CENTRAL ASIAN JOURNAL OF WATER RESEARCH (2022) 8(1): 126-142

https://doi.org/10.29258/CAJWR/2022-R1.v8-1/126-142.eng

Central Asian Journal of Water Research

Changing with the weather: Afghan farmers adapt to drought

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ABSTRACT

Drought is one of the significant impacts of climate change affecting agricultural productivity and subsistence for Afghanistan's farmers. Producers have applied various adaptation measures making use of their native resources in response to drought. Studying the cases of the Panjab and Waras districts in the south of Bamyan province of Afghanistan, this research aims to analyse Afghan farmers' drought adaptation strategies. Farmers' adaptation strategies to drought and the effectiveness of such actions to decrease the effects of this natural hazard were studied. The adaptive strategies were categorised into five groups, including: (*i*) cropping practices, (*ii*) soil and water conservation, (*iii*) animal husbandry management, (*iv*) wage labour use and (*v*) financial management. Major adaptive strategies for cropping practices include growing early maturing crops, drought-tolerant crops, inter-cultivation systems, changing cropping patterns, seed treatments, growing non-traditional crops and crop rotation. Soil and water conservation adaptive actions include bund construction, watering at night, levelling land, decreasing irrigated areas, reducing water wastage and small-scale watershed management. Drought responses for livestock included supplementary feed, increased rearing of small animals, fodder cultivation and storage. Non-farm adaptive strategies to augment income include production of handicrafts, additional unpaid family labour, borrowing money, reducing expenditures for non-food and costly food items, migration, selling assets and discontinuing agricultural activities due to drought. Data for this study was collected using a field survey with questionnaires and face-to-face semi-structured interviews with 140 farmers from Panjab and Waras districts in the study area. One of the main issues was the necessity and importance of expanding the Technical and Vocational Education and Training (TVET) support programmes for the adaptation strategies.

ARTICLE HISTORY

Received: November 3, 2021
Accepted: February 10, 2022
Published: May 26, 2022

KEYWORDS

Drought, adaptive strategies, farmers, climate change, TVET

Paper type: research paper

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Published by Kazakh German University, Almaty/Kazakhstan

1. Introduction

Following the September 2021 regime change with all its political repercussions, the economic future of Afghanistan is uncertain. Agriculture accounts for over a quarter of GDP. It is likely to play an increasing role, with the proportion of the labour force engaged on the land rising from the current 26 per cent. Cereal production, especially wheat, has been the traditional mainstay of Afghan agriculture. Increasingly significant, therefore, will be how cereal farmers adapt their modus operandi in the face of the crucial natural challenge of inadequate water supplies.

In agriculture, 'adaptation' is an essential step that requires farmers to have preliminary knowledge about climate variations and its effects so that they can respond through a befitting range of adaptations… The criticality of cultivation along with low or no adaptive capacity and high climatic exposure makes Afghanistan one of the 'most vulnerable states' to climate change. (Omerkhil et al., 2020)

Afghanistan is especially prone to drought. In 2021, over 88 per cent of farmers singled out water shortages as their most significant impediment to crop production (FAO, 2021). Currently, the government has few facilities and financial capacities to reduce or mitigate the resulting impacts (Miyan, 2015). The agriculture sector is susceptible to temperature changes, precipitation variation and snowmelt (Savage et al., 2009). Recurring droughts have been happening with severe intensity in recent decades, especially 1998–2006, 2008–2009, 2018 and 2020 (Arab et al., 2021). The drought from 1999 to 2001 is particularly symbolic of the impact on the rural population. It caused a loss of livestock and wheat stock in the southern part of Afghanistan, resulting in people consuming dried mulberry and chickling peas (lathyrus sativus). Chickling pea is usually used as fodder for animals, and its consumption by a human can be disabling, including brain damage in children (Malik & Haq, 2017).

In southern Afghanistan, rainfed wheat yields decreased about 40 per cent below average. This circumstance created a seed shortage for farmers because they consumed wheat as food for the household, and there was nothing to grow for subsequent cultivation. About 50-57 per cent of each farmer's orchard (apple, pomegranate, almonds, apricot and grapes) was damaged by inadequate rainfall. Livestock sickness and weight loss were other effects of drought, which caused many farmers to sell their animals almost at one-quarter of their original price (Qureshi & Akhtar, 2004). During 2008-2010, insufficient rains and snowfall in six provinces of Afghanistan caused the major failure of rainfed crops (UPI, 2011). Severe droughts in northern parts of Afghanistan, dryness of pastures and reduction of water resources caused the deaths of thousands of animals. For example, in Samangan province, about 1,400,000 animals have been sold at a low price, while 30 per cent of them died

because of drought (IRIN, 2011). Recurring droughts have increased food insecurity and the level of poverty (D'Souza & Jolliffe, 2014).

Severe droughts continue to have an adverse effect on water resources. They damage the farming system enormously and strain the widely used traditional karez and other gravity flow irrigation systems, particularly as they rely on winter snowfall and consequent water supply in the spring. For instance, karezes are underground canal systems that tap aquifers by gravity via subsurface tunnels. They often extend for many kilometres before surfacing to provide water for drinking and irrigation. Karezes have declined in number and efficiency due to conflict and neglect: "60–70% of the Karezes are not in use due to drought and low groundwater recharge. Out of total 5887 recorded Karezes in Afghanistan, only 11% (611) were identified as being active and 89% (5276) as inactive" (Himat & Dogan, 2019, p. 347)

There are 21 defined wetlands in Afghanistan, three of which are important at the international level. Due to long-term droughts in Afghanistan, the Sistan wetland, located on the border with Iran is completely dried up. Drought, civil war and mismanagement of water resources caused deterioration of karezes and shallow wells in Kandahar and neighbouring provinces, which are the primary source of drinking water for people. About two-thirds of karezes and shallow wells wholly dried during the last three decades and caused a decrease in clean drinking water. Lack of safe and clean drinking water created water-borne diseases like dysentery and diarrhoea in these areas (Habib, 2014). During recent decades, prolonged reduction in precipitation has declined the karez system of water harvesting and underground transmission in the Helmand river basin in southern Afghanistan (Goes et al., 2017).

Also, based on a report in 2003, there were losses of 70 per cent cattle, 77 per cent sheep, 72 per cent goat, 82 per cent horse and 86 per cent camel in five provinces, which covered 183 villages. Nomadic pastoralists lost 90 per cent of sheep and 40 per cent camel in the Registan desert during the drought period in 1998-2002 (Thomson et al., 2003).

As Keshavarz et al. (2010, p. 416) suggest, "farmers are in the forefront of drought management and suffer most from the consequences. Therefore, the micro-level management…with regard to drought is of great importance".

In Afghanistan, farmers have different adaptive strategies to cope with drought impacts. They try to reduce the severity of drought risks at household levels by using two techniques. First, they try some agricultural practices to compensate for their production loss, such as re-cultivation of crops and applying water irrigation to increase production (Jawid & Khadjavi, 2019), or shifting the cropping patterns, which is resistant to drought (Qureshi, 2004). Yet sometimes agricultural practices are not enough due to the high food prices and lower yields. Farmers need cash to provide other basic needs, so they often engage in non-agricultural practices such as

selling their land, livestock and household goods or doing some off-farm jobs to get additional money (Miyan, 2015).

Still, few studies have tried to know the complexity and severity of drought locally and throughout Afghanistan (Aliyar et al., 2021; Aliyar & Esmaeilnejad, 2021).

What are the cultivation practices of irrigated land (Waras) and rain-fed land (Panjab) to respond to droughts' effect? This research questions how farmers cope with drought events and their impacts on Afghanistan's community. Specifically, it examines various strategies used by farmers, what kind of strategies are effective in agriculture. The study demonstrates the need to know the strategies to mitigate drought impacts and presents methods to identify the effective adaptation on poverty alleviation.

2. Material and methods

2.1 Study area

Bamyan is in the Himalayan Mountains ranges in central Afghanistan and extends from 34º35'N to 35ºN, the longitude of 67°25'E to 68°E, and has an average elevation of 500 metres above sea level. Baghlan and Parvan border the province to the north-east; Sari-Pul to the north-west; Samangan to the north; Ghowr province to the west; Daykundi to the south-west; and Wardak and Ghazni to the south-east. It covers 18,029 square kilometres, which is approximately 2.76 per cent of the land in Afghanistan. It has a dry continental climate, and most precipitation occurs as snowfall during the winter months between December and April. The amount of rainfall directly correlates with altitude and varies between 100 millimetres per year and 250 millimetres per year, with mean annual precipitation of 165 millimetres per year. The mean yearly temperature is 7ºC, the maximum temperature is 30ºC in the warm season, and the minimum temperature is -20ºC.

Bamyan province is primarily mountainous with land slopes up to 8° (14 per cent) suitable for cultivation. Two-thirds of the region is unsuitable for cultivation and used for grazing. Most (97.2 per cent) of the population lives in rural areas and is engaged in agriculture. The majority of grazing land is for rearing livestock, which is a significant source of income for farmers. The economy of all communities depends on farming and animal husbandry provided by 90 per cent of the subsistence farmers. There are smallholders farming using irrigated land and rainfed land. Most sustainable farms are on irrigated land, covering 90 per cent of farmland, and irrigation depends on snowmelt-fed streams, springs and karez systems, a gently sloping underground channel to transport water. The other 10 per cent of farmland is rainfed, depending on precipitation during the rainy season. Panjab and Waras districts in the south of Bamyan province are drought-prone, and farms in these districts were chosen

for this study (Fig. 1). The first study site is Panjab district, located 2,700 meters above sea level. The mean temperature falls to –15°C or lower in January; summer temperature varies from 0 to 26 depending on altitude, mean annual precipitation, which is mostly snowfall, is about 40 cm.

The second study site is Waras district, located 2,500 meters above sea level in the southwest of Bamyan province. High mountains surround the area, and the winters are extended to about seven months with heavy snow (UNFPA, 2012). The climate is attractive in the late spring and summer, with good vegetation cover. The rest of the year is governed by harsh and cold weather, and minimum temperatures reach -25°C during winter (Cook, 2011). The migration of young people during cold seasons to foreign countries is one of the survival strategies. The important farming crops are wheat, potatoes, barley and corn. Farmers rear livestock, including sheep, goats, cows, donkeys and horses (Solidarity, 2002). Drought has significantly impacted farming activities. The number of animals has decreased remarkably, and drought effects degrade rangeland. A study conducted by Aliyar & Esmaeilnejad (2021) shows a deficiency of precipitation in 2011 with an amount of 90.9 mm per year, and precipitation decreased by 6.9 mm per year during the study period.

97.2% of the population lives in a rural area, with agriculture as the primary source of employment. Also, most land is rangeland, rearing livestock is a significant source of income for farmers. Therefore, farming and animal husbandry provide livelihoods to farmers, most of whom (90%) are subsistence farmers. The main crops of the study area are wheat and potato, which are used for self-consumption and as a cash crop. Overall, a single crop season has poor agricultural productivity due to production quality and climate status, including harsh winter, recurring drought, and summer flooding. Only 10 per cent of total cultivated land are rain-fed land, and farmers had cultivated rain fed wheat but did not get any harvest from it due to the drought in 2001 and 2002 (Solidarity, 2002).

2.2 Field survey

A farm household survey was conducted during July and August 2020 using a multistage stratified random sampling technique. It was used to select farm families who suffered from drought in Bamyan Province where “food insecurity is among the highest in the country” (Poole et al., 2019). Based on a random sampling of 70 farm families from the study site of Panjab district, in the southwestern part of the province, and 70 farm families from Waras district, in the southern part, respondents were chosen. Both study areas are predominantly Hazara, a Persian-speaking, Shi’a Muslim ethnic group, the third largest in Afghanistan. The final sample size was 140 farm households.

This method assesses the implementation of adaptive strategies to drought via interviews with respondents via a face-to-face semi-structured survey. A household survey was used to evaluate farmers' adaptation strategies to drought. The questionnaire was developed to collect qualitative and quantitative data similar to that in studies by Udmale et al. (2014), Mertz et al. (2009), Ashraf & Routray (2013) and Habiba et al. (2012). Farms were categorised into rainfed or irrigated groups. The rainfed rely on precipitation and stored soil moisture while the other farmers use managed irrigation systems. Data were processed and the results analysed using Statistical Package Social Sciences (SPSS) software. The adaptation strategies, which have been practised by farmers to abate drought effects, were descriptive. The inferential statistic has been used to process data.

3. Results and discussion

3.1 Profile of sampled respondents

The study was conducted in the rainfed (Panjab district) and irrigated sites (Waras district). A total of 140 farmer households were interviewed. Overall, the responders were 97.1 per cent male and 2.9 per cent female. However, in the rainfed area, they were 95.7 per cent male and 4.3 per cent female. The mean age of respondents was 51.4 years old, ranging from 23 to 80 years. Most, 67.1 per cent from the rainfed group and 70 per cent from the irrigated site, were illiterate, missing the basic education. The primary level of education was attained by 18.6 per cent of the rainfed group and 21.4 per cent of irrigated farmland responders (Table I).

The size of farmers' lands was categorised into small (less than 1 ha), medium (1-2 ha) and large (more than 2 ha). The mean landholding size was 2 ha per farmer household. Farms with rainfed cropland are more extensive compared to the irrigated farmlands (Table I). The income of respondents was classified into three groups. The first and second groups of income of respondents earned less than US$1,000 per year. These combined categories were 25.7 per cent from rainfed and 42.9 per cent from irrigated sites. Most respondents (74.3 per cent and 50 per cent from the rainfed and the irrigated areas, respectively) had an annual income from US$1,000 to 2,000. A few farmers (7.1 per cent) earned more than US$2,000 (Table I).

3.2 Crop practice adaptations to combat with drought

As in the 2004 study by Qureshi and Akhtar, various farm-level adaptation strategies were employed to mitigate the impact of drought. In the survey reported here, most farmers tried growing early maturing crops; 100 per cent from Panjab (rainfed area) and 95.7 per cent from Waras (irrigated area) (Table II). The irrigation source in Waras depends on karez systems and springs; therefore, the adaptation

strategies in rainfed locations were different. Waras farmers resorted to inter-cultivation methods (75.7 per cent) and grew non-traditional crops (30 per cent) or engaged in crop rotation (45.7 per cent). In contrast, rainfed crops could draw on moisture stored in the land during the rainy and snowy seasons.

In addition to the use of early maturing crops, other strategies implemented by farmers in both sites included a change in crop pattern and seed treatment before planting. Data shows that 21.4 per cent of farmers from the rainfed site and 65.7 per cent of farmers from the irrigated area changed crop patterns as an adaptive strategy. Most of the respondents (84.3 per cent from the rainfed site and 18.6 per cent from the irrigated site) practised seed treatment before planting. This finding is corroborated by other studies in Herat and Badakhshan provinces that showed farmers with local knowledge adapted various options. These included storing the crop harvest, using crop residue for livestock, early sowing and selecting less water consuming fields, reducing cultivated areas and changing the crop calendar (Iqbal et al., 2016; Iqbal et al., 2018). Similarly, earlier research highlighted changing cropping patterns and reducing cropped areas adopted by farmers in Helmand and Kandahar provinces (Qureshi & Akhtar, 2004).

Bhattacharya et al., 2004). Previous research also reported practices such as altering the crop calendar, cultivating low water-consuming crops, diversifying the crops and changing the crop pattern (Sarwary et al., 2020). In the Central Highlands of Afghanistan, Jawid and Khadjavi (2019) found that the impact of climate change spurred on improved seeds and more work on the farm. Using innovative scientific techniques during crop cultivation and turning to drought-resistant crop cultivation were adaptive techniques reported in a further study of smallholder farmers (Omerkhil et al., 2020). In parts of Afghanistan, farmers are also shown to have diversified into high-value crops to less water consumption as poppies and saffron (Mihran, 2011; Palau, 2012).

3.3 Soil and water adaptive strategies to deal with drought

In addition to rebalancing their farm enterprises, several water conservation and adaptive soil strategies are taken by respondents in response to drought. Almost 86 per cent of farmers surveyed from the irrigated site made small construction bunds or embankments to store water for crops. In rainfed sites, 41.4 per cent of respondents levelled land. Levelling land is the kind of practice that farmers traditionally employ after ploughing, or in some cases after cultivation, to conserve water or moisture.

In Panjab, most rainfed crops are common varieties of wheat and barley harvested in the autumn season using traditional methods. Farmers applied different practices such as prolonged irrigation and adding fertiliser in the irrigated research

site. The contrasting modus operandi has resulted in different adaptive strategies such as watering during the night (28.6 per cent), decreasing the area for watering (76.8 per cent), improving streams (51.4 per cent) and other watershed management methods (30 per cent). These procedures are implemented by farmers in the Waras district on irrigated farms to reduce drought impacts (Table III). The pattern is replicated in parts of central Afghanistan where similar meteorological conditions are experienced. Researchers in these areas report methods like keeping the land as fallow as practical examples of exchanging traditional irrigation systems for modern irrigation techniques. Water harvesting practices and reduced water usage strategies were followed by farmers (Sarwary et al., 2020). Studies also report drip and sprinkler irrigation (Quraishi, 2018, Iqbal et al., 2016), digging deeper and bigger wells for irrigation (Mihran, 2011; Bhattacharya et al., 2004), rehabilitating karez systems, drilling new boreholes (Goes et al., 2017) and using farm ponds to store rainwater (Qureshi & Akhtar, 2004).

3.4 Livestock management adaptation strategies to cope with drought

Animal husbandry is a significant part of Afghan farmers' livelihood. Agro-pastoralists use livestock production, selling animals and related products to ensure subsistence for themselves and their families. Rearing livestock, supplementary feed for livestock, increasing the number of animals, cultivating irrigated fodder, and preserving its resources were all major adaptation strategies. A majority (68.6 per cent) of respondents from rainfed farms, an overall 60 per cent of respondents, provided supplementary feed to livestock. Also, increasing the number of small animals, sheep and goats was mentioned by 50 per cent and 57.1 per cent from the rainfed and irrigated areas as adaptive strategies, respectively. Most livestock production is comprised of rearing sheep and goats. Farmers grow fodder crops, dried and stored for use as fodder. About half of respondents practised fodder cultivation in both rainfed and irrigated areas to support their livelihood during a critical situation.

Furthermore, fodder preservation for rearing animal husbandry during cold seasons was a primary adaptive strategy to decrease natural disaster impacts. These strategies are followed by 57.1 per cent of farmers from the rainfed site and 65.75 per cent of farmers from the irrigated area. The statistical calculation has shown no significant differences in adaptation strategies on livestock management (Table IV). In an older study in Kandahar and Helmand provinces, Iqbal et al. (2018) found a similar result in Herat as did Qureshi and Akhtar (2004). The use of stored crop residue for livestock and the selling of animals and their products are common strategies applied by farmers.

3.5 Non-farm adaptation in response to drought

Off-farm work is regularly sought by farmers in response to drought (Qureshi & Akhtar, 2004). The current study highlights similar adaptation strategies to cope with drought vulnerability. A significant majority of all the farm households studied relied on off-farm generated income. In addition to seeking employment, 52.9 per cent of respondents produce handicrafts as an adaptive strategy in the irrigated areas.

Further, migration and selling assets were tactics used by farmers in both rainfed (35 per cent) and irrigated farms (60 per cent) to compensate for the impact of drought. A few respondents (24.3 per cent) sold jewels during periods of distress. (Table IV) The study of Qureshi and Akhtar (2004) similarly points to the sale of assets like jewellery, watches and other domestic items. During the drought period under review here, 22.9 per cent of rainfed farms and 17.1 per cent of irrigated farms decreased costly foods, and 32.9 per cent of respondents from the rainfed area and 34.3 per cent of respondents from irrigated areas shunned expenses such as anniversaries, ritual ceremonies and graduations. Donations to charities also declined. There were no significant differences between farm categories concerning reducing costs (Table V).

Drought is a major problem undermining income from agriculture production. Consequently, efforts are being made to provide farmers with financial adaptation. The economic adaptation strategies were practised, i.e. borrowing money from banks, relatives and agriculture associations. Savings were drawn upon and the borrowing of food grains occurred. The severity of drought can lead to farmers shifting to non-farm work and giving up agriculture in the rainfed site. Similar types of results are shown by various researches in Afghanistan (Jawid & Khadjavi, 2019; Omerkhil et al., 2020; Quraishi, 2018): changing occupation, migrating to cities or neighbouring countries, non-farm employment, and even resorting to food aid are established responses to economic pressure (Mihran, 2011). Adaptive strategies have also been shown to include increasing child labour and early marriage of girls in exchange for money (Bhattacharya et al., 2004). The production of opium also rises. Many households resort to the sale of prepared foods and firewood. Remittances, government benefits and begging are also a feature of extreme financial pressure arising for drought episodes (Assil & Dash, 2011). Drought is a major problem undermining income from agriculture production. Consequently, efforts are being made to provide farmers with financial adaptation. The economic adaptation strategies were practised, i.e. borrowing money from banks, relatives and agriculture associations. Savings were drawn upon, and the borrowing of food grains occurred. The severity of drought can lead to farmers shifting to non-farm work and giving up agriculture in the rainfed site. Similar types of results are shown by various researches in Afghanistan (Jawid & Khadjavi, 2019; Omerkhil et al., 2020; Quraishi, 2018): changing occupation,

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The study's finding is consistent with the theme of this paper and with the data analysis presented. First and foremost, farmers are using various adaptation strategies in their farms. On the other hand, farmers are conducting off-farm adaptation strategies widely due to a lack of government support and technical knowledge and availability of poverty conditions. Also, the finding has shown annual farm income, education, and experiences to ensure that would adapt the state of the art climate adaptation strategies. Secondly, farmers do not respond to the information appropriately and achieving the correct answer is scarce. Political condition is another issue with collecting the data; the study results show by raising the awareness to address the limitation of studies in the future.

4. Discussion

Afghanistan is undoubtedly about to experience a period of political uncertainty, and many changes in policy direction may be anticipated. These new measures will impact the economic and social life of the country in unpredictable ways. Similarly, the impact on production, supply chains and consumer demand of the COVID pandemic will take time to assess. However, what is clear is that Afghanistan will face substantial climate challenges, a fate it shares with the rest of the globe. Agriculture will be at the forefront of change. The response of the Afghan government will need to be reflected in infrastructural investment in water management systems, education and social supports for affected farmers.

In the past ten years, the proportion of added value to the economy from agriculture has declined as the service sector has grown. This trend is likely to fall as foreign aid input diminishes. Farming, including the unofficial trade in opium, may take a more prominent role. The options open to farm households to adapt to climate and economic changes must be examined in detail.

Drought and climate change can have severe consequences for agricultural production. Adaptation is actions to decrease farmers' drought vulnerability and secure the farm sector's performance at the aggregate level. Bamyan province has experienced consecutive droughts during recent years. According to Miyan (2015), South and South-eastern Asian countries have been suffering from rising drought. The

central Afghanistan province of Bamyan has experienced repeated drought during recent years resulting in serious agricultural losses. The population that lives in rural areas and is engaged in agriculture and animal husbandry is especially vulnerable. Respondents in this study applied adaptive strategies based on their knowledge and experiences in the farming system.

5. Conclusion

Overall, the study results show differences in strategy practice in terms of livestock, soil and water conservation.

Similar adaptation strategies have been found in both Panjan and Waras districts:

- growing early maturing crops and change in crop pattern;
- seed treatment before planting supplementary feed to livestock;
- increase number of small animals (sheep & goats);
- fodder cultivation and Storage;
- increase the number of family labourers;
- borrowing from commercial banks, agricultural cooperatives and relatives;
- reducing non-food expenditure and spending on costly food items;
- borrowing food grains from relatives;
- migration; and,
- shifting to non-farm work.

Waras district is an irrigated area, and other adaptation strategies were implemented that differed from rain-fed sites, including:

- using tolerant crops;
- inter cultivation systems;
- growing non-traditional crops;
- crop rotation;
- construction of small bunds;
- watering during the night;
- decreasing the area for watering;
- improving streams to reduce water wastage; and,
- making watersheds

In addition, handicraft, selling jewels and other assets during distress years.

Some rain-fed farmers gave up agriculture in the drought period.

In the case of crop practices, labour use and financial management, there are no significant differences among respondents from rainfed and irrigated farms in applying adaptation action.

The present study indicates farmers have devised several ways to decrease vulnerability to drought. Farmers overall select off-farm adaptive strategies such as the production of handicrafts, or they may leave the farm to find employment elsewhere. The findings of the study indicate that farmers apply the traditional approach to abate drought effects. In addition, however, adaptive strategies were employed to address the poor productivity of crops considering water scarcity. Farmers also implemented off-farm strategies to mitigate the impact of drought. Nevertheless, the analysis of adaptive capacity in the study area shows a lack of information and financial sources were significant hindrances to implementing new adaptive strategies. Further, government policy measures are another barrier to overcome when faced with natural hazards.

Several recommendations, informed by the study, are offered, including measures to enhance farmers' understanding of how to decrease climate change effects. Further, the construction of watersheds in both study sites, barrow-well and check-dams in the irrigated area, would lessen the impact of drought. These steps should be augmented by restoring vegetation cover to conserve the water from snowmelt and soil moisture to prevent run-off and decrease water floods in both study sites. More broadly, the government needs to introduce appropriate policies on adaptation to assist farmers in coping with drought.

With targeted and sustained action by the public authorities, agriculture in Afghanistan can be equipped to adapt to droughts. The more significant challenges around climate change will require a global response, but the resilience of the farmers in this study deserves to be recorded.

Acknowledgements

The authors gratefully appreciate the support from the Higher Education Development Programme (HEDP), Ministry of Higher Education of Afghanistan.

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Annex

Table I. Profile of sampled farmers in study areas, Bamyan province, Afghanistan.

Profile	Details	Panjab district (n = 70)		Waras district (n = 70)		Chi-square
		No.	*%*	*No.*	*%*	
Gender	Male	68	97.1	67	95.7	p =0.649 ns
	Female	2	2.9	3	4.3	
Age	≤ 40	10	14.3	15	21.4	p =0.282 ns
	41 – 60	40	57.1	42	60	
	≥ 61	20	28.6	13	18.6	
Education	Illiterate	47	67.1	49	70	p =0.678 ns
	Primary	13	18.6	15	21.4	
	Secondary	7	10	5	7.1	
	Diploma	3	4.3	1	1.4	
Land size (ha)	≤ 1	12	17.1	29	41.4	p = 0.000**
	1 - 2	28	40	32	45.7	
	≥ 2	40	42.9	9	12.9	
Income (US $)	≤ 1000	18	25.7	30	42.9	p = 0. 003*
	1001- 2000	52	94.3	41	50	
	≥ 2000	0	0	4	7.1	

ns not significant; **P* < 0.05; ***P* < 0.01

Table II. Adaptation strategies to cope with drought in terms of crop practiced.

Agricultural practices	Panjab district (n = 70)		Waras district (n = 70)		Chi-square
	No.	*%*	*No.*	*%*	
Growing early maturing crops	70	100	67	95.7	p = 0.08 ns
Tolerant crops	0	0	63	90	p = 0.000**
Inter cultivation system	0	0	53	75.7	p = 0.000**
Change in crop pattern	15	21.4	46	65.7	p = 0.000**
Seed treatment before planting	59	84.3	13	18.6	p = 0.000**
Growing non-tradition-al crops	0	0	21	30	p = 0.000**
Crop rotation	0	0	32	45.7	p = 0.000**

ns not significant; ***P* < 0.01

Table III. Adaptation strategies related to soil and water conservation for field crops

Water management	Panjab district (n = 70)		Waras district (n = 70)		Chi-square
	No.	*%*	*No.*	*%*	
Construction small bund	0	0	60	85.7	p = 0.000**
Level of land (Mala)	29	41.4	0	0	p = 0.000**
Watering during night	0	0	20	28.6	p = 0.000**
Decrease area for watering	0	0	55	78.6	p = 0.000**
Improved stream (reduce water wastage)	0	0	36	51.4	p = 0.000**
Making watershed	0	0	21	30	p = 0.000**

**$P < 0.01$

Table IV. Adaptation strategies related to livestock management.

Statement	Panjab district (n = 70)		Waras district (n = 70)		Chi-square
	No.	*%*	*No.*	*%*	
Supplementary feed to livestock	48	68.6	42	60	p = 0.290 ns
Increase number of small animals (sheep & goats)	35	50	40	57.1	p = 0.397 ns
Fodder cultivation	33	47.1	37	52.9	p = 0.499 ns
Fodder Storage	40	57.1	46	65.7	p = 0.298 ns

ns not significant

Table V. Farmers' non-farm adaptation practices to cope with drought in both study areas.

Statement	Panjab district (n = 70)		Waras district (n = 70)		Chi-square
	No.	*%*	*No.*	*%*	
Handicraft	0	0	37	52.9	p = 0.000**
Increase the number family labourer	80	85.7	54	77.1	p = 0.192 ns
Borrowing from Commercial bank	16	22.9	56	80	p = 0.000**
Borrowing from agricultural co-operative	22	31.4	15	21.4	p = 0.180 ns
Savings accrued	12	17.1	15	21.4	p = 0.520 ns
Borrowing money from relatives	20	28.6	31	44.3	p = 0.053 ns
Reducing expenditure for non-food expenditure	23	32.9	24	34.3	p = 0.858 ns
Reducing spending on costly food items	16	22.9	12	17.1	p = 0.398 ns
Borrowing food grains from relatives	14	20	39	55.7	p = 0.000**
Selling jewels during distress year	0	0	17	24.3	p = 0.000**
Migration	20	28.6	42	60	p = 0.000**
Shifting to non-farm work	35	50	9	12.9	p = 0.000**
Selling assets	1	1.4	23	32.9	p = 0.000**
Giving up agriculture	15	21.4	0	0	p = 0.000**

ns not significant; **$P < 0.01$

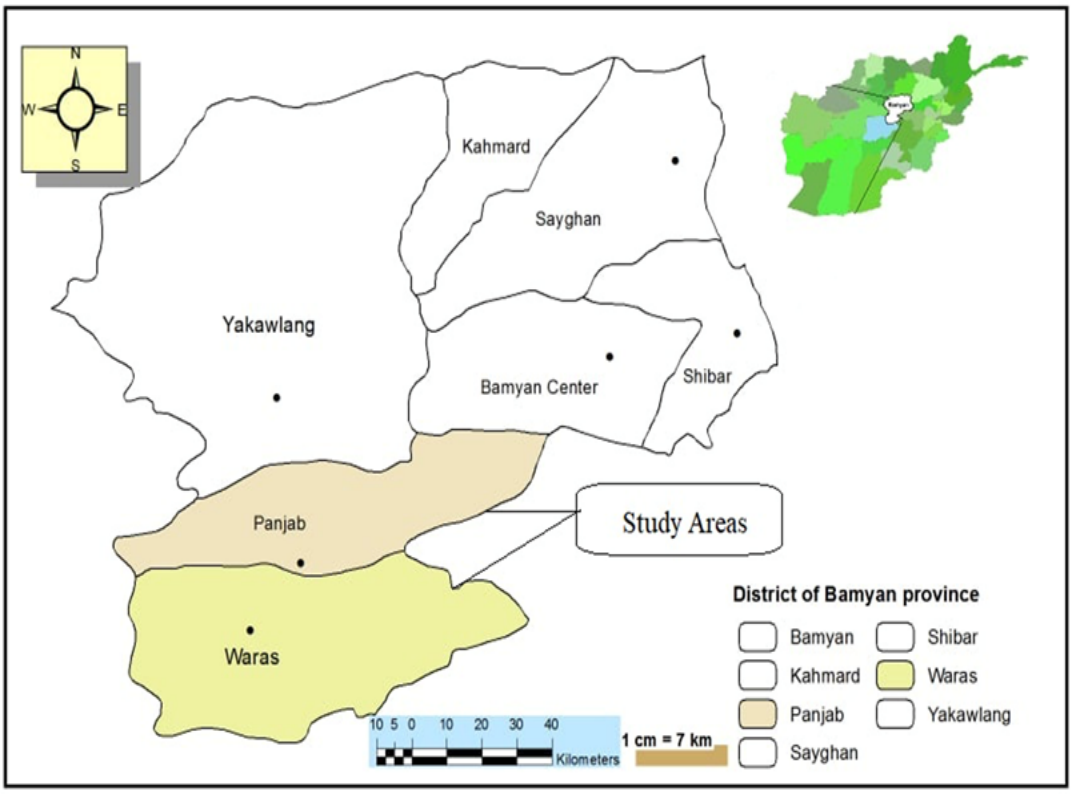

Figure 1. Map of the study area in South-Western of Bamyan Province, Afganistan