards and Municipalities/Rural Municipalities) are major institutions that can support the implementation of adaptation initiatives mentioned in LAPA. Since LAPA activities were implemented by institutions involved in the Hariyo Ban Program, people also refer to them as important institutions for the implementation of LAPA initiatives. Figure 10 shows that 91% of the respondents mentioned that LAPA would not have been much different if it were prepared by any other organization. However, they unanimously stressed that irrespective of which institutions support in the preparation of LAPA the implementing of proposed initiatives with the leadership of local institutions is crucial.

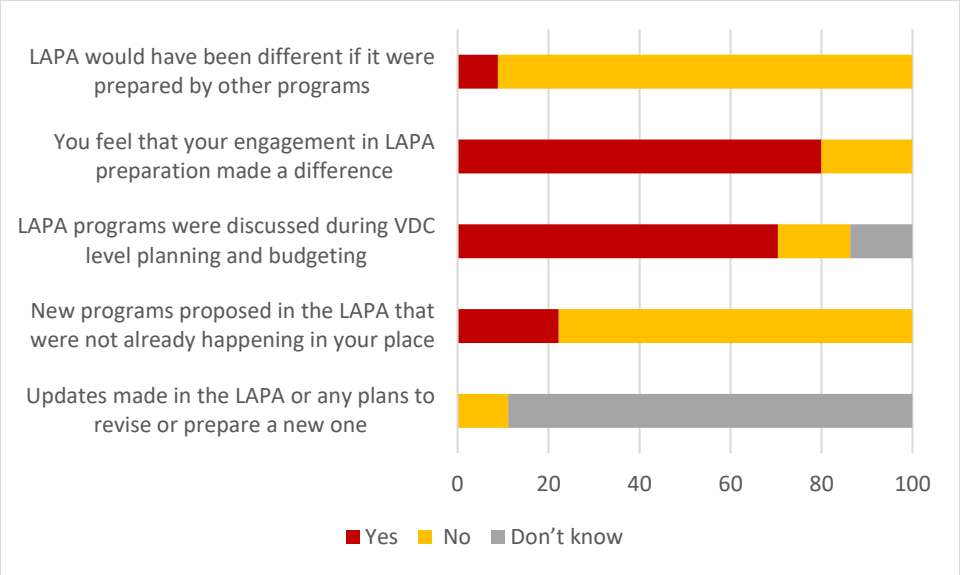


*Figure 10 Stakeholders' views on LAPA preparation and implementation (Source: Interviews with local stakeholders)*

### *2.5.2 Challenges of the LAPA initiative*

Results from the survey of local level stakeholders show that local people were encouraged with the LAPA prepared in their place, but they faced challenges while implementing proposed activities. Figure 11 shows that almost three-quarters of the respondents were satisfied with the LAPA prepared in their place. Seventy percent of the respondents mentioned that programs proposed in LAPAs were discussed during the VDC level planning and budgeting and 60% of them mentioned that they were able to integrate proposed activities with the government planning process at VDCs and municipalities level. While these results are encouraging, a majority of the respondents also mentioned that it was difficult to implement LAPA in their place.

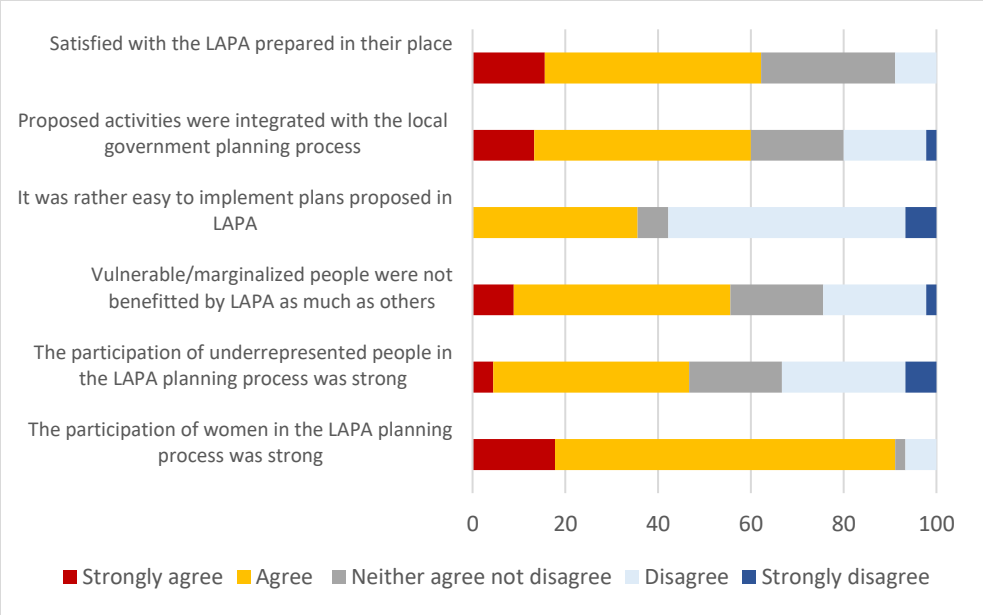


*Figure 11 Stakeholders' views on LAPA implementation and representation (Source: Interviews with local stakeholders)*

Table 1 presents a list of potential barriers that respondents have witnessed during the implementation of LAPAs in their place. As indicated by the darker band, the barriers identified by a significant number of stakeholders (>66%) are lack of financial resources, absence of functional local government, and minimal support from government institutions. Other barriers identified by a large number of respondents (33-65%) are highlighted in the light color band. They are less recognition of local knowledge, lack of support from development organizations and civil society organizations, and low interest among the management committee. Finally, some other potential barriers were considered important by fewer respondents. While Table 1 is based on the response to a predefined list of barriers, the analysis of open-ended questions revealed other concerns

such as the need for raising awareness, building local capacity, ensuring long-term support, and more participation of women and marginalized groups.

*Table 1: Barriers in the implementation of LAPA (Source: Interviews with local stakeholders)*

| Rank | Barriers | Percentage |
|---|---|---|
| 1 | Lack of financial resources | 87 |
| 2 | Absence of functional local government | 74 |
| | Minimal support from government institutions | 74 |
| 4 | Less recognition of local knowledge | 65 |
| | Lack of support from development organizations (CSO) | 65 |
| 6 | Low interest from the management committee | 43 |
| 7 | No clear institutional framework for implementation | 30 |
| 8 | Lack of support from the Hariyo Ban Program | 26 |
| | Ambitious proposal, activities difficult to implement | 26 |
| 10 | Lack of time | 22 |
| 11 | Lack of human resources | 17 |

One of the major challenges of local adaptation planning that the key experts mentioned was the lack of awareness regarding climate change among local level stakeholders and the public. Likewise, there is a lack of capacity and willingness to act on the issue of adaptation in the local government. Several local level stakeholders mentioned that though they have now understood the importance of dealing with climate change themselves, it has been difficult to convince local people as a result traditional

development agenda gets prioritized over everyday adaptation needs. According to a key informant:

> I think our weakness is not being able to make them understand the situation about impact. This requires joint planning between local level and experts. We need to add new angles to intervene and to teach them. People need to modify how they view the problem, if done so local people will themselves realize and bring appropriate programs.

The other challenge related to awareness was that local communities were not sure why LAPA was important, and how it could be a part of their development needs. In addition to LAPA, there are other plans prepared at the local levels such as yearly development planning and local disaster risk management plan (LDRMP). In such cases, local communities assumed that institutions that helped prepare those plans might help in implementing them instead of understanding how these initiatives could be integrated in local development.

The other challenge as reported by stakeholders is related to the lack of understanding of what makes an appropriate unit for local adaptation planning. While the LAPA framework of the GON has considered VDC and municipalities as an appropriate local level planning unit, some key experts working in adaptation in Nepal argue that LAPAs could be prepared in a variety of local level units. For example, in some cases, it makes better sense to think in terms of the watershed areas as it is important to understand the linkage between downstream and upstream areas as seen in the examples of Payment for Environmental Services (PES) and the establishment of early warning systems. In other cases, the understanding of the eco-region might be a better case as seen in the works of Hariyo Ban Nepal in the TAL and CHAL regions of Nepal.

Challenges such as these are difficult for local stakeholders to mention but are seen by

experts working in the sector. This is important as in most cases the LAPAs prepared at the VDC level lacked ownership after the administrative restructuring that created newer local administrative units. This created confusion among stakeholders which resulted to implementation challenges.

One major category of challenges that LAPA faced was inadequate support from the top-down. In many places, during the planning phase, people were constrained by programs and practices they are already aware of. Only 22% of respondents mentioned that there were some programs proposed in LAPA that were not already happening in their place. The key experts agree that the local people may not be able to bring entirely new practice or technology during the local level planning process and they might not be aware of the scientific merit of the traditional practices they have in their community for example the mixed farming, and historical water holes. Therefore, there is a need to work together to come up with adaptation options that are suited to the needs of the community. A key expert mentions:

> The local people can mention what climate impacts they are having but they have limited understanding about what can be done. What LAPAs have done so far is to assemble those practices that are already there. The problem is that their traditional coping mechanisms did not work so they are in need of new technologies and practices. These practices may not be entirely new but there is a need of bringing new technologies that can be helpful.

More support from the top-down level was also deemed necessary during the implementation of LAPA. Several respondents mentioned the lack of sufficient financial support and the weak engagement of the local government during the implementation of LAPAs as major concerns. This lack of support from the top-down is related to the lack of updates and follow-up with LAPAs in some places. More than 85% of respondents

mentioned that they do not know about any changes that were made in the LAPA after it was prepared or any plans at present to revise or update them.

Finally, some persistent challenges were related to the differential power among local level actors and institutions. There have been mixed responses regarding the participation of women and marginalized people in LAPA preparation and implementation. More than 80% of the respondents mentioned that the involvement of women in LAPA was strong during the preparation of LAPA (Figure 11). However, in the analysis of LAPA documents, I found that almost all LAPAs have a male member as a chair of LAPA implementation or M&E committee. During my interviews with local level stakeholders, I noticed that women respondents were hard to reach, and they often were reluctant to share their experiences. In many cases, women referred to another male member of the community as a more knowledgeable person, as a result, it required extra effort to ensure the participation of at least one-third of women respondents in my survey. I noticed that women's groups were making crucial contributions to implementing LAPA activities at the grassroots level and women were more likely to bring their issues and contributions that were not reflected during interviews with male respondents. Like with women, more respondents mentioned that the participation of people from marginalized groups was strong during the preparation of LAPA. However, despite the major focus of LAPA to benefit vulnerable and marginalized people respondents mentioned that it was difficult to benefit these groups of people as much as others. Marginalized people lack resources and have limited political power to influence decisions and take advantage of adaptation initiatives. A key informant mentions:

> The purpose of LAPA was to contribute to vulnerable people and places. In the same community there are people who do not have access to resources and their livelihood is severely impacted by climate change. Generally, these people do not have voices. They typically have one or two programs that benefit them the most. Though they voice their concern during the phase of program preparation at the bottom level that gets lost as the plan moves up. It is extremely important to curate this.

### *2.5.3 Prospects of the LAPA initiative*

There are some prospects and promising development in the LAPA initiative in Nepal, as the country has been implementing LAPAs for almost a decade now. In Nepal, the new constitution and the restructuring of the administrative units have provided more authority and increased financial resources for local governments. At the national level, the federal government has enacted the climate change policy 2019 and LAPA framework 2019 that outlines the governance of adaptation at the local level in the context of administrative restructuring and the establishment of three tiers of government at federal, provincial, and local levels. The analysis of policy documents underscores the commitment of the GON on a bottom-up adaptation approach. The lack of funds is undoubtedly a big issue but there are cases where the local government has been promoting some promising practices using their own funds. According to a key informant:

> The local governments have money, and, in some cases, they have spent their money in appropriate adaptation programs such as the solar pump irrigation system, having seen it to be successful at other places.

Enhancing the capacity of local institutions and raising awareness at local levels have been a priority for recent adaptation initiatives proposed by multiple institutions. Since local governments (municipalities and provinces) are new, several programs have

been specially targeted to increase their capacity for working on this issue. The NCCSP program, for example, has tried to work with local governments to integrate LAPA programs into their development planning. Now that the local governments have elected authorities, many respondents felt optimistic that a major barrier that hindered the implementation of the LAPA initiative has now turned into an enabling factor. An expert who has worked in the implementation of the program mentions:

> Currently it is easy because there is an elected body that consists of people who are more knowledgeable about the vulnerability of the place than us. When we worked with the local communities in the past there was no elected body, we had to rely more on the information from VDC secretaries who are government officials positioned there from elsewhere.

In the past, the climate change initiatives were coordinated by the Ministry of Environment that was weaker and lacked offices at the local level. Now with the establishment of the Ministry of Forest and Environment, there is increased hope that this ministry will be able to better coordinate its efforts at the central level and carry it to the local level. At the central level, it is seen that two ministries, the Ministry of Agriculture and the Ministry of Forest and Environment have programs that directly mention climate change adaptation. However, when it comes to the local level all they recognize is local government, non-governmental organizations, and grassroots level institutions that have been working in their communities.

The recent LAPA initiatives have focused on more integrative efforts. With the nature of adaptation programs such as those in forest and biodiversity sectors, LAPAs have been able to contribute to mitigation as a co-benefit of adaptation initiatives. At present institutions implementing LAPAs have tried to integrate LAPA with the Local Disaster Risk Management Plan (LDRMP) program, another similar plan prepared at the

local level with the support from the Ministry of Home Affairs (MOHA). This effort realizes that having multiple plans at the same municipality or rural municipality created some confusion, duplication of efforts, lack of ownership, and difficulty in implementing both plans. With differential impact analysis and focus on gender and social inclusion, the newer practices have tried to benefit women and marginalized people.

## 2.6 Discussion

The case of the LAPA initiative in the Gandaki River Basin presents an important entry point for understanding barriers of bottom-up approach in adaptation. This section discusses the contribution of the LAPA initiative to local adaptation policy objectives in three related ways.

### *2.6.1 Connecting adaptation to everyday life and local development*

The case of LAPA has highlighted the importance of integrating adaptation into local development and connecting with everyday risks and adaptation options. In the context that the adaptation governance in developing countries is seen as sectoral and top-down (Nightingale, 2015; Ojha et al., 2016), it is imperative for adaptation to not only contribute to increasing specific capacity to one stressor but is desirable to have multiple co-benefits (Eakin et al., 2014). For example, LAPA initiative in Nepal while supporting forest and biodiversity sector activities has provided mitigation co-benefits. Likewise, the recent initiative to integrate climate adaptation with LDRMP provides a good example of contributing to disaster risk reduction along with adaptation. However, it is important to realize that with this integration there might be tradeoffs as focusing more on disaster risk reduction can lessen the focus on the germane issue of providing

security of food, water, and energy. It is seen that the governance of adaptation at the local level is more integrative compared to the policies, programs, and processes at the national level that are often criticized for being siloed. Since local stakeholders do not feel that LAPA might have been different if it was prepared by institutions other than Hariyo Ban Project, this finding supports previous studies that have seen less difference between activities proposed in LAPAs implemented by different programs (Silwal et al., 2019).

It is important for adaptation initiatives to be part and parcel of the everyday life of local people and their adaptation needs. Several studies have documented that initiatives that are driven without understanding local context are likely to be rejected by local communities (Johansson & Vinthagen, 2016; Scott, 1985, 1989). Thus, the connection to everyday life is crucial for raising awareness and increasing ownership among local level actors. So far, most adaptation initiatives have focused on national and top-level policies, programs, and commitment but it is important for such initiatives to understand local implementation mechanisms, organizational arrangements, adaptation needs, and available knowledge and skills.

### *2.6.2 Stakeholders' engagement in adaptation planning, financing, and implementation*

The case of LAPA has explained how adaptation initiatives require a "whole of government" approach that gives attention to all levels of scale (Funder & Mweemba, 2019). The interaction between local and higher levels is crucial in all aspects of local adaptation initiatives including planning, budgeting, and implementation.

During the planning phase, the case of LAPA suggests that adaptation planning can be conducted at appropriate local level units. This finding agrees with Westoby et al. (2020) on the idea that it might be helpful to be flexible in defining appropriate local level units based on the focus on local adaptation needs. For example, preparing a watershed level plan can enhance downstream and upstream linkage through schemes such as payment of environmental services or flood early warning systems. Some programs such as the Hariyo Ban Program have conducted planning at the macroscale of ecosystem level and micro at the community level. In another case, the Ecosystem Based Adaptation at Panchase has focused on a mountain ecological region (Adhikari et al., 2018). In some cases, local units can be transboundary such as in the case of protecting larger ecosystems or watershed areas. Likewise, the engagement of local and higher-level actors is also crucial in the development of context-specific adaptation techniques and tools that make the best sense at a particular place. In the context that most adaptation technologies and practices proposed were similar and based on existing information and limited knowledge (Regmi & Bhandari, 2013), local communities can prepare more suitable options working with expert and central level research institutes. In such a case, the support from top-down can be helpful in some aspects of local-level planning to spark new ideas and realize the potential of existing adaptation practices (Nightingale, 2017; Silwal et al., 2019). For example, in Africa local practices of Zai pit and farmer-managed natural regeneration were able to make widespread and effective adaptation after it was recognized with appropriate policies by the government (Amaru & Chhetri, 2013; Reij et al., 2009). Nepal has been successful in transforming the traditional top-down

bureaucratic approach to a more participatory approach for the development of location-specific technologies for agricultural adaptation (Chhetri et al., 2012) and more such initiatives are expected to adapt to the changing climate.

The lack of financial resources is often cited as a major obstacle in LAPA implementation. In absence of ample funding, most of the adaptation plans in LAPA documents have become a mere wish list rather than a feasible list of programs. As Eisenhower once said, “Plans are worthless, but planning is everything”. In the case of LAPA, multiple programs are proposed but most of those are implemented by organizations who helped in the preparation of LAPA as long as the project was active. In Nepal, NAPA mentioned that 80% of the fund for climate change adaptation should go to the local level for implementation which is promising. However, it was observed that despite promising policies limited financial resources reached the local level for program implementation. This has been a persistent problem for locally led initiatives in Nepal and around the world.

Several studies have mentioned that the lack of financial resources was seen as a major obstacle in climate change adaptation and mitigation (Dhungana et al. 2020). The subnational level often lacks adequate technical and technological capacity, financing, and support and calls for international cooperation to strengthen the capacity of municipalities and other local institutions (MCLD, n.d.). Several studies have seen the short-term nature of adaptation initiatives implemented by the government or NGOs as a barrier for addressing climatic impacts (Vij et al., 2019). One of the principles of locally led adaptation is providing predictable and continuous funding that can be assessed easily

by the local level institutions (Soanes et al., 2021). This requires a decision-making process that prioritizes the agency of front-line local actors to identify adaptation solutions that they chose to finance. By now more than 40 international organizations have endorsed the principles of LLA which demonstrates the international commitment to increasing access of local institutions to finance.

Looking at adaptation financing from the LAPA perspective I suggest that in addition to the commitment of funding agencies and international organizations in local adaptation, the adaptation finance at the local level could also utilize public and private funds. For example, the local government can fund some initiatives as a part of their regular development works and some economically viable options might be of interest to the private sector. In the case of Nepal, the restructuring of administrative units has provided more authority and financial resources to local levels. This suggests that funding might come from multiple ways if the planning is impactful. So, the adaptation governance requires support from a top-down approach and often state-level planning and budgeting. It is crucial to understand that public views can be short-term and reactive, therefore local level plans might need flexibility in terms of regular review, periodic update, and continuous monitoring.

### *2.6.3 Understanding the differential power and the political nature of adaptation*

The case of LAPA has demonstrated the crucial role of multiple actors in adaptation governance, but these local actors have different levels of power and authority. Local-level institutions such as local government, women's groups, forest users' groups, local community-based organizations, and NGOs including the Hariyo Ban Program

partners had a crucial role in implementing LAPA. Among them, the local government is crucial as an enabler and implementer. The democratically elected local government has been helpful for the implementation of the LAPA initiative in Nepal. The LAPA framework 2019 has focused on enhancing the capacity of newly formed local government which is an encouraging sign. So far, adaptation has been considered as a public sector responsibility, but the role of civil, and private institutions is crucial for enhancing local capacity in the case of LAPA and other locally led adaptation initiatives. Moreover, the engagement with multiple actors not only builds the capacity of local institutions it also raises awareness regarding climate change impacts and the need for local action (Regmi & Bhandari, 2013). This is crucial for raising interest and ownership on climate adaptation from the local government which was lacking until recently (Rai et al., 2015).

This analysis has revealed that though LAPA aimed to focus on vulnerable people and places it has been a persistent challenge to provide more benefits to these groups. As seen in this case, the vulnerable people have fewer demands, but they get lost during the planning, budgeting, and implementation process. Initiatives such as conducting differential impact assessments and having a separate conversation with marginalized and vulnerable people can be effective for adaptation but more important is to ensure that their agendas are implemented. One of the principles of locally led adaptation is to address structural inequalities by bringing women and marginalized people to the forefront of the planning and implementation process (Soanes et al., 2021). Like we have seen in the case of LAPA one of the strategies for ensuring meaningful participation of

marginalized groups in adaptation decision making might be by writing in policies or frameworks prepared at the higher level. Unless deliberatively worked upon finding voices of marginalized groups can be difficult as the power structure can be different for different places.

## 2.7 Conclusion

Climate change impacts in the Gandaki River Basin are evident. My findings suggest that communities see climate change manifested in the form of everyday problems or disasters they are already facing. Major hazards reported in LAPAs were landslides, followed by fire, hail, crop pest/disease, and drought. Most of the locals believe that disaster risks due to these climate-related hazards are rising compared to the past. Local communities have identified a plethora of adaptation initiatives that can help to adapt to the changes and these options are mostly based on local knowledge and capacities. While communities have prepared local plans to enhance their resilience, they have struggled to implement them. Major challenges identified by local level stakeholders are: insufficient financial resources, lack of support from governmental and non-governmental institutions, limited knowledge or awareness, and less recognition of local knowledge.

My findings suggest that options of dealing with climate change does not have to be grand schemes, but it can be mundane approaches of learning by doing by communities. While large and costly initiatives promoted by external agents might struggle in connecting with everyday livelihood of affected people, contextual approaches can be helpful to build local resilience. Understanding adaptation as an

everyday interaction can help connect adaptation initiatives to the lives of local people while contributing to local development aspirations. Further, this chapter underscores that top-down support in planning, financing, and implementation is crucial for locally led initiatives to thrive. Finally, the adaptation initiatives need to understand where power lies and how the voices of those marginalized can be enhanced while making powerful agents more accountable. There is a need for further research to understand how local communities can be at the forefront of adaptation decision-making and for engaging actors at all levels for adaptation planning, implementation, and monitoring. Likewise, it is crucial to understand whether the adaptation strategies are effective and be flexible to update or modify them.

# 3 INSTITUTIONAL INNOVATION FOR CLIMATE SMART AGRICULTURE

## 3.1 Introduction

The issues of institutional innovation remain a critical dimension of agricultural adaptation to climate change. If the welfare of smallholder farmers is to be addressed effectively by technological innovation on demand, institutions play a critical role in adaptation to climate and other ongoing changes. Institutional dimensions of climate adaptation, according to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), include strategic integration of climatic inputs into technological innovation, planning, decision-making, and implementation (Pachauri et al., 2014). The concept of an institution in adaptation governance is broad and it compasses informal local level entities (such as local clubs, saving groups, informal farmers organizations, and short-term committees) to formal government agencies (e.g., extension services, municipalities, sectoral offices, and ministries), civil society organizations from local to international levels, and private institutions at various levels. Institutions, therefore, can play a critical role in interpreting highly science-centric and abstract attributes of climate change to meaningful forms (O'Riordan & Jordan, 1999), such as the urge for innovation in location-specific agricultural technologies (Chhetri et al., 2012). For institutions to operate effectively, there is a need for interactions between public (administrative units), private firms (business), and civic (NGOs) institutions (Agrawal, 2008) as well as a meaningful collective action among those that have heterogeneity in terms of scale and operational contexts (Adger, Brown, et al., 2003). The cultural theory seeks to understand the relationship between individuals, institutions, and their everyday activities in matters

of public interest. After all, these institutions promote different rationalities, hierarchical (promoted by public or administrative units), individualist (preferred by market-based private organizations), and egalitarian (advocated by community-based and right based groups) in dealing with issues such as climate change (Gyawali & Thompson, 2016; Thompson, 2003).

Effective adaptation requires utilizing knowledge, skills, and best practices (Regmi & Bhandari, 2013) as well as technological, institutional, and relational innovation (Rodima-Taylor et al., 2012), highlighting the undisputable relationship between adaptation, innovation, and institutions. It also calls for a stronger collaboration between research institutions, extension systems, community-based organizations, and private sectors to enhance innovation at the farm levels (Bhatta et al., 2017). Because of their centrality to climate adaptation, institutional context determines the extent to which new technological innovations result in wider adoption (Agrawal, 2010; Chhetri & Easterling, 2010). Thus, among five major characteristics that determine the rate of adoption of innovation namely: (a) attributions of innovation, (b) type of innovation decision, (c) communication channel, (d) nature of social systems, and (e) the extent of promotion by agents (Rogers, 2010), a number of them point to the need of understanding institutional aspects of innovation.

The climate change adaptation is used by multiple institutions as a boundary concept – a loose concept that has a strong cohesive power (Löwy, 1992) and can be helpful for dealing with complex problems (Star, 1989). This vagueness facilitates coordination and communication between multiple actors and to engage with the concept

without losing their own identities (Allen, 2009). The concept of boundary work argues that the demarcation between science and nonscience is contingent on circumstances rather than being defined by rigid parameters (Guston, 2001). In the case of climate change adaptation, some organizations act as boundary organizations that play a critical role in interpreting highly science-centric and abstract attributes of climate change to meaningful forms (O'Riordan & Jordan, 1999). Such boundary organizations play an instrumental role to foster stakeholder engagement and contribute to institutional and technological innovation for the implementation of initiatives and achieving adaptation objectives.

Despite the importance accorded to the role of institutions in facilitating adaptation, there is a limited scholarly attention on investigating how the challenges of adapting to climate change may induce new forms of institutional arrangement. Adaptation policies and practices need to recognize the crucial role of institutions in social, economic, and institutional processes in determining adaptation outcomes. In this chapter I analyze the role of institutions, operating at multiple levels, in shaping the outcomes of Nepal's climate smart village (CSV) strategically designed to generate evidence on the utility of climate-smart agriculture (CSA) technologies and services in building resilient agricultural production systems in Nepal. In the CSV approach, farmers are piloting interventions that are Nutrient Smart, Water Smart, Crop Smart, ICT Smart, Energy Smart, and Future Smart involving a range of actors, interactions, and processes within them. Using the case of CSV, this chapter illustrates how the institutional context

has influenced the wider adoption of CSA technologies in Nepal, a country highly vulnerable to climate change.

Climate change impacts are evident in the Nepalese context and their burdens are disproportionately shared by the nation's farmers. The analysis of observed data indicates that the maximum temperatures rose at the rate of 0.04-0.06 °C per year from 1975 to 2005 that is already around 1.5 °C in 30 years. During the same time interval, the annual precipitation data shows a general decline in pre-monsoon precipitation in the western part of Nepal and a few pockets of central and eastern Nepal (MoE, 2010). Recent studies have confirmed that the rise in the maximum temperature is higher compared to the rise in the minimum temperature in all seasons (DHM, 2015) and the temperature rise in the mountain region is higher than in other regions (Thakuri et al., 2019; Wester et al., 2019). Along with multiple stressors and forces acting on the Himalayan systems, studies have also shown the rise in climate-induced events such as dry spells, erratic and intense rainfall, flash floods, landslides, forest fires, and glacial lake outburst floods (Xu et al., 2019). These climatic changes and events have significant impacts on agricultural productivity and water availability, particularly for natural resources dependent rural communities (Dhungana et al., 2020).

Any departure from the expected "*normal*" climate poses serious threats to the long-term sustainability of food production in the country (Chhetri et al., 2012). Generally, lower than average rainfall is cause for concern and has a profound impact on the country's agriculture sector that contributes to one-third of the GDP and provides employment to nearly three-quarters of the population (CIAT, World Bank, CCAFS and

LI-BIRD, 2017). Studies have shown frequent occurrences of severe episodes of droughts in cropping cycles of summer maize and winter wheat in 1992, 1994, 2006, 2008, 2009, 2012, and 2015 (Hamal et al., 2020). Given the strategic importance of Nepal's agriculture to the nation's economy, potential impacts of climate variability and change on national food security are causes for concern. According to the Demographic and Health Survey (2016), 4.2 million people of Nepal's 28.6 million population are food insecure (USAID, 2019). While food insecurity precedes and has other causes than climate change, the climatic stresses and changes add layers of complexity that can exacerbate food insecurity in different parts of the world. The traditional approaches have not been adequate to contribute to agricultural adaptation in the changing context.

The remainder of the chapter is organized as follows. Section 3.2 provides a brief introduction of the CSA and CSV approaches. Following that, section 3.3 presents CSA technologies as an integrated approach to adapt to change through the smart village concept. Section 3.4 presents the description of the study area and the CSA initiative in Nepal. In section 3.5, I discuss the analytical framework and methodology of my study. Section 3.6 presents the revised framework, results, and discussion. Finally, the concluding section provides the gist of this chapter.

**3.2 Climate Smart Agriculture and the analytical framework**

One of the interventions for adapting agriculture to climatic variability and change that has been gaining currency in Nepal and elsewhere is the CSA, a set of interventions that embraces intellectual openness to blending science and technology with local knowledge. CSA interventions implemented in different parts of the world have

identified several promising technologies and practices. Farmers and stakeholders have shown a considerable preference for CSA technologies such as agricultural insurance, weather-based agro-advisories, nutrient and water management, and contingent crop planning (Khatri-Chhetri et al., 2017, 2019). Many of these CSA practices are being implemented throughout the world, such as the watershed management approach piloted in India, modern weather services and agricultural helplines in Ghana, climate and crop modeling approach in India and Mali (ICRISAT, 2016), the use of biopesticides (*jholmal*) in Nepal (Subedi et al., 2019), and solar pump irrigation systems in Nepal and India.

Institutions largely working in the area of food security, climate and development are also increasingly embracing the idea of CSV. According to the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), the CSV approach is a key part of agriculture research-for-development (AR4D) and climate adaptation (CCAFS, 2016). This approach prioritizes testing and piloting technological innovations while simultaneously devising institutional and policy innovation. The overarching vision is to generate evidence of best practices through partnership and technical guidance and knowledge for the design, implementation, and evaluation of the CSV approach. Active engagement institutions operating at multiple levels are considered critical in scaling up the concept of the CSV. With its focus on the co-development of CSA technologies at the community level, the CSV approach is also expected to empower local communities and their supporting institutions (Bayala, 2021).

The wider adoption of CSA technologies has been a challenge due to the weak institutional mechanisms. With the exception of Nepal, most of these are being

implemented as pilot projects at a smaller scale by NGOs. Should the CSV approach need to generate evidence on the utility of CSA technologies for building resilient agricultural production systems, it needs to be applied at a larger scale. One important factor that causes the low uptake of CSA technologies is the near absence of institutional mechanisms such as government extension services, and the recognition of the role of a variety of formal and informal institutions in the changing climatic context. And if adaptation needs of smallholder farmers are to be addressed by innovation a broader understanding of institutions operating at the community level to one that works at the supranational level is required. In Nepal and elsewhere, the CSV approach has been recognized as a potential pathway to generating policy support for building resilient and viable agricultural production systems (Xu et al., 2019). However, the institutional aspects necessary to scale are not studied adequately. The scaling of the CSV approach in climatically vulnerable areas of Nepal through the engagement of multiple actors provides a case for institutional innovation for the scaling of CSA. The objectives of this chapter are to, a) evaluate an institutional framework for scaling the CSA with climate-smart village approach, b) assess institutional innovations to combine local and global knowledge, c) assess the sustainability of the CSA scaling approach based on indicators (e.g. level of collaboration, cost/benefit share by the stakeholders, environmental co-benefits, alignment with domestic and international commitments such as NDC under the Paris Agreements and SDGs).

I use the conceptual model that integrates institutional and technological innovation in agriculture (Chhetri et al., 2012) to analyze the initiatives for the scaling of

climate smart agriculture (Figure 5). The framework suggests that the climate change induced impacts in the resource endowment (e. g. changes in crop growing seasons, change in soil moisture, increase in pest infestation, etc.) provide signals to farmers and their supporting institutions that trigger institutions to start talking about potential climate change impacts. Farmers' institutions could make adjustments in their social activities, such as changes in crop types that better suit the new environment or investment in irrigation infrastructure should drier conditions be created due to change in rainfall patterns, to ensure crop growth and development. This conversation spurs or instigates some type of institutional innovation that gives rise to technology development or improvement. Since adaptation is a local process the local organizations such as farmers groups exert influence in institutional innovation making cultural components an important part of the conversation. According to Chhetri et al., (2012), Nepal has transformed the traditional top-down bureaucratic approach to a more participatory and collaborative approach which has contributed to agricultural research and development in the country. This transition fostered the development of location-specific technology in vulnerable places while simultaneously contributing to the formation of a pragmatic institutional mechanism. Recent studies on farmers' adaptation and technology development in Nepal have highlighted the need for including farmers and their existing knowledge and skills in the adaptation planning process to enhance the benefits of policies (Khanal et al., 2018).

### 3.3 Scaling of CSA technologies through CSV approach

Climate change and associated extreme events are major challenges for the agricultural system worldwide. According to the World Health Organization, about 700 million people worldwide were undernourished and two billion people experienced some kind of hunger in 2019 and a large proportion of the food insecure people live in developing regions of Asia and Africa (WHO, 2020). Climate change impacts in the food system, along with unsettling social and political conditions, are expected to destabilize global food security in the future (Pachauri et al., 2014). On the other hand, the global food system is one of the largest sources of greenhouse gas emissions that contributed an average of 25-30 % of total anthropogenic emissions during the 2007-2016 period that includes emissions from agriculture, land use, and beyond farm gate activities (Mbow et al., 2019). All these realities have made the agricultural sector a center for inquiries for both climate change adaptation and mitigation. The CSA concept was launched by FAO in 2010 and has gained rapid and widespread interest and attention (Lipper et al., 2014). It goes beyond technologies to include enabling policies and institutions as well as identification of financing mechanisms.

The CSA is being recognized worldwide for its contribution to climate compatible interventions (Lipper et al., 2014), while simultaneously addressing food security and livelihoods concerns of smallholder farmers. With its focus on reorienting agricultural policy to support agricultural development under climate change, the CSA identifies synergies and trade-offs among food security, adaptation, and mitigation (Scherr et al., 2012). An agricultural practice can be considered as CSA if: it improves productivity or

increases the efficiency of the use of scarce resources (**Food security goal**); if it reduces exposure, sensitivity, or vulnerability to climate variability or change (**Resilience goal**); and if it sequesters carbon from the atmosphere or reduces agricultural emissions (**Mitigation goal**) (Neufeldt et al., 2013). While these three goals are equally important, in developing countries the food security goal has a greater currency whereas the mitigation is generally regarded as a co-benefit. While the CSA represents a variety of practices used in the field of ecological agriculture, soil conservation, agroforestry, and conservation tillage agriculture (Chandra et al., 2018), its larger purpose is to manage risk and enhance resilience in the context of agriculture development (Neate, 2013).

With the aim of increasing the adoption of CSA technologies by smallholder farmers in developing countries, CCFAS and partner organizations have implemented in more than 20 countries in Asia, Africa, and South America. This includes multiple sites in the three South Asian countries: Andhra Pradesh, Bihar, Karnataka, and Punjab-Haryana states of India, six districts of Nepal, and Barisal, Khulna, and Sylhet divisions of Southern Bangladesh. Results from initial studies have indicated that the CSV program is promising in setting a framework for scaling up adaptation options in agriculture for farmers and their supporting institutions (Aggarwal et al., 2018; Bayala, 2021).

The International Crop Research Institute for the Semi-Arid Tropics has been working on five approaches for building CSVs around the world (ICRISAT, 2016). First, the watershed management approach piloted in India utilizes a pool of climate smart practices (e.g. weather, rainfall and groundwater monitoring, water harvesting and management, and improving livelihoods and market links) to rehabilitate the agricultural

ecosystem. Second, the multi-model approach (e.g. using climate data, and crop, livestock and economic models for producing climate simulation till 2050) has given policymakers in Zimbabwe the opportunity to plant alternative crops. Third, the digital technologies approach (e.g using information from meteorological agencies, processing it, and informing through a private mobile service provider) has benefited farmers in the remote locations of Ghana through the use of modern weather services and agricultural helplines. Fourth, the meteorological advisory and farm system approach in Mali has benefited farmers by utilizing climate information in agricultural decision making with interventions such as participatory planning, establishing facilitating groups/institutions, capacity building, and mainstreaming gender into their activities. Finally, the climate and crop modeling approach has helped farmers in drought-prone regions of India through crop advisories and cropping decision support with the prediction of regional rainfall, downscaling of the rainfall data, crop modeling, and discussions with farmers and researchers. All these programs highlight the need for strong institutional collaboration for scaling and widespread adoption of each program by farmers.

Some programs have demonstrated the initial success in the extension of CSA and CSV programs through horizontal and vertical scaling (Aggarwal et al., 2018) – two broad mechanisms for scaling of CSV. In horizontal scaling (also called, scaling out) the CSV sites serve as demonstration sites whereby promising agricultural technologies and practices are fostered through farmer-to-farmer learning. By organizing exposure visits and/or other interactions, farmers and their supporting institutions learn about successful CSA technologies and promote them through local policies, programs, and grassroots

institutions. For example, in Senegal, a pilot CSA program that focuses on climate forecast and farm advisories, first implemented in the Kaffrine region, has now extended to other parts of the country through a partnership between institutions operating at multiple levels (CCAFS, 2016).

In vertical scaling (also called, scaling up) the success of the CSV program influences policymakers, funding agencies, and implementing organizations so that changes in policy instruments, institutions, or investments are made for the promotion of promising technologies and practices. For example, in the state of Haryana in India, having worked in CSV programs promoted by other organizations, the state government has made policy changes to promote promising CSA practices. At present, through the participatory process, the government of the Indian state of Haryana is implementing the program in more than a hundred villages with the commitment to expand it to 500 villages (Aryal et al., 2020). The range of strategies for scaling climate smart technologies and practices exhibit different characteristics, and all have considerable potential and limitations to scale CSA intervention (Westermann et al., 2018). Both vertical and horizontal scaling demonstrate the need of understanding institutional aspects that can scale or impede CSA interventions. However, the role of institutional innovation in scaling adaptation options has received less scholarly attention.

The collaborative efforts from multiple stakeholders, particularly government, private sector, development organizations, and grassroots institutions is crucial to contribute to the scaling of climate smart technologies, practices, and services appropriate for a particular location or a farming community. The public sector can promote

promising technologies and practices through plans, policies, and programs. The private sector can contribute by delivering climate smart services and technologies including the development of new seeds and breeds, the innovation of promising agricultural machinery, development of agro-advisory, and development of sensors for water and nutrient management (Khatri-Chhetri et al., 2019). Finally, the community-based organizations, cooperatives, and farmers groups have a major role in the scaling of CSA in communities.

### 3.4 The study area and the CSV approach in Nepal

In this chapter, I present the case study of a decade-long experience of Nepal's farmers and their supporting institutions to implement CSV pilot programs. Nepal makes an ideal case for the study of the role of institutions for a number of reasons. Nepal ranks as one of the most vulnerable countries in terms of climate change impacts due to its fragile geology, climate-sensitive ecosystems, and socio-economic circumstances (MoE, 2010). Nepal is an agricultural country as the agriculture sector contributes about one-third of Nepal's GDP and provides employment for nearly 74% of the people (CIAT, World Bank, CCAFS, and LI-BIRD, 2017). According to the 2011 census, about 83% of Nepal's population lived in rural areas (CBS, 2012), and agriculture is their most important income source (Gentle et al., 2018). Enhancing their livelihoods and income through the smallholder production system is crucial for reducing poverty and achieving food security. Projections indicate that nationally, agricultural production will need to double by 2050 to meet increased demand due to the rise in population, and most of this will need to come from increased productivity (Ray et al., 2013). Increases in the

frequency and intensity of extreme events such as drought, heavy rainfall, flooding, and high maximum temperatures are already occurring and are expected to accelerate in many regions (Xu et al., 2019). Average and seasonal maximum temperatures are projected to continue rising (Thakuri et al., 2019), with higher and untimely rainfall in parts of the country (Wester et al., 2019). Studies have also shown an increase in hazards that are related to farm products such as an increase in invasive weeds coverage, crop infestations, and livestock diseases (Gentle et al., 2014, 2018).

These effects will not, however, be evenly distributed. Nepal's agricultural systems to date also face a host of challenges, including high dependence on climatic conditions, limited access to irrigation facilities, lack of agricultural inputs when needed, and an increasing trend of land abandonment associated with a high rate of outmigration and the lack of interest in agriculture. Finally, Nepal makes an interesting case in the governance of climate change adaptation where the agricultural sector has been a prime focus. In addition to the enactment of enabling policies such as the National Adaptation Program for Action (NAPA) 2010 and Climate Change Policy 2011 (now replaced by Climate Change Policy 2019) at the central level, the GON has set a model for promoting grassroots level adaptation initiatives through programs such as Local Adaptation Plans of Action (LAPA) and Community Level Adaptation Plan (CAPA). One initiative that connects grassroots and national level institutions and aspirations is the promotion of CSA interventions through the CSV approach.

The CSA interventions in Nepal are implemented by more than a dozen NGOs with the aim of adapting to climate impacts in the agriculture sector (Xu et al., 2019). The

CSA intervention in Nepal follows a series of interventions by NGOs working with government organizations such as the Nepal Agriculture Research Council (NARC), Ministry of Population and Environment and major donor agencies such as CCFAS, ICIMOD, USAID, and the World Bank. Some of the early works on the CSV approach include the one implemented by ICIMOD and partner organizations in Kavrepalanchowk district (also known as resilient mountain village), the CSA program by SNV and other organizations in Western Nepal, and the pilot program by Local Initiatives for Biodiversity Research and Development (LI-BIRD) and CCAFS in the Gandaki region. Following the initial success, the idea of CSV was incorporated into national policies and plans. For example, with its focus on increasing the resilience of Nepal's farmers, the Agricultural Development Strategy 2014 has a strong focus on promoting CSA. In its fiscal year 2016/17 program, the GON stated its plan to implement the CSV concept as a part of its efforts to adapt to climate change. Consequently, the Department of Environment (DOE), Ministry of Population and Environment, initiated a pilot CSV program in 2016 with the target of establishing 170 climate smart villages throughout the country (Pudasaini et al., 2019). Currently, three provinces, namely, Gandaki, Lumbini, and Sudurpaschim, are actively implementing the CSV approach as one of the agricultural development programs, and together they have implemented the idea in more than 200 villages. This study focuses on two pilot CSV programs in the Gandaki River Basin of Nepal: the development of the CSV portfolio in Nepal initiated by one of Nepal's national NGOs LI-BIRD and the recent works by Gandaki Province that has extended the idea to all eleven districts and 36 provincial constituencies (Figure 12).

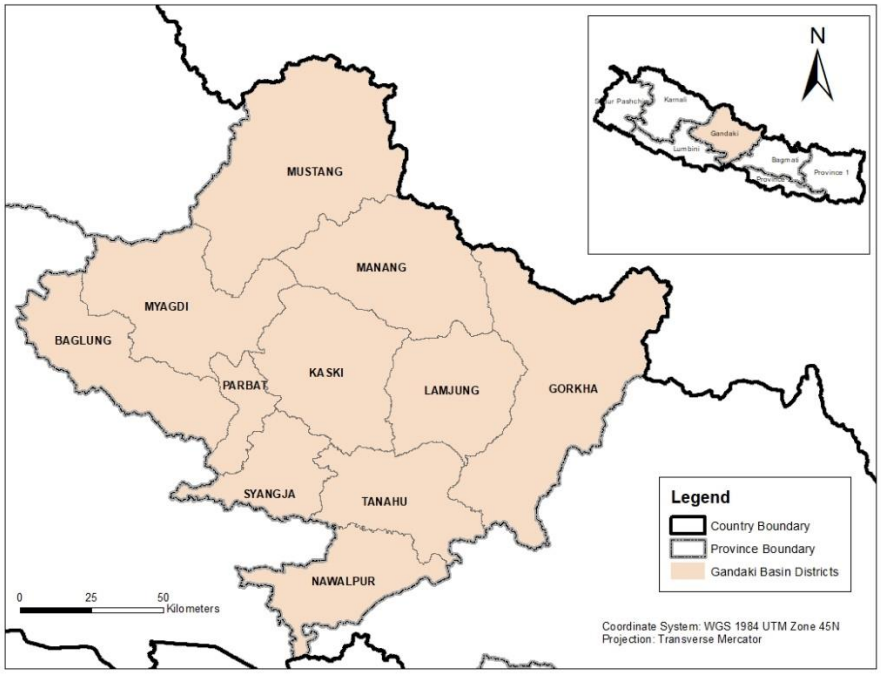


*Figure 12 Map of Nepal showing Gandaki Province*

### 3.5 Methodology

Using qualitative and exploratory methods this chapter evaluates an institutional model of CSA scaling with a case study of the CSV approach in Nepal. The evaluation includes prioritization of CSA options for local context, evidence generation with piloting the technologies in farmers' fields in the different agro-ecological regions, collaboration, and engagement of a range of CSA stakeholders (farmers and their communities, local government officials, agriculture departments, private sector), level of scaling of CSA through CSV approach. First, the preparatory works for this chapter began with a visit by the first author from November 2017 to January 2018 that included field observation and consultations with key stakeholders involved in CSA programs in Nepal. Following that,

project reports, data, and publications were reviewed and used for this assessment. Finally, using a snowball sampling method the first author conducted fifteen semi-structured qualitative interviews from September 2020 to January 2021. The interviews included policymakers and stakeholders from research institutions, government and non-governmental organizations, funding agencies, and media houses working in adaptation governance in Nepal, including agricultural officials involved in implementing these CSV in the Gandaki region. The authors made sure that at least one-third of the respondents are women. During the field visit and interviews, approval was taken from the Institutional Review Board of the first author's institution and other relevant institutions in Nepal

### 3.6 Results and discussion

This section explains the results from the CSA initiative in the Gandaki region followed by the discussion. As one of the pioneering programs 'Scaling up of CSA in Nepal' program was initiated by LI-BIRD in partnership with CCAFS, The Climate and Development Knowledge Network (CDKN), and the GON in 2015-16. This initiative conducted an extensive national-level study with the identification and prioritization of CSA technologies. Steered by a Project Advisory Committee consisting of high-level government agencies working in agriculture and allied sectors, this project was implemented in collaboration with communities, local governments, and district agricultural development offices. First, this project identified a pool of 147 potential CSA technologies, practices, and services, drawing on literature review, previous experiences, and deliberate consultations with development organizations and farmers. Second, these

identified potential CSA options were screened using four criteria of appropriateness to form a portfolio of CSA technologies and practices: technical considerations, farmers' acceptance, climate sensitivity, and scalability. Third, for field verification, selected options were planted in farmers' fields at three districts Nawalparasi, Kaski, and Lamjung districts (Paudel et al., 2017). Fourth, after field validation, a portfolio of champion CSA options was prepared with further prioritization using four criteria: three pillars of CSA, namely, food security, adaptation, and mitigation plus a crosscutting theme of gender and social inclusion (GESI). Based on the consultation of agricultural exports and farmers, these four criteria were given different weightings. Food security being a major national concern received 40 percent of the total weighting. The mitigation that is generally considered as a co-benefit for a country having a low carbon footprint received 10 percent of the total weighting (Khatri-Chhetri et al., 2017). Adaptation and GESI were given 30 and 20 percent of the total weighting respectively. Based on piloting, testing, and validation of promising technologies, the program ultimately came up with 17 technologies suited for scaling up. Finally, this initiative proposed three models for scaling them up: a knowledge-transfer/extension model, a commercial business model, and a policy incidence model (Khatri-Chhetri et al., 2017).

This intervention formed the basis for the scaling of the CSV approach in the region with the re-packaging, co-development, testing, and piloting of multiple promising CSA options at village levels. LI-BIRD and a team with support from CGIAR have extended the CSV program with a package of interventions in more than 30 sites at five districts, Mohottari, Nawalparasi, Dang, Bardiya, and Gorkha. This initiative aimed to

pilot test and evaluate the two CSV models, one with solar-based irrigation systems (piloted in 12 villages) and another without solar-based irrigation systems (piloted in 18 villages). With their engagement with the provincial and national government prominent NGOs such as LI-BIRD have been promoting CSV programs through government initiatives at national, provincial, and local levels.

This pioneering work by NGOs and development partners together with the local government became a starting point for the scaling of CSA by the GON. In 2018 Gandaki Province initiated a program based on the CSV approach for the sustainable development of the agriculture sector by the promotion of climate-friendly technologies and practices and the utilization of local resources. This program was named The Chief Minister Environment Friendly Model Agricultural Village (MAV) program and implemented by the Ministry of Soil Conservation, Agriculture, and Cooperative working together with multiple institutions. This program was implemented in 36 villages in the first year and then extended to 72 villages in the second year and 85 villages in the third year. Building on prior works by NGOs and civil society organizations on the CSV approach, the MAV program has created a mutual learning environment. The program has engaged multiple institutions such as Agriculture Knowledge Center, Livestock Service Experts Center, provincial Nepal Agricultural Research Center (NARC), and municipalities/rural municipalities. Along with the aim of partnering with universities, there is a discussion about getting the private sector involved in the program.

Further, the MAV program has a strong focus on capacity enhancement for local people and the development of suitable technologies. Implemented through an

agriculture-based cooperative at each village this initiative aims to enhance the capacities of local institutions. Each village is supported for four years with a subsidy decreased by 50% in subsequent years to make sure these villages build capacity and become less dependent on external resources as the program continues. To encourage integrative engagement with local communities, all CSVs are provided with a dedicated agricultural technician from the same village or nearby areas. The MAV program has proposed a list of more than 60 technologies and practices for local communities to think about their adaptation options. In addition to using previously identified CSA options, this initiative aims to do action research with the involvement of multiple actors and institutions in the development, improvement, monitoring, and evaluation of adaptation options. For example, a technical committee is established with the coordination of a member from the National Planning Commission (Agriculture sector expert) to provide technical support, guidance, and monitoring of the program.

The implementation of CSV programs in Nepal through governmental and nongovernmental organizations is not a panacea, however. These programs are new and ambitious, and it might be early to say how they perform in the future. For example, the MAV program by Gandaki Province was ambitious to start at 36 villages in the first year alone and scale up massively. On the other hand, the technical advice of the officials from the experts who supported the program development was to start with the implementation in fewer villages, build capacity, and gradually scale the program in partnership with local governments. Likewise, the program has not been able to accomplish a few things proposed in the implementation manual. For example, the

program has not been able to sign an MOU with the university and the COVID-19 pandemic brought unexpected implementation challenges. Despite having some weaknesses, the implementation of CSA through the CSV approach in Nepal has presented a promising case of institutional collaboration in climate adaptation and scaling of CSA that provides a case for the study of institutional innovation in adaptation.

### *3.6.1 Conceptual model of institutional innovation and the CSA intervention*

This analysis proposes a revised conceptual model updating the framework proposed by Chhetri et al. (2012) to make it more applicable for the scaling of practices and technologies for agricultural adaptation. Figure 13 presents the revised framework that recognizes a strong link between the cultural endowment with the institutional and technological innovation and is divided into two spheres: biophysical and social, cultural, and relational. This framework emphasizes the integration between biophysical and socio-cultural aspects, realizing that adaptation programs, particularly in developing countries, are top-down in nature that focuses more on biophysical aspects and offers technical solutions to the problem (Nightingale, 2015). I recognize that the framework provided by Chhetri et al. (2012) is an improvement on the earlier framework that focused more on climate change and technology interaction (Chhetri & Easterling, 2010) and believe that the close coupling between cultural endowment and institutional innovation requires a further extension. I suggest that institutional innovation will change the attitude and skills of policymakers and agricultural experts that will facilitate the vertical scaling of an adaptation initiative. Likewise, the recognition of the cultural endowment will foster community participation and enhance knowledge, attitude, and

skills of farmers and community organizations increasing chances for horizontal or farmer to farmer scaling of any adaptation initiative. All in all, this framework offers an integrated model of community, government, and private sector involvement, along with the integration of global and local knowledge. This is elucidated by the example implementation of the CSV initiative in Nepal with the integration into the existing agricultural extension system of local agriculture offices.

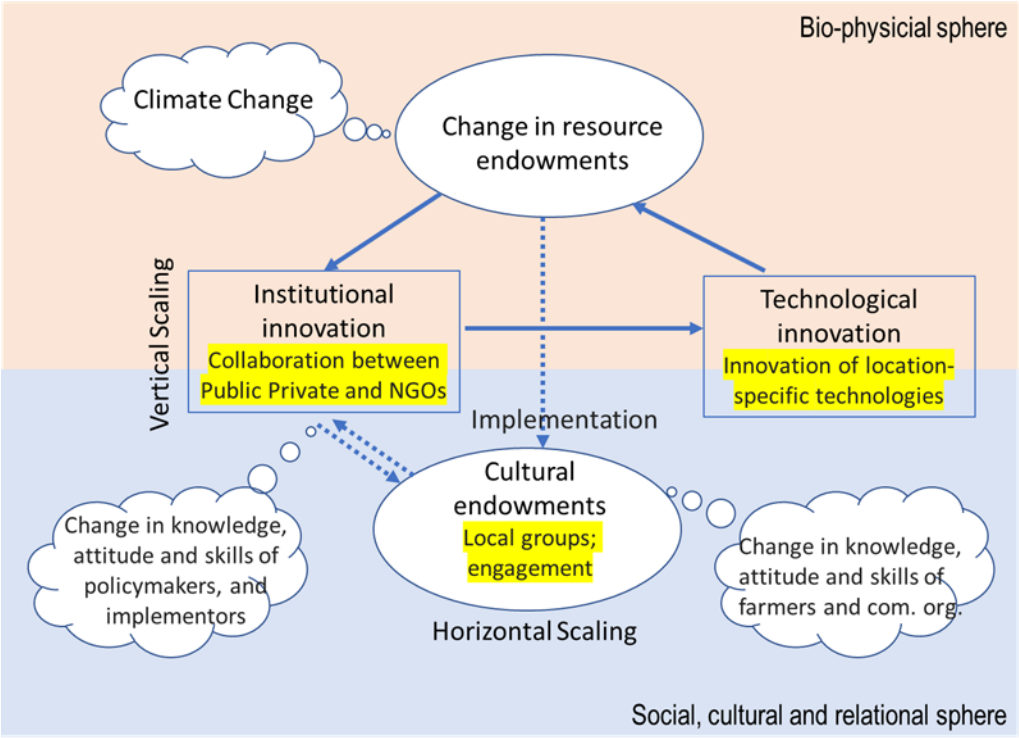


*Figure 13 Revised conceptual model illustrating interactions between institutional, cultural, and technological innovation in agriculture*

Here I explain how the framework builds on the ongoing conversation in the agricultural adaptation and CSA literature with the focus on four major aspects of the

conceptual model: change in resource endowments, institutional innovation, cultural endowments, and technological innovation. First, the impacts of climate change are visible in agricultural systems around the world. The agriculture sector in the Hindukush Himalayan region is highly susceptible to climate change impacts due to poor irrigation and high dependence on rainfall. Along with that the drying of water sources, erratic rainfall, the increase in the incidence of pests and diseases, and increased flood and droughts have posed serious concerns in the agricultural systems in the region (Rasul et al., 2019). According to Nepal's NAPA, local communities have reported that the change in climate has caused a decrease in agricultural and livestock production and productivity (MOE, 2010).

Second, appropriate institutional and governance mechanisms are required to ensure the broad participation of stakeholders for the scaling up of climate smart technologies (Palombi & Sessa, 2013) that calls for institutional innovation. To advance the agenda of CSA, proponents have always proposed collaboration between private, public, and civil society actors and institutions at various levels (Faling et al., 2018; Lipper et al., 2014). The major priority of CSA is "strengthening national and local institutions to support adaptive capacity through enhancing people's access to assets, including information" (Lipper et al., 2014, p.1070). The CSV program is seen as a correction to the top-down and expert-led community development model that aims to strengthen local institutions and to integrate the efforts of multiple institutions for agricultural adaptation. With this, the CSV approach has been an important part of the agricultural development agenda in changing the knowledge, attitude, and skills of

policymakers and institutions involved in agriculture and allied sectors at all levels. The CSV in Nepal has become a site for collaboration between public, private, and civil society organizations. The CSV approach in the Gandaki River Basin has demonstrated interactions and mutual learning between multiple institutions. The CSV approach first initiated by LI-BIRD and other organizations is adopted by the government of Gandaki Province and has involved multiple organizations in the implementation of these initiatives. The preparation of training materials and the focus on strengthening collaborative capacity among institutions have been changing the knowledge and skills of policymakers and institutions working in agriculture-related sectors in the region. The implementation of the CSV approach in Gandaki Province has been a lesson for municipalities and rural municipalities in the province and institutions working at multiple levels in other parts of the country. Thus, the CSV approach in the Gandaki region provides a good example of vertical scaling of promising adaptation initiatives.

Third, the scaling of CSA has a strong focus on the cultural endowment aspect. Scholars have recognized that scaling of CSA is not possible without the strong engagement of farmers and local farmers groups. The integration of scientific evidence of CSA with local knowledge is a key component of the CSV approach. Figure 13 links the CSV approach to the knowledge and experience of community resource management. Initiatives that recognize and promote community experience and are based on collaboration between bottom-up and top-down approaches have proven to be more effective in a variety of situations. For example, several donor-funded programs tried to increase the productivity of rural Africa, but these interventions worked as long as their

program was active. Whereas local practices of Z*ai pit* and farmer-managed natural regeneration were able to make widespread and effective adaptation after it was recognized with appropriate policies by the government (Amaru & Chhetri, 2013; Reij et al., 2009). One of the focuses of the CSA and CSV programs has been to empower and strengthen local-level organizations and local communities so that they can continue the program with minimum support from the partner organizations. According to Aggarwal et al., (2018, p.3), "the key focus in a typical CSV is on strengthening capacities and empowering the farming communities and their local organizations". Likewise, community participation in Nepal has global recognition. For example, initiatives such as community forestry, farmers managed irrigation management systems, and microfinance have created strong institutions at the local level. The CSV approach for CSA has been successful to capitalize and reinvigorate the cultural endowment and in changing the knowledge, attitude, and skills of farmers and community organizations that are critical for the success of any program. The CSV approach in Gandaki Province has reached the most vulnerable parts of the region working with farmers cooperatives at the local level. The provision for local agricultural technicians for each village, gradually reducing subsidies, and iterative consultations with communities have been helpful in the knowledge and skills of farmers and local institutions. This type of interaction proves to be helpful to extend CSV options horizontally to other farmers not initially in the group.

Finally, the CSV program has been prioritizing contextual technologies working with local communities. Past experiences have demonstrated that one size fits all solutions are ill-suited to responding to climate change as the impacts of climate change

differ from place to place. Thus, CSA differs from 'business-as-usual' approaches by emphasizing the capacity to implement flexible, context-specific solutions, supported by innovative policy and financing actions (Lipper et al., 2014). Some adaptation programs such as drought-resistant seeds prepared by large biotech companies perform better if complemented by the widespread adoption of farmer communities. Likewise, promising community-based interventions such as *Zai pit* farming in Kenya benefit if integrated by government programs and plans for widespread use of such promising technologies. While several other programs are reliant on traditional approaches or technological approaches for adaptation, the CSV approach in Nepal has been active in blending traditional knowledge with new science-based insights for adaptation. The plethora of adaptation options developed, piloted, and recommended by the CSV program in Nepal is a testament of the potential of the CSV approach in developing and scaling context-specific adaptation options. To start with the piloting program initiated by NGOs working with the GON identified promising technologies and the current program of Gandaki Province has been utilizing this approach to produce context specific practices. With more engagement of NARC, Agriculture Knowledge Center, and Livestock Service Experts Center this initiative aims to bring newer practices to the package of intervention.

### *3.6.2 Impact of the new institutional approach – CSV in Nepal*

The CSV approach in Nepal has proposed a new model of agricultural adaptation that can be seen as a form of institutional and technological innovation with changes in the financial model, collaboration, capacity building, and the integration of global and local knowledge. By analyzing the sustainability of these measures this section presents

their challenges and contributions to global and national adaptation and mitigation agenda.

*3.6.2.1 Enhancing collaboration*

The case of the CSV initiative in Nepal demonstrates a mechanism for strong cooperation between civil, public, and private sector organizations in implementing and co-financing in climate change adaptation and mitigation in the agriculture sector. Though the CSV approach came as a top-down agenda from the UN system, the idea found an appropriate implementation mechanism at the local level in Nepal. The initial success of the CSV initiative in scaling up is based on the cultural context of strong grassroots level organizations and the rich history of management of natural resources by communities. Further, this also demonstrates the active role of civil society organizations and the strong commitment from the public sector in promoting local level adaptation initiatives in Nepal. For example, while most Least Developed Countries (LDCs) did not mention local institutions as having a role in implementing adaptation in their countries' NAPA submitted to the United Nations (Agarwal et al., 2012), Nepal made a remarkable commitment. The NAPA of Nepal proposed a plan for preparing LAPA and committed to investing 80% of the climate change budget at the local level for implementation while leaving only 10% each for coordination at central and functional levels (MoE, 2010). Continuing such commitments, the new institutional approach has increased the model for co-financing in climate change adaptation and mitigation in agriculture at the local level. The initiative taken by provincial and local governments without active financial support from donor agencies provides a clear message of the public sector commitment.

This shows how NGOs/INGOs and the local government can work together in identifying appropriate technologies and practices and implement them. All in all, the CSV approach has served as a boundary concept to bring multiple institutions together and each actor has seen a value proposition for engaging in this initiative without losing their identity or core function (Allen, 2009). By playing crucial roles in building together knowledge and skills through their incomprehensible interactions in multiple sectors and levels, provincial governments and the local NGO have demonstrated their roles as boundary organizations. These boundary organizations working in adaptation governance play an instrumental role to foster stakeholder engagement for the implementation of initiatives and achieving adaptation objectives.

The CSV initiative in Nepal has demonstrated strong collaboration between multiple stakeholders such as farmers, communities, private sectors, government extension systems, and development organizations. With the strong engagement of the public sector with grassroots level stakeholders and institutions for agricultural adaptation this initiative has demonstrated examples of a plethora of ways that can contribute to the scaling of the CSV approach. Broadly these approaches fall under three models for scaling of CSA as suggested by the scaling of CSA in Nepal project - a) knowledge transfer model, b) commercial business model and c) policy incidence model (Khatri-Chhetri et al., 2017). First, the knowledge transfer model focuses on the strong engagement of local institutions, civil society organizations, and I/NGOs in increasing the adoption of promising technologies through training, exposure visits, and demonstrations to farmers. Second, the commercial business model focuses more on the

private sector and is suitable for CSA options that require more input or private sector involvement. Finally, the policy incidence model calls for increased support from the government in the form of subsidies and agricultural extension programs. The initiative in Nepal recognizes that different institutions might take leadership in each of the three models, each of which calls for strong collaboration between multiple actors. In general, the knowledge transfer model is conceptually closer to horizontal scaling, the policy incidence model builds on the idea of vertical scaling, and the commercial business model lies somehow in between these. This suggests that, while bringing multiple institutions together, the CSV approach also supports horizontal and vertical models for scaling of promising CSA options. For the scaling of CSA one size may not fit all, as these options differ based on their characteristics, methods of application, and the contextual factors of a given place. Often the scaling of CSA options also requires a combination of approaches rather than having one best approach (Khatri-Chhetri et al., 2017).

*3.6.2.2 Integrating local and global knowledge for climate action*

The integration of local and global knowledge for climate action has produced context appropriate technologies and practices. Several practices are not new, but they have been integrated from the local and traditional practices. For example, communities have been practicing mixed farming for many generations without knowing the scientific merits of the practice. The CSV approach has tried to stir these practices and indigenous knowledge in working with farmers and communities. In doing so this initiative demonstrates that the divide between indigenous and scientific knowledge is misleading

as local or traditional knowledge can be science-based, and the scientific knowledge is deeply intertwined with the social sphere (Agrawal, 1995). Moreover, while coming up with separate sets of adaptation options suited for different ecological regions initiatives the CSV approach recognizes that there is a large difference in climatic impacts and available adaptation options within and among the Mountain, Hills, and Terai region (Chhetri, 2011).

The CSV approach has been helpful in strengthening the capacity of actors for agriculture adaptation and mitigation to climate change by changing their knowledge, attitude, and skills at all levels. With the engagement with local government units newly established after the enactment of the Constitution of Nepal 2015, this initiative was able to forge new partnerships and enhance the capacity of all institutions working on the agricultural adaptation. The leadership of the provincial and local government in association with pioneer NGOs and other organizations was helpful to advance the idea of locally led adaptation that recognizes that local communities are at the forefront of witnessing climate change impacts and in responding to local changes and calls for more ownership by local actors on adaptation programs, funding, and practices being implemented in their place (Westoby et al., 2020). This is in contrast to contemporary practices on adaptation that have been largely top-down in nature, driven by international and national agendas, where the voices of local communities struggle to reach the decision-makers. Capacity strengthening is an important part of agricultural adaptation and there should be a value proposition or incentive for all stakeholders to contribute to adaptation.

*3.6.2.3 Addressing national and global climate policies*

The CSV approach provides environmental co-benefits and aligns with domestic and international commitments such as Paris Agreements, NDC, and SDGs. Though the agricultural system in developing countries is largely conservation agriculture producing a lesser amount of greenhouse gases emissions, having come from the CSA intervention that aims to have triple benefits CSV approach contributes to NDC and the mitigation goals. The NDC of Nepal notes that having an agriculture-based economy, the agriculture sector contributes to a larger portion of GHGs emissions from the country, however, the share of the agriculture sector has been decreasing as the emissions due to the burning of fossil fuel have increased. In NDC Nepal promises to promote climate-friendly practices in agriculture and using local and indigenous knowledge and build on efficient technologies such as the development of flood and drought-resistant crop varieties. The Agriculture Development Strategy 2014 has planned to gradually transition towards commercial agriculture to reduce climate change vulnerabilities. In the context that the agriculture sector in developing countries provides a small carbon footprint and the focus has been more on the adaptation of the agriculture sector against climate change impact, the commitment towards mitigation as a co-benefit means a lot.

Among 17 SDGs proposed by the United Nations in 2015 to be completed by 2030, the CSV approach contributes to multiple SDGs. This approach directly supports two goals (#2 zero hunger and #13 climate action) and indirectly contributes to multiple other goals. The CSA initiative in developing countries in general and more specifically CSV approach has focused on food security more seriously. For example, the food

security goal was given the highest weightage (40% of total) for evaluating CSA options. Likewise, the CSV program also has a strong focus on climate action, adaptation, and mitigation. Thus, as discussed in the last paragraph the CSV approach has the potential in providing mitigation co-benefits for achieving country-specific mitigation goals.

The CSA intervention indirectly contributes to multiple SDGs, #1 No poverty, #3 good health and wellbeing, #5 gender equality, #6 clean water and sanitation #7 affordable and clean energy #15 life on land #16 peace, justice, and strong institutions and #17 partnership for the goals. With the increase in productivity, the CSV approach can reduce poverty and increase income for marginalized smallholder farmers. Since the focus on CSV approach has been on practices such as mixed farming, homestead garden, reducing pesticide use, and encouraging biopesticide and biofertilizers these all can contribute to providing balanced nutrition, good health, and wellbeing. The commitment of the CSV approach to gender equality is evident from the fact that GESI is one of the pillars for prioritizing CSA options. In addition, there is a strong involvement of women and women's groups during the implementation of this initiative. The CSV programs have categorized CSA options as water-smart and many such programs are geared towards providing clean water and sanitation at the household and community levels. Similar to providing water security the CSA options promoted through CSV programs provide alternative energy sources such as improved cooking stoves, solar pump irrigation systems, small hand devices, etc. Strongly contributing to the forest and biodiversity another benefit of these practices can be on flora and fauna living on land. Finally, institutional innovation through the CSV initiative has promoted the

strengthening of institutional capacity while fostering partnership and collaboration between multiple actors.

All in all, by contributing to multiple SDGs, this approach can provide multiple avenues for advancing national and international commitments to development and wellbeing. Further, this approach advances the idea of SDGs, which aims for moving beyond traditional policy silos to recognize the integrated and indivisible interconnection between multiple goals (United Nations, 2015). My analysis lies closer to other studies that have suggested that CSA intervention can contribute to governing SDGs in the context of developing countries. For example, Newell et al., (2019) with the study of four Eastern African countries have discussed the potential of building more climate-resilient food and agricultural systems that can contribute to achieving the SDGs.

Having said all these, CSV programs being implemented in Nepal also have some challenges. Aryal et al. (2020) suggest preparing LAPA for mainstreaming CSVs to address agricultural sustainability issues that have been challenged by climate change and natural resource depletion. Though LAPAs are prepared in several places inside Gandaki Province, CSV programs have not been able to integrate them with LAPA. The CSV initiative in Nepal is relatively new and is ambitious to reach out to a large number of places in the short term. Moreover, most research and publication on CSV and CSA interventions have focused on NGO programs, whereas the government program despite being imperative in scaling up CSA and CSV programs is relatively new. Works of NGOs and development partners can best contribute to conducting research, test, pilot programs but it is hard for them to make a long-term impact through their programs only

due to the short-term and project-based nature of these programs. While considering the important role of government in scaling adaptation programs recommended by NGOs and INGOs, it is also imperative to understand the dynamic nature of socioeconomic, institutional, and technological factors that shape the development and scaling of CSA options (Waaswa et al., 2021). With the analysis of government policies and related documents of Nepal, Paudyal et al., (2019) have mentioned that CSA intervention is gender-responsive in general, but this initiative will benefit from disaggregating data by developing gender-responsive technologies and practices. Finally, it is imperative to extend the number of villages benefiting from the CSV initiative as prior studies have demonstrated that farmers from a CSV are more aware of climate variability and likely to adopt adaptation options compared to farmers from a village that has not implemented the CSV program (Tetteh et al., 2020).

### 3.7 Conclusion

The CSV approach promoted by multiple institutions in Nepal makes a strong case for scaling CSA through institutional and technological innovations for climate change adaptation in agriculture. The CSV program promoted collaboration among public, private, and development sector organizations to design, implement, monitor, and evaluate climate actions at the local level. Recognizing the capacity of community-based organizations, this approach enhances engagement with local communities and grassroots-level institutions. With the involvement of provincial and local governments, CSV programs are deploying already tested and evaluated climate smart technologies, practices, and services to the farmers and their communities. This approach is also

serving as a hub for active learning and innovation for climate action in agriculture and allied sectors.

This study highlights a need for building collaboration among multiple institutions - local to international level and between private, public, and civil society for scaling up/out of climate smart agricultural technologies, practices, and services. This collaboration catalyzes innovation in climate change adaptation and enhances farmers' participation and adoption of CSA. This is also crucial to cultivate an ideal partnership with local government, community-based organizations, development organizations (NGOs), and the private sector. Local institutions (i.e., farmer groups) and intermediaries (i.e., non-governmental organizations) can play a leading role in institutional innovation and integration of local and global knowledge for effective design, management, and monitoring of the CSV approach of scaling the CSA.

# 4 CO-PRODUCTIVE IMAGINARIES FOR ADAPTATION

## 4.1 Introduction

Climate change continues to be a threat to the lives and livelihoods of the people of Nepal, and the impact is disproportionately severe for farmers. Given the strategic importance of Nepal's agriculture to the nation's economy, potential impacts of climate variability and change on national food security are causes for concern (Chhetri et al., 2013). The agriculture and livestock subsectors contribute around 21% of the national GDP (MOALD, 2021) while providing employment to nearly three-quarters of the population (CIAT, World Bank, CCAFS and LI-BIRD, 2017). According to a survey conducted in 2016 approximately 4.2 million people of Nepal's 28.6 million population are food insecure (USAID, 2019). In response to potential threats emanating from changing climate and other ongoing stresses, Nepal has developed a range of adaptation initiatives. These initiatives draw heavily on external (scientific, often led by the state) as well as traditional (often held within communities) knowledge. With the case of the Local Adaptation Plans of Action (LAPA) initiative in Nepal, this chapter explores how scientific and local knowledge, experience, and motivation are brought together as a response to the threats posed by changing climate. I argue that communities take action against climate change, with or without the insights about it, to reach their livelihoods goal. They proceed by trial and error, building on what works. At each step, they move pragmatically and creatively, using their experiential learning as well as the scientific knowledge that they are exposed to.

Following Nightingale et al. (2020), I argue that addressing vulnerabilities and risks is a social and political challenge and cannot be solely addressed through technical means. Unfortunately, for too long adaptation policies have been largely technological and top-down, with lesser attention paid to local knowledge and lived experiences that have been an important part of communities' responses to ongoing challenges. While the recent turn towards local adaptation practices is promising, these initiatives have struggled to meaningfully change the ontological foundation of adaptation to climate change. This chapter, inspired by the idea of social imaginaries as "collectively imagined forms of social life and social order" (Jasanoff & Kim, 2009, p. 120) demonstrates that the responses to changing climate are deeply connected to the social, cultural, and everyday reality of a place. For the purpose of this dissertation, I define imaginaries of climate adaptation as collectively held visions of social responses to local climate change attained through and supported by different forms of knowledge including the advancement in science and technology. Following Jasanoff (2004), imaginaries of climate adaptation, I argue, are deeply influenced by the notion of co-production whereby knowledge and society cannot exist without each other and cannot be separated. For this reason, the distinction between scientific and indigenous knowledge is unwarranted (Agrawal, 1995), and blending modern science with local practices strongly connects people and places to respond to the threats posed by climate.

Following James Scott (1998) I draw upon ideas of *metis* -- an umbrella term that refers to contextual knowledge situated at the confluence of social and spiritual belief systems as well as the lived experience of a community in question. Generally, *metis* is

referred to as place-based, contextual, and experiential logic, and measured by its focus on solving local issues. Different from *metis*, the technical knowledge or "*techne*" is defined as universal knowledge "organized analytically into small, explicit, logical steps and is both decomposable and verifiable" (Scott, 1998, p. 320). These two knowledge systems, *metis and techne*, exhibit profound ontological and epistemological differences.

First, focused on local knowledge as a source of innovation for climate adaptation, *metis* recognizes adaptation as a socio-natural process where biophysical and sociocultural aspects are coproduced (Jasanoff, 2004) and they are hard to decouple (Nightingale, 2016). Following Parthasarathy (2016), I posit that adaptation practices under consideration by communities as a solution to climate adaptation are a part of larger sociotechnical systems that are deeply embedded in social, economic, historical, and political contexts. I argue that it is important to understand the "situatedness" in understanding how communities and individuals make knowledge claims (Haraway, 1988) as each community is unique. There are no best practices that fit for everyone, only better practices, depending on the local context. By considering climate adaptation as sociotechnical imaginaries, I bridge the gap between climate adaptation led by science technology and local people's knowledge and views for combating everyday challenges.

Second, *techne* represents state-led and globally framed approaches that promote technological solutions to addressing the problem. To this end, climate change is merely a biophysical process and can be managed through technological fixes. Not surprisingly, this dominant approach to addressing climate problems sidesteps from other more germane issues, including local cultures, values, and knowledge systems (Hulme, 2009).

Unable to understand the local context at which climate change manifests itself, the technological solutions to dealing with climate change reinforce existing power differentials and inequities that further accentuate social vulnerabilities (Nightingale, 2015). Techno-fix approach to climate adaptation may find itself inappropriate as each community possesses unique socio-cultural and political realities, and is likely to reject scientific and top-down approaches led by state and/or motivated politically (Johansson & Vinthagen, 2016; Scott, 1985, 1989). Therefore, it is imperative for science and technology-led practices to connect to community aspirations for their adoption and scaling.

By combining insights from the field of Science and Technology Studies (STS) and cultural geography, this chapter contributes to the richness of adaptation literature. By considering *metis*-based adaptation practices implemented by the rural communities of the Gandaki River Basin in the Western region of Nepal, this chapter also advances the importance of a place-based approach to climate adaptation. This chapter explores a) how the practice of climate adaptation at the local level promotes sociotechnical imaginaries and b) how it is manifested into the socio-cultural practice for advancing adaptation. In the next section, I describe the background of my study followed by a short description of the study site in Section 4.3. Section 4.4 describes the methodology, and Section 4.5 presents the results. Finally, I discuss my findings in the penultimate section of this chapter followed by a short concluding section that offers a summary of this chapter.

## 4.2 Background

Natural resource-dependent communities show considerable resourcefulness in the face of external change (Lebel 2013). Several examples around the world suggest that communities have been managing multiple natural resources at the local level (Ostrom, 1990), be it farmers managing small irrigation systems in the Himalayas (Pradhan, 1989), *Zai pit* farming in Kenya (Amaru & Chhetri, 2013; Reij et al., 2009), the community-based forest management program of Nepal (Ojha et al., 2009) or traditional seed-exchange system (Chhetri et al., 2013). The idea of *metis* is not limited to local or traditional knowledge, it can also be other practical knowledge or acquired information or skills-based training that people learn working with newer technologies. It can also represent practices that bring together traditional knowledge with modern science and technology. For example, through participatory approaches to innovation in technology, smallholder farmers in Nepal have developed crops with desired traits through *in-situ* plant breeding (Chhetri and Easterling, 2010). Likewise, the promotion of a homemade bio-fertilizer and bio-pesticide (*Jholmal*) in Nepal aims to control crop pests by using the right amount of *Jholmal* at the right time (Subedi et al., 2019).

The example above underscores the importance of co-production, the idea that maintains that knowledge is generated and simultaneously shaped by the social relations of production (Jasanoff, 2004; Nightingale et al., 2020). It goes beyond merely stakeholders' consultation to recognize the need for combining multiple forms of knowledge (Klenk & Meehan, 2015) and is targeted to address location-specific needs. As an alternative to the standard practice of science-technology, the co-production model

creates climate adaptation imaginaries through the harmonization of the lived experience of the community in question. For this reason, imaginaries of climate adaptation go beyond the scientific approach to creating a deeper understanding of the social and ecological systems (Jasanoff & Kim, 2015).

While the study of sociotechnical imaginaries is tilted towards the study of modern technologies (e. g. nuclear power; genetically modified organisms), a small number of STS scholars have extended the idea of sociotechnical imaginaries in environmental management and climate change, including imaginaries of sustainability (Miller, 2020) and socio-environmental imaginaries (Milkoreit et al., 2017). The adaptation initiatives in Nepal, particularly the case of the LAPA expand the literature on socio-technical imaginaries to consider the placed-based approach to dealing with climate. Placed-based adaptations include: diversifying towards climatically optimal crops and livestock, adjusting land use and cropping systems, intensifying the use of technologies that buffer deleterious impacts of climate change, and improving water management practices (Chhetri & Easterling, 2010).

### 4.3 Climate change and Nepal

Climate change continues to be a threat to the lives of the people of Nepal, the majority of whom depend on agriculture for their livelihoods. In recent years, evidence of changing climate, such as the decline in agricultural productivity, water availability, and ecosystem services, and the rise in climate related disasters such as floods, landslides, drought, and unpredictable rainfall patterns have been well documented in the region (Xu et al., 2019). Given that the nation's economy and wellbeing are dependent on agriculture

and natural resources, potential impacts of climate variability and change are causes of concern for the country.

In 2010, the GON initiated the adaptation planning process by the development of the National Adaptation Program of Action (NAPA), followed by Climate Change Policy 2011 and LAPA framework in 2011 along with the initiation of the National Adaptation Plan (NAP). While Nepal's approach to climate adaptation is criticized for being top-down, technocratic, and sectoral (Huq & Khan, 2006; Nightingale, 2015; Ojha et al., 2016), the NAPA provides clear guidelines for the disbursement of at least 80 percent of the adaptation fund at the local level. For this reason, the GON has enacted ambitious adaptation policies and plans focusing on devising local level response strategies. For example, the LAPA intends to implement the priorities of NAPA more effectively through engagement at the local levels and integration of adaptation into the sectoral plans and policies.

Nepal's LAPA framework aims to make climate adaptation planning inclusive and flexible processes that will allow local people to make informed decisions on priority actions (Wiseman & Chhetri, 2011). The LAPA also provides a mechanism for mainstreaming local adaptation needs and capacities into development planning for the effective implementation of the most urgent and immediate adaptation needs which were prioritized in NAPA. Nepal's LAPA process has gained global recognition and as a result has been adopted in several other countries (Maharjan, 2019). Figure 7 shows the map of Nepal's Gandaki River Basin where over 70 LAPAs were prepared and implemented by the Hariyo Ban Program.

## 4.4 Methodology

As illustrated in Figure 4, this chapter combines both qualitative and quantitative research methods. First, the preparatory work for this study began with a site visit by the first author which included meetings with relevant stakeholders and field observation. Second, to identify adaptation activities being implemented in the Gandaki River Basin, I analyzed documented reports from three community-based adaptation projects. They include: 1) Ecosystem Based Adaptation (EbA) in Mountain Ecosystem program (2011-2016); 2) Climate Smart Agriculture (CSA) program (2015-2017); and 3) Hariyo Ban Program (2011-2016). Drawing on a policy brief that synthesizes scaling of CSA in Nepal pilot program (Poudel et al., 2017), EbA program completion report (GON/UNDP, 2016), and annual performance report (Hariyo Ban Program, 2016), I compiled a list of adaptation practices implemented across the Gandaki River Basin. In order to understand the link between the local adaptation plan as articulated in the LAPA documents ($n$=65) and actual activities implemented by the three programs at the Gandaki River Basin, I manually compiled the list of adaptation activities. This list formed the basis for my understanding of the link between the policy and its outcomes on the ground.

Third, I conducted 45 structured interviews (by telephone) with local stakeholders responsible for designing and implementing the LAPA. Some of my research subjects were also affiliated with local government, schools, community forest users' groups, and conservation areas management committees, representing 29 communities from 11 districts where the Hariyo Ban Program prepared the LAPA. I used *Qualtrics*, an online platform, to enter the responses directly into the database. Interviews with local

stakeholders were used as the primary basis for identifying stakeholder perceptions regarding proposed climate adaptation action in LAPA and their implementation. This is also the basis of quantitative analysis. I followed the snowball sampling method, a non-probability sampling technique where an existing subject provides referrals to identify and recruit the sample required for a study. It is important to note that a third of the respondents were women. I also conducted 15 (five with women) semi-structured interviews (by Zoom) with policymakers and stakeholders from research institutions, governmental and non-governmental organizations, media houses, and development partners operating at the national level. The interviews with these key informants were more exploratory in nature and centered on how local-level adaptation plans, policies, and initiatives are connected to the national and international level discourse. It was qualitative in nature. Both sets of interviews helped to triangulate the findings of the document review conducted using secondary data.

**4.5 Imaginaries of adaptation**

Table 2 presents a list of major adaptation activities implemented in the Gandaki River Basin. My study reveals that a wide range of adaptation activities are currently being adopted by the communities. The activities promoted and implemented through the CSA program are largely focused on creating resiliency in the agricultural sector at the household level. Activities implemented by the EbA and Hariyo Ban Program are mostly community-based and are linked to maintaining the functioning of the common-pool resources such as forests, rangeland, and water.

*Table 2: Major adaptation activities in the Gandaki River Basin by: a) Ecosystem Based Adaptation b) Hariyo Ban Program c) Climate Smart Agriculture (Source: Author - Review of reports)*

| Activity | Ecosystem Based Adaptation | Hariyo Ban Program | Climate Smart Agriculture |
|---|---|---|---|
| **FOOD** | | | |
| Maintenance of irrigation canal | | √ | |
| Agro-insurance | | | √ |
| Use of ICT as a decision tool | | | √ |
| Community seed bank | | | √ |
| Plantation of fodder trees | √ | | |
| Distribution of new crops or vegetable seeds | | √ | √ |
| Home garden | | √ | √ |
| Mixed farming | | | √ |
| Improvement of cattle-shed | | | √ |
| Use of plastic tunnel | | √ | √ |
| Agroforestry | | | √ |
| FOREST | | | |
| Plantation of trees | √ | √ | √ |
| Plantation of Non-Timber Forest Products | √ | | |
| Establishment of nursery | √ | √ | |
| Maintenance of fire lines in the forest | | √ | |
| Invasive species cleaning | | √ | |
| Bio-fencing | | √ | |
| WATER | | | |
| Conservation of water source and wetlands | √ | √ | √ |
| Construction of ponds | √ | √ | √ |
| Supply of piped drinking water | | √ | |
| Construction of water tank | | √ | |
| Drip irrigation | | | √ |
| Zero tillage | | | √ |
| Retention of residue | | | √ |
| Rice intensification | | | √ |
| ENERGY | | | |
| Solar irrigation | | | √ |
| Hand tools | | | √ |
| Improved cooking stoves | | √ | |

My results also reveal that the degree of adoption is determined by the type of activities. Figure 14 shows the frequency at which the different adaptation activities are adopted by communities. The left side of the panel shows EbA activities, at the middle are the mixture of EbA activities coupled with a set of technologies introduced to make

the system more resilient, and at the lower righthand side are science-based activities introduced by external agencies.

For the heuristic purpose I have illustrated EbA and science-based adaptation options as two ends of a continuum, however, both these options can be *metis*-based and EbA options can be science-based as well. While science-based approaches require more contextualization, EbA options are practiced by the communities as a part of their routine approach to dealing with ongoing stresses. The idea of EbA emerged strongly during an international workshop on "Adaptation to Climate Change: the role of Ecosystem Services" held in Costa Rica in 2008 (Vignola et al., 2009). Ever since the idea has been getting attention in adaptation planning including the major global policy reports (e. g. IPCC 2014). The significance of EbA has also been recognized in REDD+ as well as payment for environmental services (PES) (Dasgupta et al., 2014). In general, the EbA integrates the use of biodiversity and ecosystem services into an overall strategy to help people adapt to the adverse impacts of climate change (Munang et al., 2013; Vignola et al., 2009). It involves a wide range of ecosystem management activities targeted to increase resilience and reduce the vulnerability of communities to external shocks (Colls et al., 2009).

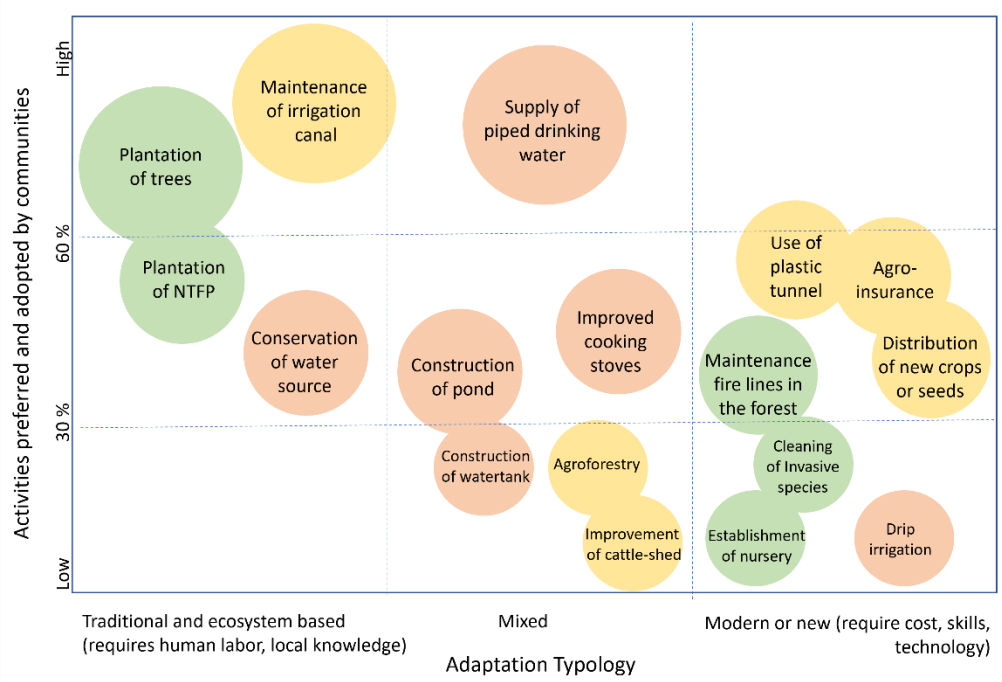


*Figure 14 Activities proposed in LAPA by communities inside Gandaki River Basin (Source: Author – Review of reports and LAPA documents)*

The analysis of the LAPA reveals that the planting of trees was the most favored adaptation activity proposed by over 90% of the LAPA documents, followed by maintenance of irrigation canal and supply of piped drinking water proposed by about 60% of the LAPA documents. My study also reveals that the adaptation activities requiring significant financial capital (e. g. solar irrigation) and technological sophistication were hardly included in these documents. Simultaneously, adaptation activities considered low cost such as improved cooking stove and improvement of livestock shed were moderately proposed. I also found that adaptation activities requiring

external technology were proposed sparingly in the LAPA documents. These activities include agro-insurance, drip irrigation, and the use of plastic tunnels.

There might be several reasons for the higher preference for EbA. Activities geared towards biodiversity conservation such as agroforestry, conservation of forests, and protection of water sources are known to provide multiple benefits to farmers (Adhikari et al., 2018). Primary advantages of the EbA include its low cost, the use of local capital, and mobilization of locally available resources and skills. Unlike science-based adaptation measures, EbA can be readily implemented, adopting the best practice approaches for the sustainable management of human-environment systems. For this reason, they are considered fail-safe measures. Some of the EbA can also increase soil organic matter, enhance soil and water conservation, and diversify food production systems while providing mitigation measures and co-benefits to human health. Additionally, EbA can also support ecosystem services and other sustainable development goals and, if carefully designed, can also improve productivity and yield stability.

The EbA, therefore, offers a means of adaptation that is readily available to the smallholder farmers, can be readily integrated into community-based activities, and addresses many of the concerns and priorities of the communities. In the case of Nepal, farmers who managed irrigation systems and community forestry management have a long history of success. Scholars have noted that farmers who managed irrigation systems in Nepal were able to build social capital and outperform Agency Managed Systems (Ostrom, 2002). The case of selecting forestry management practices as adaptation

measures demonstrates how forests and biodiversity have contributed to the livelihood and wellbeing of rural communities. These seemingly mundane traditional practices bring together sophisticated ecosystem-based knowledge (*metis*) for adapting to a changing environment. They are more pragmatic, flexible cost-effective, and widely applicable alternative tools for adaptation planners (Munang et al., 2013).

Despite all the benefits of the EbA, it faces a range of barriers. Since many scholars and policymakers have condescending views on ecosystem-based approaches, the progress on promoting these practices has been rather slow. They believe that these practices may not be enough to address the dire climate change impacts that have created new socio-ecological conditions that are distinct from the ones that existed in the past. In general, coping is more related to the idea of autonomous adaptation or instantaneous adaptation which refers to small-scale adjustments to the environment (Chhetri et al., 2019). The increased frequency and severity of unpredictable consequences have made it difficult for affected people to cope effectively (Agrawal, 2010), necessitating deliberative support through technology.

The ecosystem-based approach to adaptation also has its own limitations. For example, opportunities to increase ecosystem resilience to future climate change may only be effective for lower levels of climate change (≤2-3°C). Beyond certain levels of climate change, however, impacts on people and ecosystems are expected to be severe and largely irreversible (Pachauri et al., 2014). In some situations, technological and/or science-based solutions will still be required alongside EbA. Recognizing this, some science-based practices have been serving the adaptation needs of communities inside the

Gandaki River Basin (e. g. solar irrigation, ICT-based agro-advisory, drip irrigation, and tunnel farming). Solar energy, long considered ideal for home lighting in off-grid communities, has become attractive for pumping water for irrigation -- a key to achieving higher crop yield while enhancing resilience to the system. Of course, there are several other modern technologies that help farmers adapt to changing climate. According to an INGO expert:

> In the last project I worked on, we launched Krishi Ghar App, a mobile app that provided the agricultural information through a toll-free number linked with the DOHM [Department of Hydrology and Meteorology], and supported 3-4 days weather forecasting for planning, harvesting etc. If farmers have questions, they could directly ask them to the ministry of agriculture in the local Nepali language. This krishi ghar app was helpful and was also appreciated by the farmers. The app updated other information related to farming including the products prices and other agricultural updates.

Although investment in technology is necessary to adapt to changing climate, the technology adoption process is slow. The adaptation activities that rely on new practices that are led by innovation in technologies (e. g. solar based irrigation and sprinkle irrigation) can only be implemented with the support from external agents. Their adoption may be limited to a few who can afford and have the skills to translate those technologies to desirable outcomes. It is also possible that these sophisticated activities also run the risk of technological failure. In addition to the cost, these technological solutions require more work on the part of external agencies. Like any other new technology, awareness about them is going to be critical which requires strong coordination between actors in local level adaptation planning. According to one of Nepal's experts on climate adaptation:

> Some local governments are willing to invest their financial resources to replicate promising newer adaptation technologies. For example, in Nawalparasi the local government saw solar-based pump irrigation successful in one place and replicated the same model in two or three other places using their own financial resources. ... However, they [local government] lack technical capacity so look to NGO or INGOs for providing technical help.

While government and policymakers are making concerted efforts to promote science-led innovation as a solution to climate adaptation (Khatri-Chhetri et al., 2019), my findings reveal that communities prefer EbA options over the ones promoted by the government. At the same time, examples of co-production of location-specific technologies or the coupling of EbA activities with science and technology-based options look promising. For example, activities such as participatory plant breeding (Chhetri & Easterling, 2010) and biopesticides have the potential to generate pathways to adaptation. According to a key informant:

> It is important to capture indigenous knowledge of communities and tie up new technologies. For this, consultation with the community is important and the experts should be able to present adaptation options that were successful in other places so that communities can make informed decisions.

The integration of EbA and technological interventions has been gaining more attention recently in urban adaptation with the realization that conventional (technological or hard) adaptation measures are often associated with higher cost, less flexibility and conflicting interests (Brink et al., 2016). Likewise, bioengineering or the use of plants in tandem with engineering measures has become popular among engineers for slope stabilization and coastal restoration. Many recent climate change adaptation initiatives have focused on the use of modern technologies and EbA options to design climate resilient infrastructure. For example, the United Nations Environmental

Programme (UNEP) plans to assist developing countries in addressing climate change by creating enabling conditions to promote EbA through technology development, diffusion, piloting, demonstration, and capacity building (Munang et al., 2013). Similarly, the use of EbA together with technological measures can be an effective option for rural and agricultural adaptation initiatives. After all, a science-based approach might have universal crop-specific technical knowledge, but local communities generally have *metis*-based knowledge of local or traditional biological control practices that textbooks cannot provide (Scott, 1998).

**4.6 Discussion**

*Metis*-based practices give rise to new imaginaries and simultaneously shape society's response to climate adaptation. However, the distinction between *metis* and *techne* is not straightforward. For example, tree plantation programs are local responses to stabilize gullies and protect soil across the Himalayas and are an integral part of communities. However, in a number of cases tree plantation programs are also led by external agencies, with new species of trees promoted as better than local ones. The case of LAPA suggests that the two forms of knowledge cannot be separated meaningfully. Schemes such as the LAPA are trying to mediate differences between these two extremes of a continuum, and it is extremely important to understand the difference between a variety of knowledge and insights these approaches bring to the community. In my case, activities proposed by the CSA program are more technology focused and those implemented by EbA program are more traditional. Practices included in both these programs can be best integrated into development planning by incorporating them in

LAPAs, prepared at the local level (Aryal et al., 2020). The government of Nepal with support from external agencies has been trying to internalize the LAPA process by experimenting with different approaches to adaptation governance. After the restructuring of the governance units, a revised framework for LAPA was developed in 2019 and the government is piloting this framework to better support the LAPA initiative. In bringing multiple knowledge systems together, LAPAs have also brought multiple sectors together. For example, EbA focuses on the forests and biodiversity sector whereas CSA is often promoted as an agricultural development strategy.

My research also revealed that the government of Nepal was quick to initiate a community based and ecosystem-based adaptation. These initiatives build on the rich history of successful local response to addressing complex challenges and strong grassroots level institutions. However, despite profound interest in EbA options among local people and government policies in Nepal, there still is a need for understanding that these local initiatives are as intelligible and as informative as western knowledge. Assuming traditional practices as merely coping is not an accurate categorization since modern technologies such as discussed above can be coping measures as well and traditional practices such as farmers managed irrigation systems can be sizeable. Therefore, the condescending view towards EbA that assumes modern technologies to be better and transformational belies the fact that public interests and aspirations are with traditional approaches for adaptation. On the other hand, overreliance on EbA measures and proposing them as no-brainer solutions may not be productive. Instead, effective use

of such options might include understanding context-specific options and improving upon these traditional practices.

At the same time, my findings reveal that modern and technological solutions to climate adaptation at the local level have struggled to create part of everyday life among local stakeholders to ensure wider adoption. Therefore, it is imperative for modern technologies to contribute to cultural, practical, and location-specific adaptation needs. The integration of knowledge systems is not simply adding different knowledge, but it is a political process resulting in the co-production of knowledge among multiple institutions and systems (Nightingale et al., 2020). While the government of Nepal is keen to scale CSA (Khatri-Chhetri et al., 2017), despite its promise, farmers are less enthusiastic about the wider benefit (Vernooy & Bouroncle, 2019). A study of CSA in India suggests that the mainstreaming of CSA practices into development planning can be facilitated by the preparation of LAPA at the local level (Aryal et al., 2020). These findings underline a need for the integration of modern and traditional knowledge and practices for fostering the sociotechnical imaginaries of adaptation. Since most EbA practices are bottom-up, the support from top-down can be helpful in some aspects of local-level planning to spark new ideas or adaptation practices that the locals might not be aware of (Nightingale, 2017; Silwal et al., 2019). A co-productive path for mobilization of local knowledge for adaptation does not homogenize or undervalue the local knowledge by considering it as an object ready to pick up (Klenk et al., 2017) but understands that poor and marginalized communities can be rich in innovation, knowledge, and sustainable practices (Gupta et al., 2003). The rigid government

mechanism and the top-down nature make it difficult to engage meaningfully with communities unless the government collaborative with private and civil society organizations for underlying drivers of vulnerability and social exclusion (Jones & Boyd, 2011). Successful adaptation depends on combining EbA initiatives with technological interventions by appropriately considering local contexts (Amaru and Chhetri 2013) so that these measures complement each other or come together as a hybrid solution. The case of the interactions between the age-long irrigation practice through the networks of priests and technological approaches of irrigation management in Bali provides a strong example for co-producing traditional knowledge and modern technological prowess (Lansing, 1991, 2006).

My analysis confirms that classifying knowledge systems into traditional and science-based knowledge is arbitrary and the integration of different types of knowledge is inherently complex (Raymond et al., 2010). For example, the study of the hydro-social relationship in the Mustang district of Nepal in the context of climate change adaptation shows that it is difficult to fuse scientific and indigenous knowledge for climate adaptation (Clark et al., 2017). This case suggests that indigenous knowledge that has emerged through innumerable human–hydrological interactions in the past are hard to discern and disentangle. The same holds true for agricultural adaptation, EbA, and other forms of adaptation. Chhetri and Chhetri (2015) call for *Alternative Imagination*, the platform that welcomes traditional knowledge while also embracing heralds from scientific achievements. I also see *metis*-based imaginaries, an alternative co-productive approach for adaptation to dismantle the divide between traditional versus science-based

practices in adaptation governance. Institutions and individuals working on adaptation should ask if we would like to make science-based adaptation technologies something that is actionable and useful for communities (Arnott, 2020) or something that will be ultimately thwarted by local communities (Johansson & Vinthagen, 2016; Scott, 1985, 1989).

### 4.7 Conclusion

My findings suggest that the distinction between traditional and scientific knowledge is not helpful as local knowledge can be science-based and the scientific knowledge is deeply intertwined with the social sphere – what is important is the appreciation of how these adaptation practices relate to societal needs and capacities. *Metis*-based adaptation practices represent traditional and contextualized modern practices, are constantly being shaped by and are shaping rural livelihoods and have tremendous potential for adaptation to climatic and other stressors. These practices present imaginaries of adaptation that integrate multiple knowledge systems and are based on socio-natural aspects for dealing with climate change. I see that it is important to a) lift the taboo on EBA measures that sees these practices as merely coping mechanisms; b) improve traditional practices so that they are not proposed as a no-brainer solution but are geared towards solving adaptation needs, c) localize modern technologies to suit cultural, practical, and location-specific adaptation needs; and d) build a hybrid solution with traditional and modern practices or make sure that they complement each other so that communities can use both these solutions as and when needed without hurting the other. Though the distinction between *techne*- and *metis*-

based adaptation practices is fuzzy, *metis*-based practices can have contextualized science-based knowledge vetted by communities. In general, these practices are co-productive and more likely to be owned by local communities as these practices are more connected to people and address their immediate adaptation needs. Programs such as LAPA are instrumental in bringing local communities to the forefront of adaptation initiatives and innovating technologies and practices working with communities.

# 5 CONCLUSION

As climate change continues to threaten livelihoods in developing countries, adaptation strategies are emerging as the most promising way to cope with these changes. In the context of the Himalayan region, climate change has added layers of complexity to the already existing multiple stressors that people in the region are facing. With the case of Nepal, my research has explained how local level initiatives have been addressing complex environmental stresses by bringing together multiple stakeholders and different sets of knowledge and attitudes. This dissertation research has revealed that most adaptation activities proposed by local communities are low cost, based on experiential learning, and require local resources. These community-based adaptation activities also are strongly connected to everyday life and local development goals, revealing the synergy between adaptation policy objectives and development. Along with local ecosystem-based and traditional adaptation activities, some communities have started using science-based activities for adaptation. These adaptation activities options based on modern science are sparingly used as they are yet to form a part of the everyday life of local people. As communities are using both traditional and scientific knowledge for adaptation to climatic stresses, it is crucial to understand how these approaches are deeply intertwined with the social and political processes (Eriksen et al., 2015). Further, my research has shown that traditional and contextualized modern practices are constantly being shaped by and are shaping rural livelihoods and have tremendous potential for adaptation to climatic and other stressors. Thus, local and scientific knowledge coalesces at the community level, illustrating a complex and hybrid nature to climate adaptation.

This knowledge co-production in adaptation can contribute to a more integrated imaginaries for adaptation by bringing together multiple forms of knowledge (Jasanoff, 2004; Nightingale et al., 2020).

Based on these findings my study suggests that co-productive approaches for adaptation are more likely to be owned by local communities as these practices are more connected to people to address their immediate adaptation needs. Moreover, for better outcomes of adaptation initiatives, my study suggests enhancing the usefulness of adaptation options available to communities. Specifically, it is important to: a) lift the taboo on EBA measures that sees these practices as merely coping mechanisms; b) improve traditional practices so that they are not proposed as a no-brainer solution but are geared towards solving adaptation needs, c) localize modern technologies to suit cultural and practical adaptation needs based on the local specific needs; and d) make sure traditional and modern practices complement each other or build a hybrid solution so that communities can use both these solutions as and when needed.

My research has shown that the low cost and less resource-intensive adaptation activities proposed by local communities had difficulty in aligning with the national and global policies. By exploring barriers and enablers of the LAPA initiative my research has shown the disconnect between policies objective at the higher level and the actual adaptation activities happening at the local level. The case of LAPA has demonstrated three major ways adaptation initiatives can be strengthened: a) improve connections with local knowledge and development needs, b) Foster engagement of actors at all levels and provide continuous support from top-down, and c) understand differential power among

local level actors and reduce inequality. First, my research has shown that it is imperative for adaptation initiatives to understand the everyday nature of adaptation by connecting adaptation initiatives to the lives of local people. Unless adaptation initiatives form part and parcel of the everyday life of local people, these initiatives are likely to be rejected by local communities (Johansson & Vinthagen, 2016; Scott, 1985, 1989). Adaptation to climate change cannot be different from the local development aspirations of communities so as per the aspiration of LAPA it is imperative to integrate adaptation planning into development planning. Second, the support from the top-down level is imperative for any local level adaptation initiatives in terms of planning, financing, and implementation. Finally, this research has explored differential power relationships between different stakeholders at the local level. While local government has more influence, the marginalized groups including women's groups have lesser power. As a result, it is imperative to carefully solicit and enhance the voices of those who are marginalized while making powerful agents more accountable.

With the case of CSA, my dissertation has demonstrated how technological and institutional innovations co-produce local specific knowledge required to adapt to changing climate. The collaborative efforts by different institutions operating at multiple levels for scaling CSA through the CSV approach provide justification for working together to address the climate adaptation policy objectives. The collaboration among public, private, and civil society organizations brings together multiple rationalities i.e, hierarchical, individualist, and egalitarian as suggested by the cultural theory (Gyawali & Thompson, 2016; Thompson, 2003). With the engagement of grassroots-level institutions

and the leadership of provincial and local governments, this approach is deploying already evaluated climate smart options while also serving as a hub for active learning and innovation for climate action in agriculture and allied sectors. Further, my study has demonstrated how feedbacks and mutual learning between global and local processes are imperative for successful adaptation initiatives (Eriksen et al., 2011). Further, my analysis has demonstrated how the seemingly small initiative of the CSV approach has the potential to contribute to national development and climate goals.

All in all, my dissertation highlights the value of engaging multiple stakeholders and knowledge systems in adaptation governance. Boundary organizations working in adaptation governance play an instrumental role to foster stakeholder engagement for the implementation of initiatives and achieving adaptation objectives. National governments and NGOs are playing crucial roles in building together knowledge and skills though their incomprehensible interactions in multiple sectors and levels. Initiatives such as LAPA and CSA are some examples of bringing local communities to the forefront of adaptation initiatives and innovating technologies and practices working with actors are multiple levels. This research has provided valuable insights for improving upon these initiatives for enhancing their adoption.

While this research provides insights on how adaptation governance can be enhanced through co-production, innovation, and wider engagement of stakeholders, more research is required on this issue. Future research needs to address how to make powerful agents more responsible in adaptation governance and how to bring voices that are often missing in this conversation. There is a need for further research to understand

how local communities can be at the forefront of adaptation decision-making and for engaging actors at all levels for adaptation planning, implementation, and monitoring. Likewise, it is crucial to understand whether the adaptation strategies are effective and be flexible to update or modify them. This research has primarily used interviews and secondary data analysis, future research can extend this approach by considering more ethnographic or field-based methods. Using micro case studies, future research can interrogate more on the interactions between multiple organizations and further explain how adaptation initiatives can be more sustainable.

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