Pakistan Geographical Review, Vol.77, No. 1, June, 2022, PP 01-15

DRY LAND AGRICULTURAL HOUSEHOLD AND PERCEPTION OF CHANGING CLIMATE IN CHOLISTAN DESERT OF PAKISTAN

SAADIA SULTAN WAHLA[1- 3]* • SYED JAMIL HASSAN KAZMI[1]

[1]Department of Geography, University of Karachi, Karachi-Pakistan
[2]Department of Geography, Govt .Post-graduate College for Women, Bahawalnagar
[3]Department of Anthropology, University of Georgia, 250 Baldwin Hall, Athens, Georgia 30606 USA

*Corresponding author's E-mail: geosaadiasultan@gmail.com

ABSTRACT

Global climate change is posing a threat and compromising the long-term viability of humanity in this century. There are legitimate and significant worries about the influence of shifting patterns in climate on agriculture. In order to understand the farmer's perception of climate change, research has been conducted. Humans and animals alike rely on rainwater to survive in the Cholistan desert, which is the sole supply of potable water. A survey has been conducted and this research is based on questionnaire. A variety of family agriculture methods may be utilize to reduce the impact of shifting climate conditions. The vast majority (89.4%) of farmers have changed their agricultural methods in response to climate changes, and only 0.6% of farmers do not alter their agricultural practices.

KEY WORDS: Dry land, household, climate, variability, perception, Cholistan

1. INTRODUCTION

Environmental inconsistency and climate change have the potential to worsen the situation of the world's poorest people. (Swain & Hayhoe, 2015). Meanwhile, according to the Intergovernmental Panel on Climate Change (IPCC), climate change is expected to increase the risk of desertification in dry lands. South Asia is home to over half of the world's dry land population, according to estimates (Wang & Chen, 2014). According to Singh et al.,(2012) South Asia area endures to suffer from water shortages. (Wang et al., 2014), 2% of the total population in the region lives in extreme poverty (IPCC, 2007). Under the shared socio-economic route (SSP) for global warming of 2 degrees Celsius, the world's dry land population is 974 million people, with half of this vulnerable population living in South Asia (Khan et al., 2019). As a result of these estimates, it's vital to understand people's ability to adapt to climate change in dry land areas so that more efforts can be made to improve future adaptive capacity. The ability of a population to adjust to changes in their environment through time is known as adaptation capability. Food insecurity, reduced animal productivity, a lack of viable livelihood options, and a general decline in human well-being may follow if climate change

and desertification are not handled with appropriate adaptation methods. (Syed et al., 2014).

Adaptability is essential for bridging the resilience and vulnerability divide (Xie et al., 2013), and it is often mistakenly considered to be synonymous with resilience (Khan, N et.al.,2019). Another definition of adaptive capacity has been provided in the literature as a component of resilience. (Forouzani & Karami, 2011), as a measure of a system's resistance to changes in resilience (Kazmi et al., 2015), and as a group's collective ability to manage resilience (Miyan, 2015; S. A. Anjum, M. F. Saleem , M. A. Cheema, 2012; Xiao-jun et al., 2012).

Lambin, E. F et al. (2003) has identified economic resources as one of the most important drivers of adaptive ability, which can be influenced at both the macro and micro levels .Technology, skills, knowledge, and access to institutions, infrastructure, and equity are all essential factors of adaptive capability. Similarly, Touma et al., (2015) investigate the vulnerability of both groups and people, highlighting that discrepancies in vulnerability at one level have a significant impact on vulnerabilities at other levels. Nam et al., (2015) reflect the importance that policymakers must place on heterogeneity in adaptive ability at lower administrative levels, while simultaneously developing national-level metrics to measure this diversity in capacity

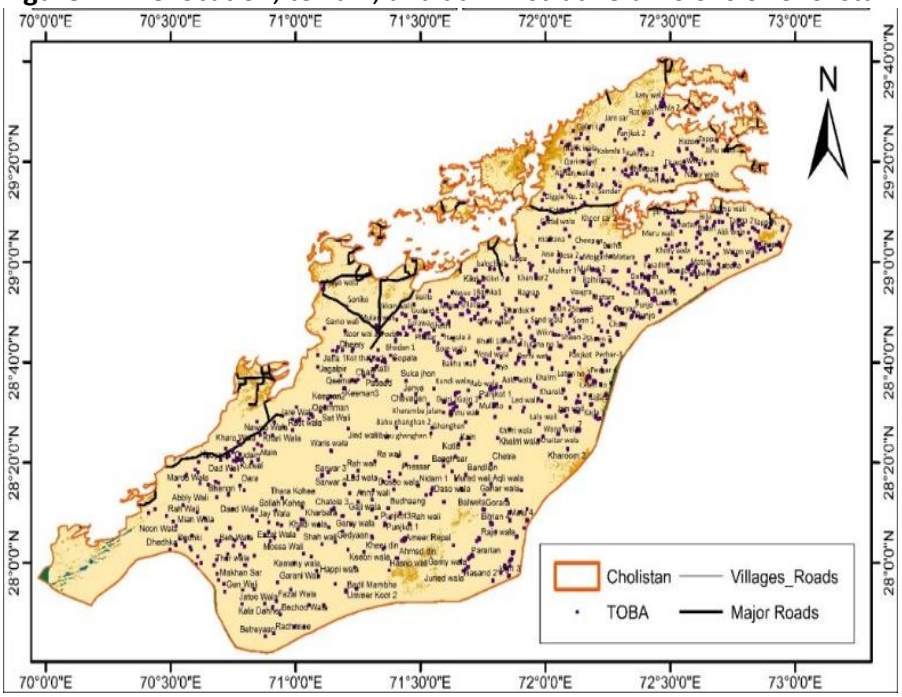
2. MATERIAL AND METHODS

3. Study Area

The research region consists primarily of Cholistan, a vast and underused sandy desert in the northwestern section of the Great Indian Rajputana Desert. The Cholistan covers two third area of the total area of Bahawalpur Division and include southern part of Bahawalnagar, Bahawalpur and Rahim Yar Khan. The study region is located between 27° 42’ 30’’ and 29° 45’ 30’’ north latitude and 69°57’ 30’’ and 72° 52’ 30’’ east longitude. The desert stretches for around 480 kilometers in length and 32 to 192 kilometers in width. It begins in Bahawalnagar and extends across three southern Punjab districts, passing through Bahawalpur and into the Rahim Yar Khan district. This desert stretches all the way to the Indo-Pakistan border in the east and south. The area is bounded by the surveyed area of Bahawalnagar, Bahawalpur and Rahim Yar Khan in the north. Pasture animal husbandry is a traditional sector in Cholistan, and it is the economic backbone of the region. Animal farming employs half of the Cholistan, Punjab, and Pakistani population. Desertification has posed a severe threat to the environment and has harmed the long-term viability of animal husbandry in the Cholistan desert.

The research area's climate is in the subtropical hot zone, with monsoons having a significant impact. The most notable feature of the Cholistan Desert is the occurrence of droughts every couple of years, i.e. for 4-6 years in a row. The temperature range swings dramatically not only on an annual basis, but also on a daily basis. Summer temperatures range from 30 to 52 degrees Celsius from May to June, and winter temperatures range from 10 to 25 degrees Celsius from December to February. Annual rainfall is minimal and unpredictably low, ranging from 100 to 250 mm annually, with peaks in the monsoon months of July to September and the winter months of January to March.

Figure 1. The location, terrain, and administrative divisions of Cholistan



The climate data (Rainfall, Temperature and Relative humidity) presented and discussed this section associate to Bahawalpur, Khanpur and Fort Abbas. These stations though they are located outside the study area but maybe regarded the reflect climate of the area also because these areas are so close with study area.

In today's climate-change-affected world, it is becoming more important to conduct frequent multidimensional evaluations of adaptation capacity on a regular basis. Community members with excellent adaptability skills are more able to choose and apply adaptation options in order to

cope with, adjust to, and change as a result of shocks and pressures. (Chandrasekar, 2017). Ownership of livelihood assets is often shown to be strongly connected with adaptive ability (Ahmed et al., 2019). It is generally accepted that persons who have more assets have a stronger adaptive capacity, on the assumption that they are able to move between the sorts of assets that are necessary to adjust during times of shock and stress (Ahmed et al., 2018).

4. Results and Discussion

There is a considerable amount of research on Adaptive capacity and vulnerability assessments at various sizes, but it is rarely linked to the core factors that influence local livelihoods, nor is it organized spatially. The visualization of patterns of adaptive capability may aid decision-makers in determining where greater investment is required. Vulnerability assessment is becoming increasingly popular. (Bannari et al., 1995; Motohka et al., 2009; Rodríguez-Moreno & Bullock, 2014; Rondeaux et al., 1996) and some researchers have attempted to present the results geographically (Jönsson & Eklundh, 2004; Myneni et al., 1997).

This section covers these concerns, as well as improving the use of spatial mapping in vulnerability assessments. The researchers hope to determine the role of sustainable livelihood components (such as physical and human capital, financial capital, social capital, and natural resources) in determining the adaptive capacity of dry land agricultural household communities in Cholistan Punjab, Pakistan: an area that has received little empirical research but is often thought to have a limited ability to adapt to climate-related disasters (Jones et al., 2012). It focuses on the spatial clusters of adaptive capacity variation in the study area in relation to places that have experienced varying degrees of desertification exposure. A new technique for clustering geographically adaptive capacity is devised, which combines household adaptive capacity indicators into a geographically explicit, unit-less adaptive capacity index. Because this is the size at which livelihood assets are most commonly managed in developing nations, it is vital to focus on adaptive capability at the household level.

Figure 2: Demographic information of respondents

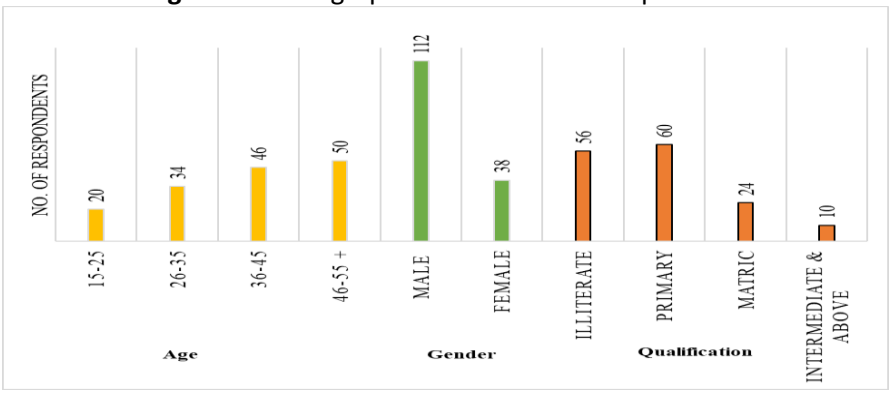


Figure 2 describes the profile of farmers in the research region, based on a variety of criteria that were chosen. In the study, it was discovered that the majority of respondents (33 percent) are in the elderly age group, followed by 33 percent in the middle age category. 2 percent of respondents are above the age of 55, 2.6 percent are under the age of 55, and 2 percent are under the age of 20. The gender makeup of the research region reveals that males account for 75 percent of all respondents, with females accounting for 25 percent of the total population. The literacy rate in the research region reveals that 40 percent of respondents have had primary education, with the remaining 37 percent being illiterates. Only 20% of those who answered the survey had a moderate to upper-intermediate level of schooling.

Table 1: Cross-tabulation of the occurrences of climate and farm location on the same farm

Locality	Occurrence	Occurrence of incidences %				
		Extremely severe	Severe	Significant	Irrelevant	I don't know
Near River	Floods	53.66	5.6	7.23	1.23	5
	Drought	25.30	19.38	37.33	9.3	8.5
	Farm destruction	4.47	46.35	6.38	0.85	9.6
	Erosion	40.25	9.45	7.02	3.25	7.95
Away from River	Floods	30.45	26.35	34.56	6.38	4.32
	Drought	10.23	8.25	48.23	10.23	8.23
	Farm destruction	4.85	51.78	6.78	2.89	0.87
	Erosion	23.54	24.68	2.58	9.32	8.52
Lowland	Floods	26.53	22.56	35.3	6.5	3.4
	Drought	41.25	4.36	1.25	31.25	5.6
	Farm destruction	6.2	3.2	4.3	26.5	36.5
	Erosion	27	36.3	34.2	6.23	3

Changes in temperature are perceived differently by farmers, as seen in Figure 3. A handful majority of farmers think that climate change has occurred in the last 30 years. In this time span, farmers predict that temperatures will rise, according to 80 percent. Only 7.3 percent of farmers in the district of Cholistan feel that the temperature is not rising any more. In contrast, the climate data for the district reveals that the mean annual temperature has decreased since 2005, as compared to the previous year.

It was decided to pose a question in order to acquire insight into farmers' perceptions of changes in rainfall patterns. The timing of rainfall, rather than the severity, is believed to alter by 53% of those who responded (Figure 4). Farmers are just 23 percent certain that rainfall would decrease throughout this time frame. Farmers reported that rainfall had risen by zero percent. Furthermore, 3 percent of respondents anticipate that there will be no change in the pattern of rainfall throughout this time period. According to climate statistics, rainfall decreased between 997 and 2000, after an increase in rainfall over that time period.

Figure 3: Farmers' perceptions of variations in temperature over the last 30 years are summarized below.

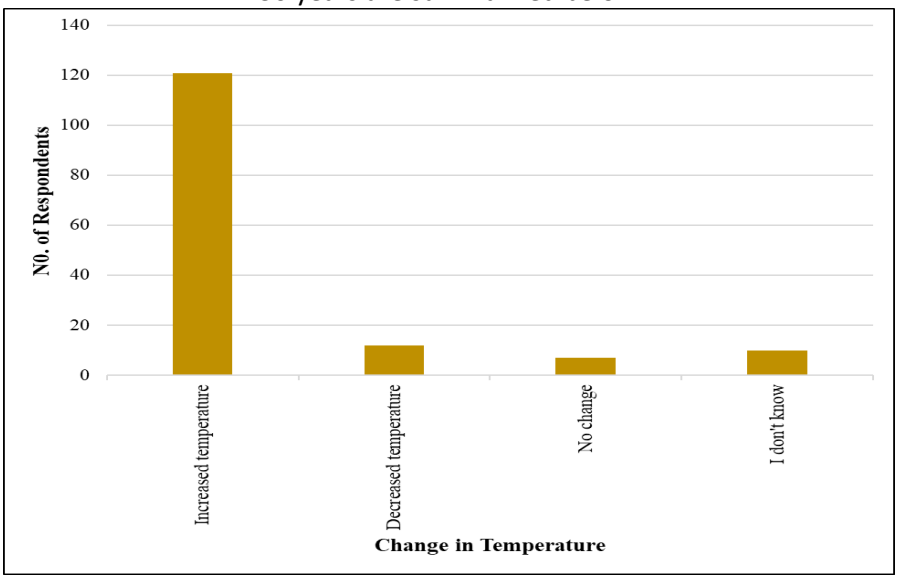


Figure 4: Farmers' perception towards change in rainfall pattern.

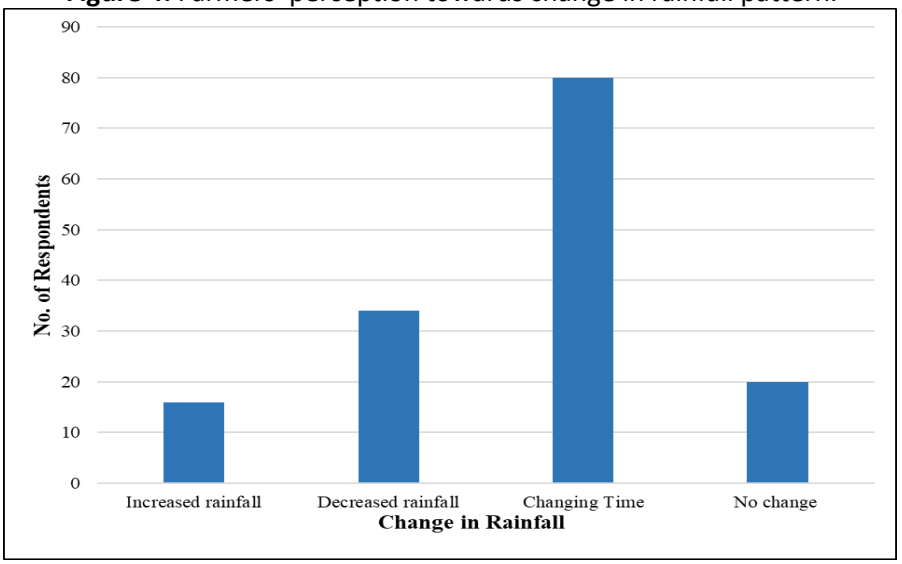
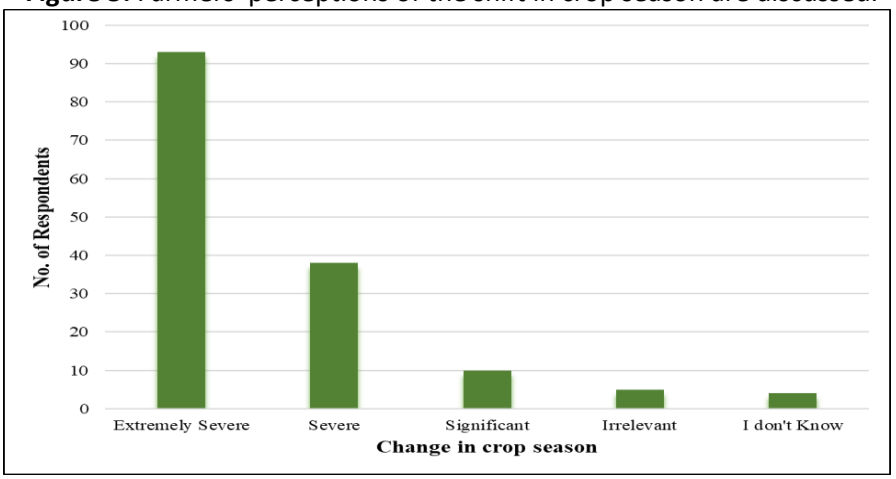


Figure 5: Farmers' perceptions of the shift in crop season are discussed.



The vast majority of farmers Six percent of respondents believe that crop season fluctuations are really severe. Change may be either a reduction in the growing season or an increase in the growth season (Figure 5). During the conversation, they said that the growing season for wheat has been shortened in the last 30 years. This shift is related to an increase in temperature, which has resulted in a shorter growth season. It is considered serious by 25% of those who answered the survey questions. Six percent of those polled thought it is noteworthy. 4 percent believe it is either unimportant or that they have no awareness of what it is.

Figure 6: Farmers see Crop failure negatively.

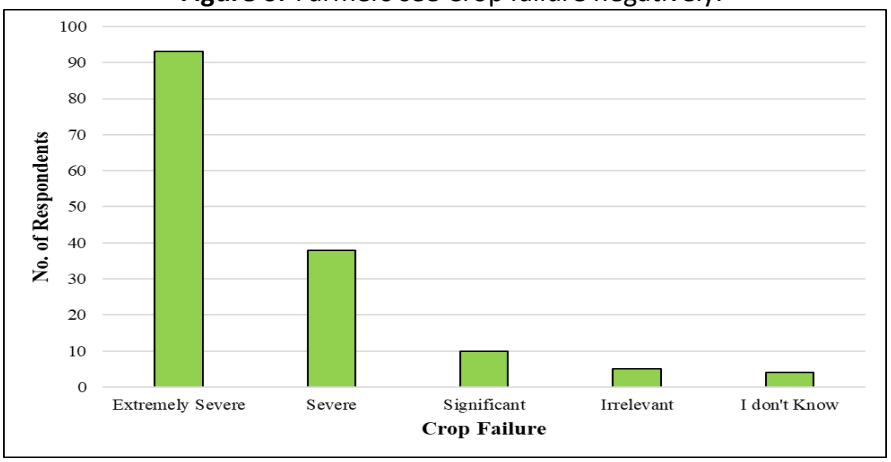


Figure 7 illustrates that 6 percent of farmers consider that crop loss is highly severe as a result of temperature and precipitation fluctuations. As a result of changes in climatic factors, severe occurrences and crop failures are becoming more common. Peasants regard it as severe and substantial in proportions of 25 percent and 6 percent, respectively. Farmers disagree with this statement, with 0% believing it to be false and 0% believing it to be untrue. Farmers feel that siltation of water bodies has become exceedingly serious in the last 30 years, according to 62 percent of them. 26 percent believe it to be severe, 6 percent believe it to be important, and 4 percent believe it to be completely meaningless. Farmers in two percent of the counties are unaware of it.

Figure 7: Farmers' perspectives on water body siltation

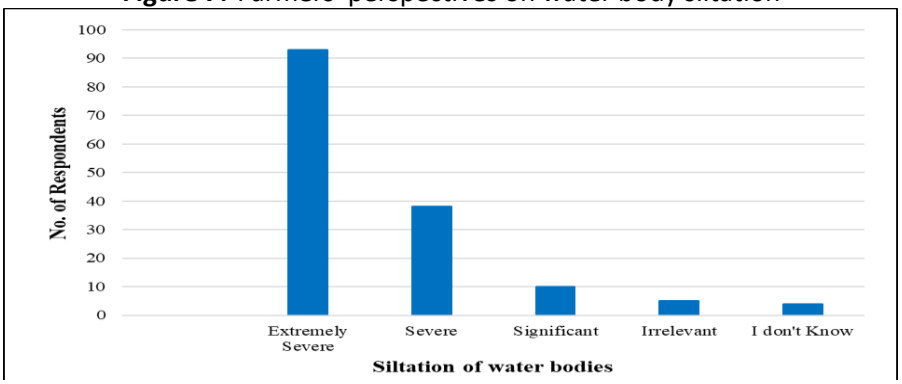


Figure 8 shows that 36% of farmers believe illness prevalence is extremely severe as a result of changes in climate conditions. It is considered severe by 2% and significant by 7% of those polled. However, 20% of peasants believe it is irrelevant, and 6% have no knowledge of it. Figure 7 show that 36% of farmers believe illness prevalence is particularly high as a result of

changes in climate conditions. It is considered severe by 2% and significant by 7% of those polled. However, 20% of peasants believe it is unimportant, and 6% have no knowledge of it.

Figure 8: Farmers' perception towards prevalence of diseases.

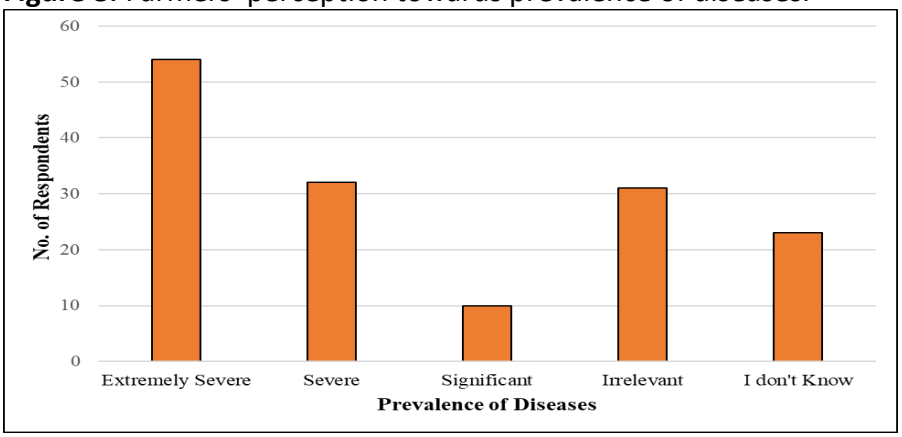


Figure 9: Farmers' perspectives on the scarcity of drinkable water.

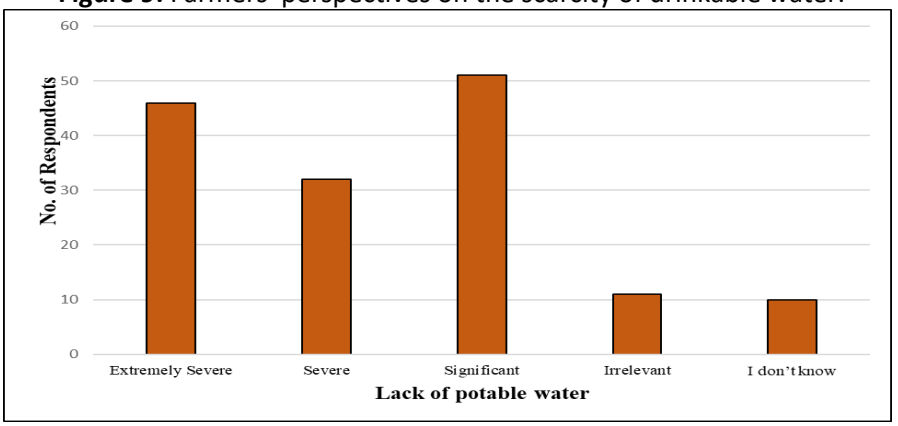


Figure 10: Farmers' attitudes regarding unexpected season changes

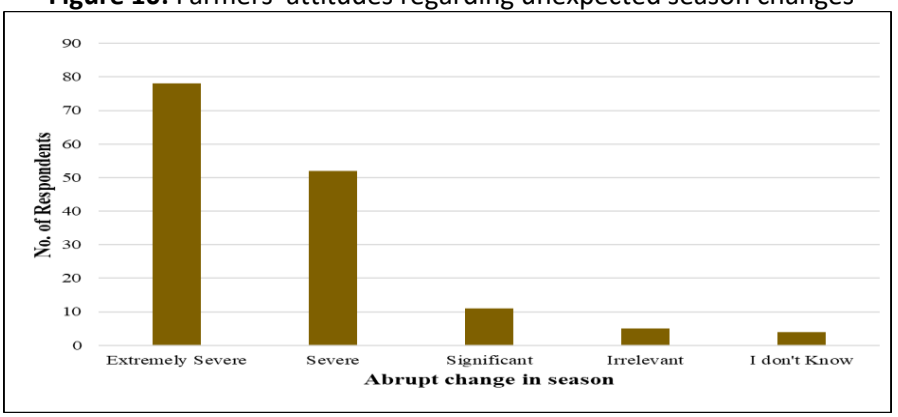


Figure 11: Farmers' attitudes regarding pest infestations.

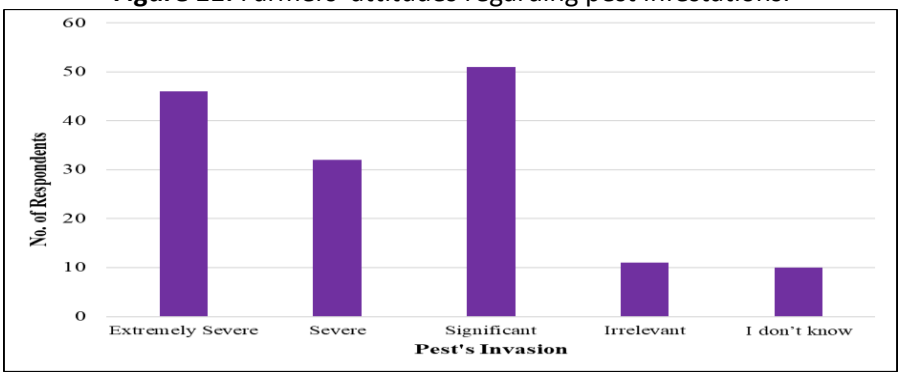


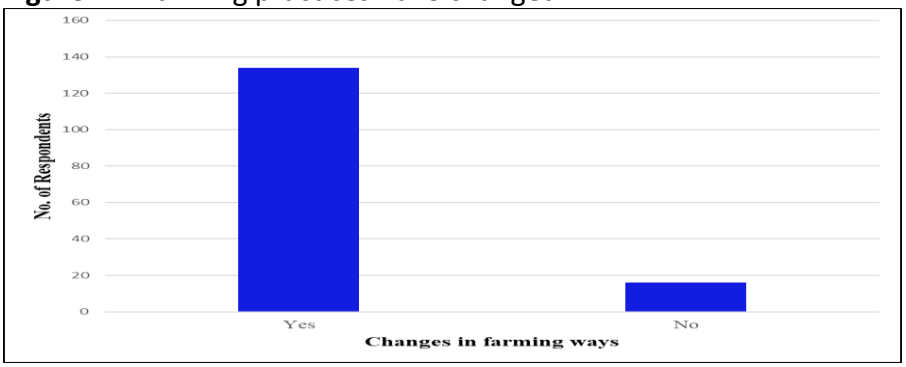
Figure 11depicts how temperature and other environmental factors cause major shifts in seasons. Farmers rate it as extremely bad in 52% of instances, whereas peasants rate it as severe in 34.6 percent. The remaining 7.33 percent, 3.4 percent, and 2.6 percent, respectively, feel it is significant, insignificant, and they are unaware of it.

Figure.11 displays the increase in pest infestation with the passage of time. Farmers say it is extremely severe in 30.66 percent of cases and severe in 20 percent of cases, respectively. Farmers say it is significant in 34 percent of cases, whereas it is unimportant in 6.6 percent of cases and not important in 8.04 percent of cases.

5. CONCLUSION

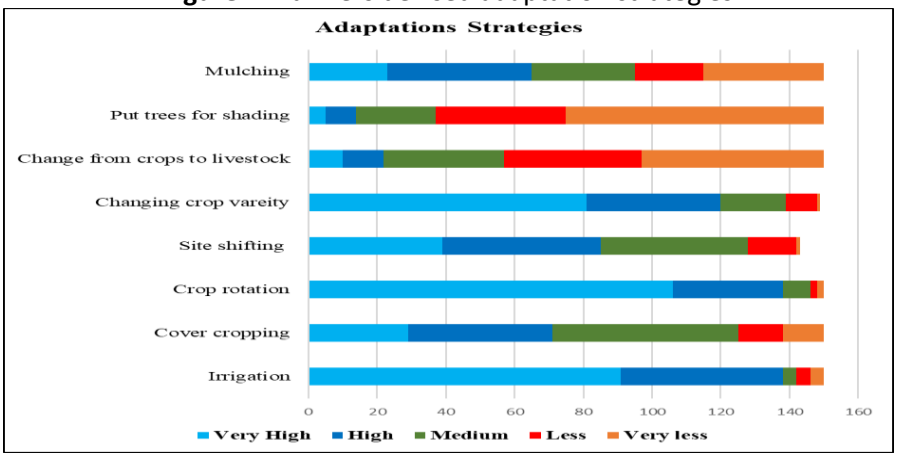
A variety of family agriculture methods may be utilized to decrease the effect of shifting environment conditions. Pakistan, like many other developing nations, is predominantly susceptible to climate change. Farmers adopted a variety of local, traditional ways to alleviate the effects of climate change. Different socioeconomic and climatic effects must be considered when adapting any plan to decrease the impact of severe occurrences (Mo et al., 2016).

Figure 12: Farming practices have changed.



A large community of farmers have changed their agricultural methods in response to climate changes, according to 89.4% of respondents. 0.6 percent of farmers do not alter their agricultural practices.

Figure 1: Farmers devised adaptation strategies.



Mulching is not favored by the majority of farmers, with just 5% and 28% rating it very high to very high, respectively, and 56% rating it medium to very low. Most farmers do not utilize trees for shade; just 9% of farmers use very high to high trees. 5.33 percent chose medium, while 75 percent chose less to very little. Farmers also do not switch from crops to cattle. 6.6 percent and 8% of farmers chose very high and high, respectively, while 26.7 percent chose medium and 62 percent chose less to very little. Changes in crop varieties or crop kinds were favored by most farmers (50 percent and 33 percent, respectively). It was rated as medium to very low relevance by 20% of those polled. A quarter of farmers (25%) and a quarter of farmers (27%) said they would like to change the location. This method was employed by 48 percent of farmers at a medium to small scale. Crop rotation was employed by 70% of farmers, who evaluated it extremely highly. 3% ranked it as extremely high, while 0% rated it as medium to very low. Farmers prefer not to use cover crops. Farmers ranked themselves as very high-to-high in 46 percent of cases. The most essential and extensively utilized approach is irrigation. It received a very high rating from 57 percent of farmers. This is accomplished via the use of modern irrigation systems.

In the Cholistan Desert, the availability of water is already a significant limitation. We lived in a constantly changing environment, whether it is

due to the influx of people, the demand for resources, climatic constraints, or even political instability. Since the 1970s, changes in the way the economy has been handled have had a negative impact on the livelihood of local residents, particularly in terms of natural resources such as low crop yields, poor soil and grazing land, and a lack of available land for agricultural production. Developments in the traditional organizational resource system have occurred as a result of the changes outlined above. Agricultural pastoralism is a centuries-old human vocation, and pastoralists have brought forth a diversified culture, environmental harmony, and a management system that has been modified via technological innovation in recent years. Similarly, the cattle industry has undergone tremendous transformation. Traditional herding techniques have been altered as a result of the increased diversity of animal herds. Although the Cholistan Desert is arid, food stalls and modern cow ranching are becoming more prevalent. Farmers in the Cholistan Desert have embraced the natural reproductive process. When the number of people living in a certain region increases, this is referred to as population growth. The increase in population places a significant strain on the production of these readily accessible resources. More people need more food for consumption as well as more land for housing.

REFERANCES

Ahmed, K., Shahid, S., Chung, E. S., Wang, X. jun, & Harun, S. Bin. (2019). Climate change uncertainties in seasonal drought severity-area-frequency curves: Case of arid region of Pakistan. *Journal of Hydrology*, *570*(January), 473–485. https://doi.org/10.1016/j.jhydrol.2019.01.019

Ahmed, K., Shahid, S., & Nawaz, N. (2018). Impacts of climate variability and change on seasonal drought characteristics of Pakistan. *Atmospheric Research*, *214*(May), 364–374. https://doi.org/10.1016/j.atmosres.2018.08.020

Ashraf, M., Hameed, M., Arshad, M., Ashraf, Y., & Akhtar, K. (2006). Salt Tolerance Of Some Potential Forage Grasses From Cholistan Desert Of Pakistan. In M. A. Khan & D. J. Weber (Eds.), *Ecophysiology of High Salinity Tolerant Plants* (pp. 31–54). Springer Netherlands.

Bannari, A., Morin, D., Bonn, F., & Huete, A. R. (1995). A review of vegetation indices. *Remote Sensing Reviews*, *13*(1–2), 95–120.

https://doi.org/10.1080/02757259509532298

Becker, A., Finger, P., Meyer-Christoffer, A., Rudolf, B., Schamm, K., Schneider, U., & Ziese, M. (2013). A description of the global land-surface precipitation data products of the Global Precipitation Climatology Centre with sample applications including centennial (trend) analysis from 1901-present. *Earth System Science Data*, *5*(1), 71–99. https://doi.org/10.5194/essd-5-71-2013

Chandrasekar K. (2017). Monitoring of Agricultural Drought using Satellite based Drought Severity Index over Andhra Pradesh State of India. *International Journal of Advanced Remote Sensing and GIS*, *6*(1), 2343–2359. https://doi.org/10.23953/cloud.ijarsg.299

Fensholt, R., & Sandholt, I. (2005). Evaluation of MODIS and NOAA AVHRR vegetation indices with in situ measurements in a semi-arid environment. *International Journal of Remote Sensing*, *26*(12), 2561–2594. https://doi.org/10.1080/01431160500033724

Forouzani, M., & Karami, E. (2011). Agricultural water poverty index and sustainability. *Agronomy for Sustainable Development*, *31*(2), 415–431. https://doi.org/10.1051/agro/2010026

IPCC. (2007). Climate Change 2007 - The physical science basis: contribution of working group I to the fourth assessment rep. *Bulletin Fuer Angewandte Geologie*, *18*(2), 5–19. https://doi.org/10.5169/seals-391142

Jones, M. O., Kimball, J. S., Jones, L. A., & McDonald, K. C. (2012). Satellite passive microwave detection of North America start of season. *Remote Sensing of Environment.*, *123*, 324–333. https://doi.org/10.1016/j.rse.2012.03.025

Jönsson, P., & Eklundh, L. (2004). TIMESAT - A program for analyzing time-series of satellite sensor data. *Computers and Geosciences*, *30*(8), 833–845. https://doi.org/10.1016/j.cageo.2004.05.006

Kazmi, D. H., Li, J., Rasul, G., Tong, J., Ali, G., Cheema, S. B., Liu, L., Gemmer, M., & Fischer, T. (2015). Statistical downscaling and future scenario generation of temperatures for Pakistan Region. *Theoretical and Applied Climatology*, *120*(1–2), 341–350. https://doi.org/10.1007/s00704-014-1176-1

Khan, N., Shahid, S., Ismail, T. bin, & Wang, X. J. (2019). Spatial distribution

of unidirectional trends in temperature and temperature extremes in Pakistan. *Theoretical and Applied Climatology*, *136*(3–4), 899–913. https://doi.org/10.1007/s00704-018-2520-7

Lambin, E. F., Geist, H. J., & Lepers, E. (2003). D Ynamics of L and -U Se and L and -C Over C Hange in T Ropical R Egions . *Annual Review of Environment and Resources*, *28*(1), 205–241. https://doi.org/10.1146/annurev.energy.28.050302.105459

Miyan, M. A. (2015). Droughts in asian least developed countries: Vulnerability and sustainability. *Weather and Climate Extremes*, *7*, 8–23. https://doi.org/10.1016/j.wace.2014.06.003

Mo, X., Wu, J. J., Wang, Q., & Zhou, H. (2016). Variations in water storage in China over recent decades from GRACE observations and GLDAS. *Natural Hazards and Earth System Sciences*, *16*(2), 469–482. https://doi.org/10.5194/nhess-16-469-2016

Motohka, T., Nasahara, K. N., Miyata, A., Mano, M., & Tsuchida, S. (2009). Evaluation of optical satellite remote sensing for rice paddy phenology in monsoon Asia using a continuous in situ dataset. *International Journal of Remote Sensing*, *30*(17), 4343–4357. https://doi.org/10.1080/01431160802549369

Myneni, R. B., Keeling, C. D., Tucker, C. J., Asrar, G., & Nemani, R. R. (1997). Increased plant growth in the northern high latitudes from 1981 to 1991. *Nature*, *386*(6626), 698–702. https://doi.org/10.1038/386698a0

Nam, W. H., Hayes, M. J., Svoboda, M. D., Tadesse, T., & Wilhite, D. A. (2015). Drought hazard assessment in the context of climate change for South Korea. *Agricultural Water Management*, *160*, 106–117. https://doi.org/10.1016/j.agwat.2015.06.029

Rodríguez-Moreno, V. M., & Bullock, S. H. (2014). Vegetation response to hydrologic and geomorphic factors in an arid region of the Baja California Peninsula. *Environmental Monitoring and Assessment*, *186*(2), 1009–1021. https://doi.org/10.1007/s10661-013-3435-5

Rondeaux, G., Steven, M., & Baret, F. (1996). Optimization of soil-adjusted vegetation indices. *Remote Sensing of Environment*, *55*(2), 95–107. https://doi.org/https://doi.org/10.1016/0034-4257(95)00186-7

S. A. Anjum, M. F. Saleem , M. A. Cheema, M. F. B. and T. K. (2012). an

Assessment To Vulnerability, Extent, Characteristics and Severity of Drought Hazard in Pakistan. *Pakistan Journal of Science (Vol.*, *64*(2).

Singh, A., Seitz, F., & Schwatke, C. (2012). Inter-annual water storage changes in the Aral Sea from multi-mission satellite altimetry, optical remote sensing, and GRACE satellite gravimetry. *Remote Sensing of Environment*, *123*, 187–195. https://doi.org/10.1016/j.rse.2012.01.001

Swain, S., & Hayhoe, K. (2015). CMIP5 projected changes in spring and summer drought and wet conditions over North America. *Climate Dynamics*, *44*(9–10), 2737–2750. https://doi.org/10.1007/s00382-014-2255-9

Syed, F. S., Iqbal, W., Syed, A. A. B., & Rasul, G. (2014). Uncertainties in the regional climate models simulations of South-Asian summer monsoon and climate change. *Climate*

Touma, D., Ashfaq, M., Nayak, M. A., Kao, S. C., & Diffenbaugh, N. S. (2015). A multi-model and multi-index evaluation of drought characteristics in the 21st century. *Journal of Hydrology*, *526*, 196–207. https://doi.org/10.1016/j.jhydrol.2014.12.011

Wang, L., & Chen, W. (2014). A CMIP5 multimodel projection of future temperature, precipitation, and climatological drought in China. *International Journal of Climatology*, *34*(6), 2059–2078. https://doi.org/10.1002/joc.3822

Wang, L., Chen, W., & Zhou, W. (2014). Assessment of future drought in Southwest China based on CMIP5 multimodel projections. *Advances in Atmospheric Sciences*, *31*(5), 1035–1050. https://doi.org/10.1007/s00376-014-3223-3

Xiao-jun, W., Jian-yun, Z., Shahid, S., ElMahdi, A., Rui-min, H., Zhen-xin, B., & Ali, M. (2012). Water resources management strategy for adaptation to droughts in China. *Mitigation and Adaptation Strategies for Global Change*, *17*(8), 923–937. https://doi.org/10.1007/s11027-011-9352-4

Xie, H., Ringler, C., Zhu, T., & Waqas, A. (2013). Droughts in Pakistan: A spatiotemporal variability analysis using the Standardized Precipitation Index. *Water International*, *38*(5), 620–631. https://doi.org/10.1080/02508060.2013.827889