

## Determinants of Adaptation Strategies to Climate Change by Farmers in District Sargodha, Pakistan

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Received: 22 November, 2017

Accepted: 20 April, 2018

**Abstract:** Pakistan is one of the most affected countries vulnerable to climate change. Additionally, being a predominantly agricultural economy, farming community is more at risk and climate change is predicted to decrease crop yields in Pakistan as a result of higher temperature, variability in rainfall and floods. Understanding the perception and adoption strategies to climate is important to preparing farming community for climate change impact. The present study was aimed to explore determinants of adaptation strategies to climate change by farmers. The data were collected through interview schedule. Logit regression model was used to explore the factors influencing the decision of farmer adaptation strategies to climate change. The study explored that education, farming experience, annual farm income, access to television, access to extension services, access to climate change information and membership in community based organization are main factors influencing the decision of farmers to climate change adoption. The study recommends that Government must ensure extension service, climate information and credit schemes to farmers to alter the production strategies in response to climate change.

**Keywords:** Adaptation strategies, climate change, extension services, following continuity.

### Introduction

Climate change is a serious issue all over the world. Developing countries have low level of adoption strategies to climate change. Due to poverty and lack of awareness developing countries are adversely affected by climate change (IFAD, 2010). Agriculture, which facilitates sustainable livelihood like food, fiber and feed, is most vulnerable to climate change (National Research Council, 2010). Pakistan is facing a serious problem of climate change, including decrease in rainfall, rise in temperature, floods and droughts (IUCN, 2009). Agriculture remains the backbone of Pakistan's economy, contributing to about 20% of the total GDP and employing 43% of the workforce. More than two-thirds of Pakistan's population lives in rural areas and their livelihood continues to revolve around agriculture (Government of Pakistan, 2003). Climate change is likely to exert undesirable impacts on agricultural production of the country. The major impacts on agriculture are: increasing temperature. Changes in accessibility of irrigation water. Changes in rainfall patterns. Severe water stressed conditions in arid and semi-arid areas. These factors cause decrease in yield by about 6 - 18%. Communities most vulnerable to climate change in Pakistan are small land owners that are more than 80% of the total farming community (Ullah, 2017). Wheat, rice, sugarcane, maize, cotton, fruit and vegetables account for more than 75% of the value of total crop output (Government of Pakistan, 2012-13). In this milieu, agriculture is vital for ensuring food security. However, climate

change has threatened the agricultural sector in Pakistan (Aggarwal and Sivakumar, 2011). Agricultural adoption measures by using farmers can for instance limit yield loss. Adoption to weather change is important for two fundamental reasons: it could lower exposure and vulnerability (Abidet al., 2015). Adaptation practices can involve changes in planting dates, fertilizer used, irrigation, plant breed or other aspects of crop management and the cultivation process (Challinoret al., 2014) Finding of numerous studies have assured that food productivity is increased by adoption to climate change. The adoption strategies of climate change are determined by numerous socio-demographic and economic factors. In most studies, simple adoption strategies such as heat stress and altering varieties have significantly negative impact on crops (Shongweet et al., 2014). Therefore, to check the effectiveness of model alternatives, improving existing weather risk management, and developing more resilient agricultural structures are urgently needed (Howden et al., 2007). Many studies measuring the socio-economic impact of climate change on agriculture explains that such impacts can be diminished through adoption strategies (Kurukulasuriya and Mendelssohn, 2007; Seo and Mendelssohn, 2006; Benhin, 2006). The adaptation practices usually reduce impact of climate change. Keeping in mind the importance of agriculture, the significance of climate change adaptation strategies are essential. Climate change adoption is an urgent issue that needed to be addressed. Therefore present study was conducted to explore climate change

adoption and determinants of adaptation strategies to climate change by farmers.

**Materials and Methods**

The present study was conducted in district Sargodha. The Sargodha district was selected purposively. A multistage simple random technique was used. At first stage one Tehsil Kot Momin was selected. Kot Momin is located on motorway at a distance of 50 km from Sargodha, 17 km from Bhalwal and about 30 km from Salam. It is not linked with railway network. Tehsil Kot Momin has population of 2.666 million (PMDFC, 2011). At second stage 6 union councils were selected randomly. A list of farmers was obtained from agriculture department (3) Sargodha and union council office. From each union council 20 farmer households were selected using simple random sampling. A total of 120 farmer households were selected. Data on determinants of adaptation strategies to climate change were obtained from the heads of each household through interview schedule using questionnaire. With the help of statistical package for social science (SPSS) collected data from the field were analyzed to change it into information.

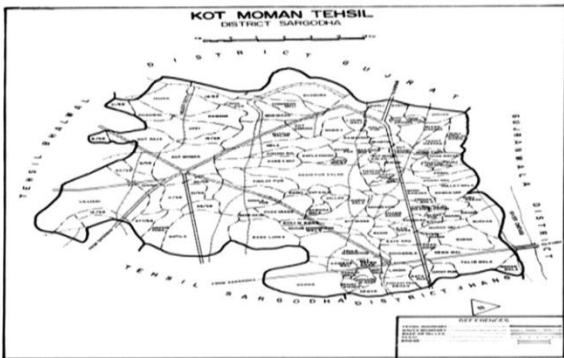


Fig. 1: Map of study area (Tehsil Kot Momin) Source: (Pakistan Bureau of Statistics, 2017).

**Empirical model**

The dependent variable is dichotomous variable. This dichotomous variable is dummied as 1 for any adoption strategy and 0 otherwise (Bryan et al., 2011). Therefore researcher used binary logit model for present study for analyzing factors affecting adoption to climate change. By taking natural log linear log it model is expressed as follow

$$L_i = \ln[P_i / (1 - P_i)] = Z_i = \beta_0 + \beta_1 X_{1i} + \dots + \beta_n X_{ni} + e$$

$P_i$  = probability of adoption to climate change

$\beta$  = parameters to be estimated

$X$  = independent variables

$e$  = error term

$P_i$  is probability to adopt at least one adoption strategy.  $P_i$  ranges from 0 to 1.  $P_i$  is dependent variable. The

description of all variables used in analysis is presented in Table 1.

**Results and Discussion**

**Characteristics of respondents**

The mean age of the respondents was 49.57 years. The majority of the respondents were male. This means, in study area most active farmers were male. Majority of the farmers were married. Majority of the respondents had primary education. Education is an important factor for adoption to climate change. Education is supposed to be an important factor in accessing new agriculture technology and enhanced agriculture productivity (Elahi et al., 2015). The household size of 65 percent respondent was up to 5-7. The annual farm income of 71 percent respondent was 65000 PKR and above. The 49 percent respondents have access to credit and 69 percent respondents were owners of television and 68 percent were also owners of mobile phone. Media play a significant role in exposure to adoption to climate change (Hannigan, 1995). In this regard, farmers will be aware about new climate change strategies.

Table 1 Description and measurements of variables used in analysis.

Variables	Description	Measurements
X <sub>1</sub>	Age	In years
X <sub>2</sub>	Gender	1 is male, 0 otherwise female
X <sub>3</sub>	Primary education	1 for attend, 0 otherwise
X <sub>4</sub>	Secondary education	1 for attend, 0 otherwise
X <sub>5</sub>	Marital status	1= Married, 0 otherwise
X <sub>6</sub>	Household size	In numbers
X <sub>7</sub>	Farming experience	In years
X <sub>8</sub>	Annual farm income	In Pakistani rupees
X <sub>9</sub>	Access to credit	1 yes, 0 otherwise
X <sub>10</sub>	Access to extension services	1 yes, 0 otherwise
X <sub>11</sub>	Access to climate change information	1 yes, 0 otherwise
X <sub>12</sub>	Decrease in rainfall	1 yes, 0 otherwise
X <sub>13</sub>	Ownership of television	1 yes, 0 otherwise
X <sub>14</sub>	Land size	In acres
X <sub>15</sub>	Annual income	In Pakistani rupees (PKR)
X <sub>16</sub>	Access to market information	1 yes, 0 otherwise
X <sub>17</sub>	Ownership of mobile phone	1 yes, 0 otherwise
X <sub>18</sub>	Membership in community based organizations	1 yes, 0 otherwise
X <sub>19</sub>	Information on water availability	1 yes, 0 otherwise
X <sub>20</sub>	Tenancy	1= ownership, 0 otherwise

Table 2 Logit regression for determinants of adaptation strategies to climate change.

Variables	Coefficient	Standard error	Z statistic	P-value
Age	0.001	1.176	0.653	0.032
Gender	1.032	1.452	0.948	0.006
Primary education	2.345**	1.853	1.264	0.042
Secondary education	0.491	0.065	0.581	0.361
Marital status	0.076	0.059	0.043	0.541
Household size	-0.271	1.371	-0.659	0.380
Farming experience	0.073**	0.632	1.154	0.021
Annual farm income	0.075**	0.042	0.045	0.030
Access to credit	-0.004	0.043	2.371	0.046
Access to extension services	0.039**	0.022	0.873	0.082
Access to climate change Information	1.729*	0.764	2.431	0.059
Decrease in rainfall	1.197***	0.459	1.852	0.076
Ownership of television	1.392***	1.153	1.943	0.010
Land size	0.484	0.044	0.742	0.023
Annual income	0.001*	0.001	1.664	0.001
Access to market information	0.057	0.211	0.681	0.431
Ownership of mobile phone	1.630**	0.033	1.985	0.006
Membership in community based organization	0.841*	0.382	0.914	0.075
Information on water availability	0.784	0.066	1.043	0.341
Tenancy	0.431	0.173	0.547	0.820
Constant	3.564**	1.548	1.875	0.041
Log likelihood	-40.832***			0.000

### Determinants of adaptation strategies

To measure the impact of variable on adoption decision to climate change logit model was used. The likelihood is significant at 1% which means that variables in logit model are significant in determining the decision of farmer to adopt one or more strategy of climate change. The results are presented in Table 2. The coefficient of education is significant at 5%. The education plays an important role in decision to adopt strategies to climate changes. The result is consistent with (Elahi et al., 2015; Abid et al., 2015) who found a positive relationship between education and decision of adoption to climate change. Here it can be concluded that education is positively related to adoption strategies of climate change. If a person is educated he is more adoptive. The household size is negatively related to decision to adoption to climate change. This result is consistent with (Jonge, 2010; Deressa et al., 2009; Taruvinga et al., 2016) they also found negative effect of household size on adoption to climate change. The effect of access to credit is negatively related to adoption to climate change. The annual income is significantly related to adoption strategies. The result is consistent with the findings of (Blessing et al., 2015) who found a positive relationship between annual farm income and adoption strategies to climate change. This means that farmers

who have more income are more likely to adopt strategies to climate change. The likelihood of adoption strategies increases with increasing in income. The effect of membership in community based organization is significant with decision to adoption to climate change. The result is consistent with finding of (Saguye, 2016) who found a positive relationship between memberships in community based organization and adoption to climate change in Ethiopia. The access to climate change information is significant at 5%. The variables like ownership of mobile phone and access to extension services are significant at 1 percent and 5 percent respectively and farming experience is also significant. These results are consistent with findings of (Hannigan, 1995; Falco et al., 2011; Deressa et al., 2009). The model shows that who have more exposure to media like mobile phone and television are more likely to adopt strategies to combat climate change, farming experience also increase likelihood of adoption strategies to climate change. Finding of the study revealed that education, access to climate information, ownership of television, access to phone, decrease in rainfall, annual farm income, farming experience, access to extension services, membership in community based organization and access to climate information are statistically significant determinants of adoption strategies to climate change.

### Conclusion

Pakistan is mainly an agrarian country and climate change is an increasing threat to better yield. Agriculture is main source of income in rural areas and agriculture sector, in particular, is impacted by reduction in rainfall; increase in the frequency of droughts and floods. Farming community is more vulnerable when changeable weather patterns and variable rainfall strike their crops and yield decreases. In this regard, adoption strategies are imperative to cope with climate change. The study found that education, ownership of television, access to phone, decrease in rainfall, annual farm income, farming experience, access to extension services, member of a community based organization and access to climate information are significant determinants of adoption to climate change. In the light of above knowledge, current study revealed that Government should incorporate climate change adoption in development plan, raise awareness about risks of climate change and new adoption strategies through training, informal education, workshops and campaigns through media. Government should also establish climate change information center in the rural areas in order to make farmers aware in advance and launch a crop insurance scheme at large scale. Furthermore, current study suggested that Government and other stakeholders must ensure extension services to farmers to educate and alter the production strategies in response to climate change.

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