

**ADAPTATION TO SOCIAL-ECOLOGICAL CHANGE ON THE SWAT
AND KABUL RIVERS OF PAKISTAN**

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This dissertation is dedicated to my great aunt Ann: I would not be where I am today without your generous love. And to my own nieces, Lakelyn, Ellie, Liana, Hannah, and Isla: thank you for reminding me how to laugh and play.

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ABSTRACT

Social-ecological change has driven rural households throughout the world to employ a diverse array of adaptation strategies. Social, economic, and cultural factors along with environmental changes have been widely studied as determinants of adaptation decision-making. Increasingly, scholars are also examining the socio-cognitive processes and the role of values in these decisions. Many have posited that adaptation to social-ecological change will necessitate tradeoffs of these values; however, little empirical work has been done to identify and examine these tradeoffs.

We had three primary research objectives to address this gap in our understanding of adaptation decision-making. First, we identify how farmers and fishers adapted to multiple social-ecological stressors in northwestern Pakistan. Second, we investigate how social-ecological factors, perceived changes, and perceived costs influence adaptation decision-making and adaptive capacity. Third, we examine the role of and tradeoffs between values in adaptation decision-making. We utilized a mixed-methods approach to collect and analyze qualitative and quantitative data to address these research objectives. Specifically, we conducted 25 semi-structured interviews with formal and informal community leaders, farmers, and fishers and 448 in-person surveys with household heads in communities along with Swat and Kabul rivers in Khyber Pakhtunkhwa, Pakistan.

Our data shows that farmers and fishers frequently employed environmental management and livelihood diversification to adapt to water stress and that communal pooling was often used to support these strategies. In terms of livelihood diversification, respondents frequently reported decreasing their reliance on fishing, entering the tourism industry, or migrating for labor. Environmental management often took the form of increasing agricultural inputs or changing water supply systems. Our data confirm previous work demonstrating that adaptation decisions are influenced by perception of social-ecological change as well social-economic factors such as age, income, and education of the household head. We further show that adaptation strategies vary across household structures in part due to joint families' greater access to capital in comparison to nuclear families. In particular, we posit that high entry barriers to livelihood diversification can increase existing income inequalities across household structure.

We found that values do influence tradeoff decisions. Specifically, time, labor, and finances appear to be expected and accepted costs of adaptation that respondents are willing to tradeoff in order to adapt. Respondents were also willing to go against friends' and leaders' opinion, however, the opinions of family members and tradition were less likely to be traded off in order to adapt. However, our data suggests that even these values may be traded off if necessitated by the intensity of social-environmental change. Our work also demonstrates how adaptation decisions and values that influence them are a part of multi-scalar processes. That is, households' adaptations can be constrained or supported by processes occurring at broader scales (i.e., community, region, etc.) and the negotiation of value tradeoffs reflect the broader social-cultural context in which adaptation decisions are employed. Based on our findings, we posit that in addition to the identification of values, it is also necessary to examine values as they relate to one another, change over time, and are embedded in multi-scalar processes. This will allow us to more fully understand the factors that influence adaptation decisions and support more equitable strategies that align with stakeholders' diverse values.

CHAPTER 1. INTRODUCTION

1.1 Adaptation to social-ecological change

Social-ecological change has driven rural households throughout the world to employ a diverse array of adaptation strategies in response to compounding stress and complex variability. Rural households in the Global South are especially vulnerable to the impacts of social-ecological change due in part to their reliance on natural resources that are increasingly stressed by both climate variability as well as social, political, and economic factors (Smit & Pilifosova, 2003; Thomas & Twyman, 2005; Wheeler & von Braun, 2013). These stressors are expected to intensify as the climate continues to change (Challinor et al., 2014; Howden et al., 2007), thus adaptations strategies, their outcomes, and the decision-making processes that surround them have been an increasing focus of research (Bryan et al., 2013; Burnham & Ma, 2016; Deressa et al., 2009; Truelove et al., 2015).

1.2 Overview of research area and interdisciplinary project

Pakistan is ranked as one of the most water stressed countries in the world (Hofste et al., 2019) and it is projected that climate change will further stress the country's water supply (Hussain & Mumtaz, 2014). In the Khyber Pakhtunkhwa (KP) province in northwestern Pakistan, the Swat and Kabul Rivers supply water for irrigated agriculture, hydropower, and habitat for both wild catch and cultured fish, domestic needs, and serves as an aesthetic draw for tourists. Like many rivers throughout the world, these water systems are continuously transformed by social-ecological processes including urbanization, industrialization, hydropower development, agricultural intensification, conflict, and natural disasters (Khan et al., 2018; Tariq & Rashid, 2014; Ullah et al., 2013; Yousafzai et al., 2008).

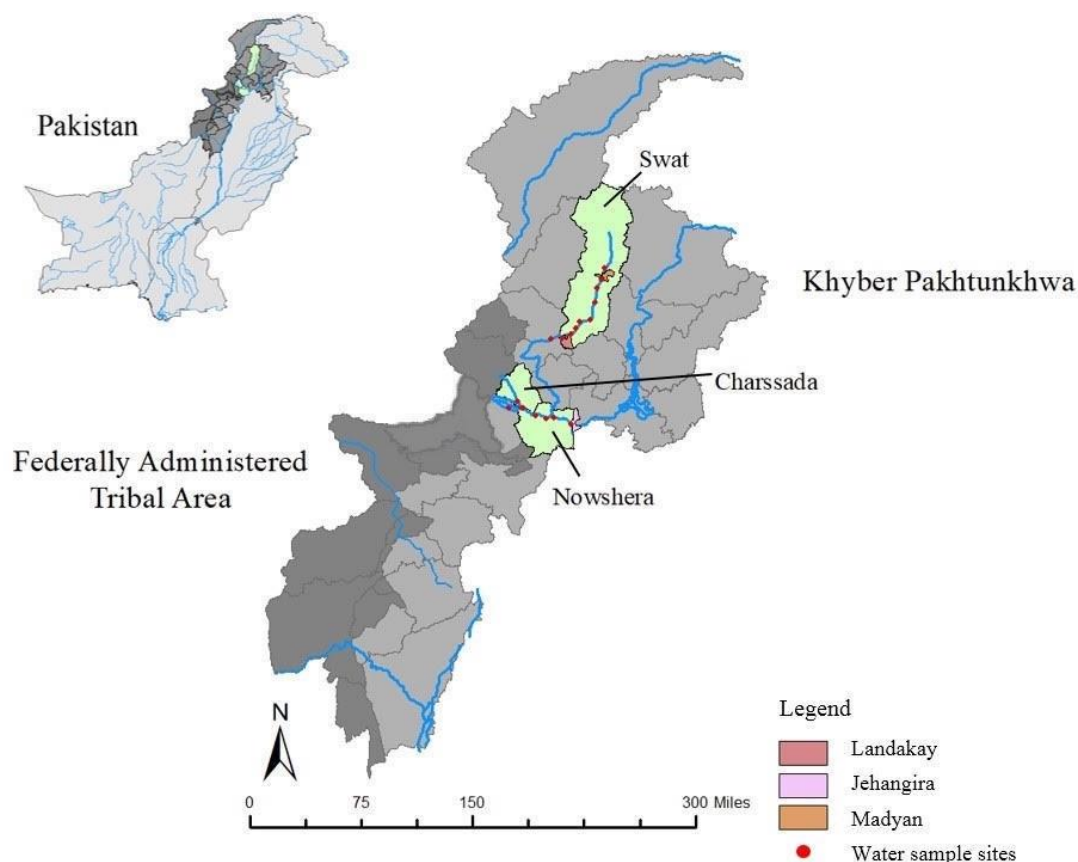


Figure 1.1 Map of research area and data collection

Given such complex contexts, an interdisciplinary approach is necessary to more fully understand adaptation decision-making process and outcomes. As such, this research on adaptation decision-making is situated within a broader study conducted by researchers at the University of Peshawar (UP) in Peshawar, Pakistan and Purdue University in Indiana, USA to assess the impacts of water quality on river ecosystems, fish health, and livelihoods of communities along the Swat and Kabul Rivers. This project focused specifically on endocrine disrupting chemicals (EDCs) as they are common in industrial, agricultural, and municipal wastewater and can have serious health effects for both wildlife and humans (Kolpin et al., 2002; Snyder et al., 2003); however, we employed methods that also allowed us to assess the social-ecological system more broadly.

This project aimed to: 1) evaluate the EDC types and concentrations in the Kabul and Swat Rivers; 2) identify factors impacting EDC loads in this watershed; 3) evaluate aquatic ecosystem health with a focus on fish diversity and selected reproductive endpoints; 4) correlate fish diversity/health with contaminant concentrations; 5) assess local communities' perception of water

quality and river ecosystem health, their relationships to their lives and livelihoods, and their willingness to engage in conservation practices to improve the situation; and 6) provide recommendations to reduce the impact of EDCs on river health for use by policy makers, researchers and regulatory agencies. As shown in Figure 1 above, our data collection focused on the KP regions in northwestern Pakistan. Water samples (indicated by red dots the map) and fish samples were taken from both the Swat and Kabul rivers and interview and survey data were collected from communities along both rivers. Specifically, interviews were conducted in Nowshera, Charsadda, and Swat districts. Surveys were conducted in Landakay, Madyan, and Jehangira.

1.3 Adaptation to social-ecological change and decision-making

We draw on a broad range of literature to inform our understanding of adaptation to social-ecological change and decision-making. First, we understand adaptation decisions to be in response to multiple compounding social-ecological stressors and changes, therefore adaptation not driven by a specific climatic stressor; but rather, it is a suite of responses to various forms of social-ecological change and complex uncertainty (Burnham & Ma, 2018; Forsyth & Evans, 2013; Manuel-Navarrete & Pelling, 2015).

Second, in terms of adaptation strategies, multiple typologies categorize and describe how individuals, groups, and systems adjust to the broad effects of a changing climate (Füssel, 2007; Smit et al, 2000; Park et al., 2012). In this research, we categorize adaptations by Agrawal's (2009) five types: 1) mobility, 2) storage, 3) diversification, 4) communal pooling, and 5) market exchange, and Burnham and Ma's (2016) addition of environmental management and labor migration.

Third, our study is situated within the understanding that adaptation is influenced by the wider political economy in which the distribution of capital or resources benefits some actors at the expense of others (Sovacool et al., 2015) and that adaptive capacity, or the ability of an individual, group, or system to respond to environmental and non-environmental stressors (Smit & Wandel, 2006) varies among individuals and systems (Adger, 2003). Therefore, adaptation to social-ecological change is embedded in and can exacerbate existing power dynamics and social-economic inequality (Eriksen et al., 2015; Nagoda & Nightingale, 2017).

Fourth, we acknowledge that adaptation strategies interact across temporal and spatial scales. That is, short-term gains may result in increased vulnerability in the longer term, and adaptation for one sector or system may have maladaptive outcomes in another (Adger et al., 2003; Burnham & Ma, 2018; Nielsen & Reenberg, 2010; Pittock, 2011). Further, short-term and long-term adaptation goals may conflict (Smit & Pilifosova, 2001), and autonomous and planned adaptations interact with one another as they respond to multiple risks and actors' diverse needs (Milman & Warner, 2016; Burnham & Ma, 2018).

Finally, we draw on previous work that has examined how decision makers' social-economic demographics, cultural context, perception of social-ecological change and the economic costs of the strategy influence adaptation decisions (Asfaw et al., 2019; Below et al., 2012; Bryan et al., 2009; Deressa et al., 2009; Tessema et al., 2013).

1.4 Values and tradeoff decision-making

In addition to literature on adaptation to social-ecological change, we also draw on conceptualizations of tradeoff decision-making and values. In economics, tradeoffs are understood to create opportunity costs, or the loss of potential benefits from alternatives when the preferred option is chosen. This theory traditionally assumes rational choice theory, that is, that actors will choose options that maximize their utility and minimize opportunity costs (Edwards, 1954). However, other understandings of tradeoffs acknowledge bounded rationality (Simon, 1972); as such, tradeoff decisions are also influenced by multiple social and cognitive factors (Fiske & Tetlock, 1997; Luce et al., 2001; Tetlock, 2000).

Particular attention has been given to the tradeoff of values; Tetlock (2003) conceptualizes values tradeoffs as either routine trade-offs (between secular values), taboo trade-offs (between secular and sacred values), or tragic trade-offs (between sacred values). We aim to build upon this understanding of the value tradeoffs in the context of adaptation to social-ecological change. To do this we draw on Schwartz's (1992) definition stating that values 1) are beliefs linked to affect; 2) relate to desirable goals; 3) transcend specific situations, 4) serve as standards or criteria to evaluate behavior and events, 5) are ordered by relative importance, and 6) guide actions through the relative importance of multiple values. Finally, we draw on a distinction made by Dietz et al. (2005) between values and attitudes; the latter are evaluations of something specific while values are more general and can be applied to various situations and contexts.

Scholars have increasingly demonstrated the influence of values in adaptation decisions (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013); they have been shown to influence the limits of adaptation (O'Brien, 2009) and what adaptation strategies are perceived as successful (Wolf et al., 2013). It is largely understood that the type of values that influence adaptation are highly context dependent; therefore, assessed values are wide ranging and diverse (i.e., tradition, safety, health, belonging, and freedom) (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013). As seen above, much research has been done to demonstrate the role of value tradeoff in decisions more broadly and while scholars have pointed to the need to understand these processes in adaptation, little empirical research has done so. For example, Tschakert et al. (2017) state that tradeoff of values is likely in adaptation decision-making because, "people hold multiple values and more than one may be at risk from climate change. Yet, only a small number of studies have attempted to examine the various tradeoffs people are likely to make between the lived values that are important in their lives and livelihoods" (p.10). Additionally, our understanding of tradeoffs across time is particularly limited (Tschakert et al., 2017). Finally, while many authors have qualitatively assessed the role of values (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013) little research has used mixed-methods to examine and compare the influence of values on adaptation decisions.

1.5 Summary of dissertation objective and methods

This dissertation aims to address this gap in our understanding. In the context of the broader interdisciplinary project, the goals of this dissertation are to: 1) gain a better understanding of how households adapt to complex social-ecological change in the little-studied context of northwestern Pakistan, 2) examine how demographic factors, perceived changes, and perceived costs influence adaptation decision-making and adaptive capacity, 3) assess the role of values in adaptation decision-making, and 4) explore if and how value tradeoffs are present within the adaptation decision-making processes.

We utilized a mixed-methods approach in this research, that is, we conducted both individual interviews and household surveys to collect data. Specifically, we conducted 25 semi-structured interviews with farmers, fishers, and informal community leaders in, Nowshera, Charsadda, and Swat districts. We then administered 448 in-person household surveys in Landakay, Madyan, and Jehangira. These methods were conducted in partnership with faculty and

graduate students at UP as a part of the interdisciplinary project described above. Interview protocol was developed by faculty and graduate students at both Purdue and UP and were conducted in summer of 2018 by myself, UP graduate students, researchers, and faculty. Next, we developed surveys informed by the interview findings. Surveys were then piloted in communities similar to the research areas, questions were revised, and the survey was administered by graduate students and researchers from UP in spring and summer 2019.

The remaining chapters are organized as follows. Chapter two draws from 25 semi-structured interviews with farmers, fishers, and informal community leaders to demonstrate the ways in which values influence adaptation decisions and are embedded in multi-scalar social, cultural, economic, and political processes. Chapters three and four draw on a survey of 448 household heads in three communities. Specifically, chapter three examines livelihood and adaptation strategies across joint and nuclear household structures. Chapter four illustrates how the influence of economic and non-economic costs vary across adaptation strategy. Finally, chapter five synthesizes the findings from each chapter to discuss how these studies add to our understanding of adaptation decision-making to inform more equitable adaptation practices and policies that align with individual and societal values.

1.6 A note on researcher positionality and collaboration

It is important to note that, as in any research, the positionality of the researchers in this project influenced how research questions were formed and how data was collected and interpreted (see Appendix C for further information on methods in this context). Specifically, it has been shown that researchers' positionality influences the data collection process (Liamputtong, 2010; Meeriam et al., 2010; Song & Parker, 1995). Specifically, the researchers' gender, age, nationality, affiliations, and ethnicity can impact what participants disclose in an interview or survey and how they interact in the data collection process more broadly (Song & Parker, 1995). Relatedly, research also has a tradition of extractive methods and inequality (Zanotti et al., 2020) so it is important to acknowledge existing inequalities and power dynamics present in the research process (Meeriam et al., 2010; Zanotti et al., 2020). This critical reflection can then promote methodologies that are appropriate to the researchers' positions and research context.

For this research project, we relied heavily on the partnership between Purdue University and UP to build relationships with community gatekeepers and employ methods appropriate to the

area. Specifically, we worked with the Fisheries Department in the study area which provided invaluable logistical support and connections to the community. Working with gatekeepers such as the Fisheries Department inevitably introduces bias in the ways their involvement may influence if and how participants disclose information, however, it is also a vital and effective way to build rapport with participants and connect with the community (Ritchie et al., 2014; Liamputtong, 2010).

All data for this project were collected in Pashto. We acknowledge that the translation process can be complex and problematic. Translators have a significant influence on the data as they interpret, clarify, filter, or miscommunicate language (Liamputtong, 2010). Language is embedded in culture; therefore, words and phrases can misrepresent meaning even when the literal translation is accurate (Liamputtong, 2010). We addressed these issues by working in a team and engaging in long discussions about language. Specifically, translations of data collection protocol and interview transcripts were translated and checked by multiple UP graduate students and a post-doctoral researcher who were fluent in both Pashto and English. Countless hours were also spent translating both the data collection tools and interview transcripts in teams to ensure a shared understanding and consensus about difficult meanings.

In addition to language, identities and associated positions are complex, thus, researchers' positions are known to shift depending on the relationships between the researcher and participants (Sherif, 2001; Song & Parker, 1995). Nevertheless, I acknowledge that my own identity often placed me as an outsider in this context and that it impacted both interactions with participants and my interpretation of the data. Specifically, my nationality, academic affiliations, and gender influenced the data collection process. Broadly, it has been shown that affiliations with academic institutions can give a level of credibility to research (Liamputtong, 2010; Merriam et. al., 2010), however, the presence of an outside researcher can also incite suspicion and that causes hesitancy and unease in the interview process (Liamputtong, 2010). These identities seemed especially salient in the post-conflict, religiously conservative context in which we conducted research. We addressed these concerns in multiple ways throughout field work. First, I always traveled and conducted research with UP students and dressed in culturally appropriate ways as recommended by our hosts. We also traveled without additional security which served both to decrease attention placed on us and limit participant unease in what can be an already unfamiliar process of participating in data collection. As a woman, I deferred to my male colleagues in interactions with

other males. In the few cases that we did interview women, myself and another female UP student conducted the interview (rather than the male researchers) and permission was granted by the interviewees' father or husband. Finally, we clearly explained our affiliations and research goals to the participants so that they could better understand our process and reasons for interviewing in their communities.

Despite these considerations, this context did require the alterations of some of our initial data collection plans. First, we encountered barriers in our attempts to interview women in this context. We recognize that their perspective is vital to more fully understanding water use and it was in our initial plan to include women in our sample. However, we deferred to local norms and guidance that made it more appropriate to largely limit our data collection to male household heads due to a predominantly patriarchal research area. Second, we had also planned to stay in the research area for the duration of the survey distribution. This would have allowed me to have more direct experience in the research context while managing the survey in person, but security concerns dictated that I only stay in the area to pilot the survey and train enumerators. The collaboration with UP made it possible to collect survey data, however, in order to include women in this research, further work would benefit from additional ethnographic methods that allows for more time to build rapport between researchers and participants (O'Reilly, 2012). Third, we had planned to return to the field to report our findings and host a forum for decision-makers to discuss the collaboration needed to address the water supply challenges in their communities. However, travel restrictions related to COVID-19 made it impossible to do so. Nevertheless, we maintain that finding new ways to make research accessible and promote these conversations will be an important next step to disseminate the results and more broadly, to further promote collaboration between the researchers and the research communities.

This project also supported international collaboration through involvement of both Purdue and University of Peshawar faculty and students and the exchange of information, technology, and other resources between the universities. For instance, graduate students, including myself, received training in data collection, analysis, and reporting in addition to mentorship from a diverse group of faculty. While we experienced multiple barriers to collaboration (see Appendix C) it gave us invaluable experience in an international and interdisciplinary project. This lays the foundation for us to continue to engage in these important partnerships throughout our careers.

CHAPTER 2. VALUES IN HOUSEHOLD ADAPTATION TO SOCIAL-ECOLOGICAL CHANGE IN NORTHWESTERN PAKISTAN

2.1 Abstract

Values are important components of adaptation to social-ecological change and shape perceptions of impacts, acceptable risk, and successful adaptations; however, little empirical work examines how these values interact to influence adaptation decision-making. We draw on 25 semi-structured interviews with formal and informal community leaders, farmers, and fishers in northwestern Pakistan to identify types of adaptations employed and explore what values are present in these households' adaptation decisions. Our data shows that farmers and fishers frequently employed environmental management and livelihood diversification and that communal pooling supported these strategies. We found that multiple values influence adaptation, and that adaptation often involves a tradeoff of values. Further, these decisions are embedded in multi-scalar social, cultural, economic, and political processes. Overall, our work demonstrates value tradeoffs in adaptation decision-making and highlights the importance of developing adaptation policies and programs that acknowledge stakeholders' diverse values in order to mitigate conflict and minimize maladaptive outcomes.

2.2 Introduction

Adaptation to social-ecological change among agricultural households has been widely documented amidst projections that these changes will continue and intensify (Challinor et al., 2014; Howden et al., 2007). The traditional definition of adaptation as an adjustment to actual or expected changes in climate (IPCC, 2001) has been expanded to acknowledge that adaptation is not an isolated action driven by a specific stressor. Rather, it is often in response to various forms of social-ecological change and complex uncertainty (Burnham & Ma, 2018; Forsyth & Evans, 2013; Manuel-Navarrete & Pelling, 2015; López-I-Gelats et al., 2015). Non-environmental factors, such as political-economic constraints (Eakin, 2000; Mertz et al., 2010; Mckune & Silva, 2013; Groenewald et al., 2012), policy change and reform (Hageback et al., 2005), and power relations (Feola et al., 2015; McDowell & Hess, 2012) can be more important than climate in driving adaptation.

The literature has further documented how decisions to adapt can sometimes result in adaptation or maladaptation to social-ecological change. Particularly, there has been much work done on maladaptation to climate change, or the “actions, or inaction that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future” (IPCC, 2014, p.857). For example, adaptation decisions that generate short-term gains may result in increased vulnerability in the longer term, and short-term and long-term adaptation goals may conflict (Smit & Pilifosova, 2001). Additionally, adaptation in one sector or system may have maladaptive outcomes in another (Adger et al., 2003; Burnham & Ma, 2018; Nielsen & Reenberg, 2010; Pittcock, 2011). Thus, some scholars have situated adaptation in the wider political economy in which the distribution of capital or resources often benefits some actors at the expense of others (Sovacool et al., 2015).

These complex conditions create specific contexts in which adaptation takes place; thus, adaptations are embedded in local, context-specific processes (Adger et al., 2013; Burnham & Ma, 2018; Forsyth & Evans, 2013). At the household scale, it has been demonstrated that adaptation decisions are influenced by decision-makers’ socio-cultural characteristics as well as their perceptions of social-ecological change (Adger, 2003; Deressa et al., 2011; Fosu-Mensah et al., 2012; Grothmann & Patt, 2005; Hyland et al., 2016; Mertz et al., 2009; Mubaya & Mafongoya, 2017). In recent years, an emerging body of literature has examined how values also underlie decisions to mitigate and adapt to climate change. Research has used traditional value typologies (i.e., Kopelman et al., 2003; Rokeach, 1973; Schwartz, 2012) to examine intrinsic values such as tradition and safety, arguing that these assessments increase our understanding of the effects of climate change as they matter to those impacted (Graham et al., 2013; McShane, 2017; Wolf et al., 2013; O’Brien & Wolf, 2010; Ruoso, 2019).

Scholars have further argued that climate change threatens multiple values and that adaptation will require a tradeoff of these values (Tschakert et al. 2017; Warner, 2016). More broadly, scholars have examined different types of values (Tetlock, 2003) and their roles in tradeoff reasoning and the related decision-making processes (Barlas, 2011; Tetlock, 2000). Tradeoffs, according to Luce et al. (2001) “are arguably the most pervasive aspect of choice. More explicitly, if there are no tradeoffs to resolve, there is either only one option or one option dominates the others. In either case, active decision-making is not necessary. Because tradeoffs have such a prominent role in choice, understanding how people make them is critical” (p. 3).

However, so far, little research has explicitly examined the value tradeoffs associated with adaptation decision-making (Tschakert et al., 2017).

Our research addresses this gap through an examination of the perceptions of social-ecological change, adaptation practices, and values in the case of water use in northwestern Pakistan. Pakistan is one of the most water stressed countries in the world and rural livelihoods in Pakistan are highly dependent on a water supply that is continuously impacted by numerous social and ecological transformations (United Nations, 2013). In the Khyber Pakhtunkhwa (KP) province in northwestern Pakistan, the Swat and Kabul rivers supply water for irrigated agriculture, fish habitat, domestic use, hydropower, and river-based tourism. At the same time, climate change does and will continue to stress the nation's water supply (Hussain & Mumtaz, 2014). Such stress is further compounded by rapid industrialization, hydropower development, and agricultural intensification and rural populations face a multitude of challenges to adapt to the changing social-ecological conditions. As our research aims to identify and assess tradeoffs in adaptation, this rapidly transforming area with multiple stressors provides a rich context for analyzing adaptation decision-making to complex social-ecological change. Below, we describe our data collection and analysis methods. We then present our results on perceived changes, commonly reported adaptations, and household values associated with adaptation decision-making. Finally, we discuss how this assessment of value tradeoffs contributes to our understanding of the complex and shifting role of values in adaptation decision-making.

2.3 Research design and methods

2.3.1 Research area and site selection

This research study was a part of an interdisciplinary project that examines water quality in the Swat and Kabul Rivers in KP, Pakistan. The larger project aims to 1) evaluate endocrine distributing chemicals in the Kabul and Swat Rivers, 2) assess aquatic ecosystem health, 3) examine local

communities' perceptions of water quality and river ecosystem health and its impact on their livelihoods, and 4) provide recommendations to reduce the impact of EDCs. We work in Swat, Nowshera, Charsadda Districts (see Figure 1).

While these communities are located within 150 miles (240 km) of each other, they have distinct environmental and industrial conditions and were thus chosen to provide various adaptation contexts. For instance, Swat River is at a higher elevation and therefore well suited to hydropower and less vulnerable to industrial pollution than Kabul River. Communities on Swat River are also highly reliant on seasonal tourism. The communities on the Kabul River are located downstream from industrial development and thus more susceptible to industrial pollutants. In contrast to the Swat Valley, the Kabul River area is not a very common tourist destination, and more individuals have relied on fishing operations as a livelihood strategy.

In spite of rapid industrialization and urbanization, agriculture remains, by far, the largest source of employment and user of Pakistan's water sources, accounting for 23% of the country's GDP and 94% of the total water withdrawal (FAO, 2011; World Bank, 2018). In two of the research areas (Swat and Charsadda) about half of the employable population works in agriculture, while a quarter is employed in agriculture in Nowshera. Much of this agriculture is small-scale,

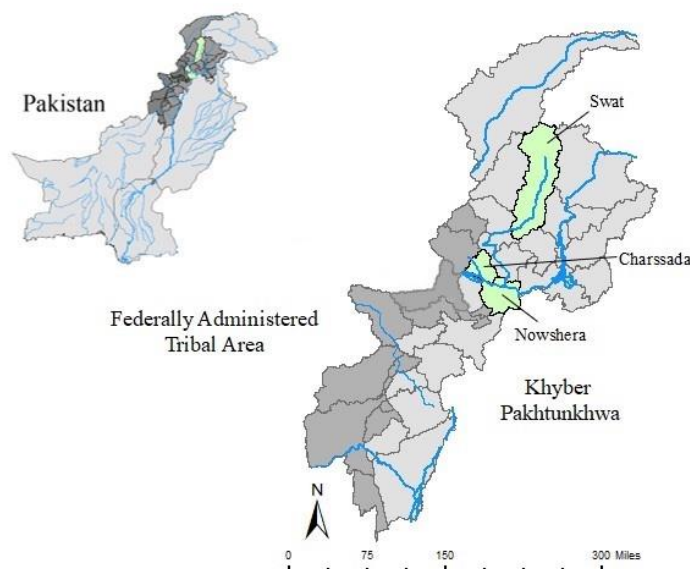


Figure 2.1 Map of interview study areas

with many of these farmers producing on less than 5 hectares (ha) of land. Irrigated land in Pakistan has historically relied on surface water and canal infrastructure, however, farmers are increasingly irrigating with groundwater (FAO, 2011). As shown in Table 2.1, irrigation water source in our research area varies by location and associated water availability; a majority of farmers use government canals for irrigation water in Charsadda while private canals and wells are more common in Swat. As Table 2.1 illustrates, domestic water supply also varies across the research areas; while most households have piped water or a pump, some rely on a dug well for their domestic water.

The stressors on Pakistan's water supply are compounding; the rising population and industrialization in rural areas intensifies water demand and wastewater discharge while agricultural intensification increases the amount of fertilizers and pesticides in run-off (Ullah et al., 2013). In KP, assessments of both the Kabul and Swat Rivers reveal a number of pollutant sources including industrial chemical waste, untreated domestic wastewater, and hotel waste (Porter & Fuller, 1994; Ullah et al., 2013). It is further estimated that only 1% of the 80,000 m³ of industrial effluents received each day is treated before being discharged in the Kabul River (*National Environmental Policy*, 2005). In largely rural areas such as Swat that are being transformed by tourism and rising populations, these stressors can have significant adverse impacts where traditional livelihood strategies often depend directly on the quality and quantity of this water supply.

Historically, the Swat Valley has attracted visitors with its mountain vistas and cool temperature, but the flood and Taliban activity significantly decreased the number of visitors. In 2008, the Taliban occupied more than half of the Swat District and the government military operation displaced an estimated two million people from the district (District Disaster Management Plan, 2015). In 2010, a massive flood caused widespread infrastructure damage as roads, irrigation canals, and wells were washed away throughout the Swat District (District Disaster Management Plan, 2015). Recent years, however, have seen rehabilitation from the flood and a decrease in violence (Hye & Khan, 2013) resulting in hotel and restaurant industries again becoming a significant source of income for the area. Finally, in addition to these current changes and stressors, future climate change projections indicate the intensification of water stress in Pakistan due to the increased variability in the monsoon season, receding Himalayan glaciers, and increased extreme weather events (GOP, 2010).

2.3.2 Data collection

To explore our questions about adaptation and value tradeoffs, we conducted face-to-face semi-structured interviews with 25 formal and informal community leaders and water users in three districts (Swat, Nowshera, and Charsadda) along the Swat and Kabul Rivers in June of 2018. Interviews covered topics about household or community demographics, water uses for irrigation, fishing, and domestic purposes, as well as water management institutions and decision-making processes (see Appendix A). The research protocol was approved by Purdue University's IRB and by Pakistani researchers from UP and permission to collect data was given by both formal and informal leaders in the research area. Interviews preparation took place over a nine-month period and the interviews were conducted during a two-week fieldwork period within a three-year project during which the interdisciplinary team from UP visited frequently to collect water and fish samples. This served to both build rapport and identify gatekeepers in the research area (Bernard, 2017; Denzin & Lincoln, 2011). Purposive sampling was used to select interviewees based on particular features (e.g., livelihood strategies, socio-demographic characteristics) that meet the following inclusion criteria: 1) formal or informal community leaders; or 2) individuals whose main livelihood strategies comes from the fishing industry, irrigated agriculture, and/or the tourism industry (see Table 2.2 for an overview of respondents). This enables rich descriptions of specific processes, relationships, and events (Corbin & Strauss, 2008; Neuman, 2010; Ritchie et al., 2013) and allowed us to maximize representation from multiple livelihood strategies and locations. Due to the interdisciplinary coordination of the project it was also necessary to select households close to the water sampling collection sites. Interviews were conducted in Pashto (interviewees were given the choice of Pashto or Urdu, but all chose Pashto) with translations by researchers from UP. The length of the interviews ranged from 11 to 55 minutes with most interviews lasting about 35 minutes. Data saturation for main research questions was reached after 17-20 interviews with additional interviews conducted after saturation in order to test for the emergence of new information and ensure saturation (Ritchie et al., 2013).

Due to the cultural context in which households are largely headed by men, 23 of the 25 interviewees were male. Four were either informal or formal leaders in their communities. Most of our respondents engaged in multiple livelihood strategies. Fourteen reported farming, ten reported capture or culture fishing, and four worked in tourism. Interviews were audio-recorded, translated verbatim from Pashto to English, and transcribed by a team of researchers from both

Purdue University and the University of Peshawar. In order to supplement interview data and add to our understanding of the research area, we examine secondary data from the Pakistan Bureau of Statistics, World Bank, Private Power and Infrastructure Board of Pakistan and the Planning and Development Department of Khyber Pakhtunkhwa.

2.3.3 Data analysis

This data was analyzed in NVivo 12 using open coding to identify emergent themes while allowing literature to inform our codes (Saldaña, 2010). Following open coding protocol (Strauss & Corbin, 1990) codebooks were developed using both an inductive and deductive approach. The codebook and coded interviews were repeatedly reviewed and discussed by other members of the team for intercoder agreement (Campbell et al., 2013). In this process a team of coders establishes the coding scheme after which a singular coder codes the remaining transcripts (Campbell et al., 2013; Hruschka et al., 2004). Further, a sample of the coded interviews were reviewed by a University of Peshawar team member to ensure appropriate interpretation of the translations. Finally, after interview data analysis we reviewed national and regional environmental data in order to examine how interviewees' observations and adaptations compare to these data sources.

2.4 Results

The following results draw on interview data as well as regional and national data to understand value tradeoffs in adaptation decision-making. We first illustrate the social-ecological context described by interviewees and regional and national data followed by self-reported adaptations from our interviewees. We then present household value tradeoffs and the ways in which they are embedded in multi-scalar processes.

2.4.1 Social-ecological context

We asked our interviewees to describe any changes they have observed and experienced in their lives and communities over the past ten year in order to assess the contexts in which interviewees were making decisions. This period was chosen to include the 2010 flood and allow interviewees to use that memorable event as a reference point for their responses. Overall, our

interviews revealed that changes observed and experienced in the last ten years include shifts in climate, water quality, and fish populations.

First, our interviewees indicated changes in the climatic conditions in the area, especially in reference to the changes in precipitation, stating that *“Rainfall does not occur much anymore. Heavy snowfall and rainfalls used to occur here, but they have significantly decreased. For the last 3-4 years I haven’t seen a snowfall here”* (Interview K.6). Interestingly, regional climatic data shows an increase in precipitation (Chaudhry, 2017), but there have also been fewer days of high-intensity rainfall (UNDP, 2017), which could contribute to interviewees’ perception of decreased precipitation. Interviewees also cited increasing temperature, stating that *“When I was a child we never turned on the fan here. But now in June and July there is very hot weather here and you always need the fan”* (Interview S.3). Again, regional climatic data shows a slight decrease in summer temperatures in KP, but both the number of heat waves and winter temperatures have increased (Chaudhry, 2017). As water demand increases with more heat waves and drier soil, water availability continues to decrease (Hussain & Mumtaz, 2014) and necessitates adaptations to the changing water supply.

Second, many respondents reported changes in water quality and attributed such changes to a variety of factors. Some cited nearby industry as the major contributor to water pollution:

“The Kabul River is polluted mainly because of the sugar mill. The untreated waste goes directly into the river and causes huge problems. This may be the major reason for the decline in the fish population and the decrease in water quality.” (Interview K.24)

In contrast to those dependent on the Kabul River, interviewees on the Swat River often attributed the decrease in water quality to the rise in the tourism industry, stating that *“all the hotels upstream have channeled the wastewater from their drains into the streams so all that pollution enters it”* (Interview S.6). In addition to stress from the tourists, population growth and the associated increase in waste were also repeatedly cited as stressors on the water supply system and quality. Indeed, KP has seen an average annual population increase of 2.9% in the past 15 years (Provisional Summary Results of 6th Population and Housing Census, 2017). Perception of this increase was reflected by an interviewee in Swat who stated that,

“As far as the availability of water is concerned, it has decreased because the population has increased. The pipelines are not sufficient for the water supply and the drinking water has become contaminated. [Before the flood] we got water from a spring and that water

was clean, but now the stream water is coming to our homes, and all kinds of pollutants come with it. It is not good quality.” (Interview S.9)

This highlights the interviewee’s perception of how population growth compounded with the shock of the 2010 flood to further stress the water supply.

Finally, the decreasing fish populations was one of the most frequently cited changes. Indeed, in 2011 the IUCN reported that the Golden Mahseer (*Tor putitora*), one of the freshwater species in Pakistan, had declined by more than 50 percent and has thus been labeled as critically endangered due to overfishing (Young et al., 2019). Interviewees often compared the size of their recent catches with years past, as one interviewee described,

“When I was 12 years old, I used to catch fish. I would use a net and 7-8 kg of fish were easily caught... And nowadays when you start from Sardaryab and end at Nowshera [more than 15 km] you cannot even catch 3 kg of fish.” (Interview K.15)

Some interviewees attributed the decreasing fish numbers to water quality issues:

“Because of the pollution, fish can’t be caught in the river. Earlier people would go to the river to catch fish, but now the fish are gone. People don’t go fishing now, because [the fish] are not there, and fishing is just a waste of time.” (Interview S.5)

Another interviewee stated that the decrease in the fish population *“is mainly because of [fishing with the electric] current. Using a current kills all types of fish including young fish which leads to the decreasing fish”* (Interview K.16). News reports similarly indicate that the use of electric currents, dynamite, and tobacco powder has been used in the research area to increase fish catch (AFP, 2016). While many interviewees stated that these practices have decreased in use, they all reported them as one of the most important reasons for fish population and size decreases.

The aforementioned observed changes in water quality serve to illustrate the many shifts occurring in the research area and that while interviewees are concerned about the changing climate, they perceive multiple compounding stressors on their water supply. Within this complex context, interviewees employed multiple strategies in order to adapt to climatic change, extreme weather events, increasing industry, decreasing fish populations, and population growth.

2.5 Adaptation strategies

Our interviewees discussed a variety of adaptation strategies that they have employed to address ongoing social-ecological changes. Multiple typologies exist for categorizing and

describing how individuals, groups, and systems adjust to the broad effects of a changing climate (Füssel, 2007; Smit et al, 2000; Park et al., 2012) and our coding process allowed all adaptation types to emerge in our analysis. However, at the end of this combined inductive and deductive process, all adaptation strategies discussed by our interviewees fit into typologies by Agrawal (2009) and Burnham and Ma (2016). Subsequently, we coded and analyzed interviewees' adaptation strategies using Agrawal's (2009) five types of adaptation: 1) mobility, 2) storage, 3) diversification, 4) communal pooling, and 5) market exchange, and Burnham and Ma's (2016) addition of environmental management and labor migration. Specifically, we discuss environmental management, labor migration, diversification, communal pooling, and market exchange. Storage and mobility, while a part of Agrawal's (2009) typology, were not discussed by our interviewees and are thus not included in this section.

Environmental management was especially seen in the adoption of new technologies to improve water access. For instance, many interviewees installed tube wells or increased the depth of existing wells. One interviewee stated that *"there was a decrease in our well water because there was less rain. The well dried so we dug it out for more water"* (Interview S.11). For domestic water supply, many interviewees also discussed installing wells to shift from a public source to private sources as the quality and quantity of government-provided water was often perceived to be poor. Others shifted from surface to groundwater supply in order to increase the reliability of their irrigation water.

We also draw on Burnham and Ma's (2016) distinction between labor migration and mobility to define labor migration as a portion of the household moving for labor and mobility as the movement of an entire household. While the latter was not reported, labor migration was employed largely through the movement of male household members to urban centers for temporary work, as described by an interviewee below:

"I was in Saudi Arabia for a small job but currently I am unemployed. I have no land to grow crops and my sons drive to earn money...sometimes our car has problems. We live a simple life and hard times come but we manage with very limited resources." (Interview K.22)

This quote reveals the often temporary nature of labor migration that takes place in the research area.

Diversification, and specifically livelihood diversification was one of the most commonly discussed adaptation strategies among interviewees. Fishing in particular has been a predominant livelihood strategy for many households in the research area; however, many interviewees have either completely exited fishing or decreased the amount of time they spend fishing while beginning new livelihood strategies. For instance, one interviewee said that *“when I started fishing 30 years ago we would catch 15 to 20 kg of fish every day. Now we catch a maximum of 5 kg so I started farming with my friend”* (Interview K.16). Similarly, another interviewee described how his family pooled resources to manage multiple hotels and said: *“We are 6 brothers living and working together...We manage the finances, serve, cook, and everything for [the three hotels]”* (Interview S.1). These interviewees illustrate the combination of diversification and communal pooling, that is, the pooling of resources to allow for or support livelihood diversification.

Market exchange in this context was largely in reference to adaptation to the changing crop markets as evident in the following quote:

“The market situation is bad here now because vegetables from other countries like Afghanistan and India come earlier and have a good market price, 50 or 60 Rupees per kilogram (kg) of tomatoes. When our vegetable crops come the price is very low, 20 to 30 Rupees per kg. So now we transport our tomato crops to Karachi where the rate is 400 Rupees per package. But it costs 200 Rupees for transportation.” (Interview S.15)

Others utilized crop diversification to respond to market changes, as described by an interviewee who stated that *“The most important crops we used to grow were barley, rice and wheat...but now we grow onion, cauliflower, tomatoes and strawberries because the profit is higher with these crops”* (Interview S.5). This interviewee adapted to changing markets not by taking his crop to another location but rather by changing what he grew, illustrating the combining of diversification and market exchange to adapt.

In summary, interviewees discussed responding to social-ecological change in a variety of ways and combining adaptation strategies to support their household's livelihood. In the next section we use these examples of adaptation to demonstrate the ways values and associated values tradeoffs are key factors in adaptation decision-making.

2.5.1 Values in environmental management and livelihood diversification

To closely examine values in adaptation to social-ecological change, we focus our analysis on environmental management and livelihood diversification because they were the most frequently and intensely discussed adaptation strategies in our study. In order to understand how values are traded off in order adapt, we focus on the ways respondents' report giving up (or trading off) values in adaptation to social-ecological change.

The most explicit value in environmental management adaptations was financial, that is, interviewees frequently discussed how they traded off money to support environmental management in response to water stress and to improve water security. For instance, one interviewee described the costs associated with installing and maintaining a tube well and stated: *"There were a lot of expenses [to dig the tube well] and now we spend thousands of rupees for oil for the generator. But now there is no issue with the water"* (Interview K. 16). This clearly illustrates the tradeoff associated with improving the security of water supply; in this case it is not a one-time tradeoff of finance for water security, rather an ongoing decision to make financial sacrifices in order to maintain water security.

Some households may be unable to make this tradeoff alone so tube wells are often shared between households, as one interviewee described: *"[My brother and I] dug out a tube well for our fields. The total expense for the tube well was 50 to 60 thousand rupees and now we can both irrigate our fields from this well"* (Interview K.15). Still, not all interviewees reported making such a financial trade off in order to improve their water supply. One interviewee described that while it was difficult to access water without a pump, the household could not afford an improvement in their water supply, stating that, *"We get [water] in a bucket from a dug well in our house, it is 11 feet deep. People say that a water pump is not costly but we can't afford to buy it."* (Interview S.7). This quote highlights the differences in tradeoffs across households, that is, while some households were able to tradeoff finances for water security others could not afford to make such a tradeoff.

As mentioned in the previous section, in addition to environmental management, many respondents discussed diversifying their livelihood strategies as a way to adapt to various social-ecological changes. This was especially common in response to the decrease in fish numbers. Many interviewees fished in the nearby rivers for decades and came from families that fished for generations, but they were largely willing to sacrifice this familiar and traditional livelihood strategy for a newer, less familiar but likely more profitable livelihood strategy. While some

interviewees transitioned to other river-based livelihood strategies such as farming, the transition to commerce was more frequently reported even though they had to navigate market dynamics and risks. The interviewee below described his exit from fishing:

“We have fished for 30 or 35 years...but now we have opened a shop. We are new to managing shops so it is difficult because we do not understand the market...We used to catch 10-20 kg [of fish] but not now. Now we catch 1.5 kg in the winter season as there is low flow in river and 3-4 kg in summer as it is the reproduction time for fish. But I used to catch 10 kg six years back.” (Interview K.14)

This reveals the way in which respondents traded off the tradition and familiarity of fishing in order to diversify away from river-based livelihood strategies. Further, our interviews revealed the temporal nature of tradeoffs; in order to increase long-term financial security through livelihood diversification many interviewees were willing to trade off short-term financial security. For instance, one interviewee described the financial investment required to diversify their livelihood, stating that, *“We are starting a fish farm and I will build a small hotel here... I sold two cows to pay for the fish pond because the pond cost about 100,000 Rs”* (Interview S.16). This temporal nature of tradeoffs was also evident below from an interviewee who discussed investing in a new fisheries business:

“We were experimenting to see if salmon would survive in Pakistan or not but we did suffer a loss in it. We lost 10 lac [million] rupees. We imported 20,000 salmon eggs but only 4,000 survived and 16,000 were lost. They did not hatch.” (Interview S.10)

However, not all interviewees were able to experiment with new livelihood strategies or to trade off short-term financial security in order to diversify their livelihoods for long-term financial security. For instance, one interviewee stated that, *“[Our income] is not enough but we manage. We think about new [livelihood] opportunities but we do not have the finances. We are interested but we don’t have the support”* (Interview S.11). As such, livelihood diversification as an adaptation strategy is available to some but not others due in part to the need to tradeoff financial security in order to adapt in that way.

2.5.2 Household decisions embedded in multi-scalar processes

Our interviewees discussed the ways in which their adaptation decisions and the associated value tradeoffs are embedded in processes within and beyond the community scale. Thus, we

argue that even as individuals and households trade off various values, these decisions can be limited by and conflict with processes outside the individual or household scale. We again look to environmental management and livelihood diversification as examples to discuss the multi-scalar processes within which respondents made adaptation decisions and the associated value tradeoffs.

First, we look at how environmental management-focused adaptation decisions and the associated value tradeoffs are embedded in multi-scalar processes beyond the control of any particular household. One of the most explicit multi-scalar processes that emerged from our research was about the construction of a hydropower facility and subsequent river diversion that was under construction in the research area at the time of data collection. Population growth and industrialization has resulted in rising energy needs in Pakistan; as of 2013 the country had an electricity shortage of 5,000 megawatts (United Nations, 2013). To mitigate this shortage, both micro- and large-scale hydropower projects have been developed to increase storage capacity and access to electricity in the country (Umar & Hussain, 2015; WAPDA, 2018). However, the flow modification can have concerning impacts on the river ecosystem and water distribution for irrigation and domestic uses.

The ways in which the hydropower project impacts households were frequently discussed by our interviewees. For example, one interviewee stated that, “*our drinking water and irrigation will be destroyed by shifting the stream [for the hydropower project]*” (Interview S.3). A council member from one of the three districts where we conducted interviews further described the anticipated negative consequences of the hydropower project, stating that,

“In the winter, when the water will be shifted to the hydropower constructed upstream, the situation here may be worse. Tourists come here for the river but if it is shifted then there is no reason for the tourists to come here. This hydropower will have negative impacts on the local community...we have a hydro-grain grinder on this stream. In the winter the water level decreases and if the remaining [water] is shifted to hydropower for electricity then we are not sure how the grain grinder will work.” (Interview S.2)

This quote demonstrates the myriad of stressors caused by the decision to introduce hydropower in the research area. Specifically, this regional-level decision has clear implications at the household scale through affecting the water supply and tourism industry.

Despite such implications, a provincial leader told us that “*The EPA, the Forestry Department, and the Fisheries Department held a meeting about the hydropower. No problems*

were found. It is ok. It's also a very important need for the community and for the development of the country" (Interview S.4). Earlier, we reported how households traded off finances or tradition to adapt to the changing water supply. Yet, regional-scale decisions such as the introduction of hydropower projects can threaten the potential effectiveness of the very adaptation strategies employed by individuals and households.

In analyzing the multi-scalar processes that affect households' environmental management-focused adaptation decisions, it is clear that impacts occur not only from community to household, but among households and from households to community. That is, the consequence of household decisions, especially those that accumulate over time and space, can also be felt across scales and affect the water supply of our respondents. Our interviews revealed the case of groundwater depletion caused in part by households' decisions to increase the use of groundwater for irrigation. Indeed, there has been much discussion of lowering water tables and increasing salinity due to deepening wells as farmers turn from the often variable surface water supply to the more reliable groundwater (Qureshi et al., 2010). This was evident in the following quote from an interviewee: *"Our well water started disappearing. The water table is lowering...sometimes the well dries and then you have to wait to get water"* (Interview K.24). In fact, many interviewees were aware of the increasing use of groundwater through well construction. As one interviewee explained:

"There has been a decrease in the water supply here... the wells used to be about 60 feet deep, but now the water is not there, so people have made bore holes dug with machinery. So now the water is at 150, or 130 or 120 feet deep. Everybody is trying to make his well deep." (Interview S.6)

In this case, many households dug deeper wells to obtain groundwater for irrigation, which cumulatively decreased groundwater supply over time not only in their community but also in other communities that share the same groundwater resource. Thus, we see that some households' decisions to extract groundwater conflicts with other households' ability to adapt to increasing water scarcity. Households are simultaneously trading off values in order to increase water security while these same adaptations are threatening water security over time and space.

Multi-scalar processes are also evident in livelihood diversification-focused adaptation decisions. As reported earlier, many interviewees discussed trading off short-term financial security for long-term financial security through investing in new livelihoods strategies. However,

opportunities to make such tradeoffs do not always exist in a community. For instance, a fisher from one of the three districts where we conducted our interviews stated that, *“factories and industries are needed, so that people can be employed. We have no employment opportunities here in the winter [non-tourist] season”* (Interview S.8). A farmer interviewee echoed this concern stating that, *“for us the challenge is that besides the crops, we do not have many other employment opportunities. So we work here [in the field], and this is our only source of income. But most of the times the crops get diseases”* (Interview S.5). Another interviewee spoke about how past conflicts in the region impacted their capacity to diversify, stating that *“I had a side business selling pesticides but it failed because of crises like the Taliban and terrorism. Now I do not have any side businesses”* (Interview S.3). These results demonstrate the extent to which households’ options to adapt to social-ecological change through livelihood diversification are largely shaped by processes outside of the household including development and conflict.

2.6 Discussion

Our research on value tradeoffs highlights the complex and multi-scalar nature of adaptation decision-making. The following sections will first discuss the ways in which our findings contribute to the adaptation literature broadly, followed by a discussion of the complex and fluid nature of values within adaptation decision-making. We will also discuss how tradeoff decisions can be constrained by multi-scalar processes and thus limit households’ capacity to adapt.

2.6.1 Adaptation to social-ecological change

Our research provides important empirical evidence from a little-studied region that supports previous work on adaptation decision-making and highlights the complexity of adaptation drivers. Specifically, the adaptation strategies discussed by interviewees highlight that resource users are not only adapting to climate change (i.e., decreasing precipitation rates), but they are also simultaneously adapting to other stressors and changes (i.e., decreased fish populations, changing markets), as shown in empirical research from other parts of the world (Eakin, 2000; Hageback et al., 2005).

Our research also reveals the context-specific nature of adaptation to social-ecological change. For instance, communal pooling has been one of the least commonly reported strategies

in the broader adaptation literature (Burnham & Ma, 2016); however, its common use in our research context suggests that particular adaptation strategies such as communal pooling might be more relevant if it is part of traditions and cultural norms within communities. Living and working with extended family has long been a part of these communities in northwestern Pakistan, particularly in the joint family household structures commonly seen in this region (Ahmed, 2004; Akbar, 1980; Lindholm, 1982). Our research shows how extended and joint family structures make certain value tradeoffs possible, hence enabling certain adaptation strategies to be adopted. This is partly because extended and joint families were able to pool risks associated with diversifying their livelihoods. As such, communal pooling allowed for or supported households' capacities to employ various adaptation strategies simultaneously. These findings confirm that communal pooling "tends to occur in communities where functional social networks have been previously established" (Burnham & Ma 2016, p. 305) and results showing that social capital through familial networks increase household adaptive capacity (Currenti et al., 2019). They also echo what Agrawal (2009) argued in terms of how households strategically utilize multiple adaptation strategies to minimize risk. However, it is important to keep in mind the different ways in which climate change may exacerbate existing inequalities; those with the social capital (e.g., extended and joint families) are more likely to be able to utilize communal pooling and be better equipped to employ multiple adaptation strategies than those without such social capital.

Our research identified multiple adaptation strategies that can be adaptive in the short term but maladaptive in the long term, or adaptive for a household but maladaptive for the community or landscape (Adam et al., 2018). As Eriksen et al. (2015) state, "the relative security of some social groups is achieved though the production of insecurity among others" (p. 524). As Magnan et al. (2016) point out, maladaptation to social-ecological change is a part of an adaptation pathway in which the line between maladaptation and adaptation can be subtle and shift over time, and how this line is drawn is often reflective of values that influence stakeholders' definition of a successful adaptation (O'Brien, 2009). For example, a hydropower project may be adaptive for those who are more concerned about energy security, as well as those who value political power (demonstrated by being able to secure a large development project in a region) but maladaptive for those who value the tradition of irrigated agriculture or security in water supply for fishing. Moreover, groundwater extraction might be adaptive in the short-term, but maladaptive in the long term as groundwater depletes and becomes more expensive to access. These examples from our research

illustrate the fluidity of adaptation and maladaptation, while demonstrating how adaptation decisions and outcomes are embedded in multi-scalar processes that are often beyond the control of individual households.

2.6.2 Value tradeoffs in adaptation decision-making

Our research also adds to the understanding of adaptation in the context of social-ecological change by highlighting the ways in which values are traded off in such decision-making processes. This confirms the growing numbers of studies that show the influence of values on adaptation to social-ecological change (der Linden van, 2014; Graham et al., 2013; Grothmann & Patt, 2005; McNeeley & Lazrus, 2014; Wolf et al., 2013). More specifically, our work confirms that beyond knowing what people value, it is also important to examine “how much value is endowed to a certain thing or objective in relation to other aspects that a person may value” (Tschakert et al., 2017, p. 11). This will allow us to better understand how people decide to adapt or not, and why people decide to adapt one way over the other.

Assessing these value tradeoffs in adaptation decision-making highlights the complex and diverse nature of values. There are many typologies (Kopelman, Rovenpor, & Guan, 2003; Rokeach, 1973; Schwartz, 1992) that have sought to categorize individuals' values. Schwartz's (1992) seminal work states that values 1) are beliefs linked to affect; 2) relate to desirable goals; 3) transcend specific situations, 4) serve as standards or criteria to evaluate behavior and events, 5) are ordered by relative importance, and 6) guide actions through the relative importance of multiple values. We found parts of Schwartz's (1992) basic value framework reflected in our research. For example, tradition, defined as “respect, commitment, and acceptance of the customs and ideas that one's culture or religion provides” (Schwartz, 2012, p.6) is reflected in individuals' discussion of exiting fishing as an adaptation strategy. Here, fishing would represent a form of tradition because many interviewees discussed how they had to stop or reduce fishing after decades or sometimes generations of engaging in this livelihood. Fishing has often been seen as one of the most vulnerable livelihood strategies and thus fishers' livelihood diversification has been frequently documented in multiple other contexts (Béné, 2009; Hanazaki et al., 2013). It been illustrated that fishers with less place attachment and traditional ties to fishing are more likely to diversify their livelihoods away from fishing (Martins et al., 2019) and alternatively, it has been shown that tradition can prevent fishers' diversification (Martin et al., 2013). Our research echoes

this vulnerability of fishing and further demonstrates the subsequent tradeoffs of tradition made by fishers in order to diversify livelihood strategies.

Relatedly, some interviewees' willingness to engage in new and unfamiliar livelihood strategies may reflect their willingness to tradeoff security, defined as "safety, harmony, and stability of society, of relationships, and of self" (Schwartz, 2012, p.5). Similarly, Warner (2016) demonstrates that the value for security influenced adaptations among farmers in Central America, and that in some cases, farmers made adaptation decisions that required a tradeoff of this value. Our data confirm this finding as our respondents also traded off this value in order to adapt to social-ecological change. This demonstrates that while this value may indeed be important, the stress of social-ecological change may drive the need to trade off security in order to adapt. This seems especially salient when the adaptation required a short-term tradeoff of with the hope of a long-term increase in security (i.e., investing in a tube well, opening a shop, etc.).

Another example relates to some community leaders' motivation to construct a hydropower project, which may be a reflection of their value for power, defined as "social status and prestige, control or dominance over people and resources" (Schwartz, 2012, p.5). Indeed, Funder et al. (2018) show how local leaders negotiate authority and control over natural resources through climate change adaptation policies and practices. Nightingale (2017) further shows that actors from the national to local level use climate change adaptation programs to gain authority and power. Our results confirm the role of this value in climate change adaptation and while our data does not show this stage, we suggest that decision-makers could also face a tradeoff of this value when if conflicts over adaptation cause them to relinquish this power.

As such, Schwartz's (1992) basic value framework can perhaps contribute to identifying values and value tradeoffs in adaptation decision-making. At the same time, instead of describing value categories as static (Schwartz 1992), we suggest that value categories lie along a spectrum and are influenced by social-ecological stressors and risks, as well as various political or economic constraints. For example, an individual's tradeoff of a fishing tradition may not mean they do not value tradition; rather, it may suggest that the value represented by adopting an alternative livelihood is greater than how much they value tradition. Or, multi-scalar processes may constrain their ability to act in alignment with that value. Therefore, it is paramount to investigate not only people's absolute values but also the relative values they place on one thing over another and the multi-scalar process that may be influencing their decisions. While we demonstrate that value

tradeoffs do occur, more work is needed to understand how decision-makers' negotiate these decisions, and how values may change over time and across scales. Previous work has shown that values can shift under societal and environmental transformations (O'Brien, 2009; Schwartz & Bardi, 1997) thus additional work should be done to assess if and how values shift under the stress of rapid social-ecological change. Further, while typologies such as Schwartz (1992) can inform the identification of values, it is also important to apply them with caution as values can be largely dependent on individual and social contexts (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013). Thus, more work is needed to examine these questions in other contexts in order to better understand how values and their relative importance differ across contexts.

Finally, our research contributes to the discussion on the utility of using intrinsic or instrumental values to understand conservation and adaptation decision-making. While we strongly support previous research arguing that economic considerations do not fully capture the complexity of adaptation decision-making (Graham et al., 2013; McShane, 2017; Wolf et al., 2013; O'Brien & Wolf, 2010), our research reveals that both instrumental and intrinsic considerations interact to shape adaptation decisions. For example, valuing long-term financial security may lead households to exit fishing (a traditional livelihood) and opt for new livelihoods (e.g., opening a shop, hatching salmon eggs). In this case, tradition and security are traded off for long-term financial security. In another example from our research, short-term and long-term financial security were traded off for security in water supply. Together, our findings suggest the importance of examining how instrumental and intrinsic values interact and are traded off in adaptation decision-making processes rather than focusing on one type of values or analyzing them separately. Therefore, further work is needed to understand how both instrumental and intrinsic values interact to influence adaptation to social-ecological change and how decision-makers negotiate multiple types of values in tradeoff decisions.

2.7 Conclusion

The importance of value tradeoffs in individuals' decision-making has been long established (Barlas, 2011; Tetlock, 2000; Tschakert et al., 2017). However, little research has explicitly examined the value tradeoffs associated with adaptation decision-making. Our research focused on communities that have traditionally relied on river-based livelihoods in northwestern Pakistan, a little-studied region of the world in terms of adaptation to social-ecological change.

Specifically, we examined how individuals and households traded off certain values in their adaptation decision-making processes. We posited that in addition to identifying values that are considered in adaptation decision-making, it is also necessary to examine values as they relate to one another. Further, we provided empirical evidence showing how people's adaptation decisions and the associated value tradeoffs are embedded in the multi-scalar social, cultural, economic, and political processes. Our work highlights the importance of developing adaptation policies and programs that are more cognizant of different actors' values in order to minimize maladaptive outcomes and support more equitable adaptations.

Table 2.1 Overview of three districts in our research area

	Swat	Nowshera	Charsadda
Demographics			
Population	2,309,570	1,518,540	1,616,198
Number of HH	274,620	198,808	221,058
% employed in agriculture	50.1%	25.1%	49.1%
Water supply - percent household by domestic water source			
Piped water	47%	24%	5%
Hand pump	2%	22%	38%
Motorized pump	21%	40%	43%
Dug well	9%	8%	14%
Water supply - percent irrigated area			
Government canals	4.10%	39.15%	82.78%
Private canals	37.15%	0.12%	4.53%
Tube-wells	8.44%	4.21%	0.28%
Wells	14.10%	3.24%	1.27%
Lift pump	16.36%	0%	0.03%
Other	7%	0.68%	1.86%
Farm size - percent total farmed area (ha)			
Under 1	15.6%	15.2%	15.5%
1 to under 2.5	16.5%	15.6%	13.5%
2.5 to under 5	5.2%	4.9%	6.5%
5 to under 7.5	1.9%	2.7%	2.5%
7.5 to under 12.5	0.9%	1.6%	1.6%
12.5 to under 25	0.3%	0.5%	0.7%
25 to under 50	0.0%	0.1%	0.1%
50 to under 100	0.0%	0.0%	0.0%
100 to under 150	0.0%	0.0%	0.0%

Sources: Provisional Summary Results of 6th Population and Housing Census and Agricultural Census, Pakistan Bureau of Statistics.

Table 2.2 Overview of respondents

Interview #	River	District	Livelihood strategies	Gender
1	Swat	Swat	Tourism, agriculture	M
2	Swat	Swat	Community leader	F
3	Swat	Swat	Farmer, community leader	M
4	Swat	Swat	Leader	M
5	Swat	Swat	Farmer	M
6	Swat	Swat	Farmer	M
7	Swat	Swat	Farmer	F
8	Swat	Swat	Farmer, fisher	M
9	Swat	Swat	Fisheries	M
10	Swat	Swat	Fisheries, tourism	M
11	Swat	Swat	Farmer	M
12	Swat	Swat	Farmer, fisher	M
13	Swat	Swat	Farmer, fisher	M
14	Kabul	Nowshera	Farmer, fisher	M
15	Kabul	Nowshera	Farmer	M
16	Kabul	Nowshera	Fisher	M
17	Kabul	Nowshera	Fisher, tourism	M
18	Kabul	Nowshera	Farmer	M
19	Kabul	Nowshera	Fisher, tourism	M
20	Kabul	Nowshera	Fisher	M
21	Kabul	Nowshera	Leader	M
22	Kabul	Charsadda	Farmer	M
23	Kabul	Charsadda	Farmer	M
24	Kabul	Charssadda	Leader	M
25	Kabul	Charssadda	Fisher	M

CHAPTER 3. BEYOND HOUSEHOLD SIZE: DIVERSIFICATION, ACCESS TO CAPITAL, AND ADAPTATION TO SOCIAL-ECOLOGICAL CHANGE ACROSS HOUSEHOLD STRUCTURES IN NORTHWESTERN PAKISTAN

3.1 Abstract

Livelihood diversification is widely utilized by smallholder farmers to distribute risks across assets, improve household well-being, and adapt to social-ecological change. The interactions between household size, capital, and adaptation to social-ecological change has been widely studied; however, little is known about the differences in adaptation to social-ecological change and resources between joint and nuclear household structures. We draw on a survey of 448 household heads in three communities in northwestern Pakistan to assess adaptation to social-ecological change and household capital. We demonstrate that livelihood and adaptation strategies vary across joint and nuclear household structures and location. This is in part due to joint families' greater access to capital in comparison to nuclear families as well as the difference in available resources and broader economic factors across locations. This research illustrates that both joint and nuclear households are rarely reliant on a singular livelihood strategy, however, the presence of multiple wage earners in joint family households may contribute to greater capacity to diversify and further, diversification opportunities vary across locations. Further, high entry barriers to livelihood diversification can increase existing income inequalities across household structure. Overall, our work counters the traditional assumption that large households indicate limited capital and instead highlights the need for a nuanced understanding of how household structure, not just size, influences capital, decision-making, and adaptive capacity.

3.2 Introduction

Many rural households in the Global South engage in multiple livelihood strategies, and diversification rather than specialization has long been utilized by these rural households, particularly smallholders, to reduce the impacts of climate variability and change on their sources of food and income sources (Adger, 1999; Antwi-Agyei et al., 2014; Colten et al., 2012; Ellis, 1998; Howden et al., 2007). As Ellis (2015) states "rural livelihood diversification is defined as the process by which rural households construct an increasingly diverse portfolio of activities and

assets in order to survive and to improve their standard of living” (p. 15). Indeed, livelihood diversification has been widely adopted as an adaptation to social-ecological change that allows agricultural households to distribute risks and cope with uncertainty (Agrawal, Kononen, & Perrin, 2009; Burnham & Ma, 2016; Eakin, 2005; Paavola, 2008).

Individuals and households may choose to diversify their assets in response to push or pull factors (Ellis, 2008; Loison, 2015). That is, households may be pushed to adapt due to negative stressors often related to seasonality and climate variability (Loison, 2015). Households may also be pulled into diversification by positive attractions such as market access, improved infrastructure, or increased demand for off-farm employment opportunities (Loison, 2015). Diversification is also often categorized by sector (on-farm/agricultural or nonfarm/non-agricultural), function (wage employment or self-employment), or location (on-farm or off-farm), and it has been shown to a certain extent that returns on diversification vary largely by sector (Loison, 2015).

While diversification has the potential to improve income, it often requires existing access to capital and can therefore exacerbate existing inequalities (Barrett et al., 2001; Loison, 2015). Specifically, research has shown higher education level of household head, higher age of household head, closer proximity to markets, and greater access to credit is positively associated with households’ capacity to diversify their livelihoods (Khatun & Roy, 2012). Therefore, capital in this context is conceptualized as human, natural, physical, social, political, and financial capital to demonstrate the diverse assets that households are utilizing to support their well-being and resilience (Bebbington, 1999; Scoones, 1998; Rakodi, 1999). These sources of capital have also been associated with households’ adaptive capacity (Yohe & Tole, 2002; Panda et al., 2013), or their ability “to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences” (IPCC, 2001) in that access to capital can improve household’s ability to adapt to social-ecological change.

It has also been argued that large household size enables diversification. For example, Reardon (1997) illustrates that the labor surplus in large families and families with conjugal units supports off-farm work. Ferreira and Lanjouw (2001) demonstrate a positive relationship between household size and non-farm employment activities; however, they posit that this is because of larger households’ need for more income relative to smaller households. Similarly, Woldenhanna and Oskam (2001) argue that the positive correlation between household size and diversification is a result of both the surplus labor and need for resources. The relationship between household

size, capital, and adaptation is also complex. Larger household size has been traditionally associated with poverty and vulnerability due to the distribution of resources across a large number of dependents often found in larger households (Dumenu & Obeng, 2016). In contrast, increasing household size has also been associated with increasing likelihood to adapt to climate change and adopt agricultural technologies (Croppenstedt et al., 2003; Deressa et al., 2009).

Broadly, household structure is used in reference “to the generational contours and the extent of nucleation in the household” (Madhavan, 2012, p.1895). Multi-generational household structures have long been known to support rural livelihoods in part due to the additional labor available in these households (Rosenzweig & Wolpin, 1985). Larger households may be also more likely to employ adaptations to social-ecological change (Croppenstedt et al., 2003; Deressa et al. 2009). Specifically, the joint family structure, or “multi-generational families with two or more married children” (Ruggles, 2010) has been found to be positively associated with adoption of adaptation practices to social-ecological change in Pakistan (Ali & Erenstein, 2017) and Nepal (Regmi, Dhakal, & Ghimire, 2017) due to surplus labor in these households. Senapati and Gupta (2017) show that the sharing of knowledge and information in joint families decreases their vulnerability to climate change. In addition to surplus labor and knowledge/information sharing, joint family structures often create households with multiple wage-earners or decision-makers. In the broader literature, many scholars have examined intra-household decision-making processes in relation to natural resource management (Doss & Meinzen-Dick, 2015), with particular attention on gender (Quisumbing & Maluccio, 2000). However, “the literature often implicitly assumes that within multimember households, the only bargaining is between the husband and wife; other members are assumed to be passive or unimportant to the bargaining process” (Doss, 2013, p. 57).

In fact, within the broader literature little has been documented about livelihood and adaptation decision-making in multi-generational or joint families with multiple decision-makers. As such, there have been calls to assess the role of not only household size but household structure in livelihood decision-making in order to improve our understanding of household wellbeing and distribution of resources in the context of adaptation to climatic and other social-ecological changes (White, 2002). By analyzing household survey data from northwestern Pakistan, this paper seeks to contribute to understanding of how household size and structure shape livelihood strategies, adaptation to social-ecological change, and the associated decision-making processes. Specifically, this paper focuses on multi-generational, joint-family households, which are a

traditional and prevalent household structure in northwestern Pakistan. Within this context we study the livelihood and adaptation strategies of multi-generational households in the midst of social-ecological change.

Broadly speaking, joint families are a specific type of multi-generational households that include two or more married (or otherwise partnered) adults, two or more of the couple's adult children, the children's partner(s), and their children (Ruggles, 2010). This structure is distinct from multi-generational stem families that include just one of the couple's children (United Nations, 2008). Multi-generational, joint-family households are particularly relevant for studying the role of household size and structure in livelihood and adaptation decision-making because they allow us to examine decision-making when multiple actors such as siblings, partners, and parents are involved in negotiations, which are processes that often occur in different types of multi-generational households more broadly. Additionally, while nuclear families remain the predominant household structure in most places around the world, multi-generational household structures continue to be prevalent throughout the world as well (Ruggles & Heggeness, 2008; United Nations, 2017) and have been seen to be on the rise in places where they have not been the norm (Bengtson, 2001; Easthope, Liu, Burnley, & Judd, 2017; Keene & Batson, 2010). It is also important to point out that beyond the context of multi-generational households, family members are often an important source of influence in natural resource and land use decisions in both the Global South and Global North. Such decisions are in fact commonly made collaboratively among multiple family members even without a joint family structure (Eyvindson et al., 2011; Snyder & Kilgore, 2018; Twyman, Useche, & Deere, 2015). Therefore, insights from northwestern Pakistan shed light on a broader understanding of the negotiations in household livelihood and adaptation decision-making, particularly the role of household size and structure in such processes.

3.3 Research design and methods

3.3.1 Research area and site description

This research was conducted in three communities (Madyan, Jehangira, Landakay) along the Swat and Kabul Rivers in the Khyber Pakhtunkhwa province in northwestern Pakistan (see Figure 1). Pashto

was the most commonly spoken language in our study area, but Urdu is also spoken. Respondents were given the option to conduct the survey in Pashto or Urdu but all chose Pashto. Household structures in the study area and throughout Pakistan include both joint and nuclear families, with joint families being especially common in rural areas and in predominately Pashtun communities (Amin, Ali, Ahmad, & Zafar, 2010; Lindholm, 1982).

The three communities were chosen to represent the various livelihood strategies (detailed in Table 3.3.) along the Swat and Kabul Rivers. The Swat and Kabul Rivers supply water for irrigated agriculture, habitat for wild catch and farm-raised fisheries, aesthetics that draw tourists, flow for hydropower, and domestic needs. But the area is also undergoing many stresses. However, climate change is projected to increase the frequency of extreme events including flood and droughts in this region of Pakistan due to changes in precipitation and glacier melting behavior (Hussain & Mumtaz, 2014). In addition to climate change, urbanization, industrialization, and agricultural intensification has also increased the presence of waste and pollutants in the water system (Ullah et al., 2013). So too, recent armed conflicts displaced an estimated two million people around our study area in 2008. Finally, in 2010, a massive flood resulted in widespread destruction of homes, businesses, roads and water systems, further disrupting livelihoods in the KP province (District Disaster Management Plan, 2015). Since 2010, much infrastructure development and rehabilitation has taken place (Hye & Khan, 2013), and these projects continue to shape livelihood options in the study area.

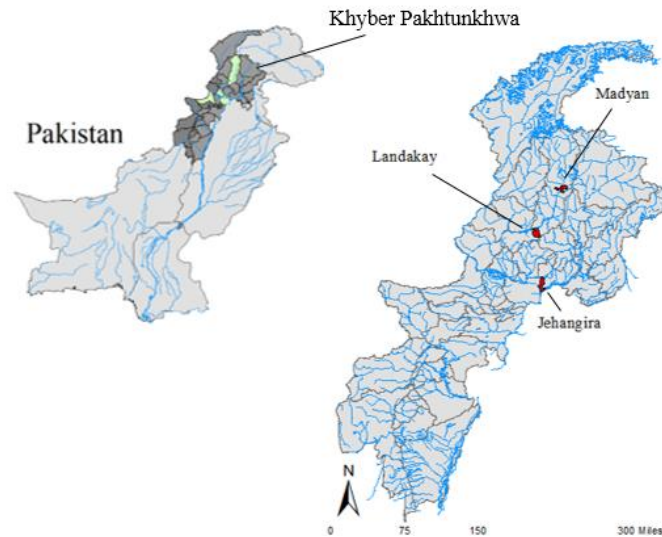


Figure 3.1 Map of survey study areas

3.3.2 Data collection and analysis

We conducted our study in two stages: June 2018 and March-July 2019. The first stage consisted of 25 semi-structured, face-to-face interviews with community members and leaders in the three KP districts. The second stage was a survey of 448 households in three communities within these districts. The survey was designed based on findings from our qualitative interviews and theoretical and empirical insights from a review of literature that was focused on livelihood decision-making, adaptation decision-making, and household structures. Specifically, the survey questions were designed to collect data on household demographics, livelihood strategies, water management practices, perceived social-ecological changes, and adaptation strategies. The survey was piloted in similar communities outside the study area and subsequently revised to increase clarity and relevance. See Appendix B for a copy of the complete survey instrument.

The final survey questionnaire was administered in person, to the self-identified household heads, by a team of trained surveyors using a handheld tablet furnished with Survey Solutions, an application supported by the World Bank. This in-person survey administration is most appropriate in the context of rural communities in the Global South and is conducive to longer or more complex survey design (Neuman, 2010). We used a random walking sampling strategy (Himelein, Eckman, Murray, & Bauer, 2016) to recruit survey participants. This sampling strategy is commonly used in rural areas in the Global South where household lists and postal records are often incomplete (Himelein et al., 2016) and/or availability of internet and phone service varies (Hughes & Lin, 2018). Selection bias has been shown as a potential weakness of this approach (Bauer, 2016) but in our study areas this is the only possible way to address the lack of records and inaccessibility of a phone or internet survey. We clearly demarcated routes to avoid “main route bias” and compared our data to secondary data (Bauer, 2016) to address the potential limitations of this sampling strategy. This research was conducted in collaboration with Pakistani researchers at University of Peshawar. It was approved by Purdue University’s Institutional Review Board and local community leaders also gave permission for data collection in each community.

Our analyses focused on the household survey data and were descriptive in nature. Descriptive analyses were well suited for this study because scant empirical research exists on livelihood and adaptation decision-making in joint families, particularly in northwestern Pakistan. Therefore, such analyses are important for generating new knowledge about livelihood and adaptation strategies that have not been previously studied (Knupfer & McLellan, 1996) and for

providing the necessary foundation for further inquiry and hypothesis generation (Grimes & Schulz, 2002). Specifically, univariate statistics were used to determine if any outliers existed and to provide an overview of the socio-demographic characteristics of the respondents and their households, as well as an overview of their livelihood and adaptation strategies in the context of observed social-ecological changes. Bivariate relationships were also assessed using a variety of tests: (1) Pearson Chi-square test for examining the relationship between categorical variables; (2) Fisher's exact test when one or more assumptions for the Pearson Chi -square test was violated; and (3) Kruskal-Wallis H test as a nonparametric alternative to a one-way ANOVA. We used a Bonferroni correction to control the family-wise error rate due to multiple comparisons conducted to identify differences in livelihood and adaptation strategies across family types and locations (Gelman, Hill, & Yajima, 2012). All statistical analyses were conducted in STATA 16.

3.4 Results

3.4.1 An overview of survey respondents and their households

An overview of the socio-demographic characteristics of survey respondents and their households is presented in Table 3.1. The average age of our respondents (self-identified household heads) was 39.4 years, and no statistically significant difference was observed across our three study communities. In terms of the educational attainment of household heads, respondents in Madyan reported 10.0 years on average, 9.1 years in Landakay, and 6.1 years in Jehangira. The mean household size was 10.0 persons (range: 2-35; SD = 5.31) which is slightly larger than the mean household size in the KP province (7.3 persons). This is likely due in part to our focus on rural communities where households are often larger (Pakistan Bureau of Statistics, 2017). In our survey, 58% of respondents reported living in a joint family structure. This is congruent with the UN estimates that 55% of households in Pakistan are multi-generational (United Nations, 2019). Neither household size nor percentage of joint family structure varied across the three study communities.

The average farm size owned by respondent households was 3.2 hectares, larger than that of the region at 1.5 hectares (Pakistan Agriculture Census, 2010). Further, there was a statistically significant difference in households' total land (both owned and rented) across the three study communities ($\chi^2 = 21.029$; $p < 0.001$). Specifically, respondents in Madyan reported an average of

6.1 hectares owned and rented while respondents in Landakay and Jehangira reported 2.4 and 1.0 hectares, respectively. This reflects other studies that show the variation in land ownership across the province, (Ullah, Shivakoti, & Ali, 2015) report a mean of 2.38 ha and (Ullah et al., 2020) report a mean of 7.02 hectares in KP in districts across KP.

In our survey, 24% of respondents reported a monthly income of 20,000 Pakistani Rupees (PKR) or less, 38% reported a monthly income between 20,001 PKR and 40,000 PKR, and 38% earned more than 40,001 PKR per month. Although we did not collect the exact household income information due to cultural sensitivity reasons, the distribution of our income data is reasonably consistent with what was reported by the Pakistani Census—an average monthly income of 35,391 PKRs (\$221.12 USD) in rural KP (Household Integrated Economic Survey, 2017). However, respondents in Madyan and Landakay reported statistically significantly higher incomes than respondents in Jehangira ($\chi^2 = 89.7851$; $p < 0.001$).

3.4.2 Livelihood strategies

As shown in Table 3.2, the average number of livelihood strategies employed by a household was 2.1 (range: 1-5, SD=1.0), revealing that many responding households relied on multiple sources of subsistence and income. Although we have no other data on livelihood strategies in the region as a comparison, our result seems to be consistent with data from the Pakistani Census which indicates that the average household in the KP province has 2.2 wage-earners (Household Integrated Economic Survey, 2017). It should be noted that respondents in Jehangira reported significantly fewer livelihood strategies (1.6 on average) than respondents in Madyan (2.3) or Landakay (2.3) ($\chi^2 = 42.105$; $p < 0.001$). The most frequently reported livelihood strategies employed by responding households were day labor (temporary employment, paid by day) (38%), crop production (38%) and animal husbandry (30%). The least frequently reported were the hotel industry (3%), fishing (9%), and salaried labor (permanent employment, paid by regular salary) (11%). Respondents in Jehangira were significantly more likely to report engaging in day labor (55%) than respondents in Madyan (23%) and Landakay (38%) ($\chi^2 = 32.394$; $p < 0.001$). Commerce was most likely to be reported in Madyan (45%) followed by Landakay (29%) and Jehangira (11%) ($\chi^2 = 41.819$; $p < 0.001$).

3.4.3 Observed social-ecological changes

Respondents identified various social-ecological changes they had observed in their communities in the past ten years. There was nearly universal agreement that river water quality had decreased (95%) and waste on both the shore (93%) and surface (90%) of waterbodies had increased. A majority of the respondents also reported a decrease in both fish number (89%) and size (78%). There were also differences in the social-ecological changes observed across the three study communities. For instance, in Madyan and Landakay respondents reported an increase in businesses related to the tourism industry. Respondents reported an increase in restaurants (89% and 58%, respectively) and hotels (84% and 57%, respectively), while only 3% of respondents in Jehangira reported an increase in restaurants (Fisher's exact $p < 0.001$) and hotels (Fisher's exact $p < 0.001$). In terms of agricultural production, 47% and 39% of respondents in Madyan and Landakay, respectively, reported a decrease in agricultural yield, while only 20% of respondents in Jehangira reported a decrease ($\chi^2 = 25.252$; $p < 0.001$).

3.4.4 Adaptation strategies

In addition to observed social-ecological changes, we asked respondents how they had responded to these changes in the past ten years. On average, respondents reported adopting 5.6 adaptation strategies (range: 5-10, SD= 0.87). The most frequently reported strategies were increasing agricultural inputs (35%), having a household member migrate to another place (30%), or decreased time fishing (21%). The least reported adaptation strategies were changing irrigation water supply (0.6%) or the type of animals raised (3%). The only statistically significance difference across the three study communities was about starting a business. As shown in Table 3.2, respondents in Madyan were more likely to have started a business (12%) in the past ten years as they adapt to ongoing social-ecological changes than respondents in Landakay (4%) or Jehangira (1%) ($\chi^2 = 16.847$; $p < 0.001$).

3.4.5 Comparisons between two types of family structure

As previously mentioned, 58% of respondents reported being the head of a joint family while 42% reported being the head of a nuclear family. We then compared joint and nuclear families in terms of their socio-demographic characteristics, their livelihood and adaptation

strategies, and a few key factors in their decision-making processes (Table 3.3). Overall, joint families reported a higher income and larger land ownership. Specifically, more joint families (63%) reported a monthly household income of over 30,000 PKRs than nuclear families (47%) ($\chi^2 = 10.6724$; $p < 0.001$). On average, joint families owned and rented more land (5.0 ha) than nuclear families (0.8 ha) ($\chi^2 = 9.562$; $p < 0.001$).

Joint family households reported more livelihood strategies (mean: 2.27; range: 1-5; SD=1.02) than nuclear families (mean: 1.77; range: 1-5 SD=0.94) ($\chi^2 = 25.672$; $p < 0.001$). Specifically, nuclear families were more likely to engage in day labor ($\chi^2 = 3.905$; $p < 0.001$). In terms of adaptation strategies adopted to address ongoing social-ecological changes, joint families were more likely to adapt by increasing their agricultural inputs (42%) ($\chi^2 = 6.369$; $p < 0.001$) and engaging in migration (35%) ($\chi^2 = 5.594$; $p < 0.001$) than nuclear families (21% and 24%, respectively).

We also asked respondents to indicate who is involved in decision-making about household livelihood strategies. Respondents could indicate any family member from both in or outside their household (i.e., they could indicate that they make decisions about their agricultural land with their father even if he is not in their household). We found that heads of joint and nuclear families made decisions with other family members at similar frequencies. For both household structures the two most frequently reported family members involved in decision-making in addition to the household head was the head's father (joint families: 25%; nuclear families: 32%) and brother (joint families: 40%; nuclear families: 18%), but only the difference in involving a brother in decision-making was statistically significantly different between joint and nuclear families ($\chi^2 = 25.793$; $p < 0.001$).

3.5 Discussion

3.5.1 Differentiated relationships between observed social-ecological change and livelihood strategies across space

Our results show that respondents in each of the three communities largely agreed on several observed social-ecological changes: decreasing water quality, increasing solid waste, and decreasing fish populations. Indeed, these changes have been widely documented in the area (Nafees, Ahmed, & Arshad, 2011; UNDP, 2017; Young et al., 2019; Yousafzai, Rehman Khan, & Shakoori, 2008). It is also worth noting that, while there was no statistically significant difference

in respondents reporting crop production as a livelihood strategy, those in Jehangira were less likely to report a decrease in crop yield but more likely to report an increase in their agricultural inputs than those in Madyan and Landakay. This difference could be because responding households in Jehangira increased their agricultural inputs to protect themselves from decreasing yields. This difference in increasing agricultural inputs may also be due in part to access; Jehangira is closer to urban centers than Madyan and Landakay, thus respondents there may have easier access to inputs and extension services that often distribute these products (Alene et al., 2008; Waithaka, Thornton, Shepherd, & Ndiwa, 2007). This proximity to urban centers and associated employment opportunities could have also contributed to respondents in Jehangira greater reliance on day labor than respondents in Madyan and Landakay. Day labor can provide important and flexible income sources; however, it is often associated with low wages and unreliable work (Gautam & Andersen, 2016; Niehof, 2004) and dependence on this livelihood strategy could contribute to the lower income reported in Jehangira in comparison to Madyan and Landakay.

The higher income, greater number of livelihood strategies, and higher engagement in the hotel industry and commerce in Madyan and Landakay could be in part due to the spatial differences in the growth of the tourism industry. Specifically, Madyan and Landakay are located in areas that have seen revitalization of the tourism industry; after years of armed conflict and recovery from a devastating flood in 2010 tourists are once again visiting the Swat River for its cool weather and mountain vistas (Hye & Khan, 2013). The World Bank estimates that 4.45 million tourists visited sites around the Swat Valley in 2018 and created nearly 10,000 jobs in the KP province, however, this growth is concentrated around the Swat River near Madyan and Landakay rather than Jehangira (World Bank, 2019). This is reflected in the observed increase in the number of hotels, restaurants, and tourists among respondents in Madyan and Landakay, as well as the higher percentage of respondents from these two locations reporting work associated with the hotel industry as a livelihood strategy. In contrast, although Jehangira is situated on the banks of Kabul River, it is located a longer distance away from the hub of tourism activities; thus, few respondents observed an increase in hotels, restaurants, or tourists in the area and no one reported the hotel industry as a livelihood strategy. This uneven spatial distribution of tourism has been documented in other contexts and has been known to increase already existing spatial inequalities (Iorio & Corsale, 2010). Therefore, while tourism has long been a part of the conversation surrounding sustainable development (Butler, 1999) and livelihood diversification

(Cinner & Bodin, 2010; Kull et al., 2007) for rural areas, support of the tourism industry should consider ways to increase equity in its growth especially for areas like our study region where development is concentrated in specific locations.

Further, visitor trends do indicate that a majority of tourists visit the Swat Valley during the four-day Eid-ul-Fitr holiday, suggesting the seasonal nature of income associated with tourism industry (World Bank, 2019). This seasonality of employment may be connected to risks and uncertainties but could also mean flexibility of livelihood structure and further livelihood diversification opportunities (Iorio & Corsale, 2010; Pellowe & Leslie, 2019). Further, while diversification through the tourism industry has been shown to increase financial security in other contexts, it is also an industry that can be highly vulnerable to social-ecological change (Forster et al., 2012), as seen in the ways the 2010 flood and conflicts decreased tourism in our study area. Therefore, these results suggest a need to further examine the role of seasonal employment in shaping household adaptation to social-ecological change and the ways in which diversification options vary across time and space (Goulden, Adger, Allison, & Conway, 2013; Shen, Hughey, & Simmons, 2008).

Overall, these results show that even when communities are observing similar climatic and ecological changes (e.g., decreasing water quality, decreasing fish populations), these changes may manifest differently in those communities, thus generating differentiated impacts on people's livelihoods (Gentle & Maraseni, 2012; Tschakert, Ellis, Anderson, Kelly, & Obeng, 2019). These results also highlight the ways in which livelihood options can be location specific, in part due to differences in available resources and broader economic factors even within a relatively small geographic region (Chamberlin, Pender, & Yu, 2006; Ellis, 1998; Yobe, Mudhara, & Mafongoya, 2019), indicating a need to provide tailored support to communities based on the challenges and opportunities present in that space. As Douxchamps et al. (2016) state, "given the high heterogeneity (composition, land area per capita, assets, incomes, orientation to markets, etc.) of households at a community level, targeting the right agricultural adaptation strategies to different household types remains a big challenge" (p. 1313). Our study further illustrates this heterogeneity in rural communities in northwestern Pakistan and highlights the associated complexity in the development of adaptation strategies fostered by livelihood diversification. For example, two households may both engage in agricultural production, however, one may also fish and receive remittances, and the other may have livestock and engage in day labor. These combinations lend

themselves to variation in adaptation decision-making and demonstrate that there may not be “one-size-fits-all” adaptation strategy especially in the midst of livelihood diversification. Policies, therefore, must be flexible and cross-sectoral in order to support households’ and communities’ diverse livelihood strategies and their ability to adapt their diverse livelihood strategies to social-ecological change. To do so, understanding the current agricultural and livelihood practices and decision-making processes in rural communities will be an important first step (Douxchamps et al. 2016), as shown in our study.

3.5.2 Differentiated adaptation strategies across household structures

By comparing joint and nuclear families, our study shows that joint families appear to own and rent more land, have higher incomes, engage in more livelihood strategies, and adapt in different ways in comparison to nuclear families. One way to process these results is through the lens of capital. Capital has long been conceptualized as human, natural, physical, social, political, and financial to demonstrate the diverse assets that households are utilizing to support their well-being and resilience, particularly in rural communities (Bebbington, 1999; Scoones, 1998; Rakodi, 1999). Following this understanding of capital, our study shows that joint families tend to have more natural, human, and financial capital than do nuclear families, which in turn contributes to their adaptive practices to social-ecological change. Nevertheless, there is currently mixed results about the role of capital and household structure. For example, Ali and Erenstein (2017) found that joint families employ more adaptation strategies than nuclear families. Yet conversely, Bashir et al. (2012) found that joint families are more likely to be food insecure than nuclear families due to their larger household size and more need for food resources but. As such, our study identifies a need to further understand if and how capital shapes differentiated household well-being between joint and nuclear families.

In terms of natural capital, Ruggles (2003) posits that multi-generational households such as joint families are actually supported by land ownership; “if the older generation lacks sufficient land to support the next generation, it may be impossible for the younger generation to stay in the household” (p. 272). Therefore, those with little land may not maintain a joint family structure due to limited land resources needed to support multiple generations within the same household. On the other hand, households with more land may be more inclined to maintain a joint family structure due to the potential high labor needs associated with owning more land. Regardless of

why land ownership is positively associated with a joint family structure, an important question is what this capital means in terms of household well-being and their ability to make a living. Nevertheless, previous work has shown the land ownership supports households' capacity to adapt to social-ecological change (Brown et al., 2019) thus we posit that joint families' land ownership contributes to their adaptive capacity.

In terms of human and financial capital, our study shows a higher income from joint families than from nuclear families, which may be related to the presence of multiple wage earners and surplus labor in joint families. More broadly, joint families report more livelihood strategies than nuclear families on average. Many existing studies have shown that livelihood diversification can contribute to several measures of household well-being, including improved income, food security, and resilience to environmental stress (Babatunde & Qaim, 2010; Barrett et al., 2001; Liu, Golding, & Gong, 2008). At the same time, Gautam and Andersen (2016) specify that the improved well-being is more contingent on the type of diversification in which the household engages; they find that households involved in the high-return sectors of trade or salaried labor tend to improve their household well-being. We posit that a similar scenario is occurring in our study area. As shown in our study, joint families are more likely to engage in labor migration, which could have higher returns and less variability than livelihood strategies such as day labor that nuclear families are more likely to report. At the same time, these families may be able to absorb the initial costs and risks of this livelihood strategy (Mendola, 2008). These livelihood differences may reflect the entry barriers that can exist for high-return diversification (Gautam & Andersen, 2016; Woldenhanna & Oskam, 2001). High-return, nonfarm activities such labor migration can be an expensive endeavor while finding day labor requires less immediate investment but also may have a lower return (Loison, 2015). Further, labor migration frequently requires a large initial investment to relocate a family member, especially in the case of international migration, and the household's ability to absorb the loss of that family member's labor at the original location (Mendola, 2008). Therefore, the joint families in our study may be more able to afford labor migration as a livelihood strategy (Huy, 2009; Mendola, 2008). As such, joint families may face lower entry barriers to diversifying livelihoods with high-returns options in comparison to nuclear families. This difference could further exacerbate existing income inequalities between joint and nuclear families (Barrett et al., 2001; Loison, 2015; Woldenhanna & Oskam, 2001).

While previous research has explored to some extent the relationship between joint families, capitals, livelihoods, and household well-being, empirical examinations of how such dynamics affect household adaptation to social-ecological changes are limited. It is worth noting that although several studies have suggested that large families (Deressa, Hassan, & Ringler, 2011) and particularly joint families (Ali & Erenstein, 2017) employ more adaptation strategies than small or nuclear families, we did not observe a significant difference in the number of adaptation strategies adopted between joint and nuclear families. Our study, however, does show that households may employ different adaptation strategies based on their household structure and the associated capital available to them (Below et al., 2012; Jezeer, Verweij, Boot, Junginger, & Santos, 2019; Kuang, Jin, He, Wan, & Ning, 2019). Specifically in our case, joint and nuclear families tend to observe similar social-ecological changes, but joint families tend to be more engaged in labor migration and are more likely to increase their agricultural inputs as their way to adapt to observed changes. This could be in part due to the difference in access to human and financial capital between the two types of households. They have higher income (i.e., financial capital) and thus may be able to afford the costs of increasing agricultural inputs (Jezeer et al., 2019; Rahman, 2003). They also have more surplus labor, as well as higher income, and thus may be more able to afford labor migration (Huy, 2009; Mendola, 2008), as discussed previously.

Although several scholars have argued that larger households tend to be more vulnerable to climate change due to the greater number of dependents (Dumenu & Obeng, 2016), our results provide an alternative view of the dynamics between household size, structure, livelihood strategies, and adaptation to social-ecological change. In fact, our study shows that joint families may be less vulnerable to climatic and other social-ecological changes despite their larger size, similar to what is discussed in Senapati & Gupta (2017). A large number of factors have been identified as shaping adaptive capacity at various scales, including “managerial ability, access to financial, technological and information resources, infrastructure, the institutional environment within which adaptations occur, political influence, kinship networks, etc.” (Smit & Wandel, 2006, p. 287). Much work has assessed the relationship between household size and adaptive capacity (Ali & Erenstein, 2017; Dumenu & Obeng, 2016; Huy, 2009; Mendola, 2008). Our study, however, show that it may not be sufficient to only consider household size when assessing adaptive capacity. Indeed, it is shown that social structures and networks mediate vulnerability (Birkenholtz, 2012), however, little work has included household structure in the assessment of networks. For instance,

even if two households are of the same size, the joint family may include more adults who can contribute to various forms of capital to be used for adaptation in comparison to the nuclear family. As such, we highlight a great need for further research to understand the role of household structure in shaping households' adaptive capacity. In joint families or other types of multi-generational households, we posit that household adaptive capacity is in part supported by the presence of multiple wage earners, surplus labor, and possibly, expanded social networks.

3.5.3 Household decision-making

Most research on household decision-making in nuclear families focuses on collaboration between the husband and wife (Acosta et al., 2020; Doss & Meinzen-Dick, 2015) while research on intergenerational households often focuses on collaboration between adult children and their parents (Evans, Mariwah, & Barima Antwi, 2015; Quisumbing, 1997; Reynolds Whyte, Alber, & van der Geest, 2008). However, in our study livelihood decision-making processes did not appear to differ across household structures, rather, both joint and nuclear families reported some levels of collaborative decision-making. Additionally, our results also show that when multiple decision-makers are present within a household, it would be unwise to assume that they are husband and wife. Rather, in our study, the two most frequently cited family members involved in collaborative decision-making with the household head were the head's father and brother. In particular, heads of joint families were more likely to collaborate with their brothers in making various livelihood decisions. This reveals that the ways in which negotiations take place within a household may be connected to the household structure; brothers are more likely to live in the same household in joint families than in nuclear families. Nevertheless, collaborating with family members other than one's spouse was common in both nuclear and joint family structures.

Undoubtedly, our results are highly situated in the cultural context of our research in which patriarchal family structures and decision-making are common (Fahad & Wang, 2018; Qasim, Nawaz Khan, Prasad Shrestha, & Qasim, 2015). However, as Rao et al. (2020) state, intra-household negotiations "are no longer restricted to couples. Households are increasingly multi-generational and multi-locational with new forms of cooperation and indeed conflict developing amongst them" (p.11). Therefore, our study confirms the need to expand examinations of intra-household decision-making and negotiations to include household members beyond a husband-and-wife duo to further understand this increasingly common dynamic.

More broadly, negotiation about land use and natural resources among non-spousal family members has been documented across the globe. Thus, the need to understand the roles of various household members in collaborative decision-making goes beyond the case of Pakistan or joint families. Indeed, our results on decision-making mirror those from studies of farmers in southern India (Selvaraju et al., 2005) and Tanzania (McCabe et al., 2010) that report collaborative decision-making in agricultural families. Multiple decision-makers have also been reported in the context of managing family-owned forestlands (Snyder & Kilgore, 2018) and small-scale farms (Iles et al., 2020) in North America. As rural households continue to face the need to adapt their livelihoods to ongoing social-ecological changes (through, for example, livelihood diversification), negotiation of resources including time, labor, finances, land, and water to support multiple strategies in one household will be commonplace, regardless of the household structure (Ellis, 2000; Loison, 2015; Niehof, 2004). Our study provides important evidence that highlights the need to gain a nuanced understanding of the various actors involved in household livelihood and adaptation decision-making in order to target not only the household head but all relevant decision-makers within a household for outreach, education, and the development and implementation of support tools.

3.6 Conclusion

Our examination of household structures, livelihood and adaptation strategies, and decision-making reveals that household structures should be considered when examining households' adaptation, livelihood strategies and capital. We found that joint family structures increase households' capacity to diversify their livelihoods and more broadly, that they have greater access to capital than nuclear families. This counters the common assumption that large households are associated with limited capital and instead highlights the need for a nuanced understanding of how household structure, not just size, influences capital and adaptive capacity.

Our results also illustrate that decision-making occurs with multiple family members in both joint and nuclear household structures, indicating the need for a broader understanding of negotiation within a household. Much of the current examination of household decision-making focuses on a husband and a wife as decision makers. However, our data indicate assessments of decision-making should include other family members such as siblings or parents regardless of household structure. This should be considered for information dissemination; that is, extension

services or climate information should be made available for the entire household to support the cooperative decision-making processes.

Finally, our study highlights the variation in livelihood and adaptation strategies occurs within and across households and locations. That is, the same social-ecological changes can manifest differently in different communities and compound with differences in available resources and broader economic factors to generate differentiated livelihood impacts. This research also illustrates that households are rarely reliant on a singular livelihood strategy, especially when a joint family household allows for multiple wage earners to be present in the household. However, the high entry barriers to diversification and differentiated opportunities can increase existing income inequalities across space and household structure. Therefore, nuanced examinations are required to inform appropriate policies and support infrastructure for households' adaptation to social-ecological change.

Table 3.1 Socio-demographic characteristics of survey respondents and their households

	Madyan (n=150)	Jehangira (n=148)	Landakay (n=150)	Total (n=448)
Mean age of household head (years)	37.6	41.9	38.7	39.4
Mean education of household head (years)	9.9	6.1	9.1	8.4
Mean household (HH) size (persons)	11.0	10.3	8.9	10.1
% of HH that were joint families	62.7	58.8	51.3	57.6
Mean land size (ha)*	6.1	1.0	2.4	3.2
% of HH with income over 30,000 PKRs*	67.6	23.4	74.8	55.7

* $p < 0.00142857$ (.05/35)

Note: Because we conducted multiple comparisons to identify differences across locations, we used the Bonferroni correction to control the familywise error rate. To do so, we found the critical value (α) for an individual test by dividing the familywise error rate (0.05) by the number of tests (i.e., 35 tests between Table 3.1 and Table 3.2). Thus, in our study, the critical value for an individual test is $0.05/35 = 0.00142857$, and we only consider individual tests with $P < 0.00142857$ to be statistically significant (Gelman et al., 2012).

Table 3.2 An overview of household livelihood strategies, observed social-ecological changes, and adaptation strategies across the three study communities

	Madyan (n=150)	Jehangira (n=148)	Landakay (n=150)	Total (n=448)
Livelihood strategies (% of responding households)				
Crop production	47.3	29.1	37.3	37.9
Animal husbandry	29.3	23.7	36.0	29.7
Day labor*	22.7	54.7	38.0	38.4
Commerce*	45.3	11.5	28.7	28.6
Migration	0.2	14.2	29.3	21.9
Salaried labor	11.3	10.1	10.0	10.5
Fishing	8.0	4.7	13.3	8.7
Hotels	5.3	0.00	4.0	3.1
Mean total livelihood strategies*	2.3	1.6	2.3	2.1
Observed changes (% of respondents)				
Decrease in river water quality	92	94.6	98.7	95.1
Increase in waste on water surface	85.3	91.2	94.7	90.4
Increase in waste on river shore	86.0	93.9	98.0	92.6
Decrease in fish number	87.3	94.6	86.0	89.3
Decrease in fish size	83.3	80.4	69.3	77.7
Increase in length of dry season	42.7	55.4	38.7	45.5
Increase in tourist number*	80.7	19.6	39.3	46.7
Decrease in yield*	47.3	20.3	39.3	35.7
Increase in hotels*	84.0	2.7	56.7	48.0
Increase in restaurant number*	88.7	2.7	58.0	50.0
Adaptation strategies (% of responding households)				
Changed animal type	4.1	2.9	1.9	2.9
Decreased time fishing	50.0	14.3	5.3	21.1
Increased agricultural input*	31.8	55.0	23.6	34.8
Changed irrigation water supply	0.0	2.4	0.0	0.6
Changed crop type	5.8	14.6	12.5	10.2
Changed domestic water supply	10.7	14.9	10.0	11.8
Applied for financial assistance	7.3	7.4	2.7	5.8
Started a business*	12.0	4.1	1.3	5.8
Family or family member moved for work	34.0	26.9	30.0	30.3
Mean total adaptation strategies	5.8	5.6	5.6	5.6
* p < 0.00142857 (.05/35)				

Table 3.2 continued

Note: Because we conducted multiple comparisons to identify differences across locations we used the Bonferroni correction to control the familywise error rate. To do so, we found the critical value (α) for an individual test by dividing the familywise error rate (0.05) by the number of tests (i.e., 35 tests between Table 3.1 and Table 3.2. Thus, in our study, the critical value for an individual test is $0.05/35 = 0.00142857$, and we only consider individual tests with $P < 0.00142857$ to be statistically significant (Gelman et al., 2012).

Table 3.3 Comparisons of joint and nuclear families regarding their socio-demographic characteristics, livelihood strategies, observed social-ecological change, the associated adaptation strategies adopted, and the associated decision-making processes

	Joint family (n=258)	Nuclear family (n=190)
Socio-demographic characteristics		
Mean age of household head (years)*	41.7	36.3
Education of household head (years)	8.4	8.4
Mean household (HH) size (persons)*	11.9	7.6
Mean land size (ha)*	5.0	0.8
% of HH with income over 30,000 PKRs*	62.5	46.8
Livelihood strategies (% of responding households)		
Crop production	43.4	30.5
Animal husbandry	34.1	23.7
Day labor*	34.5	43.7
Commerce	32.2	23.7
Migration*	29.5	11.6
Salaried labor	8.5	13.2
Fishing	10.5	9.5
Hotels	4.3	1.6
Mean total livelihood strategies*	2.3	1.8
Observed changes (% of respondents)		
Decrease in river water quality	94.7	95.4
Increase in waste on water surface	85.3	94.2
Increase in waste on river shore	93.8	91.1
Decrease in fish number	86.0	93.7
Decrease in fish size	74.8	81.6
Increase in restaurant number	55.4	42.6
Increase in hotels	52.3	42.1
Increase in tourist number	50.0	42.1
Decrease in yield*	43.0	25.8
Increase in length of dry season*	38.4	55.3
Adaptation strategies (% of responding households)		
Increased agricultural input*	41.5	21.2
Family or family member moved for work*	34.8	24.3
Decreased time fishing	13.6	31.3

Table 3.3 continued

Changed domestic water supply	12.8	10.5
Changed irrigation water supply	9.0	12.7
Started a business	7.0	4.2
Applied for financial assistance	5.8	5.8
Changed animal type	2.2	4.3
Changed crop type	0.0	1.9
Mean total adaptation strategies	5.7	5.6
Decision-making with other family members by livelihood strategy (% of respondents)		
Hotels	75.0	0.0
Animal husbandry	47.7	48.9
Crop production	35.7	41.4
Commerce	37.4	11.1
Fishing	26.1	6.3
Day labor	24.7	19.3
Migration	8.0	13.6
Salaried labor	0.0	8.0
Decision-making with other family members by member (% of respondents)		
Father	24.7	32.2
Mother	8.9	5.8
Brother*	40.3	17.9
Sister	1.6	0.5
Son	5.0	2.1
Wife	6.6	11.1
Other	6.2	4.2

* $p < 0.00010204$ (.05/49)

Note: Because we conducted multiple comparisons to identify differences across locations we used the Bonferroni correction to control the familywise error rate. To do so, we found the critical value (α) for an individual test by dividing the familywise error rate (0.05) by the number of tests (i.e., 49 tests for Table 3.3). Thus, in our study, the critical value for an individual test is $0.05/49 = 0.00010204$, and we only consider individual tests with $P < 0.00010204$ to be statistically significant (Gelman et al., 2012).

CHAPTER 4. VALUES, COSTS, AND SOCIAL INFLUENCE IN ADAPTATION TO SOCIAL-ECOLOGICAL CHANGE: EMPIRICAL EVIDENCE FROM PAKISTAN

4.1 Abstract

Smallholder farmers throughout the world have employed a diverse array of adaptation strategies in response to complex, compounding social-ecological changes. Previous research has identified socio-demographic factors and perceived changes as determinants of adaptation decisions, and financial constraints such as lower household income and limited access to capital are often considered barriers to adaptation. More recently, an increasing body of empirical research has shown that adaptation decisions involve more than financial considerations and various social, political, cultural, and psychological factors can also shape adaptation decision-making. Building upon this large body of adaptation literature, we analyzed survey data from 448 households in northwestern Pakistan to examine how household adaptation decisions in the past ten years were shaped by socio-demographic characteristics of the households, perceived social-ecological changes, and perceived economic and non-economic costs of adaptation. We found that households in our study perceived a range of social-ecological changes, including but not limited to declines of fish populations, decreased quality and quantity of river water and groundwater, as well as an increase of local tourism industry. However, perceiving social-ecological changes did not always lead to adaptation. We also found that while our study participants perceived various economic costs (e.g., finances, labor, and time) of adaptation, such perceptions did not necessarily decrease their likelihood of adaptation; rather, the influence of perceiving economic costs varied across adaptation types. In some cases, economic costs appeared to be expected and accepted costs of adaptation, thus having little effect on adaptation decisions. More importantly, we found that our study participants also perceived various social costs of adaptation. While many were willing to go against friends' and community leaders' opinions to employ a particular adaptation strategy, they were less likely to adapt if it went against the opinions of family members. These results reveal the ways in which adaptation decision-making is influenced by more than economic costs; rather, households negotiate and tradeoff between multiple economic and non-economic values that are embedded in social-ecological contexts. Therefore, we argue that while it is important to help rural households to remove economic constraints in their adaptation decision-making

processes, it is also important to recognize non-economic values that influence what adaptation strategies individuals and households are willing to employ.

4.2 Introduction

The effects of social-ecological change on agricultural livelihoods and subsequent need for adaptation and mitigation measures have been widely documented (Challinor et al., 2014; Howden et al., 2007; Morton, 2007). Recent research has examined climatic and non-climatic factors that influence the adoption of adaptation actions, including demographic predictors (Below et al., 2012; Deressa et al., 2009), political-economic constraints (Eakin, 2000; Mertz et al., 2010), and policy change and reform (Hageback et al., 2005). In this paper, climate change adaptation is defined as an adjustment to existing practices to reduce impacts of current or future climate changes (IPCC, 2001; Smit & Pilifosova, 2003). More broadly, adaptation is increasingly understood to be in response to multiple compounding social-ecological changes and non-climatic factors are often found to be significant drivers of farmers' adaptation decisions (Burnham & Ma, 2016; Carr, 2008; Forsyth & Evans, 2013; Manuel-Navarrete & Pelling, 2015). The interacting climatic and non-climatic conditions create specific contexts in which adaptation takes place; thus, while it is important to develop planned adaptation policies and programs broadly, autonomous adaptations are also necessary for responding to local, context-specific changes (Agrawal & Perrin, 2009; Gentle & Maraseni, 2012; Lemos et al., 2013).

Demographic variables such as education level, age of household head, household size, income, and land ownership have each been identified as determinants of adaptation in many studies that focus on the relationships between access to social, political, financial, and natural capital and the decision to adapt (Asfaw et al., 2019; Below et al., 2012; Croppenstedt et al., 2003; Deressa et al., 2009). Increasingly, scholars have assessed adaptation from a psycho-social perspective to understand how individual decision-making processes drive adaptation behavior. This type of research often focuses on risk perceptions, efficacy beliefs, and social appraisal (Esham & Garforth, 2013; Grothmann & Patt, 2005; Kuruppu & Liverman, 2011; Truelove et al., 2015). For example, many scholars have examined how an actors' perception of social-ecological change influences their decision to employ adaptive strategies in their livelihood (Deressa et al., 2011; Fosu-Mensah et al., 2012; Mertz et al., 2009; Mubaya & Mafongoya, 2017). Specifically, some scholars have argued that adaptation to social-ecological change contains two steps: first, an

actor must perceive the change, and then they must decide how to respond to the change (Maddison, 2006; Deressa et al. 2011). Therefore, perceptions of change have been seen to be key to understanding if and how individuals will decide to adapt (Bryan et al., 2009; Shisanya & Khayesi, 2007).

Beyond this linear depiction of individual adaptation processes, some scholars have also recognized that adaptation decisions are embedded within and influenced by multi-scalar social factors such as social capital, social norms, and political processes (Frank et al., 2011; Wolf, 2011). Studies of intra-household dynamics in adaptation decision-making have largely focused on gendered negotiations and illustrated that perceptions of climate change and adaptation decisions differ across spouses in the same household (Al-Amin et al., 2019; Ngigi et al., 2017). Adoption of resource conservation practices have also been studied through the lens of social influence, or the ways in which behavior is affected by what other people do or perceptions of what they think (Abrahamse & Steg, 2013). The related studies of peer effects (Sacerdote, 2001; Wolske et al., 2020) and social norms (Dang et al., 2014; van Valkengoed & Steg, 2019) examine how perceptions of others' behavior and expectations influence individuals' decision to adopt adaptation practices. Finally, adaptation can also be supported or constrained by political processes and policies (Burnham & Ma, 2018; Eriksen et al., 2015), as well as cultural traditions (Adger et al., 2013; Nielsen & Reenberg, 2010).

Related to these factors that influence adaptation decision-making, much research has also examined barriers to adaptation at the household scale. Economic constraints such as household income and access to capital are often the most salient in adaptation decisions (Antwi-Agyei et al., 2014; Deressa et al., 2009; Fosu-Mensah et al., 2012). At the same time, decisions to adapt or not involve more than considerations of financial costs; for example, previous research has shown the importance of time and labor costs associated with adaptation practices (Esham & Garforth, 2013; Koerth et al., 2013; Poussin et al., 2014; Tessema et al., 2013). Indeed, the Model of Private Proactive Adaptation to Climate Change specifies that the perceived adaptation costs include finances, personal cost, time and effort (Grothmann & Patt, 2005).

In addition, there is a growing literature that examines the role of intrinsic values in climate change adaptation, largely focusing on how values influence what is considered to be legitimate and successful adaptation (O'Brien & Wolf, 2010; Wolf et al., 2013). Values such as tradition, harmony, security, and belonging are commonly assessed; however, the operationalization of these

values varies as it is also understood that they are largely dependent on individual and social contexts (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013). For example, religious values were found to have a significant influence on adaptation in Kiribati (Kuruppu, 2009), freedom and safety were identified as important in Canada (Wolf et al., 2013), and culture and cooperation were two of the important values affecting adaptation in a study of the Gitga'at Nation (Reid et al., 2014). The identification of the influence of these values confirms the argument from O'Brien and Wolf (2010) that "there is a need to shift attention away from an exclusive focus on economic and material values to a deeper understanding of what climate change means for society" (p. 239). While there has been an increase in the study of values as they relate to adaptation, Tschakert et al. (2017) argue that in addition to the identification of values, we also need to understand the ways people tradeoff values in order to adapt to social-ecological change. While value tradeoffs have been studied within the fields of psychology (Luce et al., 2001; Tetlock, 2000), little has been done to assess these concepts in adaptation to social-ecological change.

To address this gap, we analyze household survey data from northwestern Pakistan to answer the following questions: 1) What are the perceived economic and non-economic costs of employing adaptation practices? 2) What is the relationship among household socio-demographic characteristics, perceived social-ecological changes, perceived economic and non-economic costs of adaptation, and the decision to adapt? Together, our results confirm previous research demonstrating that perceiving economic costs such as financial, time, and labor costs shapes household decisions to adapt to social-ecological changes. However, the effect of perceiving economic costs varies across the types of adaptation. More importantly, our study shows that non-economic factors such as family members' opinions are often associated with decreased likelihood to employ adaptation strategies. According to value conceptualizations from the field of psychology, "familial ties" may be considered a sacred value due to its importance in the study area (Johnson & Mason, 2018; Lindholm, 1982). Assessments of such values in adaptation decisions as described in this paper are an important first step for those who develop and/or implement adaptation policies and programs because they can inform support for household adaptation in a way that aligns rather than conflicts with the values held by those who adapt.

4.3 Research design and methods

4.3.1 Research area and site selection

Data collection occurred in three communities in the Khyber Pakhtunkhwa (KP) province in northwestern Pakistan: Madyan, Jehangira, and Landakay (see Figure 4.1). These communities were chosen to represent the livelihood strategies associated with the Swats and Kabul river ecosystems including irrigated agriculture, wild catch and aquaculture fisheries, and tourism. Pakistan is ranked as one of the most water stressed countries in the world (United Nations, 2013) and as in many communities around the globe, rural livelihoods in Pakistan are highly dependent on a water supply which has been impacted by numerous socio-economic and environmental transformations. Urbanization, industrialization, and agricultural intensification have increased pollutants in the water system (Ullah et al., 2013) and it is projected that climate change will increasingly stress Pakistan's water supply due to changes in precipitation and glacier behavior, causing increasing frequency of extreme events such as floods and droughts (Hussain & Mumtaz, 2014). Finally, recent armed conflict

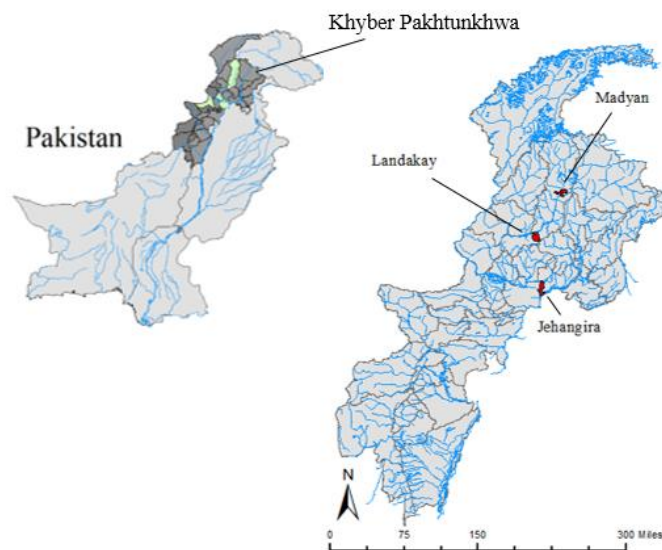


Figure 4.1 Map of survey study areas

displaced an estimated two million people around the research area in 2008 and two years later, in 2010, a massive flood resulted in widespread destruction of infrastructure in KP (District Disaster Management Plan, 2015). Much development and rehabilitation has occurred since these crises (Hye & Khan, 2013); however, they do continue to shape livelihoods in the research area. Given such complex contexts, the need for smallholder farmers to adapt in this area is high, allowing us to examine costs of employing adaptation strategies in response to compounding social-ecological change.

4.3.2 Data collection and analysis

We surveyed 448 household heads in KP in the spring and summer of 2019 (see Table 4.1 for background information of research areas). The survey was designed based on findings from interviews presented in Chapter 1 and theoretical insights from a review of literature. Specifically, we collected data on household demographics, livelihood strategies, water management, perceived social-ecological changes, adaptation strategies, and perceived costs of these adaptation strategies (see Appendix B). The survey was piloted in similar communities outside the research area and questions were revised based on this process. In-person survey administration has been found to be most appropriate for rural contexts such as our research area and is conducive to longer or more complex survey design (Neuman, 2010). Therefore, the survey was conducted in-person by researchers at UP using a random walking sampling strategy (Himelein et al., 2016) and the Survey Solutions platform. This study was approved by Purdue University's Institutional Review Board and Pakistani researchers at UP. We also obtained local leaders' permission for data collection in each community.

Respondents' answers to questions about perceived social-ecological changes were analyzed using polychoric principal component analysis (PCA) due to high correlation of these survey items. This allowed us to reduce a large number of correlated variables into uncorrelated composite variables with a minimal loss of information (Field, 2009; Pallant, 2013). Standard PCA is designed for continuous variables but categorical variables can be included by calculating the polychoric correlation matrix for the categorical variables then conducting PCA using the polychoric correlations (Kolenikov & Angeles, 2009). The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.64, greater than 0.6, and the Bartlett's test of sphericity was significant ($p < 0.05$) for the perceived social-ecological changes data, indicating a PCA was appropriate (Field, 2009).

PC loadings (i.e., the correlations between the survey items and the PC) of 0.50 or greater indicate a strong association among the survey items in that PC and are used to label the PC (Cronbach, 1951). Cronbach's alpha measures the internal consistency of survey items to determine the reliability of the PC; 0.61 or higher is often considered moderately acceptable (Taber, 2018) and PCs with an eigenvalue of one or greater should be retained (Kaiser, 1958). These criteria resulted in four PCs from the data on perceived social-ecological changes, and we labeled them as tourism changes, agricultural changes, groundwater changes, solid waste changes and fish

changes (Table 4.2). Perceiving decreases in river water quality did not meet these criteria and was thus included as an individual variable in subsequent analyses.

After data reduction, we used binomial logistic regression model to examine respondents' adaptation decisions as a dichotomous outcome (Comoé & Siegrist, 2013; Mase et al., 2017) as the model considers the relationship between the binary dependent variable and a set of independent binary or continuous variables. The model is represented as follows:

$$\text{Ln}\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k$$

The odds ratio (OR) is represented as $\left(\frac{P}{1-P}\right)$ where P is the probability of a farmer adopting an adaptation and $1-P$ is the probability of not adopting an adaptation. β_0 is the intercept, $\beta_1, \beta_2 \dots$ and β_k are regression coefficients of the independent variables of $X_1, X_2, X_3, \dots, X_k$. If the value of the odds ratio is greater than 1, the odds of adopting an adaptation increases as the independent variable increases (i.e., a positive relationship), a value less than one indicates a negative relationship, and a value of one indicates no relationship (Hosmer & Lemeshow, 2013). The response variables in our models are the decisions to employ one of the following five adaptation strategies: increase agricultural inputs, migrate, decrease time fishing, change domestic water supply, or change crop type. We only asked about livelihood specific strategies (i.e., increasing agricultural inputs) to those who indicated engagement with the relevant strategy (i.e., crop production). We asked all respondents about adaptation strategies (i.e., migration) that are not specific to a livelihood strategy. The response variable takes the value 1 if the respondent's household employed that adaptation in the past 10 years and 0 otherwise (Table 4.3).

The empirical models include a number of explanatory variables (Table 4.4), measuring household socio-demographic characteristics, perceived social-ecological changes, and perceived economic and non-economic costs of each adaptation strategy. Pseudo- R^2 is used to evaluate the goodness of fit of the model, that is, it is a measure of the amount of variation in the dependent variable explained by the model (Nagelkerke, 1991). Following methods from Wheeler et al. (2013) we modeled each adaptation strategy separately due to the heterogeneity of the adaptation strategies. To check for multicollinearity in all the models we ran a variance inflation factor (VIF) test for each regression, and the VIF scores were all below 4, the rule of thumb criterion for multicollinearity (Hair et al., 2010) (Table 4.5). All data analyses were conducted using Stata 12.0.

4.4 Results

4.4.1 Socio-demographic and economic characteristics of survey respondents

An overview of the explanatory variables in the models are presented in Table 4.4. The average respondent was 39.4 years old with 8.4 years of formal education. The mean household size was 10 persons, and 58% of our respondents reported living in households with a joint family structure, defined as “multi-generational families with two or more married children” (Ruggles, 2010). This is slightly larger than the mean household size in KP (7.3 persons), likely due in part to our rural sample where households are often larger than in urban areas (Pakistan Bureau of Statistics, 2017). Our respondents’ average farm size was 3.2 hectares (ha) which is larger than KP’s average of 1.5 ha (Government of Pakistan Statistics Division, 2010). However, more recent studies of agriculture in KP have reported large variation in farm size; Ullah et al. (2015) reported a mean of 2.38 ha and Khan et al. (2020) reported a mean of 7.02 ha. This reveals the variation in land ownership across the province. Our result could also indicate an increase in land ownership as the economy in the research area has stabilized after violent conflicts and disasters during the past decade (Hye & Khan, 2013). Overall, 14.5% of our respondents reported that a household member held a leadership position in the community currently or in the past. Finally, cattle ownership was included because it represents a source of wealth in the area (Ali & Rahut, 2018). Our respondents owned an average of 2.6 heads of cattle. Overall, the socio-demographic and economic characteristics of our survey respondents seemed to be comparable to the broader population in our study area (Government of Pakistan Statistics Division, 2010).

4.4.2 Perceived social-ecological changes, adaptation strategies adopted, and perceived costs of adaptation

We asked respondents what social-ecological changes they had observed in the past ten years in their community. There was nearly universal agreement that river water quality had decreased (95%) and waste on both the shore (93%) and surface (90%) of the water had increased. Similarly, a majority of the respondents agreed that there had been a decrease in both fish number (89%) and size (78%). Other changes reported were related to the revitalization of the tourism industry in the area: 47% of the respondents reported an increase in tourists, 48% reported an increase in hotels, and 50% reported an increase in restaurants. Decreasing agricultural yields were

reported by 36% of the respondents. Respondents also reported a decrease in ground water quality (31%) and quantity (37%), as well as changes in domestic water quantity (37%) and quality (46%)

We also asked respondents how they adapted to the aforementioned perceived social-ecological changes. Table 4.3 includes all adaptation strategies that were reported by at least 10% of our respondents and were used in the model. Increasing agricultural inputs (35%) and having a household member migrate to another place for work (30%) were the most frequently reported strategies. Other respondents reported decreasing time spent fishing (21%), changing their domestic water supply (12%), and changing the type of crop they grow (10%). Other adaptation strategies reported but excluded from our analysis are: starting a business (5.8%), applying for financial assistance (5.8%), changing the type of animal raised (2.9%) and changing the irrigation water supply (0.6%).

In terms of perceived costs associated with decisions to employ each adaptation strategy or not, financial cost was the most frequently reported cost by respondents (92%), followed by time (64%), and labor (58%). Going against friends' (13%) and leaders' (6%) opinions about an adaptation strategy were cited less frequently than going against family opinions (43%) as a cost the respondents had to bear to employ an adaptation strategy. Going against cultural traditions was reported by 18% of the respondents as a cost of adaptation and 16% reported increased uncertainty as a cost.

4.4.3 Factors influencing households' decisions to employ adaptation strategies

Results of the logistic regression models are shown in Table 4.5. First, of all socio-demographic variables included in the model, household income and cattle ownership were the only two significant variables that predicted the adoption of adaptation strategies. The odds ratio for household income was 3.09 ($p < 0.001$), which means that with all other variables held constant the odds of households with an annual income of more than 30,000 PKR adopting migration as an adaptation strategy is 3.09 times of the odds of households with lower income. Additionally, heads of cattle owned had a positive relationship with both increasing agricultural inputs and changing crop types as adaptation strategies. Specifically, an increase of one head of cattle owned was associated with a 42% increase of the odds of respondents changing their crop type ($p = 0.033$) and a 62% increase of the odds of respondents increasing agricultural inputs ($p=0.007$).

Second, of the variables measuring perceived social-ecological changes, perceiving agricultural changes was the only significant variable in one model. Specifically, for every one unit increase of perceiving agricultural changes, the odds of respondents' adapting by increasing their agricultural inputs increased 14.37 times ($p < 0.001$) when all other variables were held constant.

Finally, our model results also show how perceptions of adaptation costs were significant in several models that predicted respondents' adaptation decisions. Specifically, our results show that perceiving financial costs had a significant positive relationship with respondents' households changing their domestic water supply (odds ratio=1.63; $p < 0.001$), increasing agricultural inputs (odds ratio=6.02; $p < 0.001$), and engaging in migration (odds ratio=4.58; $p = 0.015$). Perceiving time as a cost of adaptation was positively associated with respondents' households changing domestic water supply (odds ratio=10.34; $p = 0.003$) and migration (odds ratio=2.12; $p = 0.033$). Perceiving labor as a cost of adaptation was positively associated with changing domestic water supply (odds ratio=3.92; $p = 0.019$), migration (odds ratio=2.19; $p = 0.016$), and increasing agricultural inputs (odds ratio=11.86; $p = 0.013$). Perceiving increased uncertainty as a cost was also positively associated with decreasing time fishing (odds ratio=11.43; $p = 0.039$). In addition, perceiving going against opinions of their community leaders as a cost of adaptation was positively associated with decreasing time spent fishing (odds ratio=21.56; $p < 0.001$) and perceiving going against their friends' opinion as a cost of adaptation was also positively associated with engaging in migration as an adaptation strategy (odds ratio=2.52; $p = 0.045$). However, perceiving going against their family members' opinions as a cost of adaptation was positively associated with respondents' households decreasing time fishing (odds ratio = 7.17; $p = 0.030$), but had a significant negative relationship with respondents' households engaging in migration (odds ratio=0.20; $p < 0.001$) and changing their domestic water supply as adaptation strategies (odds ratio=0.37; 0.018).

4.5 Discussion

In the following section we first discuss the results of the models to illustrate how social-demographic factors, perceived social-ecological changes, and perceived costs of adaptation influence adaptation decisions. We then highlight the value tradeoffs that are embedded in

adaptation decisions. Finally, we discuss how these value tradeoffs are a part of the social and cultural contexts in which adaptation decisions are made.

4.6 Household socio-demographic characteristics shape adaptation decisions

Our research identifies two socio-demographic characteristics of a household that shape adaptation decisions. First, respondents' household income was positively associated with using migration as an adaptation strategy. This may be explained by the fact that labor migration often requires a large initial investment to support the relocation of a household member (Mendola, 2008). As such, households with higher income may be more able to employ this adaptation strategy than those with lower household income. Additionally, heads of cattle owned by a household had a positive significant relationship with both increasing agricultural inputs and changing crop types as adaptation strategies. Cattle represent a form of wealth and often serve as a safety net in rural areas around the world, including our research area (Ali & Rahut, 2018). As such, households with more cattle may feel less risk or be more able to invest in agricultural improvements (Rapsomanikis, 2015; Wood et al., 2014). Together, our findings provide further evidence in the context of rural Pakistan that households' financial capital, including livestock ownership, supports their ability to adapt to social-ecological change (Below et al., 2012; Deressa et al., 2009). It is worth pointing out that beyond household income and cattle ownership, no other socio-demographic variables were statistically significant in our models, including age, education, and joint family structure, as suggested in other studies (Asfaw et al., 2019; Below et al., 2012; Croppenstedt et al., 2003; Deressa et al., 2009), however, the trends are similar to other findings (i.e., household size and education of the head have a positive odds ratio with increasing agricultural inputs and migration). This may be because we analyzed adaptation types separately and these indicators have different influences on these specific adaptations. The significance might also change if our sample size increased. Our research context may also influence these findings; for example, the education of the household head may not be an appropriate indicator of the education of the household, especially given past conflict and instability that might have hindered educational attainment (District Disaster Management Plan, 2015; Hye & Khan, 2013). That is, young household members might have more education than the head and might be a better predictor of adaptation. The insignificance of our socio-demographic predictors may also suggest

that the perceived cost of an adaptation may be a more important factor when assessing adaptation decisions.

4.6.1 Perceiving social-ecological changes do not necessarily result in adaptation

Our results extend previous research findings by demonstrating the complex relationships between perceptions of social-ecological changes and decisions to adapt. In our study, perceived changes in the agricultural system (in terms of water supply and crop yield, for example) was positively associated with increasing agricultural inputs as an adaptation strategy. Similar behaviors have been observed in other agricultural contexts as well, showing that farmers who perceive risks to their production are often more likely to adapt or want to adapt (Azadi et al., 2019; Mase et al., 2017).

On the other hand, it is noteworthy that perceiving other social-ecological changes was not significantly associated with adoption of adaptation strategies. For example, perceiving changes in river water and groundwater did not affect respondents' continuous use of domestic water systems even though many respondents did rely on river water or groundwater as their sources of domestic water. These results confirm what has been suggested in previous research—perceiving social-ecological changes does not necessarily lead to adopting adaptation strategies (Bryan et al., 2009; Fosu-Mensah et al., 2012). Rather, it has been shown that it even when respondents perceive climatic changes, lack of access to land, information, and finance may limit their capacity to adapt (Bryan et al., 2009, 2013). Further, perceiving climatic changes may not significantly influence adaptation because households adapt their livelihoods to multiple compounding social, economic, and environmental stressors rather than climate alone (Burnham & Ma, 2018). Indeed, non-climatic factors such as economic, political, and social stressors are often identified as more significant drivers of adaptation decisions than climate (Mertz et al., 2010; Tucker et al., 2010; Yaro, 2013). Overall, our results highlight how perceiving social-ecological changes have varied influence on households' decisions to adapt as they navigate the stressors and risks associated with multiple social-ecological changes simultaneously.

4.6.2 The differentiated role of perceived economic and non-economic costs in shaping household adaptation decisions

In addition to socio-demographic factors and perceived social-ecological changes, our results show that respondents' perceived costs of adaptation also influence their decisions to employ some adaptation strategies. Our results show that perceiving economic costs (finances, time, and labor) had a significant positive relationship with households changing their domestic water supply, increasing agricultural inputs, and engaging in migration as adaptation strategies. In other words, respondents reported employing these adaptation strategies even though they perceived them to be economically costly. It is also worth noting that perceiving financial, time, and labor costs was not significantly associated with decreasing time fishing or changing crop types. Previous research has often identified time, labor, and financial factors as costs of or barriers to adaptation with many studies documenting that these costs decrease households' likelihood of adaptation (Kuang et al., 2019; Silvestri et al., 2012; Tambo & Abdoulaye, 2012; Tessema et al., 2013). Our results contribute to this literature by revealing that economic costs do not necessarily decrease the likelihood of adaptation; rather, there may be other factors (e.g., perceived benefit of the adaptation, the perceived cost amount, etc.) that mitigate economic costs and motivate adaptation decisions. Our results also show that the influence of perceiving economic costs varies across adaptation types. In some cases, economic costs may be expected and accepted costs of adaptation, thus having no effect on adaptation decisions.

In addition to the economic costs of adaptation, we also examined various non-economic costs of adaptation including decreasing certainty and going against cultural tradition and the opinions of family members, friends, and community leaders. Our results show that the perceived opinions of community leaders, friends, and family members have varying influences on households' adoption of different adaptation strategies. In our study, respondents appeared to be largely willing to adapt in ways that go against their community leaders' opinions, for example, to decrease time spent fishing. They also seemed to be willing to go against their friends' opinions in order to migrate. They were less willing, however, to adapt in ways that go against their family members' opinions, particularly in the case of changing domestic water supply and engaging in migration. These results build on and extend multiple strands of previous research on social influence and values.

First, previous research has examined how social influence affects households' decisions to manage and conserve natural resources or adopt environmentally friendly practices, focusing largely on the ways in which actions of individuals and households are shaped by the descriptive and subjective norms in the local context (e.g., Dang et al., 2014; van Valkengoed & Steg, 2019). In some cases, social influence can be "more powerful than cost or considerations such as convenience or effectiveness" (Wolske et al. 2019, p. 202). Indeed, social influence was reflected in our research as the opinions of family members, friends, and community leaders and was shown to be equally if not more influential than economic costs in shaping households' adoption of adaption strategies. However, in a meta-analysis on the impact of social influence on conservation behavior, Abrahamse and Steg (2013) show that the degree to which social influence impacted behavior varied by group identification. That is, social influence has a larger impact on individuals who are strongly identified with their social group than those with weaker group identification. Fielding et al. (2008) find similar trends in their study of sustainable agriculture practices: individuals with strong group identification are predominately influenced by others in their social group, while those with weaker group identification are influenced by behaviors both in and outside their social group. Similarly, a message is known to be more persuasive if it comes from sources that are similar to and liked by the recipient of the message in consumer behavior (Pornpitakpan, 2004) and energy use (Wolske et al., 2020). Therefore, it makes sense that in our research, family members had a strong influence on adaptation decisions due in part to respondents' strong group identification with family members.

What was surprising is the fact that friends and community leaders appeared to have limited influence on adaptation decisions in our study. Previous research has widely documented the importance of peer influence and the influence of opinion leaders in natural resource management and conservation decisions (e.g. Abrahamse & Steg, 2013; Cialdini & Goldstein, 2004; Noll et al., 2014; Wolske et al., 2020). For example, in a recent study of purchases of alternative fuel vehicles in Sweden, neighbors had a stronger influence on the decision than family members or co-workers (Jansson et al., 2017). Our results may be related to the specific cultural context of northwestern Pakistan where it has long been shown that the value of familial ties is fundamental (Ahmed, 2004; Akbar, 1980; Lindholm, 1982); therefore, opinions of family members may be more important than opinions of others when making adaptation decisions. More importantly, our results reveal

that the extent to which social influence from various actors or sources affects decision-making may shift based on the decision in question and the different contexts in which decisions are made.

Furthermore, our research provides further empirical evidence of the role of culture and cultural values in shaping the types of adaptation employed or rejected (Adger et al., 2013; Ford et al., 2006; Nielsen & Reenberg, 2010; O'Brien, 2009). Specifically, while our respondents were largely willing to sacrifice money, time, labor, and the opinions of friends and community leaders when employing a specific adaptation strategy, they were less likely to go against the opinions of family members. In the field of psychology, values tied to moral beliefs and/or religious or ethnic identity are often identified as sacred values (Atran & Axelrod, 2008; Fiske & Tetlock, 1997; Tetlock, 2003), a category in which familial ties often fall. These values are often considered to be inviolable and immune to compromise or trade-off; however, it is increasingly argued that growing resource scarcity and intensifying social-ecological changes will drive the need to trade off even these sacred values (Tetlock, 2003; Tschakert et al., 2017). This is reflected in our respondents' decisions to decrease time spent fishing as an adaptation strategy even when they had to go against family members' opinions. This is in contrast to their decreased likelihood to change their domestic water supply or engage in migration when they perceived that these adaptations would go against family members' opinions. We argue that this is likely due to the severity of change observed in the fish population. Indeed, the decline of fish (number and size) in the Swat and Kabul Rivers has been increasingly documented due to industrial pollution, solid waste disposal, and overfishing (Nafees et al., 2011; Young et al., 2019; Yousafzai et al., 2008). Over three quarters of our respondents also reported observing a decline in fish number and size in the past ten years. Therefore, respondents may be driven by the depleting fish resources to decrease the time they spent fishing despite their family's different opinions about this traditional livelihood in the research area. In the case of other adaptation strategies we studied, it may seem less necessary to go against family members' opinions; as such, a tradeoff of this sacred value (i.e., familial ties) could be avoided.

It is important to keep in mind that there may be other possible explanations regarding the difference in how family members' opinions shape households' decisions to employ different adaptation strategies. For example, it could be due to the weights given to different family members with different opinions about an adaptation strategy (e.g., the effect may be different if a sister disagrees rather than a father). Therefore, further work is needed to examine the nuanced

influence of various family members in adaptation decision-making. In addition, our study highlights a need to better identify the social-ecological conditions under which some sacred values such as familial ties may be traded off to support certain adaptation decisions and how such tradeoffs of sacred values may continue to shape future adaptation options.

4.7 Conclusion

Overall, our research illustrates that influences of adaptation decisions go beyond the constraints of finances, time, and labor which have been a strong focus of many adaptation studies. Particularly, family members' opinions have significant influence on what adaptation strategies are employed or not. Specifically, our study participants were unlikely to adapt if they perceived an adaptation would require a tradeoff between adaptation and their family members' opinions. Therefore, we argue that while it is important to help rural households to remove economic constraints in their adaptation decision-making processes, it is also important to recognize non-economic values that influence what adaptation strategies individuals and households are willing to employ. In some cases, these non-economic values may be more influential than considerations of the economic costs associated with adaptation.

Relatedly, our research highlights the additional work needed to understand how social influence from various groups of people influence adaptation decisions. Much work has been done to show how individuals' adaptation decisions are shaped by their family members, friends, and neighbors (Dang et al., 2014; van Valkengoed & Steg, 2019); however, little has been done to tease out how the influence of these groups may vary. Particularly, identifying the conditions under which individuals are willing to counter the influence of others would greatly contribute to understanding of how disagreements among families, friends, and community or opinion leaders are negotiated in adaptation decisions at the individual and household scales.

Finally, our research confirms previous research by demonstrating that perception of social-ecological change do not necessarily lead to adaptation decisions; rather, various social, economic, and cultural factors, along with perceived social-ecological changes, may together shape individuals' and households' decisions to employ an adaptation strategy. At the same time, our research provides further evidence suggesting that as social-ecological changes intensify, individuals and households' willingness to adapt may also increase, and in some cases this may

even necessitate trading-off sacred values in an effort to adapt to intensified social-ecological changes that are fundamental to people's livelihoods.

Table 4.1 Background information of the two districts in our research area

	Swat	Nowshera
Communities sampled	Madyan, Landakay	Jehangira
Number of household surveys	300	148
River in research area	Swat	Kabul
Demographics		
Population	2,309,570	1,518,540
Number of HH	274,620	198,808
Average HH size	8.8	7.7
% employed in agriculture	50.1%	25.1%
Average HH income (PKR, KP region)		35,391
Average farm size (ha, KP region)		1.5
Sources: Pakistan Bureau of Statistics: Provisional Summary Results of 6th Population and Housing Census; Pakistan social and Living Standards Measurement Survey; Agricultural Census		

Table 4.2 Principal component loadings of perceived social-ecological changes

Survey items: perceived change in respondents' community in the past ten years	Description	% of respondents perceiving a change	Rotated principal component loading				
			Tourism changes	Agricultural changes	Groundwater changes	Solid waste changes	Fish changes
Decrease in domestic water quantity	Binary-1, if change is perceived; 0, if otherwise	37			0.75		
Decrease in domestic water quality	Binary-1, if change is perceived; 0, if otherwise	46			0.72		
Decrease in groundwater quality	Binary-1, if change is perceived; 0, if otherwise	31			0.79		
Decrease in groundwater quantity	Binary-1, if change is perceived; 0, if otherwise	37			0.72		
Decrease in irrigation water quality	Binary-1, if change is perceived; 0, if otherwise	19		0.88			
Decrease in irrigation water quantity	Binary-1, if change is perceived; 0, if otherwise	16		0.90			
Decrease in yield	Binary-1, if change is perceived; 0, if otherwise	36		0.55			
Increase in waste on surface of river	Binary-1, if change is perceived; 0, if otherwise	90				0.75	
Increase in waste on shore of river	Binary-1, if change is perceived; 0, if otherwise	93				0.83	
Increase in tourist number	Binary-1, if change is perceived; 0, if otherwise	47	0.66				
Increase in hotels	Binary-1, if change is perceived; 0, if otherwise	48	0.89				
Increase in restaurants	Binary-1, if change is perceived; 0, if otherwise	50	0.89				
Decrease in fish number	Binary-1, if change is perceived; 0, if otherwise	89					0.83
Decrease in fish size	Binary-1, if change is perceived; 0, if otherwise	78					0.82
Decrease in river water quality	Binary-1, if change is perceived; 0, if otherwise	95					
Cronbach's alpha			0.76	0.71	0.76	0.83	0.61

Table 4.3 Response variables used in the empirical models for estimating adaptation to social-ecological change and corresponding descriptive statistics

Adaptation strategies adopted in the last ten years	Description	% of respondents
Increased agricultural inputs	Binary-1, if HH increased inputs; 0, if otherwise	35
Migration	Binary-1, if HH member moved; 0, if otherwise	30
Decreased time fishing	Binary-1, if HH decreased time fishing; 0, if otherwise	21
Changed domestic water supply	Binary-1, if HH changed domestic water supply, 0, if otherwise	12
Changed crop types	Binary-1, if HH changed crop type; 0, if otherwise	10

Table 4.4 Explanatory variables used in the empirical models for estimating adaptation to social-ecological change and corresponding descriptive statistics

Socio-demographic characteristics	Description	Mean (range; std. dev.) or % of respondents
Age of household head	Continuous-years	39.4 (19-77; 12.9)
Education of household head	Continuous-years	8.4 (0-18; 5.5)
Household size	Continuous-persons	10.1 (2-35; 5.3)
Joint family structure	Binary-1, if multi-generational families with two or more married children; 0, if otherwise	57.6
Size of land in agricultural production	Continuous-hectares of owned and rented land in agricultural production	3.2 (0-151.8; 15.0)
Household income over 30,000 PKR	Binary-1, if HH income over 30,000 PKR; 0, if otherwise	55.7
Household member in a past or current leadership position	Binary-1, if HH member has held a formal or informal leadership position; 0, if otherwise	14.5
Ownership of cattle	Continuous-heads of cattle owned	2.6 (1-12; 1.9)
Perceived social-ecological changes		
PCA measuring perceiving changes in tourism	Continuous (principal component loadings, see Table 1)	0.49 (0-1; 0.47)
PCA measuring perceiving changes in the agricultural system	Continuous (principal component loadings, see Table 1)	0.18 (0-1; 0.35)
PCA measuring perceiving changes in groundwater	Continuous (principal component loadings, see Table 1)	0.21 (0-1; 0.37)

Table 4.4 continued

PCA measuring perceiving changes in solid waste	Continuous (principal component loadings, see Table 1)	0.89 (0-1; 0.25)
PCA measuring perceiving changes in fish populations	Continuous (principal component loadings, see Table 1)	0.77 (0-1; 0.28)
Perceiving decrease in river water quality	Binary-1, if change is perceived in past 10 years; 0, if otherwise	95
Perceived costs of adaptation		
Financial cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	92
Time cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	64
Labor cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	58
Family opinion cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	43
Cultural tradition cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	18
Certainty cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	16
Friends' opinion cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	13
Leaders' opinion cost	Binary-1, if cost is perceived in past 10 years; 0, if otherwise	6

	Decreased time fishing			Changed crop type			Changed domestic water supply			Migrated			Increased agricultural inputs		
	Odds ratio	95% CI		Odds ratio	95% CI		Odds ratio	95% CI		Odds ratio	95% CI		Odds ratio	95% CI	
Age of household head	1.01	0.94	1.09	0.97	0.93	1.02	1.01	0.98	1.04	1	0.98	1.02	1.03	0.99	1.07
Education of household head	0.92	0.79	1.08	0.95	0.85	1.06	1.04	0.96	1.13	1.01	0.95	1.07	1	0.91	1.11
Household size	0.94	0.77	1.14	1.08	0.99	1.18	1.01	0.93	1.09	1.03	0.98	1.09	1.03	0.95	1.12
Joint family structure	0.3	0.05	1.76	0.7	0.21	2.32	1.01	0.44	2.33	1.53	0.86	2.69	0.54	0.17	1.75
Land size in agricultural production	1	0.96	1.05	1.01	0.98	1.03	1	0.95	1.04	0.98	0.95	1.01	1.01	0.99	1.03
Household income over 30,000 PKR	2.16	0.42	11.06	1.09	0.36	3.32	0.82	0.37	1.8	3.09*	1.77	5.4	1.46	0.46	4.6
Household member in leadership position	2.11	0.29	15.51	0.73	0.18	2.99	1.75	0.65	4.66	0.89	0.42	1.86	0.29	0.06	1.28
Ownership of cattle	1.17	0.68	2.02	1.42*	1.03	1.96	0.8	0.58	1.12	0.96	0.78	1.18	1.62*	1.18	2.22
Perceiving decrease in river water quality	3.51	0.1	22.15	2.07	0.19	22.4	0.56	0.1	3.1	0.47	0.15	1.46	0.15	0.01	1.71
PCA measuring perceiving changes in fish populations	3.14	0.09	10.3	1.86	0.26	13.22	4.5	0.87	23.21	1.11	0.47	2.61	11.46	1.08	21.26
PCA measuring perceiving changes in tourism	1.47	0.33	6.61	0.7	0.23	2.13	0.7	0.31	1.58	0.89	0.5	1.57	0.32	0.11	0.97
PCA measuring perceiving changes in the agricultural system	0.68	0.06	7.99	3.69	0.86	15.84	0.92	0.31	2.75	0.62	0.27	1.41	14.37*	3.74	55.21
PCA measuring perceiving changes in groundwater	0.27	0.02	2.97	0.32	0.07	1.44	0.77	0.31	1.9	0.67	0.33	1.37	0.8	0.22	2.83
PCA measuring perceiving changes in solid waste	16.08	0.16	19.35	0.42	0.07	2.38	1.08	0.24	4.89	1.12	0.39	3.22	5.72	0.4	80.84
Financial cost	1.63	0.06	44.43	2.81	0.73	10.87	8.48	3.85	18.72	4.58*	1.32	15.93	6.02*	3.27	11.1
Time cost	10.34	0.81	31.62	0.59	0.15	2.39	6.34	1.82	22.1	2.12*	1.08	4.18	0.51	0.1	2.73
Labor cost	0.87	0.15	5.2	3.19	0.73	13.97	3.92*	1.32	11.63	2.19*	1.15	4.18	11.86*	1.75	80.6
Family opinion cost	7.17*	0.96	53.36	0.36	0.09	1.38	0.37*	0.16	0.83	0.20*	0.11	0.37	0.52	0.16	1.75
Certainty cost	11.43*	1.41	92.44	1.59	0.45	5.66	0.98	0.32	2.99	1.8	0.91	3.58	2.18	0.48	9.84
Cultural tradition cost	0.49	0.09	2.66	0.77	0.18	3.28	0.36	0.13	1.03	0.82	0.39	1.68	1.01	0.26	3.93
Leaders' opinion cost	21.56*	4.59	30.27	2.12	0.4	11.32	1.43	0.33	6.26	1.95	0.7	5.43	1.01	0.17	5.95
Friends' opinion cost	1	0.16	6.36	2.72	0.65	11.4	0.68	0.19	2.43	2.52*	1.09	5.8	0.43	0.08	2.38
VIF	2.5			2.3			2.1			2.5			2.2		
LR chi-squared (23)	66.16			34.03			90.28			108.23			174.1		
Psuedo R ²	0.5			0.19			0.28			0.2			0.55		
*p < 0.05															

CHAPTER 5. CONCLUSION

5.1 Overview

The complexity of social-ecological change creates specific contexts in which households employ a diverse array of adaptation strategies. Unique climatic and non-climatic conditions make households' autonomous adaptation particularly significant in that these strategies can draw on households' existing knowledge and resources in order to adapt in ways that are specific to their social-ecological context (Agrawal & Perrin, 2009; Gentle & Maraseni, 2012; Lemos et al., 2013). It is understood that households' adaptation decisions are influenced by multi-scalar factors including their demographics, perceptions of change (Bryan et al., 2009; Shisanya & Khayesi, 2007), access to capital (Asfaw et al., 2019; Below et al., 2012; Croppenstedt et al., 2003; Deressa et al., 2009) as well as political processes (Hageback et al., 2005), power relations (Feola et al., 2015; McDowell & Hess, 2012) and social influence (Abrahamse & Steg, 2013). In addition, scholars have increasingly demonstrated the influence of values in adaptation decisions (Kuruppu, 2009; K. L. O. O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013), however, little has been done to assess how these values interact in the decision-making process.

This dissertation research aimed to contribute to understanding of adaptation to social-ecological change and the role of values in adaptation decision-making in three ways. First, we demonstrate that adaptation decisions are driven by multiple social, environmental, and economic stressors and influenced by both the cultural context in which the decisions are made, as well as the social, economic and demographic characteristics of the household. Second, our research shows that adaptation decisions involve more than just economic costs and often require the sacrifice of tradition or family opinion. These latter costs were most likely to deter farmers and fishers from adapting to social-ecological change in the context of this research. Finally, we posit that these economic and non-economic costs point to the value tradeoffs associated with adaptation decision-making. Most work done on value tradeoffs examines the individual decision-maker, however, we show that the decisions to tradeoff, or sacrifice, economic and non-economic values are embedded in the broad socio-environmental context of the decision-maker.

5.2 Synthesis of findings and contributions

In this section, I discuss in more detail the four contributions of this dissertation research that were summarized in section 5.1. First, we found that the ways farmers and fishers adapted to multiple social-ecological stressors in northwestern Pakistan were embedded in the social and cultural contexts of the research area. Their decisions to adapt were influenced by multiple social-economic demographics and their perception of social-ecological changes. Specifically, households frequently employed environmental management and livelihood diversification. Additionally, communal pooling was supported by the traditionally strong social networks across extended families in the research area and was often utilized to enable further adaptations.

Relatedly, we also build on previous research showing that perceptions of change do not necessarily dictate adaptation to that change, rather it is influenced by complex social, ecological, economic, and political drivers (Deressa et al., 2011; Fosu-Mensah et al., 2012; Mertz et al., 2009; Mubaya & Mafongoya, 2017). Our research confirms previous studies illustrating how multiple forms of social and financial capital including education, age, and land ownership increase the likelihood that respondents will adapt to social-ecological change (Asfaw et al., 2019; Below et al., 2012; Croppenstedt et al., 2003; Deressa et al., 2009). Specifically, the joint family structure common among the Pashtun communities in the research area increased households' adaptive capacity through their greater access to social and human capital in comparison to nuclear families.

This research specifically reminds us to acknowledge household structures other than that of the nuclear family, and relatedly, to expand our understanding of household decision-making to include cooperation beyond husbands and wives. Current research on household decision-making often focuses on negotiations between the husband and wife (Acosta et al., 2020; Doss & Meinzen-Dick, 2015; Singh et al., 2016); however, we posit that research on household natural resource decisions must acknowledge the inclusion of other family members in the decision-making process in order to more accurately understand and portray household negotiations. This allows us to have a more nuanced understanding of the actors involved in household decision-making and can further help us appropriately target outreach and education programs to all actors involved in the decision-making process.

Together, these findings reveal the ways adaptation strategies are influenced by the social and cultural processes in which the adaptations are made. For instance, communal pooling has been one of the least reported strategies in other contexts (Burnham & Ma, 2016) and household

structure is rarely assessed in terms of adaptive capacity, but our research shows that these were both important aspects of farmers' and fishers' adaptations in our research area, due in part to the cultural importance of family networks (Ahmed, 2004; Akbar, 1980; Lindholm, 1982). This confirms calls for nuanced context-specific assessments of climate change adaptation that can support adaptation policies and practices that align with existing strategies and practices (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013).

Second, previous research has established the importance of economic costs associated with adaptation practices (Esham & Garforth, 2013; Koerth et al., 2013; Poussin et al., 2014; Tessema et al., 2013). In our study economic costs are commonly identified, however, they do not appear to be the sole deterrent away from adaptation, rather labor, time, and finances seem to be in expected and accepted costs of adaptation. However, it was the cost of going against family members' opinions that was most likelihood to prevent our respondents from adapting. In contrast, their willingness to adapt against their friends' and community leaders' opinion shows that the degree to which social influence sways decisions varies. In a context in which loyalty to family and tradition is highly valued (Ahmed, 2004; Akbar, 1980; Lindholm, 1982) this also reveals how social influence is embedded in the cultural context in which the decision is made.

Third, we posit that this identification of how costs influence the decision to adapt allows us to assess the economic and non-economic values that respondents are willing or unwilling to tradeoff in order to adapt. Previous research on values has drawn largely on qualitative methods to identify the impact of social-ecological change on values and the ways the values influence adaptation (Kuruppu, 2009; O'Brien, 2009; Tschakert et al., 2017; Wolf et al., 2013). We build on this research by using mixed methods to not only identify values at play in adaptation decisions, but to understand the differences in how these values influence a variety of adaptation decisions. For instance, a respondent's willingness to migrate despite its financial costs indicates that they are willing to tradeoff that value in order to adapt in that way. However, they may not be willing to migrate if their family disapproves. Thus, our research builds on previous studies examining the presence of values in adaptation decision-making by exploring the differences in influence across values and adaptation strategies, and particularly how values are traded off in the decision-making process.

Value tradeoffs have long been established as significant aspects of individual decision-making process (Barlas, 2011; Fiske & Tetlock, 1997; Tetlock, 2000). Indeed, "tradeoffs are

arguably the most pervasive aspect of choice. More explicitly, if there are no tradeoffs to resolve, there is either only one option or one option dominates the others. In either case, active decision-making is not necessary. Because tradeoffs have such a prominent role in choice, understanding how people make them is critical” (Luce et al., 2001, p. 3). We demonstrate that adaptation decisions do indeed involve tradeoffs of both economic and non-economic values. In addition to these individual decisions, however, our research shows that multi-scalar social, cultural, economic, and political processes can conflict with households’ value tradeoffs, limit their adaptive capacity, and exacerbate maladaptive outcomes. Therefore, the success of adaptation should not be defined merely by its response to the environmental conditions of financial viability, rather our research demonstrates the need for adaptation strategies that align with the values of the decision-maker. Therefore, decisions about what adaptation strategies might be acceptable and appropriate for a given context must go beyond economic or environmental assessments to include how it aligns with stakeholder values.

Finally, we posit that individuals’ willingness to tradeoff values is driven both by the social context that influence the importance of the value, as well as the intensity of social-ecological change. That is, respondents will be less likely to tradeoff values considered to be sacred in their context, however, our research suggests that values may be fluid and change over time. For example, respondents will be unlikely to tradeoff their families’ opinions for the majority of adaptation strategies, however, when it came to exiting fishing, it appeared that they were willing to tradeoff that value. The decreasing fish population was one of the most commonly reported change so this tradeoff could be because of the difficulty of maintaining fishing as a viable livelihood strategy. Indeed, Tschakert et al. (2017) state that individuals tend to “elevate the importance assigned to values they can readily attain and relegate those whose pursuit is blocked to lesser importance” (p. 5). Therefore, while some values may remain static, we confirm findings suggesting that values and associated tradeoff decisions can shift with societal transformations and environmental change (O’Brien, 2009; Schwartz & Bardi, 1997).

5.3 Future research directions

Along with other empirical studies on adaptation, this dissertation research has provided further evidence that adaptation to social-ecological change is context specific; and more importantly, this research highlights a need for a more comprehensive understanding of the role of

values in adaptation in areas beyond northwestern Pakistan. Specifically, it will be beneficial to know what values matter more or less in the context of adaptation decision-making, how such values vary across social-cultural contexts, and how individuals and households from other social-cultural contexts navigate value tradeoffs in adaptation decision-making. That is, the same values that decreased the likelihood of individuals' adaptation in our study area may not have the same effect in another area. For instance, individuals in our context were less likely to migrate if they perceived that their family would not approve. In another context, however, individuals may be willing to go against their family members' opinions in order to migrate, due perhaps in part to differing values placed on family ties, or varying opportunities and stressors. Differences in values and value tradeoffs across adaptation contexts may be key to identify what adaptation strategies are appropriate and help inform adaptation policies and programs that will likely generate positive outcomes for individuals and households in specific social-ecological contexts. Informed by previous literature on adaptation and the results from this dissertation research, we have developed a conceptual framework (Figure 5.1) to guide future assessments of value tradeoffs in adaptation decision-making. This dissertation research has examined specific components of this framework, largely focusing on decision-makers' values and the contextual factors of household demographics and socio-cultural characteristics that lead to an adaptive decision. In addition, it has focused on decision-making processes at the individual and household scales with limited discussion of the ways that these decisions are embedded in regional processes.

As such, in reference to the framework presented in Figure 5.1, more empirical work is needed on the other components to more fully understand the process through which value tradeoffs influence multi-scalar adaptation to social-ecological change. Specifically, further work should include other factors that are likely to influence value tradeoffs such as the social context within which adaptation decisions are made (i.e., if the decision is made in public or private, if the decision influences others), perceived importance of the decision to the decision-maker, degree to which value tradeoff has a negative impact on the decision-maker, and cognitive load of different kinds of value tradeoffs on the decision maker (Luce et al., 2001). At the individual level, religion has also been shown to be an important part of shaping values as they relate to the environment (Christie et al., 2019; Ives & Kidwell, 2019) and some work has begun to study the ways religion impacts adaptation decisions (Kuruppu, 2009). In the context of northwestern Pakistan, additional data on how religious values influence the acceptability of adaptation decisions would build on

initial work exploring this influence. For instance, several studies have shown that farmers in this area prefer to borrow money from family or friends rather than using formal loans because Islam forbids receiving or giving loans with interest (Saqib et al., 2016). While we did not ask questions about religion in this survey (following recommendations by local experts) due to the cultural and political contexts of the area, future work would benefit by addressing this issue if at all possible, especially in an area like northwestern Pakistan where religion is tightly connected to decision-making processes, social hierarchies, and social norms (Ahmed, 2004; Akbar, 1980; Lindholm, 1982). However, due to the sensitive nature of religion in some contexts, other methods such as interviews or participant observation may be more helpful than survey to address related research questions.

Due to the multi-scalar nature of adaptation, how individual and household decision-making processes unfold, as well as the outcomes of these decisions, should also continue to be examined explicitly in relation to other scales (i.e., spatial or temporal) in order to understand the ways in which decisions at one scale manifest across time and space (Adger et al., 2003; Burnham & Ma, 2018; Pittock, 2011). A multi-scalar assessment also builds on previous work arguing that adaptation is a political process in which power is reproduced, contested, and a mediator of vulnerability (Birkenholtz, 2012; Eriksen et al., 2015). As O'Brien and Wolf (2010) state, “a values-based approach has political implications, for it inevitably points to the role of power hierarchies and interests in prioritizing the values of some over those of others” (p. 239). An assessment of values, therefore, will add to our understanding of the political nature of adaptation decisions, that is, all adaptation processes are embedded in systems of authority that influence whose interests and values hold more power (Eriksen et al., 2015).

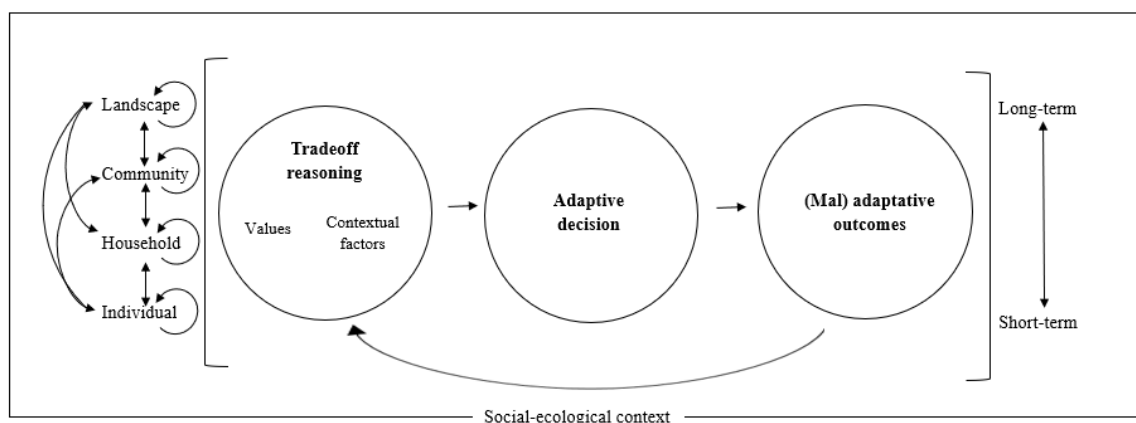


Figure 5.1 Conceptualization of multi-scalar tradeoffs in adaptation decision-making

Overall, understanding whose values are prioritized in adaptation tradeoff decisions allows us to build upon past research showing how adaptation is embedded in the existing political economy (Sovacool et al., 2015). That is, whose values are elevated in the decision-making process may be, in part, reflective of existing distribution of power and thus exacerbate existing inequalities and differentiated vulnerabilities (O'Brien & Wolf, 2010). While this dissertation focused largely on household-level data, further research would benefit from multi-scalar data to better understand these political processes. Specifically, additional data from decision-makers across scales would allow us to understand how adaptation decisions at various scales conflict or support each other, and whose values are prioritized when the values conflict. For instance, in this research it would be beneficial to have further data from regional decision-makers on hydropower construction or tourism development. This might allow us to examine what values influence their decisions about regional adaptation strategies to better understand how their values and associated adaptation decisions relate to household values and decisions. In addition, this framework also points to interactions within one scale. For example, additional data from multiple members of one household (i.e., husband and wife or father and brother) would allow us to further understand intra-household decision making. Specifically, an assessment of values would allow us to examine what values within a household align, whose values are prioritized when they differ, and how tradeoffs are negotiated when values within a household conflict. This moves us away from solely assessing what adaptation strategies are employed to instead understanding the values underlying the adaptation decisions (O'Brien and Wolf, 2010) which in turn can serve as an initial step towards promoting or assisting strategies that align with the values of those who are traditionally marginalized in decision-making processes.

In addition to an assessment of values, our work shows that an assessment of household structure may improve our understanding of capital and associated power across households. Often, adaptation can enforce what Sovacool and Linner (2016) describe as economic entrenchment or worsening social inequality because “it is typically wealthier households that possess the requisite assets to maintain resilience in the face of climate change” (p. 26). In our case, joint families’ social network may support their resilience while also increasing inequality between joint families and nuclear families. This builds on previous work showing that social networks and the often-associated political capital increases adaptive capacity (Birkenholtz, 2012). Therefore, further research is needed to examine how household structure contributes to capital and adaptation in

other research areas to broaden our understanding of the many socioeconomic factors that contribute to the distribution of power and wealth. Caste and ethnicity has also been shown to influence adaptive capacity and social networks (Nagoda & Nightingale, 2017; Onta et al., 2011); therefore, further research in Pakistan or similar contexts would benefit from additional data on how these variables relate to power, access to capital, and values in adaptation.

Finally, previous research has shown that values can shift under societal and environmental transformations (O'Brien, 2009; Schwartz & Bardi, 1997). This dissertation research further suggests that values might shift under environmental stress; as mentioned above, we posit that fishers reported decreasing time fishing despite family disagreement due in part to the severity of stress in this sector. Based on this result and the existing literature, we further hypothesize that adaptive or maladaptive outcomes influence values and contextual factors of decision-makers over time. In other words, values are continuously producing and are produced by the adoption of various adaptation strategies. Therefore, we suggest that long-term research is needed to assess how changes in values may occur over time and specifically, how individuals' willingness to tradeoff certain values may shift under varying social-ecological conditions. Interdisciplinary research that includes panel surveys or other forms of longitudinal studies alongside continuous climatic and other ecological monitoring data could enable us to examine if and how values shift alongside social, economic, and environmental changes. An assessment of changing values will inform adaptation policies that are flexible and responsive to these shifts. That is, if an adaptation strategy no longer aligns with stakeholder values, policies and other support mechanisms need to be able to respond to accommodate these shifts. These flexible and responsive policies will improve our support of adaptation strategies that align with stakeholders' values and thus promote sustainable and equitable adaptation to ongoing social-ecological change.

APPENDIX A. INTERVIEW PROTOCOLS

Household interview protocol

Interviewer:

Interview Number:

Location:

Date and Time:

Section 1 Individual/household demographics

1. Would you please tell us a little bit about you and your family?

Prompt: What do you do for a living?

Prompt: How long have you lived here?

Prompt: Who do you live with?

Prompt: What are your household's sources of income?

Prompt: Do you receive income from farming or fishing?

Prompt: Does your household receive remittances from labor migrants?

Prompt: Do you work in the tourism industry?

2. To what extent do you think your family's needs are being met?

Prompt: Are there specific needs of your family that are not met sufficiently?

Prompt: Do you feel you have sufficient income to support your household's needs?

Prompt: What additional opportunities or sources of income have you sought to improve your family's living?

3. What challenges do you face when doing____(fill in the blank by interviewer based on response to sources of income) to support your household?

Prompt: Is there variation in your income from____(fill in the blank by interviewer based on response to sources of income) from time to time?

Prompt: Is there too much competition in these industries?

4. Normally when you need to make a decision about__(fill in the blank by interviewer based on response to sources of income), where do you go for support or information to make making your decision?

Prompt: Do you discuss with your family before making a decision?

Prompt: Do you tend to make your decisions on your own without consulting anyone else?

Prompts: Do you participate in a farmer or fishing organization? If so, do you get information and help from them?

Prompts: Do you talk with community leaders?

Prompts: Are there farmers, fishers, or family members you consult?

5. Do you have any formal or informal leadership role in our community? Could you please describe what that entails?

Section 2 Farming and irrigation water

Next, I would like to ask you about irrigation water.

6. You mentioned earlier that you farm, what crops do you plant?
7. Do you plant these crops for food in your household, do you sell them for cash, or both?

Prompt: If you sell your crops, where do you sell them?

Prompt: If you sell your crops, who in your household is responsible for selling them?

8. How do you irrigate your crops?

Prompt: How often do you irrigate?

Prompt: Where do you get water to irrigate your crops?

Prompt: Do you feel you have enough water to irrigate crops as needed?

Prompt: What happens if there is not enough water to irrigate your crops?

Prompt: Who irrigates your fields?

Prompt: Who makes decisions about how much and when to irrigate?

Prompt: Are there fees you have to pay to use water to irrigate your crops? If so, who in your household is responsible for paying the fees?

9. Based on your experience, has the availability of water for irrigation changed in the past 10 years?

Prompt: If so, how has the availability changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

10. Based on your experience, has the quality (e.g., cleanness) of water for irrigation changed in the past 10 years?

Prompt: If so, how has the quality changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

11. What factors do you think have influenced irrigation water availability?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

***Prompt:** Has policy or enforcement changed?*

***Prompt:** Has hydropower or other development influenced flow?*

***Prompt:** Has competition between users increased or decreased?*

12. What factors do you think have influenced irrigation water quality?

***Prompt:** Has infrastructure improved or deteriorated?*

***Prompt:** Have management practices changed?*

***Prompt:** Has policy or enforcement changed?*

***Prompt:** Have pollutants increased or decreased?*

13. Can you list some of the ways you responded to changes to irrigation water supply?

***Prompt:** Do you irrigate more or less frequently?*

***Prompt:** Do you plant more drought resistant crops?*

***Prompt:** Do you plant more or less crops?*

***Prompt:** Do you pay more or less for water?*

***Prompt:** Do you find other income sources?*

***Prompt:** Do you find another water source [buy private water, go farther for source, dig new well]?*

14. Do you know how irrigation water is managed in your community? If so, would you briefly describe?

***Prompt:** Are there institutions that make decisions?*

***Prompt:** Are there organizations or individuals responsible for enforcing regulation?*

***Prompt:** Who participants in these organizations and how do they function?*

***Prompt:** Are there groups that are responsible for resolving conflicts?*

Section 3 Domestic water use

Next, I would like to ask you similar questions, but these are about domestic water- water your household uses for drinking, cooking and cleaning.

15. How do you get water for household use?

***Prompt:** Do you use the same source for drinking, cooking, and cleaning?*

***Prompt:** Do you have a tap in the house?*

***Prompt:** Do you use water from a well?*

***Prompt:** Do you use a tap on the street?*

***Prompt:** Do you use river water?*

Prompt: How do you store water for your household?

Prompt: Do you treat the water you use?

Prompt: If you don't have direct access in your house to water, who is responsible for getting water?

Prompt: Are there fees you have to pay for domestic water? If so, who in your household is responsible for paying the fees?

16. Based on your experience, has the availability of domestic water changed in the past 10 years?

Prompt: If so, how has the availability changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

17. Based on your experience, has the quality (e.g., cleanness) of water for irrigation changed in the past 10 years?

Prompt: If so, how has the quality changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

18. What factors do you think have influenced domestic water availability?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Has competition between users increased or decreased?

19. What factors have influenced domestic water quality?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Have pollutants increased or decreased?

20. Can you list some of the ways you responded to changes to domestic water supply?

Prompt: Do you use more or less water for cooking?

Prompt: Do you use more or less drinking water?

Prompt: Do you use more or less water for cleaning?

Prompt: Do you pay more or less for water?

Prompt: Do you find other water sources [private water, go farther for source, dig new well]?

21. Do you know how domestic water is managed in your community? If so, would you briefly describe?

Prompt: Does your community have a central location for storage?

Prompt: Does the community treat the water before it is distributed?

Prompt: How is wastewater handled in your community?

Prompt: Are there institutions that make decisions?

Prompt: Are there organizations or individuals responsible for enforcing regulation?

Prompt: Who participants in these organizations and how do they function?

Prompt: Are there groups that are responsible for resolving conflicts?

Section 4 Fisheries

Now I would like to hear about your household's involvement in fishing.

22. What is the role of fishing in your household?

Prompt: Do you fish for household consumption?

Prompt: Do you engage in fish farming/aquaculture?

Prompt: Do you sell your catch? How?

Prompt: Are there fees associated with fishing licenses/the right to fish?

Prompt: Who fishes in your family?

Prompt: Who is responsible for selling the catch?

23. Based on your experience, have the fish resources [size, number, type] changed in the past 10 years?

Prompt: If so, how has the changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

24. What factors do you think have influenced fish resources?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Have pollutants increased or decreased?

Prompt: Has hydropower or other development influenced flow?

Prompt: Has competition between users increased or decreased?

25. Can you list some of the ways you respond to the changes in fish resources?

Prompt: Do you fish more or less?

Prompt: Do you invest in different equipment?

Prompt: Do you find other income sources?

Prompt: Do you fish in other locations?

26. Do you know how fisheries are managed in your community? If so, would you briefly describe?

Prompt: Are there institutions that make decisions?

Prompt: Are there organizations or individuals responsible for enforcing regulation?

Prompt: Who participants in these organizations and how do they function?

Prompt: Are there groups that are responsible for resolving conflicts?

Section 5 Development

Finally, as we finish up this interview, I would like to hear your perspective on the development of the pharmaceutical industry, hydropower and tourism in the area.

27. Based on your experience, what have been the impacts of pharmaceutical industry development for your household?

Prompt: Has the development provided jobs?

Prompt: Have you seen a change in water quality?

28. Based on your experience, what have been the impacts of tourism development for your household?

Prompt: Has the development provided jobs?

Prompt: Have you seen a change in water quality?

29. Based on your experience, what have been the impacts of hydropower development for your household?

Prompt: Have you seen a change in the power supply?

Prompt: Have you seen a change in water flow?

Prompt: Have the projects provided jobs?

30. Is there another type of industry that has impacted your household we should know about? If so, what have been the impacts of this industry on your household?

Prompt: Have you seen a change in the power supply?

Prompt: Have you seen a change in water flow?

Prompt: Have the projects provided jobs?

Those are all the questions I have. Is there anything else you would like to share about the topics we discussed?

Thank you so much for your time.

Community leader interview protocol

Interviewer:

Interview Number:

Location:

Date and Time:

Section 1 Leadership role and community characteristics

1. Would you tell us a bit about your community?

Prompt: What are the major employment opportunities?

Prompt: What are the main groups of people who live here?

Prompt: What have been significant events in the past year?

2. Would you tell us a bit about your leadership role in the community?

Prompt: What are your responsibilities?

Prompt: How long have you held this position?

Prompt: How did you obtain this position?

Prompt: What other individuals do you work with in this role?

3. Are there any groups of people and/or organizations who manage day-to-day affairs in your community?

Prompt: Are there fishing cooperatives?

Prompt: Are there women's organizations?

Prompt: Are there water user associations?

Prompt: Are there any environmental, development or other types of NGOs in the area?

4. Are there any groups of people and/or organizations who make major decisions about your community?

Prompt: Are there fishing cooperatives?

Prompt: Are there women's organizations?

Prompt: Are there water user associations?

Prompt: Are there any environmental, development or other types NGOs in the area?

5. What changes have you seen in this community in the past__(fill in the blank with length of time in leadership role)?

Prompt: Have there been positive changes?

Prompt: Have there been negative changes?

Prompt: *Have population demographics changed?*

Prompt: *Have sources of income for the community changed?*

Prompt: *Has infrastructure changed?*

6. What challenges do you face as _____ (fill in the blank by interviewer based on response to role)?

Prompt: *What factors make this role difficult?*

Prompt: *What barriers do you face when working in this role?*

Section 2 Farming and irrigation water

Next, I would like to ask you about irrigation water in your community.

7. What are the main crops people grow in your community?
8. Do you know how irrigation water is managed in your community? If so, would you briefly describe?

Prompt: *Are there institutions that make decisions?*

Prompt: *Are there fees farmers pay for water or the operation and maintenance of the system?*

Prompt: *Are there organizations or individuals responsible for enforcing regulation?*

Prompt: *Who participants in these organizations and how do they function?*

Prompt: *Are there groups that are responsible for resolving conflicts?*

9. Based on your experience, has the availability of water for irrigation changed in the past 10 years?

Prompt: *If so, how has the availability changed in the past 10 years?*

Prompt: *Are you concerned about this change? Why?*

10. Based on your experience, has the quality (e.g., cleanness) of water for irrigation changed in the past 10 years?

Prompt: *If so, how has the quality changed in the past 10 years?*

Prompt: *Are you concerned about this change? Why?*

11. What factors do you think have influenced irrigation water availability?

Prompt: *Has infrastructure improved or deteriorated?*

Prompt: *Have management practices changed?*

Prompt: *Has policy or enforcement changed?*

Prompt: *Has hydropower or other development influenced flow?*

Prompt: *Has competition between users increased or decreased?*

12. What factors do you think have influenced irrigation water quality?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Have pollutants increased or decreased?

13. Can you list some of the ways your community responds to the changes in irrigation water supply?

Prompt: Do you change the amount of water farmers receive?

Prompt: Do you change the monitoring and regulation of water use?

Prompt: Do you invest in infrastructure development?

Prompt: Do you adjust fees for irrigation water?

Prompt: Do you address issues with higher authorities?

14. Do you notice any groups of people who are particularly successful in responding to changes in irrigation water?

Prompt: Are there groups that have successfully changed their water source?

Prompt: Are there groups that can successfully afford water fees?

15. Do you notice any groups of people who are particularly challenged in responding to changes in irrigation water?

Prompt: Are there groups that are challenged in changing their water source?

Prompt: Are there groups that are challenged in affording water fees?

Section 3 Domestic water

Next, I would like to ask you similar questions, but these are about domestic water- water your community uses for drinking, cooking and cleaning.

16. What water sources does your community use for drinking, cleaning, and cooking?

Prompt: Do you use the same source for drinking, cooking, and cleaning?

Prompt: Is water piped into homes?

Prompt: Do you use water from a well?

Prompt: Do you use a tap on the street?

Prompt: Do you use river water?

17. Do you know how domestic water is managed in your community? If so, would you briefly describe?

Prompt: Does your community have a central location for storage?

Prompt: Do you treat the water before it is distributed?

Prompt: How is wastewater handled in your community?

Prompt: Are there institutions that make decisions?

Prompt: Are there organizations or individuals responsible for enforcing regulation?

Prompt: Who participants in these organizations and how do they function?

Prompt: Are there groups that are responsible for resolving conflicts?

Prompt: Are there fees for domestic water use?

18. Based on your experience, has the availability of domestic water changed in the past 10 years?

Prompt: If so, how has the availability changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

19. Based on your experience, has the quality (e.g., cleanness) of water for irrigation changed in the past 10 years?

Prompt: If so, how has the quality changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

20. What factors do you think have influenced domestic water availability?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Has competition between users increased or decreased?

21. What factors have influenced domestic water quality?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Have pollutants increased or decreased?

22. Can you list some of the ways your community responds to changes to domestic water supply?

Prompt: Do you find another water source [buy private water, go farther for source, dig new well]?

Prompt: Do you change the amount of water users receive?

Prompt: Do you change the monitoring of water use?

Prompt: Do you change policies/regulations of water use?

Prompt: Do you invest in infrastructure development?

Prompt: Do you adjust fees for domestic water?

Prompt: Do you address issues with higher authorities?

Section 4 Fisheries

Now I would like to hear about fishing and aquaculture in your community.

23. What is the role of fisheries in your community?

Prompt: Do individuals fish for household consumption?

Prompt: Is there a fish farming/aquaculture industry in your community?

Prompt: How do fishers sell their catch? How?

24. Do you know how fisheries are managed in your community? If so, would you briefly describe?

Prompt: Are there institutions that make decisions?

Prompt: Are there organizations or individuals responsible for enforcing regulation?

Prompt: Who participants in these organizations and how do they function?

Prompt: Are there groups that are responsible for resolving conflicts?

Prompt: Are there fees associated with fishing licenses/the right to fish?

25. Based on your experience, have fish resources [size, number, type] changed in the past 10 years?

Prompt: If so, how has the quality changed in the past 10 years?

Prompt: Are you concerned about this change? Why?

26. What factors do you think have influenced fish resources in your community?

Prompt: Has infrastructure improved or deteriorated?

Prompt: Have management practices changed?

Prompt: Has policy or enforcement changed?

Prompt: Have pollutants increased or decreased?

Prompt: Has hydropower or other development influenced flow?

Prompt: Has competition between users increased or decreased?

27. Can you list some of the ways your community responds to the changes in fish resources?

Prompt: Do you change monitoring of fishing?

Prompt: Do you change fishing policy/regulations?

Prompt: Do you address issues with higher authorities?

Section 5 Development

Finally, as we finish up this interview, I would like to hear your perspective on the development of the pharmaceutical industry, hydropower, and tourism in the area.

28. Has there been major pharmaceutical industrial development in the area? If so, what impact have you seen these projects having on your community?

Prompt: Have job opportunities changed?

Prompt: Has infrastructure changed?

Prompt: Has water quality changed?

29. What role do you think tourism (may) play/s in your community?

Prompt: Have job opportunities changed/could they change?

Prompt: Has infrastructure changed/could it change?

30. Has there been hydropower development in the area? If so, what impact have you seen these projects having on your community?

Prompt: Have you seen a change in the power supply?

Prompt: Have you seen a change in water flow?

Prompt: Have the projects provided jobs?

31. Is there another type of industry that has impacted your household we should know about? If so, what have been the impacts of this industry on your household?

Prompt: Have you seen a change in the power supply?

Prompt: Have you seen a change in water flow?

Prompt: Have the projects provided jobs?

32. Do you know of any planned industrial development projects in the area? If so, can you briefly describe them?

Prompt: Who is involved in the development?

Prompt: What are the goals of the development?

Prompt: In your opinion, what will be the impact of the project on your community?

33. Do you know of any planned hydropower development projects in the area? If so, can you briefly describe them?

Prompt: Who is involved in the project?

Prompt: What are the goals of the project?

Prompt: In your opinion, what will be the impacts of the project on your community?

34. Do you know of any planned tourism development projects in the area? If so, can you briefly describe them?

Prompt: *Who is involved in the project?*

Prompt: *What are the goals of the project?*

Prompt: *In your opinion, what will be the impacts of the project on your community?*

35. In your vision of the future, is there anything you would like to change or see happen in your community?

Those are all the questions I have. Is there anything else you would like to share about the topics we discussed?

Thank you so much for your time.

APPENDIX B. SURVEY PROTOCOL

Generated by nixon17, Apr 11, 2019 12:12
Questionnaire created by nixon17, Mar 30, 2019 08:21
Last modified by nixon17, Apr 08, 2019 16:22

Not shared with anyone

Sections: 13, Sub-sections: 39,
Questions: 496,
Questions with enabling conditions: 252
Questions with validation conditions: 3
Rosters: 11
Variables: 0



PAK_US_Final

SURVEY IDENTIFICATION INFORMATION QUESTIONNAIRE DESCRIPTION

INTRODUCTION

No sub-sections, No rosters, No questions, Static texts: 2.

CONSENT AND LOCATION

No sub-sections, No rosters, Questions: 3.

DEMOGRAPHICS AND BACKGROUND

No sub-sections, Rosters: 6, Questions: 47, Static texts: 1.

WATER SOURCES

Sub-sections: 2, Rosters: 4, Questions: 17, Static texts: 1.

WASTE MANAGEMENT

Sub-sections: 1, No rosters, Questions: 8.

OBSERVED CHANGES

No sub-sections, No rosters, Questions: 22, Static texts: 1.

HOUSEHOLD CHANGES

Sub-sections: 11, No rosters, Questions: 107, Static texts: 11.

FARMING CHANGES

Sub-sections: 11, No rosters, Questions: 116, Static texts: 11.

FISHING CHANGES

Sub-sections: 10, No rosters, Questions: 120, Static texts: 10.

ANIMAL HUSBANDRY CHANGES

Sub-sections: 4, No rosters, Questions: 46, Static texts: 4.

COMMUNITY LEVEL IMPACTS

No sub-sections, Rosters: 1, Questions: 9, Static texts: 1.

PICTURES

No sub-sections, No rosters, No questions, Static texts: 1.

CONCLUSION

No sub-sections, No rosters, No questions, Static texts: 1.

APPENDIX A — INSTRUCTIONS

LEGEND

SURVEY IDENTIFICATION INFORMATION QUESTIONNAIRE DESCRIPTION

Basic information

Title PAK_US_Final

INTRODUCTION

Intro

STATIC TEXT

Note to surveyor: enter your location in the map application before beginning the survey Hello, my name is [insert your name] and I am a part of a joint research project between the University of Peshawar and Purdue University. The purpose of this study is to gain an understanding of water quality and water management decision making in Swat Valley, Pakistan. We are conducting surveys with individuals about how water is managed in the community to gather information about decision making in the midst of competing water uses and some of our team members are collecting water and fish population samples. The project is funded by the Pakistan–United States Science and Technology Cooperation Program, implemented in the U.S. by the National Academy of Sciences and by the Higher Education Commission in Pakistan. Surveys will take no longer than 60 minutes at a location and time of your choice. You are being asked to participate because you are a household head in the community. Surveys will take place with individuals whose main livelihood strategy is based on fishing, irrigated agriculture, or the tourism industry. All interviewees must be 18 years of age or older. Would you consider participating in our study? If so, may I read you the Consent Form so you can make a decision about being surveyed?

STATIC TEXT

Read the following consent form to the participant.



CONSENT AND LOCATION

ConsentLocation

I am going to read a few statements. Please indicate if you agree or not. You have had the opportunity to hear the consent form and have the study explained. You have had the opportunity to ask questions about the study, and your questions have been answered. You are prepared to participate in the research study described above. You will be offered a copy of this consent form after you give my verbal consent. Do you agree with the above and consent to being surveyed?

E1 Consent == 1

M1 You must receive verbal consent before administering the survey.

SINGLE-SELECT

Consent

- 00 ☐ No
01 ☐ Yes

When is this survey being administered?

DATE: CURRENT TIME

Date

Where is this survey being administered?

SINGLE-SELECT

Location

I Do not ask this question. Surveyor enter this information.

- 01 ☐ Madyan
02 ☐ Jehangira
03 ☐ Landaky
04 ☐ Pilot

DEMOGRAPHICS AND BACKGROUND

STATIC TEXT

I am now going to ask you some questions about yourself, your family, and your work.

<p>Surveyor enter gender</p> <p>I Donotaskthis question. Enter answer based on your observation.</p>	<p>SINGLE-SELECT Gender</p> <p>00 <input type="radio"/> Male</p> <p>01 <input type="radio"/> Female</p>
<p>What year were you born?</p>	<p>NUMERIC: INTEGER Age</p> <p>-----</p>
<p>What is your ethnicity?</p>	<p>SINGLE-SELECT Ethnicity</p> <p>000 <input type="radio"/> Other</p> <p>001 <input type="radio"/> Pashtun</p> <p>002 <input type="radio"/> Punjabi</p> <p>003 <input type="radio"/> Sindhis</p> <p>004 <input type="radio"/> Hindko speaker</p> <p>-888 <input type="radio"/> No answer</p>
<p>What is your marital status?</p>	<p>SINGLE-SELECT Maritalstatus</p> <p>000 <input type="radio"/> Never married</p> <p>001 <input type="radio"/> Married</p> <p>002 <input type="radio"/> Divorced</p> <p>003 <input type="radio"/> Widowed</p> <p>-888 <input type="radio"/> No answer</p>
<p>How many years of formal education have you completed?</p> <p>I Please round up to full year (i.e. do not list months or decimals).</p>	<p>NUMERIC: INTEGER Education</p> <p>-----</p>
<p>How many people live in your household?</p> <p>I A household is defined by the people occupying one housing unit or joined housing units (include joint family members in household). Include everyone who lives there for more than 6 months out of the And 5 other symbols [1]</p>	<p>NUMERIC: INTEGER HH_size</p> <p>-----</p>
<p>How many nuclear family units live in your household?</p> <p>I A nuclear family unit is a married couple and their children.</p>	<p>SINGLE-SELECT HH_fam_units</p> <p>001 <input type="radio"/> 1</p> <p>002 <input type="radio"/> 2</p> <p>003 <input type="radio"/> 3</p> <p>004 <input type="radio"/> more than 3</p> <p>-888 <input type="radio"/> No answer</p>
<p>How many household members are under the age of 18?</p> <p>E1 HH_Children < HH_size</p> <p>M1 The number of members under 18 cannot be more than the total number of household members.</p>	<p>NUMERIC: INTEGER HH_Children</p> <p>-----</p>
<p>How much land does your household own in marlas?</p> <p>I Round to nearest marla, enter 0 if household does not own any land.</p>	<p>NUMERIC: INTEGER Land_own</p> <p>-----</p>
<p>How much land does your household lease in marlas?</p> <p>I This is referring to land leased by the participant, not land that the participant owns and leases out to others. Round to nearest marla and enter 0 if household does not lease land.</p>	<p>NUMERIC: INTEGER Land_lease</p> <p>-----</p>

Does a household member (including yourself) currently hold a leadership position in your community?	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Leadership_current
Is the position formal or informal? E Leadership_current == 1	SINGLE-SELECT 00 <input type="radio"/> Informal 01 <input type="radio"/> Formal -888 <input type="radio"/> No answer	Leadership_currentforminform
Did a household member (including yourself) hold a leadership position in your community in the past?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Leadership_past
Was the position formal or informal? E Leadership_past == 1	SINGLE-SELECT 00 <input type="radio"/> Informal 01 <input type="radio"/> Formal -888 <input type="radio"/> No answer	Leadership_pastforminform
Do any of the male household members, (including children) have any of the following?	MULTI-SELECT 00 <input type="checkbox"/> Typhoid 01 <input type="checkbox"/> Malaria 02 <input type="checkbox"/> Hepatitis A 03 <input type="checkbox"/> Tuberculosis -888 <input type="checkbox"/> No answer	Male_health
Do any of the male household members have other health concerns?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Male_health_other
What other health concerns do male household members have? E Male_health_other == 1	LIST -----	M_health_other_type
Do any of the female household members (including children) have any of the following?	MULTI-SELECT 00 <input type="checkbox"/> Typhoid 01 <input type="checkbox"/> Malaria 02 <input type="checkbox"/> Hepatitis A 03 <input type="checkbox"/> Tuberculosis -888 <input type="checkbox"/> No answer	Female_health
Do any of the female household members have any other health concerns?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Female_health_other
What other health concerns do female household members have? E Female_health_other == 1	LIST -----	F_health_other_type
How many members of the household have had diarrhea in the past 30 days? E1 Diarrhea_members <= HH_size M1 The number of members who have had diarrhea must be less than or equal to the total number of household members.	NUMERIC: INTEGER -----	Diarrhea_members

What are your household's sources of food and/or income?	MULTI-SELECT Incomefood_source 00 <input type="checkbox"/> Crop production/agriculture 01 <input type="checkbox"/> Animal husbandry/livestock 02 <input type="checkbox"/> Fishing 03 <input type="checkbox"/> Aquaculture 04 <input type="checkbox"/> Hotel owner 05 <input type="checkbox"/> Day labor 06 <input type="checkbox"/> Business (not hotel)owner 07 <input type="checkbox"/> Remittances (money from working elsewhere) 08 <input type="checkbox"/> Wage labor (salaried job) 09 <input type="checkbox"/> Government worker -888 <input type="checkbox"/> No answer
Please specify the type of business E Incomefood_source.Contains (6)	TEXT Business_type -----
Please specify the type of wage labor E Incomefood_source.Contains (8)	TEXT wagelabor_type -----
Does your household have other sources of income or food?	SINGLE-SELECT Incomefoodsource_other 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer
What are your household's other sources of income? E Incomefoodsource_other ==1	LIST Incomesources_other -----

DEMOGRAPHICS AND BACKGROUND
Roster: LIVELIHOOD STRATEGIES ROSTER
generated by multi-select question Incomefood_source

In your household, who makes decisions about %Livelihood_types%?	MULTI-SELECT Decisionmaker 00 <input type="checkbox"/> Myself 01 <input type="checkbox"/> Myself and a family member 02 <input type="checkbox"/> A family member 03 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
What family member? E Decisionmaker.ContainsAny (1,2)	MULTI-SELECT Fam_decisionmaker 00 <input type="checkbox"/> Father 01 <input type="checkbox"/> Mother 02 <input type="checkbox"/> Brother 03 <input type="checkbox"/> Sister 04 <input type="checkbox"/> Wife 05 <input type="checkbox"/> Husband 06 <input type="checkbox"/> Other 07 <input type="checkbox"/> No answer
Please specify your relationship with the other decision maker E Decisionmaker.Contains (3)	TEXT Decisionmaker_othertype -----
Please specify your relationship with the decision maker E Fam_decisionmaker.Contains (6)	TEXT Decisionmaker_othertype -----

DEMOGRAPHICS AND BACKGROUND
Roster: OTHER TYPES OF LIVELIHOODS
 generated by list question [Incomesources_other](#)

Livelihoodtypes_other

E Incomefoodsource_other ==1

In your household, who makes decisions about %Livelihoodtypes_other%?	MULTI-SELECT Decisionmaker_other 00 <input type="checkbox"/> Myself 01 <input type="checkbox"/> Myself and a family member 02 <input type="checkbox"/> A family member 03 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
What family member? E Decisionmaker_other.ContainsAny (1,2)	MULTI-SELECT Fam_decmaker_other 00 <input type="checkbox"/> Father 01 <input type="checkbox"/> Mother 02 <input type="checkbox"/> Brother 03 <input type="checkbox"/> Sister 04 <input type="checkbox"/> Wife 05 <input type="checkbox"/> Husband 06 <input type="checkbox"/> Other 07 <input type="checkbox"/> No answer
Please specify your relationship with the other decision maker E Decisionmaker_other.Contains (3)	TEXT Decisionmakerother_othertype -----
Please specify your relationship with the decision maker E Fam_decmaker_other.Contains (6)	TEXT Decisionmakerother_otherfamtype -----
Please indicate your household's average monthly income (in RS).	SINGLE-SELECT Income_month 000 <input type="radio"/> 10000 or less 001 <input type="radio"/> 10001 to 20000 002 <input type="radio"/> 20001 to 30000 003 <input type="radio"/> 30001 to 40000 004 <input type="radio"/> 40001 to 50000 005 <input type="radio"/> 50001 or more -888 <input type="radio"/> Prefer not to answer
Please indicate the crops grown by your household (select all that apply). E Incomefood_source.Contains(0)	MULTI-SELECT Crops 000 <input type="checkbox"/> Wheat 01 <input type="checkbox"/> Rice 02 <input type="checkbox"/> Maize 003 <input type="checkbox"/> Barley 004 <input type="checkbox"/> Tobacco 005 <input type="checkbox"/> Onion 006 <input type="checkbox"/> Tomato 007 <input type="checkbox"/> Fruit crops 008 <input type="checkbox"/> Other vegetables -888 <input type="checkbox"/> No answer
Does your household grow other crops? E Incomefood_source.Contains(0)	SINGLE-SELECT Crops_other 00 <input type="radio"/> No 01 <input type="radio"/> Yes -888 <input type="radio"/> No answer
What other crops does your household grow? E crops_other == 1	LIST Crops_other_type -----

DEMOGRAPHICS AND BACKGROUND
Roster: HOUSEHOLD CROPS
 generated by multi-select question [crops](#)

HH_crops

Does your household use %HH_crops% for household use, to sell, or both?

SINGLE-SELECT

HH_crop_use

- 000 ☐ Household use
 001 ☐ To sell
 002 ☐ Both
 -888 ☐ No answer

DEMOGRAPHICS AND BACKGROUND
Roster: HOUSEHOLD OTHER CROPS
 generated by list question [crops_other_type](#)

HH_crops_other

E Crops_other == 1

Does your household use %HH_crops_other% for household use, to sell, or both?

SINGLE-SELECT

Household_crop_other_use

- 00 ☐ Household use
 01 ☐ To sell
 02 ☐ Both
 -888 ☐ No answer

E Crops_other == 1

What type of animals does your household own?
 (select all that apply)

MULTI-SELECT

Livestock_type

- 00 ☐ Cattle
 01 ☐ Sheep
 02 ☐ Goats
 03 ☐ Fish (aquaculture)
 -888 ☐ Other

E Incomefood_source.Contains(1)

Does your household own other livestock?

SINGLE-SELECT

Livestock_other

- 00 ☐ No
 01 ☐ Yes
 -888 ☐ No answer

E Incomefood_source.Contains(1)

What other livestock does your household own?

LIST

Livestock_other_type

E Livestock_other == 1

DEMOGRAPHICS AND BACKGROUND
Roster: LIVESTOCK TYPE ROSTER
 generated by multi-select question [Livestock_type](#)

Livestock_type_roster

E Incomefood_source.Contains(1)

How many %Livestock_type_roster% does your household own?

NUMERIC: INTEGER

Livestock_quant

E Incomefood_source.Contains(1)

DEMOGRAPHICS AND BACKGROUND
Roster: OTHER LIVESTOCK
 generated by list question [Livestock_other_type](#)

Livestock_quant_other_roster

E Livestock_other == 1

How many %Livestock_quant_other_roster% does your household own?

NUMERIC: INTEGER

Livestock_quant_other

E Livestock_other == 1

WATER SOURCES / AGRICULTURAL WATER SOURCES / IRRIGATION INFRASTRUCTURE USED

Roster: OTHER IRRIGATION INFRASTRUCTURE USED

generated by list question [Irr_infras_oth_type](#)

[Irr_infrast_other_use](#)

E [Irri_infrast_other==1](#)

Who owns the %Irr_infrast_other_use% you use for irrigation?	MULTI-SELECT 00 <input type="checkbox"/> Community 01 <input type="checkbox"/> My household 02 <input type="checkbox"/> Shared among households (not entire community) 03 <input type="checkbox"/> Government -888 <input type="checkbox"/> No answer	Irrigation_own_other
Do you pay for irrigation water?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Irrigation_cost
How much do you normally pay for irrigation water per month in RS (during growing season)?	NUMERIC: INTEGER -----	Irr_cost_amount

E [Irrigation_cost == 1](#)

WATER SOURCES

DOMESTIC WATER SOURCES

What are your sources of domestic water for your household? (select all that apply)	MULTI-SELECT 00 <input type="checkbox"/> Tube well 01 <input type="checkbox"/> Hand dug well 02 <input type="checkbox"/> Spring 03 <input type="checkbox"/> River 04 <input type="checkbox"/> Tanker/truck 05 <input type="checkbox"/> Bore hole with hand pump 06 <input type="checkbox"/> Bore hold with mechanized pump 07 <input type="checkbox"/> Neighbor's water -888 <input type="checkbox"/> No answer	Domestic_source
Do you have another source for your household's domestic water?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Domestic_source_other
Please specify the other sources of your domestic water	LIST -----	Dom_source_oth_type

E [Domestic_source_other== 1](#)

WATER SOURCES / DOMESTIC WATER SOURCES

Roster: DOMESTIC INFRASTRUCTURE USED

generated by multi-select question [Domestic_source](#)

[Domestic_infrast_use](#)

Who owns the %Domestic_infrast_use% your household uses for domestic water?	SINGLE-SELECT 000 <input type="radio"/> Community 001 <input type="radio"/> My household 002 <input type="radio"/> Shared among households (not entire community) 003 <input type="radio"/> Government -888 <input type="radio"/> No answer	Domestic_infrast_own
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WATER SOURCES / DOMESTIC WATER SOURCES / DOMESTIC INFRASTRUCTURE USED

How do you use your fish catch? E Incomefood_source.Contains(2)	SINGLE-SELECT wildcatch_use 000 <input type="radio"/> Householdconsumption 001 <input type="radio"/> To sell 003 <input type="radio"/> Both -888 <input type="radio"/> No answer
How do you use fish from aquaculture production? E Incomefood_source.Contains (3)	SINGLE-SELECT Aquaculture_use 000 <input type="radio"/> Householdconsumption 001 <input type="radio"/> To sell 002 <input type="radio"/> Both -888 <input type="radio"/> No answer

WATER SOURCES

WATER SOURCES AGRICULTURAL WATER SOURCES

E Incomefood_source.Contains(0)

STATIC TEXT

Next I am going to ask you about your water sources for agricultural use.

What is the source of your irrigation water? E Incomefood_source.Contains(0)	SINGLE-SELECT Irrigation_source 00 <input type="radio"/> Groundwater 01 <input type="radio"/> Surface water 02 <input type="radio"/> Both -888 <input type="radio"/> No answer
What infrastructure do you use for irrigation water supply? E Incomefood_source.Contains (0)	MULTI-SELECT Irrigation_infrast 00 <input type="checkbox"/> Canal 01 <input type="checkbox"/> Tube well 02 <input type="checkbox"/> Hand dug well 03 <input type="checkbox"/> Lift pump -888 <input type="checkbox"/> No answer
Do you use any other infrastructure for your irrigation water supply?	SINGLE-SELECT Irri_infrast_other 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer
Please specify the other irrigation infrastructure you use. E Irri_infrast_other== 1	LIST Irr_infras_oth_type -----

WATER SOURCES / AGRICULTURAL WATER SOURCES Roster: IRRIGATION INFRASTRUCTURE USED

generated by multi-select question [Irrigation_infrast](#)

Who owns the %Irrigation_infrast_use% you use for irrigation?	MULTI-SELECT Irrigation_own 00 <input type="checkbox"/> Community 01 <input type="checkbox"/> My household 02 <input type="checkbox"/> Shared among households (not entire community) 03 <input type="checkbox"/> Government -888 <input type="checkbox"/> No answer
---	--

Roster: OTHER SOURCES OF DOMESTIC WATER

generated by list question Dom_source_oth_type

Domestic_infrast_other_use

E Domestic_source_other==1

Who owns the %Domestic_infrast_other_use% your household uses for domestic water?

E Domestic_source_other==1

SINGLE-SELECT

Domestic_infrast_other_own

- 000 ☐ Community
 001 ☐ My household
 002 ☐ Shared among households (not entire community)
 003 ☐ Government
 -888 ☐ No answer

About how far do you have to go to get domestic water for your house?

SINGLE-SELECT

Water_distance

- 000 ☐ Inside house/compound
 001 ☐ .5 km or less
 002 ☐ .6 to 1 km
 003 ☐ 1.1. to 2 km
 004 ☐ 2.1 to 3 km
 005 ☐ More than 3 km
 -888 ☐ Prefer not to answer

How long does it take to get to your domestic water source from your home, get water, and come back?

E Water_distance!=0

SINGLE-SELECT

Water_time

- 000 ☐ 1 to 15 minutes
 001 ☐ 16 to 30 minutes
 002 ☐ 31 to 45 minutes
 003 ☐ 46 minutes to 1 hour
 004 ☐ More than 1 hour
 -888 ☐ Prefer not to answer

Do you pay for domestic water?

SINGLE-SELECT

Domestic_cost

- 000 ☐ No
 001 ☐ Yes
 -888 ☐ No answer

How much do you normally pay for domestic water per month (in Rs)?

E Domestic_cost == 1

NUMERIC: INTEGER

Dom_cost_amount

WASTE MANAGEMENT

What kind of toilet facility does your household use?

SINGLE-SELECT

HH_waste

- 000 ☐ Open defecation
 001 ☐ Flush system (linked to sewerage)
 002 ☐ Flush (linked to septic tank)
 003 ☐ Flush (connected to open drain)
 005 ☐ Pit latrine
 006 ☐ Other
 -888 ☐ No answer

Please specify the type of toilet facility.

E HH_waste== 6

TEXT

HH_waste_other

What is the primary way in which your household disposes of solid waste?	MULTI-SELECT HH_solidwaste 01 <input type="checkbox"/> Burn 02 <input type="checkbox"/> Bury 03 <input type="checkbox"/> Disposal in designated land area 004 <input type="checkbox"/> Disposal in non designated area 005 <input type="checkbox"/> Disposal in river 006 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
Please specify the other way in which your household disposes of solid waste.	TEXT Hhsolidwaste_other -----

E HH_solidwaste.Contains (6)

WASTE MANAGEMENT HOTEL WASTE MANAGEMENT

E Incomefood_source.Contains (4)

What kind of toilet facility does your hotel use?	SINGLE-SELECT Hotel_waste 000 <input type="radio"/> Open defecation 001 <input type="radio"/> Flush system (linked to sewerage) 002 <input type="radio"/> Flush (linked to septic tank) 003 <input type="radio"/> Flush (connected to open drain) 004 <input type="radio"/> Pit latrine 005 <input type="radio"/> Other -888 <input type="radio"/> No answer
Please specify the type of toilet facility.	TEXT Hotel_waste_other -----
What is the primary way in which your hotel disposes of solid waste?	MULTI-SELECT Hotel_solidwaste 001 <input type="checkbox"/> Burn 002 <input type="checkbox"/> Bury 003 <input type="checkbox"/> Disposal in designated area 004 <input type="checkbox"/> Disposal in non designated land area 005 <input type="checkbox"/> Disposal in river 006 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
Please specify the other way in which your hotel disposes of solid waste.	TEXT Hotelsolidwaste_other -----

E Hotel_waste== 6

E Hotel_solidwaste.Contains (6)

OBSERVED CHANGES

STATIC TEXT

Now I am going to ask you to think about changes you have seen in your community in the past ten years. Please indicate whether you have observed any of the following decrease, increase, or stay the same in your community over the past 10 years.

River water quality	SINGLE-SELECT River_water_qual 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
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River water level	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	River_water_level
Domestic water quality (of primary source)	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Dom_water_qual
Domestic water quantity (of primary source)	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Dom_water_quant
Irrigation water quality	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Irr_water_qual
Irrigation water quantity	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Irr_water_quant
Groundwater quality	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Groundwater_quality
Groundwater level	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Groundwater_level
Average rainfall	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Rainfall
Length of the dry season	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Dryseason_length
Amount of waste on the surface of river water	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	waste_surfacewater

Amount of waste on the shore	SINGLE-SELECT waste_shore 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Number of fish in the river	SINGLE-SELECT Fish_number 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Size of fish in the river	SINGLE-SELECT Fish_size 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Number of fishers on the river	SINGLE-SELECT Fisher_number 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Number of tourists	SINGLE-SELECT Tourist_number 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Agricultural yields	SINGLE-SELECT Yield_amount 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Number of hotels	SINGLE-SELECT Hotel_amount 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Number of restaurants	SINGLE-SELECT Restaruant_amount 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Hydropower facilities	SINGLE-SELECT Hydropower_amount 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer
Number of industries	SINGLE-SELECT Industry_change 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer

Frequency of floods	SINGLE-SELECT 000 <input type="radio"/> Decrease 001 <input type="radio"/> Increase 003 <input type="radio"/> Stay the same -888 <input type="radio"/> No answer	Flood_changes
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HOUSEHOLD CHANGES

STATIC TEXT

Now I am going to ask you about changes your household has made in response to the community changes you indicated above.

HOUSEHOLD CHANGES MOVING

Have you or someone in your household moved to another location to work in the past ten years?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Moved_change
What were the reasons you did not move? (select all that apply) E Moved_change == 0	MULTI-SELECT 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I made another change instead of moving 09 <input type="checkbox"/> I did not see the need 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer	Nomove_reasons
Please specify the other change you made E Nomove_reasons.Contains (8)	TEXT -----	Nomove_otherchangespec
What is the other reason you did not make this change? E Nomove_reasons.Contains (10)	TEXT -----	other_reasonnomove
STATIC TEXT E Moved_change == 1 <i>I am now going to read you a list of statements of potential costs associated with moving. Please indicate if you agree or not.</i>		

<p>It had significant financial costs</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_friendscost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>Community leaders didn't approve of the decision</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_leader cost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It required me to go against government regulations</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_govcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It required me to go against my cultural traditions</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_culturalcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>I was uncertain about the outcome</p> <p>E Moved_change == 1</p>	<p>SINGLE-SELECT Move_uncertaincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

HOUSEHOLD CHANGES / MOVING
MOVING IMPACTS

E Moved_change==1

STATIC TEXT

Please indicate if moving decreased or increased the following factors.

<p>Time spent working</p>	<p>SINGLE-SELECT Moving_timeworking</p> <p>000 <input type="radio"/> Nochange</p> <p>001 <input type="radio"/> Decrease</p> <p>002 <input type="radio"/> Increase</p> <p>-888 <input type="radio"/> No answer</p>
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Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Moving_income
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Moving_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Moving_Comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Moving_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Moving_Comafety
Are you satisfied that you or a household member made the decision to move? E Moved_change== 1	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	Satisfaction_move

HOUSEHOLD CHANGES
STARTED A NEW BUSINESS

Have you or someone in your household started a new business in the past ten years?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Business_change
Did you start the business by yourself, with your family, or with your friends? E Business_change==1	SINGLE-SELECT 00 <input type="radio"/> By myself 01 <input type="radio"/> With family 02 <input type="radio"/> With friends -888 <input type="radio"/> No answer	Newbusiness_people
Please specify the type of business you started E Business_change==1	TEXT -----	Newbusiness_type

<p>What were the reasons you did not start a business? (select all that apply)</p> <p>E Business_change == 0</p>	<p>MULTI-SELECT Nobusiness_reasons</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I made another change instead of moving</p> <p>09 <input type="checkbox"/> I did not see the need</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify what change you made</p> <p>E Nobusiness_reasons.Contains (8)</p>	<p>TEXT Nobusiness_changespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E Nobusiness_reasons.Contains(10)</p>	<p>TEXT other_reasonnobusiness</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E Business_change == 1</p> <p><i>I am now going to read you a list of statements of potential costs associated with starting a business. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E Business_change == 1</p>	<p>SINGLE-SELECT Business_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Business_change == 1</p>	<p>SINGLE-SELECT Business_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Business_change == 1</p>	<p>SINGLE-SELECT Business_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Business_change == 1</p>	<p>SINGLE-SELECT Business_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Business_change == 1</p>	<p>SINGLE-SELECT Business_friendcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My community leaders didn't approve of the decision E Business_change == 1	SINGLE-SELECT Business_Leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against government regulations E Business_change == 1	SINGLE-SELECT Business_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against my cultural traditions E Business_change == 1	SINGLE-SELECT Business_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
I was uncertain about the outcome E Business_change == 1	SINGLE-SELECT Business_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

HOUSEHOLD CHANGES / STARTED ANEWBUSINESS
STARTING A NEW BUSINESS IMPACTS

E Business_change==1

STATIC TEXT

Please indicate if starting a business deceased or increased the following factors.

Household income	SINGLE-SELECT Business_income 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Time spent working	SINGLE-SELECT Business_timeworking 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household health	SINGLE-SELECT Business_health 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Health of community	SINGLE-SELECT Business_Comhealth 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Business_HHsafety 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer

Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Business_Comafety
Are you satisfied that you made the decision to start a new business? E Business_change == 1	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	satisfaction_business
HOUSEHOLD CHANGES LIVING WITH FAMILY OR FRIENDS		
Have you or someone in your household starting living with family or friends in the past 10 years?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Living_change
What were the reasons you did not start living with family or friends? (select all that apply) E Living_change == 0	MULTI-SELECT 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer	Noliving_reasons
Please specify the change you made E Noliving_reasons.Contains (9)	TEXT -----	Noliving_specifichange
What is the other reason you did not make this change? E Noliving_reasons.Contains (10)	TEXT -----	other_reasonnoliving
STATIC TEXT E Living_change == 1 <i>I am now going to read you a list of statements of potential costs associated with living with family or friends. Please indicate if you agree or not.</i>		
It had significant financial costs E Living_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Living_fincost

It took a significant amount of time E Living_change == 1	SINGLE-SELECT Living_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of labor E Living_change == 1	SINGLE-SELECT Living_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My family didn't approve of the decision E Living_change == 1	SINGLE-SELECT Living_famcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My friends didn't approve of the decision E Living_change == 1	SINGLE-SELECT Living_friendcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My community leaders didn't approve of the decision E Living_change == 1	SINGLE-SELECT Living_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against government regulations E Living_change == 1	SINGLE-SELECT Living_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against my cultural traditions E Living_change == 1	SINGLE-SELECT Living_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
I was uncertain about the outcome E Living_change == 1	SINGLE-SELECT Living_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

HOUSEHOLD CHANGES / LIVING WITH FAMILY OR FRIENDS
LIVING WITH FAMILY OR FRIENDS IMPACTS

E Living_change==1

STATIC TEXT

Please indicate if living with family or friends decreased or increased the following factors.

Household income	SINGLE-SELECT Living_income 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Time spent working	SINGLE-SELECT Living_timeworking 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer

Household health	SINGLE-SELECT Living_health 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Health of community	SINGLE-SELECT Living_comhealth 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Living_HHsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT Living_comsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or a household member made the decision to live with family and friends? E Living_change== 1	SINGLE-SELECT Satisfaction_live 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

HOUSEHOLD CHANGES APPLIED FOR FINANCIAL ASSISTANCE

Have you or someone in your household applied for financial assistance in the past 10 years?	SINGLE-SELECT Fin_change 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer
What were the reasons you did not apply for financial assistance? (select all that apply) E Fin_change == 0	MULTI-SELECT Nofinassist_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer

Please specify the other change you made E Nofinassist_reasons.Contains (9)	TEXT Nofin_otherchangespec -----
What is the other reason you did not make this change? E Nofinassist_reasons.Contains (10)	TEXT other_reasonnofinassist -----
STATIC TEXT E Fin_change == 1 I am now going to read you a list of statements of potential costs associated with applying for financial assistance. Please indicate if you agree or not.	
It had significant financial costs E Fin_change == 1	SINGLE-SELECT Fin_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of time E Fin_change == 1	SINGLE-SELECT Fin_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of labor E Fin_change == 1	SINGLE-SELECT Fin_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My family didn't approve of the decision E Fin_change == 1	SINGLE-SELECT Fin_famcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My friends didn't approve of the decision E Fin_change == 1	SINGLE-SELECT Fin_friendcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My community leaders didn't approve of the decision E Fin_change == 1	SINGLE-SELECT Fin_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against government regulations E Fin_change == 1	SINGLE-SELECT Fin_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against my cultural traditions E Fin_change == 1	SINGLE-SELECT Fin_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
I was uncertain about the outcome E Fin_change == 1	SINGLE-SELECT Fin_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

HOUSEHOLD CHANGES / APPLIED FOR FINANCIAL ASSISTANCE
APPLYING FOR FINANCIAL ASSISTANCE IMPACTS

E Fin_change==1

STATIC TEXT

Please indicate if applying for financial assistance decreased or increased the following factors.

Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fin_income
Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fin_timeworking
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fin_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fin_comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fin_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fin_comsafety
Are you satisfied that you or a household member made the decision to apply for financial assistance?	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	Satisfaction_financial

E Fin_change== 1

HOUSEHOLD CHANGES

CHANGED DOMESTIC WATER SUPPLY

Have you or someone in your household changed your domestic water supply in the past 10 years?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Domwater_change
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HOUSEHOLD CHANGES / CHANGED DOMESTIC WATER SUPPLY

DETAILS ON CHANGES

E Domwater_change==1

<p>Did you previously use a private, shared (not with entire community), community, or government domestic water supply?</p>	<p>SINGLE-SELECT Domesticwater_previous</p> <p>00 <input type="radio"/> Private</p> <p>01 <input type="radio"/> Shared</p> <p>02 <input type="radio"/> Community</p> <p>03 <input type="radio"/> Government</p> <p>-888 <input type="radio"/> No answer</p>
<p>What were the reasons you did not change your domestic water supply? (select all that apply)</p> <p>E Domwater_change == 0</p>	<p>MULTI-SELECT Nodomwater_reasons</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I did not see a need</p> <p>09 <input type="checkbox"/> I made another change instead of moving</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify the other change you made</p> <p>E Nodomwater_reasons.Contains (9)</p>	<p>TEXT Nodom_otherchangespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E Nodomwater_reasons.Contains (10)</p>	<p>TEXT other_reasonnodomwater</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E Domwater_change == 1</p> <p><i>I am now going to read you a list of statements of potential costs associated with changing your domestic water source. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E Domwater_change == 1</p>	<p>SINGLE-SELECT Dom_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Domwater_change == 1</p>	<p>SINGLE-SELECT Dom_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Domwater_change == 1</p>	<p>SINGLE-SELECT Dom_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Domwater_change == 1</p>	<p>SINGLE-SELECT Dom_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My friends didn't approve of the decision E Domwater_change == 1	SINGLE-SELECT Dom_friendcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My community leaders didn't approve of the decision E Domwater_change == 1	SINGLE-SELECT Dom_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against government regulations E Domwater_change == 1	SINGLE-SELECT Dom_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against my cultural traditions E Domwater_change == 1	SINGLE-SELECT Dom_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
I was uncertain about the outcome E Domwater_change == 1	SINGLE-SELECT Dom_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

HOUSEHOLD CHANGES / CHANGED DOMESTIC WATER SUPPLY
CHANGING DOMESTIC WATER SUPPLY IMPACTS

E Domwater_change==1

STATIC TEXT

Please indicate if changing your domestic water supply decreased or increased the following factors.

Quality of household domestic water	SINGLE-SELECT Domwater_HHdomqua1 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quantity of household domestic water	SINGLE-SELECT Domwater_HHdomwater quant 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of community domestic water	SINGLE-SELECT Domwater_comdomqua1 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quantity of community domestic water	SINGLE-SELECT Domwater_comdomwater quant 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer

Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Domwater_timeworking
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Domwater_income
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Domwater_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Domwater_comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Domwater_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Domwater_Comsafety
Are you satisfied that you or a household member made the decision to change your domestic water source? E Domwater_change== 1	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	Satisfaction_domwater

FARMING CHANGES

E Incomefood_source.Contains (0)

FARMING CHANGES CHANGED IRRIGATION WATER SUPPLY

Have you or someone in your household changed your irrigation water supply in the past 10 years?	SINGLE-SELECT 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Irrwater_change
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FARMING CHANGES / CHANGED IRRIGATION WATER SUPPLY DETAILS ON CHANGES

E Irrwater_change==1

Did you previously use a private, shared (not with entire community), community, or government irrigation water supply?	SINGLE-SELECT Irrwater_previous 00 <input type="radio"/> Private 01 <input type="radio"/> Shared 002 <input type="radio"/> Community 003 <input type="radio"/> Government -888 <input type="radio"/> No answer
---	--

STATIC TEXT

E Irrwater_change == 0

I am now going to read you a list of statements of potential reasons you or a household member did not change your irrigation water supply. Please indicate if you agree or not.

What were the reasons you did not change your irrigation water supply? (select all that apply) E Irrwater_change == 0	MULTI-SELECT Noirrigation_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leadership wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
--	--

Please specify the other change you made E Noirrigation_reasons.Contains (9)	TEXT Noirwater_otherchangespec -----
---	--

What is the other reason you did not make this change? E Noirrigation_reasons.Contains (10)	TEXT other_reasonnoirwater -----
--	--

STATIC TEXT

E Irrwater_change == 1

I am now going to read you a list of statements of potential costs associated with you or a household member changing your irrigation water source. Please indicate if you agree or not.

It had significant financial costs E Irrwater_change == 1	SINGLE-SELECT Irrwater_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
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It took a significant amount of time E Irrwater_change == 1	SINGLE-SELECT Irrwater_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
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It took a significant amount of labor E Irrwater_change == 1	SINGLE-SELECT Irrwater_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
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My family didn't approve of the decision E Irrwater_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Irrwater_famcost
My friends didn't approve of the decision E Irrwater_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Irrwater_friendcost
My community leaders didn't approve of the decision E Irrwater_change == 1	SINGLE-SELECT 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Irrwater_leaderscost
It required me to go against government regulations E Irrwater_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Irrwater_govcost
It required me to go against my cultural traditions E Irrwater_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Irrwater_culturalcost
I was uncertain about the outcome E Irrwater_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Irrwater_uncertaincost

FARMING CHANGES / CHANGED IRRIGATION WATER SUPPLY
CHANGING IRRIGATION WATER IMPACTS

E Irrwater_change==1

STATIC TEXT

Please indicate if changing your irrigation water source decreased or increased the following.

Quantity of household irrigation water	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_HHdomwaterquant
Quality of household irrigation water	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_HHdomqua1
Quality of community irrigation water	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_comdomqua1

Quantity of community irrigation water	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_comdomwaterquant
Crop yields	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_yield
Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Irrwater_timeworking
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_income
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_Comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Irrwater_Comafety
Are you satisfied that you or a household member made the decision to change your irrigation water source?	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	Satisfaction_irrwater

FARMING CHANGES
PLANTING DIFFERENT CROP TYPES

Have you or someone in your household changed the crops you plant in the past 10 years?	SINGLE-SELECT Croptype_change 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> No answer
What were the reasons you did not plant different crop types? (select all that apply) E Croptype_change == 0	MULTI-SELECT Nocroptype_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
Please specify the other change you made E Nocroptype_reasons.Contains (9)	TEXT Nocroptype_otherchangespec -----
What is the other reason you did not make this change? E Nocroptype_reasons.Contains (10)	TEXT other_reasonnocroptype -----
STATIC TEXT E Croptype_change == 1 <i>I am now going to read you a list of statements of potential reasons costs associated with changing the crops you plant. Please indicate if you agree or not.</i>	
It had significant financial costs E Croptype_change == 1	SINGLE-SELECT Croptype_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of time E Croptype_change == 1	SINGLE-SELECT Croptype_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of labor E Croptype_change == 1	SINGLE-SELECT Croptype_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My family didn't approve of the decision E Croptype_change == 1	SINGLE-SELECT ICroptype_famcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

My friends didn't approve of the decision E croptype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	croptype_friendcost
My community leaders wouldn't approve of the decision E croptype_change == 1	SINGLE-SELECT 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer	croptype_leaderscost
It required me to go against government regulations E croptype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	croptype_govcost
It required me to go against my cultural traditions E croptype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	croptype_culturalcost
I was uncertain about the outcome E croptype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	croptype_uncertaincost

FARMING CHANGES / PLANTING DIFFERENT CROP TYPES CHANGING CROP TYPE IMPACTS

E croptype_change==1

STATIC TEXT

Please indicate if changing your crop type decreased or increased the following.

Crop yields	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	croptype_yield
Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	croptype_timeworking
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	croptype_income
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	croptype_health

Health of community	SINGLE-SELECT Croptype_Comhealth 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Croptype_HHsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT Croptype_Comafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or a household member made the decision to change your crop type?	SINGLE-SELECT Satisfaction_croptype 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

FARMING CHANGES
AGRICULTURAL INPUTS

Please describe your household's use of agricultural inputs (pesticides or fertilizers).	SINGLE-SELECT Aginputs 000 <input type="radio"/> We have not changed our use of inputs 001 <input type="radio"/> We decreased our use of inputs 002 <input type="radio"/> We increased our use of inputs -888 <input type="radio"/> No answer
What were the reasons you did not change your agricultural inputs? (select all that apply) E Aginputs == 0	MULTI-SELECT Noaginputs_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
Please specify the other change you made E Noaginputs_reasons.Contains (9)	TEXT Noinputs_otherchangespec -----

What is the other reason you did not make this change?	TEXT other_reasonnoinput -----
E Noaginputs.Reasons.Contains (10)	
STATIC TEXT	
E Aginputs.InList (1,2)	
<i>I am now going to read you a list of statements of potential costs associated with changing your agricultural inputs. Please indicate if you agree or not.</i>	
It had significant financial costs	SINGLE-SELECT Inputs_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
It took a significant amount of time	SINGLE-SELECT Inputs_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
It took a significant amount of labor	SINGLE-SELECT Inputs_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
My family didn't approve of the decision	SINGLE-SELECT Inputs_famcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
My friends didn't approve of the decision	SINGLE-SELECT Inputs_friendcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
My community leaders didn't approve of the decision	SINGLE-SELECT Inputs_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
It required me to go against government regulations	SINGLE-SELECT Inputs_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
It required me to go against my cultural traditions	SINGLE-SELECT Inputs_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	
I was uncertain about the outcome	SINGLE-SELECT Inputs_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Aginputs.InList (1,2)	

FARMING CHANGES / AGRICULTURAL INPUTS
AGRICULTURAL INPUTS IMPACTS

E Aginputs.InList (1,2)

STATIC TEXT

Please indicate if changing your agricultural inputs decreased or increased the following.

Quality of household irrigation water	SINGLE-SELECT Aginputs_HHirrqua1 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of household domestic water	SINGLE-SELECT Aginputs_HHdomqua1 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of community domestic water	SINGLE-SELECT Aginputs_comdomqua1 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of community irrigation water	SINGLE-SELECT Aginputs_comirrqua1 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Crop yields	SINGLE-SELECT Aginputs_yield 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Time spent working	SINGLE-SELECT Aginputs_timeworking 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Number of fish in river	SINGLE-SELECT Aginputs_fishquant 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Fish diversity in river	SINGLE-SELECT Aginputs_fishdiversity 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household income	SINGLE-SELECT Aginputs_income 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household health	SINGLE-SELECT Aginputs_health 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer

Health of community	SINGLE-SELECT Aginputs_Comhealth 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Aginputs_HHsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT Aginputs_Comsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or a household member made the decision to change your agriculture inputs?	SINGLE-SELECT Satisfaction_inputs 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

FARMING CHANGES
FARM LAND

Please describe your household's use of farm land in the past ten years.	SINGLE-SELECT Farmland 000 <input type="radio"/> We have not changed the amount of land we farm. 001 <input type="radio"/> We decreased the amount of land we farm. 002 <input type="radio"/> We increased the amount of land we farm 003 <input type="radio"/> We stopped farming -888 <input type="radio"/> No answer
What were the reasons you did not change the use of your farm land?(select all that apply) E Farmland == 0	MULTI-SELECT Nofarmland_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
Please specify the other change you made E Nofarmland_reasons.Contains (9)	TEXT Nofarmland_otherchangespec -----

What is the other reason you did not make this change?	TEXT other_reasonnofarmland -----
E Nofarmland.Reasons.Contains (10)	
STATIC TEXT	
E Farmland.InList (1,2,3)	
<i>I am now going to read you a list of statements of potential costs associated with changing the use of your farmland. Please indicate if you agree or not.</i>	
It had significant financial costs	SINGLE-SELECT Farmland_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
It took a significant amount of time	SINGLE-SELECT Farmland_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
It took a significant amount of labor	SINGLE-SELECT Farmland_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
My family didn't approve of the decision	SINGLE-SELECT Farmland_famcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
My friends didn't approve of the decision	SINGLE-SELECT Farmland_friendcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
My community leaders didn't approve of the decision	SINGLE-SELECT Farmland_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
It required me to go against government regulations	SINGLE-SELECT Farmland_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
It required me to go against my cultural traditions	SINGLE-SELECT Farmland_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	
I was uncertain about the outcome	SINGLE-SELECT Farmland_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
E Farmland.InList (1,2,3)	

FARMING CHANGES / FARMLAND
CHANGING FARM LAND IMPACTS

E Farmland.InList (1,2,3)

STATIC TEXT

Please indicate if changing your farm land use deceased or increased the following.

Crop yields	SINGLE-SELECT Farmland_yield 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Time spent working	SINGLE-SELECT Farmland_timeworking 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household income	SINGLE-SELECT Farmland_income 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household health	SINGLE-SELECT Farmland_health 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Health of community	SINGLE-SELECT Farmland_comhealth 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Farmland_HHsafety 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT Farmland_comsafety 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or a household member made the decision to change how you use your farm land?	SINGLE-SELECT satisfaction_farmland 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

FARMING CHANGES
SELLING CROPS

<p>Please describe your household's practices of selling crops in the past ten years.</p>	<p>SINGLE-SELECT sellcrops</p> <p>000 <input type="radio"/> We have not changed how we sell crops.</p> <p>001 <input type="radio"/> We decreased the amount of crops we sell.</p> <p>002 <input type="radio"/> We increased the amount of crops we sell.</p> <p>003 <input type="radio"/> We changed where we sell crops.</p> <p>-888 <input type="radio"/> No answer</p>
<p>What were the reasons you did not change the way you sell crops? (select all that apply)</p> <p>E sellcrops == 0</p>	<p>MULTI-SELECT nosellcrops_reasons</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I did not see a need</p> <p>09 <input type="checkbox"/> I made another change instead of moving</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify the other change you made</p> <p>E nosellcrops_reasons.Contains (9)</p>	<p>TEXT nosellcrops_otherchangespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E nosellcrops_reasons.Contains (10)</p>	<p>TEXT other_reasonnosellcrops</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E sellcrops.InList (1,2,3)</p> <p><i>I am now going to read you a list of statements of potential costs associated with changing how you sell crops. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E sellcrops.InList (1,2,3)</p>	<p>SINGLE-SELECT sellcrops_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E sellcrops.InList (1,2,3)</p>	<p>SINGLE-SELECT sellcrops_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E sellcrops.InList (1,2,3)</p>	<p>SINGLE-SELECT sellcrops_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My family didn't approve of the decision E sellcrops.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	sellcrops_famcost
My friends didn't approve of the decision E sellcrops.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	sellcrops_friendcost
My community leaders didn't approve of the decision E sellcrops.InList (1,2,3)	SINGLE-SELECT 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer	sellcrops_leaderscost
It required me to go against government regulations E sellcrops.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	sellcrops_govcost
It required me to go against my cultural traditions E sellcrops.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	sellcrops_culturalcost
I was uncertain about the outcome E sellcrops.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	sellcrops_uncertaincost

FARMING CHANGES / SELLING CROPS
SELLING CROPS IMPACTS

E sellcrops.InList(1,2,3)

STATIC TEXT

Please indicate if changing how you sell crops has decreased or increased the following.

Crop yields	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	sellcrops_yield
Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	sellcrops_timeworking
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	sellcrops_income

Household health	SINGLE-SELECT sellcrops_health 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Health of community	SINGLE-SELECT sellcrops_Comhealth 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT sellcrops_HHsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT sellcrops_Comsafty 00 <input type="radio"/> No change 01 <input type="radio"/> Decrease 02 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or a household member made the decision to change how you sell crops?	SINGLE-SELECT satisfaction_sellcrops 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

FISHING CHANGES

E Incomefood_source.Contains (2)

FISHING CHANGES FISHING TIME

Please describe your household's time spent fishing in the past ten years.

SINGLE-SELECT Fishtime
 000 ☐ We have not changed the amount of time we fish.
 001 ☐ We decreased the amount of time we fish.
 002 ☐ We increased the amount of time we fish.
 003 ☐ We stopped fishing.
 -888 ☐ No answer

<p>What were the reasons you did not change the amount of time you spend fishing? (select all that apply)</p> <p>E Fishtime == 0</p>	<p>MULTI-SELECT Nofishtime_reasons</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I did not see a need</p> <p>09 <input type="checkbox"/> I made another change instead of moving</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify the other change you made</p> <p>E Nofishtime_reasons.Contains (9)</p>	<p>TEXT Nofishchange_other changespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E Nofishtime_reasons.Contains (10)</p>	<p>TEXT other_reasonnofishtime</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E Fishtime.InList (1,2,3)</p> <p><i>I am now going to read you a list of statements of potential costs associated with changing your fishing practices. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E Fishtime.InList (1,2,3)</p>	<p>SINGLE-SELECT Fishchange_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Fishtime.InList (1,2,3)</p>	<p>SINGLE-SELECT Fishchange_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Fishtime.InList (1,2,3)</p>	<p>SINGLE-SELECT Fishchange_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Fishtime.InList (1,2,3)</p>	<p>SINGLE-SELECT Fishchange_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Fishtime.InList (1,2,3)</p>	<p>SINGLE-SELECT Fishchange_friendcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My community leaders didn't approve of the decision E Fishtime.InList (1,2,3)	SINGLE-SELECT 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Fishchange_Leaderscost
It required me to go against government regulations E Fishtime.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Fishchange_govcost
It required me to go against my cultural traditions E Fishtime.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Fishchange_culturalcost
I was uncertain about the outcome E Fishtime.InList (1,2,3)	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Fishchange_uncertaincost

FISHING CHANGES / FISHING TIME CHANGING FISHING IMPACTS

E Fishtime.InList (1,2,3)

STATIC TEXT

Please indicate if changing your household fishing has deceased or increased the following.

Number of wild fish caught	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishchange_fishcaught
Number of fish in river	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishchange_fishquant
Fish diversity in river	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishchange_fishdiversity
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishchange_income
Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishchange_timeworking

Household health	SINGLE-SELECT Fishchange_health 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Health of community	SINGLE-SELECT Fishchange_comhealth 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Fishchange_HHsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT Fishchange_Comsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or your household changed the time spent fishing?	SINGLE-SELECT Satisfaction_fishingtime 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

FISHING CHANGES FISHING LOCATIONS

Have you or someone in your household changed fishing locations in the past ten years?	SINGLE-SELECT Fishloc_change 000 <input type="radio"/> No 001 <input type="radio"/> Yes -888 <input type="radio"/> Prefer not to answer
What were the reasons you did not change fishing locations? (select all that apply) E FishLoc_change == 0	MULTI-SELECT Nofishloc_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer

Please specify the other change you made E Nofishloc_reasons.Contains (9)	TEXT Nofishloc_otherchangespec -----
What is the other reason you did not make this change? E Nofishloc_reasons.Contains (10)	TEXT other_reasonnofishloc -----
STATIC TEXT E Fishloc_change == 1 <i>I am now going to read you a list of statements of potential costs associated with changing your fishing location. Please indicate if you agree or not.</i>	
It had significant financial costs E Fishloc_change==1	SINGLE-SELECT Fishloc_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of time E Fishloc_change == 1	SINGLE-SELECT Fishloc_timecost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It took a significant amount of labor E Fishloc_change == 1	SINGLE-SELECT Fishloc_laborcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My family didn't approve of the decision E Fishloc_change == 1	SINGLE-SELECT Fishloc_famcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My friends didn't approve of the decision E Fishloc_change == 1	SINGLE-SELECT Fishloc_friendscost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
My community leaders didn't approve of the decision E Fishloc_change == 1	SINGLE-SELECT Fishloc_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against government regulations E Fishloc_change == 1	SINGLE-SELECT Fishloc_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against my cultural traditions E Fishloc_change == 1	SINGLE-SELECT Fishloc_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
I was uncertain about the outcome E Fishloc_change == 1	SINGLE-SELECT Fishloc_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

FISHING CHANGES / FISHING LOCATIONS
FISHING LOCATIONS IMPACTS

E Fishloc_change==1

STATIC TEXT

Please indicate if changing your fishing location decreased or increased the following.

Number of wild fish caught	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_fishcaught
Number of fish in river	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_fishquant
Fish diversity in river	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_fishdiversity
Household income	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_income
Time spend working	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_timeworking
Household health	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Fishloc_Comafety

Are you satisfied that you or your household changed fishing locations?	SINGLE-SELECT satisfaction_fishingloc 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer
---	--

FISHING CHANGES
ELECTRIC CURRENT

Please describe your household's use of an electric current for fishing. E Electcurrent_current.InList (0,2)	SINGLE-SELECT Electcurrent_current 000 <input type="radio"/> We have never used an electric current 001 <input type="radio"/> We started using an electric current 002 <input type="radio"/> We have always used an electric current 003 <input type="radio"/> We stopped using an electric current -888 <input type="radio"/> No answer
What were the reasons you did not change the use of the electric current? (select all that apply) E Electcurrent_current.InList (0,2)	MULTI-SELECT Noelectric_reasons 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer
Please specify what other change you made E Noelectric_reasons.Contains (9)	TEXT Noelectric_otherchangespec -----
What is the other reason you did not make this change? E Noelectric_reasons.Contains (10)	TEXT other_reasonnoelectr -----
STATIC TEXT E Electcurrent_current.InList (1,3) <i>I am now going to read you a list of statements of potential costs with changing your use of an electric current. Please indicate if you agree or not.</i>	
It had significant financial costs E Electcurrent_current.InList (1,3)	SINGLE-SELECT Electric_fincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

<p>It took a significant amount of time</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_friendcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My community leaders didn't approve of the decision</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_leaderscost</p> <p>000 <input type="radio"/> Disagree</p> <p>001 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It required me to go against government regulations</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_govcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It required me to go against my cultural traditions</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_culturalcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>I was uncertain about the outcome</p> <p>E Electcurrent_current.InList (1,3)</p>	<p>SINGLE-SELECT Electric_uncertaincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

FISHING CHANGES / ELECTRIC CURRENT
FISHING WITH ELECTRIC CURRENT IMPACTS

E Electcurrent_current.InList (1,3)

STATIC TEXT

Please indicate if changing you use of an electric current for fishingdeceased or increased the following.

<p>Number of wild fish caught</p>	<p>SINGLE-SELECT Electric_fishcaught</p> <p>000 <input type="radio"/> No change</p> <p>001 <input type="radio"/> Decrease</p> <p>002 <input type="radio"/> Increase</p> <p>-888 <input type="radio"/> No answer</p>
<p>Number of fish in river</p>	<p>SINGLE-SELECT Electric_fishquant</p> <p>000 <input type="radio"/> No change</p> <p>001 <input type="radio"/> Decrease</p> <p>002 <input type="radio"/> Increase</p> <p>-888 <input type="radio"/> No answer</p>

Fish diversity in river	SINGLE-SELECT Electric_fishdiversity 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household income	SINGLE-SELECT Electric_income 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Time spent working	SINGLE-SELECT Electric_timeworking 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Household health	SINGLE-SELECT Electric_health 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Health of community	SINGLE-SELECT Electric_comhealth 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of household	SINGLE-SELECT Electric_HHsafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Safety of community	SINGLE-SELECT Electric_Comafety 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Are you satisfied that you or your household made the change about using the electric current?	SINGLE-SELECT Satisfaction_electriccurrent 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer

FISHING CHANGES CHEMICALS

Please describe your household's use of chemicals for fishing.	SINGLE-SELECT Chemicals_current 000 <input type="radio"/> We have never used chemicals 001 <input type="radio"/> We started using chemicals 002 <input type="radio"/> We have always used chemicals 003 <input type="radio"/> We stopped using chemicals -888 <input type="radio"/> No answer
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<p>What were the reasons you did not change your use of chemicals? (select all that apply)</p> <p>E Chemicals_current.InList (0,2)</p>	<p>MULTI-SELECT Nochem_reasons</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I did not see a need</p> <p>09 <input type="checkbox"/> I made another change instead of moving</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify what other change you made</p> <p>E Nochem_reasons.Contains (9)</p>	<p>TEXT Nochemicals_otherchangespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E Nochem_reasons.Contains (10)</p>	<p>TEXT other_reasonnochem</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E Chemicals_current.InList (1,3)</p> <p><i>I am now going to read you a list of statements of potential costs associated changing your use of chemicals to fish. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E Chemicals_current.InList (1,3)</p>	<p>SINGLE-SELECT Chemicals_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Chemicals_current.InList (1,3)</p>	<p>SINGLE-SELECT Chemicals_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Chemicals_current.InList (1,3)</p>	<p>SINGLE-SELECT Chemicals_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Chemicals_current.InList (1,3)</p>	<p>SINGLE-SELECT Chemicals_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Chemicals_current.InList (1,3)</p>	<p>SINGLE-SELECT Chemicals_friendcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My community leaders didn't approve of the decision E chemicals_current.InList (1,3)	SINGLE-SELECT chemicals_leaderscost 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against government regulations E chemicals_current.InList (1,3)	SINGLE-SELECT chemicals_govcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
It required me to go against my cultural traditions E chemicals_current.InList (1,3)	SINGLE-SELECT chemicals_culturalcost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer
I was uncertain about the outcome E chemicals_current.InList (1,3)	SINGLE-SELECT chemicals_uncertaincost 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer

FISHING CHANGES / CHEMICALS
FISHING WITH CHEMICALS IMPACTS

E chemicals_current.InList (1,3)

STATIC TEXT

Please indicate if changing how you fish with chemicals decreased or increased the following.

Quality of household irrigation water	SINGLE-SELECT chemicals_HHirrqua1 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of household domestic water	SINGLE-SELECT chemicals_HHdomqua1 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of community domestic water	SINGLE-SELECT chemicals_comdomqua1 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Quality of community irrigation water	SINGLE-SELECT chemicals_comirrqua1 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer
Crop yields	SINGLE-SELECT chemicals_yield 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer

Number of wild fish caught	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_fishcaught
Number of fish in river	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_fishquant
Fish diversity in river	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_fishdiversity
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_income
Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_timeworking
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	chemicals_Comsafety
Are you satisfied that you or your household made the change about using chemicals for fishing?	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	satisfaction_chemicals

FISHING CHANGES
FISHING NET SIZE

<p>Have you or someone in your household decreased the size of your fishing net in the past ten years?</p>	<p>SINGLE-SELECT Netsize</p> <p>000 <input type="radio"/> No</p> <p>001 <input type="radio"/> Yes</p> <p>-888 <input type="radio"/> No answer</p>
<p>What were the reasons you did not decrease the size of your fishing net? (select all that apply)</p> <p>E Netsize == 0</p>	<p>MULTI-SELECT Nonet_reasons</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I did not see a need</p> <p>09 <input type="checkbox"/> I made another change instead of moving</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify the other change you made</p> <p>E Nonet_reasons.Contains (9)</p>	<p>TEXT Nonetsize_otherchangespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E Nonet_reasons.Contains (10)</p>	<p>TEXT other_reasonnonet</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E Netsize==1</p> <p><i>I am now going to read you a list of statements of potential costs associated with changing your fish net size. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E Netsize==1</p>	<p>SINGLE-SELECT Netsize_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Netsize==1</p>	<p>SINGLE-SELECT Netsize_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Netsize==1</p>	<p>SINGLE-SELECT Netsize_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Netsize==1</p>	<p>SINGLE-SELECT Netsize_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My friends didn't approve of the decision E Netsize==1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Netsize_friendcost
My community leaders didn't approve of the decision E Netsize==1	SINGLE-SELECT 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Netsize_leaderscost
It required me to go against government regulations E Netsize==1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Netsize_govcost
It required me to go against my cultural traditions E Netsize==1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Netsize_culturalcost
I was uncertain about the outcome E Netsize==1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Netsize_uncertaincost

FISHING CHANGES / FISHING NET SIZE FISHING NET SIZE IMPACTS

E Netsize==1

STATICTEXT

Please indicate if changing your fish net size deceased or increased the following.

Number of wild fish caught	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Netsize_fishcaught
Number of fish in river	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Netsize_fishquant
Fish diversity in river	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Netsize_fishdiversity
Household income	SINGLE-SELECT 000 <input type="radio"/> Nochange 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Netsize_income

Timespendworking	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Netsize_timeworking
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Netsize_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Netsize_comhealth
Safety of household	SINGLE-SELECT 00 <input type="radio"/> No change 01 <input type="radio"/> Decrease 02 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Netsize_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> Prefer not to answer	Netsize_Comsafety
Are you satisfied that you or your household made the change to decrease your net size for fishing?	SINGLE-SELECT 00 No 01 Yes 02 Unsure 03 No answer	Satisfaction_netsize

ANIMAL HUSBANDRY CHANGES

E Incomefood_source.ContainsAny (1,3)

ANIMAL HUSBANDRY CHANGES ANIMAL TYPE

Have you or someone in your household changed the type of animal you raise? I This can also include fish for aquaculture production.	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes -888 <input type="radio"/> No answer	Animaltype_change
Please specify the type of animal you stopped raising E Animaltype_change==1	TEXT -----	Animaltype_stopped
Please specify the type of animal you started raising E Animaltype_change==1	TEXT -----	Animaltype_started

<p>What were the reasons you did not change the type of animal you raise? (select all that apply)</p> <p>E Animaltype_change == 0</p>	<p>MULTI-SELECT Noanimaltype_reason</p> <p>00 <input type="checkbox"/> It would have had significant financial costs</p> <p>01 <input type="checkbox"/> It would take a significant amount of time</p> <p>02 <input type="checkbox"/> It would require a significant amount of labor</p> <p>03 <input type="checkbox"/> My family wouldn't approve of the decision</p> <p>04 <input type="checkbox"/> My friends wouldn't approve of the decision</p> <p>05 <input type="checkbox"/> My community leaders wouldn't approve of the decision</p> <p>06 <input type="checkbox"/> It would require me to go against our cultural traditions</p> <p>07 <input type="checkbox"/> I was uncertain of the outcome</p> <p>08 <input type="checkbox"/> I did not see a need</p> <p>09 <input type="checkbox"/> I made another change instead of moving</p> <p>10 <input type="checkbox"/> Other</p> <p>-888 <input type="checkbox"/> No answer</p>
<p>Please specify the other change you made</p> <p>E Noanimaltype_reason.Contains (9)</p>	<p>TEXT Noanimalchange_otherchangespec</p> <p>-----</p>
<p>What is the other reason you did not make this change?</p> <p>E Noanimaltype_reason.Contains (10)</p>	<p>TEXT other_reasonnoanimaltype</p> <p>-----</p>
<p>STATIC TEXT</p> <p>E Animaltype_change == 1</p> <p><i>I am now going to read you a list of statements of potential costs associated changing the animals you raise. Please indicate if you agree or not.</i></p>	
<p>It had significant financial costs</p> <p>E Animaltype_change == 1</p>	<p>SINGLE-SELECT Animal1_fincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of time</p> <p>E Animaltype_change == 1</p>	<p>SINGLE-SELECT Animal1_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Animaltype_change == 1</p>	<p>SINGLE-SELECT Animal1_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Animaltype_change == 1</p>	<p>SINGLE-SELECT Animal1_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Animaltype_change == 1</p>	<p>SINGLE-SELECT Animal1_friendscost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

My community leaders didn't approve of the decision E Animaltype_change == 1	SINGLE-SELECT 000 <input type="radio"/> Disagree 001 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Animal_leader_scost
It required me to go against government regulations E Animaltype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Animal_govcost
It required me to go against my cultural traditions E Animaltype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Animal_culturalcost
I was uncertain about the outcome E Animaltype_change == 1	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	Animal_uncertaincost

ANIMAL HUSBANDRY CHANGES / ANIMAL TYPE
CHANGING ANIMAL TYPE IMPACTS

E Animaltype_change==1

STATIC TEXT

Please indicate if changing animal types decreased or increased the following factors.

Time spent working	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Animal_timeworking
Household income	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Animal_income
Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Animal_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Animal_comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Animal_hhsafety

Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	Animal_Comsafety
Are you satisfied that you or your household made the decision to change the type of animals you raise?	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	Satisfaction_animal

ANIMAL HUSBANDRY CHANGES NUMBER OF ANIMALS

<p>Have you or someone in your household substantially changed the number of animals you raise?</p> <p>I This can also include fish for aquaculture production.</p>	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes, decreased the number 02 <input type="radio"/> Yes, increased the number -888 <input type="radio"/> No answer	AnimalNumber_change
<p>What were the reasons you did not change the number of animals you own? (select all that apply)</p> <p>E AnimalNumber_change == 0</p>	MULTI-SELECT 00 <input type="checkbox"/> It would have had significant financial costs 01 <input type="checkbox"/> It would take a significant amount of time 02 <input type="checkbox"/> It would require a significant amount of labor 03 <input type="checkbox"/> My family wouldn't approve of the decision 04 <input type="checkbox"/> My friends wouldn't approve of the decision 05 <input type="checkbox"/> My community leaders wouldn't approve of the decision 06 <input type="checkbox"/> It would require me to go against our cultural traditions 07 <input type="checkbox"/> I was uncertain of the outcome 08 <input type="checkbox"/> I did not see a need 09 <input type="checkbox"/> I made another change instead of moving 10 <input type="checkbox"/> Other -888 <input type="checkbox"/> No answer	Noanimalnum_reasons
<p>Please specify what change you made</p> <p>E Noanimalnum_reasons.Contains (9)</p>	TEXT -----	Noanimalnum_changespec
<p>What is the other reason you did not make this change?</p> <p>E Noanimalnum_reasons.Contains (10)</p>	TEXT -----	Other_reasonnoanimalnum
<p>STATIC TEXT</p> <p>E AnimalNumber_change.InList (1,2)</p> <p><i>I am now going to read you a list of statements of potential costs associated with changing the number of animals you raise. Please indicate if you agree or not.</i></p>		
<p>It had significant financial costs</p> <p>E AnimalNumber_change.InList (1,2)</p>	SINGLE-SELECT 00 <input type="radio"/> Disagree 01 <input type="radio"/> Agree -888 <input type="radio"/> No answer	AnimalNumber_fincost

<p>It took a significant amount of time</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_timecost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It took a significant amount of labor</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_laborcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My family didn't approve of the decision</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_famcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My friends didn't approve of the decision</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_friendcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>My community leaders didn't approve of the decision</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_leaderscost</p> <p>000 <input type="radio"/> Disagree</p> <p>001 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It required me to go against government regulations</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_govcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>It required me to go against my cultural traditions</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_culturalcost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>
<p>I was uncertain about the outcome</p> <p>E Animalnumber_change.InList (1,2)</p>	<p>SINGLE-SELECT Animalnumber_uncertaincost</p> <p>00 <input type="radio"/> Disagree</p> <p>01 <input type="radio"/> Agree</p> <p>-888 <input type="radio"/> No answer</p>

ANIMAL HUSBANDRY CHANGES / NUMBER OF ANIMALS
CHANGING ANIMAL NUMBER IMPACTS

E Animalnumber_change.InList (1,2)

STATIC TEXT

Please indicate if changing the number of animals deceased or increased the following factors.

Household income	<p>SINGLE-SELECT Animalnumber_income</p> <p>000 <input type="radio"/> No change</p> <p>001 <input type="radio"/> Decrease</p> <p>002 <input type="radio"/> Increase</p> <p>-888 <input type="radio"/> No answer</p>
Time spent working	<p>SINGLE-SELECT Animalnumber_timeworking</p> <p>000 <input type="radio"/> No change</p> <p>001 <input type="radio"/> Decrease</p> <p>002 <input type="radio"/> Increase</p> <p>-888 <input type="radio"/> No answer</p>

Household health	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_health
Health of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_comhealth
Safety of household	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_HHsafety
Safety of community	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_comsafety
Quality of household irrigation water	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_HHirrrqual
Quality of household domestic water	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_HHdomqual
Quality of community domestic water	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_comdomqual
Quality of community irrigation water	SINGLE-SELECT 000 <input type="radio"/> No change 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	AnimalNumber_comirrrqual
Are you satisfied that you or your household made the decision to change the number of animals you raise?	SINGLE-SELECT 00 <input type="radio"/> No 01 <input type="radio"/> Yes 02 <input type="radio"/> Unsure 03 <input type="radio"/> No answer	Satisfaction_AnimalNumber

COMMUNITY LEVEL IMPACTS

CommunityLevelImpacts

STATIC TEXT

This is the last section of the survey. I am now going to ask about the impacts of community changes on your

household and your communication with leadership.

Which of the following do you see in your community?	MULTI-SELECT 00 <input type="checkbox"/> Hydropower development 01 <input type="checkbox"/> Tourism 02 <input type="checkbox"/> Industrial development 05 <input type="checkbox"/> Climate variability 08 <input type="checkbox"/> Floods	commimpacts_comm
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COMMUNITY LEVEL IMPACTS

Roster: COMMUNITY IMPACTS ROSTER

generated by multi-select question Commimpacts_comm

Commimpacts

How does %Commimpacts% impact your household's irrigation water quantity? E Incomefood_source.Contains(0)	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	irrigationwaterquant_comimpacts
How does %Commimpacts% impact your household's irrigation water quality? E Incomefood_source.Contains(0)	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	irrigationwaterqual_comimpacts
How does %Commimpacts% impact your household's domestic water quantity?	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	domesticwaterquant_comimpacts
How does %Commimpacts% impact your household's domestic water quality?	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	domesticwaterqual_comimpacts
How does %Commimpacts% impact your household's income?	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Decrease 002 <input type="radio"/> Increase -888 <input type="radio"/> No answer	income_comimpacts
How does %Commimpacts% impact your household's health?	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Worsened 002 <input type="radio"/> Improved -888 <input type="radio"/> No answer	health_comimpacts
How does %Commimpacts% impact your household's safety?	SINGLE-SELECT 000 <input type="radio"/> No impact 001 <input type="radio"/> Worsened 002 <input type="radio"/> Improved -888 <input type="radio"/> No answer	safety_comimpacts

Do you interact with or receive information from the following individuals?

MULTI-SELECT

Leadership_comm

- 000 ☐ Fisheries department
001 ☐ Fisheries watcher
002 ☐ TMA/WSSC
003 ☐ MPA
004 ☐ Jirga
005 ☐ Assistant Commissioner
006 ☐ District Commissioner
-888 ☐ No answer
-

PICTURES

STATIC TEXT

If you are at their home, ask the respondent if you can take pictures of their water sources, agricultural fields, or other points of interest. Then put them on the WhatsApp group!

CONCLUSION

STATIC TEXT

Thank you so much for being willing to complete this survey. Do you have any questions for me? If you are interested in accessing the results, please contact: Survey coordinator: Becca Nixon: WhatsApp: (+1 317 370 1449); nixon17@purdue.edu; Purdue PI: Dr. Zhao Ma: WhatsApp (+1651 308 3390); zhaoma@purdue.edu; U of P PI: Dr. Bushra Khan (00-92-91-921674); bushraasu@yahoo.com

APPENDIX C. FIELD WORK CONSIDERATIONS

Conducting international research in an area recovering from years of violent conflicts and in an area known for conservative religious traditions such as northwestern Pakistan poses specific challenges and opportunities. While each context requires specific methods, there are some principles and methods that I learned in this context that could be applied to other similar research areas. Specifically, this project illustrated that: 1) flexibility is necessary; 2) the right technology can be used support data collection; and 3) field visits, when possible, build trust and lay the foundation for clear communication and collaboration.

First, this project required a high degree of flexibility from both the students and faculty both in planning and conducting data collection. For instance, we had to make numerous changes to our data collection plans due to security concerns. For example, we initially canceled our survey data collection trip and made plans for virtual survey training and facilitation. However, mailing the tablets to Pakistan proved difficult if not impossible and we foresaw difficulty trying to have conversations about survey questions and translations over unstable internet. Therefore, we negotiated permission for me to travel to Pakistan for one week and stay near Islamabad (outside of the zone that was categorized as high risk) to train a team of enumerators and pilot the survey. These changes required a significant degree of flexibility for all parties involved in order to quickly form a team of enumerators, plan survey training, and arrange travel and accommodation. This was only possible because of the investment of students, faculty, and administrators. Further, we had to maintain a high degree of flexibility to respond rapidly changing plans during data collection due both to the interdisciplinary nature of the project and opportunities that develop in the field. For example, we were simultaneously collecting fish samples, water samples, and interviews during one two-week field visit and needed to travel together for security. Therefore, if the fisherman had fish ready for us to pick up we redirected our plans and shifted the interview plans for the day. At the same time, last minute plans also benefited our data collection. For instance, interviewees would often take time to show us various points of interest such as hydropower construction or their irrigation infrastructure, and while these were not planned, were significant for our understanding of the context.

After a week of training and piloting the survey, we relied on technology to facilitate the survey collection when I came back to Purdue. Specifically, I had weekly check in meetings with

the survey supervisor (a UP post-doctoral researcher) who compiled the number of surveys completed and any issues encountered from the enumerators. We used WhatsApp to communicate because it was the most convenient and reliable method especially when they were in the field with limited internet. We also used Survey Solutions to collect data which allowed me to review the surveys collected by each enumerator as soon as they uploaded them to the server. These communication and data collection methods allowed for regular and timely checks of the data collection process despite the time differences and geographical distance.

Finally, research in this context was also made possible due to the collaboration from both UP and Purdue students and faculty, which was supported by field visits when possible. While field work was difficult, the time I spent in the field proved to build trust with the UP students working on the project. That way, for instance, when I was texting about the survey with the field supervisor or talking to another student who was translating an interview, we knew each other as friends and colleagues. I was able to visit the field twice, and importantly, both trips included not only data collection but also gave time team an opportunity to share meals and get to know each other during long bus trips to field sites. Therefore, trips to the field were significant not only to collect data but to build relationships between Purdue and UP researchers that benefit not only this research project, but also builds connections for future collaborations. This is especially significant for the graduate students, including myself, who have learned how to engage in international partnerships from this project and can continue to build on these collaborations throughout our careers.

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