GENDER FACE OF CLIMATE CHANGE: WOMEN PERCEPTIONS AND COPING STRATEGIES

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CERTIFICATE

This is to certify that this thesis entitled: "Gender Face of Climate Change: Women Perceptions and Coping Strategies" submitted by Ms. Hajra Batool is accepted in its present form by the Department of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Philosophy in Economics**.

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*I **Hajra Batool** declare and affirm on oath that I myself have authored this M.Phil. Thesis with my own work and means, and I have not used any further means except those I have explicitly mentioned in this report. All items copied from internet or other written sources have been properly mentioned in quotation marks and with a reference to the source of citation.*

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ABSTRACT

Climate change is nowadays accepted as the major global problem the world faces presently. Along with affecting population overall, climatic change is pressurizing rural women more in many areas of the world due to their different socio-economic characteristics, assigned role and responsibilities making them different from men in terms of impact, perception and adapting to the changing climate. This study explores the gender dimension of climate change focusing on women's perception about climate change and their decision of adapting coping strategies in response to the climate related shocks in Pakistan.

Treatment Effect Model was used in the study to evaluate the determinants of women perception and adoption of coping strategies. This assessment was undertaken using data from "Climate Change Impact Survey, (CCIS, 2013) by PIDE-IDRC. The results from the Selection (Perception) equation showed that education, farming experience and climate information through traditional sources were significantly and positively affecting the women's likelihood of perceiving the changing climate. Moreover, the results from the outcome (Adaptation) model revealed that age, education, farm experience, land rights, women empowerment, livestock ownership and change in rainfall are crucial factors in determining the adoption of coping strategies by women. The results further suggest that to avoid the adverse effect of climate change, policymakers should focus on promoting awareness about climate change, providing credit facilities to women for undertaking adaptation measure, encouraging informal social network and besides these, it is also necessary to invest in education to increase the adaptive capacity of women.

CHAPTER 1

INTRODUCTION

1.1. Background to the Study

Climate change[1] is considered to be a major threat to the human security in the present world today (UNFCCC, 2005; Brien and Leichenko, 2007; IPCC, 2007; Mearns and Norton, 2010). The highly enriched CO_2 atmosphere, highly volatile patterns of precipitation and high temperature make the poor most vulnerable to these serious threats the world face today. Climate change and its impacts is now considered to be a sustainable development issue as the anthropogenic climatic changes are causing transformations not only in the environmental systems but they also have serious implications on the social system which is closely related to human livelihoods (Francis, 2013; IPCC[2], 2001, 2007).

These changes not only straight away affect the economies but also harm the social development. The effects vary from region to region and amongst different generations and income groups and between men and women (Hunter *et al.,* 1998; Brien & Leichenko, 2008). The analysis of social, economic, political, and cultural and gender dimensions of the climate change is attaining increasing attention in this regard[3].

Climate change has many faces that vary from place to place i.e. change in temperature, change in rainfall patterns, floods, droughts and rise in sea level etc. Altered precipitation rate is one of the

[1] The Intergovernmental Panel on Climate Change (IPCC) refers climate change to "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period. Climate change may be due to natural internal processes or external forces or to persistent anthropogenic changes in the composition of the atmosphere or in land use".
[2] Intergovernmental panel on climate Change established in 1988 by UN.
[3] For details see Pachauri (2004).

serious climate change impact as in the monsoon, increased intensity of rainfall is leading to more and recurring floods in Asia and that is expected to accompany by the drier weather conditions in semi-arid and arid places in Asia (Pachauri, 2004).

As argued above, climate change has diverse impacts across the sectors and people such that industrial and agricultural, poor and non-poor, most importantly on agriculture which is the most vulnerable sector. These climatic changes directly hit the agriculture sector. The impact on agriculture sector includes reductions in crop yields, livestock and plants, changes related to the crops and increase in agricultural prices so the climate change will alter what the people do because of their livelihood/dependence on agriculture (FAO, 2008).

Along with affecting the population overall, these frequent floods and severity of droughts have adverse, unfavorable and unequal distributed impact on women's health and their livelihood (WHO, 2008). Also these climate disturbances are expected to pressurize people in poor rural areas more (Adger, 2001, 2003; Burton, Diringer & Smith 2006). So amongst the poor it is women which comprise 70%[4] of the population living below the poverty line making them more in danger as to bear the heaviest burden when any natural hazard happens. The world today has accepted widely that both the genders experience the change in climate quite differently and the more the gender inequality is, more worsen would be the women's coping abilities (Cannon, 2002; Denton, 2004; FAO, 2007; Petrie, 2010; Nelson, 2011 etc.).

Gender dimensions are also important in the context of climate change because of the differences in assigned social and economic roles of women, their responsibilities as well as existing disparities in rural areas such as income generation, land tenure, access to resources, access to

4 The Global Poverty Project, globalpovertyproject.com/infobank/women

credit, and decision-making power, men and women differ in terms of vulnerability, impact and also in responding to climate change (Denton, 2004).

Rural women of the world are majorly dependent on natural environment for their survival as they are responsible to secure and collect water, food and energy for their families. The higher the women dependency on the natural resources the more she is open to every danger and threat caused due to these changing climate (Nelson, 2011). According to a Women Watch report[5], women in the rural part of the world are most vulnerable to climatic changes by affecting their livelihoods in different ways. As women in the rural areas are heavily reliant on natural resources and these climatic changes are disturbing the main course of their lives. The report says that women form a larger share of the poor population in most of the developing countries of the world.

Women's role in mitigating the negative impacts of the climatic changes and in developing sound coping strategies has now been acknowledged in dealing with the menace. It is generally argued in the gender analysis of climate change that inequalities between men and women within the male headed household make women even more vulnerable to the changing climate (Araujo *et al.*, 2007) and undermines their capability to cope up with the menace and also in contributing their knowledge in decision making process (Demtriade and Esplen, 2008).

Due to their distinct gender roles, chores and responsibilities, women have different perspectives on and knowledge about how the risk due to climate change can be protected. Women tend to have poor credit facilities, less access to valuable resources (Denton, 2004) and less decision making power, also they don't have much information on changing climate and due to their dependence

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[5]UN Women Watch Report, 2009: Information and Resources on gender quality and empowerment of women.

on subsistence farming they face severe hardships in tackling with the adverse effects of the changing climate. Hence women have less flexibility to buffer any larger shift in their production mechanism (Francis, 2013).

On the impact of climate change, the situation is more or less same when it comes to the case Pakistan. Pakistan[6], being an agriculture dependent country and having agriculture the major source of livelihood, is one of the most vulnerable countries to climate change (Asian Development Bank, 2009). Pakistan has an area of 880,000 km^2 of which almost 80% is both arid and semi-arid land while the remaining 20% of the land is sub dry humid and humid land.[7] Out of the available land some 60% of the land is available for agricultural use and out of the 24 Million ha cropland available almost 18 Million ha is the irrigated land. (Sustainable Land Management Program to Combat Desertification in Pakistan 2013-14 to 2018-19).

The average rainfall in Pakistan was recorded to 494.00 mm per year as per 2014 statistics reported by Food and Agricultural Organization electronic files[8]. Weather related events such that floods, droughts, heavy rainfall have become more frequent and intense from the last 10-20 years also in Pakistan. According to the Task Force Report on Climate Change, precipitation on average has increased by 25% in Pakistan which is projected to decrease in winter and increase in summer, hence varying the monsoon period and also intensifying the frequency and severity of weather related shocks i.e. droughts and floods[9].

It is expected that Pakistan will lose between 2 to 16 billion dollars on average annually as a result of climate change till the end of 21st century (Mendelsohn *et al.*, 2001). A recent study by Ahmad

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[6] Pakistan is ranked 16 by Maplecroft in list of countries most vulnerable to climate change.
[7] www.pc.gov.pk/pc1
[8] Index Mundi Facts and figures/Pakistan
[9] Task Force Report on Climate Change, 2010, Planning Commission, Government of Pakistan.

et al. (2013) reported that if suitable technologies were not adapted in rural Pakistan to moderate the adverse effect of climate change will give rise to poverty boost and serious food insecurity. The study further added that among the affected it is the poor children and women (according to a study report conducted by Shirkat Gah Women Resource Centre, 2011 in Sindh district about one half of population of Pakistan are of women) that will suffer more in response to climate change because of their overdependence on agriculture in Pakistan. It is the women that are already poorly paid as well as overburdened in Pakistan but climate change may increase their susceptibility and capability further. The finding of the Shirkat Gah women resource Centre (2011) suggest that out of the total poor people who are vulnerable to climate change 70 percent are women.

In response to climate change women vulnerability increases. Because of the reproductive role of women a study by (Oxfam, 2011) on the impact of climate change on women in Burkina Faso, finding suggest that women's workload increases (i.e. they are required to arrange food for their families, responsible to care their children and sick family members, food preparation and working in the field). Besides reproductive role women also play an important role in markets to sell their products and to grow crops.

This over-responsibility of women is never supposed to compensate neither in terms of fair work distribution nor they are given access to their earning (assets). Because of these impair treatment, women vulnerability to climate change increases. Women are the most affected group in the past natural disasters happened in Pakistan. These disasters include the 1999 and 2000 droughts in Baluchistan in which the most suffered groups are women and children (Bushra Khaliq (2012). Likewise, the 2010 floods throughout the country affect a total of 713000 women between the age of 15-49 among which pregnant women are 133,000 (Pakistan Monsoon Floods, 2010).

It is in this context we argue that women perception about climate change and the most appropriate coping strategies (policy options) are crucial to well address the adverse impacts of climatic changes (Adger *et al.*, 2003; Kurukulasuriya and Mendelsohn 2006a). Most commonly coping strategies adopted by women are storing food, reducing food expenditures, buying less clothes, income diversification, use of different crop varieties and diversity of crop among others (Bradshaw *et al.*, 2004; Kurukulasuriya and Mendelsohn 2006a, Okonya, 2013).

Information about coping strategies will improve the policies designed to confront the challenges changing environment is enforcing on Pakistani women. Although, the literature around the globe (Mertz *et al.*, 2009; Byg and Salick 2009; Fosu-Mensah *et al.*, 2010 among others) suggest that women farmers respond to climate change, but there is little evidence found in case of Pakistan. This lack of evidence will make the climate change policy and new coping strategies less effective and will ultimately hamper the agricultural productivity.

Women should play a vital role in adoption of coping strategies, in moderating disaster-specific strategies besides it tricked due to environmental change. Their role in to households and communities as custodians of resources make them capable to react better in response to climate change. Women play an important role in societies because they have knowledge, abilities and experiences and hence should adapt better (Emmeline, 2011). There exist a bulk of literature on climate change adaptation, some of the literature focus on how authority response to climate change or community level often leaving out autonomous adaptation at the individual or household level and participation of women in adaptation efforts (Smit *et al.*, 2009; Rasmus *et al.*, 2009; Bryant *et al.*, 2000 and Smit and Skinner, 2002).

In the literature on gender and disasters, it is stated that vulnerability of women are greater in disasters because of their inadequate access to resources, that they have unique capacities as

community leaders or managers of natural possessions and that they are underutilized in strategies for managing emergencies (Agrawal and Perrin, 2008).

There is bulk of literature available on interlinkage between gender and agriculture (Jamali, 2009; FAO, 2010; Begum and Yasmeen, 2011), poverty (Khan and Naqvi, 2000; Kabeer, 2003; Blackden and Woddon, 2006) and inequality (World Bank, 2006; Esplen and Brody, 2007; Klasen and Lamanna, 2008; GTZ, 2009) and Livelihood (Francis, 2000; Lipton, 2005; ILRI, 2014). But gender analysis in the context of climate change is somehow the unfocused issue (Brody *et al.*, 2008) in literature also in Pakistan. Research on climate change perception, its impact and coping mechanism is in its preliminary stages in Pakistan.

The available literature in Pakistan measures the economic cost of the impacts of climate change and adaptation and one common thing between literatures in Pakistan is negation of women as the gender face of women in the context of climate change is ignored in literature in Pakistan. Against this backdrop, a gender-responsive approach is the need of the day to over throw the negative consequences of these changes through standard and handy policies to adapt. Therefore, studying the participation of women in adaptation activities and their distinct roles in decision making is important.

Before we get into details, it is worth explaining that the word "adapting" and "coping" has been used interchangeably in the study. According to Francis (2013), difference between adaptation and coping is of the time scale as adaptation is associated with longer time scale while coping is the short time response to the impacts of climatic changes. However, coping strategies would become adaptation technique in the long run when they will be utilized by individuals over the number of years and over seasons (Anderson *et al.*, 2010). Though by construction both the coping and adaptation are different but in international literature they have been used interchangeably in

some studies (Okonya *et al.,* 2013). Given the fact that in this study we only have data on coping strategy for females, we are taking coping as adaptation in this study.

1.2. Rationale of the Study

Climate change impacts vary across the gender. Not only the impact but the perception level also varies between men and women (Javed et al 2015)[10]. The rationale for why considering only the impact of climate change on women's perception and their adopted coping strategies can be backed by the one that was already provided by Javed *et al.,* (2015) where they write that "climate change works in different dimensions and a general rule cannot work for all". There results indicated different perception level of climate changes across the gender in Pakistan. Working in the same spirit this study is thus taking only women's data from 16 districts of Pakistan to analyze the women's perception of climatic changes and how do they cope up with these changes.

1.3. Significance of the Study

Studies in Pakistan have not yet assessed the economic feasibility of adaptations, experiences of women with the adaptations, and the gender dimensions of the impact of climate change and adaptation.[11] This study attempts to fill the void. Although there is lot of policy relevant research done on climate change in Pakistan (Ahmed *et al.,* 2013; Javed *et al.* 2013; Joshi *et al.*, 2013; Chaudhary and Bawa, 2011; Khan, 2011; Farooqi *et al.*, 2005) but limited research has been carried out in the context of gender side of climate change; women's perceptions and the coping strategies adopted.

[10] PIDE-IDRC working paper 7 available at www.pide.org.pk
[11] Chaudary et al.,(2011), LEAD Pakistan (2009), GCISC (2009), Siddique et al., (1999), Ministry of Environment (2003)

Single study so far on the said issue has been available for Khyber PakhtunKhawa Pakistan conducted by Islamic Relief Program (2011) where no appropriate econometric technique has been employed to assess the impact of climatic changes impact on women farmer perception and the study is only confined to a single province. However this study contributes to literature of Pakistan both academically and methodologically.

Drawing on the survey base data, that is first national representative survey[12] on climate change at rural household, we extended the analysis in terms of coverage and efficiency in this study, attempting to unpack the determinants of and inter-linkage between the perceptions and in response the coping strategies of women. The findings of the study would be more effective in fighting climate change and identifying coping strategies. Moreover, it would be helpful in designing target base adaptation policies specifically for women.

1.4. Objectives of the Study

The aim and objectives of the study is to evaluate the factors that affect women's perception about the changing climate and further to analyze the coping strategies that women adopt in case of any climate related change. The objectives of the study are:

1. To identify the key factors that influence women perception regarding the change in climate.
2. To identify the determinants of coping strategies by women with respect to climate change in Pakistan.
3. To draw policy lessons based on the findings of study.

[12] Climate Change Impact Survey (CCIS, 2013) collected under the project titled "Climate Change, Agriculture, and Food Security in Pakistan: Adaptation Options and Strategies" by PIDE-IDRC.

Two step Treatment Effect Model is used in the study to meet these objectives. The estimation was made using the primary data obtained from farm level household survey for 16 districts of Pakistan.

1.5. Plan of the Study

The study comprises five chapters where the first chapter is the introductory chapter while rest of the study is organized as: the second chapter reviews the literature where both the theoretical and empirical studies have been mentioned. Third chapter of the study describes the conceptual framework, variables construction, data and the underlying econometric technique used in the study. Descriptive analyses and the interpretation of estimated model results are provided in chapter four. Finally, the sixth chapter comprehends the conclusion and policy recommendations.

CHAPTER 2

LITERATURE REVIEW

Introduction

In this chapter, the thematic review explores the gender dimension of climate change focusing on women's perception about climate change and their decision of adopting coping strategies in response to these climate related shocks. So the chapter begins by reviewing the general global climate change and its socio-economic impact particularly on women and then further moves to their perception about changing temperature and weather related events. Lastly reviews the literature in the Pakistan context.

2.1. Climate Change Impact and Women Vulnerability

The world is now facing so many new challenges due to changes in climate world widely. The predictions of future environmental change are indeterminate particularly in connection to situations of future rainfall, floods and droughts. Researchers around the globe are studying and analyzing not only economic impacts of climate change but social consequences of it as well. Agriculture production has been affected mostly by the core climate change drivers like spatial and temporal variation of precipitation and increased temperatures (ODI, 2009). Other consequences of the increased temperature levels include decrease in soil moisture, harming the crops due to increase in diseases; unpredictable increase in rainfall; and also the climatic events may become more severe and extreme (Boruru, Ogara and Oguge, 2011).

The cause and impact assessment of climate change has firstly been undertaken by IPCC (1988). So far IPCC has produced its five major assessment reports which are helping policymakers to

understand the changes in climate, that is the dynamic interaction b/w the earths' atmosphere, oceans and biosphere is what defines the earths' climate system[13]. However the anthropogenic (human based) activities are throwing this earths' climate system out of balance[14].Drought and floods like severe climatic happenings may prove a peril to agricultural system as well as it becomes a basis of prolonged and transient insecurity of food. This is on the grounds that numerous harvests have yearly cycles and yields that vary with atmosphere variability, especially precipitation and temperature (FAO, 2008). As a result of environmental change, food insecurity is larger in the rural areas that depend on rain fed agriculture.

According to a study conducted by United Nations Economic Protection UNEP (2011), women specially the Asians are currently at greater risk as the change in climate affected almost over a hundred million people annually in the said region. As per this study, over a billion people are living in the mountainous areas and some half of the south Asia's cereal production is taking place in those regions whose millions of women are directly involved in the production.

Though Pakistan is not contributing much in causing global warming but it is more vulnerable to the changing climate and had worsening impacts due to its geographical location (Mehmood and Khalil, 2013). Iqbal *at al.,* (2015) conducted a study to evaluate the gender disaggregated determinants of food security and vulnerability to climate change using binary logit/probit and ordered logit regression models. The results obtained from the study suggested that in Pakistan female education, their participation in social gatherings and empowerment through decision making makes women less vulnerable and hence more food secure to the changing climate.

[13] IPCC (1990), (1995), (2001), (2007) and (2014).
[14] Pachauri (2004), Climate Change and its implications for Development: The Role of IPCC Assessments.

The increasing number of floods and frequent droughts has implicated many social and economic consequences. Mehmood and Khalil (2013) investigated the impact of climatic and non-climatic variables on farmer's revenue in Pakistan and wheat productivity in Pakistan using VAR model. It was found out in the study that an increase in the precipitation by one unit will reduce the wheat productivity by 0.02 kg/ hectare. Similarly a one unit increase in temperature would reduce 0.6 kg/hectare wheat production in Pakistan. So these increasing climate changes are bringing far more threatening effects to the food security and to women involved in the region as per United Nations reports of 2011 and 2012.

In Pakistan, change in rainfall patterns and increasing temperature are main impacts of climate change noticed by the people. Khan *et al.,* (2012) conducted a study to analyze people perceptions about climate change. They reported that Pakistan is extremely vulnerable to the climate changes and will be affected seriously from the impacts of climatic change. According to their findings the changes will impact the arid part of the country more seriously and will affect the lives of the general masses almost in every term i.e. physical, biological, and socio economic environment.

Mohsin *et al.,* (2011) conducted a survey and reports in the study that 100% of the respondents of their sample believe that climate is changing, 57% of the people are of view that the sole reason for these climatic changes are human activities like industrialization, carbon enriched atmosphere, waste mismanagement and atmospheric pollution and that is why they are termed as anthropogenic activities.

2.1.1 Concept of Vulnerability in Climate Change

Vulnerability can be characterized from alternate points of view, contingent upon the participants (Adger, 2006; Heltberg *et al.*, 2008). Vulnerability to environmental change is not in disconnection

from the more extensive political economy of asset use. It is frequently determined by unintentional or purposeful human activity that strengthens self-interest and the dissemination of power, other than communicating with biophysical frameworks (Ribot, 2010).

The strategy setting in which atmosphere dangers are managed and adjusted to is communicated by two different explanations of vulnerability, specifically, hazard danger (Francis, 2013; Adger, 2006) and social idealist structures (Kelly and Adger, 2000; O'Brien *et al.*, 2007).The risk-hazard model has a tendency to assess the various results of a sole atmosphere incident, while the social idealist structure exemplifies the numerous reasons for single results (Adger, 2006)

The danger risk methodology considers vulnerability to be a direct consequence of environmental change effects and points at decreasing the anticipated effects through innovative 'fixes'(Eriksen and Kelly, 2004; Brien *et al.*, 2007). Then again, the social idealist structure considers vulnerability as a feature of social and biological frameworks that are created by different variables and procedures (Eriksen and Kelly, 2004). Different from the risk-hazard model, the social idealist structure puts the same problem inside of the social framework (Adger, 2006; Ribot, 2010).

Though both structures of vulnerability are valuable for strategy reaction to natural change, a combing system is more valuable for arranged adaptation to environmental change. This is on the grounds that it connects the two methodologies and perspectives vulnerability as relying upon both biophysical as well as human variables (Fussel, 2007; Francis, 2013).

It is also important to highlight that capacity and extent of communities and societies to which they adapt to the climatic change depend also upon their socio-economic and institutional features like access to technological and financial resource, human capital and political influence (Easterling *et al.*, 2004; Smit and Wandel, 2006; Heltberg *et al.*, 2008). It stretches to the consensus that women play a vital role in the management of the ecosystem and food security that is why

women stand more vulnerable to the impact of floods, droughts and inequitable cultural and social norms.

As per UN's report (2011), globally 43% of women are involved in the agricultural sector which makes a huge number and that is why they stand vulnerable to the impacts brought forward by the climate change. The report further elaborates that in Asia and Africa the proportion of women's participation is much higher in agricultural sector while it exceeds above 50% in the mountainous region.[15] Different studies have reported women's involvement and their responsibilities for their household food production. According to UN reports in Asia, 65% of the women are responsible for their families production, while 75% of sub-Saharan African women bears the responsibility and 45% of the Latin American women provides for their families (UN Women Watch; 2009 and Robinson, 2006).

In the past many years, reports published by the Intergovernmental Panel on Climate Change, IPCC describes women particularly of the Asian region more vulnerable to the climate change. IPCC publishes its reports on the impact of climatic changes at macro level for different regions. The report published in 2007 gives some insightful information about the region including Pakistan. The report says that endemic diseases and mortality due to diarrheal diseases, specifically associated with floods and droughts, are expected to increase in the region due to projected changes in the hydrological cycle. The report further claims that by 2050 fresh water availability goes on decreasing specially in the large river basins (IPCC, 2007).

As per UN report the reason for women's more vulnerability to the climate changes are their greater involvement in the agricultural sector, their responsibility for household food security and

[15] For more details, see UN's Report, "Women at the front line of Climate Change", 2011

their increased reliance on threatened natural resources on the daily basis for their livelihoods (UN Women Watch 2009).

Study conducted by ICIMOD reports that mountainous women in India undertake almost 6 times of the agriculture work to that carried by their counterparts. Statistics of women's vulnerability to the climatic changes shows a very worrisome picture. Any flood or drought in any part of the world has affected women the most. For instance 57% of the deaths caused by a cyclone in Bangladesh were women (Begum, 1993). This and many other such stories leave women at a greater risk of death than men from changes in climate. The reason again is the culturally constructed norms and identities which make women more vulnerable to those harsh impacts (Nelson *et al.*, 2003).

Despite of all the above hardship they are treated unequally, remain ineligible for ownership, have very less control to these resources and are never being involved in the policy making forums. These and many more such reasons make women of the world more vulnerable to climate change (Mitchell *et al.*, 2007).

2.2. Women's Perception of the Climate Change

According to climate Asia's Report on Pakistan, nearly 44% of Pakistani's believe that the changes in environment has affected their lives and according to their surveyed report 40% of the respondents were not well aware of the coping strategies.45% of women, particularly, didn't know about how to cope up with the menace. The report further briefs that in Pakistan many people cannot even comprehend the term climate change. While these people have actually experienced its implications and are engaged in coping up with the adverse impact caused by these climatic changes.

Adaptation at farm-level involves two stages: perceiving the change in climate, and deciding

whether to adapt or not, or which adaptation strategy to choose (Maddison, 2007). There are still important questions on perception that need to be addressed, such as: Are Women farmers able to perceive the change in climate in the long run, which changes are they able to perceive, what economic, social and institutional factors influence their level and speed of perception (Deressa *et al.*, 2009). Farmers who have perceived the change in climate may not adapt or the nature of their adaptation response may vary as a result of a complex interplay between social, economic and institutional factors (Maharjan *et al.*, 2011). In another study, Gbetibouo (2009) argues that farmers with access to extension services are likely to perceive changes in the climate because extension services provide information about climate and weather. Consequently, awareness and perceptions of a problem shapes action or inaction on the problem of climate change.

Literature review suggests that women's perceiving of the change in climate depends on range of factors i.e. their household characteristics, different socio-economics factors and some institutional factors (O' Brien *et al.*, 2000; Maddison, 2006; Nhemachena and Hassan, 2008; Deressa *et al.*, 2009; Merts *et al.*, 2009). Perception in the context of climate change literature is defined as the opinions, knowledge, belief and understanding of the people regarding the change in climate and also how it is interpreted by them based on their past experiences (Blaike *et al.,* 1997). So this perception of the changing climate guides decision making and further that how to respond and what possible action could be taken as climate change adaptation (Kisauzi *et al.,* 2010). In this regard, a study by Adger *et al.,* (2008) argues that perception along with other limitations such that availability of resources and other elements limits the climate change adaptation. Literature suggests that developing countries in Asia are more vulnerable to the changing climate because of different factors and those developing countries including Pakistan are compound further by

gender inequality (IPCC, 2001) where women are at more disadvantage in perceiving the changing climate and in adapting.

Blaike *et al.,* (1997) argued that knowledge and perception regarding climate change is not homogeneous as it varies with respect to gender among the respondents which introduces the variation in knowledge and perception about the changing climate, on the basis of gender, among men and women. In another study, Brody *et al.,* (2008) identified that the differences in decision making power, access to education, and control over resources among men and women shapes the differences in men and women understanding of and perception of the changing climate.

Adaptation to climate change requires that Women first notice that the climate has changed, and then identify useful adaptations and implement them. Generally, studies on women's perception of and adaptation to climate change have elicited significant research interest among researchers. Studies in Pakistan on farmers vulnerability and food security (Iqbal *et al.,* 2015), perception and adaptation (Amin *et al.,* 2015) also revealed that perception regarding changing climate and in response adapting with the change varies across gender and in terms of other factors like ownership of land and size of land.

2.3. Coping Mechanism and Baseline Information

Coping up with the adverse impacts of climate change is not an anomaly but a custom. Human history shows that people adapted to climate change by changing their colonies, varying form of agriculture and other aspects of their social life (McCarl *et al.,* 2001; Easterling *et al.,* 2004; Burton *et al.*, 2006; Adger *et al.*, 2007;Heltberg *et al.,* 2008).

Coping strategies are short term and are considered to be spontaneous related to any natural hazard. These adaptations of strategies depend upon risk perception, as well as socio-economic

characteristics such as wealth, education, age, on and off farm experience. All these are main participants of coping strategies (Grothmann and Patt 2005; Deressa *et al.*, 2009).

Coping to climate change is one of the main points of existing development discussion. Consequently, this adaptation to climate change is considered as response policy in the UNFCCC and the subsequent Kyoto Protocol in 1997. Article 4.1 (f) of the UNFCCC describe the adaptation strategies as follows:

"*Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions..., with a view to minimizing adverse effects on the economy..., to mitigate or adapt to climate change*".

The basic aim of coping to climate change is to make the societies resilience on the way to the different changing environment. In contrast to the natural system, societies should better forecast and adapt to the likely climatic stimuli (Adger, 2000; Folke *et al.,* 2002; Easterling *et al.*, 2004). In absence of resilience, societies are no more capable to absorb and cope to climatic change and hence become vulnerable (Folke *et al.*, 2002). This study is presumed to identify the determinants of perception to climate change and adaptation to climate change. Where adaptation to climate change is defined as the alteration in social system in response to climate change and their influences (IPCC, 2001; Smit & Olga, 2001).

Coping and adaptation is treated as a policy option to mitigate the negative impact of climate change (Deressa, 2008). The expressions "adapting" and "coping" are frequently utilized reciprocally to reflect techniques for acclimations to changing climatic and ecological conditions (O'Brien *et al.*, 2012). Nevertheless, the two are connected with diverse time scales and speak to distinctive procedures (Eriksen & Kelly, 2007). Whereas, coping is a fleeting receptive reaction to

atmosphere variability, adaptation is connected with longer time scales and focuses at conformities as key changes of the frameworks practices, procedures or structures to changes in mean conditions, with adjustments, new adapting extent is set up (Smit &Wandel, 2006).

Sarah *et al.*, (2012) studied the perceptions and response to climatic changes in Kenya. Their study reveals that there exists significant relationship between drought perception and adaptation. Local based there at the districts started migration and sold their livestock which are considered to be a coping strategy with the climatic changes [sustainability 2012, 14]. Derresa studied the impacts of the changing climate on farming community and reports the result that farmers who have perceived the climatic changes have adapted different techniques as a coping and adaptations strategies. The strategies include soil conservation, planting trees, different varieties of crops and altering the plantation dates etc. While those who have not adapt have given many reasons such as lack of information, lack of money, labors etc. [Deresa 2010]

To understand women's role in coping and adaptation strategies to the climate change, we need to know the power differential amongst both the genders. Further investigation to the climatic changes studies will portray how these power relations have been widened by the climatic changes (Brody *et al.*, 2008). Different studies have suggested that men and women are affected unequally by the climate change (see, e.g. Denton, 2000; Mitchell *et al.*, 2007). The reasons are quite crystal clear for these differentiations. Some of them have different cultural and social identities, socio economic differences, different and unique gender roles assigned geographically and socially to each gender (Roehr, 2007, FAO, 2008). Due to all such differences climate change affects them differently and that is why the choice of adaptation and coping strategies differs as well (Connell, 2005 and Terry, 2009).

2.3.1 Determinants of Adoption of Coping Strategies

Literature demonstrates a number of factors i.e. household and farm characteristics, institutional elements, and local climatic and agro-ecological conditions which determine the choice of coping strategy (Maddison, 2006; Gbetibouo, 2009). Most of the farmers not only take adaptation options just to build adaptive capacity but a number of these farmers also discourse preservation of ecological and natural possessions (SEI, 2009).

It is argued that women should adopt better than men to climate change on the basis of information and managing experience about climatic conditions and other responsibility like food needs of the households (Nhemachena & Hassan, 2007). One of the important determinants in coping up with the changing climate is education as higher education is generally associated with more access to information on modern and improved technologies. (Reardon & Vosti, 1995; Nkonya *et al.*, 2008; Gbetibouo, 2009).However, household size has indeterminate impact on adaptation decision. Labor availability as a proxy of household size should reduce the labor constraints and therefore it effect adaptation of new technology positively (Marenya & Barrett, 2007). In sub-Saharan Africa, family members are working for farm operation rather hired and therefore not facing any constraint about adaptation practices (Nkonya *et al.*, 2008). However, households with many family members entertain some of their labor force to somewhere in off-farm doings. This is because to diversify their earning sources in order to ease the large family consumption burden (Tizale, 2007; Gbetibouo, 2009). Farm size and soil fertility are the two farm specific factors that could affect the adoption decisions.

Farm size influences both the access to information and the adaption decisions. Along with the other determinants like that of the farm or non-farm income, farm experience, contacts with the extension service agents, farm size positively influences the use of adaptive measures taken in

order to tackle with the climatic changes. Moreover, farm size and more crop acreage is associated to enhance the information disclosure and also provides the better access to credit and technological advancement (Marenya & Barrett, 2007; Daberkow & McBride, 2003). The cost associated with invention like transaction and information given uncertainty, a minimum level may exist which is critical to farm size that prevents smaller farms from adapting (Daberkow & McBride, 2003; Gbetibouo, 2009; Gbegeh & Akubuilo, 2012). Thus, large mechanized farms will probably be the first to adapt to climatic change.

Institutional elements that affect adoption of coping strategies include access to credit, information provision, off-farm employment, and land tenure. Institutional strengthening via access to conventional and unregulated institutional structure and meteorological capability increases the likelihood of uptake of adaptation techniques. Households having access to conventional agricultural development, farmer-to-farmer extension and future information about climate adjustment are more chances to regulate their agricultural methods when there is change in environment (Smit *et al.*, 2001; Mariara & Karanja 2007; Yesuf *et al.*, 2008; Nkonya *et al.*, 2008). In addition, those farmers who have access to extension services are more chances to observe fluctuations in the environment as they have information about climate and weather changes (Gbetibouo, 2009). However, information sources should add more to effectiveness "change agents" than others and various information sources can influence the possibility of adoption differently (McBride & Daberkow, 2003). Similarly, different sources of information become influential during different stages of adoption process.

The mass media for instance, are important in the early awareness stage, while interpersonal information sources such as extension officers and other farmers are critical in transferring more adoption-promoting information. Although technical information from extension services is

shown to be most important to the potential adopter, the extension-farmer linkages are extremely weak in some parts of Sub-Saharan Africa and most agricultural information is obtained via farmer-farmer contacts (Adesina & Forson, 1995).

This suggests that women are also important as sources of information and agents of technology transfer. Studies also reveal that information regarding changing climate and adoption techniques flow through social networks, and do not essentially spread because of geographical proximity (Maddison, 2006). Thus future extension should engage farmer cooperatives in research process and on-farm trials for a variety of evaluation and demonstrations.

The trained farmers thereafter be able to diffuse the adoption technologies since heterogeneity of farm situation invariably makes it challenging to provide government extension (Pannell, 1999) Studies have shown that under conditions of imperfect credit, smallholder farmers and resource users will adopt certain conservation practices (Reardon & Vosti 1995; Gbetibouo, 2009).This is because the adoption of new technologies requires borrowed or owned capital.

Thus lack of borrowing capacity may hamper any efforts to embrace adaptation measures that require heavy investment upfront such as irrigation, terracing, tree planting and fertilizer use. The other institutional factor which are conditional on technology adaptation mainly relate to the prevailing system of property rights (Gbetibouo, 2009; Shiferaw, Okello & Reddy, 2009). Tenure security can contribute to technology adaptation that linked to land such as irrigation equipment or soil conservation practices. Farmers will not invest, if they do not have economic reasons to invest i.e. if they cannot capture the full benefits of their investments.

2.4. The Pakistan Context

Pakistan is amongst the countries that are seriously and adversely affected by the climatic changes

that have far reaching implications for livestock, agriculture production and, in turn, for those relying on these resources, specifically the women farmers whose major source of livelihood is agriculture and livestock (Akmal *et al.*, 2014)[16]. Women in Pakistan account for 50% of the population (Shirkat Gah Women Resource Centre, 2011). Like other developing countries, women in Pakistan face a set of multiple, crosscutting and interrelated problems. Because of these problems Pakistani women's did not get access to productive resources. Most of the women do not take part in planning and decision-making process (Zaheer and Colom, 2013; Islamic Relief, 2011).

Since 2001, Pakistan has been witnessing the worst disasters i.e. floods and despite the number of disasters in past, the need for impact assessment was felt after 2010's devastating flood (Winsten *et al.*, 2013).Akmal *et al.*, (2014) conducted a study for four rain fed districts of Pakistan, two from Khyber PakhtunKhawa and two from Punjab, serving an understanding of the male and female perceptions and experiences on the changing climate by employing the qualitative research methodology. Decreasing temperature in winter and autumn and the change in seasonal duration patterns was reported in the study as per male and female perceptions.

Another study by Khan *et al.*, (2012) analyzes the peoples' perceptions about the changing climate, its impacts and coping up with the problem by using primary data and findings of the study shows that 100% of the participants have perceived the change in climate out of which 90% of the participants are taking personal action in adapting with the adverse impacts of these climatic changes with not much support from any institution.

Women usually adapt to the key sectors like agriculture, water, food Security, forests, health and the economy in response to climate change. In most of the communities these are the sectors

[16] This Study documented the "farmers experience on climate change and adaptation for Rain fed areas of Pakistan" commissioned by "Inter cooperation Pakistan through Climate change centre, University of Agriculture Peshawer"

women been working in it, therefore it is necessary to underline, that in these areas women are already very active and innovative with the objective to protect the survival of their families and communities (Frank, 2009).

Ahmed *et al.,* (2015) estimated the impact of adaptation uptake on the food security in Pakistan by applying treatment effect model in which three equations have been estimated simultaneously. The findings of the study showed those households that adapt to the changing climate were relatively more food secure than the non-adapters. The results of the study further suggested that education of male and female household head, ownership of livestock, house structure, non –farm income and crop diversification positively affects the food security of the household.

The only study on women's perception about climate and adaptations funded by Islamic relief (2011) in the province KPK has shown some interesting pictures of the women's perception of the climate change. The study covered 16 villages of 4 districts of Khyber Pakhtunkhwa for the analysis. According to the study, a group of women were asked different questions regarding the rainfall, temperature livestock management and floods. Participatory Rural Appraisals (PRAs) method was used for conducting the study. The study reports that women in the particular area were mainly affected by floods causing some severe and potential damages to their mental and physical health. The study further reports that many of the women were well aware of the changing climate without any help from any institution (women farmer perception in KPK).

2.5. Summary

As discussed above gender aspect of determinants of perception and coping up with the changing climate is not properly addresses in the literature. Land rights, women empowerment and social bound are the gender specific determinants of perceptions and adoption of coping strategy, used in the study with the possible justification that joining social groups, land rights and decision

making power encourages women to adapt to the changing climate. According to Roehr (2007), women's dependence on male family member, absence of land rights, lacking access to credit and information and less empowerment makes her more vulnerable to changing climate and turns out to be a limitation in adapting to the climatic change.

Despite of all the hardship the rural women face, they still are deprived of the decision making and economic presence as compare to the men in their societies. It is now of quite importance to identify the needs of both the men and women (Nelson, 2007) in this changing world today, therefore for the said reasons Gender based analysis is of quite importance today to tackle and understand the diversified impacts of climate on today's men and women.

2.6. Critical Appraisal of literature

As a conclusion to preceding literature, it can be construed that the determinants of coping and perception of climate change has not been addressed so far in the gender context for Pakistan. Previous studies used only qualitative research methods in order to assess the impact of climatic changes, perceptions and coping strategies however no such study in Pakistan's context deals with the women perceptions and coping strategies using any appropriate econometric technique. This study fills the gap by employing the Treatment Effect model and by incorporating different household characteristics, socio-economic and institutional factors. In addition, this study empirically estimates the dynamic impacts on women perception and coping strategies nationally using first national representative survey[17] on climate change at rural household.

[17] Climate Change Impact Survey (CCIS, 2013) collected under the project titled "Climate Change, Agriculture, and Food Security in Pakistan: Adaptation Options and Strategies" by PIDE-IDRC.

CHAPTER 3

DATA, VARIABLES AND METHODOLOGY

This chapter is to explain the data and models needed to determine the factors influencing the perception of women about climate change as well as the possible coping strategies adopted by the women. This chapter includes three sections. Section one explains the conceptual framework for the study. Detailed econometric methodology is explained in the section two of this chapter. The third section of this chapter explores the model empirically and the nature and source of the data used in the study.

3.1. Conceptual framework

Adaptation to climate change literature review indicated that, climate change adaptation is vital for rural people, which they used for productivity improvement, income and to manage the resources, on which they depend, in sustainable way.

Climate change adaptation is the subject of considerable importance to rural population, especially to rural women who commonly suffer from isolation and have difficulties in communicating their priorities to decision makers. Coping to climate change depends to large extent on the level of understanding of climate change, how to adapt with it and climatic information exchange between and among women farmers on the one hand, and a wide range of other actors contrastive to plan effective adaptation activities.

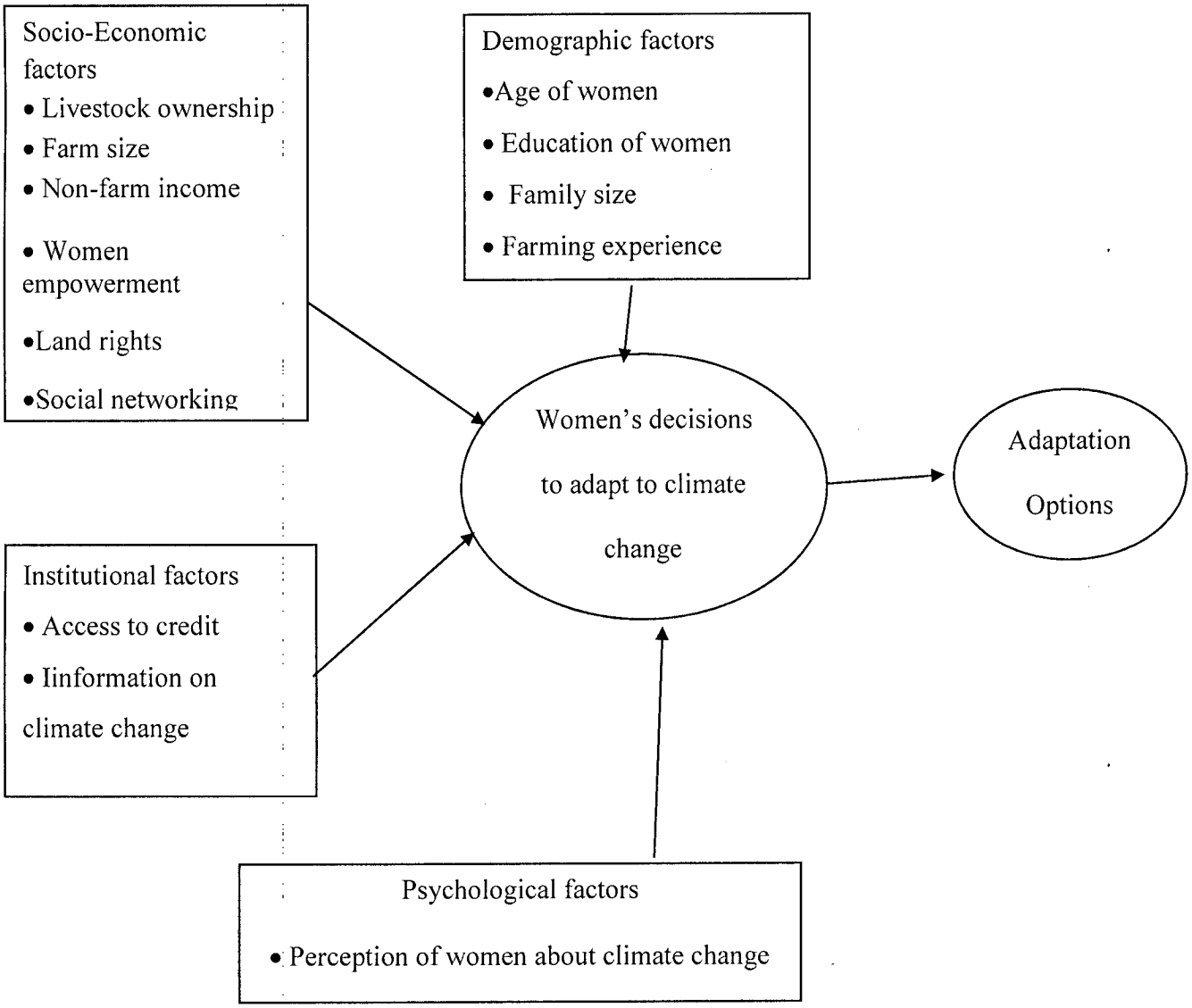


Figure 3.1.1 Conceptual frame work showing factors influencing women decision to adapt to climate change.

Women play an important and challenging role in coping up with the adverse impacts of changing climate. Despite their more dependency on natural resources, still they have lesser decision making power and are deprived of access and control over resources (Mitchell *et al.*, 2007; Terry, 2009). The foundation of the argument, that women is more vulnerable to changing climate and that

women perceives and adapts differently in response, is backed by the concept of gender inequality that are income, social and economic inequalities (Masika, 2002; IUCN, 2013). So adaptive capacity of women reduces and they become more vulnerable when such inequalities curb their involvement and contribution to climate change planning and decision making and when these pre-existing disparities amongst men and women causes multifaceted economic disturbances (Demetrides and Esplen, 2008).

The conceptual framework used in this study portrays links between factors that affect the decision of women farmers regarding adoption of coping strategies to the change in climate. Figure-1 illustrates the conceptual framework constructed on the assumption that there are various driving forces behind women's decisions to adapt in response to changing climate. Some of the major factors that determine adaptation options are economic factors such as Livestock holding, Farm size and Non-farm income; the institutional factors such as access to credit, information on climate change and Training; demographic factors such as age of women, family size, education of women and farming experience; psychological factors including perception of women about climate change.

3.2. The Econometric Model

3.2.1 The Analytical Framework: Heckman sample selectivity model

The aim of this section is to explain the models needed to answer the question that which factors determine the perception of women about climate change as well as the possible coping strategies adopted by female farmers. Since the study uses random sample, the selection Bias problem arises. In this case, when the selection bias problem is inevitable, simple Ordinary Least Square (OLS) method will give the biased and inconsistent parameter estimates. So Heckman's Two Step Model

will be used in such type of studies to avoid the problem of selection bias as it estimates the unobservable in selection equation with the help of Inverse Mills Ratio or Lambda and uses this Lambda in the outcome model (Greene, 2003).

Selection biasness exists due to the difference between the perceivers and non-perceivers in the model. As not all those who have perceived the change in climate will adapt. According to Greene (2003), under the normality assumption for whole population, the residual of the regression is normally distributed.

The determining factors of perception about climate change by women can be estimated by Probit Maximum Likelihood method specified by Greene (2003) as follows

$$w_i = \beta' H_i + \varepsilon_i = \varphi(\beta' H_i) \quad (3.1)$$

$$w_i = 1 \; if \; the \; ith \; women \; adapt \; and \; percieve \; the \; climate \; change$$

$$w_i = 0 \; otherwise$$

Where the vector explanatory variables is represented by H_i while β' is the coefficient vector. Similarly $\varepsilon_i \sim N(0,1)$ is the random term and the cumulative standard normal distribution is given by$\emptyset$. The resultant Likelihood function is written as follows

$$L_i = \sum[w_i ln\emptyset(\beta' H_i) + (1 - w_i)\ln(1 - \emptyset(\beta' H_i))] \quad (3.2)$$

The assumption that sample is drawn randomly from population will be violated if the maximum likelihood method will be used because of non-response of some of the observation of population, and so the estimated parameter will not be consistent. Identifying the determinants of perceptions and coping strategies to climate change is the two stage process (Maddison, 2006). Firstly whether

the change in climate is ascertained by the respondent (which is women in our case) or not and secondly, in response to the perceived change in climate by the respondent, adopting the coping strategies is then conditional on the perceived change in climate (Gbetibouo, 2009). Since coping strategies in response to climate change is the sub-sample of the first stage, therefore this coping strategy at the second stage is not the same with those who did not perceive climate change, hence the result is the selection bias. The multinomial logit and probit models are less appropriate to be used in two step adaptation procedure; therefore the conventional Heckman two-step model is the alternative appropriate technique to avoid this bias of selection.

The familiar Heckman two-step model is used in many studies for multiple purposes. For example, the Heckman likelihood two-step regression model is used by William (2003) for United States of America to identify the awareness factors and in result which new technology is adopted thereafter. A similar methodology is used by Yirga (2007) and Kaliba *et al.,* (2000) to investigate that which technology is adopted by farmers and how potent is the input used in Ethiopia. Maddison (2006) utilize the same two-step[18] approach to study the adaptation of climate change by farmers in South Africa. The Heckman two-step procedure is also used by Deressa *et al.,* (2008) and Gbetibouo (2009) recently for Ethiopia and South Africa to identify the determinants of farmers (particularly women) perception about climate change and the possible coping strategies.

The given study by following Maddison (2006), utilized the advanced form of Heckman two-step procedure to know the factors that determine perception of women about climate change and of the strategies the women farmers will adopt to cope with the change in climate. Specifically, this procedure involves two equations/functional relations. Firstly, the sample selection (participation)

[18]In the first step the farmers (women in our case) perceive the change in climate and in the second step coping strategies are adopted.

model will be regressed which evaluates the determinants of perceptions of the change in climate and the second model, conditioned on the selection equation , is the outcome model in which the factors that determine the decision of coping up with the adverse impacts of climate change are evaluated. The specification of Heckman two-step model proposed by Maddison (2006), Deressa *et al.,* (2008) and Gbetibouo is written as follows

$Y_1 = \beta' X + U_1$ Outcome Equation (3.3)

$Y_2 = \gamma' Z + U_2$ Selection Equation (3.4)

Specifically the above two equation can be rewritten as follows

$Adaptaton_i = f_i(Perception) = \alpha + \beta X_i + \gamma Percption + U_i$ (3.5)/

$Perception_i = a + bZ_i + v_i > 0$ (3.6)/

Equation (1) is adaptation /outcome equation or regression model and (2) is perception/ selection equation or selection model. $Adaptation_i$ and $Perception_i$ are binary dependent variables for ith women farmer.

Observation on perception and adaptation will be allotted a value of 1 if farmer perceived and adapted and 0 if not in both case.

$Adaptation_i = 1$ if $Perception_i > 0$

$Adaptation_i = 0$ otherwise

Two different results are possible for adaptation of farmer depending on whether perception is 1 or 0. $X_i$and $Z_i$are vectors of exogenous variables or covariates are the fixed characteristics of the farmers. There is a linear relationship between observable outcome 'adaptation' and variable 'perception' and all other explanatory variables with a constant effect across all individuals represented by parameter β, b and γ.

Heckman two-stage model made three statistical assumptions;

i) u_i and v_i are iid with standard normal distribution

ii) X_i is independent of u_i

iii) Z_i is independent of v_i

If the unobservable of selection equation (v_i) has an influence on the dependent variable of outcome equation (adaptation) then it means there is a relationship between u_i andv_i, and that variable perception has a correlation with the error term u_i. in other words an unobserved reason of why farmers take a decision to adapt by perceiving climate change is correlated with an unobserved reason that farmer acted upon after perception by adapting an adaptation strategy. This correlation or endogeneity of perception in the model can be captured by the parameter ρ where $\rho = E(u_i|\, perception, X_i) \neq 0$ and it can take values between -1 and 1.

Because of the presence of $\rho \neq 0$ the vector of coefficient $\beta^{/}$ will be biased owing to the fact that

$$\mathrm{E}\left[{}^{Y_1}/_{Y_2} > 0, X, Z\right] = \beta^{/}X + \rho\sigma\emptyset(\gamma^{/}Z)/\varphi(\gamma^{/}Z) \tag{3.7}$$

Where φ, $\emptyset$ are the cumulative bivariate normal distribution function and the corresponding density function respectively. Whereas the variance U_1 and the correlation between U_1 and U_2 are given by σ^2 and ρ respectively. Thus gives us

$$\mathrm{E}\left[{}^{Y_1}/_{Y_2} > 0, X\right] = \beta^{/}X + \rho\sigma\mathrm{E}[\emptyset(\gamma^{/}Z)/\varphi(\gamma^{/}Z)X] \tag{3.8}$$

The sample selection bias in the above equation is the second term on the right hand side if we have $\rho \neq 0$.

More specifically if X and Z are independent of each other, then we have

$$\mathrm{E}[\emptyset(\gamma^{/}Z)/\varphi(\gamma^{/}Z)X] = \mathrm{E}[\emptyset(\gamma^{/}Z)/\varphi(\gamma^{/}Z)] \tag{3.9}$$

Finally to correct sample selection problem and to get efficient estimate of model parameter $\beta^{/}$, equation $(3.5)^{/}$ and $(3.6)^{/}$ are estimated.

The log-Likelihood specification of the Heckman Probit model is as follows

$$Ln\, l = \Sigma ln\Phi[\beta^{/}X, \gamma^{/}Z, \rho]$$

$Y_1 = 1, Y_2 = 1$

$+\Sigma ln\Phi[-\beta^{/}X, \gamma^{/}Z, -\rho]$

$Y_1 = 0, Y_2 = 0$

$+\Sigma ln\Phi[-\gamma' Z]$

$$Y_2 = 0$$

Here the sample $n_{1,1}$ is the set of respondent for which$Y_1 = 1$, $Y_2 = 1$(meaning that those respondent who adapt in response to the climate change), $n_{1,0}$ are the respondent for which$Y_1 = 0$, $Y_2 = 0$ (meaning that those respondent who did not adapt in response to the climate change) and finally n_0 are the respondent for which $Y_2 = 0$ (meaning that those respondent who did not perceive the climate change).

3.3. Empirical Model and Model Variables

3.3.1. Heckman's Two step Method

Decision making process in adapting to the negative impact of climate change usually requires two step modelling. The equations of interest in two step regression model are the (I) Selection Equation (Participation Model) and the (II) Outcome Equation (Response Model).

*3.3.1.1.*Sample selection Model (Perceptions of Climate Change)

In Heckman Sample Selection Model, the dependent variable is a binary variable related to whether or not women perceive the change in climate. The explanatory variables have been chosen based on the available data and climate and gender related literature. This set of regressors include: Age (Deressa *et al.*, 2010; Gbetibouo 2009; Maddison, 2006), Education (Daberkow and McBride, 2003; Ndambiri *et al.*, 2001), farming experience (Gbetibouo, 2009; Nhemachena and Hassan, 2007), traditional knowledge of climate change (Nhemachena and Hassan, 2007), climate information through media (Ndambiri (2011); Maddison, 2006) social bound and household size (Teklewold *et al.*, 2006; Ndambiri *et al.*, 2011).

The algebraic representation of the model is given as:

$$Mi = (\beta Xi) + \varepsilon$$

Where:

Mi = ith Women's perception that the climate is changing.

X_i = the vector of explanatory variables of probability of perceiving climate change by the ith women.

β_i = the vector of the parameter estimates of the regressors hypothesized to influence the probability of women is perception about climate change.

Table 3.3.1.1 Model variables of Selection Equation

Variable	**Value**
Dependent Variable	
Women's Perception of Climate Change	Dummy: takes the value of 1 if perceived and 0 otherwise
Independent variables	
Age	Years; continuous
Education	Years; continuous
Farming experience	Years; continuous
Climate information (traditional knowledge)	Dummy: 1 if available otherwise 0
Social bound	Dummy: 1 if allowed to join any social group, otherwise 0
Climate information (through media)	Dummy: 1 if available otherwise 0
Household size	No of family members; continuous

3.3.1.2. Outcome Model (Adaptation to Climate Change)

In Heckman outcome Model, the dependent variable is again a binary variable[19] related to whether or not women cope up in response to the adverse effects of the changes that occur in climate or not.

The algebraic representation of the model is given as:

$$Mi = (\theta Xi) + \varepsilon$$

Where:

Mi = ith Women has or has not developed coping strategies to climate change.

X_i = factors affecting women's strategies to cope with climate change.

θ_i = the vector of the parameter estimates of the regressors that determine the decision of adoption of coping strategy.

The explanatory variables being chosen based on the available data and climate and gender related literature as mentioned above. This set of regressors also include: age (Deressa *et al.*, 2010; Gbetibouo 2009; Maddison, 2006), Education (Daberkow and McBride, 2003; Ndambiri *et al.*, 2001), household size (Ndambin *et al.*,2011; Deressa *et al.*, 2010), farming experience (Gbetibouo, 2009; Nhemachena and Hassan, 2007), non-farm income (Tesso *et al.*, 2012; Knowler and Bradshaw, 2007), farm size (Bradshaw *et al.*, 2004), land rights (Gbetibouo, 2009; Shultz *et al.*, 1997), social networking, women empowerment, livestock ownership (Yirga, 2007; Maddison,

[19] Another option can be Multinomial construction of dependent variables ((Mendelsohn, 2006; Gbetibouo, 2009 and Hassan & Nhemachena, 2008) which further determines that from all of the strategies, which coping strategy has what determinant but the study in hand uses only binary dependent variable.

2006) access to credit (Brien *et al.*, 2000; Deressa, 2010), change in rainfall and change in temperature (Kansiime *et al.*, 2014).

Table 3.3.1.2 Model variables of Outcome Equation

Variable	Value
Dependent Variable	
Adaptation to climate change (If the Women has developed a coping strategy or not)	Dummy: takes the value of 1 if women has adapted any strategy and 0 otherwise
Independent variables	
Age	Years; continuous
Education	Years; continuous
Household Size	Number; continuous
Farming experience	Years; continuous
Non- farm income	Pakistani Rupees; continuous
Farm size	In hectares; continuous
Land rights	Dummy=1 if they had land rights in their community, 0 otherwise
Social networking	Number of times help received/ no of times help given; index
Women empowerment	Dummy=1 if they are allowed to disagree with the decision made by men, 0 otherwise
Livestock ownership	Dummy=1 If livestock owned , 0 otherwise
Access to credit	Dummy: 1 if have access and 0 otherwise
Change in temperature	Dummy:1 if temperature has increased and otherwise 0
Change in rainfall	Dummy:1 if precipitation has increased and otherwise 0

3.4. Data

Cross section data has been extracted from Climate Change Impact Survey (CCIS, 2013) conducted by Pakistan Institute of Development Economics (PIDE), Islamabad, under the project

titled, *"Climate Change, Agriculture, and Food Security in Pakistan: Adaptation Options and Strategies"*, sponsored by IDRC. This surveyed data is the first national representative survey on climate change at rural household level. Data for 3298 rural households from randomly selected 16 districts[20] of three provinces[21] (KPK, Sindh and Punjab) of Pakistan is used in the study. The study covers primarily women's questionnaire[22] providing information on different socio-economic, institutional and household characteristics to depict a clear picture of women's perceptions regarding the climate change and their role in developing different coping strategies.

3.5. Summary

To achieve the objectives of identifying the determinants of perception and coping model of women, study in hand used the advanced form of two step Heckman Model that is Treatment Effect Model and the results obtained are discussed in the next chapter. According to Green (2003), Treatment Effect Model is useful for two reasons (i) it tackles the problem of selection bias and (ii) it is useful for counterfactual analysis. In treatment effect model, Inverse Mills Ratio or lambda is calculated from the perception model and is used in adaptation model automatically. Statistically significant value of lambda shows that there was problem of selection biasness in the model and it has now been corrected.

[20] These districts includes Attock, Chakwal, Bhakkar, Multan, Vehari, Sialkot and Bahawalpur from Punjab; D.I. Khan, Nowshehra, Mansehra and Kohat from KPK; and Hyderabad, Umarkot, Nawabshah, Larkana and Khairpur from Sindh.

[21] The survey has not been carried out in Baluchistan due to security reasons.

[22] The questionnaire for females covers questions regarding Household profile, family size, education, employment status and farm/non-farm income, participation in farm activities, housing and sanitation, expenditure on food and nonfood items, ownership of livestock and household durables, Climate change perceptions, impact on their livelihood and adopted coping strategies.

CHAPTER 4

RESULTS AND DISCUSSION

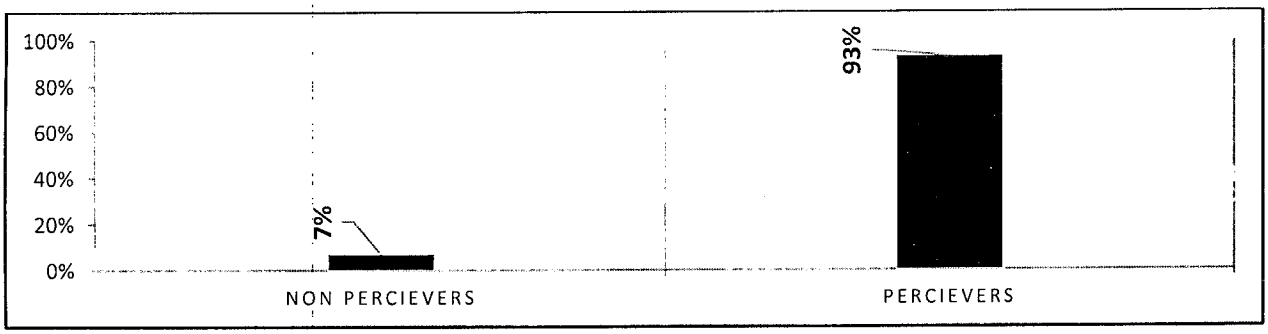
This chapter of the study briefs the results obtained from the Treatment Effect Model followed by descriptive analysis of women's perception of climate change by age, education and their farming experience. The results are tabulated in the form of percentages, mean and standard deviation. Also by using the household data for women in Pakistan, coping strategies have been analyzed to find out the most commonly used coping strategy among women in Pakistan.

4.1. Descriptive Analysis: Women's Perception of Climate change

This section provides the discussion on descriptive analysis and empirical results obtained from the regressions. In order to analyze the women's perception about the change in climate in Pakistan, primary data from 16 districts of Pakistan was used in which women farmers were asked to specify that whether or not they have noted the: (i) Change in Climate (specifying what they have observed regarding Summer and Winter season's temperatures (ii) Increase in overall Rainfall patterns (iii) Decrease in Rainfall patterns Or (iv) No change in Rainfall patterns. The Results are shown below in the form of charts and furthermore in tables:

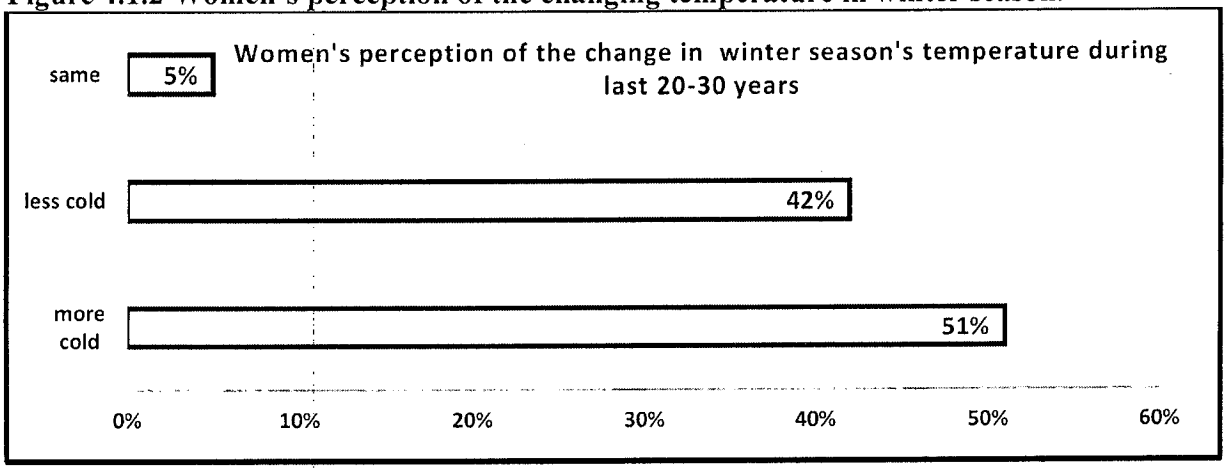
Descriptive statistics of the study sample are shown in the table below. The analysis of the women's perception about changing climate indicates that of 3431women, 240 (7% of the sample) are those women who were unaware of the fact that the climate is changing while 3191 (93% of the women in this study) had perceived the change in climate.

Figure 4.1.1 Women's perception of the change in climate



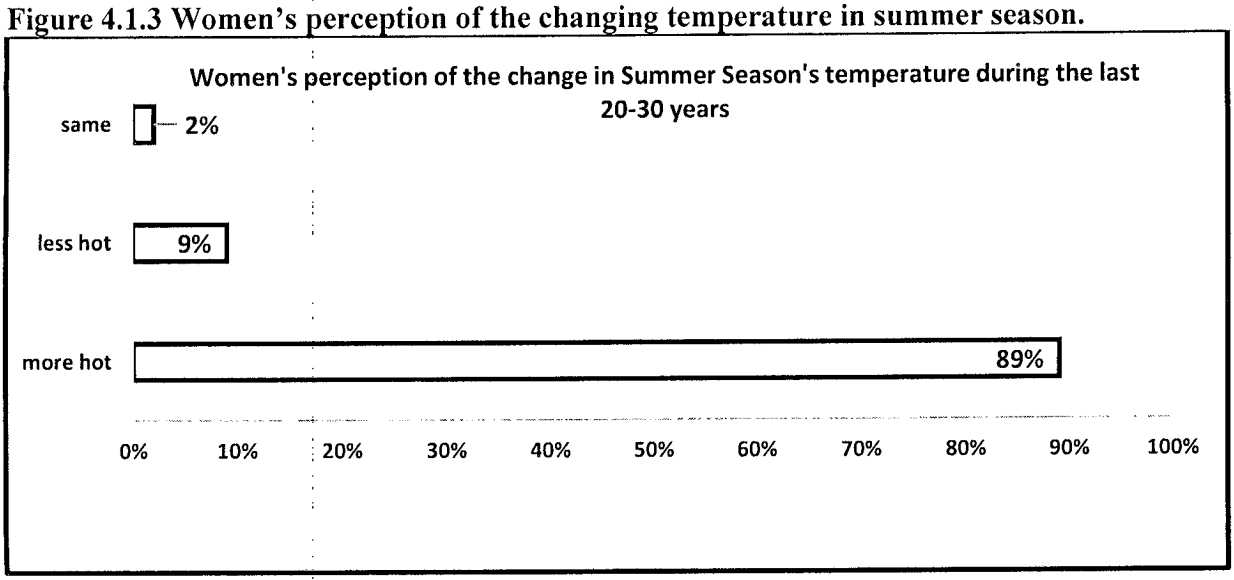
The evidence from surveyed data in the study indicated that 51% of the surveyed women farmers in various regions of Pakistan have observed more cold winter season in the last 20-30 years while 42% have perceived the less cold winter season. And according to remaining 5% of the surveyed women farmers, the winter season stayed the same.

Figure 4.1.2 Women's perception of the changing temperature in winter season.



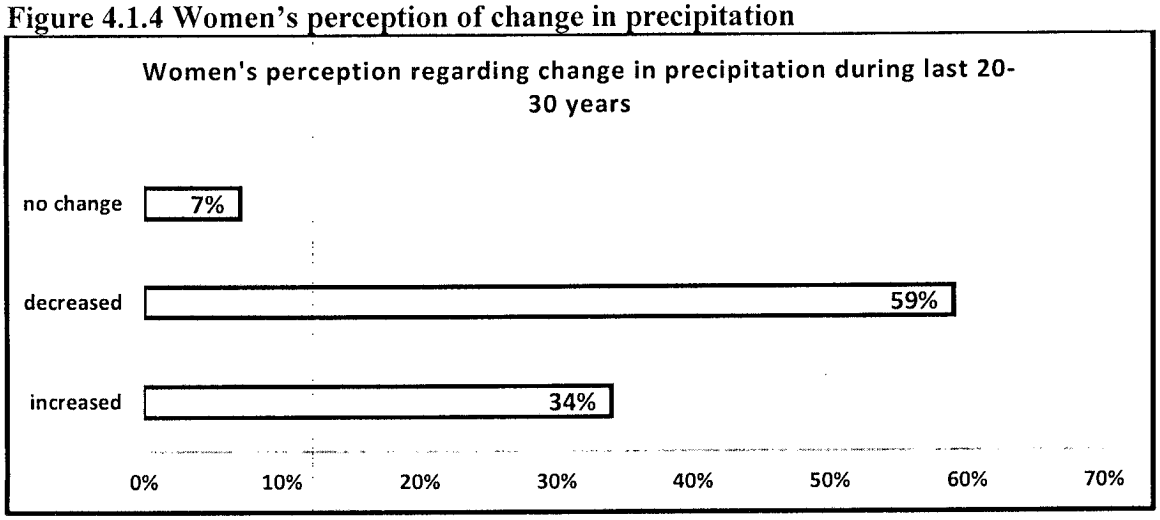
Moreover, for the women's perceptions about the summer season, analysis shows that 89% of the women in the survey had observed more hot summer season's temperature compared to that it was used to be 20-30 years ago. Whereas 9% of the women reported less hot summer season temperature and 2% of them reported no change in summer season's temperature.

Figure 4.1.3 Women's perception of the changing temperature in summer season.



Women's perceptions about the change in rainfall were divided into three categories. The results showed that 59% of the women perceived that rainfall received over the last 20-30 years has declined significantly while 4% of the women had perceived increased rainfall and 7% of the women from the sample had perceived no change in overall rainfall.

Figure 4.1.4 Women's perception of change in precipitation



4.2. Cross Tabulation of Women's Perception of Climate Change by Age, Education and Farming Experience

There are some factors that shape the women's perception and adoption of coping strategies. To understand formation of perception at micro level, the Climate Change Impact Survey (2013) makes prospects for analyzing and exploring the gender differentiated perceptions and adaptations. For this we dig in detail analysis of women perception and coping strategies considering major factors: Age, Education and Farming experience[23].

4.2.1. Women Perception of Climate Change by Age

A cohort analysis of the women's perception of climate change with the age of women illustrated that out of 93% of the women who have perceived that the climate has been changing, majority of the women (42%) were between the age group (41-60 years) while 37% were in the age group (26-40) years as compared to the women farmers above 60 years of age (14%) and between 15 to 25 years (6%) as shown in table 4.1.below.

Table 4.2.1 Women Perception of Climate Change by Age

	Women Perception by Age (as a % of Respondents)			
Women Perception	15-25 years	26-40 years	41-60 years	Above 60
Non-Perceivers	8%	44%	33%	15%
Perceivers	6%	37%	42%	14%
Increase in Temperature	6%	37%	42%	15%
Decrease in temperature	7%	46%	37%	9%
No change in Temperature	7%	40%	44%	9%
Increase in precipitation	5%	35%	42%	18%
Decrease in precipitation	7%	40%	41%	12%
No change in precipitation	8%	41%	40%	12%

[23] Similar classification can be drawn against other determinants also.

Among those perceivers, an increase in temperature has been reported by the same ratio in all the cohorts as most of the women (42%) perceiving the increase in temperature were of age group 41-60 years, 37% were between 26 to 40 years while only 15% and 6% of them were above 6o years and between 15-25 years respectively.

With regards to decrease in temperature, majority of the perceivers (46%) were from cohort of women between the ages of 26-40 years. From the age group 41 to 60 years, 37 % of the women have observed decrease in temperature and only 9% and 7% of the women from the age group (above 60) and (15-25) years observed a decrease in temperature during last 20-30 years. In relation to women's perception about the change in precipitation, 42% of the women, from the age group 41 to 60 years, observed an increase in precipitation, besides this, 35% were between 15-25 years and 18% of the perceivers were above 60 who noticed an increase in precipitation.

4.2.2. Women Perception of Climate Change by Education

A cross tabulation between the women's education level and the women's perception regarding changing climate revealed that majority of the women (36%) who have perceived the changing climate had got post standard education (more than the primary level of education) while 32% had attained up to primary level of education and 32% of them who have perceived the changing climate were not literate (table 4.2.2)

Table 4.2.2 Women Perception of Climate Change by Education

	Women Perception by Education (as a % of Respondents)		
Women Perception	Illiterate	Up to Primary (1-8 years)	Post Primary (9 plus years)
Non-Perceivers	30%	28%	43%
Perceivers	32%	32%	36%
Increase in Temperature	33%	32%	36%
decrease in temperature	29%	32%	39%
No change in Temperature	31%	27%	41%
Increase in precipitation	36%	29%	35%
Decrease in precipitation	31%	33%	36%
No change in precipitation	33%	30%	37%

For women's perception regarding increase in temperature, this ratio was same as of perceivers. However, with regard to decrease in temperature, 39% of the women farmers with more than the primary level of education noted decrease in temperature and 41% of the women with the same cohort observed no change in temperature.

Similarly analysis of women's perception about the change in precipitation by education of women elucidated that among all the perceivers, 36% of the women with no education had perceived increase in precipitation while 29% of the women with education up to primary level and 35% of those with post primary education observed an increase in precipitation. In contrast, 37% of the women with more than 9 years of education perceived no change in overall rainfall.

4.2.3. Women's perception of climate change and their farming experience

Concerning women's perception of climate change and their farming experience, it was established in the study that among the perceivers 82% of the women were those who had high farming

experience (more than 10 years of farming) while 18% of their counterparts had low farming experience (0 to 10 years).

Table 4.2.3 Women Perception of Climate Change by Farm Experience

	Women Perception by Farm Experience (as a % of Respondents)	
Women Perception	Low Farming Experience (0 to 10 years)	High Farming Experience (10+ years)
Non-Perceivers	16%	84%
Perceivers	18%	82%
Increase in Temperature	18%	82%
decrease in temperature	22%	78%
No change in Temperature	14%	86%
Increase in precipitation	17%	83%
Decrease in precipitation	19%	81%
No change in precipitation	18%	82%

Moreover the analysis further revealed that 82% of the women farmers with farming experience of 10 or more years have noted an increase in temperature during the last 20-30 years while only 18% of those who observed an increase in temperature had less or no experience of farming. 78% of those women who had perceived decrease in temperature were those having high farming experience and 22% of them had low farming experience (0 to 10 years).In a nutshell, majority of the women farmers who had perceived the change in temperature and change in precipitation were those who have farming experience (more than 10 years of farming).

Summarizing, it is concluded that women with more education (post primary) tend to perceive the change in climate more than the women with no year of schooling. The reason is that educated women have more access to information and they can better forecast the changing climate. Similarly it was found that women with farming experience more than 10 years were more aware of the changing climate. This can be justified with a possible reason that more farming experience shows the greater skills of women in farming and hence they can perceive the changing climate.

4.3. Coping strategies adopted by women

4.3.1. Coping strategies/mechanisms followed by the women in the aftermath of climate change or other hazard shock during last 5 years

In order to identify the coping strategies adopted by women in 16 various districts of Pakistan, women farmers were asked to specify the coping strategy adopted by them, in response to any climatic hazards or changing temperature and rainfall patterns during the last 5 years, from the following methods shown in table below:

Table 4.3.1 Coping Strategies aftermath of Change in Climate

Coping Strategies	N	% of Respondents adopted
Reduced frequency of buying clothes	2,614	78%
Bought less expensive foods	2,608	77%
Sold large ruminants (bullock, cow, buffalo etc.)	2,057	61%
Used Savings of Household	1,918	56%
opted for less expensive health services	1,843	54%
sold small ruminants (goats and sheep)	1,845	54%
Sought help from Relatives and Friends	1,601	47%
Used up seed stocks kept for next season	1,330	39%
Reduced proportions/number of meals by adult women	1,330	39%
labor on other farms for wages	1,117	33%
sold jewelry	1,109	33%
Moving female children to less expensive schools	934	28%
individual(s) migrated to work for wages	894	26%
Sold transport (cycle, motor cycle etc.)	750	22%
Stopped female children from going to school	648	19%
Sold agricultural machinery and implements	542	16%
Supported by NGOs	386	11%
Supported by District/ Local Government	363	11%
leased out agricultural land	356	11%

Note: Percentages may not sum up to 100% as the coping strategies are mutually exclusive (A women can adopt more than one coping strategies at a time)

So it was established in the study that out of 97% women who have adapted in response to adverse impacts of changing climate, most of the women farmers had reduced frequency of buying clothes (78%) and many of them started buying less expensive foods (77%). 61% of the women farmers had sold large ruminants while 56 % of them used their household savings to cope up with the changing climate. The least adopted way of coping was leasing out agricultural land and only 11% of the women farmers adopted this method.

4.3.2. Cross Tabulation of coping strategies adapted by women by Age and Education

By Age:

A cross tabulation between women's adapted coping strategies and the age of women in the study revealed that out of total women who reduced frequency of buying clothes (43%) and bought less expensive food (42%) in response to any climate hazard during the last 5 years, majority of the women farmers were in the age of 41 to 60 years. While 37% of the women who reduced expenditures on food and clothes were between 26-40 years. Only a handful, 14% and 6% were at the age above 60 and between 15-25 years, respectively. Similarly, most of the women farmers in the study who used household savings in order to cope up with the changing climate were in the age group 41-60 years (42%), 38% of those who adapted the same strategy were between 26 to 40 years, while only 7% and 13% of them were in age group 15-25 years and above 60, respectively.

	By Age (years) (as a % of Respondents)			
Coping Strategies adapted by Women	**15-25**	**26-40**	**41-60**	**Above 60**
Reduced frequency of buying clothes	6%	37%	43%	14%
Bought less expensive foods	6%	37%	42%	15%
Sold large ruminants (bullock, cow, buffalo etc.)	7%	38%	43%	13%
Used Savings of Household	7%	38%	42%	13%
opted for less expensive health services	6%	36%	43%	15%
sold small ruminants (goats and sheep)	6%	39%	41%	13%
Sought help from Relatives and Friends	7%	38%	42%	14%
Used up seed stocks kept for next season	6%	38%	43%	14%
Reduced proportions/number of meals	6%	38%	42%	14%
labor on other farms for wages	6%	37%	41%	15%
sold jewelry	6%	39%	42%	13%
Moving female children to less expensive schools	8%	37%	42%	13%
individual(s) migrated to work for wages	8%	40%	40%	12%
Sold transport (cycle, motor cycle etc.)	5%	38%	45%	11%
Stopped female children from going to school	7%	39%	40%	14%
Sold agricultural machinery and implements	6%	37%	45%	12%
Supported by NGOs	5%	34%	43%	18%
Supported by District/ Local Government	7%	41%	39%	13%
leased out agricultural land	6%	39%	44%	11%

Furthermore, it was established in the study that 43% of the rural women in Pakistan were from age group 41-60 years who sold large ruminants (bullock, cow, buffalo etc.) Moreover, analysis of adapted coping strategies by age of women shows that 42% of the women who reduced frequency of meals in response to climatic shock were between 41 to 60 years of age.

Overall, by the analysis of adapted coping strategies with the women farmer's characteristics, it was established the study that out of all the women who developed some coping strategy in response to any climatic hazard, majority of them were in the age group 41to 60 years.

By Education:

With regard to education level, it was established in the study that most of the women who adapted various coping strategies had more than 9 years of education. The most common coping strategies adapted by rural women in Pakistan having post standard education were: reduced frequency of buying clothes (37%), bought less expensive clothes (36%), sold large ruminants (bullocks, cows and buffalos) (37%), bought less expensive clothes (36%), sold small ruminants (35%), sought help from relatives (35%), reduced proportion of meals (36%), migrated to work for wages (35%) and supported by district / local government (35%).

By Education (as a % of Respondents)

Coping Strategies adapted by Women	Illiterate	Up to Primary (1-8 years)	Post Primary (9 plus years)
Reduced frequency of buying clothes	31%	32%	37%
Bought less expensive foods	32%	32%	36%
Sold large ruminants (bullock, cow, buffalo etc.)	31%	33%	36%
Used Savings of Household	34%	33%	34%
opted for less expensive health services	32%	32%	36%
sold small ruminants (goats and sheep)	33%	32%	35%
Sought help from Relatives and Friends	33%	32%	35%
Used up seed stocks kept for next season	32%	35%	33%
Reduced proportions/number of meals	31%	33%	36%
labor on other farms for wages	32%	31%	36%
sold jewelry	33%	35%	32%
Moving female children to less expensive schools	33%	34%	33%
migrated to work for wages	31%	34%	35%
Sold transport (cycle, motor cycle etc.)	32%	36%	32%
Stopped female children from going to school	32%	36%	32%
Sold agricultural machinery and implements	32%	37%	31%
Supported by NGOs	38%	32%	31%
Supported by District/ Local Government	33%	31%	35%
leased out agricultural land	30%	36%	34%

However, the most common strategies used by the women who have education level up to primary were: used up seed stocks kept for next season (35%), sold jewelry (35%), moved female children to less expensive schools (34%), sold transport (36%), stopped female children from going to school (36%), sold agricultural machinery and implements (37%) and leased out agricultural land (36%). Coping strategies majorly adapted by women with no year of schooling was support from NGOs (38%).

Overall the analysis of women's characteristics in the study showed that majority of the women in Pakistan who adapted some coping strategy to tackle with the adverse impacts caused by the climatic shocks had some years of schooling, either education level up to primary or post standard education. So it can be said on the basis of this analysis that education is a key contributing factor in analyzing the factors determining coping strategies of women in climate change impact and response assessment.

4.4. Empirical Model: Results and Discussion

This section reports the results of the study from regression analysis to identify and evaluate the factors influencing women's perception and adoption of coping strategies. The estimation was made using Treatment Effect Model to correct the problem of Selection Biasness. The results presented in this section are based on cross-sectional data collected from 16 various districts of Pakistan. The basic summary statistics of the variables are shown in table 4.4.1 below.

Table 4.4.1 Summary Statistics

Variables	Mean	Std. Dev.	Min	Max
(a) Independent Variables				
Age (continuous)	43.877	12.616	0	90
Education (continuous)	5.804	4.864	0	20
Household Size (continuous)	8.509	4.094	2	45
Farm Experience (continuous)	25.034	12.83	0	75
Social bound (D=1, otherwise 0)	—	—	—	—
Non-Farm Income (continuous)	0.153	0.36	0	1
Farm Size (continuous)	9.871	14.99	0	400
Land Rights (D=1, otherwise 0)	—	—	—	—
Social Networking (continuous)	0.898	0.324	0	6
Gov. Help (D=1, otherwise 0)	—	—	—	—
Women Empowerment (D=1, otherwise 0)	—	—	—	—
Livestock ownership (D=1, otherwise 0)	—	—	—	—
Access to loan (D=1, otherwise 0)	—	—	—	—
Climate Information (Traditional Knowledge) (D=1, otherwise 0)	—	—	—	—
Climate Information (through Media) (D=1, otherwise 0)	—	—	—	—

Table 4.4.1 provides the summary statistics of the continuous variables only and the mean, standard deviations, minimum and maximum values have not been reported as they are meaningless for categorical variables. So the analysis reports that women in our sample, on average, have age of 43 years and with respect to education, on average every women in the study has passed five years of schooling with farming experience of 25 years on average.

The two step Adaptation Model results are presented in the table 4.3.2. Treatment Effect Model was run and the appropriateness of the model for the study was tested (finding the correlation between the error terms in the Outcome Model and the Selection Model). Since the value of rho is

statistically different from zero (Wald $\chi 2$ = 37.89 with P=0.004) suggesting that the use of Treatment Effect Model is appropriate to avoid the sample selection problems. This significant value of the Wald test indicates also the good fit of the Model (Green, 2003).

The results from Perception Model (Selection Model) show that among the independent variables; Age, Education, Household Size, farm experience, Weather information (through Media) and Weather information (traditional knowledge) positively affect the likelihood (probability) of perceiving climate change.

As is evident from table 4.4.2 for the Adaptation Model (Outcome Model) Age, Education, Farm Experience, Land Rights, Women empowerment, Livestock index and perceived change in Rainfall found to be significantly affecting the women decision of adopting coping strategies or not.

Table 4.4.2 Results of the Treatment Effect Model of Women's Perception of and Adaptation to climate change in various districts of Pakistan

Variables	Adaptation Model (Outcome Model)		Perception Model (Selection Model)	
	Coefficients	P-Value	Coefficient	P-Value
Age	-0.0022***	0.004	0.0637	0.156
Education	0.0080*	0.09	0.0802**	0.057
Household Size	-0.0013	0.131	0.0086	0.362
Farm Experience	0.0004**	0.034	0.0031***	0.017
Social bound			-0.0512	0.527
Non-Farm Income	0.0052	0.514		
Farm Size	0.0009	0.684		
Land Rights	0.0102*	0.109		
Social Networking	-0.0035	0.684		
Women Empowerment	0.0112*	0.086		
Livestock ownership	-0.0009*	0.069		
Access to loan	0.0065	0.295		
Climate Information (Traditional Knowledge)			0.1298**	0.051
Climate Information (through Media)			0.0508	0.549
Change in Temperature	-0.0012	0.854		
Change in Precipitation	0.0153***	0.005		
Female Perception (as a treated variable in outcome model)	0.4523**	0.035		
Constant	0.5267***	0.008	1.3114***	0.000
Lambda	-0.2208**	0.034		

Wald chi2 (18)=37.89

Prob >chi2=0.004

No of Observations= 3352

Statistically significant at 0.1 (*), 0.05 (**), 0.01 (***) level of probability

Age of the women found out to be positively but not significantly associated with the probability of perceiving the changing climate by women in the study (β= 0.63, $p>0.1$). However with regard to probability of adapting, it was found to be inversely and significantly related to the age of women (θ=-0.002, $p<0.5$). Gbetibouo (2009), Teklewold *et al.*, (2006), Adesiona and Forson (1995) also cited the negative relationship between the age of farmers and the decision of adopting technologies with a view that the older farmers would have a lesser likelihood of adapting with the changing climate as they might would be more risk averse and less flexible as compare to the younger ones. So the results in this study also indicates that older women have more likelihood of perceiving the change in climate but smaller probability of adopting any coping strategy in response to the adverse impacts of the changing climate.

As for the education level of the women, the results revealed that more educated women were more likely to perceive the change in climate than the less educated women (β=0.0802, $p=0.05$). In relation to adapting with the changing climate, the study established that more educated women had higher probability of adapting in response to the changing climate than that of the less educated women (θ=0.008, $p<0.1$). Higher education is normally linked up to more access to information and awareness of changing climate. The findings are similar to that of Gbetibouo (2009), Daberkow and McBride (2003), Ndambiri *et al.*, (2001) and Igoden *et al.*, (1990) who argued that higher level of education increases the probability of forecasting the weather and in response tackling with the climatic changes, adopting new technologies and making rational decisions.

As far as household size is concerned, it was found in the study that households with more family members were more likely to perceive the change in climate than the smaller households (β=0.0086, $p=0.36$). However, for adaptation model, the study revealed a negative relationship with household size showing that larger families were less likely to adapt in response to climate

change compared to the smaller families (θ=-0.0013, p=0.13) as pointed out by Teklewold *et al.*, (2006), Tizale (2007) and Ndambiri *et al.*,(2011) that they considered household size as a proxy to availability of labor. Since the labor force in households having more family members usually divert toward the off farm activities striving to earn more for their family. But the variable household size in both the models was found out to be statistically insignificant.

Regarding women's farm experience, the results in the study showed a positive and strong impact on the both the perception (β=0.0031, p=0.01) and adaptation (θ=0.0004, p<0.05) models. The findings are similar to that of Ndambiri *et al.*, (2011), Gbetibouo (2009), Nhemachena and Hassan (2007) with the possible explanation that women with more farm experience have high skills in a diversifying portfolios, managing and coping up with the adverse impacts of the changing climate relative to the women having less farming experience.

As far as the determinant social bound in the perception model is concerned it was found to be inversely and insignificantly related to the women's likelihood of perceiving the change in climate (β=-0.052, p>0.1). So women's participation in any social group has no significant impact on their perception regarding the changing climate.

As expected, the likelihood of women's developing a coping strategy in response to the changing climate had a positive but insignificant relationship with the non-farm income (θ=0.0052, p>0.5). According to Tesso *et al.*, (2012), Knowler and Bradshaw (2007) and Franzel (1999) non-farm income represents wealth and less risk aversion of farmers as for agricultural adaptation, adequate financial wellbeing is required that can possibly come from other non-farm income generating activities.

Additionally, the livestock ownership in the model also represents the wealth .Yirga (2007) describes livestock as a mean of store of value and source of income and associated it as positively influencing the likelihood of adapting with the changing climate while in this study the negative but significant relationship was discovered with the likelihood of adaptation (θ=-0.0009, $p<0.1$).

Farm size was found to be positively but insignificantly related to the women's decision of adopting a coping strategy (θ=0.0009. $p>0.1$). The results are in line with the findings of Teso *et al.*, (2012) and Bradshaw *et al.*, (2004) and the probable reason is that women farmers having large scale farms have more capital and resources and they can invest easily so they are more likely to adapt. In response to the changing climate.

In relation to the land rights, women farmers having secure land rights are more likely to adapt with changing climatic conditions (θ=0.01, p=0.1)with the possible reason that landownership encourages adoption of new technology and investments linked to land (Gbetibouo, 2009; Shultz *et al.*, 1997 and Lutz *et al.*, 1994).

Unlike the prior expectation, the variable social networking in the study found out to be inversely but insignificantly related to the likelihood of adaptation (θ=-0.0035, $p>0.1$). Moreover, for women empowerment (Decision making power), the results originated were same as were hypothesized and a positive and significant association was established amongst the women empowerment and women adaptation to climate change (θ=0.0112, $p<0.1$).

As mentioned earlier that for agricultural coping sufficient financial funds is requisite and lack of financial resources appears to be a hindrance in adapting to the changing climate (O' Brien *et al.*, 2000; Caviglia and Harris, 2002; and Nhemachena and Hassan, 2008). Empirical results in the study also revealed that access to credit positively influences the women's decision of adaptation

uptake and hence is more likely to adapt to the changing climate compared to the women with no access to credit (θ=0.0065, $p<0.1$). The results reveal the importance of institution support in upholding of adaptation measures for women farmers in dealing with the menace.

Women's knowledge of climate change through traditional sources was found to be positively and significantly increasing the women's likelihood of perceiving the changing climate by 13% at 5% significant level. However climate related information through media was found to be statistically insignificant and positively affecting the women's probability of perceiving the changing climate by 5% ($p>0.1$). Many studies like Ndambiri (2011), Maddison (2006) and Nhemachena and Hassan (2007) reported the same results that access to information enhances the probability of perceiving the change in climate and in response adopting some coping strategies in order to evade the threats caused by the climatic shocks.

The model includes Rainfall and temperature as a variable that is how the respondents have perceived rainfall patterns and temperature to be increased or decreased which gives us their perception of the changing climate. The model demands a time series data of how women farmers responded over the time to such climatic changes which further analyze the relationship between the variables used as a proxy to capture the impact of the change in climate (Maddison, 2006). No such data has been available so far which completely captures the effects that is why cross-sectional data has been used for the analysis in the study in hand. Kansiime *et al.*, (2014) in their study used cross section data as a proxy for temporal variations. The study therefore used subjective indexation of the rainfall which has been constructed by asking the respondents a series of questions based on their previous season experience of the rainfall occurrence in their respective areas. Contrary to expectation, the results showed the negative (though not significant) association between the women's perception of the change in temperature and the adaptation uptake by women

farmers (θ=-0.0012, $p>0.1$). However, with regard to the change in precipitation the study revealed that it is positively associated with the women's adaptation of climate change (θ=0.45, $p<0.5$) that is women who has noted an increase in rainfall was more likely to adapt as compared to her counterpart who had not noticed the change in precipitation. Hence noticing the change in precipitation increases the likelihood of adapting by 45% at 5% level of significance.

The Lambda (Inverse Mill ratio) in the model shows the presence or absence of sample selection problem (Green, 2003). As the Lambda in estimation results is negatively signed and is statistically significant with P value equal to 0.03 which shows that the error terms in selection and outcome model are negatively correlated. This means there was sample selection problem and now it has been corrected.

The coefficient of female perception in the adaptation model (outcome model) represents the coefficient of perception model (selection model) as a whole; it is incorporated as a treated variable in outcome model. So the coefficient associated with the estimated treatment affect variable in the outcome model is 0.452 and the associated value of p is 0.03 shows that, other things being constant, the women who perceived the change in climate had a mean score that was 45% greater than the women who didn't perceived the change in climate. This difference is statistically significant at 5% level.

4.5. Discussion

The results of the analysis as discussed above illustrates that analysis for various 16 districts for Pakistan shows us how much the Pakistani women perceive the changes and which factor determines that women adapt to the climatic hazards. So considering age of the women, that was positive and significant in case of women's perceiving the changing climate shows that with the

increasing age of the women in Pakistan, they are more able to perceive climate change but for adaptation the case is opposite as it is negatively associated with adaptation. One possible rationale is that as the women in Pakistan grows older, the more she become risk averse and hence were found to be less prone to adapt to the change in climate.

Education as we know is a fact that the more the learned and educated women is, the more she is able to have a better understanding of her surroundings. In our analysis we found that if more opportunities given to Pakistani women, she will be more able to perceive and adapt in response to the changing climate. Education plays a crucial role in perceiving changing climate and adopting coping strategies in response to climate related shocks. Rural women with no education are at great disadvantage as they have limited access to information about the changing climate and hence cannot interpret this information. So this limitation undermines their ability to perceive, understand and cope up with the climatic changes.

In rural part of Pakistan, priority is made to educate boys and female children are the first ones who are stopped from going to school or moved to less expensive school as the data in the study shows that in response to climatic shocks during last 5 years, 28% of the women reported that they moved female children to less expensive schools and 19% of them reported that they pulled out female children from schools.

Due to lack of educational opportunities, women will have limited access to information regarding the climate change which will further increase women vulnerability and will reduce coping capacity of women in Pakistan. Increasing the women education is an active process for empowering women and in turn increasing her awareness and knowhow of changing climate.

Gender inequality in terms of access to land is greater in Pakistan, where on average male headed households have more land holdings than female households (FAO, 2011). In Asia, specifically Pakistan, cultural norms and practices dictates the inheritance of land to men while rural women mostly have access to resources and land through their male relatives. So when it comes to property rights, traditions are given more importance than laws in Pakistan. Land reform authorities and institutions should support legislation regarding gender equity and enforcing land rights. Women should be educated regarding their legal rights, and they should be kept aware of the protection and enforcement of those rights through the laws of the land.

Aguilar *et al.,* (2002) describes women empowerment as a process by which a women can have control over their lives and having more decision making power, encompassing the increased access to and control over the use of resources and credit facilities. Women empowerment is recognized as an essential element of development policies (Joarder, 2013). Savariet e*t al.,* (2010) studied the role of women in decision making and involvement of women in local communities as a significant factor in improving the approaches towards sustainable livelihood and resilience to the changing climate.

The higher level of women empowerment is conceptualized as a key point for developing sustainable livelihood for the reason that women undertakes simultaneous and multiple responsibilities, on the basis of her knowledge and her experience, and her active role in the productive areas like management of households, agricultural production, income generation and in other socio-economic and cultural institutions. The study in hand established a positive and significant relationship between women empowerment and adoption of coping strategies for Pakistan. However, social marginalization and exclusion of women from decision making and policy making process, food insecurity, lack of resources, limited access to credit and limited

access to education are some of the dynamics or push factors that put rural women of Pakistan at distinct disadvantages.

Addressing these types of constraints and considering women in decision making shows that the women had been taken into account while formulating and implementing climate related policies. Also providing women equal rights in decision making results in more resilient livelihoods, better income, improved health and better education.

CHAPTER-5

CONCLUSION AND POLICY IMPLICATION

This study evaluated the determinants of women's perception of climate change and further highlighted the coping strategies adopted by women in response to climatic hazard with special reference to 16 various districts of Pakistan. This assessment was done using farm level household survey based data "Climate Change Impact Survey, (CCIS, 2013).

We find the evidence that that majority of the women were very well aware of the fact that the climate has been changing and most of the women had perceived that the summer season's temperature has now become more hot compare to that it was used to be 20-30 years ago. A cohort analysis w.r.t age, education and farming experience revealed that more educated women and those within age group 41-60 years and with more farming experience tend to have better understanding of the changing climate and hence they can adapt better in response to climatic shocks.

Treatment Effect Model was employed in the study to examine the determinants of perception and coping strategies adopted by women in Pakistan. The results suggest that education, farming experience and climate information through traditional sources significantly and positively affect the women's likelihood of perceiving the changing climate. Moreover, the results from the outcome model revealed that age, education, farm experience, land rights, women empowerment, livestock ownership and change in rainfall are crucial factors in determining the adoption of coping strategies by women.

The analysis of coping strategies adopted by rural women in response to climatic changes revealed that majority of the women in Pakistan reduced their expenditures by decreasing frequency of buying clothes and buying less expensive foods. Similarly other coping strategies adopted by many

rural women were selling out large and small ruminants, using household savings, opting for less expensive health services and reducing proportions of meal by adult women. However, the least adopted coping strategies among rural women in Pakistan were leasing out agricultural land, support by NGOs and local government.

The findings of the study further reveal that though the women in Pakistan take the climate change as a serious issue but limited access to credit, lack of weather related information, lack of resources, lack of knowledge on coping methods and lack of empowerment are some of the perceived hindrances in undertaking the adaptation measures. So there is a need to overcome this information and knowledge gap regarding the effect of climate change and an immediate action is needed to relegate the climate change impacts by information dissemination through conducting different awareness and training programs, and by considering the role of public administration as the promoters and facilitators of climate adaptation.

Women's education serves as an investment in human capital and is clearly linked to the factors that determine the opportunities, agricultural productive capacity and economic and social wellbeing of women. Investing in human capital by educating women and increasing their practical skills would make women a productive worker, more influential in communities and within households, and will increase their ability to cope up with the hazards.

With regard to land rights, women in rural areas of Pakistan have less control over land and the part of land in their control is usually in smaller plots and of poor quality. As land rights in the study has positive and significant impact on the women's adoption of coping strategy, this depicts that strengthening the rural women farmer's access to land, rights and control over the land and tenure security is an important mean of women's influence and in raising status within

communities and households. It also directly affects the farm productivity and has far reaching implications for better and improved household welfare and better adoption of coping strategies in response to the changing climatic events.

Furthermore, it is concluded that women in climate change debate should not treated as homogeneous as they are differentiated by different socio economic and institutional characteristics such that age, education, farming experience, access to credit, and income that magnify and shape their vulnerabilities, perception of changing climate and development of coping strategies in response to climatic shocks. Due to limited access to resources, education and lack of decision making, women in Pakistan have less coping capacity and hence are more vulnerable to the changing climate.

Rural women in Pakistan can spark positive changes when they will be provided suitable frameworks and necessary tools, knowledge, resources and skillset regarding changing climate and the strategies to cope up with the menace. To build women's coping capacity, they need access to resources, education and training that will support and make them well informed regarding changing climate and decision regarding household management. Women's representation in decision making process will ensure women's empowerment and makes them less vulnerable to climate change and they can adapt better in response to climatic hazards.

Summarizing, it can be said that women with more access and control over resources and income would be in a stronger bargaining position in the context of making economic decisions regarding production and consumption with strong influence over the household management decisions. Such that reducing the gender gap would strengthen women and will generate larger economic and

social benefits for women and also in coping up with the adverse impacts caused by the change in climate.

Policy Implication and recommendations:

In gender debate of climate change, women are often considered as the victims of the adverse effects of climate change. However, they can be the key active member of the society in adaption to climate change, only if the policies made would be gender aware and they would be provided the equal opportunities as that of provided to man. Women face disadvantages because of unequal access to resources and decision making power.

The results suggest that to avoid the adverse effect of climate change, policymakers should focus on promoting awareness about climate change, providing credit facilities to women for undertaking adaptation measure, encouraging informal social network and besides these, it is also necessary to invest in education to increase the adaptive capacity of women.

So there is a need to:

a) Organize information provision and awareness campaigns about the changing climate, its impacts and the way of coping up with the adverse impacts of the change in climate among rural women.

b) Grant rural women the right to land ownership and promoting their access to credit and other financial resources needed to cope up with the climatic hazards.

c) And to make women's education available at least up to primary level on priority basis.

d) Also setting up serious ethic about environmental conservation among women is only possible by educating them on the significance of the conservation of

natural environment and by educating them the implications of the climate related changes and by educating them the use of modern coping methods.

e) Since the women empowerment has significant positive impact on adaptation uptake so another important policy implication in this regard would be to empower women through considering them as a part of decision making and giving them proper land rights.

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