Towson University

Office of Graduate Studies

ENVIRONMENTAL CHANGE AND FARMERS' ADAPTATION IN PUNBJAB, PAKISTAN

by

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A thesis

Presented to the Faculty of

Towson University

in Partial fulfillment

of the requirements for the degree

Master of Arts

Department of Geography

Towson University

Towson, Maryland 21252

May 2020

TOWSON UNIVERSITY OFFICE OF GRADUATE STUDIES

THESIS APPROVAL PAGE

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Entitled:

Environmental Change and Farmers' Adaptation in Punjab, Pakistan

Has been approved by the thesis committee as satisfactory completing the thesis requirements for the degree: Master of Arts

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Abstract

ENVIRONMENTAL CHANGE AND FARMERS' ADAPTATION

IN PUNJAB, PAKISTAN

Nick Mason

Extreme temperatures and unpredictable precipitation patterns are causing both drought and flooding to the agricultural sector of Punjab, Pakistan and negatively impacting farmers' lives. The latest provincial agricultural policy framework seeks to provide advisory services, access to credit, subsidies, new agricultural technology, and information on adaptation, but not all farmers are able to access or afford these, extension services are spread thin, and most farmers in Punjab are small landholders and while policies acknowledge them, they do not favor the poorest.

This thesis begins with a discussion on the geography and climate of Pakistan and then the Pakistani Prime Minister's favorable views on environmental adaptation and mitigation. I then critique Punjab, Pakistan's latest provincial agricultural policy, followed by a literature review which describes how farmers are perceiving and adapting to environmental change. I conclude that the poorest farmers in Punjab do not benefit from most agricultural policies.

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Section I: Introduction

1.1 Introduction

This research is important for a few reasons. It examines resource disparities between the most vulnerable and advantaged; and it compares relevant researchers' results to the provincial agricultural policies. The research analyzes the practices of farmers in Punjab, Pakistan and how they may adapt to environmental change. I have also studied how national and provincial agricultural policies are created as a reaction to environmental change and how farmers' practices are affected by them.

This thesis draws from multiple disciplines—in addition to geography—including political science when discussing policies, NGOs, government, and intergovernmental relations, history as it explores the legacy of past practices, and anthropology through the inclusion of individual experiences. I have integrated political science to analyze equitable resource distribution, where access to human resources, education, and the use of technology are not distributed equitably to farmers throughout Punjab, Pakistan. Again, anthropological insights drew my attention to the voices of farming community members and their need to work with scientists, researchers, policy makers, and institutions. Geography was used to integrate climate, environment, agriculture, and how farmers interact with their surroundings.

Because the environment plays such a critical role in farmers' lives, and the agriculture sector contributes approximately 25 percent to the nation's GDP, it is important both to better understand the ways farmers are reacting and adapting to environmental changes and the role the Punjabi government may play in farmers' coping strategies. Consequently, this thesis examines the following questions.

- How are farmers responding to environmental change in Punjab, Pakistan?
- Are environmental changes influencing the Pakistani local and national governments' agricultural policies? How are these policies affecting farmers' practices?

1.2 Background

Punjab, Pakistan has been experiencing extended periods of drought, intense heat, and periods of flash floods at an increasing rate due to anthropogenic forcing from CO_2 and other greenhouse gases (GHGs) (Craig, 2016). These extreme weather events are becoming more common and are taking a toll on agricultural systems. Provincial policies exist to assist farmers, but not all are able to access them equally. Those with larger plots of land, more education, and off-farm income can benefit and adapt to environmental change more efficiently. They are also able to respond to environmental events, therefore able to act and adapt more efficiently (Abid et al., 2016).

According to both researchers and the most recent Punjab provincial 2018 Agriculture Department Policy, the poorest farmers are not receiving the same amount of help as those with larger farms (Agriculture Department, 2020, p.15). They both agree that extension services are spread thin, but action still needs to be taken so that all farmers have equitable access to human resources (Elahi et al., 2017). Researchers such as Abid et al., 2016 and 2018, Elahi et al., 2017, and Ashraf et al., 2018 have addressed some of the variables which create social inequities in farming, such as education, access to technology, plot size, etc. They have not matched these thoroughly with the provincial agricultural policy, to address how the Agriculture Department can adjust policies that might benefit the most vulnerable. Most of the policies seem created for all farmers and do not take income or other socioeconomic factors into consideration. For example, the policy recommends mitigation of greenhouse gases (GHGs) in the agriculture

sector, which applies to all farmers (Agriculture Department, 2020, p. 48). Policies like this ignore socioeconomic factors because they are tailored to cover everyone and not provide discounts or advantages to farmers based on income, even if one farm produces more GHGs than others. Another broad policy recommendation the Department made is to downsize its current extension services staff and provide them with advanced degrees (Agriculture Department, 2020, p. 38).

Much of the existing literature focuses on perception of environmental change which can lead to the intent to adapt (Abid et al., 2016). But as the following researchers learned, perceptions, adaptation, and mitigation can change based upon education, location, off-farm income, access to information, experience, and cooperation with others (Abid et al., 2016; Ashraf et al., 2018). Perception is important because this reveals how a farmer views environmental change, if they have the intent to adapt, and how they will attempt to respond (Abid et al., 2016).

Global average temperatures have been increasing, potentially destroying crops. Seasonal monsoon winds bring torrential downpours which have brought floods. Pakistan has 7,253 known glaciers (Craig, 2016). These are located on the three northern mountain ranges of the Hindu Kush, Himalayas, and Karakoram. With rising temperatures, the glaciers can melt at such a rapid rate that they do not replenish (Ijaz, 2017). When they melt at natural rates every spring, they provide fresh water to the Indus River and its tributaries which empty into the Arabian Sea (Ijaz, 2017). But excess glacial melt can cause flooding and flash floods can cause mudslides, ruin livelihoods, destroy infrastructure, cause loss of lives, and destroy crops and farmers have had to adapt accordingly (Ijaz, 2017).

Most farmers own less than two hectares of land (4.94 acres), and many of them do not have access to human or agricultural-related technological resources to adapt efficiently (Ashraf

et al., 2018). Agriculture contributes one-fifth of Pakistan's economic output and keeps two-fifths of its workers employed (CIA, 2019). Agriculture made up 24.4 percent of the Gross Domestic Product (GDP) composition by end use for 2016 according to the United States CIA Factbook. Agriculture can be affected in many ways by changes in the environment. When rivers overflow, they can oversaturate crops, cause diseases from stagnation, and wash products away. Excessive heat can burn and dehydrate yield and evaporate water.

There have been advancements in farm-related technology such as drip and sprinkler systems, crop varieties, weather-related early warning systems, climate monitoring, and various forms of communications that allow for new strategies of adaptation (Sukhera, 2017). Some farmers are receiving help from nongovernmental and governmental organizations, such as the United States Agency for International Development (USAID). On February 20, 2019, Punjab Chief Minister Usman Buzdar released the first Punjabi agriculture policy. Punjab government officials want to increase the role of agriculture in the national economy (Baig, 2019). This is significant because it took 72 years to finally make a policy in the province and for 2018-2019 the government invested 36 billion Rs ($229,167,000) just for agriculture. Minister for Information & Culture Fayyaz-ul-Hussan Chohan believes that the country cannot progress without boosting this sector (Baig, 2019). With this, the government has begun a crop insurance scheme and increased interest free loans for the spring of 2020 from Rs 25,000 to 30,000. The Punjabi government also decided to increase subsidies on more crops such as sunflower, because this could decrease the country's imports (Baig, 2019). Provincial and national governments have not tilted policies in favor of poorer or less fortunate farmers who may not be able to afford relevant technology or have equal access to extension services.

1.3 Methodology

Relying on selected published materials, the literature review constitutes the primary outcome of my research. It consists of several important components, including a synthesis of key materials which helped guide my research questions. Further, it traces the intellectual progression of key research themes, and my choice of materials indicates those most pertinent for this thesis. While the literature review represents my synthesis of critical arguments and ideas it serves as a foundation and support for subsequent critical insights on nature-society interactions in Punjab, the focus of my discussion section.

I selected the published materials for the literature review by finding peer reviewed articles on Google Scholar, ResearchGate, and Towson University's Cook Library advanced search system. I found them by searching for "agricultural adaptation in Punjab, Pakistan," and "environmental change in Punjab, Pakistan" in the above research sites. From there, I was able to note frequently referenced authors' names in the list of references. I also searched for "environmental change and agricultural adaptation" which enabled me to find works that were not in Punjab.

To complement the literature review, I analyze primary resources, such as governmental and nongovernmental organization (NGO) documents, Pakistani state and Punjab provincial websites, and books and news articles published primarily in both Pakistan and the United States.

Section II: Physical Geography

2.1 Geography

The first two subsections briefly discuss the physical geography and climate of Pakistan and are important for understanding vulnerabilities of farmers living in the province of Punjab. Geography and climate can be intertwined as geographic location can determine what the climate will be. Punjab has extensive mountains to the north, intricate river and canal system and fields, and an arid climate, which allow for heat waves, flooding, and drought (Ali and Erenstein, 2016). These can all contribute to socio-economic inequities when the most vulnerable are not protected by policies to help them recover. This subsection also provides basic information on the environmental conditions in which the people live, an element of human geography.

Punjab's two main water sources come from precipitation and glacial melt from the Karakoram mountain ranges to the north. Punjab's farmers receive water from the Indus Basin Irrigation System (IBIS) via 23 canals, water courses, farm channels, and field ditches (Ahmad et al., 2018). In turn, this system is fed by rainfall, glacial melt, snowmelt, and runoff. Surface water availability here is at 820mm per irrigated hectare and it is estimated that by 2025 water will be 32 percent below what is usually used for irrigation (Ahmad et al., 2018). This is the result of seasonal temperature changes, shifting snow cover, and how snowfall has also changed course. Snowfall directly influences runoff of the IBIS because when the snow melts, the additional water becomes part of the river which is diverted to the canals (Ahmad et al, 2018). Climate change can impact these canals by evaporating the water through drought, flushing away soil nutrients in floods, saltwater intrusion, chemicals, and other toxins through heavy precipitation (Ahmad et al., 2016).

This subsection illustrated some of the physical conditions of Punjab's environment that are directly affecting farmers. Plains located next to a glacial-fed river system can offer effective irrigation for agriculture. When the canals are stressed, they become less useful and can put strain on crops and livelihoods. Those without extra income or are poor cannot afford irrigation technology to make up for these losses (Ahmad et al., 2016).

2.2 Climate

This subsection discusses how increases in temperature can affect crops and farmers' livelihoods. Changes in climate can negatively impact agriculture, increasing risks of flooding and drought. Echoing the geography subsection, those who are most vulnerable have a more difficult time rebounding from the effects of environmental change. When monsoon seasons arrive later in the year as a result of climate change, this impacts farmers. Timing is unpredictable and this may shift market and profits for them, making income unreliable (Ijaz, 2017).

The Global Change Impact Studies Centre and Pakistan Meteorological Department have helped determine that Pakistan's climate is changing, and this is apparent from the increase in average annual temperature in the country by 0.6C in the last century (Ahmad et al., 2016). An increase in temperature by 1C in Pakistan could reduce wheat production in the northeastern Pakistani province of Punjab by five to seven percent, particularly in arid zones (Ali and Erenstein, 2016). Warmer weather accelerates grain growth in southern Punjab, but there are consequences involved such as lower crop yield and both irregular grain size and decrease of grain size (Ahmad et al., 2018). Most developing countries such as Pakistan have agrarian economies and these rely heavily upon agriculture (Ahmed et al., 2015).

Monsoons have reportedly shifted in both time and space. The Pakistan Meteorological Department has stated that in the past thirty years the monsoons have moved westward 100 kilometers. The summer monsoons have pushed toward the end of the season and the winter rains have been delayed to late February and March (Ijaz, 2017). This is significant because it can alter traditional planting times for farmers. A change of planting seasons can lower crop yields, provide insecure income, and increase psychological stress. Monsoons have been the primary source of precipitation in Punjab and their unreliability takes its toll on farmers because planting dates are affected as well as irrigation schedules and water surplus for crops (Ijaz, 2017).

This subsection addressed how weather extremities can destroy crops and livelihoods. While flooding, drought, increased temperatures, torrential rain, and other extreme weather events reach all farmers indiscriminately, those who are poorest are unable to recover as easily (Ali and Erenstein, 2016). Access to water resources such as rivers, precipitation, and glacial melt are productive when used efficiently and under stable climate conditions. When these are stressed, those in poverty and who are most vulnerable to environmental change become further trapped in poverty, are unable to adapt, and do not receive equitable attention from institutional policies and policy makers.

Section III: Policies

This subsection addresses provincial policies and their inequitable application. Those who are most vulnerable are not able to benefit from many of the policies provided by the Agriculture Department. Some of these reasons include unaffordable new technology, lack of training on the latest agricultural techniques, long and complicated loans, and farmers do not

have equal access to extension services for information and advice (Elahi et al., 2017). This subsection reviews the 2018 Punjab Agriculture Department's policies and inattention to the most vulnerable.

The Agriculture Department's most recent policy states "Lack of coherent policies, benefitting few and leaving many in the rural communities out, including the small farmers, rural women and rural youth," which can result in high poverty in rural areas (Agriculture Department, 2020, p. 8). The policy makers also note that lack of access to bank credit, advice, and information result in low yields and profits for farmers (Agriculture Department, 2020). This is especially critical for those who are already in poor situations and do not have much land, money saved, or other sources of income.

There are a few places in the latest 2018 Agriculture Department's policies where marginalized farmers are mentioned, but policies are still not directed towards them. The policies acknowledge that Punjab has a poverty rate of 42.6 percent and one of the objectives is to raise the standard of living for everyone, especially those living in rural areas (Agriculture Department, 2020, p. 17, 13). As well as acknowledging the level of poverty, the Agriculture Department hoped to focus policies on small commercial farmers with land between three and 75 acres (Agriculture Department, 2020, p. 7). The Department believes that targeting such a wide range will stimulate the economy beyond the farming community even though a majority of those in poverty own 12.5 acres or less (Agriculture Department, 2020, p. 19). Through Zarai Taraqiati Bank Limited, a Pakistani-government owned agriculture bank, the Agriculture Department does provide farmers with 2.5 to 12.5 acres access to the e-Credit scheme (ZTBL, 2020). The only other policy listed which aids those with less than 12.5 acres is the Area Yield Index Insurance (AYII) which is designed to aid small farmers against natural disasters and the

effects of climate change. AYII has 16000 farms insured and is available in nine out of Punjab's 36 districts. Only those with e-Credit can use AYII, so both policies which help those with under 12.5 acres of land are linked (Agriculture Department, 2020, p. 49).

The latest Punjab Agriculture Department's policy claims to assist all farmers, whether they own large plots or are landless, and to work for both the long and short term equally. While the policy points out poverty levels of farmers and that it focuses on farmers with land less than 15 acres, there is nothing specific in its framework regarding resource distribution designed to benefit the poorest (Agriculture Department, 2020, p. 19).

The Food and Agriculture Organization of the United Nations' 2015 report "The Impact of Disasters on Agriculture and Food Security" placed Pakistan at the top of the developing countries list for risk for loss of agriculture (Gill 2016). Punjab is susceptible to the consequences of climate change as it hosts a large number of poor people who still depend on agricultural-based economies in rural areas. Punjab contributes 53 percent of the total agricultural gross domestic product (GDP) of Pakistan and 56 percent of the total cultivated area (Abid et al., 2018, p. 4). Poorer farmers cultivate over 80 percent of Pakistan's agricultural space (Shaikh and Tunio, 2017), and agriculture contributes a fifth of the country's GDP and 43 percent of Pakistan's workforce (Ali and Erenstein, 2016).

Of the 5,249,800 farms in Punjab, 67 percent own less than two hectares (4.94 acres) of land. In fact, the average farm is now one hectare in size (Agriculture Department, 2020). Small landowners make up 80 percent of farmers in Pakistan (Ashraf et al., 2018) and Punjab has the highest number of poor people, reaching 42.6 percent poverty rate (Agriculture Department, 2020). According to data from 2014, 44.5 percent of farmers with land smaller than 12.5 acres were living in poverty (Agriculture Department, 2020). Nearly 34 percent who lived on land

between 12.5 to 25 acres of land were in poverty, and 13.9 percent were in poverty who lived on 25 to 50 acres of land (Agriculture Department, 2020). The larger the land plot, the less likely the farmer was to be in poverty.

Those who lived on more land than 50 acres were no longer considered below the poverty line (Agriculture Department, 2020). Wealthier farmers with more land and education have been finding it easier to adapt to environmental change than those who are poorer, less educated, and own less land. Wealthier farmers also have more space to experiment with, more land for crop diversification, and income from crop sales (Abid et al., 2016).

The Punjabi government plans to move forward in promoting crop diversification. The policy claims that most research produced so far is supply-driven and does not account for market demand, which can result in overstock of monocrops (Agriculture Department, 2020). By not diversifying crops, the government has found an overabundance of some crops and a lack of others. Diversifying crops can help with food and nutritional security and surplus can be used for foreign exchange, one of the specific goals of the policy framework in the 2018 Policy (Agriculture Department, 2020).

Current research does not focus on farmer and extension service relationships, new issues such as environmental change, and not much attention has been put into evaluating the impact and quality of research. The Agriculture Department also notes that scientists do not have much incentive to perform small-scale research and there is scarce communication between universities and research institutes, as well as a lack of extension agents to work with farmers (Agriculture Department, 2020).

Water conservation is another focus of the Department's policies. There have been reforms to adapt to the droughts, but they have not all been implemented yet. Drip and sprinkler

technology, drought tolerant crop varieties, early warning systems, and climate monitoring are either new in the country or are in the process of being applied (Sukhera, 2017). Many of these adaptations such as water conservation are expensive and cannot be executed by those who are poorer. Installing drip irrigation, for example, can cost $700 per hectare in Bakrani, Larkana, Sindh, located just southwest of Punjab province (Shaikh and Tunio, 2017). Having an education also puts farmers at an advantage because they may have the knowledge to implement lasers which level the land, lowering water consumption by 60 percent (Shaikh and Tunio, 2017). Those who are educated also are more likely to have finances to fund projects such as land laser leveling. Knowledge can assist in helping farmers adapt in ways that do not require money or land size (Shaikh and Tunio, 2017).

Early warning systems and climate monitoring would also need to be used by many farmers in different regions for these systems to be fully efficient. Efficiency is important because the sooner people are aware of weather risk events such as flood warnings, they can take necessary precautions (Sukhera, 2017). Lack of trained technical staff to design, install, and maintain the technology can prevent proper adaptation. Many of the parts for technology are imported and there are high tariffs and custom duties which create additional problems (Sukhera, 2017). Early warning systems, climate monitoring, and access to this information would be critical for farmers to be able protect their crops.

Both the federal and provincial governments offer subsidies to farmers. The former has $478,409,439.20 while the latter $360,360,356.80 for a total of $838,769,796.00 (Agriculture Department, 2020, p. 29). Most of the federal subsidies go to fertilizer, gas and reduction in electricity tariffs for tube wells (Agriculture Department, 2020). Most provincial subsidies are placed into wheat procurement schemes, irrigation maintenance and repair, and interest free

loans. This shows a difference in priority (Agriculture Department, 2020, p. 29). Placing so much emphasis on wheat ($226,867,606) creates a surplus that exceeds international levels for support price. The wheat then needs additional storage and incurs handling costs. The Department suggests that wheat be left to the free market instead of remaining under government control (Agriculture Department, 2020). Water, land, and fertilizer could go to other projects, according to the Agriculture Department. The 2018 policy recommends all unproductive and inefficient subsidies such as wheat to be phased out (Agriculture Department, 2020). Currently, most subsidies benefit farmers with large plots of land and the latest policy aims to change that by channeling funds to agriculture research and technology that would help lead to sustainable crop yields, as well as the promotion of climate smart agriculture and crop mixing (Agriculture Department, 2020).

Farmers who attend prestigious universities such as the University of Faisalabad in Punjab are able to learn about the latest bio-engineered seed varieties which are pest resistant, and increase crop yield (Shaikh and Tunio, 2017). To assist small landowning and poorer farmers, Akther Ali, agroecologist at the International Maize and Wheat Improvement Centre in Islamabad recommended subsidizing access to technology and providing credit schemes (Shaikh and Tunio, 2017). The provincial government also recognizes connections among education and farm size and farmers' access to formal credit (Agriculture Department, 2020). Lack of access to formal credit, technology, and technical advice are not only hurting farmers' adaptation, but those trying to run a small agribusiness (Elahi et al., 2017). Many farmers were unable to obtain bank loans because they did not have land for collateral, bank documents were too complicated, and other obstacles. Farmers then relied mostly on informal credit sources such as commission

agents who have unfair practices, leaving farmers in a perpetual cycle of poverty (Elahi et al., 2017).

The Punjab Agriculture Policy states that farmers' yield growth potential in Punjab is low but can be enhanced through advisory services and better access to technology, yet the Agriculture Department plans on cutting staff. Access to technology is also a privilege that not all farmers have equal access to. The Agriculture Department wrote in their policy that private sector small and medium enterprises (SME) can aid farmers through digital information, providing them with farm technologies and advisory services. SMEs in the agricultural sector are underrepresented, which the Agriculture Department states as a reason for low production (Agriculture Department, 2020).

Teaching small landowning farmers about environmental adaptation and helping them with subsidized technology and small loans can help relieve poverty (Shaikh and Tunio, 2017). Providing information and advisory services to farmers are two other priorities for the Agriculture Department and are written in the 2018 Policy. Providing information and advisory services to farmers can result in higher crop yields, an increase in agricultural income, and a stronger likelihood that the farmers will diversify their crops (Elahi et al., 2017). Extension services are supposed to distribute basic information and technical skills to the farmers. Due to a lack of extension services, farmers have been seeking advice from each other, informal advisors, university faculty, and input sellers (Elahi et al., 2017). In the past, Punjab has used top-down, supply-driven approaches for extension services. As of now, the provincial government is using a strategy that utilizes village level extension field schools, but even so, agents must work with a large territory, thus spreading human resources thin. They are only fulfilling a fifth of the required regional coverage. Communication between extension services and research networks

are weak, which produces gaps in information distribution (Agriculture Department, 2020). A majority of the field assistants do not have advanced training or degrees. There are plans to replace current staff with those with higher degrees when they retire, and to also offer some who work as extension agents the opportunity to obtain advanced education. The government aims for a smaller, more specialized staff for higher efficiency when it would suit the farming community's interests to hire more competent staff (Agriculture Department, 2020).

As of December 2018, the Agriculture Department began distributing information with forecasts for yields and production of major crops, however this included market intelligence and information, rather than climate change or environmental adaptation (Agriculture Department, 2020, p. 27). Climate change and environmental adaptation are important to include because they could verify farmers' perceptions and provide targeted information.

Many of the federal and provincial Punjab government's agricultural policies are implemented through private sectors. The Agriculture Department partnered with an unnamed private sector mobile service company to create the Connected Agricultural Platform Punjab (CAPP), which offers digital information and advice through different smartphone apps. CAPP also provides information on weather updates, pesticides warnings, and advice on crop practices that are displayed through both articles and videos (Agriculture Department, 2020). Not all farmers have smartphones, and the Agriculture Department expects CAPP to be more successful as farmers gain access to them (PITB, 2020). The policy does not say what language or dialect the information in the applications is in. Currently it is only available to e-Credit scheme farmers so it is limited in range. E-Credit is a mobile banking loan program available to farmers with less than 12.5 acres of land. This is one positive program for those who are poorer, as 44.5 percent of farmers who own less than 12.5 acres of land are living in poverty (Agriculture Department,

2020). E-Credit boasts 350,000 registered farmers (PITB, 2020) out of 5,249,800 agriculture farms (Agriculture Department, 2020).

The Agriculture Department stated that farmers can mitigate environmental change damage without losing productivity by using Climate Smart Agriculture (CSA) techniques. To do so they have a list of recommended focus points. The Agriculture Department aims to recognize vulnerabilities from environmental changes, lower GHG emissions in the agriculture sector, create an effective framework for CSA practices, and reduce the effects that finance and human resource limitations would have on mitigation goals. These goals would require both time and cooperation (Agriculture Department, 2020). To maximize efficiency for this CSA, climate information needs to be timely, accurate, and dependable. Weather infrastructure such as dams and canals need to be improved and maintained, and scientific and empirical research should be combined, which many researchers have written about (Martin, 2015). To implement these, the Department suggests creating an Institute for Climate Smart Agriculture staffed with technical personnel, who would oversee CSA practices (Agriculture Department, 2020).

While Punjab's policy is on the right track and addresses marginalized communities and the poorest farmers, it is still providing more educated and large landowners an advantage, such as through extension services. These farmers can read and complete lengthy loan applications, have access to advanced technology such as for drip irrigation, laser leveling, and sprinkler systems, and the land area for crop diversification (Shaikh and Tunio, 2017). Poorer farmers are not able to afford water conservation techniques as easily either. The policy recognizes mistakes made in the past such as focusing more on supply than demand, which leads to overstock. The policy also notes that research is not focusing on farmer and extension service relationships. What information was distributed did not contain anything on climate change which is

detrimental for farmers to properly adapt (Agricultural Department, 2020). While the latest policy has good intentions and is paying attention to the poor, its contents are still general and benefit the wealthier and more educated.

There are intergovernmental organizations that can assist farmers with productivity, development, and adaptation, such as the United States Agency for International Development (USAID) who has collaborations in Pakistan. These programs only last a few years.

Pakistan and Punjab have government departments which can assist farmers, however they do not specifically help marginalized farmers. The Agricultural Innovative Program (AIP) is a part of the Pakistan Agricultural Research Council (PARC) and United States Agency for International Development (USAID) initiative (PARC, 2019). PARC consults and facilitates agricultural development in different regions of Pakistan. AIP's aim is to increase crop productivity and the value of livestock, horticulture, and cereal to help farmers profit more. AIP reaches farmers through commissioned projects. It also seeks to provide food for the poor, promote agricultural growth, and to aid in climate change resilience and adaptation. Punjab has its own Punjab Agricultural Research Board (PARB), which is a research funding department. PARB is important for the region because they provide funding for local workshops, research, scientific publications, and technology (PARC, 2019).

Pakistan created PARC at the federal level and PARB at the provincial level. PARB does not perform any research itself, rather it evaluates agriculture results. PARB also facilitates professional activities and involves scientists in capacity building (Agriculture Department, 2020). PARB's purpose is to coordinate research work and identify priorities. The Agriculture Department suggested transferring research funds to this bureau to better allocate them. In allocating resources to PARB, the Agriculture Department hopes to catch up to other countries

regarding research. Through PARB, the Agriculture Directorate Generals of Extension and Adaptive Research, and Ayyub Agriculture Research Institute (AARI) would provide more incentives to everyone involved in technology and innovation for agricultural reforms and research (Agriculture Department, 2020).

USAID's goal in coordination with the Pakistan government is to increase private sector development, agricultural productivity, and create a more efficient environment for businesses to thrive. They want to help increase sales, assist people in obtaining jobs, and make the agricultural sector more profitable via new technology, enhanced irrigation, and market incentives (USAID, 2019). These are not available for everyone, though. Technology and modern irrigation can be expensive, so only those with access to capital are able to afford them. USAID has invested over $390 million into Pakistan's private sector for small and medium agricultural enterprises. This money has helped to develop and support seeds, grain silos, equipment, and livestock breeds, as well as renewable energy solutions, pharmaceuticals, and education (USAID, 2019). Since 2010, over one million households have benefited, 824,000 acres of land have been improved, over 60,000 jobs have been added, and 362,000 farmers have used skills gained from USAID (USAID, 2019). USAID's assistance in Punjab has been both successful and beneficial to farmers. USAID collaborates with the Agriculture Department but is not mentioned in the Department's policy other than by name. How long the jobs provided by USAID last and income are not specified.

While there are many policies released by the Punjab Agriculture Department and the poorest farmers are mentioned often, they are not tailored for marginalized farmers. There are only two policies which are designed to help the 44.5 percent of Punjabi farmers who are living in poverty (Agriculture Department, 2020). They are both connected to the e-Credit scheme and

assist those who own less than 12.5 acres of land. Most of the other policies assist farmers with land between three and 75 acres (Agriculture Department, 2020). The Punjab Agriculture Department's policies aid farmers with larger land and more income.

This section was designed to breakdown key policies and illustrate that not all farmers benefit from the newest agricultural policies.

Section IV: Literature Review

The following literature review analyzes farmers' perceptions of and adaptation to environmental changes as well as responses to some of the governmental agriculture policies that are available for farmers. There are many governmental policies and agricultural aids, but not all farmers are using them, either because they are unaware of their existence, institutional outreach is limited, or stakeholders cannot afford them. The review transitions into the discussion of resource distribution, which considers resolution to many of these policy issues by distributing resources equitably. Many policies focus on covering a homogenous set of people, but as research shows, socioeconomics of farmers are heterogenous.

This section also discusses the work of some of the most prominent researchers who have studied agricultural adaptation in Punjab, Pakistan. I have analyzed their research, comparing results, finding their work through Google Scholar, ResearchGate, and Towson University's Cook Library advanced search system, only using peer reviewed scholarly articles. Some of these researchers have worked together such as Muhammad Abid and Ehsan Elahi, which allows for collaboration on new ideas. A few articles were chosen as they were referenced in other articles, indicating researchers' cross-referencing and acceptance of others' work.

Not all the researchers studied Punjab, Pakistan. Some of them examined how farmers were adapting to environmental change in Jamaica, Ghana, Bangladesh, the North China Plain, and Zimbabwe. Many of the topics that these researchers discussed could be implemented in Punjab as well. They were used in this literature review to strengthen positions on adaptation techniques of crop diversification, inequitable resource distribution, cooperation between farmers and institutional services, and the importance of extension workers interacting directly with farmers to create more effective agricultural policies.

The literature review attempts to answer the following questions: "how are farmers responding to climate induced environmental change in Punjab?" And "are Pakistani agricultural policies effective to assist farmers adapt to environmental change?" Farmers will adapt if and how they see the environment changing and use different techniques depending on what knowledge they have and resources are available. There are policies available through the Punjab Agriculture Department to assist farmers, but they may not be able to assist all people equally.

4.1 Perception

If and how farmers perceive risks may lead to how and if they decide to act upon them. If farmers notice a change in precipitation and temperature and the negative consequences they bring such as flooding, drought, and cotton disease, they may adapt. Perceptions of climate change are more likely to be accurate if the farmers are more experienced and have contextual information. Context may include past weather patterns, past crop yields, and changes in the local environment such as an increase in flooding over time. More accurate perceptions can also lead to stronger adaptation such as changing crop varieties and planting dates (Abid et al., 2018).

When researchers have asked farmers in Punjab about perceived changes in the environment and if those have led to agricultural adaptation, many include questions related to socio-economics. This is because perceptions, adaptation, and mitigation techniques may all shift dependent upon a farmer's education, location, off-farm income (Abid et al., 2016), experience, cooperation with others, access to weather-related information and extension services, and whether they were members of community organizations (Abid et al., 2018). Possessing more of these increases the likelihood of successful agricultural adaptation.

However, on both national and farm levels, it can be hard to adapt to risks because of limited resources, especially for those most vulnerable. This can happen even with the aid of public institutions, such as the Agriculture Department when they do not make equitable policies (Abid et al., 2016). Sometimes those in more destitute positions need extra help to raise them to a level where they can adapt effectively. Although many of the policies are designed to cover a broad range of people, they do not consider that farmers have different needs dependent upon location, income, land size, etc.

Topography (Ahmed et al., 2015), poverty (Ashraf et al., 2018), agriculture-based economies, rural communities, and climate change can all play a role in agricultural vulnerability to environmental change (Ali and Erenstein, 2016). Ashraf et al., 2018 analyzed intersections of poverty in Pakistan with flooding, drought, increasing temperatures, decreasing rainfall, and found crops and food production affected by these changes. Their research showed positive correlations between education, access to a cellular phone, farm experience, income, access to extension services, and climate change adaptation (Ashraf et al., 2018).

Most farmers in Abid et al.'s, 2016 results also expressed an increase in environmental hazards, such as floods and increased episodes of rainfall and crop disease. Still, Ali and

Erenstein, 2016 said part of the Agriculture Department's policies should focus on increasing awareness of climate change and the risks and benefits of adapting to it.

4.2 Adaptation Techniques

Farmers who have perceived climate-induced environmental change as a risk to their agricultural production may attempt adaptation techniques if they have the knowledge and capabilities such as income and land size. Crop diversification is used in not only Punjab, but other areas around the world such as rural Zimbabwe, as Makate et al., 2016 covered. Crop diversification is one of the most popular forms of agricultural adaptation because it increases pest control, soil fertility, resilience, productivity, income, and provides a habitat for helpful insects (Makate et al., 2016).

Eighty-one percent of the 500 smallholder farmers Makate et al., 2016 interviewed were using crop diversification techniques such as crop rotation and intercropping. The farmers interviewed had a mean land size of 5.68 acres. With an acre increase or decrease in land they discovered a 15.8 percent increase or decrease in the probability of diversifying crops. The use of this practice can be dependent upon farm size, the farmer's experience, their assets, location, access to extension services and information (Makate et al., 2016).

The majority of the 100 farmers who diversified their crops in Faisalabad, Punjab were under the age of 36, had additional off-farm income, were educated and owned farm equipment (Boz et al., 2017). Some farmers in Punjab use crop rotation and drought and flood tolerant plants as an adaptation technique because they do not have access to credit (Adib et al., 2016). Crop diversification is not just different types of crops, but equal care vested into each one (Boz et al., 2017), meaning each type of crop needs to be tended to properly. It can also be an

inexpensive and effective measure against both climate change and market price differentials (Boz et al., 2017).

There are multiple factors which can constrain crop diversification and other adaptation techniques. Owning more land allows for multiple types of crops. While there may not be a minimum requirement of land size for crop diversification, it is more efficient with a larger plot. However, 67 percent of Punjab's farmers own less than two hectares (4.94 acres) of land (Ashraf et al., 2018).

In their study of Pakistan, Ali and Erenstein (2016) also found that farmers who planted different types of crops, used drought tolerant varieties, and changed sowing times were younger, more educated, wealthier, and had more land.

4.3 Policies

Globally, many researchers have written about the benefits of smallholder farmers working with policy makers, researchers, and scientists for more efficient agricultural adaptation. Barahona et al., 2018 studied agricultural progress around the globe over the past decade by surveying farmers in five regions, 21 countries, 315 villages, and 6300 households, to determine whether agricultural organizations were working with local farming communities. The importance of working with small landholders is that policy makers would be able to create strategies based on local regional context and situations such as floods and drought (Barahona et al., 2018).

If farmers' lived experiences were combined with scientific climate change research, stronger agricultural adaptation measures could potentially be implemented (Martin, 2015). It is important for policy makers to address more farmers' needs and create policies that fit more than one population. Farmers, researchers, policy makers, and scientists working together not only

create stronger policies, but can assist farmers in creating more effective adaptation changes (Martin, 2015).

Dumenu et al., 2015 suggested that information intended for farmers should contain local dialect, so it is easier to understand by a diverse audience. In Punjab there are many languages and dialects such as Punjabi, Urdu, Saraiki, Sindhi, and more. This is another reason it is important to work directly with communities. Only 20 percent of Islam and Nursey-Bray's, 2017 interviewees felt that culture was considered when addressing climate change by the agriculture Department. Those interviewed felt that formal services such as extension agents should have cultural and regional knowledge before engaging with farming communities (Islam and Nursey-Bray, 2017).

Views differ among researchers with the ongoing role of technology regarding equity issues amongst farmers in Punjab, Pakistan. Some say farmers should learn to use new technology (Curtis et al., 2014). Others argue that since technology is not available to all farmers, especially those who are low-income, policies should focus on informal-source community-based adaptation methods (Islam and Nursey-Bray, 2017).

Knowing how to apply for grants, subsidies, and loans would help more vulnerable farmers to adapt more adequately (Curtis et al., 2014). Chen et al., 2015 recommended creating governmental policies that can provide subsidies, rewards, or incentives. But applying for these can be lengthy, complicated, and at times require advanced literacy. Crop loan insurance schemes in Pakistan are also new and cannot reach enough people (Abid et al., 2016).

To create more equitable policies would be to ensure that farmers who are most vulnerable and poorer would receive more agricultural-useful resources such as access to credit, advisory services, loans, etc. than those who are already wealthy (Curtis et al., 2014). When

collaborating with farmers, individual and community needs are heard, and it is possible to create policies that work for more people. Understanding vulnerability and adaptation at the local level and not using singular approaches applied by a national policy is important as multiple approaches can reach more farmers (Dumenu et al., 2015). One policy may work in one region or for one group of people but not for another, which reinforces the need to work directly with communities to create context-specific policies. Dumenu et al., 2015 suggested having district-level assessments to gauge vulnerabilities.

Having 36 districts, this could be a challenge for Punjab, however, there are nine divisions (Babakhel, 2018) for which assessments could work. Pakistan is split into four provinces (Khyber Pakhtukhwa, Punjab, Balochistan, and Sindh), two autonomous territories (Azad Kashmir and Gilgit Baltistan), and a federal territory (Islamabad). Each province is broken into divisions and those are separated into districts (Babakhel, 2018). The Department of Agriculture's latest policy packet does not mention anything about district or division specific policies. Crops, agro-ecological zones, culture, and rural-to-urban differences vary throughout the province.

In Punjab policy makers have not written policies that address the specific needs of small land holders, instead policies are written broadly for all farmers. For instance, the 2018 Agriculture Department's policy recommends increasing research to .4 percent of the agriculture gross domestic product (GDP) so that it is level with other countries in the Indian subcontinent (Agriculture Department, 2020, p. 35).

Farmers also have the option to obtain information and resources from agricultural and developmental non-governmental organizations (NGOs). The Sungi Development Foundation assists with climate change adaptation (Sungi, 2020). Other NGOs such as the Rural

Development Foundation of Pakistan aim to teach communities to work together for more efficient irrigation management (RDF, 2020).

Often it is quicker and easier for farmers to obtain information from informal services such as friends, family, neighbors and university faculty if they have access, and members of their community. Formal services are not always available, can be expensive, and farmers may not trust them as much as they do family and friends. But information from formal services can also be more accurate, there are less chances of exploitation, and they can be more trustworthy (Elahi et al., 2017). If designed equitably, formal services can be more reliable for farmers to use. Generally, poorer farmers are more likely to use informal sources than those with more capital (Elahi et al., 2017). Those with more money, assets, and who are less vulnerable generally have more disposable income to pay extra interest on credit and can access formal sources easier (Elahi et al., 2017).

Many farmers were relying on informal services because outreach services were limited by personnel in Punjab, Pakistan (Elahi et al., 2017) and this made it difficult for farmers in remote regions to receive assistance (Abid et al., 2016). Elahi et al.'s, 2017 study showed that outreach services were not as efficient as they could be. Seventy to seventy six percent of farmers did not have access to information. Some institutions such as extension services ignored many farmers' needs, which limited their trust in the Agriculture Department (Elahi et al., 2017). Farmers were also accessing credit from informal services more often than through public and private organizations, Elahi et al., 2017 found. Agriculture is close to a fifth of Pakistan's gross domestic product (GDP), so ensuring that everyone has equal access to extension services could have a strong multiplier effect (Ali and Erenstein, 2016).

Elahi et al., 2017 suggested that extension services could be improved by increasing the number of and outreach by training staff as well as eliminating credit misuse by implementing policies and monitoring services. Improved advisory services could let farmers know about new adaptation techniques and could improve relationships with researchers. Current advisory services in Punjab do not take into consideration climate change and the corresponding events, which are a reason to adapt (Elahi et al., 2017).

I have combined a comprehensive collection of scholarly articles that integrates the themes of farmers' perception and agricultural adaptation, institutional agricultural policies and how farmers are using them. Through these, we can evaluate how policies could be shaped more effectively in Punjab, Pakistan if the local government and institutions listened to farmers and were mindful of socioeconomic inequalities. Absent access to education and technology, policies need to be directed toward the poor so that they have more opportunity to succeed.

There is not a singular "strongest" article used, as I was able to derive relevant information from each article to shape my literature review. Most researchers agreed that perceptions led to better agricultural adaptation and a lack of assistance from institutional policies negatively impacted perceptions and proper adaptation (Abid et al., 2016). Even if the farmers had perceived risks, due to lack of knowledge or access to services provided through the Department of Agriculture they may still not be able to adapt efficiently. While researchers managed to write about institutional neglect for many farmers, they did not match them with the Department of Agriculture's Policy. Boz et al., 2018 was the only group of researchers who noted a connection among farmers, institutions, and GDP. Policies are neither designed for nor reach poorer and more vulnerable farmers. Researchers have not written about how and if farmers are using the Agriculture Department's policies in Punjab, Pakistan. Researchers

studying agricultural adaptation in Punjab could interview officials from the Department of Agriculture, review the most recent policies, and identify how farmers were responding to them. They would need to gather more information on wealth disparities in farming communities and analyze how income, land size, etc. compare to actual policy effectiveness from the Agriculture Department.

Section V: Research Discussion

5.1 Research Discussion

Punjab is in a flood-prone area that is heavily used for agriculture. The geographic location of this province is critical to understand precipitation patterns. Farmers rely on the monsoon winds to bring most of the rain and if these and temperatures are shifting, farmers must adapt (Ijaz, 2017). Punjab's physical geography plays an important role in how communities are influenced by environmental factors such as flooding, drought, and torrential rain.

It was important to include provincial governmental departments and intergovernmental organizations to show that the Punjab Agriculture Department coordinates with other sources. The United States Department of Agriculture (USDA) works with NGOs, the Pakistan Agricultural Research Council (PARC), and the provincial Punjab Agricultural Research Board (PARB) to train local youth and women, facilitate research and development of agriculture, and so forth. I included these research councils and governmental departments because there is more to agriculture than just farmers growing crops and selling them. It is a global market with many networks. There is widespread recognition that youth, women, and the poor need assistance, but more targeted work needs to be done (Agriculture Department, 2020).

I performed a literature review because it shows how experts in the field are researching and writing about: "perception and adaptation in relation to environmental change," "policies for agricultural adaptation," and "resource distribution in agricultural adaptation." I wanted to know if farmers were perceiving changes, if they were working with provincial institutions, and if marginalized or poorer farmers were able to access the services provided by the government for adaptation as are large landowners.

I was able to find relevant topics on Google Scholar, Research Gate, and Towson University's Cook Library advanced search system. I could then organize these articles to create a narrative which I later compared and contrasted with the Punjab Agriculture Department's policy. I also researched the climate and geography of Punjab, Pakistan, and agricultural adaptation steps taken by farmers in the region, to understand governmental and intergovernmental relations regarding both climate change and aid.

The researchers in my literature review wrote about farmers' adaptation to environmental change, not just in Punjab, Pakistan but also the North China Plain, Jamaica, Zimbabwe, and Ghana. Islam and Nursey-Bray, 2017 researched the importance of communities and governments working together. This corresponds with what other researchers such as Martin, 2015 have suggested such as blending qualitative and quantitative research. When working directly with and listening to marginalized farmers, it is easier to address their concerns and apply them to policies. Islam and Nursey-Bray, 2017 noted in their research that communities who worked with institutions were able to adapt more efficiently.

Some researchers such as Abid et al., 2018 and Ashraf et al., 2018 studied how farmers perceive environmental change versus how they may or may not adapt. If farmers did not perceive a change in the environment, they would have no reason to adapt. Abid et al., 2016

deduced that perceived change would lead to the intent to adapt. Not only did the authors study environmental change perceptions, but risk perceptions that would affect agricultural production, flooding, and other areas (Abid et al., 2016). I incorporated adaptation methods as a way to analyze how farmers were responding through education, land size, and by age. One of the most popular adaptations was crop diversification, and that was later echoed when I read the 2018 Punjabi Agriculture Policy, as it can increase resilience and production (Makate et al., 2016).

Elahi et al., 2017 wrote about the successes and challenges farmers face with extension and financial services and credit. Dumenu et al., 2015 wrote that policies should not be written as broadly, but to understand social impacts, vulnerability, and adaptability of climate change at the local level is critical. Ali and Erenstein, 2016 acknowledged that those living in developing countries are most vulnerable to climate change and that South Asia is dependent on agriculture, but they did not take into consideration farmers at the individual or community level. They instead spoke about farmers as one (Ali and Erenstein, 2016). Islam and Nursey-Bray, 2017 raised the point that researchers and farmers need to come together to create proper adaptation procedures. Curtis et al., 2014 said that farmers need to know how to apply for grants, loans, and subsidies, and how to use and afford modern technology.

What was critical about using a literature review for a research method was the opportunity to examine variables that affected perception and access to extension services and technology. Abid et al., 2016, and 2018, and Ashraf et al., 2018 discussed how perceptions, adaptation, and mitigation can be influenced by education, off-farm income, access to information, etc. Abid et al., 2018, Chen et al., 2015, and Dumenu et al., 2015 recommend easier access to training, credit, extension services, information, and literature that featured vulnerability. These suggestions, variables, and results enabled me to realize researchers

studying agricultural adaptation in Punjab, Pakistan were not comparing and contrasting the Agriculture Department's policy.

Much of the information in the 2018 Agriculture Department's policy was discussed by researchers in my literature review. Lack of extension services, i.e.., advisory and outreach, were of major concern (Elahi et al., 2017). Many farmers are also unable to afford some of the recommendations in the Agriculture Department's policy framework. Crop diversification was a popular and inexpensive method used by farmers and mentioned throughout the policy (Boz et al., 2017).

The provincial government's policy framework was where I was able to crosscheck researchers in my literature review's results who wrote about agriculture adaptation in Punjab, Pakistan. Those were Elahi et al., 2017, Abid et al., 2016, Abid et al., 2018, Ashraf et al., 2018, and Ali and Erenstein, 2016. Nearly all the data matched, confirming that I had chosen relevant research articles and that the policy fit into the thesis.

Reviewing the 2018 Punjab Agriculture Department's policy, climate change was brought up 18 times, while the term "environmental change" was nowhere to be found. Climate change was mostly mentioned in reference to mitigation and adaptation practices, minimizing greenhouse gases (GHGs), or that natural resources had been exhausted from the consequences of it. The Department also admits that they only focused on water conservation with little to suggest regarding climate change mitigation (Agriculture Department, 2020, p. 9). The policy does not describe what climate change is either.

Major components of the policy's framework which tied in with the literature review were topics of credit, advisory services, distribution of information, crop diversification, agricultural-relevant technology, and access to extension services and technology. Including the

policy framework into my thesis was critical because I wanted to blend the provincial governments' and the researchers' perspectives, who had already incorporated many farmers' perspectives. Triangulating these, I could realize that there is a gap in policies and services that focus on the poorest farmers, which account for over 40 percent of Punjab's population (Agriculture Department, 2020). This is significant because most people in Punjab, Pakistan, and South Asia rely on agriculture. For non-subsistence farmers, their surplus enters the market and contributes to a hefty portion of the country's GDP. When the poorest farmers perform well, both the province and country do too (Agriculture Department, 2020).

Although I am investigating how farmers are adapting to environmental change, as in any group, not all farmers are equal. For simplicity, I divided them by most and least vulnerable. The less vulnerable generally had plots of land larger than 12.5 acres (Agriculture Department, 2020) and were more educated, had off-farm income, access to extension services and agriculture-related technology. The opportunity to have a higher education such as attending an agricultural university is a privilege, at times facilitating a higher level of wealth than those who are not able to attend (Shaikh and Tunio, 2017). To be admitted to a university also requires previous formal education and literacy. Those who graduate are able to learn trade skills, further develop literacy, learn about new technology, are more willing to try new technology, and they are more likely to take out loans and credit because they can read and understand the documentation involved with the application process (Elahi et al., 2017).

Literacy also allows farmers to read information documentation provided by the Agriculture Department, which contain information on weather forecasts and crop production yields (Agriculture Department, 2020), although this information omits discussion of environmental and climate change. Although Dumenu et al., 2015 performed their research in

Ghana, their suggestion that given high illiteracy rates among farmers, information packets should be written in local terminology for clarity is applicable to Punjab.

Farmers who owned large areas of land were able to receive credit on non-agricultural items more than small landowners. They tended to spend their credit on weddings for children, school, etc. They were able to do this because many had off-farm sources of income as well (Elahi et al., 2018). This seems to suggest that those farmers are living more comfortably and are secure enough to afford extra items. Targeting small landowners with more nuanced policies would allow them to improve their material well-being, as studies have shown they use credit for intended purposes (Elahi et al., 2018), and this would benefit the agriculture sector.

Perceptions are important too and can lead to the intent to adapt to environmental change, as Abid et al., 2016 observe. Farmers need to be aware of environmental change in order for them to adapt effectively, if they will adapt at all. Boz et al., 2017 said that the Punjabi government needs to work on increasing the literacy rate of farmers, as 60 percent of participants in their study group in Faisalabad were illiterate. In combination with literacy, if extension literature had information on climate and environmental change, farmers could not only learn, but perhaps confirm their perceptions with scientific findings and pursue appropriate measures.

Equitable resource distribution can facilitate collective attempts to help everyone adapt better, and can help reveal the types of actions necessary to benefit more farmers more equitably (Curtis et al., 2014). While the 2018 Agriculture Department's policy is on the right track by mentioning the most vulnerable farmers, those who own less than two hectares of land are not benefiting equally. To create more equitable conditions, the Agriculture Department needs to target the poorest with policies that will contribute to adaptive farming.

Farmers are experiencing the environmental changes affecting their crops and land. Consequently, researchers, policy makers, extension agents, and other institutional staff need to more effectively work with farmers. Institutions should hire more extension agents instead of cutting staff when they are already spread thin. The extension workers could receive more adequate training and learn more about climate and environmental change themselves. In turn, while educating farmers, they could also hear the stakeholders' concerns, reporting this information back to the extension agency. While this may appear to be a simple solution, the Agriculture Department is downsizing extension workers. They plan to have fewer, more educated workers and provide them with extensive training (Agriculture Department, 2020).

When researchers and scientists work closer with farmers, they can blend statistical and empirical data together. Collecting quantitative information is important, but the lived experience, especially of the most vulnerable complements raw data. Lived experience reveals perceived cause and effect. Lived experience is crucial to working together as a larger community to create policies that benefit everyone.

Without helping the poor, who make up the largest population at 80 percent of small landowners (Ashraf et al., 2018), there could be negative effects in other sectors. Agriculture is a fifth of Pakistan's GDP and if a portion of the 80 percent of landowners are not performing as well as they could, the province and country are also affected (Ali and Erenstein, 2016). Focus on the most vulnerable farmers and boosting their environmental adaptation can benefit everyone.

To achieve this, researchers need to focus more on resource disparities, and incorporate more detail on actions for how to solve the imbalances. Qualitative and Quantitative research need to be blended together as well, leading to more insight. Each approach offers information

that the other does not. Lastly, policy makers, researchers, scientists, and farmers, especially the most vulnerable, need to work together and communicate. If farmers relay relevant information to researchers, and both hard and soft sciences are blended properly, the farmers can work with scientists who study climate and environmental change, as well as other earth sciences and in turn work with policy makers to create more effective policies that truly benefit everyone.

5.2 Results

- How are farmers responding to environmental change in Punjab, Pakistan?
- Are environmental changes influencing the Pakistani local and national governments' agricultural policies? How are these policies affecting farmers' practices?

My results show that poor farmers in Punjab are not well served by provincial agricultural policies. The Pakistan government spends $6 to $14 billion U.S. annually on climate change adaptation methods (PPI, 2015), but the policies are not targeting the most vulnerable. The national government seems more prioritized on reducing greenhouse gas (GHG) emissions (PPI, 2015), planting trees to absorb carbon dioxide, and building new infrastructure (Dawn, 2019) than directly helping the agricultural sector. That has been primarily under the provincial governments. Punjab's agricultural research and development spending is also the lowest in South Asia (Agriculture Department, 2020).

The 2018 Punjab Agriculture Department's policy framework acknowledges small landowners, rural women, and youth are left out of most policies and that these benefit those with more land, higher education, and more income. While extension services, which include advice and information are available, they are short staffed, the agents are unskilled, and services are not easily accessible by the poor. Agriculture related modern technology is also not easily

accessible to the poor. E-Credit schemes are one positive way that small landowners have been able to advance and have been recommended by researcher and agroecologist Akther Ali (Shaikh and Tunio, 2017).

There are only two policies in the 2018 Punjab Agriculture Department's framework which target farmers with less than 12.5 acres of land and both are connected to e-Credit. One is access to e-Credit for farmers with land between 2.5 and 12.5 acres through Zarai Taraqiati Bank Limited (Agriculture Department, 2020). The other is Area Yield Index Insurance (AYII) which helps farmers with less than 12.5 acres against natural disasters and climate change (Agriculture Department, 2020).

The Agriculture Department has also recommended Climate Smart Agriculture (CSA) techniques to farmers as a way of mitigating environmental change damage. This is an approach that recognizes vulnerabilities from environmental change and supports GHG emissions reduction in the agricultural sector (Agriculture Department, 2020). Ultimately, the Department plans on creating an Institute for Climate Smart Agriculture employed with personnel to would oversee CSA practices (Agriculture Department, 2020).

Small landowners make up 80 percent of the farming population in Pakistan (Ashraf et al., 2018). In 2010, 67 percent of farms in Punjab were under two hectares, which is 4.94 acres (Agriculture Department, 2020). Data from 2014 showed that farmers in Punjab with land under 12.5 acres fell in the 44.5 percent poverty range (Agriculture Department, 2020). A large percentage of Punjab's farmers are classified as poor or marginalized and are not represented equally in policy solutions. According to Shaikh and Tunio 2017, poorer farmers cultivate over 80 percent of Pakistan's agricultural space. Punjab contributes 53 percent of Pakistan's agricultural gross domestic product (GDP), which is a significant amount (Abid et al., 2018).

Forty three percent of Pakistan's workforce is connected to agriculture and this sector contributes to a fifth of the country's total GDP (Ali and Erenstein, 2016).

Forty percent of Pakistan's population is vulnerable to the effects of environmental change (Ahmed et al., 2015). Two thirds of Pakistan's (Ali and Erenstein, 2016) total population of 280 million (Boz et al., 2017) are also rural, which can lead to thinning of extension services, poor infrastructure, and other challenges to agricultural adaptation. More than half of Pakistan's population earns less than $2 (Abubakar, 2016).

In response to environmental change, many farmers have used adaptation techniques such as crop diversification. Crop diversification is an inexpensive way for farmers to adapt (Boz et al., 2017). Farmers with larger plots of land are able to diversify more crops, which becomes a challenge in Punjab because 67 percent of farmers own less than 4.94 acres (Ashraf et al., 2018).

The Punjab Agriculture Department has acknowledged there are many small landowning farmers in poverty living in the province and they have provided data indicating land size versus poverty correlations. However, most of the policies in their framework are not designed to target these small landowning farmers. Instead, they are broadly written and as a result, they benefit those with larger farms and more income.

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Curriculum Vitae

Nicholas Mason

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Education

Towson University, Towson, MD
Master of Arts, Geography and Environmental Planning — May 2020

Towson University, Towson, MD
Bachelor of Arts, International Studies — May 2017

York County Community College, Wells, ME
Associate of Arts, Graphic Design — May 2014

Work Experience

Photographer/ Volunteer — January 2018 - Current

Council on American-Islamic Relations, Catonsville, Maryland

- Photograph and live stream events, news conferences, and vigils for the Maryland Outreach Director of CAIR, Zainab Chaudry
- Assist in setting up and taking down events
- Lobby inside the U.S. Capitol for human rights annually
- Lobby inside Maryland State Capitol annually for relevant needs

Photographer/ Volunteer — December 2018 - Current
Justice for All, Washington, DC

- Photograph fundraisers, rallies, and events for Uyghur and Rohingya awareness
- Attended training and lobbied in DC for Uyghur, Kachin, and Rohingya rights
- Editor for Free Kashmir Facebook page

Graduate Assistant/ Teaching Assistant — January 2018 - May 2019

Towson University Geography Department, Towson, Maryland

- Guest lectured when professors were unable to attend
- Held office hours to aid students in understanding core material and grade papers and tests

- Created an interactive PowerPoint for students to use for Physical Geography class to complement their textbook study material.

Volunteer January 2017 - September 2019

Helping Hand for Relief and Development, Catonsville, Maryland

- Folded and packed clothing to send to countries in need such as Jordan, Pakistan, Nepal, and Somalia
- Helped raise funds at venues for orphans, clean water, and food for people in other countries
- Photographed fundraisers, banquets, and other events when needed

Mentor September 2016 - March 2017

Refugee Youth Project, Baltimore, Maryland

- Assisted a high school student in applying to local universities
- Toured campuses with every mentor/student pair once a month
- Navigated language barriers through patience and understanding on both ends

News Correspondent December 2014 - June 2015

York County Coast Star, Kennebunk, Maine

- Covered bi-weekly town hall meetings in Ogunquit, ME
- Attended annual and new festivals and community events
- Stories ranged from the individual to local business
- Photographs and articles were written and taken by me
- Articles on Civil Rights and International Women's Day