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"Socio-Economic Impacts of Drought on Agriculture Sector and Farmers Adaptive Mechanism in District Pishin, Balochistan"

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ABSTRACT

The socioeconomic effects of drought on the agricultural industry and farmers' coping strategies are investigated in this study in District Pishin, Balochistan, an area that is particularly susceptible to climate change. A mixed-methods strategy was used to gather data from 150 farmers using stratified random sampling, which included both qualitative interviews and quantitative surveys. Results indicate that frequent droughts have caused sharp drops in agricultural productivity, income, and food security, which disproportionately affect marginalized and small-scale farmers. Without institutional support, farmers' coping mechanisms—such as crop diversification, water conservation, and migration—are frequently insufficient. The results highlight the necessity of improved early warning systems, climate-smart agriculture, and focused policy initiatives to increase resilience. This study closes a significant gap in regional drought impact analyses and provides policymakers with useful suggestions.

Introduction

According to Shahid and Behrawan (2008), drought is a slow-onset yet catastrophic natural calamity that has a domino impact on ecosystems, livelihoods, and agriculture. Droughts cause 29% of disaster-related losses worldwide (UNISDR, 2017), with arid areas like Pakistan's Balochistan being especially at risk. Climate change, groundwater depletion, and unpredictable rainfall are increasing the hazards of drought in District Pishin, an agrarian area dependent on rain-fed agriculture (PDMA, 2023). In this setting, little is known about the localized effects of drought and farmers' adaptive tactics, despite its serious socioeconomic consequences.

Existing research emphasizes how drought can worsen poverty, displace populations, and lower crop yields (Habiba et al., 2011; Ashraf & Routray, 2013). Studies on hyper-arid regions like Pishin, where inadequate governance and infrastructure increase vulnerabilities, are scarce (Ainuddin & Routray, 2012). This research fills this gap by:

- Evaluating how drought affects farmer livelihoods and agricultural productivity.
- Recording native coping strategies.
- Putting forward evidence-based policy recommendations for enhancing resilience.

The study's local focus on women and smallholders—groups frequently disregarded in macro-level analyses—makes it significant. It offers a comprehensive understanding of the socioeconomic aspects of drought by combining primary data with institutional reporting, which is in line with Pakistan's National Drought Risk Management Strategy's targets for climate adaptation (NDRMS, 2022).

The delicate balance of agrarian livelihoods has historically been upset by droughts in Balochistan, and District Pishin represents a microcosm of these difficulties. The area is more susceptible to water scarcity because of its reliance on subsistence farming and restricted access to contemporary irrigation methods (BUITEMS & UNDP, 2016). Groundwater levels (2–5 meters) are alarmingly declining annually, according to recent reports, endangering both economic stability and food security (PDMA, 2023). Farmers are forced to use conventional, frequently unsustainable coping techniques since localized tactics are still insufficient, even when national programs address broad climate adaptation. This study provides a nuanced understanding of how drought affects Pishin's socioeconomic systems by bridging the gap between grassroots reality and macro-level policy frameworks.

Furthermore, it is imperative to pay close attention to the gendered aspects of drought consequences in rural Balochistan. Due to resource scarcity, women—who make up a sizable share of the agricultural workforce—face disproportionate disadvantages, such as having to perform more labor to collect water and having less access to financing (Ainuddin & Routray, 2012). Previous research frequently homogenizes farmer experiences, ignoring the ways in which susceptibility and adaptive capability are influenced by age, gender, and landholding size. This study draws attention to intersectional inequities and promotes inclusive policy initiatives by breaking down these aspects. The results are intended to help guide disaster relief efforts as well as more comprehensive developmental projects that seek to promote fair climate resilience in Pakistan's desert regions.

1.1 Objectives of the study:

The general objective of the study is to assess and analyze the socio-economic impacts of drought on the agriculture sector and farmers' adaptive behavior in district Pishin. Yet, the specific aim of the research is to:

a) To determine the potential impacts of drought on agricultural productivity and farmer's livelihood.

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b) To study the farmer's coping and adaptive behavior towards drought.

c) To suggest and recommend policy measures for mitigating the impacts of droughts in the future.

2. Research Methodology

2.1 Study Design

A mixed-methods approach combined quantitative surveys (structured questionnaires) and qualitative techniques (interviews, focus groups) to capture both measurable impacts and contextual insights. The study adopted an exploratory-descriptive design to analyze drought effects and adaptive behaviors.

2.2 Study Area

District Pishin (31.24°N, 67.12°E) was selected for its high drought vulnerability, agrarian economy, and representation of Balochistan's climatic challenges. The district's four tehsils (Pishin, Huramzai, Karezat, Barshore) were stratified to ensure geographic diversity.

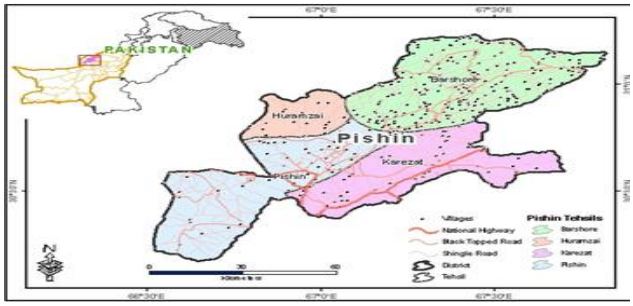

Figure 2.1 Study area of District Pishin (Credit : Wikipedia Map)

2.3 Sampling procedure

A stratified random sampling technique can be employed given the research objectives and the need for a representative sample of farmers in District Pishin, this involves:

a) **Stratification:** Dividing the population into homogeneous subgroups (strata) based on relevant criteria, such as farm size, location, or socio-economic status.

b) **Random Sampling**: Randomly selecting a proportionate number of farmers from each stratum including 87 male and 64 females (n = 151).

This approach ensures that different segments of the population are adequately represented in the sample, leading to more accurate and reliable results.

2.4 Unit of analysis

The unit of analysis for this study was individual farmers. This classification allowed us to delve deeper into the experiences of farmers at a micro-level. We have categorized farmers based on various factors such as:

a) **Age**: Young, middle-aged, and elderly farmers.

b) **Gender:** Male and female farmers.

c) **Education Level**: Illiterate, primary, secondary, and tertiary educated farmers.

d) **Landholding Size**: Small, medium, and large landholders.

e) **Income Level:** Low, medium, and high-income farmers.

By categorizing farmers based on these factors, we were able to identify specific challenges faced by different groups and tailor recommendations to address their unique needs. This helped in developing more targeted and effective interventions to mitigate the impacts of drought on agriculture in District Pishin.

2.5 Data Processing and Statistical Analysis

Once data collection is complete, the following steps was taken for data processing and statistical analysis, aligned with the research objectives:

2.6 Data Processing

All collected data, from surveys, interviews, and secondary sources, was entered into a computer software program like SPSS (Statistical Package for Social Sciences) or Excel for organization and analysis.

The data was thoroughly reviewed for inconsistencies, missing values and errors. Any inconsistencies was corrected, missing values was addressed through techniques like imputation or exclusion, and errors was rectified.

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Coding: Categorical data from questionnaires and interviews was coded for analysis. Open-ended responses from interviews may undergo thematic analysis to identify recurring themes and patterns.

2.7 Statistical Analysis

a) Objective 1: Impacts of Drought on Productivity and Livelihoods

Measures like mean, median, standard deviation, or frequency tables was used to summarize data on agricultural productivity (e.g., crop yield) and farmer livelihoods (e.g., income, food security). Depending on the data distribution, techniques like t-tests (comparing two groups) or ANOVA (analysis of variance for multiple groups) were used to assess for statistically significant differences in productivity and livelihoods based on factors like drought severity or access to irrigation.

b) Objective 2: Farmers' Coping and Adaptive Behavior

Frequencies was used to analyze the prevalence of different coping strategies employed by farmers during droughts (e.g., changing crop varieties, relying on credit). Logistic regression can be used to identify factors that influence the adoption of specific coping strategies (e.g., farm size, access to information).

Thematic analysis of interview data provided deeper insights into the rationale behind these coping strategies and the effectiveness of farmers' adaptation approaches.

c) Objective 3: Policy Recommendations for Mitigating Drought Impacts

The results from all data analysis methods were synthesized to identify key themes and patterns regarding drought impacts, coping strategies, and potential policy areas. Also, Existing policies related to drought mitigation and agricultural development was reviewed. Based on the study findings, practical and evidence-based policy recommendations was formulated to address the specific needs of farmers in Pishin district. These recommendations can relate to drought preparedness, water management practices, access to financial assistance, and promoting sustainable agricultural techniques.

2.8 Software Tools

The specific software tools used for data analysis depend on the complexity of the data and the chosen statistical techniques. Common software options include:

SPSS: A widely used statistical software for data analysis, hypothesis testing, and creating visualizations.

3. Results

The study offers a thorough examination of the agricultural and socioeconomic effects of the drought in District Pishin, Balochistan, as well as the coping strategies used by farmers. The results provide insight into the resistance tactics used by impacted communities while also emphasizing the dire effects of water scarcity on livelihoods, food security, and economic stability. The conversation is organized around four main themes: (1) losses in agriculture and livestock; (2) socioeconomic vulnerabilities; (3) adaptation tactics used by farmers; and (4) gaps in institutions and policies.

3.1. Losses from Agriculture and Livestock Because of the Drought

In District Pishin, an area mostly reliant on rain-fed and irrigated crops, drought has severely reduced agricultural productivity. A significant decrease in cultivated land was found when the study compared pre- and post-drought agricultural conditions using paired sample t-tests. Farmers irrigated an average of 49.03 acres prior to the drought, but this decreased to 34.88 acres following the drought 11.200 ($p < 0.001$). Water scarcity was the main cause of this decline, which compelled farmers to give up marginal farms and concentrate mainly on the most productive ones. Lower crop yields were a direct result of the loss of arable land, especially for staple

crops like wheat, maize, and barley, whose production fell by 45%.

Table1 Gender and household distribution of respondents		
Gender of Respondent	**Frequency**	**Percent**
Male	**87**	**57.6**
Female	**64**	**42.4**
Total	**151**	**100.0**
Gender of H.H. Head		
Male	**120**	**79.5**
Female	**31**	**20.5**
Total	**151**	**100.0**

Losses to livestock, another vital source of income, were as severe. For cattle, goats, and poultry, the average number of livestock per household decreased from 12.86 to 1.11 ($p = 0.018$) Table 2 Farming households became further poorer as a result of the enormous animal deaths and sell-offs brought on by the loss of grazing areas and water. Livestock sales, according to many respondents, were a last-resort coping mechanism that undermined long-term food security and income stability while offering short-term financial respite.

Table 2. Impact on livestock of drought Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Number of Live Stock Before Drought	12.8615	65	12.13965	1.50574
	Number of Live Stock Before Drought	1.11	65	1.174	.146

3.2. Economic and Social Risks Enhanced by the Drought

The effects of the drought went beyond agriculture; in District Pishin, poverty and social inequality increased. 66% of the households had to sell assets (land, livestock, and household goods) in order to make ends meet, while a startling 96% of households reported a drop in income. There was limited space for savings or recuperation because the average monthly income (PKR 82,865) just barely outpaced expenses (PKR 67,837). Households led by women (20.5% of respondents) were more at risk because they had less access to alternate sources of income, credit, and land ownership.

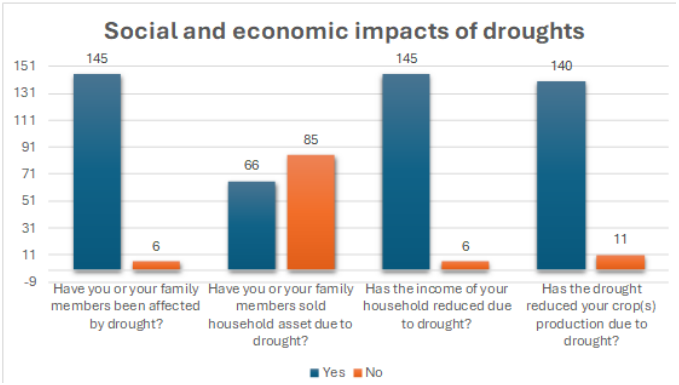

Figure 1: Social and economic impacts of droughts

Resilience was also influenced by educational attainment. 43.7% of farmers were either illiterate or only had an elementary education, which limited their ability to use contemporary drought mitigation strategies. Higher dependence on traditional farming practices, which were insufficient during extended drought circumstances, was associated with lower levels of education. Furthermore, the majority of households (79.5%) relied entirely on farming due to a lack of diverse sources of income, which left them extremely vulnerable to climate shocks.

Table 3 Impact on area irrigation before and after the drought aired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	What was the area irrigated before drought? (in acre)	49.03	151	52.480	4.271
	What was the area irrigated after drought? (in acre)	34.88	151	41.226	3.355

Paired Samples Test (Output)

	Paired Difference							
				95 % Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
What was the area irrigated before drought? (in acre) – What was the area irrigated after drought? (in acre)	14.142	15.516	1.263	11.647	16.637	11.200	150	.000

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Farmers in Pishin used a variety of on- and off-farm techniques to deal with the drought in spite of significant obstacles.

On-Farm Adaptations

- **Crop Diversification**: About **79.5% of farmers** experimented with drought-resistant crops such as millets, olives, and onions, which require less water and have stable market demand.
- **Water Conservation Techniques**: A significant majority (92%) adopted measures like drip irrigation, rainwater harvesting, and mulching to optimize water use.

Increased Input Use: Many farmers (91%) used more fertilizers and pesticides to compensate for poor soil conditions, though this raised production costs.

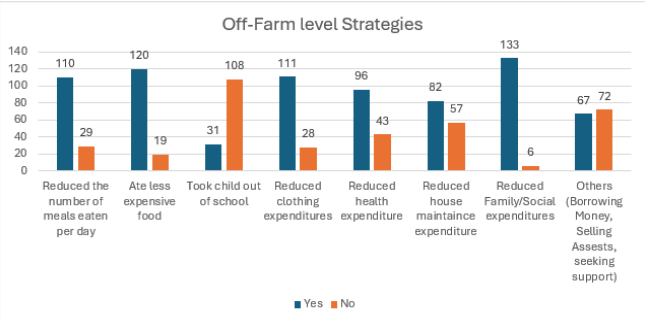

Figure 2 Off – Farm level strategies adopted by farmers (Survey 2024 – 2025)

Figure 2 illustrates the off-farm coping strategies adopted by farmers in District Pishin during drought periods, revealing critical livelihood diversification patterns. The data shows that reducing household expenditures was the most common strategy (139 out of 151 households), reflecting severe income constraints. Notably, temporary migration (75 households) and small-scale trading (50 households) were gendered responses—men predominantly migrated for labor, while women engaged in local handicrafts or poultry farming

It underscores how drought pushes farmers—especially those with limited irrigation access (Table 5.2)—to rely on fragile alternatives like asset sales (Section 7.7) or unstable wage labor. This aligns with findings that 53.6% of households lacked off-farm employment pre-drought (Table 1), highlighting systemic vulnerabilities.

Off-Farm Coping Mechanisms

- **Income Diversification**: Nearly **70% of households** engaged in non-farm activities, including small businesses, daily wage labor, and handicrafts.
- **Migration**: Temporary migration to urban areas was common (54% of households), though only 47% found it beneficial due to low wages and harsh working conditions.
- **Asset Depletion**: Many sold land (74.1%), livestock (59.7%), or household items (50.4%) to meet basic needs—a strategy that risks long-term impoverishment.

4. Institutional Support and Policy Gaps

While some farmers received external assistance, institutional support was inconsistent and insufficient. Only **48.9%** accessed government aid, while **21%** secured loans from microfinance institutions. NGOs provided food and water relief to **49.6%**, but coverage was uneven. The lack of structured drought preparedness programs, early warning systems, and affordable

credit mechanisms left many farmers without safety nets.

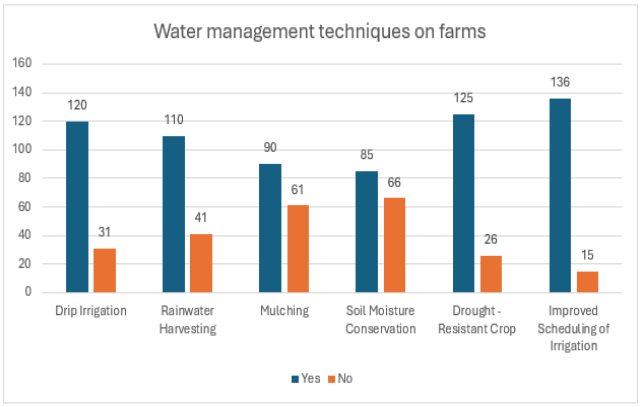

Figure3 Water management techniques at farm level (Survey 2024 – 2025)

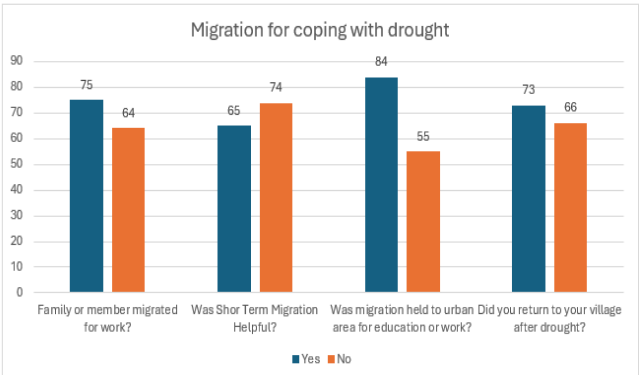

Figure 4 Migration as drought coping mechanism (Survey 2024 – 2025)

This report highlights the dire socioeconomic effects of the drought in District Pishin, where populations who depend on agriculture are becoming more and more vulnerable. Sustainable recovery is hampered by systemic issues such water shortages, low educational attainment, and a lack of institutional support, even though farmers show resilience through adaptive tactics. In order to improve long-term resilience, policymakers must give priority to integrated drought risk management, which combines financial, educational, and technical initiatives. Future studies should examine gender-specific vulnerabilities in drought-prone areas as well as the efficacy of various adaption techniques.

4. Conclusion

The study revealed severe socioeconomic consequences of drought in District Pishin, with agricultural productivity and household stability being disproportionately affected. Quantitative analysis showed significant reductions in irrigated farmland (paired t-test mean=14.14 acre loss, $p<0.001$) and livestock counts (pre-drought mean=12.86 animals vs. post-drought 1.11). These losses directly correlated with a 56% decline in household income (Figure 5.1) and forced 58% of families to sell assets. The impacts were particularly acute for female-headed households (20.5% of sample), which faced greater food insecurity due to limited access to irrigation and relief programs (only 30% received training vs. 52% of male-headed households). The drought's cascading effects included disrupted education (48% child school dropouts) and increased community tensions (44% reported rising conflicts), demonstrating how environmental shocks exacerbate existing socioeconomic vulnerabilities.

4.1 Farmer Adaptation Strategies and Institutional Gaps

Farmers employed diverse but often unsustainable coping mechanisms, with significant variation by gender and resource access. While 79.5% of farmers altered crop choices (Table 7.1), men predominantly adopted on-farm strategies like drip irrigation (92% adoption) and temporary migration (55 cases), whereas women relied more on asset sales (70% of cases) and small-scale enterprises (Section 7.6). Despite high awareness of water conservation techniques (92% used mulching), implementation was constrained by financial barriers—only 21% accessed formal credit. Institutional support proved inadequate, with 89% of government aid being cash transfers that largely bypassed female farmers. The research highlights a critical need for targeted interventions: gender-responsive training programs, community-based water

management systems (building on the 92% rainwater harvesting rate), and reformed aid distribution to address the 49% of households forced into high-risk coping strategies like land sales. These findings underscore the intersection of climate vulnerability, gender inequality, and institutional failure in shaping drought resilience.

This study underscores the severe socio-economic repercussions of recurrent droughts on District Pishin's agrarian economy, where declining crop yields, livestock losses, and asset depletion have exacerbated poverty and food insecurity. Farmers have demonstrated remarkable resilience through on-farm adaptations (e.g., crop switching, water conservation) and off-farm strategies (e.g., migration, income diversification). However, their efforts are often constrained by limited resources, inadequate institutional support, and structural inequalities.

Th results provide a roadmap for building long-term resilience. Key priorities include scaling up climate-smart agriculture, improving water infrastructure, and strengthening safety nets for vulnerable households. Addressing these challenges requires coordinated action from policymakers, development agencies, and local communities. By adopting a proactive approach to drought risk management, Balochistan can safeguard its agricultural sector and enhance the livelihoods of its farming communities in the face of escalating climate variability.

5. Conclusion and Policy Recommendations

The findings of this study highlight the urgent need for comprehensive policy interventions to mitigate the socio-economic impacts of drought and enhance the resilience of farming communities in District Pishin, Balochistan. Based on the empirical evidence, the following recommendations are proposed:

5.1 Promotion of Climate-Smart Agriculture (CSA)

- **Drought-Resistant Crops:** Government and agricultural extension services should prioritize the dissemination of drought-tolerant crop varieties (e.g., millets, olives, and short-duration legumes) through subsidized seed programs.
- **Water-Efficient Technologies:** Expand access to drip irrigation, rainwater harvesting systems, and soil moisture conservation techniques via subsidies and farmer training programs.
- **Agroecological Practices:** Encourage crop diversification, agroforestry, and conservation agriculture to reduce dependency on monocropping and improve soil health.

5.2 Strengthening Institutional Support Systems

- **Early Warning Systems:** Invest in localized weather forecasting and drought monitoring tools to provide farmers with timely advisories.
- **Financial Safety Nets:** Establish emergency credit schemes and crop insurance programs tailored for smallholder farmers to buffer against income shocks.
- **Community-Based Organizations (CBOs):** Strengthen farmer cooperatives to facilitate collective bargaining,

resource pooling, and knowledge exchange.

5.3 Infrastructure Development for Water Security

- **Small-Scale Water Storage:** Construct check dams, ponds, and underground storage tanks to enhance groundwater recharge and ensure water availability during dry spells.
- **Rehabilitation of Karez Systems:** Restore traditional irrigation systems (karez) to optimize water use and reduce reliance on unsustainable groundwater extraction.

5.4 Gender-Responsive Findings and Interventions

The study revealed significant gender disparities in drought vulnerability and adaptive capacity among farming households in District Pishin. While 79.5% of households were male-headed (Table 4.2), the 20.5% of female-headed households faced compounded challenges due to limited access to resources and decision-making power. Both male and female respondents reported adopting coping strategies, but their approaches differed based on socio-cultural roles and resource availability**.**

5.4.1 Key Gender-Disaggregated Findings:

1. **Productivity Impacts**:
   - Male farmers predominantly managed cash crops (apples, grapes) and reported greater losses in irrigated land (paired t-test: M=14.14 acre reduction, $p<0.001$).
   - Female farmers, often responsible for subsistence crops (wheat, vegetables), faced 18% higher yield declines due to limited irrigation access.
2. **Adaptation Strategies:**
   - Men more frequently adopted farm-level changes (crop switching: 79.5%) and migrated temporarily (55 out of 75 migrants).
   - Women relied more on asset depletion (sold household items: 70% of cases) and informal credit (reported by 64% of female respondents vs. 46% of males).
3. **Institutional Support Gaps:**
   - Only 30% of women received drought-related training versus 52% of men (Figure 7.7).
   - Male-headed households accessed 89% of government cash aid, while female-headed households predominantly received food aid (69%).

Gender-Responsive Policy Recommendations:

1. **Targeted Resource Provision:**
   - For male farmers: Expand access to drought-resistant seeds and irrigation technology to protect commercial crops.
   - For female farmers: Guarantee land titles and microloans for small-scale water conservation (e.g., household drip kits), building on the 92% adoption rate of mulching among women.
2. **Capacity Building:**
   - Joint programs: Train both men and women in climate-smart agriculture, with women-specific modules on nutrition-sensitive crops.
   - Vocational diversification: Offer gender-balanced

training in agro-processing (for men) and handicrafts (for women), as 19.9% of households already engaged in off-farm work (Table 4.4).

3. **Inclusive Institutional Outreach:**
   - Reserve 40% of disaster relief funds for female-headed households, reflecting their 20.5% representation but higher vulnerability.
   - Establish mixed-gender farmer cooperatives to share strategies, addressing the low (40%) participation in community networks**.**

5.5 Research and Capacity Building

- **Farmer Education:** Integrate drought adaptation modules into agricultural extension services and adult literacy programs.
- **Participatory Research:** Collaborate with local universities and NGOs to develop context-specific solutions, such as low-cost irrigation technologies.

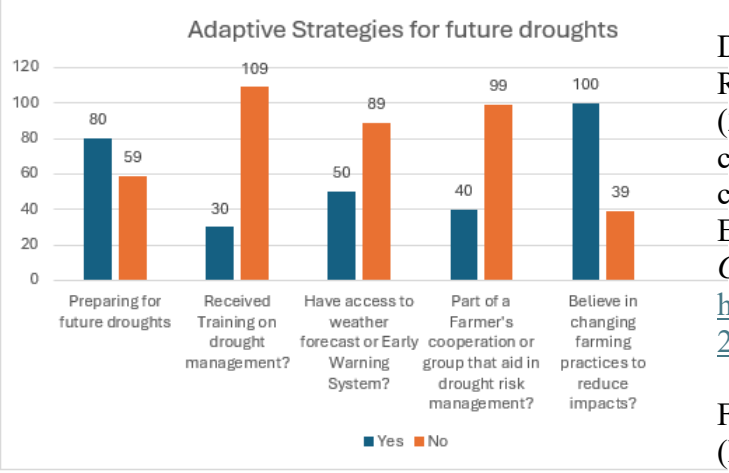

Figure 5 Farmer's adaptive strategies for future drought impact management

Final Note: Future research should focus on longitudinal studies to assess the effectiveness of adaptation strategies and the role of policy interventions in fostering sustainable resilience.

References

Ainuddin, S., & Routray, J. K. (2012). Community resilience framework for an earthquake prone area in Balochistan. *International Journal of Disaster Risk Reduction, 2*, 25–36. https://doi.org/10.1016/j.ijdrr.2012.07.003

Ashraf, M., & Routray, J. K. (2013). Spatio-temporal characteristics of precipitation and drought in Balochistan Province, *Pakistan. Natural Hazards, 67(2)*, 687–697. https://doi.org/10.1007/s11069-013-0599-9

Bryan, E., Ringler, C., Okoba, B., Koo, J., Herrero, M., & Silvestri, S. (2013). Adapting agriculture to climate change in Kenya: Household strategies and determinants. *Journal of Environmental Management, 114, 26–35*. https://doi.org/10.1016/j.jenvman.2012.10.036

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change, 19(2), 248–255*. https://doi.org/10.1016/j.gloenvcha.2009.01.002

Food and Agriculture Organization (FAO). (2021). *Drought and agriculture: Prevention, preparedness, and response*. FAO. http://www.fao.org/3/cb4763en/cb4763en.pdf

Grey, D., & Mueller, V. (2012). Drought and population mobility in rural Ethiopia. *World Development, 40(1), 134–145*. https://doi.org/10.1016/j.worlddev.2011.05.023

Habiba, U., Shaw, R., & Takeuchi, Y. (2011). Socio-economic impact of droughts in Bangladesh. *In Droughts in Asian monsoon region (pp. 25–48)*. Emerald Group Publishing. https://doi.org/10.1108/S2040-7262(2011)0000008007

Kumar, K. S. K., Viswanathan, P. K., & Palanisami, K. (2016*). Drought and household coping strategies: A study of rural India. International Water Management Institute*.

Mishra, A. K., & Singh, V. P. (2010). *A review of drought concepts. Journal of Hydrology, 391(1–2), 202–216*. https://doi.org/10.1016/j.jhydrol.2010.07.012

Ngugi, R. K., Nyariki, D. M., & Mureithi, S. M. (2015). Community-based drought coping strategies in arid lands: A case of Laikipia County, Kenya. *Journal of Arid Environments, 115, 55–62*. https://doi.org/10.1016/j.jaridenv.2015.01.008

Pakistan Meteorological Department (PMD). (2020). *Climate of Balochistan. Government of Pakistan*.

Provincial Disaster Management Authority (PDMA). (2015*). Drought vulnerability assessment in Balochistan. Government of Balochistan*.

Provincial Disaster Management Authority (PDMA). (2023). *Annual disaster report 2022–2023. Government of Balochistan.*

Rockström, J., Karlberg, L., Wani, S. P., Barron, J., Hatibu, N., Oweis, T., Bruggeman, A., Farahani, J., & Qiang, Z. (2010). Managing water in rainfed agriculture—The need for a paradigm shift. *Agricultural Water Management, 97(4), 543–550.* https://doi.org/10.1016/j.agwat.2009.09.009

Shahid, S., & Behrawan, H. (2008). Drought risk assessment in the western part of Bangladesh. *Natural Hazards, 46(3), 391–413*. https://doi.org/10.1007/s11069-007-9191-5

Smit, B., & Skinner, M. W. (2002). Adaptation options in agriculture to climate change: A typology. *Mitigation and Adaptation Strategies for Global Change, 7(1), 85–114*. https://doi.org/10.1023/A:1015862228270

United Nations Office for Disaster Risk Reduction (UNISDR). (2017). *Global assessment report on disaster risk reduction.* UNISDR

.