

Understanding the Adaptation Process of Rural Smallholder Farmers toward climate change: evidence from northern Malakand area of Pakistan

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Received: February 20, 2017

Accepted: May 8, 2017

ABSTRACT

It is crucial to understand the farm-level adaptation strategies to improve the action needed to cope with climate change. The aim of this study is to explore the perception of smallholder farmers about climate change, information sources on climate change, and types of adaptation strategies and the factors hindering adaptation process in northern Malakand area of Pakistan. This study is based on primary data collected from 220 smallholder farmers through structure questionnaire. Results of the study revealed that farm household perceived only one aspect of change in climate throughout their life. Tree planting was considered an important adaptation strategy as 39% of the farm household too this strategy. It is believed by the majority of the farmers that deforestation is the key reason of change in climate and so that's why the prefer tree planting as an adaptation strategy. However, about 44% of the farmers employed one other measure on top of planting tree. In addition, the other adaptation measures are; early planting, irrigation, terracing and praying. The farmer's own experimentation (56%) remains the main source of information on climate change. At last, this research identified that the most important obstacle to climate change adaptation was lack of information. Moreover, other barriers were; lacking money, shortage of land, lack of seed, labor shortage, lack of water, insecure land tenure system and lacking access to market. This study recommends enhancing awareness about climate change, improving access to farm inputs and providing information on newly introduced adaptation strategies.

KEY WORDS: climate change; adaptation; Pakistan; farm-household; perception.

INTRODUCTION

According to (IPCC 2001), adaptation to climate change is referred to “*adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities*”[1]. Moreover, adaptation can be occurred at different level such as local, regional, sub-national and national. At local level adaptation is the most difficult as these are the ones that face the severity of the climate change[2]. Perception can be regarded is a cognitive process in which information is received and interpreted. Despite the correction perception, people sometimes do not respond to changes in climate due to lack of resources, lack of information or lack of capacity[3].

Change in climate is an environmental and development concern worldwide. Pervasive and ubiquitous real world environments are generally complex and multifarious[4].The negative impacts of climate change mostly affect developing countries negatively due to low adaptation [5].The change is slow but at negatively affects production of crop[4]. It is expected that due to change in climate the problem of food security may arise in the middle of 21st century. The region of South Asia will be the hub for most of the food insecure people. It is estimated that the yield of cereal crop will decline by about 30% with a decrease in water of nearly 37% per capita during 2001 to 2059[6]. Climate change is occurring rapidly as we experience change in temperature, precipitation, floods, drought, typhoon and hurricane[7, 8], and failed to build a global consensus greenhouse gas (GHG) mitigation [9]. The European countries have recognized these effects and adopted certain measures to mitigate the negative impact of climate change.

Climate change is a global phenomenon. But the need for adaptation is higher among developing countries because level of exposure to climate change is higher[10]. The change in climate is expected to greatly affect the productivity of African agriculture. Agriculture is considered a risky sector and farmers have to cope with various socio-economic and environmental factors[11]. As agriculture is considered important for the livelihoods of many

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poor people in rural areas [12], it is necessary to safeguard the livelihood of farmers to avoid the problem of insecurity. The need for adaptation measure depends on frequency of occurrence of extreme events, greater the frequency greater will the losses and greater will be the demand for adaptation measures. Access to credit and insurance are identified to be the two most important adaptation measures[13]. However, there are various adaptation strategies available to farmers as revealed by[14, 15].

Change in climate has affected agriculture sector in many regions of the world[16, 17]. Agriculture is the most sensitive sector to climate change. It is confirmed by[18] almost 60% crop yields is explained by variation in climate. The impact of climate change can be felt more seriously in developing countries because they mainly rely on agriculture for their livelihoods [19].Agriculture is the most important sector of Pakistan economy as it provides employment to approximately 43% of the labor force[20]. Climate change adversely affects farmers [21]. The adaptive capacity of Pakistan towards climate change is low due to prevalence of poverty and lack of resources such as physical and financial[15, 21].

Pakistan is among the most affected countries in the world due to poor infrastructure and low adaptive capacity[22]. It is expected that by 2050 a 2-3 degree increase in temperature would occur in Pakistan accompanied with significant variation in distribution of precipitation[23]. Pakistan is ranked 8th by Global Climate Risk Index (GCRI) in a list that includes the most affected countries by extremes weather events during 1995-2014[24]. Over the last two decades the productivity of major crops such as rice, cotton, wheat and sugarcane have been affected negatively which lead to deterioration of rural livelihoods[21]. The most devastating floods of 2010-2014 and the droughts that last from 1999 to 2003 has a significant impact the agriculture sector of Pakistan[21].

Currently, there is very limited support available to the agriculture of Pakistan to take adaptation measures. Moreover, the climate policy is ineffective and the technological and financial capacity of the country is very low in adapting to change in climate[25]. An integrated policy is needed at national to adapt to changes in climate[26]. The important aspects of adaptation policy towards climate change should include, awareness, investment in new high resistant varieties, insurance of crop, social awareness and programs for protection[27].

Pakistan is among the top few countries that are vulnerable to climate change. Despite the fact that Pakistan is gifted with plenty of natural and human resources such as fertile lands, mountains and lakes, range of seasons, world best irrigation systems and comparatively more tillable agriculture sector[28]. Still, Climate change is inevitable and Pakistani famers have to adapt to this inevitable change in climate. Adaptation can occur at different level such as farm-level, individual, national or international. Some adaptation measures are observed at farm-level but that is not enough and needed government intervention[13, 29].The farm-level adaptation can be understood by examining national and international level adaptation[12].

Adaptation is a two-step process. First, one has to perceive climate change and associated risk, second, steps taken to minimize the negative effects of climate change. The perception of the people can go in either direction; right or wrong, so perception in the wrong direction might have adverse effects. The correct perception about climate change depends on access to information and knowledge of the farmer. However, knowledge is associated with the number of years the farmer has attended school and the faming experience[3].Still there are some important questions including how farm-household perceive climate change over a long period? What type of changes they perceive? What factors shape their behavior towards adaptation such as social, economic or institutional? What is the speed of adaptation?[30-32]?However, perception is not the only mean of adaptation toward climate change. It is not necessary that farmers who perceive it will adapt to or their response to adaption may vary depending on different institutional, economic and social factors[12, 33].

Agriculture is generally the main source of livelihood for majority of the rural parts in the world[34]. In majority of the developing countries agriculture remained an important source of livelihood for rural household and this is the case with Pakistan. Thus, an adaptation to climate change is necessary to overcome the negative impacts of climate change to ensure food security and protect the livelihood of many rural household. Adaptation to climate change is an effective measure at farm level. This can reduce vulnerability of rural household towards negative impacts of climate change and prepare them to deal with adverse events[35].

In developing countries, awareness and knowledge about adaptation process at farm-level is hindered by low level of risk perception, lacking research on environmental impacts and lack of stimulus that result in adaptation[36, 37].This is especially the case with Pakistan where most of the literature on agriculture and climate change is based on economic and bio-physical relationship between agriculture and climate change across different districts and regions[38, 39]. The previous studies on Pakistan stress on the need for adaption to climate change, but actually the field-based studies focused at farm adaptation to climate change are limited[21, 23, 40]. The emphasis on field-level studies is increasing due to its importance in understanding the farm level adaptation to counter the adverse effects of climate change.

The studies carried in the context of Pakistan are limited to central area i.e. to Punjab. The need for the study of northern area arises. This study would provide new insight on the process of adaptation at farm level. The northern area i.e. Malakand might be a good example in this respect. The landholdings are small in this area and consist of mixed cropping system, producing cash crops such as sugarcane and cotton and cereal like wheat, rice and maize. This area is adversely affected by floods during 2010 and 2014. Moreover, the change in pattern of rainfall and sometimes hailstorm destroy all the crops. So, a study focused on the measures necessary for the adaptation against climate change would be a great supplement to the growing body of literature on the process of adaptation and can help reduce the negative impact of climate and can reduce income of the farmers substantially.

The aim of this research is to examine the process of adaptation starting from perception to adaptation response in Northern Malakand area. This will investigate the degree and process of smallholder farmer's perception to climate change. In addition, it will identify the factors which shape the adaptation responses of smallholder farmers and the hindrances they face adaptation process. Hence, this research would provide a valuable insight on the farm-level adaptation in Pakistan. The finding of this study may be helpful for policy makers in formulating policy to protect smallholder farmers from the adverse effects of climate change.

REVIEW OF LITERATURE

A great interest exists in adaptation which leads to several definitions of climate adaptation. It is defined by Intergovernmental Panel on Climate Change (IPCC) as "*The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities*". Other focused on much broader definition, which is accompanied by any action which improves the situation of society caused by change in climate[41].

Climate change and weather are sometimes intertwined but significant difference exists between the two[42]. Climate refers to the average weather conditions over a long period which can affect the cropping intensity and area. On the other hand weather is a climate-related event that can occurs any time. However, both affects cropping area and yield but in different ways[43]. The adverse effects of climate change have been predicted across all sectors and all scales.[44] reported that fundamentally societies are adaptive to climate change and it is possible that some groups or regions might be more vulnerable than others to climate related risk. The adaptation to climate change generally depends on the level of vulnerability of the individual or region to natural catastrophes [45]. For example, it is expected that nearly 250 million in Africa would be exposed to greater water risk by 2020[46].

Global agricultural production is challenged by change in climate[47]. Climate change affects different crops and regions differently but generally it is expected that agricultural productivity will decline[48]. In fact some decline can already be seen. According to one calculation by[49], climate change resulted in reduction of global maize yield by 3.8% during 1980 and 2010. The farmers were not threatened evenly compared to crops. The share of subsistence farmers in emission of GHGs but they were the most vulnerable group to climate change[50-52].

Economic losses from extreme weathers conditions are increasing due to climate change [53, 54]. It is projected that average temperature will rise and patterns of rainfall will change. Consequently, it is likely that more intense events and floods will occur in the coming decades. This will cost the community a huge amount in the form of rescue operation, loss of human life, damage to assets and disruption of business[55]. It is difficult for the government to pay the bill of damages.

Adaptation to climate change by smallholder farmers is influenced by several factors including socio-economic characteristics of a household such as household size, marital status, gender and age of the head of household[56]. The above-mentioned factors vary across individual, communities, regions and countries[57].It is reported that household head's education has a significant impact on adaptation to climate change [32], because education increase access to information related to adaptation[58]. Education plays a crucial role in farmer's understanding of new concepts about climate change[58].Moreover, household head's gender is important in shaping the behavior of the farmer towards adaptation strategies [59]. In terms of gender [60] reported that male headed household are more capable of understanding the concepts related to adaptation strategies than female headed households. Moreover, female headed household may have adverse effects on the adaptation strategies towards climate change. This may be attributed to the lack of information, land and other resources on account of women due to social and traditional barriers[61]. Contrary to this, [59] assert that household having female head will adapt to variation in climate because of having responsibility for their work and have experience.

It is important that farmer perceive climate change in a right direction before taking any adaptation measure as in the case of Eastern Kenya. The current adaptation process was significant in successful adaptation because they mainly depend on rain-fed agriculture[62]. This is to identify the appropriate adaption options and apply them accordingly. The climate variability such as prolong dry spells and drought compelled smallholder farmers to take

adaptation measures accompanied with conventional approach to counter the adverse effects of climate change. In this context, adaptation is focused to maximize the yield by changing management of the farms through the introduction of new agricultural technologies which are mainly focused to increase the agricultural growth. This was reported by [63] who stated that poverty compels farmers to stay in agriculture. The first step needed for the farmer to move out of agriculture is going out of poverty before entering into other enterprises.

However, the adaptation measures such as reforestation on large scale and changing use of land pattern may cause some problems such as economic insecurity and livelihood issues [64] and social problems [65]. In addition, the literature mainly focused on qualitative evaluation and theoretical arguments, so it is unclear which adaptation strategy work effectively to reduce agriculture sector's vulnerability to extreme climate events and improve livelihood of rural farmers and result in social-ecological development.

It is difficult to ignore climate change and the impact it has on the life of humans [66]. To minimize the impact of climate change and enhance yield farmers need to adapt to cropping system. This is referred to as "*agricultural adaptation to climate change*" which includes how the change in climate is perceived and what type of action is taken keeping in mind the perception [16]. The perception and action of the farmer towards climate change may vary across different regions. The adaptation process towards climate change is affected by socio-economic factors, knowledge and environmental forces [67]. Therefore, this study is planned to understand the knowledge of small holder farmers, their attitudes and actions in relation to expected or perceived change in climate.

Pakistan is considered one of the highly vulnerable countries to climate change as reported by [24]. It has ranked 21th by Global Climate Risk Index (GCRI) in terms of exposure to extreme weather events over the period 1993 to 2012 [24]. The World Bank listed Pakistan as the 12th highly exposed countries to change in climate [68]. The economy of Pakistan is based on agriculture which contributes 21.4% GDP to and employ about 45% of the labor force and is providing livelihood opportunities for approximately 62% of the rural population [69]. The farmers of Pakistan are resource poor; they do not have access to modern tools and technology and struggling hard to find a solution to their problems [70]. Besides its importance for Pakistan, this sector is facing serious challenges from changes in climate such as rise in temperature, droughts, floods and losses in yields [68].

Over the last few decades the impacts of climate change become apparent [71]. It is expected that in change in climate will mostly affect the low income countries [72, 73]. Pakistan is experiencing extreme climate events including high temperatures, floods, shortage of water, droughts and increase attack of diseases and pests [74]. The ranking of Pakistan with respect to climate change vulnerability is bad as it stood at 29th in the list of most vulnerable countries for 2009-10 and ranked 16th in 2010-11 by Global Climate Change Vulnerability Index (CCVI) [75]. The severe floods of 2010, 2011, 2012 and 2014 and droughts ranging from 1999 to 2003 are among the few examples related to climate events of Pakistan. It is expected climate change will have an adverse effect on the economy of Pakistan as extreme weather events are already occurring such as changes in pattern of rainfall, droughts and floods [76]. Pakistan is especially vulnerable to change in climate due to its dependence on natural resources. Thus, appropriate adaptation measures are need.

This study is focused to explore the awareness of farmers towards climate change, their capacity to adapt and measures to changes in climate. However, it is not easy to support the adaptation process with the currently available services. Therefore, collaboration is needed at different levels to continue smooth process of adaptation. This might be in the shape of public-private partnership. This clearly indicated the need for research at local farm level, in different agro-ecological zones to identify and develop a sound adaptation policy for the agriculture sector.

METHODOLOGY

Study Area

Malakand (Pashto: ملاکنډ) is located in the north of Pakistan and is a (district of Khyber Pakhtunkhwa province. The total area of district Malakand is of 952 km² (368 sq mi) and having a population of 567,581 with a density of 600/km² (1500/sq. mi). The majority of the people belong to Pashtun tribe and Pashto is their native language. The main source of income includes trade, public service and agriculture. The major source of income is agriculture and the total cultivatable land being 456,600 hectares (1,763 sq mi). Malakand is a hilly area; its soil is loamy and moist and is irrigated by the Swat River which flows from Swat, through Kohistan and joins the river Kabul near Peshawar. The average rainfall in the area is not enough; hence, the soil needs artificial irrigation. The district of Malakand is surrounded by high mountains rich with mineral resources which are yet to be exploited. Agriculture is the main activity in the area and the important crops were grown are rice, maize, millet, tobacco, sugarcane, barley and grain. The agriculture sector of this area is in transition phase and new technology is being adopted quite rapidly by smallholder farmers and as a consequence the production as well as the food security situation improved over the last few years.

Sampling Strategy

This study utilized the random sampling technique. District Malakand was selected for this study due to its economic importance as it remains an economic hub for all the surrounding areas. The farmers from the surrounding areas send their agriculture production to Malakand for sale. A huge agricultural market is present there, where all kind of agriculture products are traded. Moreover, district Malakand also produces a variety of agriculture commodities such as wheat, rice, maize, sugarcane and some kind of fruits. The farmers were selected randomly to ensure the presence of all. Thus, the number of household included in the study was 220. The survey conducted in November-December 2016. The research distributed 250 questionnaires but received 220 in good shape and order. The remaining questionnaires were checked but nothing was found important so they were discarded which is a good strategy under condition[77].

For collection of data, a semi-structured interview method was used. Enumerators were guided about the aims and objectives of the study and a thorough guide was provided on the content of the questionnaire, including climate change adaptation at farm level, the importance of adaptation and the basic ideas related to research such as interviewing, sampling and processing of data. Both qualitative and quantitative techniques of analysis were utilized in the analysis of the data. The qualitative analysis includes arguments, comparisons and interpretations. While quantitative technique used descriptive statistics such as percentages and graphs.

RESULTS AND DISCUSSION

This study is planned to explore the adaptation of farmers towards climate change vulnerability. Since from the beginning of the world mankind is totally dependent on crops for most of his food, as well as for many other important needs[78].The adaptation strategies of the farmers depend on the socio-economic characteristics of household, agro-ecological conditions and institutional settings. The demographic characteristics of the respondents are given in Table 1.

Table No 1 Demographic characteristics of the respondents

| Variable | Frequency | Percentage |
|---------------------|-----------|------------|
| Gender | | |
| Male | 208 | 94.5 |
| Female | 12 | 5.5 |
| Age | | |
| less than 20 | 19 | 8.6 |
| 20-29 | 89 | 40.5 |
| 30-39 | 44 | 20 |
| 40-49 | 47 | 21.4 |
| 50 & above | 21 | 9.5 |
| Fomal_Edu | | |
| Yes | 112 | 50.9 |
| No | 108 | 49.1 |
| Asst_Farming | | |
| 2-3members | 66 | 30 |
| 4-5members | 70 | 31.8 |
| 6-7members | 74 | 33.6 |
| 8-9members | 5 | 2.3 |
| 10 & above | 5 | 2.3 |
| HH_size | | |
| 2-3members | 6 | 2.7 |
| 4-5members | 68 | 30.9 |
| 6-7members | 77 | 35 |
| 8-9members | 47 | 21.4 |
| 10 & above | 22 | 10 |

It is expected that agro-ecological settings of farmers such as soil and climate affect their adaptation to change in climate. The efficiency of agriculture production is largely related to climate condition[79]. It is reported that farmers in hotter and drier climate are expected more to respond to changes in climate as compared to farmers in wetter and cooler areas[32]. Pakistan is divided into ten agro-ecological zones. The study area falls in 7th zone. The average annual rainfall in this zone ranges between 300-1000 mm. Soil types are deep and clayey. The climate

in summer is mild, while in winter is cold. Hence, it is expected that farmers will not likely to adapt to change in climate[80].

The participation of females in agriculture sector in the study area is very rare. It is possible that in very remote and rural area some woman may help in the farms but generally the y are not involved in agriculture sector. It is expected that female-headed household are less likely to adapt to climate change due to lack of access to information, lack of access to land, limited access to inputs, institutional barriers and social barriers[81]. However, it was found by[59]that females-headed household takes adaptive measures to climate change as compared with male-headed household.

It is estimated that household size can affect adaptation to climate change due to endowment of labor. It is reported that large household leads to adaptation measures in two ways, first it leads to adoption of technology by utilizing the available labor force[82], secondly it provides additional income as extra labor is employed in off-farm sector[83]. Therefore, it is expected to positively influence adaptation to climate change.

Perception of farmers about change in climate

The farm household were asked about their perception of climate change such has change in temperature and change in precipitation. Though, farmers generally were conscious with numerous kinds of risk[84].A significant difference exists in how farmers perceive changes in temperature and precipitation as shown in Figure 1 and Figure 2. Almost 40% of the farm-household perceive rise in temperature over several years, while exactly 42% perceived decrease in temperature and only 18% perceived that there was no change in temperature. In contrast, 37% of the farm-household perceived increases in precipitation, 21% decrease in precipitation and 27% perceived no change in precipitation. In addition, about 15% neither agree on increase or decrease and nor with no change of precipitation rather they claimed that rainfall during the past 20 years was variable, sometimes low and sometimes high. However, approximately all farmers have a high perception regarding at least one aspect of climate change.

Figure 1 Farmer's perception of change in temperature due to climate change

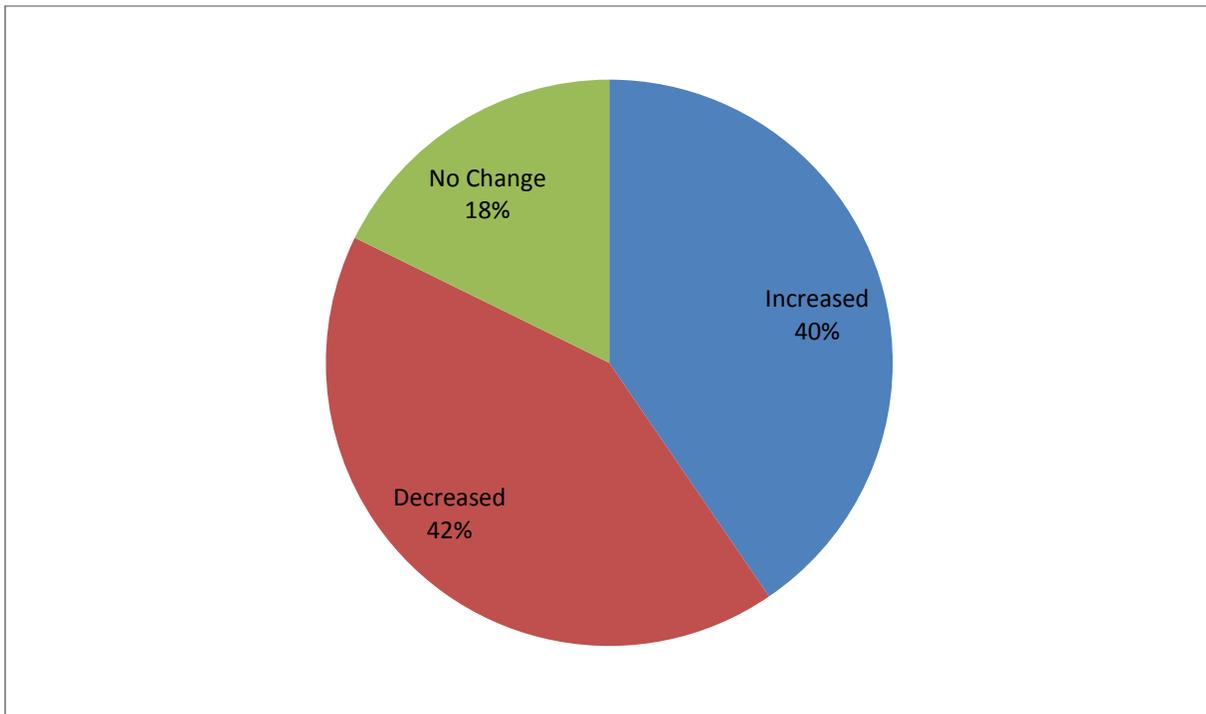
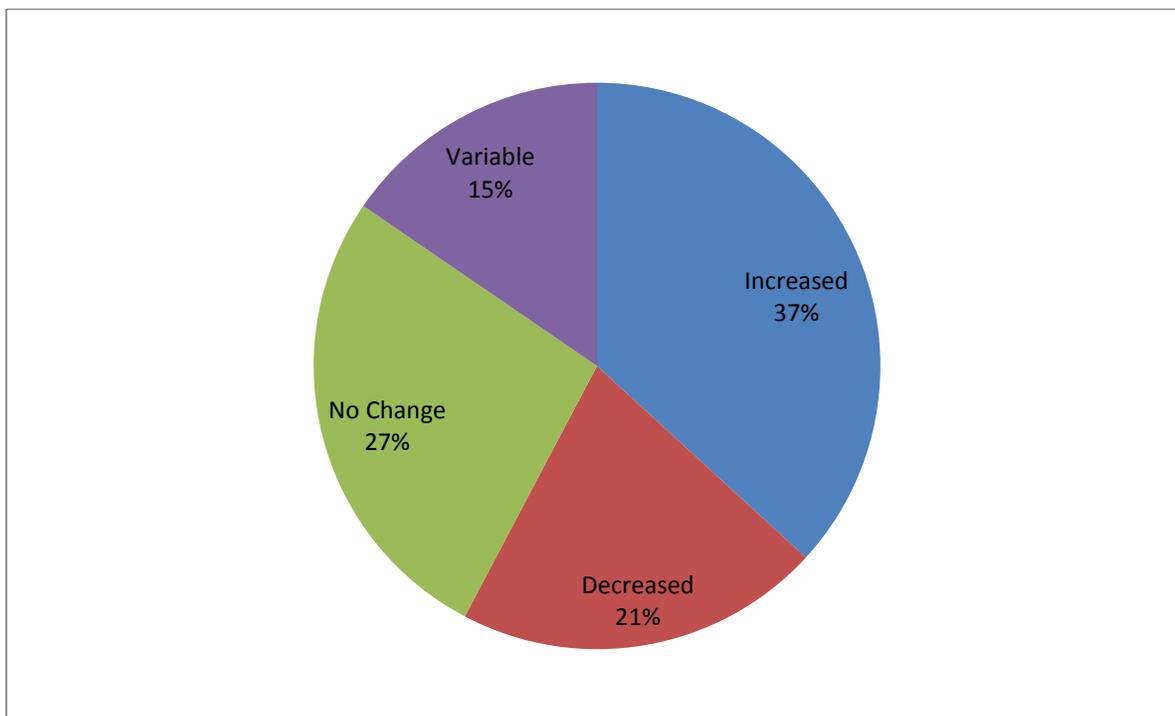


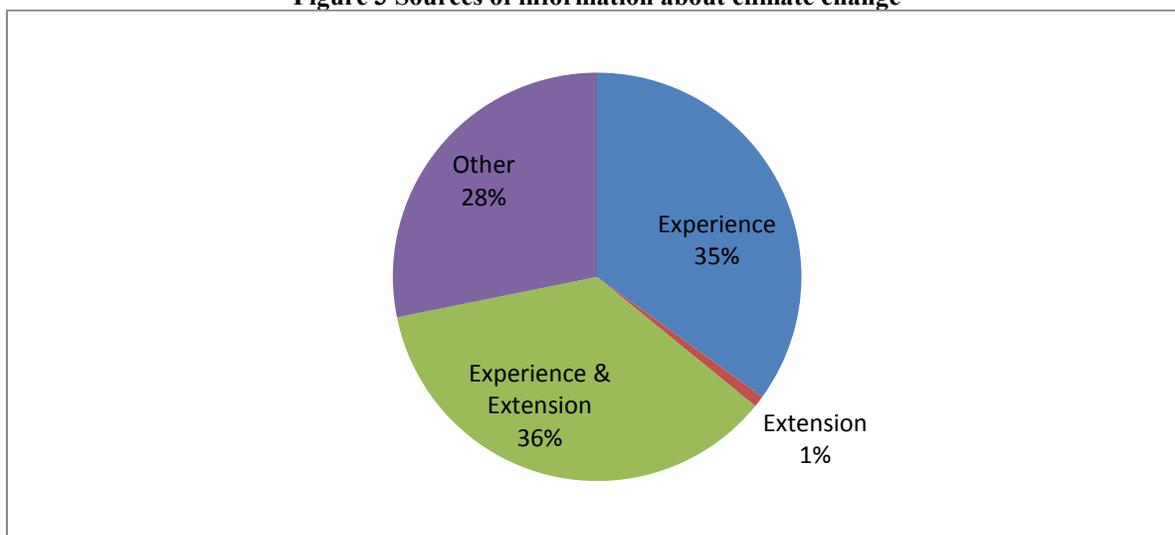
Figure 2 Farmer's perception of change in precipitation due to climate change



Information sources with respect to climate change

The farm households were asked to tell us frankly how they come to know about climate change for the first time (Figure 3). About 36% of the respondents perceived climate change through experience and extension, 35% through their life experience and only 1 %through extension services. This clearly indicates that majority of the farmers perceived climate change through their life experiences and the role of extension services is very limited. This result shows that farmers in the study area are still rely on their old perception of climate change. Furthermore, it stated that extension services in the study area is not enough to update farmers about climate changes or farmers do not attach any credibility to the information of extension department.

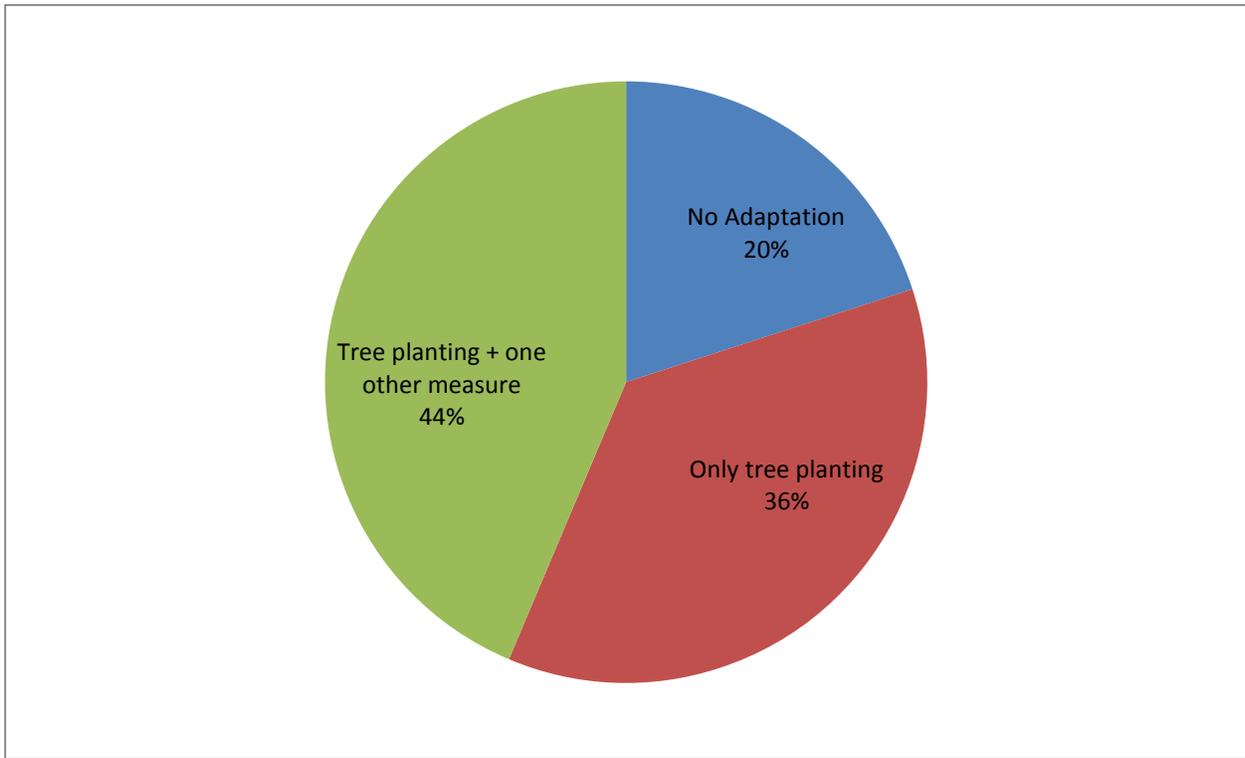
Figure 3 Sources of information about climate change



Adaptation strategies by farmers towards climate change

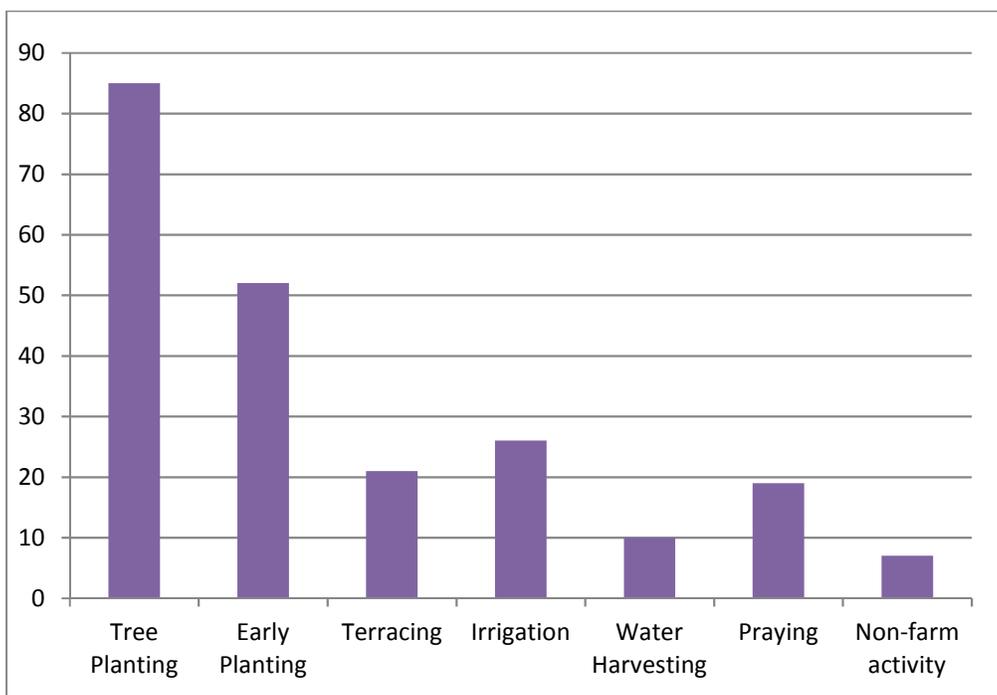
The result of the study shows that almost 36% of the respondents adapted only tree planting as a strategy to counter the negative effects of climate change, while 44% adapted tree planting + one other measure and only 20% of the respondents do not adapted any strategy as show in Figure 4. A research by[32, 67] reported that tree planting remained a common adaptation strategy in the Nile Basin of Ethiopia. Tree planting has several economic and ecological benefits, which lowers the negative impact of climate change. However, the responses of the farmers depend on their understanding of the reasons which causes climate change. A major portion of the respondents ‘claimed that deforestation is the prime reason of climate change. Similar findings were also observed by[16] for Ghana. Hence, tree planting can be considered by the farmers as a mitigation strategy towards climate change. Deforestation is one of the reasons which cause climate change, but emission of greenhouse gases (GHGs) from industrial sector of developed countries is the main reason behind climate change[85]. Therefore, the result indicates the existing gap in understanding farmer’s perception about the reasons behind climate change and the misconception strategy of tree planting.

Figure 4 Adaptation strategies by the farmer towards climate change



Although three adaptation strategies were listed (Figure 4), but actually there are seven adaptation strategies identified as shown in Figure 5. Almost 39% of the farmers adapted tree planting as an adaptation strategy. The trees can influence the urban temperatures because they can intercept, reflect, absorb and transmit the sunlight[86]. Other measures which were common in the study area include, early planting, irrigation, terracing, praying, water harvesting, and non-farm activity. Being a religious society, approximately 9% of the respondents adapted praying as an adaptation strategy. This strategy arises because people associate climate change with super natural power as in the case of Ethiopia, a religious society[87]. The rare responses to climate change were non-farm activity and water harvesting. The result of this study is similar to[1, 13, 31, 32, 67].

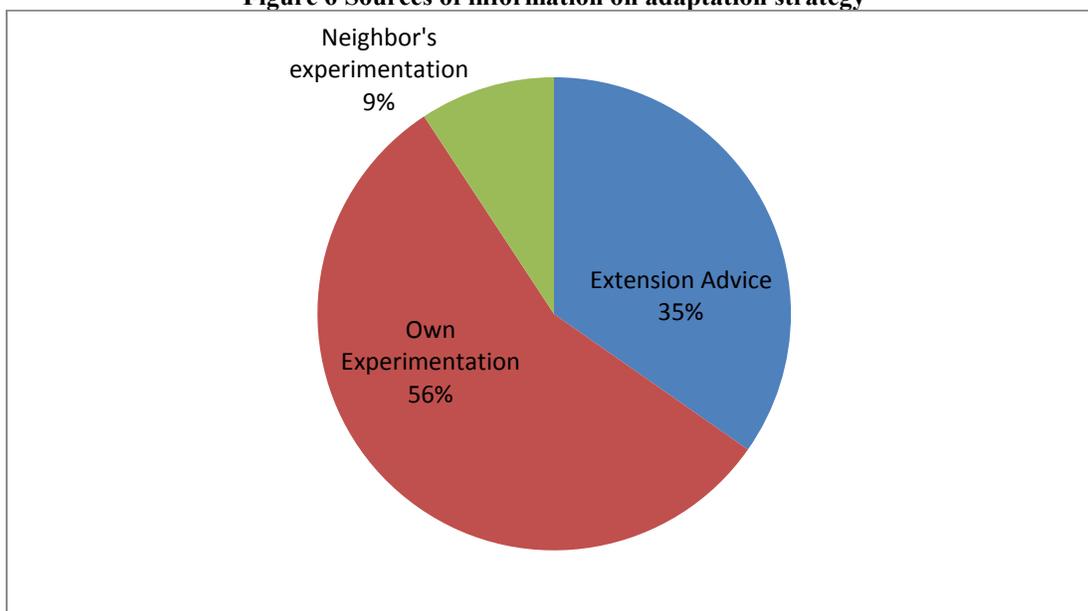
Figure 5 Adaptation strategies by the farmer



Information sources on adaptation strategies

According to the findings of [88] there are three sources through which farm-household came to know about new innovation (i) Extension advice, (ii) own experiments, (iii) neighbor’s experiments. In this study respondents were asked to reveal their information sources on adaptation strategies. The results of the study shows that own experimentation is the leading source of information for farmers (about 56%), while extension advice is second about 35% as shown in Figure 6. Moreover, approximately 9% of the farmers use their neighbor’s experimentation and revealed it as an information source for adaptation. The result shows the significance of farmer’s own experimentation in deciding which strategy to adapt. In addition, this also shows the lack of extension services in the study area.

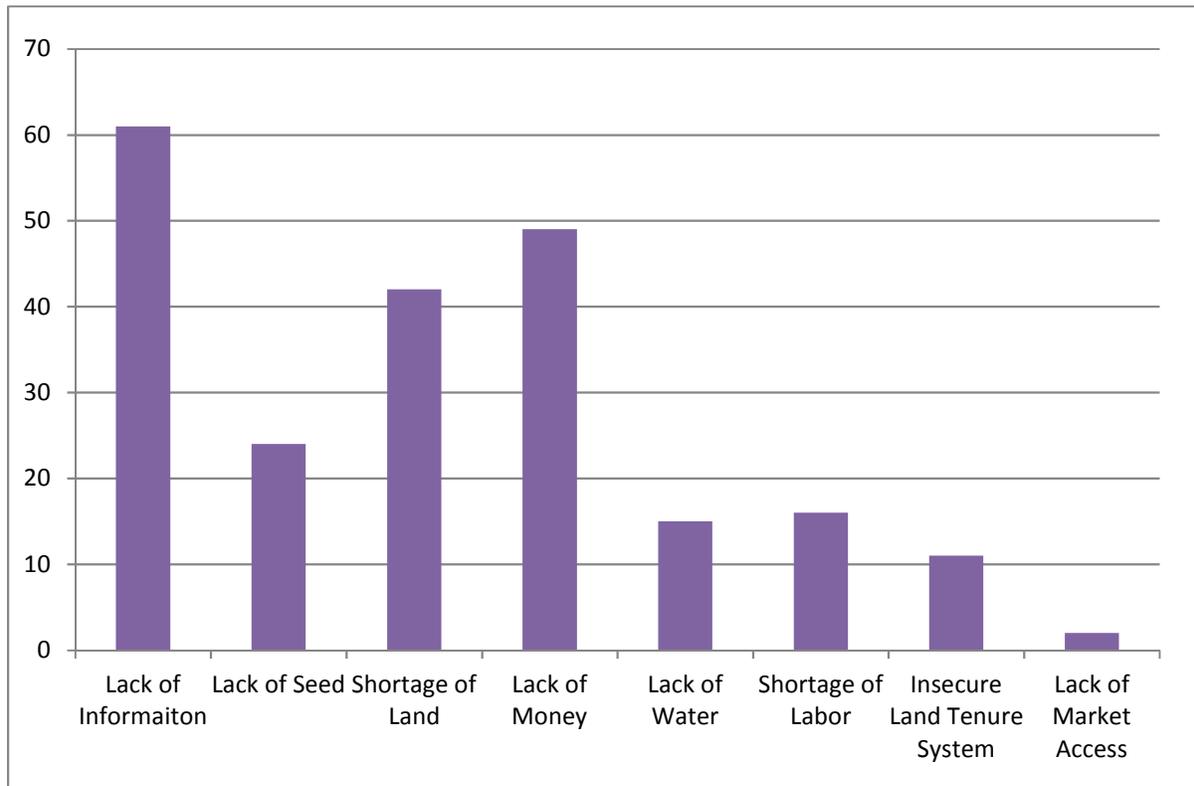
Figure 6 Sources of information on adaptation strategy



Adaptation Barriers

Farming being susceptible to the weather conditions is a business activity subject to risky events [89].The process of adaptation to climate change is a rigors process. A number of barriers were mentioned by farmers such as institutional, economic and social as shown in Figure 7. The major factor which obstructs adaptation to climate change is the lack of information (accounting for about 28%). This is due to several factors such as lacking institutional support and failure of the government policy to include climate change in the country’s extension services. Other important barriers include lack of money, land shortage and lack of seed accounting for about 22%, 19% and 11% respectively. This is due to the fact that study area is a low income region, where farmers have low income. Moreover, the large and un-economic holding by few landlords is a problem which limits small farmer’s adaptation to climate change. In addition, some other barriers which farmers mentioned are shortage of labor, lack of water, insecure land tenure system, and lack of access to market. Generally, the findings of this study are in confirmatory with other countries such as[1, 12, 13, 32, 67].

Figure 7 Barriers to adaptation



Conclusion

This study was undertaken in district Malakand. Data was collected randomly from 220 farm household over the last 20 years. Approximately all the farm household adapted at least one type of climate strategy i.e. based on their life experiences. It was found in the study that tree planting was the most single adaptation strategy. Nearly, 36% of the farmers’ adapted tree planting as a sole strategy while 44% take one additional measures on top of it. Besides, planting of tree, the other important adaptation strategies taken by farm household are; early planting, terracing, irrigation, and praying and non-farm activity. The majority of the farm household learned from their own life experience about climate change. Thus, the adaptation towards climate change by plating tree may be attributed to their life experiences. Furthermore, majority of the farmers miss-understood the cause of climate change and considered deforestation to be the main cause of it so that’s why they are planting to mitigate the negative effects of climate change. Therefore, farmers should be educated about climate change and adaptation strategies.

The farm household was asked what the key barrier in adaption of climate change is. The key barrier which obstruct farmers from adaptation to climate change are the lack of access to information, lack of money, land shortage, lack of seed, lack of water, shortage of labor, insecure land tenure system and lack of access to market.

The result of the study shows the need for provision of modern tools and technology, improving the division of land and providing modern seeds. The policy of price floors should be introduced to safeguard farmers from the adverse effects of climate change and increase their income.

In a nutshell, this study shows a gap in information regarding extension services and among farm-household regarding the reasons behind change in climate, strategies for adaptation and overall performance. Tree planting should not be focused so much to counter the negative impacts of climate change rather more sophisticated, advance and diverse strategies should be introduced. Intervention is necessary to improve income, access to land, availability of seeds, and diversification of enterprises should be an important climate change adaptation strategy and policy. In addition, it is suggested that social capital should be used in adaptation to climate change by small farm households.

Acknowledgement

The authors would like to thank anonymous reviewers for providing helpful suggestions on an earlier draft of this paper.

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