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RESEARCH PAPER

Farmers' Coping and Adaptive Behavior toward Drought Hazard in the North-West Region of Balochistan, Pakistan

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ABSTRACT

The aim of this study was to understand the farmer's coping and adaptive behavior toward drought and to determine its negative effects on agriculture in the northwest of Balochistan. Drought is the most devastating disaster which not only affects agriculture but also livestock, humans and other sectors. To achieve the desire objectives, 264 farmers were selected and interviewed personally through multistage sampling. In addition, weighted average index, adaption strategy index has also been employed. The worse climatic condition had led to crop failure, decline in crop production, water scarcity and loss of livestock. Farmers employed number of techniques to cope with the climatic stress that include, crop diversification, efficient water management, input adjustment, asset depletion and consumption smoothing etc. There is a need of a more resilient strategies to decrease the vulnerability of drought and cultivate climate resilient crops that can be sustained with low water and give high production.

KEYWORDS Adaptation, Adaptive Strategy Index, Balochistan, Coping, Drought

Introduction

Balochistan the largest province of the country in term of area is one of the most vulnerable province concerning environmental, social and economic impacts imposed by climate change (Maria et al., 2023). More than half of its land is under the severe threat of drought hazard. Almost 85% of the province's population income is mainly dependent on agriculture sector. Balochistan has frequently faced many severe droughts events in the recent past, i.e., 1966–1968, 1970, 1973 to 1974, 1993, and 1998 to 2003. Communities in the Balochistan province are highly dependably on agriculture and have face difficulty in adapting to and managing with the drought in order to maintain their way of life. The agriculture related communities in the Province are struggling with drought coping and adaptation in order to manage their lives and livelihoods (Durrani et al., 2021). Farmers had suggested several coping and adaptation practices for drought mitigation and management that are time consuming and required a significant amount of investments (Islam et al., 2014). Coping strategies are mainly developed to mitigate the adverse impact of drought hazard based on the farmers' awareness and preparedness. It is important to understand that which kind of coping strategies are taken by farmers using their local indigenous knowledge and existing resources to minimize the drought impacts in the study area. The north-west farming communities of the province are struggling and have faced difficult time as a result of drought to sustain their agriculture practices and livelihood. Present study was conducted in district Mastung located in the North-west region of Balochitsan. The north-west region of the province has been observed by the previous extreme drought spells. According to Durrani et al., (2021) the yield reduction of major fruits was reported as 15-25% in the province. According to Pakistan Metrological Department and Pakistan Economic Survey District Mastung is one of the most vulnerable District of Balochistan province and agricultural production in the district was declined severely during last drought spell (NDMC & PMD, 2016). Beside other district of Balochistan District Mastung, is severely affected by drought and depleting more than 50% of their vegetation.

This study particularly intends to evaluate the farmers' coping mechanisms against the drought in the Balochistan's northwest, and to comprehend the adverse impact of droughts on agriculture. Hence, farmers have been adapting some useful adaptation measures in this region through their own commitments and efforts, to overcome the consequences of drought disaster which should be enhanced through proper research and acknowledged.

Literature Review

Climate change is an environmental issue which is worsening in the future due to extreme environmental conditions (IRDR & ICSU, 2013). Drought is slow on set disaster but also have immediate impacts on all sectors that cannot be passed over such as decreased crop yields, a drop in groundwater levels, an increase in pasture and forest fires, and an increase in the mortality rates of both domestic and wild animals. Additionally, it has unintended consequences including decreased crop yields, rising commodities prices, immigration, and unemployment (Prokopy et al., 2013, Chilimba et al., 2020, Zobeidi et al., 2022). The main source of income of the South-Asian countries is agriculture and its related production. So, adverse climate change conditions pose severe threats to their economic well-being, social, and ecological (Zobeidi et al., 2022). In Pakistan 70-80% of the total population's foods and livelihoods depends on agriculture sector and is directly linked with the vulnerable farming communities and environment (Ashraf & Routray, 2015).

Khan et al., (2018) argue that "farmers create coping mechanisms to cushion abrupt shocks and strains in their farming systems, and these mechanisms frequently co-exist with longer-term adaptive techniques". Further, while coping methods work well for temporary adjustments and are less long-term durable than the adaptive ones. Some of the coping strategies and approaches are used and shared within farming communities throughout the region, such as use of salinity/drought tolerant varieties, shifting the planting time, changes in irrigation patterns and rainwater harvesting (Ashraf et al., 2014). Drought mitigation strategies requires substantial amount of investment and is time consuming.

Material and Methods

Research Study area

The Mastung district is situated between longitudes 66° 11ˡ 34" and 67° 25ˡ 59" east and latitudes 29° 20\ 13" to 30° 15\ 8" north. It is bordered by the districts of Quetta to the north, Sibi and Bolan to the east, Kalat to the south, and Chagai to the west. The weather in the district is extreme. Summers are scorching and winters are bitterly cold.

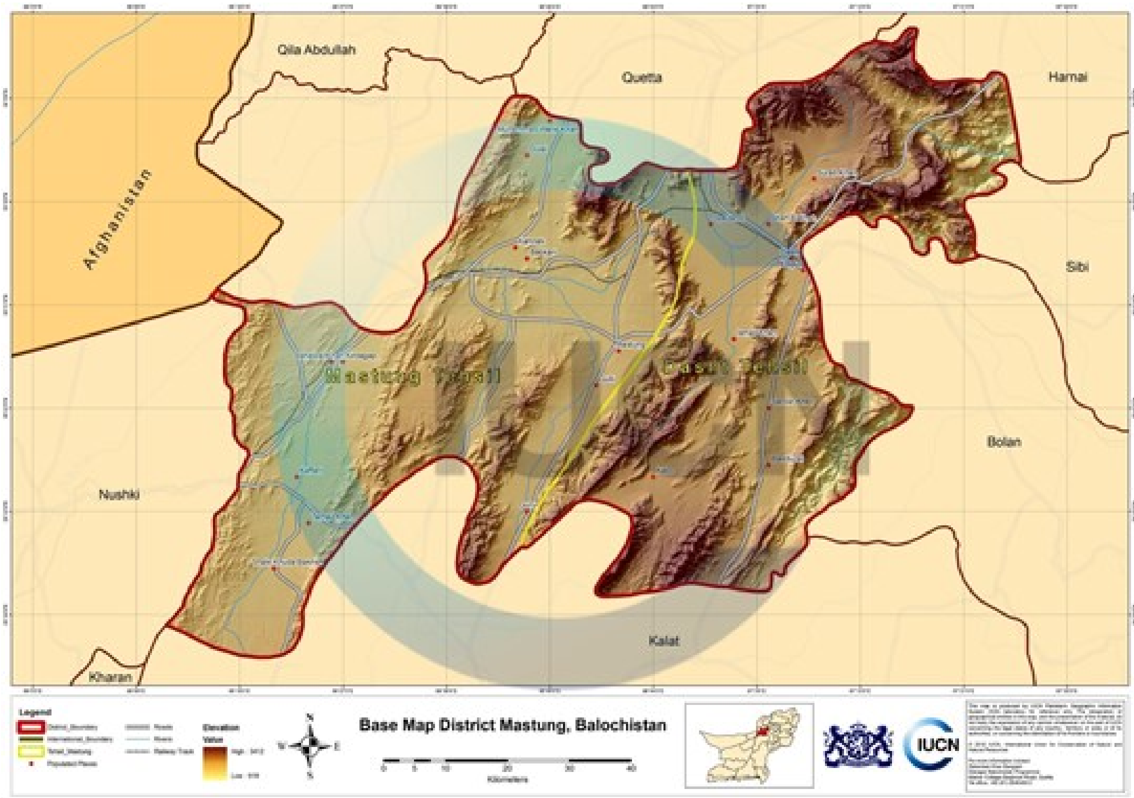

Figure 1. Study Area Map (Source: IUCN)

The winter months of January through March see the most of the precipitation. There is snowfall but not much rain in the district. The district receives 200 mm of rainfall annually. Only a small portion of the district is covered with forest and these are the Balochistan dry temperate scrubs (Steppe) forest. Mid-April marks the beginning of the summer season, which lasts until mid-September. The warmest month is July, with mean high and low temperatures of roughly 36°C and 20°C, respectively.

Sampling design

Household's heads who are responsible for all kinds of major decisions and socio-economic activities is the primary unit of analysis for the questionnaire survey in this study. The study area is characterized by a thin and scattered population. Nushki District consists of ten (10) union councils. A union council is the grass root level political unit in the district. Four (04) most affected union councils, as reported by (Khair et al., 2015) were selected for the household survey. The selected union councils that are affected from drought include union council Ahmed Wal, Anam Bostan, Daak and Kishingi. The sample size (264) was derived on the basis of the population size (number of households) in the selected union councils. The sample size (Equation 1) was calculated following the formula of sample size calculation by Arkin & Colton (1963) with 5% margin of error and 95% confidence interval. In order to select the respondents from the field, multistage sampling has been used. Union councils have been chosen on the basis of their vulnerable situation in the context of drought hazard at the first stage. Villages (a small administrative unit in term of rural area) were taken randomly at the second stage. Finally, farmers were chosen randomly from each village of Union Councils to collect the required information. Semi-structured questionnaire which is an effective tool for data collection is used to collect the desired information.

$$n = \frac{Nz^2 PQ}{Ne^2 + z^2 PQ}$$ Equation 1

Weighted average index (WAI)

Weighted average index is used for perceived effects of drought on horticulture crops. A number of questions were asked from farmers regarding drought coping strategies. Each question was further categorized into five knowledge categories such as memorizing, understanding, applying, examining and evaluating climate change and droughts and their coping strategies. A mark of (2-3) was assigned to each question on the basis of farmers responses. For the correct answer a full mark is given, half a mark and zero mark were given for a partial and wrong answer respectively. A four points rating scale is used to examine the impacts that farmers believe the drought has had on their agriculture sector. The most important thirteen indicators were considered such as soil water moisture scarcity, increase in production's cost, stunted crop growth, decrease in crop production, low income, , shortage of food, off-farm activities transformation, crop wilting, enhance fallow land, loss of livestock production, variation in planting time, variation in livestock composition and crop failure. Following the indicator selection, the study area's farmers were asked to assess the negative effects of the drought on their agricultural output on a scale of high, medium, low, or none at all, with corresponding scores of 3, 2, 1, and 0. The scale's score ranges from 0 to 39, where 39 indicates a high effect and 0 indicates no effect. To know the high effect of drought the ranking of the variables was prioritized. Similarly, a weighted average index (WAI) carried out by Ndamani & Watanabe (2016) as indicated by equation 2, a particular coping strategy was further evaluated to determine which coping strategy among the strategies in the study area was most important.

$$WAI = \frac{Fh * 3 + \mathrm{Fm} * 2 + Fl * 1 + \mathrm{Fn} * 0}{\mathrm{N}}$$ Equation (2)

Where,

WAI = weighted average index,

Fh = frequency of respondents responses with high drought effect,

Fm = frequency of respondents responses with moderate drought effect,

F_l = frequency of respondents responses with low drought effect,

Fn = frequency of respondent's responses with no drought effect, and

N = Total number of respondents.

Adaptation strategy index (ASI)

The adaptation strategy index is used to determine the extent to which farmers have practiced coping strategies in the event of a drought. Based on the responses collected, the farmers were divided into four categories regarding their use of coping strategies: regularly, occasionally, seldom, and not at all. The scores assigned to these categories ranged from 0 to 42, where 0 indicated no practice and 42 indicated widespread practice. Based on the obtained scores, the farmers were further divided into three divisions, namely low, moderate, and high practicing. To determine how many farmers responded by utilizing the drought coping strategies, an adaptation strategy index (ASI) for individual coping strategies was computed by Uddin et al. (2014) in (Equation 3). The equation 3 illustrates how an adaptation strategy index (ASI) for a particular coping strategy was further evaluated to determine the proportion of farmers who responded to employ that specific coping strategy out of all the techniques in the research area.

$$ASI = ASr * 3 + ASo * 2 + ASs * 1 + ASn * 0 \quad \text{Equation (3)}$$

Where,

ASI = is the adaptation strategy index,

ASr = is the number of respondents with regular practice of drought coping strategies,

ASo = is the number of responses with occasional practice of drought coping strategies,

ASs = is the number of responses with rare practice of drought coping strategies,

ASn = is the number of responses with no practice of drought coping strategies.

The data is processed by using a different statistical test to identify the problems, current scenario and generate a genuine result on the bases of facts and figures in the study area.

Results and discussion

On-farm strategies

Crop diversification and management

Crop diversification refers to the practice of growing a variety of crops instead of relying on a single crop growing high yielding and drought tolerant crops. Crop diversification techniques strengthen agricultural communities' resistance to climate change and lessen their susceptibility to severe weather occurrences (Gora et al., 2019). Different crops have varying tolerances to temperature, precipitation, and other environmental factors. By diversifying crops, farmers can spread the risk and ensure some level of productivity even if one crop is adversely affected by climate conditions. Luu et al., (2019) indicated that crop diversification is one of the important tools to minimize the losses of agriculture production due to climatic events. In this study, we examined the crop diversification practiced by farmers in the study area. The aim was to assess how diversifying crop choices contributes to yield stability, resource-use efficiency, and overall farm sustainability. Results of the Figure 2 shows that, about 17% of the farmers opted to grow drought tolerant crops in their fields due to recurrent phase of climate change. Similarly, almost 9 % farmers planted high yield verities. Farmers mentioned that high-yield crop varieties play a crucial role in their agriculture production, helping them to increase productivity and meet the growing demand for food. Some of the farmers mentioned that, Norman is the new type of wheat verity practiced by them in the study area which is known for its high yielding, adaptability to various growing conditions, and resistance to common wheat diseases. In addition, about 7% of the farmers planted short duration verities. They further revealed that these short duration varieties in agriculture typically refer to crop varieties that have a shorter growth cycle, allowing for quicker harvesting. These varieties are often developed to adapt environmentally stress conditions or to facilitate multiple cropping cycles in a year. Farmers in the study area have been also practicing to grow more than one crop or verity in that particular piece of land. The farmer's perceived that, growing different crops on the same land reduces the risk associated with relying on a single crop. If one crop fails due to pests or adverse weather conditions, others may still thrive. When the prolonged drought hit the region, farmers had little actual information of which drought-resistant crops to plant (Durrani et al., 2021). Some farmers further explained that planting a mix of crops can improve soil health. Some plants may add nutrients to the soil, while others may help control soil erosion like tomato, potato, onion etc.

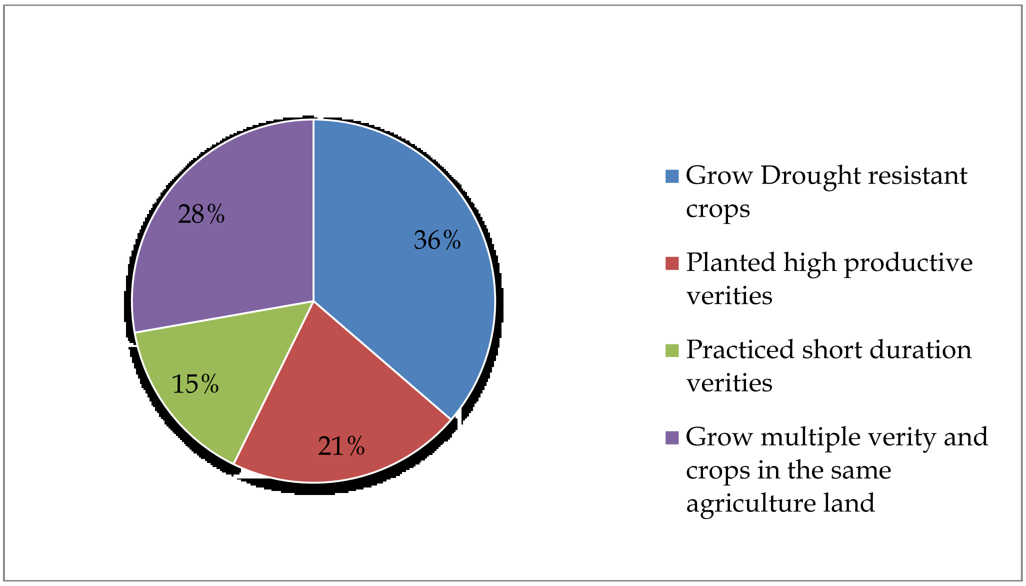

Figure 2. Farmers crop diversification practices.

Agriculture inputs adjustment

In addition to crop management, agriculture inputs adjustments are also one of the impotent adaptive strategy against climate change. Agriculture inputs adjustments refer to modifications or changes made in the various elements that contribute to the agricultural process. Agriculture inputs include fertilizers, pesticides and manure. The main purpose of the inputs adjustment was to enhance productivity, reduce environmental impact, and ensure the long-term viability of farming practices. Figure 3 provides the comparative analysis of agriculture inputs in the study area before and after drought situation. Due to drought stressed condition farmers increased the use of fertilizer by 15% in the study area. Farmers further explained that by adjusting the use of inputs, particularly water-soluble fertilizers, it can reduce water requirements for crop growth. This is crucial during drought conditions when water availability is limited. Similarly, more than 6% increase has been observed in the use of pesticides in the study area. Farmers explained that drought-weakened plants are often more susceptible to pests and diseases, so the use of more pesticide can protect the plants from disease. Apart from fertilizer and pesticides an increase of more than 4% observed in the use of manure as well. They mentioned that manure can enhance a plant's ability to tolerate stress. For example, certain micronutrients or organic amendments may improve a plant's resilience to drought conditions.

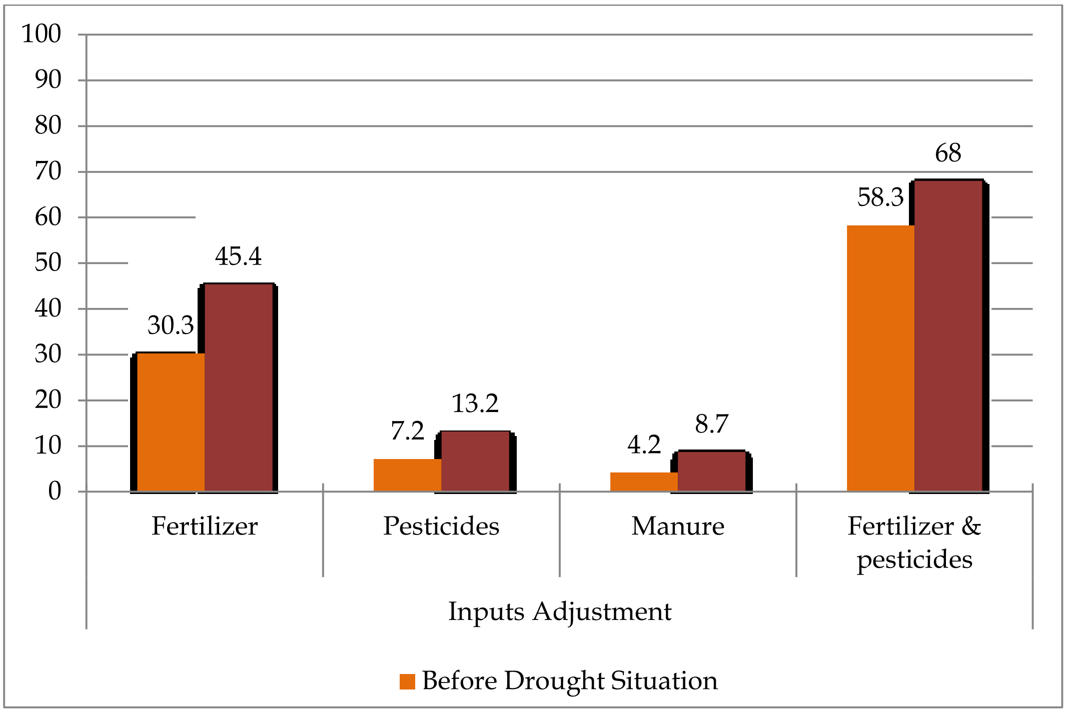

Figure 3. Agriculture inputs adjustment by farmers due to drought/climate change.

Water management practices

To reduce the severe impacts of drought in the study area, farmers have used a number of techniques to efficiently use the available water to fulfill the water requirements for their orchards. These techniques include, digging more tube-wells, rain water harvesting, cutting of extra tress, cemented ponds construction, giving water to the plants at night time and dividing the land into small piece of plots. The study area's farmers made every effort to shield their orchards from the effects of drought and climate change. Majority (65%) of the farmers used digging more tube wells as a coping strategy in order to fulfill the water requirements for their orchards and to minimize the severe impact of drought. In order to minimize the overuse of water, 17% farmers opted to use pipes for watering. Pipe watering provides a range of benefits, including reduced water loss, precise water delivery, conservation of water resources, and enhanced control over the irrigation process. Similarly, 9% farmers constructed cemented water channels to save water. Some more than 4.5 % farmers opted rainwater harvesting. They argue that rainwater harvesting is a versatile and sustainable practice that contributes to water conservation, improves water availability, and provides an alternative water source for various needs. In addition, 20% farmers practiced watering at night. Off-farm revenue was cited by (Ashraf et al., 2014 & Salmoral et al., 2020) as a risk-reduction strategy employed by farmers to reduce the hazards associated with droughts. However, the farmers are also encouraged to use rainwater gathering by their off-farm income (Ashraf et al., 2014 & Salmoral et al., 2020). They further explained that watering at night time takes advantage of cooler temperatures and lower wind speeds; it reduces the rate of evaporation, ensuring that more water reaches the plant roots instead of being lost to the atmosphere. At the same time some of the farmers removed more water consuming crops and cut down extra trees to manage drought stress condition. Farmers perceived that, removing water-consuming crops and engaging in extra cutting of trees are strategies that might consider during drought conditions as a way to manage water resources more effectively. Only 2% farmers in the study area used drip/sprinkle irrigation system to cope with drought condition.

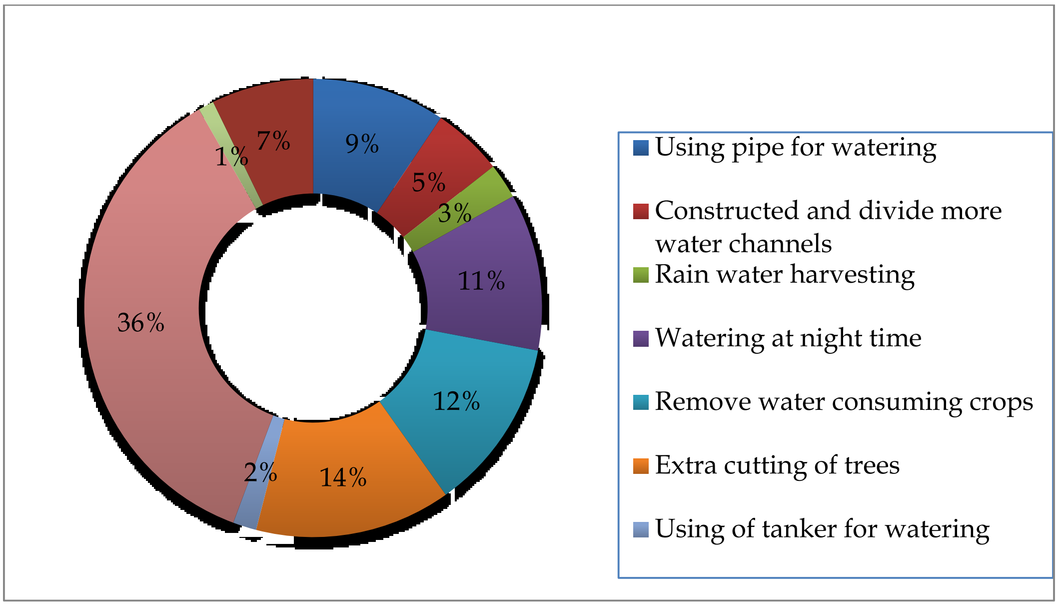

Figure 4. Water management practices during drought condition.

Off-farm strategies

Depletion of assets

Apart from on-farm adaptive strategies farmers also practiced off-farm adaptive strategies. Filed survey further revealed that farmers in the study area practiced assets depletion, consumption smoothing and migration as a coping strategies to cope with drought situation. Murtaza et al., (2023) found that assets depletion is strongly interlinked with drought condition particularly in developing countries. Results of Figure 5 indicates that farmers in the study area sold their assets to cope with drought condition. They sold their non-agriculture and agriculture farm land, livestock, agriculture equipment's and their castles. Majority of the farmers (41%) sold their agriculture equipment's to sustain the livelihood and save their orchards from the effect of drought/climate change. Similarly, 36% of the farmers sold their castles to cope with drought stress condition. In addition, 32% farmers sold their poultry to sustain the agriculture practices in the study area. While 18% and 15% farmers sold their land and household utensils respectively to cope with situation.

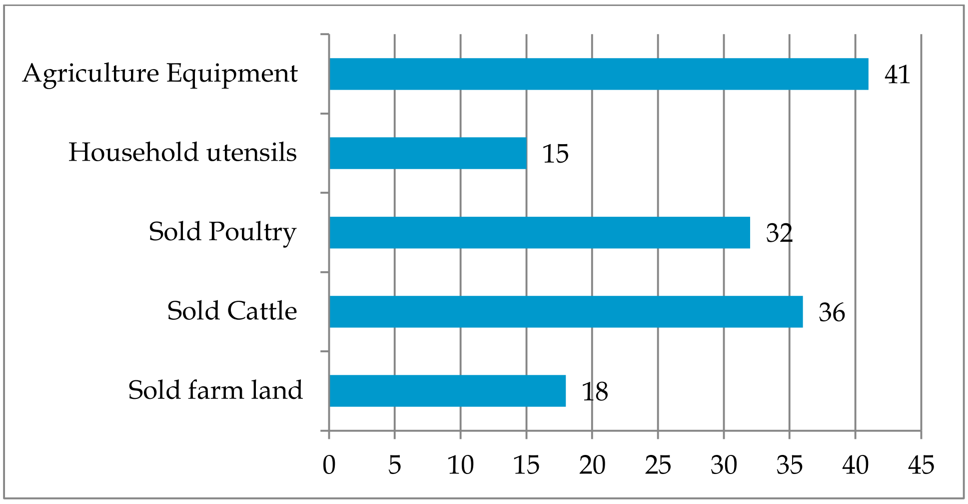

Figure 5. Depletion of assets to cope with climate change.

Consumption smoothing

Apart from assets depletion consumption smoothing is also one of the important adaptive strategy practiced by farmers whenever they faced a severe decline in their income level due to climate change and drought condition. Prior research studies conducted in drought prone countries like India (Chopra, 2006), Pakistan (Durrani et al., 2021), Bangladesh (Islam et al., 2014) and Iran (Hesam et al., 2021) discovered that during drought conditions, farmers with low income levels reduced their household expenditures on food, medical services, education, and other miscellaneous expenses. The majority (66%) of farmers in the study area reduced the amount they spent on their kids' schooling. Poor farmers in the study area couldn't able to continue their children education due low level of income during drought situation. Results of Figure 6 further revealed that majority of the farmers minimized their household expenditures on cloths, food, household construction and festivals.

Migration

As our planet undergoes significant environmental transformations, human populations are increasingly confronted with the need to adapt to these changes. Migration, both internal and external, emerges as a crucial and often pragmatic response to the challenges posed by a changing climate. Agriculture and fisheries have been negatively impacted by rising temperatures, altered precipitation patterns, and extreme weather events. In response, communities may choose to migrate to areas with more favorable conditions for their accustomed way of life. Results of the field survey confirm that 36% of the farmers in the study area migrated to nearby towns and cities to find out the alternative source of livelihoods.

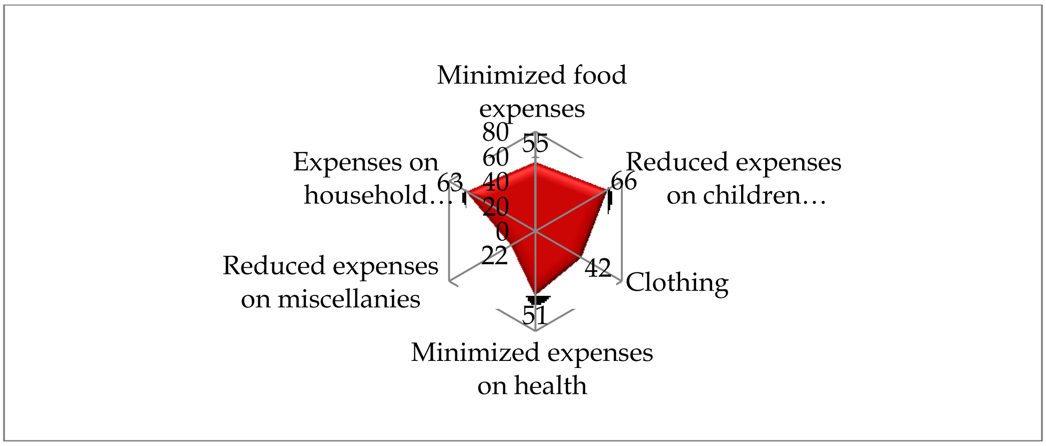

Figure 6. Consumption smoothing due to drought situation.

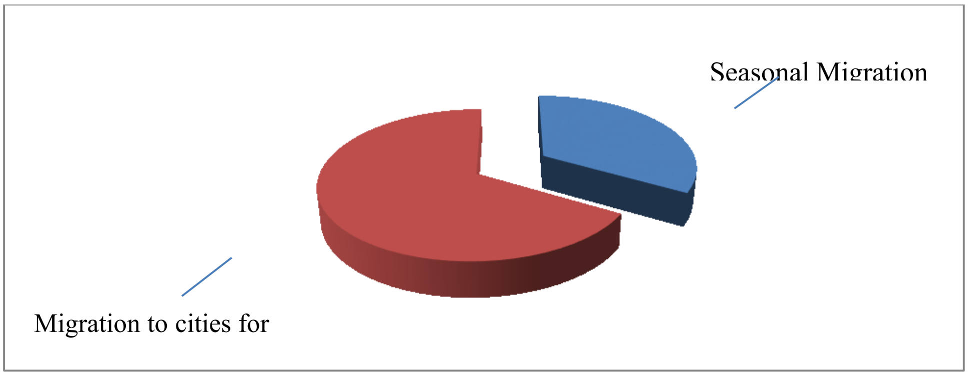

Figure 7. Migration as an adaptive strategy

Famer's perception of drought effects

Agriculture is an important sector for the lives and livelihoods of the farming communities which is highly impacted by the drought hazard throughout the globe (Islam et al., 2014). Based on a set of indicators, the impact of drought danger in the research region was ascertained and the WAI approach was employed for analysis, as indicated in Table 1. Given a WAI score of 2.56, farmers identified the crop failures that had the greatest impact of drought. Respondents reported that using groundwater for fruits and vegetables cultivation i.e. apples, Gaga, Apricot, Grapes, wheat etc. (these crops require a high quantities of water) particularly, in the peak growing seasons, water shortages arises. Farmers further explained that, due to irregular and less precipitation river and the canal is dry all year round, therefore we utilize fully groundwater resources for domestic and irrigation purpose. In the end, we run out of water during the busiest growing season, which leads to crop failure. Farmers believed that the current drought had a negative impact on household income, livestock, agricultural productivity and groundwater consumption (Durrani et al., 2021). Decrease of crop production in the study area with a (WAI of 2.53) is the second highest effect of drought determined by farmers. Farmers reported that the decline in crop production was due to insect outbreaks and pests, which are effects of the drought.

Farmers of the study area further elaborated that, we need to invest a huge amount of money and resources for water and irrigation resources because only few farmers in the study area have their own irrigation sources, However, during the dry season, bug infestations increase and therefore incur additional costs. Majority of the participants confirmed this statement, thus, the proper access to irrigation water resources and installation of new tube wells is of ultimate need to recover farmers' crop production in the study area. The severe impact of drought in the north-west Balochistan has been observed, resulting in decreased agriculture production of fruits and vegetables which are highly dependent on ground water availability. Farmers in the study area with a WAI score of 2.45 determined that the third most significant impact of drought is soil water scarcity. These results are consistent with the other research as well. According to a comparable survey done in Kenya (Makoti & Waswa, 2015), nearly 70% of the farmers (n = 120) said that the most important problem caused by the drought was a lack of water. Similarly, a different study carried out in India by (Udmale et al., 2014) revealed that farmers perceived the depletion of water supplies as the primary consequence of the drought. Similarly, farmers ranked increased production costs (with a WAI score of 2.43) as the fourth most detrimental effect of the drought.

Table 1
Impact of Drought on Horticulture: Farmers' Perspectives

Indicators/Variables	Effects				N	WAI	Rank Order
	High	Moderate	Low	No Effect			
Crop failure	186	54	10	14	264	2.56	1
Decrease of crop production	185	38	39	2	264	2.53	2
Scarcity of soil water	175	45	32	12	264	2.45	3
Increase cost of production	168	55	29	12	264	2.43	4
Lower income	166	44	35	19	264	2.35	5
Loss of livestock	155	55	31	23	264	2.29	6
Food shortage	138	76	37	13	264	2.28	7
Stunted crop growth	98	58	75	33	264	1.83	8
Wilting of crop growth	102	55	65	42	264	1.82	9
Increase of fallow land	110	45	55	54	264	1.79	10

Changes in planting time	45	53	55	111	264	1.12	11
Transformation to off-farm active	55	25	44	140	264	0.98	12
Changes in livestock composition	35	40	45	144	264	0.87	13

Source: Survey data (2021-22)

The shortage of water resources particularly during the peak season of drought requires a huge amount of money for adjustment of water resources, thus it results in the increasing of production cost. Farmers went on to say that in order to cover those additional expenditures, they had to forgo all other necessities, including health and education. Lower income, loss of livestock and food shortage with WAI's scores of (2.35, 2.29 and 2.28) having the fifth, sixth and seventh high effect of drought perceived by farmers respectively. Farmers in the study area also reported that the livestock production i.e. (camels, goats, sheep's and poultry mainly depending upon agriculture production. The majority of respondents stated that the study area's farmers keep an average amount of cattle (10 to 25), and all these animals are herbivores, and they rely on plants and other agriculture production. Thus the lack of proper availability of water resources for agriculture production ultimately results in decrease of crop production and livestock production and finally it results in lower income of the farming community. However, variables from (8 to 13) mentioned in Table 1 perceived comparatively less effects of drought on agriculture production with WAI scores less the 2. The farmers also reported changes in livestock composition with a WAI 0.85 were among the lowest in the study area.

Farmer Adaptation Strategies to Drought

Following expert interviews and with the aid of existing research, a list of fourteen crucial coping mechanisms was discovered. The findings of Table 2 verify that the majority of farmers in the research area (85%) were found to be using low-level drought coping methods. Of the farmers in the research area, just two percent reported a high level of adaptation to drought coping measures, while only thirteen percent reported a medium level of practice. An array of factors, including social, economic, and climatic ones, can impact adaptation techniques to climate change and drought (Shrestha et al., 2017). Rural farming communities are particularly vulnerable to climate change because they typically lack the resources needed to deal with the effects of the drought and the changing environment. The study's findings unequivocally demonstrate that late and low coping and adaptation measures to drought hazard are associated with poor economic conditions, farmers with small land holdings, and ignorance of drought coping tactics. Farmers employ a variety of coping mechanisms to mitigate the worst effects of drought, including deep tube wells, irrigation through pipes rather than open channels, dividing gardens into smaller plots of land, crop diversification, rainwater collection, drought tolerant plants and more. Fruits i.e. (apples, apricot, peach and plum) and vegetables i.e. (potato, tomato, onion and Pease) are found the main agriculture production in the research area. But some farmers also plant olives, grapes, and other novel varieties of apples as alternate, because it consumes less amount of water as compared to rest of the verities. Deep tube well with an ASI score (580) has found the most common coping strategy by farmers in the study area. Due to low precipitation when water resources drying up on the surface of earth then farmers dig deep tube-wells almost more 1000 feet in order to cover the shortage of water for their agriculture fields. Watering through pipes instead of open channels is found the second most common coping strategy by farmers with ASI score of (545). In water stress condition farmers divided their agriculture fields into small piece of land to overcome the water stress condition. This particular coping strategy is found third most common with ASI score of (530) by farmers.

Table 2.
Farmer Adaptation to Drought and Climate Change

Drought Coping Strategies	Extent of Practice				N	ASI	R.O
	(3)	(2)	(1)	(0)			
Deep tube well	135	65	45	19	264	580	1
Watering through pipe instead of open channel	140	45	35	44	264	545	2
Divide garden into small piece of land	140	40	30	54	264	530	3
Drought-tolerant Trees (Olive, Kamari, Gaga, etc.)	130	40	40	54	264	510	4
watering at night time	130	40	34	60	264	504	5
crop diversification	110	67	34	53	264	498	6
Cultivating drought-tolerant crop	101	72	45	46	264	492	7
Re-excavation of pond, khari and canal	120	46	34	64	264	486	8
Rain water harvesting	110	55	25	74	264	465	9
Income diversification	120	35	13	96	264	443	10
Shallow tube-well	55	84	65	60	264	398	11
Less water required crop cultivation	95	35	32	102	264	387	12
Agriculture inputs (Fertilizer, Pesticides and Manure)	40	65	45	114	264	295	13
Hand tube-well	20	24	15	205	264	123	14

Source: Survey data, 2021-22. Code: 3 = regularly, 2 = occasionally, 1 = seldom and 0 = Not at all, RO = Rank Order

Cultivation of drought-tolerant crops varieties such as Olives, Grapes etc. was found the fourth most important and common drought coping strategy with ASI score (510) as mentioned in Table 2. Watering to the plants at night time is found the fifth most common strategy with ASI score of (504). This assertion also aligns with the findings of (Ashraf & Routray, 2013). Crop diversification and drought-tolerant crop cultivation has found the sixth and seventh most common drought coping strategies adapted by farmers with ASI scores of (498 and 492) respectively in the study area. Some other coping strategies such as re-excavation of pond with ASI score (486), khari and canal, rain water harvesting with ASI score (465), income diversification with ASI score (443), shallow tube-well with ASI score (398), less water required crop cultivation with ASI score (387) and agriculture inputs (Fertilizer, Pesticides and Manure) with ASI score (295) are partially adapted by farmers. The use of hand tube-well with an ASI score (123) deemed to be of the least importance for irrigation water. Compared to tube-wells, hand tube-wells require less effort and use less water due to their human power.

Conclusion

In the context of climate change, adaptation strategies are typically assessed using various indices and indicators that evaluate a region or a country's readiness and capacity to adapt to the impacts of climate change. The coping strategies employed by farmers, such as crop diversification, agriculture input adjustments, and various water management practices, highlight their resilience and adaptability. However, the effectiveness of these strategies is often limited by economic constraints and a lack of empirical knowledge about more sustainable drought-resistant practices. To evaluate the perceived impact of the drought and coping mechanisms in the research area, the

Adaptation Strategy Index (ADI) and the Weighted Average Index (WAI) are employed in this study.

Recommendations

The results suggest a pressing need for more targeted interventions to support farmers. This includes investment in irrigation infrastructure, access to drought-tolerant crop varieties, and education on advanced agricultural techniques. Furthermore, policy measures should aim to enhance the socio-economic resilience of these communities by providing financial assistance, improving market access, and ensuring the availability of critical resources during drought periods. The findings of this study underscore the significant challenges posed by drought to agriculture in Balochistan, particularly in the Mastung district. The primary impacts include crop loss, soil water scarcity, increased production costs, and diminished crop yields, all of which severely affect the livelihoods of farming communities. In conclusion, while farmers in Balochistan have demonstrated commendable adaptability, there is an urgent need for comprehensive support systems to mitigate the adverse effects of drought. Enhancing the capacity of farmers through education, infrastructure development, and policy support will be crucial in ensuring the long-term sustainability of agriculture in the region amidst increasing climate variability.

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