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FARMERS' PERCEPTIONS AND ADAPTATION PRACTICES TO CLIMATE CHANGE IN RAIN-FED AREA: A CASE STUDY FROM DISTRICT CHAKWAL, PAKISTAN

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Farmers in the rain-fed regions are becoming more exposed to extreme weather adversities and hence, suffer significant losses. The present study was designed to decipher the impacts of the climate change on the farming communities residing in the rain-fed areas of Pakistan. For this purpose, 475 households were surveyed through a pre-tested structured questionnaire to know farmers' perceptions about climate change and its impacts; available sources of information and strategies adopted to cope with climate-related events. The results indicated that 96% of the respondents perceive that the climate in their surroundings is not only changing rather aggressively denting on crop productivity, livestock sustenance and human health. These climatic variations are being realized in the form of rising temperature (61%), irregular pattern of precipitation (86%) hailstorm (73%), delay in the start of winter season (71%), incidents of the cold breeze (67%) and heat waves (65%), storms (64%), frost (59%) and an increase in the occurrences of drought conditions (39%). This factor by and large tantamount the overall depression in the rain-fed farming community pressing them to look for the alternative avenues for their livelihood. Nevertheless, the farmers rely on different adaptation strategies (changing planting decisions: 76%, changing cropping pattern: 46%, left land fallow: 24% etc.), but these are insufficient and less effective. In conclusion, only few farmers could adapted their agricultural strategies to changing climate due to limited resources and capacities and majority is vulnerable Therefore, the scenario demands for integrated technical, financial and institutional support to the farmers. This upcoming alarming situation requires potential measures be taken to ensure resilience of agriculture sector that may ultimate poverty reduction.
Keywords: Climate change, perception, farmers, adaptation strategies, rain-fed agriculture.

INTRODUCTION

Climate change is becoming a daunting and challenging threat for the global food security. The phenomena is proving burdensome for the natural and human resources and, thus, a real challenge for the social, economic and ecological sustainability of the resource-stricken developing regions such as South Asia (IPCC, 2014; Bokhari *et al*., 2018; IPCC, 2018). The researchers such as Abid *et al*. (2016), Atif *et al*. (2018a) and Wu *et al*. (2017) opined that the consequential impacts of these weather and climatic fluctuations are adversely impacting the environmental resources of these regions. Whereas, the economic and social viabilities of these contextual settings are dependent on the agricultural productivities, therefore, integrated efforts are incumbent for ensuring the resilience of their agro-based economies.

The scientific postulations regarding the likely upsurge in the global surface temperature (Easterling *et al*., 2000; McCarthy *et al*., 2001) and findings of the similar investigations (IPCC, 2014; Wu *et al*., 2017) corroborating the notions of Pachauri *et al*. (2014) that the climate-induced anomalies are exasperating the socio-economic stabilities and affecting food-insecurities in the South Asian region. Food and Agriculture Organization (FAO, 2015) reported that approximately 50% of the total land area in the South Asian region is being utilized for agricultural activities, thus, integrated efforts for the resilience of the agricultural sector are obligatory.

The growing population density, technological innovations and concomitant lifestyle changes are exerting their own pressures on Land Use Land Cover (LULC) changes. These LULC modifications are incumbent to fulfilling the growing demands for food and abode in this densely populated region (Vadrevu *et al*., 2015). The resultant LULC transformations are taking place at the cost of shrinkages in the forested and pastoral lands (Mitra and Sharma, 2012). These planned and unplanned intrusions in the natural equilibrium are exacerbating the impacts of the weather and climatic anomalies. Thus, the consequential imbalances in the natural

environment are proving more stressful for the life and livelihood strategies in this part of the globe.

The conjectures, based upon simulation modelling techniques, indicate that the slightest surge in the surface temperature of the earth will negatively affect the yield and quality of the cereal crops such as wheat, rice and maize etc. (Morton, 2007). The ultimate victim of these corollaries will be the small landholding farmers (Harvey *et al*., 2014). Their poor economic base, lack of awareness and preparedness further compromises their capacities to address these mounting challenges. Atif *et al*. (2018b) opined that the contemporary environmental degradation necessitates for corrective and remedial measures through identifying context-based strategies. These measures are obligatory to moderate the looming impacts of climate induced vulnerabilities for the farming communities (Bryan *et al*., 2013; Abid *et al*., 2016; Jin *et al*., 2016).

Pakistan is located in the region, which is vulnerable to natural disasters such as the earthquakes, floods, droughts, cyclones, land and soil erosion (GoP, 2017-18). In this connection, Global Climate Risk Index (2017), ranked Pakistan at the 7th position among the most adversely affected countries by the phenomena of climate change. The National Disaster Management Authority (NDMA) of Pakistan estimated an approximate loss of 4 billion US dollars, to national economy in the past twenty years (1994-2013) due to such unwarranted events. The reported rise in the temperature (Aggarwal and Sivakumar, 2010; Ahmad *et al.*, 2013) and unpredictable patterns of precipitation (Abid *et al*., 2015; Pak-INDC, 2016; Ali and Erenstein, 2017) in Pakistan are badly impacting the per acreage yields of the food crops (Prikhodko and Zrilyi, 2013; Abid *et al.*, 2015; FAO, 2015). Resultantly, the supply-demand gap for the food crops is broadening (Zulfiqar and Hussain, 2014). Whereas, the focus towards this pressing issue is far from satisfactory in Pakistan and, thus, stresses for immediate attention (Smadja *et al*., 2015).

Pakistan is classified among those countries which are more vulnerable to abrupt climatic oscillations. The lack of orientations towards the above catalogued critical issues allied with low adaptive capacity and compromised financial resource base are further aggravating the situation (Stocker *et al*., 2013; Atif *et al*., 2018a). Therefore, the country is in the dire need of approximately 07 to 14 billion US $ to address the looming challenges linked with the climate change (Pak-INDC, 2016).

In this connection, the knowledge about contextual agricultural practices and an assessment of the perception about climate change are the prerequisites for postulating doable adaptation strategies (Bryan *et al*., 2009; Abid *et al*., 2018). The analysis of socio-economic factors and the identification of sources through which the information disseminates among the stakeholders are also mandatory for devising pragmatic strategies.

Apropos to this, the present study was conducted to know farmers' perceptions about climate change and its impacts on their lives and livelihoods. The current study tried to decipher the socio-economic conditions of the farming communities and their perception about the fluctuations in the climatic patterns such as droughts, untimely rains, temperature rise etc. It also focuses the on-farm and off-farm adaptive practices/ strategies deployed by the farmers to cope with the climate-related events in the rain-fed rural settings.

MATERIALS AND METHODS

***Study area*:** Pakistan Agricultural Research Council (PARC) sub-divides the Province of Punjab into four agro-ecological zones i.e. Irrigated plains, *Barani* (rain-fed) regions, *Thal region* and the Marginal lands (Abid *et al.*, 2016).The current study was carried out in the contextual settings of the *Barani* (rain-fed) region of the Northern Punjab, known as the Potohar Plateau. This geographical region is located in the *Sind-Saghar doab* (river-interfluve) and comprises over five districts Attock, Chakwal, Islamabad, Jhelum and Rawalpindi. The field investigations for the current study were made in five tehsils (sub-divisions) of Chakwal district i.e. Chakwal, Choa Saiden Shah, Kallar Kahar, Lawa and Talagang. The study area approximately lies across 32°55'29.39" N and 72°51'11.99" E (Fig. 1). The total area of Chakwal District is 6690 km^2. The total population of the district is 1.49 million people of which 81% are residing in the rural areas (PBS, 2017).

The rain-fed agriculture of the Chakwal district is dependent upon the *summer monsoons* and the precipitation from the *western depressions* during the winter season. Therefore, the agricultural productivity is subject to extreme weather and climatic fluctuations (NDMA, 2017). The uncertainties about the crop yields/outcomes are making the livelihood of the people more fragile and vulnerable. Thus, the selected geographical location is an appropriate contextual setting for assessing the farmers' perceptions regarding climate-related impacts.

Data collection: The data for this study were collected with the help of a structured questionnaire. This mechanism for the data collection was prepared on the basis of the contextual information obtained through a pilot survey. The questionnaire used for this study was compartmentalized in different sections. The first part of the questionnaire deals with the demographic and socio-economic characteristics of the respondents. While, the remaining sections of the questionnaire were conceived to acquire information regarding: the availability of basic civic facilities, land- use patterns, agricultural production, perception about climate change, adaptation strategies and access to institutional support etc. The questionnaire was initially developed in the

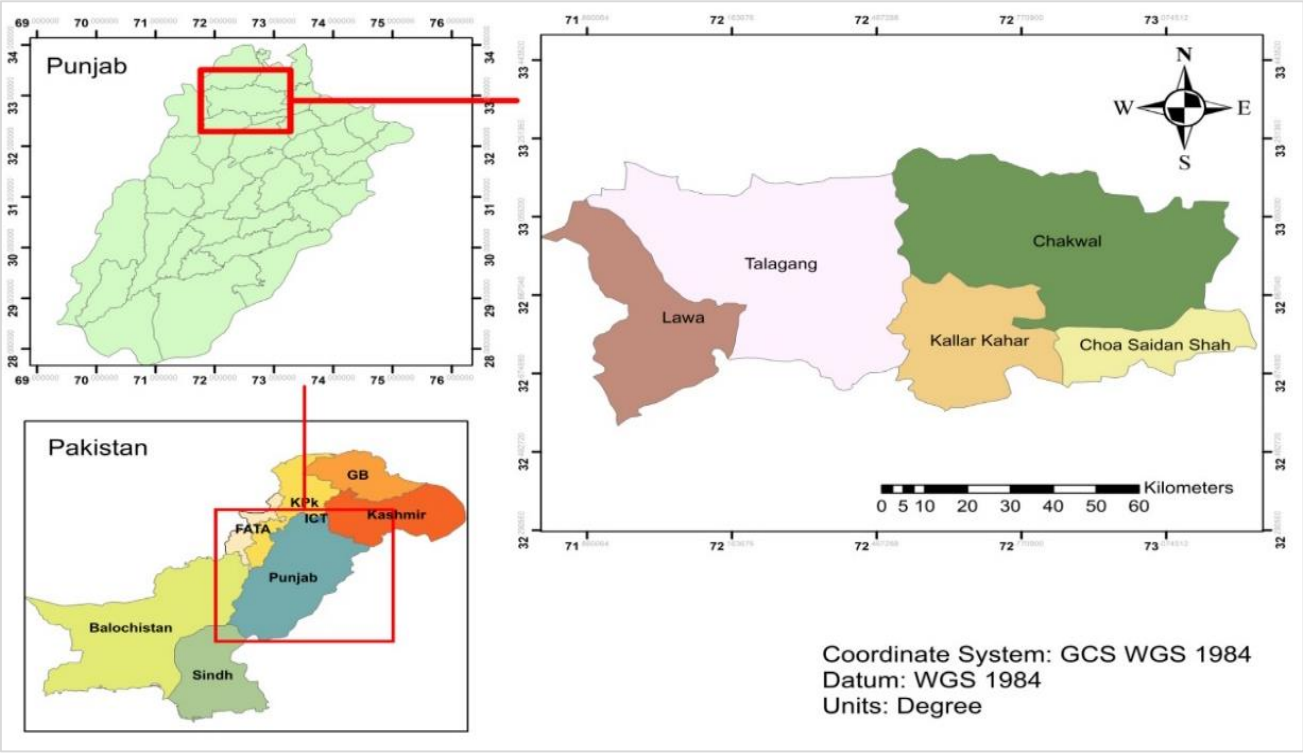

Figure 1. Location map of the study area

English language and was subsequently translated into Urdu for the convenience of the respondents.

However, vernacular was used during the course of interviewing. The field investigations and interviews of 475 respondents were conducted during the months from April to August, 2017. The respondents were selected from 183 villages of the study area through cluster-sampling technique (Fig. 2). The individual respondent was approached with the help of snowballing technique on the principle of convenience sampling method.

***Data analysis*:** Data were condensed in spreadsheet for further processing and subsequent analysis in the Statistical Software 'R' (version 3.4.3). The descriptive statistical methods and techniques such as those dealing with the frequency distribution, median etc. were deployed for the initial probes. In the subsequent stage, the non-parametric Spearman correlation test was relied upon to explore the nature of relationships between the socio-economic status of the household and their farming characteristics. The assessments were also made to evaluate the nature and orientation of adaptation strategies deployed by the farming communities in the study area.

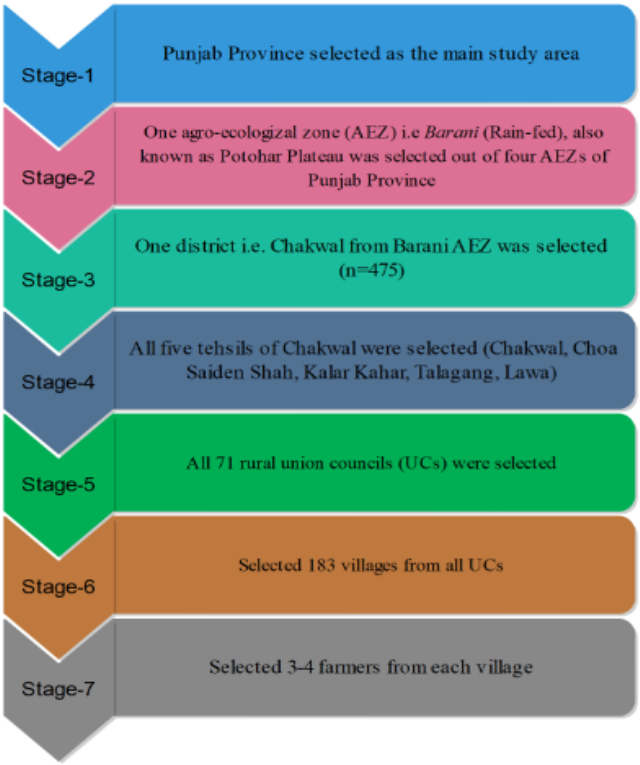

Figure 2. Sampling framework of the study

RESULTS

Socio-economic and demographic characteristics: The demographic and socio-economic profile of the respondents (Fig. 3) portrays the characteristics of a patriarchic rural society. It is quite evident from the fact that all of the respondents were farmers, mature and experienced with a mean age of $52.9 \pm \mathbf{12}$ years and the mean household size being $7.5 \pm \mathbf{3.3}$ members. The preliminary investigations reflected the state of compromised economic base of the respondents. The subsequent dependency ratio for the sampled population was found 1.3. The proportionate share of "nucleated families" was larger (65%) than the "combined families" (35%) indicating socio-economic restructuring of the rural society. Regrettably, the low literacy rate and education level of the respondents is discouraging. The majority of them (93%) rely on firewood for domestic energy needs. However, the modern gadgetries such as television, refrigerator and computers etc. are rapidly gaining acceptance among the study population (Fig. 3).

Characteristics of farming systems: The salient characteristics of the farming practices show a consistent biannual cropping pattern of *Kharif* (summer) and *Rabi* (winter) crops. The *Kharif* crops such as groundnut, maize, Green Gram (Moong), Black Gram (Mash) and vegetables etc. and *Rabi* crops like wheat, oilseed, fodder crops, lentils, vegetables etc. complete their production cycle from May to September and October to April, respectively.

The size of agricultural tract used for cultivation is small as 53% of the respondents cultivate on less than 2.5ha of land. In addition to crop production, the majority of respondents also keep livestock for personal use or for supplementary income. In terms of Total Livestock Units (TLUs), it was found that 71% of households had up to 10 TLU. Most small farmers get rental support from service providers as they don't own their machinery. It's evident from the table that only few farmers own tractor (41%) and threshers (19%). However, the majority (90%) of the respondent conveyed that they could not purchase any new asset for farming purposes during the last five years. It was also observed that the use of chemical fertilizers is gaining acceptance as (87%) of the respondents rely on these additional inputs for improving their agricultural yields.

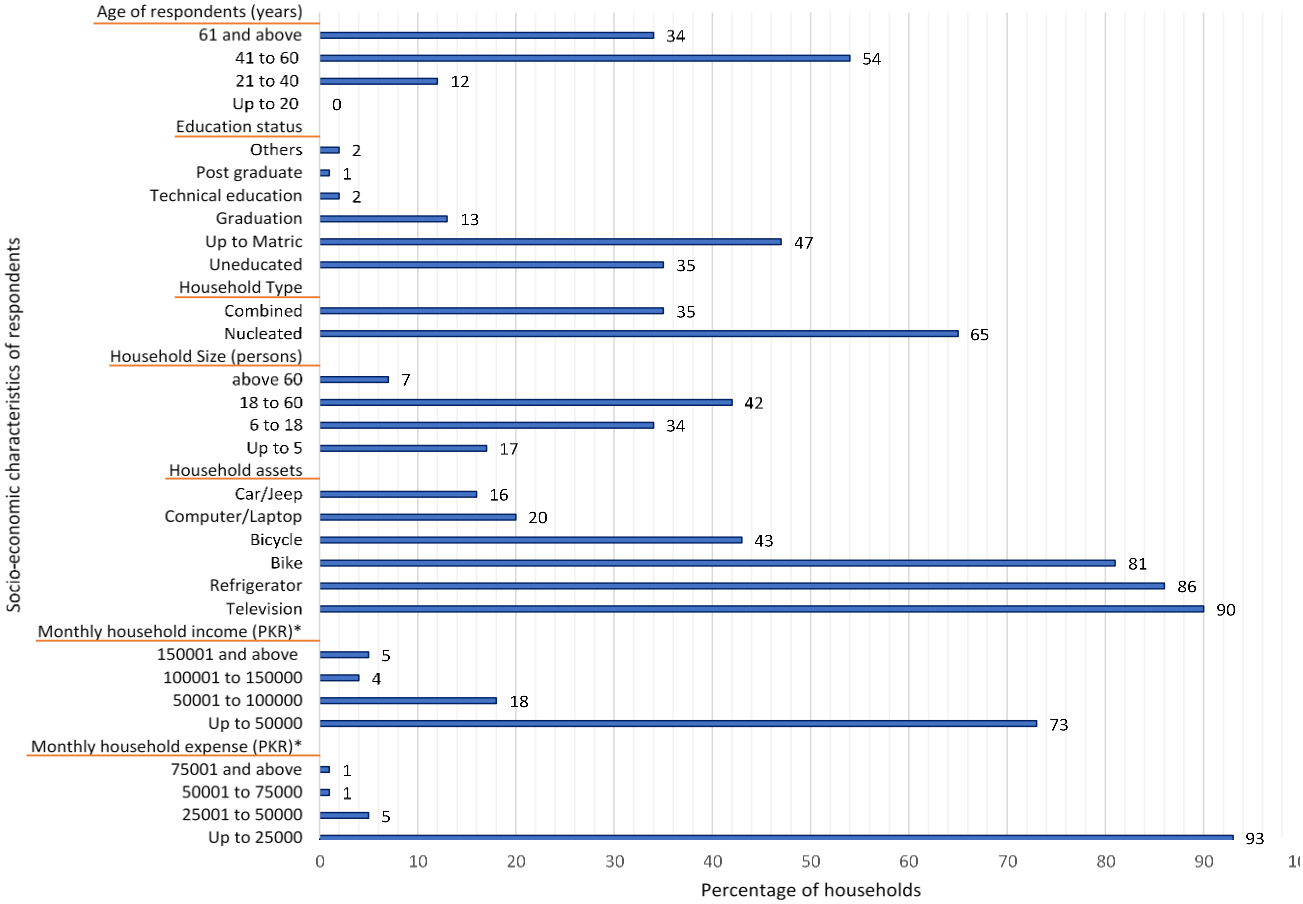

Figure 3. Demographic and socio-economic statistics of the sample
(One hundred and forty one Pak rupees are equal to 1$ (United States Dollar) on May, 02, 2019)

Table 1. Characteristics of the farming systems of the surveyed households.

Variables		
Farm assets	**N=475**	**% of households**
Tractor	475	41
Thresher	475	19
Tube well (electric)	475	35
Fodder chopper (electric)	475	78
Fodder chopper (manual)	475	06
Land ownership (ha)	**N=475 (% Total)**	**Cultivated (%)**
up to 2.5	206 (43)	53
> 2.5 to 5	142 (30)	28
> 5 to 7.5	54 (11)	09
> 7.5 and above	73 (15)	10
Household Crop diversification	**N**	**Mean**
No. of crops grown per household	475	4.7
Total Livestock Units (TLU)	**N=475**	**% of households**
Up to 10	335	71
> 10 to 20	89	19
> 20 to 30	35	07
> 30 to 40	12	03
> 40 to 50	02	0.4
> 50 and above	07	1.4

***Limitations and impediments for the farmers*:** The study also tried to evaluate the impacts of climatic uncertainties in conjunction with contextual impediments on the perception and performance of agricultural sector in the rain-fed areas. The study tried to decipher the causes and consequences of the financial limitations on the produce and perception of the farming communities. The findings revealed that water scarcity and drought conditions (98%), land degradation (64%) and soil erosion (32%) are being reported as the potent threats for the agricultural sector (Fig. 4). Besides, a substantial proportion (76%) of respondents also complained against man-made impediments such as the lack of access to agricultural inputs, absence of a coherent mechanism for financial assistance (49%) and non-availability of technical guidance (39%) for sustained agronomic practices. The findings portray that more than half of the respondents (54%) do not have any access to such vital information. Whereas, the information disseminating through mass media receives due attention in the study area (Fig. 4). While, the role and effort of the agriculture extension department was observed insignificant/unimpressive. The field visits meant to stimulate awareness for promoting increased use of technology are gradually decreasing. The active presence of community based farmer research groups is discouraging as only 11% of the respondents reported the presence of such entities in the area (Fig. 4).

Livelihood strategies and food security: Rain-fed agriculture is the primary economic activity in the study area. The crop yields and livestock improvement are important for the

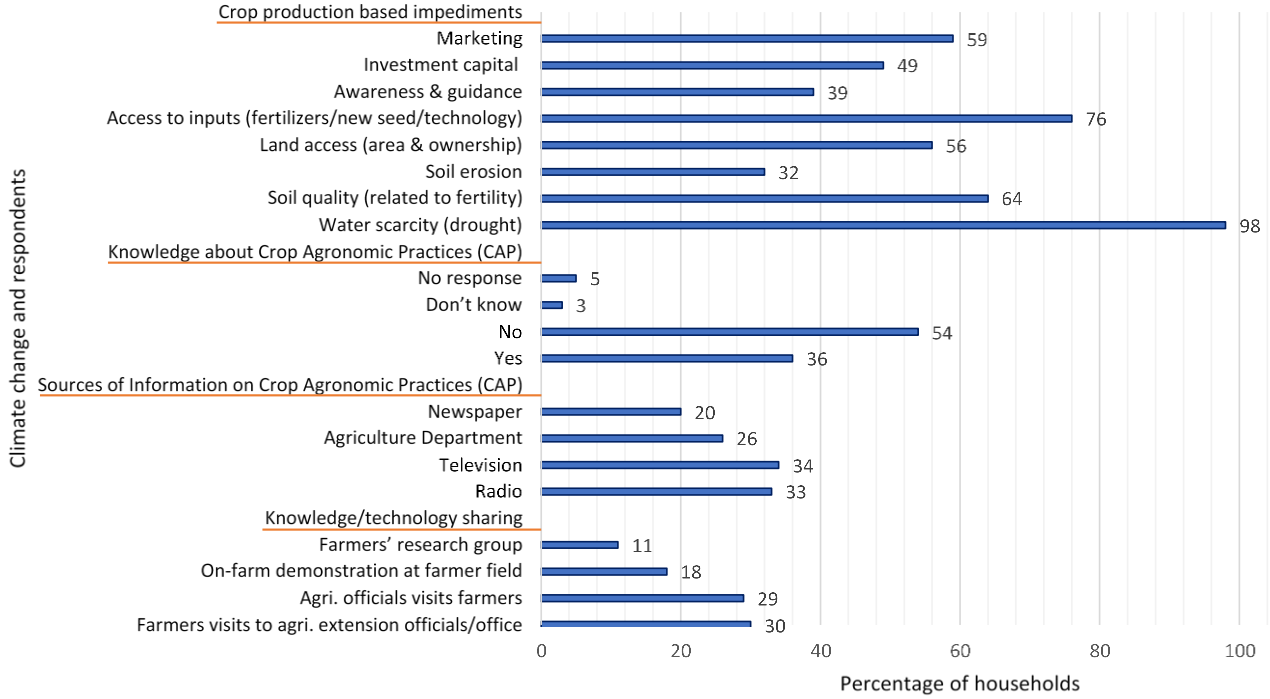

Figure 4. Limitations and impediments in study area

domestic food needs and contribute significantly to the household income. However, additional income generated through raising animal heard, government vs private jobs by some family members and obtaining part time farm labor jobs by other members, are key elements that help sustain livelihood of such small farming communities. (Fig.5). The majority of respondents (66%) claimed their self-sufficiency regarding food availability, while, a sizeable minority (34%) is vulnerable in case of crop failure or food shortage. Loans from acquaintances (14%), selling of livestock (27%) or nonagricultural belongings (6%) and government subsidies (8%) are the most preferred strategies to cope with the scenario. Factors positively related to household food security included livestock ownership (r=0.11, p=0.01), crop diversification (r=0.16, p<0.001) and education level of respondents (r =0.04, p< 0.0001).

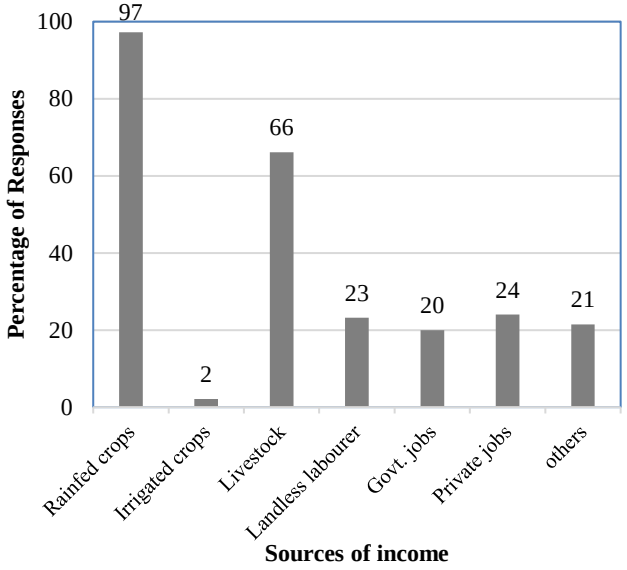

Figure 5. Livelihood strategies of respondents

Perception about Climate change: The majority (96%) of the respondents perceive that the weather and climatic conditions are changing in their surroundings. The findings also revealed that the majority (57%) of these respondents rely on their sensory perception, conventional wisdom and traditional knowledge for such atmospheric assessments. The farming community was more apprehensive about fluctuations in the pattern of precipitation and drought conditions. The respondents also opined that the frequencies and intensities of these unwanted phenomenon have become more recurrent.

***Climatic hazards and their impacts*:** The farmers were inquired about the nature and consequential impacts of climate-induced hazards for their lives and livelihoods. The majority of respondents were apprehensive about the occurrences of incidents such as the untimely rains, hailstorms, delay in the start of winter season, unpredictable incidents of the cold and heat waves etc.

The consequential outcomes of these extreme events directly and indirectly influence the socio-economic conditions in such rural environments. The respondents overwhelmingly reflected concerns over their suffering further added by unpredictable climatic adversities posing dire impact on the overall crop husbandry, livestock maintenance and ultimate human health (Table 2). However, the ramifications were adjudged asymmetrical and heterogeneous across the study area.

Adaptation strategies and farmers: The findings divulged that farm and non-farm based coping strategies are deployed to alleviate the effects of climatic instabilities (Fig. 6). The farm-based strategies such as the temporal re-adjustments in the cultivation (76%), changes in the cropping patterns (46%), more reliance on the techniques for improved production (28%) and irrigation (27%) etc. are the preferred choices. The farmers also sell their livestock (55%), land resources (25%) and consult expert opinions (25%) to cope with the situation. In addition to that, the non-farm based strategies such as

Table 2. Climatic fluctuations and their impacts on farmers over the last 20 years or so (1997-2017)

Climate-related events	Responses			Rate of Change		Impacts on human health (Disease/Illness)			Impacts on crop yield/productivity (Uncertainty/Decline)			Impacts on livestock (Disease/Death)		
	Yes (%)	No (%)	Don't know (%)	Increase (%)	Decrease (%)	Increase (%)	Decrease (%)	No change (%)	Increase (%)	Decrease (%)	No change (%)	Increase (%)	Decrease (%)	No change (%)
Drought	39	32	29	30	1	24	0	2	15	15	1	15	13	1
Hailstorm	73	8	18	54	8	48	0	2	38	15	2	35	12	12
Untimely rains	86	3	11	64	2	21	1	2	15	12	0	14	8	8
Winter arrival (late)	71	8	21	42	18	18	0	0	13	8	1	13	6	6
Cold breeze	67	9	24	15	42	18	0	0	14	5	1	14	5	0
Summer arrival (early)	72	7	21	55	4	16	0	0	13	6	2	12	5	5
Heat waves	65	10	25	55	2	16	0	0	13	7	1	12	5	5
Storm	64	11	25	46	3	12	0	1	9	6	0	8	4	4
Frost	59	17	23	41	5	5	0	1	1	6	1	1	4	4
Temperature Change	61	7	31	59	2	32	0	1	17	2	1	16	1	1

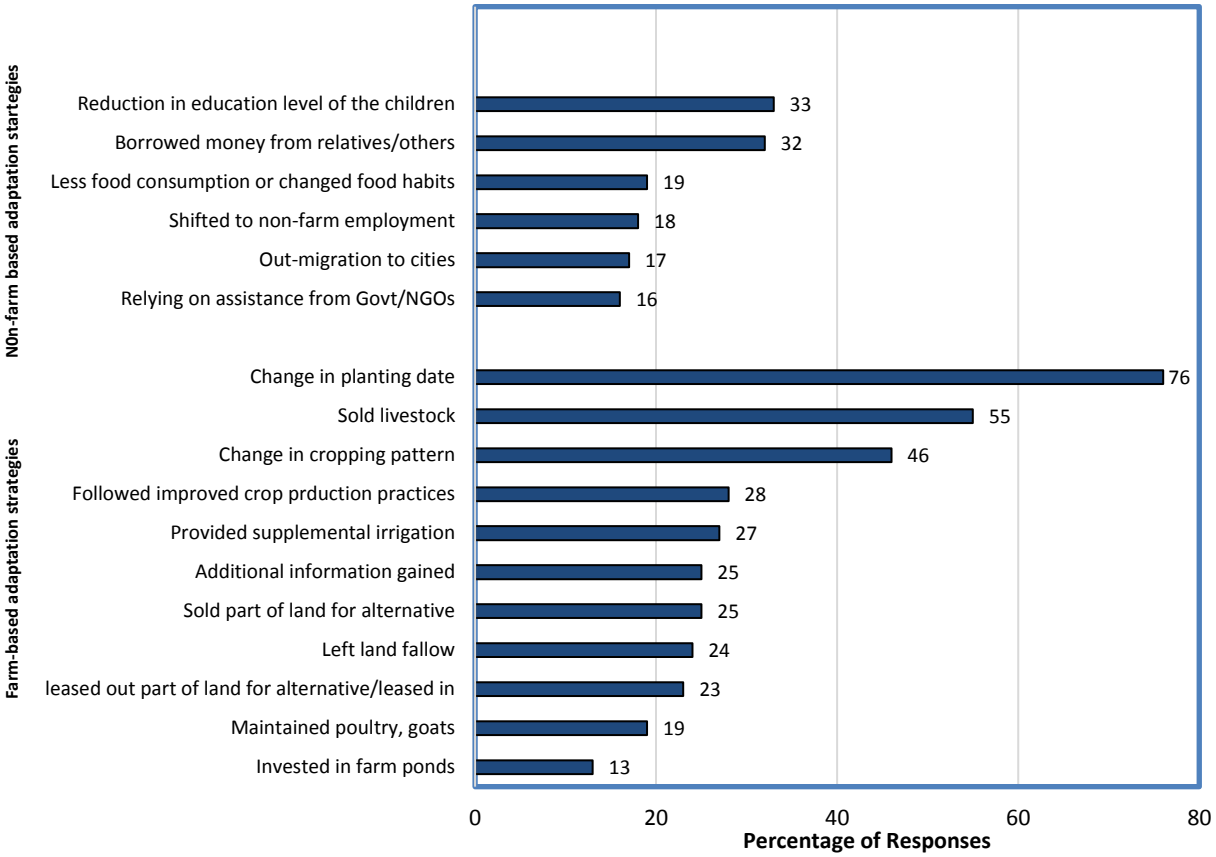

Figure 6. Respondents and their adaptation strategies

migration to cities, borrowing of money, compromises over the dietary requirements, health and educational needs are also relied upon for ensuring socio-economic resilience (Fig.6). However, a small proportion of (16%) the respondents also acknowledged the availability of financial assistance from government/NGOs (Non-governmental organizations) in case of acute shortages. The results of the Spearman correlation test indicated that there is a positive correlation between the number of adaptation measures adopted per household with sources of income ($r = 0.24$, $p<0.001$), farmer education levels ($r = 0.17$, $p< 0.001$), food security ($r = 0.28$, $p< 0.001$) and livestock ownership ($r = 0.19$, $p<0.001$). Whereas, it was found negatively correlated in case of crop diversification ($r= -0.01$, $p = 0.69$).

DISCUSSION

Farmer vulnerability to climate-related hazards: The current rain-fed agricultural practices are more susceptible to climate and weather related unpredictable changes. Therefore, the situation warrants for the assessment of preventive and curative strategies deployed by the farming communities. The research based initiatives are incumbent (Bryan et al., 2013; Harvey et al., 2014; Abid et al., 2015; Abid et al., 2016; Tran et al., 2017; Akhtar et al., 2019) for addressing the looming threats from climate change. The reported findings such as Ali and Erenstein (2017) and Abid et al. (2018) divulge that the phenomena of climate change is seriously threatening the socio-ecological landscape of Pakistan. The reported weather and climatic abnormalities are jeopardizing the objectives such as the food security and poverty reduction in this country (Ali and Erenstein, 2017). The present study was carried out for evaluating the orientations of farming communities regarding the phenomena of climate change in the rain-fed rural settings of the Punjab.

The findings of the present study divulge that the socio-economic conditions in the rural settings of the district Chakwal are dependent on the rain-fed agriculture (Fig. 5). These outcomes conformity with the earlier assertions such as Harvey *et al*. (2014) and Abid *et al*. (2016) that agro-based economic activities are the primary source for food and income generation in the rural landscape of Pakistan. The results substantiate the conclusions of Field *et al*. (2012), IPCC (2007), IPCC (2014), Dong *et al.* (2015), Wu *et al.* (2017), and Tesfahunegn *et al.* (2016) that fragile socio-economic sustainability of such rural settings are dependent

upon the agricultural outputs. Whereas, the low agricultural yields in these areas (Morton, 2007; Tesfahunegn *et al*., 2016; Oweis, 2018) are, still, far from the global standards (Prikhodko and Zrilyi, 2013; Abid *et al.*, 2015; FAO, 2015). The compromised performance of the agricultural sector, thus, further aggravates the socio-economic vulnerabilities of farming communities (Abid *et al*., 2015; Li *et al.*, 2016). The findings substantiate the notions of Lobell *et al.* (2008) and Li *et al*. (2016) that the inadequate resource base, ineffective adaptation strategies and absence/or compromises over the policies are also culpable for the exacerbation. Therefore, making these locations, intrinsically, more prone to the impacts of climatic oscillations and, hence, demand coordinated efforts to ensure their socio-economic resilience (Bryan *et al*., 2013; Harvey *et al*., 2014; Abid *et al*., 2015; Abid *et al*., 2016; Tran *et al*., 2017).

The findings of the study in (Table 1) portrayed that a significant proportion of respondents is susceptible and unprepared to absorb the impacts of abnormal climatic fluctuations or non-climatic shocks. The corollary affects further reduce their agricultural outputs and adversely impact the food availability. The repercussions manifest themselves in the form of malnutrition, compromises over socio-cultural spending and child mortality etc. (Pachauri *et al*., 2014; FAO, 2015). The small size of fields, inadequate use of agricultural inputs (fertilizers, pesticides, improved seed varieties etc.), less/low reliance on technology and soil /land degradation are the perceptible explanations for the reported low agricultural productivity in the study area. Besides this, the less organized and poorly integrated mechanisms of connectivity between the farms and markets are the other noticeable impediments in the study area. The farmers have to bear extra financial burden on transporting their produce and agricultural inputs. The resultant reduction in the profit margin, ultimately, retards the capacity and will of the farmer for innovative measures to address the looming challenges associated with the climate change (Harvey *et al*., 2014; Abid *et al*., 2015; Abid *et al*., 2016; Ali and Erenstein, 2017; Arshad *et al*., 2017).

The lack of access to formal safety nets such as the absence of coordinated mechanism for crop/livestock insurance is another critical factor that is also responsible for the socio-economic exacerbation in the study context. The absence of an integrated mechanism forced the agrarian communities to rely on informal support systems i.e. borrowing money/ food from family or friends. Farmers are also further constrained by the limited access to agro-meteorological and market related information (Fig. 4). Though, the local NGOs and an agricultural extension department are operating in the study area, yet, a significant proportion (40%) of the respondents reported that they didn't receive any technical guidance. The technical assistance is a prerequisite for informed decision making concerning the choice of crops, planting dates and devising strategies to overcome/minimize the impacts of droughts and climate-related hazards (Maddison, 2007; Woods *et al*., 2017).

The findings of the study helped to cognize about the multiple challenges the farmers are facing in the rain-fed rural surroundings, ranging from socio-economic impediments to abrupt atmospheric anomalies. The consequential outcomes are complex, manifold and far-reaching for the agricultural productivity and livelihood. It also transpires that these challenges have an acknowledgment in the study area. The consequential impacts are becoming more detectable and proving detrimental for the small farmers. These marginalized sections of rural landscape are economically more vulnerable, thus, are the apparent victims. Therefore, the growing incidents of crop failures/ yield reductions are proving counter-productive for initiatives to reduce poverty in rural areas. Thus, the emerging scenario demands for coordinated efforts for ensuring socio-economic sustainability in the rain-fed rural areas of Pakistan (Mertz *et al*., 2011; Mougou *et al*., 2011; Choudri *et al*., 2013; Harvey *et al*., 2014; Abid *et al*., 2016; Arshad *et al*., 2017; Barrucand *et al*., 2017).

***Climate change and adaptation needs*:** Farmers in the study area rely on different coping strategies for ameliorating the impacts of climate change. The farm-based and non-farm based approaches (Fig. 6) are deployed for optimal agricultural production and ensuring food security. Though, these coping strategies significantly contribute to the wellbeing of the farmer, yet, the effectiveness of such measures are dependent on the socio-economic status of the individual and temporal settings of the phenomena. Besides this, there are certain limitations of such individualistic efforts. Therefore, the situation requires an integrated initiative for the socio-ecological and economic sustainability of the rural life.

The projections regarding escalating temperature (IPCC, 2014; Janjua *et al*., 2014; Abas *et al.*, 2017) and predictions about fluctuations in the patterns of precipitation in Pakistan (Abid *et al*., 2015; Pak-INDC, 2016; Ali and Erenstein, 2017) necessitate on postulating measures for the protection of small farmers. There is an urgent need to chalk out the contours of pragmatic strategies based upon the indigenous resources. The outcomes of such an endeavor will help to convert such looming challenges into opportunities.

However, the farmers, particularly the small landholders in the study area are reluctant to experiment with the innovative measures/methods due to the lack of financial support and awareness. The limited exposure and compromised resource base of the farmers makes it difficult and risky for them to improvise. Therefore, proactive engagements from the private sector such as agriculture service providers backed by the public sector are imperative for the desired objectives.

***Conclusions*:** The findings of the study revealed that the farming communities have awareness about the weather and climatic abnormalities. The respondents are mindful about the

repercussions for their crops, livestock and health. The reported decline in the agricultural production is adversely impacting their livelihoods and making them more vulnerable. The farmers also have a realization that they can adjust with the phenomena through technical and financial support. Therefore, it requires the capacity-building and financial support of the stakeholders to adapt climatic changes. Although, the agricultural departments are operating but its imprints are less visible due to lack of clarity and consistency in policies. Whereas, the Sustainable Development Goals stresses on "taking urgent actions to combat climate change and its impacts" (SDG 3). Therefore, further research initiatives and transferring the technological outputs of the similar orientations are required for ensuring the socio-economic uplift and resilience of the farmers residing in the study area. Further, it is also recommended that similar or location based modified surveys be conducted in the other agro-ecological rain-fed zones as per description of the PARC agro-ecological zones of Pakistan.

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