



Women's Perception of Climate Change and Coping Strategies in Pakistan: An Empirical Evidence

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Abstract

This paper examines the women's perception about climate change and coping strategies in response to climate-related shocks in Pakistan. It is among the ten countries that have been affected most by climate change. There is no denying the fact that climate change is bringing miseries for the vulnerable population particularly for the rural women. The study used the Treatment Effect Model to evaluate the determinants of women's perception and adoption of coping strategies using data from Climate Change Impact Survey (PIDE 2013). Secondary data of 3298 rural households in Punjab, Sindh and KPK as provided by Pakistan Institute of Development Economics (2013) were utilized to conduct this research. The results of this study demonstrate that age, education, farming experience, land rights, women empowerment, livestock ownership and change in rainfall are crucial factors for women's coping strategies to avoid the adverse effect of climate change. There is dire need to raise awareness about climate change in women and provide credit facilities for undertaking adaptation measures, encourage informal social networks and enhance women capacity to climate change.

Keywords Women's perceptions · Coping strategies · Climate change · Heckman model

1 Introduction

Climate change has become an indisputable phenomenon and most challenging crisis that the world is facing today (UNFCCC 2005; Brien and Leichenko 2007; IPCC 2007; Mearns and Norton 2010). It is the most significant challenge to achieving sustainable development, and it threatens to drag millions of people into poverty. Such climatic changes are causing transformations not only in the environmental systems but have serious implications on the social

system, which is closely related to human livelihoods (Francis 2000; IPCC¹ 2001, 2007).

Presently, Pakistan is highly vulnerable to the effects of climate change and ranked among the ten countries that have been affected most. It affects several sectors, particularly the agriculture sector which can adversely impact those who are already economically deprived marginalized in society (ADB 2016).

It is usually the rural households, smallholders, and particularly women who are the most vulnerable to natural calamities due to gender inequalities that are inherent in our social system. (Adger 2001, 2003; Burton et al. Burton 2006). Although women are more prone to the adverse impacts of climate change (Djoudi and Brockhaus 2011), yet they get sidelined in most research literature.

A plethora of literature is available around gender, agriculture (FAO 2008; Begum and Yasmeen 2011), poverty (Blackden and Woddon 2006) inequality (World Bank 2006; Esplen and Brody 2007; Klasen and Lamanna 2009; GTZ 2009) and livelihood (Francis 2000; Lipton 2005; ILRI 2014). But the impact of climate change on women particularly the rural women is missing in the literature. An

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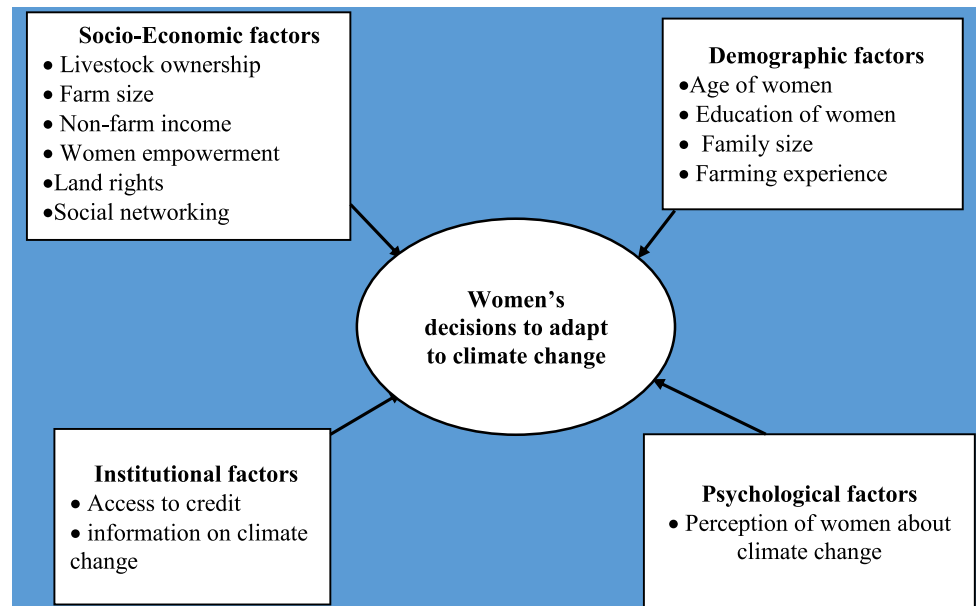
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Fig. 1 Factors influencing women decision to adapt to climate change



important gap in the literature regarding the climate change related issues in Pakistan is that it is mostly devoid of human dimension, i.e., how women especially the rural women have perception about climate change and awareness about coping strategies that how to minimize the adverse impact of climate change.

Although women are more vulnerable to the effects of climate change, however, they have poor credit facilities, lower access to valuable resources, limited decision-making power and insufficient information about climate change and coping strategies (Masika 2002; IUCN 2013). Thus, women's perceptions of climate change and the most appropriate coping strategies are argued to be crucial in order to address the adverse impacts of climatic change (Adger 2003). Therefore, the *paper aims to examine the women's perceptions about climate change and coping strategies to reduce the effects of climatic risks in Pakistan.*

The next section of this study provides the details of methodology such as describe the conceptual framework, variable construction, data and underlying econometric techniques. Section 3 covers empirical estimation and results. Lastly, conclusion and required policy reforms are elaborated in Sect. 4.

2 Materials and Methods

2.1 Conceptual Framework

The overarching framework employed in this study is drawn from the concept that there are various driving forces behind women's decisions to adapt in response to climate change. Some of the major factors that determine adaptation options

are economic factors including 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. For further details, see following Fig. 1.

2.2 The Econometric Model

2.2.1 The Analytical Framework: Heckman sample selectivity model

Determinants of perceptions and coping strategies for climate change are identified by a two-stage process (Maddison 2006). Firstly, whether the change in climate is perceived by women respondent or not. Secondly, adopting the coping strategies is then conditional on the perceived change in climate (Gbetibouo 2009). Since coping strategies in response to climate change are the sub-sample of the first stage. Therefore, coping strategies are not the same for those who did not perceive climate change. This situation may cause the selection bias. That is why the Heckman two-step model is used as an alternative technique to avoid the sample selection bias.

Heckman two-step model is used in several studies for multiple purposes such as to identify the knowledge factors and the resulting new technologies to be adopted thereafter (William 2003). A similar methodology is used by Yirga (2007), Kaliba et al. (2000) to investigate that which technology is adopted by farmers and how much the input has potential to be used in Ethiopia. Maddison (2006) utilize the same two-step approach to study the adaptation of climate

Fig. 2 Women's perception of the change in climate

change by farmers in South Africa. Deressa et al. (2008) and Gbetibouo (2009) use the same model to identify the determinants of farmers (particularly women) perception about climate change and the possible coping strategies.

One another study also utilized the Heckman two-step procedure to identify the factors that determine the perception of women about climate change and the coping strategies. The specification of Heckman two-step model is written as follows:

$$\text{Adaptation}_i = f_i(\text{Perception}) = \alpha + \beta X_i + \gamma \text{Perception} + U_i \quad (1)$$

$$\text{Perception}_i = a + bZ_i + v_i > 0 \quad (2)$$

Equation (1) is adaptation/outcome equation and (2) is perception/selection equation. Adaptation_i and Perception_i are binary dependent variables for i th women farmer.

Observation on perception and adaptation will be assigned a value of 1 if farmer perceived and adapt to the climate change and 0 if not in both cases.

$$\begin{aligned} \text{Adaptation}_i &= 1 \text{ if } \text{Perception}_i > 0 \\ \text{Adaptation}_i &= 0 \text{ otherwise (if } \text{Perception}_i < 0) \end{aligned}$$

The difference between perceivers and non-perceivers of climate change causes the bias which in turn is associated with adaptation. A Probit model² is estimated in which the information regarding the unmeasured characteristics (i.e., the difference between perceivers and non-perceivers) is available in the residual of the model. Therefore, the selection bias control factor is constructed using the residual of the selection equation. This selection bias control factor is called Lambda which is equivalent to the Inverse Mills ratio. It also captures the effect of measured characteristics and is used an additional independent variable in the second step of Heckman procedure, since we have a control factor for the effect of perception-related unmeasured characteristics which in turn are related to adaptation decisions. Therefore, the other variables in the model have not related to this effect and hence the coefficients of the regression are unbiased.

² It is assumed in Heckman model that the error terms of this model are normally distributed.

2.3 Data

The study used the data of Climate Change Impact Survey (PIDE 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". Data are a nationally representative sample of 3298 rural households. The data have been obtained from 16 districts³ from three provinces⁴ (KPK, Sindh, and Punjab) of Pakistan. The study covers primarily women's questionnaire⁵ 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 roles in developing different coping strategies.

3 Results and Discussion

3.1 Descriptive Analysis: Women's Perception of Climate change

The following figure exhibits the women's perceptions about climate change and clearly indicates that 93% of women are aware about climate change while 7% are unaware (Figs. 2, 3, 4, 5).

51% of female farmers observed that winter season is more prolonged as compared to last 20–30 years while other respondents have different opinion.

89% of rural women have observed the raise in temperature in summer season while 5% saw no changes in summer weather.

³ The districts includes Attock, Chakwal, Bhakkar, Multan, Vehari, Sialkot and Bahawalpur from Punjab; D.I. Khan, Nowshera, Mansehra and Kohat from KPK; and Hyderabad, Umarkot, Nawabshah, Larkana and Khairpur from Sindh.

⁴ The survey has not been carried out in Baluchistan due to security reasons.

⁵ 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.

Fig. 3 Women's perception of the change in winter season's temperature during last 20–30 years

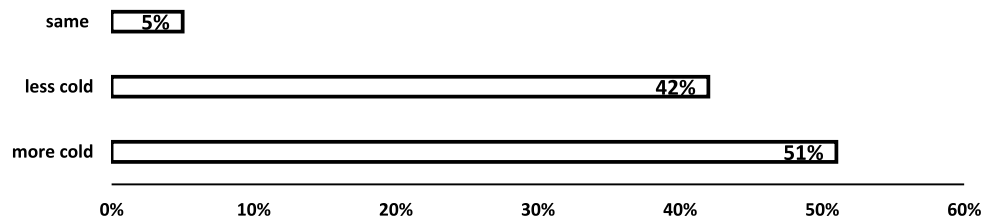


Fig. 4 Women's perception of the change in Summer Season's temperature during the last 20–30 years

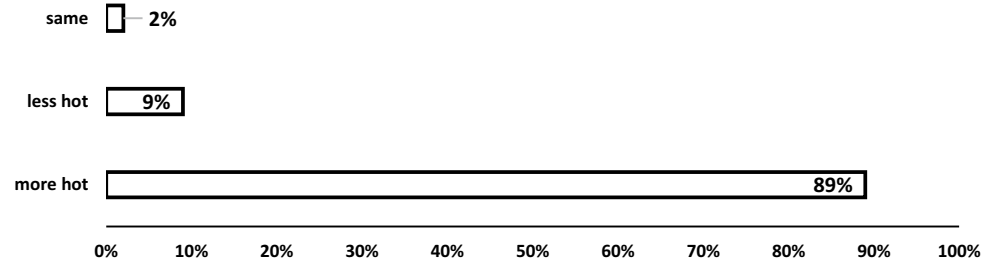
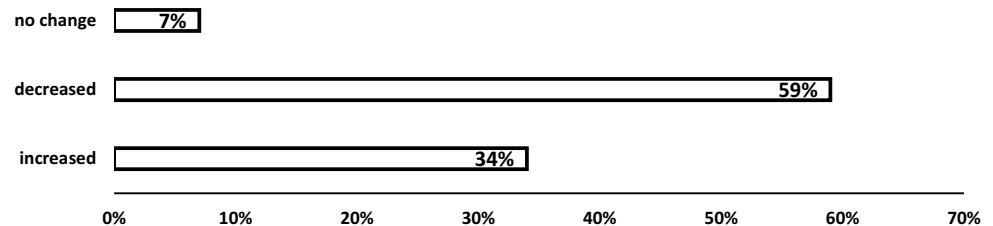


Fig. 5 Women's perception regarding the change in precipitation during last 20–30 years



Regarding rainfall 59% of rural women responded that rainfall has been decreasing as compared to last 20–30 years while rainfall has been increasing over the time.

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

3.2.1 Women Perception of Climate Change by Age

A cohort analysis of the women's perception of climate change with the age of women shows that 93% of women who have perceived that the climate has been changing, among them 42% were between the age group of (41–60 years), 37% were in the age group of (26–40) years and 14% were above 60. While 6% were between the age of (15–25) years as shown in following Table 1

Table 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

Table 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

3.2.2 Women Perception of Climate Change by Education

A cross-tabulation revealed that a large proportion of educated women such as up to primary and post primary perceived the climate is changing as opposed to women who are illiterate (Table 2).

3.2.3 Women's perception of climate change and their farming experience

Concerning women's perception of climate change and their farming experience, among the perceivers, 82% women had high farming experience (more than 10 years) while only 18% had low farming experience (0–10 years) (Table 3).

Table 3 Women perception of climate change by farm experience

Women perception by farm experience (as a % of respondents)		
Women perception	Low farming experience (0–10 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

3.3 Coping Strategies Adopted by Women

3.3.1 Coping Strategies/Mechanisms Followed by the Women During Last 5 Years

During the last 5 years, the coping strategies in response to climate change, the women responses are shown in the table below (Table 4):

This table clearly indicates that out of 97% women who have adapted in response to changing climate, most of the women farmers had reduced frequency of buying clothes (78%), 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.

3.3.2 Cross-Tabulation of Coping Strategies Adopted by Women by Age and Education

The results show that out of total women who have reduced frequency of buying clothes (43%) and bought less expensive food (42%) in response to any climate hazard during the last 5 years, are in the age bracket of 41–60 years. While 37% of the women who reduced expenditures on food and clothes were between 26 and 40 years. Similarly, most of the women farmers in the study who used household savings in order to cope up with the changing climate are in the age group 41–60 years (42%); 38% of those who adopted the same strategy are between 26 and 40 years. Most of the women farmers adapted any of the coping strategies are in the age group of 26–40 and 41–60 as shown in the table below. This means that coping strategies are adopted by those who have more responsibilities on their shoulders (Table 5).

Table 4 Coping strategies

Coping strategies	<i>N</i>	% of Respondents adopted
Reduced frequency of buying clothes	2614	78
Bought less expensive foods	2608	77
Sold large ruminants (Bullock, cow, buffalo etc.)	2057	61
Used Savings of Household	1918	56
opted for less expensive health services	1843	54
sold small ruminants (goats and sheep)	1845	54
Sought help from relatives and friends	1601	47
Used up seed stocks kept for next season	1330	39
Reduced proportions/number of meals by adult women	1330	39
labor on other farms for wages	1117	33
sold jewelry	1109	33
Moving female children to less expensive schools	934	28
individual(s) migrated to work for wages	894	26
Sold transport (cycle, motorcycle 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

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)

Table 5 Coping strategies adapted by women by age

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

Table 6 Coping strategies adapted by women by education

Coping strategies adapted by women	By education (as a % of respondents)		
	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

Table 7 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)	–	–	–	–

3.3.3 By Education

With regard to education level, most of the women who had 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 are: 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%) (Table 6).

Table 8 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 χ^2 (18)=37.89				
Prob > χ^2 =0.004				
No of observations =3352				

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

3.4 Empirical Model: Results and Discussion

The basic summary statistics of the variables are shown in Table 7.

Table 7 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 an age of 43 years and with respect to education, on average every woman in the study has passed 5 years of schooling with farming experience of 25 years on average.

The two-step adaptation model results are presented in the Table 8. The study used the treatment effect model after testing its appropriateness (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 χ^2 =37.89 with P =0.004) suggesting that the use of treatment effect model is appropriate to avoid the sample selection problems.

The results from perception model and adaptation model are given in first and second part of Table 8, respectively.

Statistical results show that age is not a determinant of perception of climate change, whereas age is a significant determinant of climate change adaptation. The study results are consistent with Gbetibouo (2009), Teklewold et al. (2006), who also found negative relationship between the age of farmers and the decision of adopting technologies. The older farmers might be more risk-averse and less flexible as compared to the younger ones.

Perceiving and adapting to the change in climate are more likely for educated women than the less educated women. Higher education is normally linked up to more access to information and awareness of changing the climate and, therefore, increases the probability of adopting new technologies and making rational decisions. In a rural part of Pakistan, priority is given to educated boys while girls are sent to the less expensive school. Results of this study show, in response to climatic shocks during last 5 years, 28% women sent female children to less expensive schools while 19% were pulled out female children from schools.

The change in climate is perceived by those women whose household size is large than the women having fewer family members in home. However, for adaptation model,

the study revealed a negative relationship as pointed out by (Teklewold et al. 2006; Tizale 2007). These studies considered household size as a proxy for the availability of labor, since the labor force in households having more family members usually diverts toward the off-farm activities striving to earn more for their family.

The results show that women's farm experience is the main determinant of both perception and adaptation to climate change. The findings are consistent with (Gbetibouo 2009; Nhemachena and Hassan 2007). Women with more farm experience have high skills in a diversifying portfolio, managing and coping up with the adverse impacts of the changing climate relative to the women having less farming experience.

Women's participation in any social group has no significant impact on perceiving the changing climate. The likelihood of women's developing a coping strategy in response to the changing climate had an insignificant relationship with the non-farm income. The negative relationship between livestock ownership and adaptation to climate change is unexpected results of the study. For being as a mean of the store of value and source of income, the livestock ownership is expected to be positively influencing the likelihood of adapting the changing climate (Yirga 2007).

The study observed the insignificant relation between farm size and the women's decision of adapting a coping strategy (Bradshaw et al. 2004). Large-scale women farmers are adapting more coping strategies because they have more capital and resources; therefore, they can invest easily. Land-ownership women are encouraging adaption of new technology and investments (Gbetibouo 2009). 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 2008). In Asia, specifically Pakistan, cultural norms, and practices dictate the inheritance of land to men.

Social networking also plays a major role in adaptation to climate change, but as social networking is very poor in Pakistan especially for marginalized women in rural areas. Moreover, social networking has an insignificant impact on the likelihood of adaptation. Moreover, for women empowerment (Decision-making power), the results show a positive and significant association between women empowerment and women adaptation to climate change. Access to credit positively influences the women's decision of adaptation uptake compared to those having no access to credit. 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 push factors that put rural women at distinct disadvantages.

Women's knowledge of climate change through traditional sources significantly increases the women's likelihood

of perceiving the changing climate; however, climate-related information through media was found to be statistically insignificant.

Analyzing the impact of rainfall and temperature on women's adaptation of climate change requires time series data. Due to non-availability of time series data, the study used cross-sectional data as a proxy for temporal variation. Therefore, the study 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 occurs in their respective areas. The study result shows that change in temperature has no significant association with adaption to climate change; however, with regard to the change in precipitation the study revealed that it is positively associated with the women's adaptation of climate change.

The Lambda (Inverse Mill ratio) in the model shows the presence or absence of sample selection problem (Greene and Hensher 2003). The significant Lambda having negative sign predicts that there was sample selection problem and now it has been corrected.

The positive and significant coefficient of the treatment affect variable shows that other things being constant, the women who perceived the change in climate had a mean score which is 45% greater than the women who did not perceive the change in climate. This difference is statistically significant at 5% level.

4 Conclusion and Policy Outcomes

The current study involved a concerted effort to examine the determinants of women's perception of climate change and coping strategies in response to climatic change using national data and employing robust statistical methods. The results indicate that majority of the women were well aware of the fact that climate has been changing over time. A cohort analysis with respect to age, education and farming experience revealed that more educated, older age group (41–60 years) and women having more farming experience tend to have a better understanding of the changing climate and hence they can adapt better in response to climatic shocks.

The study utilized the treatment effect model to examine the determinants of perception and coping strategies. The findings revealed 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 coping strategies adopted by rural women in response to climatic changes include a reduction in their expenditures by decreasing frequency of buying clothes and buying less expensive foods along with selling out large and small ruminants, using household savings, opting for less expensive health services and reducing proportions of the meal by adult women. However, the least adopted coping strategies among rural women in Pakistan are leasing out the agricultural land, support by NGOs and local government. The study findings further suggest that 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 deterrents in undertaking the adaptation measures.

There is a dire need to get insight this information and knowledge gap regarding the effect of climate change. An immediate action is needed to relegate the climate change impacts through information dissemination through conducting different awareness and training programs. Public administration also plays a major role in promotion and facilitation of climate change adaptation. The results suggest that to avoid the adverse effects of climate change, policy-makers should focus on promoting awareness about climate change, providing credit facilities to women for undertaking adaptation measure and encourage informal social networks among rural women.

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