Farmers' Strategies for Drought Adaptation Based on the Indigenous Knowledge System: The Case of Iran

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ABSTRACT: Considering the widespread and cross-cultural effects of climate on various production sectors, environmental factors, and human societies, drought is nowadays regarded as one of the most important environmental challenges of the current century. Because of their close relationship with the natural environment and their limited opportunities, rural communities have long been exposed to drought, and farmers in dry and semiarid regions have been applying measures to adapt to and cope with it. The main purpose of this study was to investigate and identify farmers' native methods to reduce the effects of drought. The research method was phenomenological and survey based. The population included villagers in Kangavar County, Kermanshah Province, in Iran. Sampling was done by the targeted and snowflake method. The data collection instrument was an in-depth interview in the qualitative section and a self-designed questionnaire in the quantitative section. The results showed that farmers used different measures for coping with and adapting to drought, including using no-tillage farming; uprooting trees with high water demands; hope and oblation; mulching; reducing, changing, and/or mixing livestock types (reaction behaviors); diversifying the sources of livelihoods; changing cropping patterns; correcting irrigation practices; changing planting time; seeding before the drought; and using water storage techniques (fractional behaviors). In addition, farmers had a weaker capability to cope with the environmental, economic, and social vulnerabilities than with drought. This presented the vulnerability of farmers to drought in all economic, social, and environmental spheres.

KEYWORDS: Asia; Drought; Climate prediction

1. Introduction

Considering the widespread and cross-cultural effects of climate on different production sectors, environmental factors, and human societies, drought is nowadays regarded as one of the most important environmental challenges with serious economic consequences. Drought has put pressure on rural communities through its negative impacts on food systems. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) indicates that changes in global temperature and precipitation regimes will affect global food security, impacting all aspects of society (Porter et al. 2014). The most negative effects of drought from a socioeconomic perspective are anticipated to occur in regions that are already economically marginal and where livelihoods are precarious (Samson et al. 2011; Shojaei-Miandoragh et al. 2019). One reason that the poor are more vulnerable to climate variability and shocks is their reliance on agriculture. Agriculture plays a crucial role throughout the lifetime of a given economy and is the backbone of a given country's economic system. Agriculture not only provides food and raw materials but also provides employment opportunities for a very high percentage of the population (Mohammadi-Mehr et al. 2018). Agriculture is also crucial for the growth of any society. The primary sector of an economy includes agriculture and other activities, and that sector makes an important contribution to gross domestic product (GDP). Agriculture supplies raw materials to a number of industries that form the backbone of societies. Most importantly, it helps a country supply food and other agricultural products (Zamani et al. 2016; Sadeghi et al. 2019; Gholamrezai et al. 2021). Although various sectors such as water, industry, tourism, and energy are affected by drought (Kemfert 2009; Hope 2005; Ataei et al. 2019), agriculture is the sector most dependent on climate, so climate is the main determinant of the location, production, and productivity of agricultural activities (Reilly 1999; Izadi et al. 2019).

Arid and semiarid climates (such as Iran) are more sensitive and vulnerable to drought. Sensitivity is the extent to which a system will react to a change in climate conditions, such as the extent of change in the composition, structure, and functioning of the ecosystem. Vulnerability is the degree to which climate change can interfere with a system. It depends on the sensitivity of the system and its adaptability to the new climate conditions (IPCC 2012). The prospect of drought in Iran over the next 30 years indicates that the drought will increase so that most areas of Iran will be suffering from severe and very severe droughts by 2025, 2032, 2035, and 2039 (IPCC 2007).

Drought has various socioeconomic impacts, such as lowering household income, decreasing alternative sources of income, increasing working hours and workload, making conflicts over water use, food insecurity, malnutrition, reducing health and access to health services, reducing the possibility of continual education, unequal access to financial support services, increasing rural immigration, reducing the quality of life, and impairing social cohesion (Vanclay 2002; Gupta and Gupta 2003; Alston and Kent 2008; Alston 2011; Ataei and Zamani 2015; Keshavarz

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and Karami 2014; Ataei and Karimghasemi 2017; Ataei et al. 2017, 2018). A few studies have focused on the evaluation of the effects of drought, the diversity of the spatial and temporal scales of this phenomenon has made drought a unique phenomenon. The results of these studies cannot be generalized to other areas because it has been shown that the social conditions of communities add to the complexity of the effects of drought. However, it should also be considered that the effects of drought can be the result of a natural phenomenon interaction and increasing demand for human systems for the use of water and other natural resources (Keshavarz et al. 2013; Ataei et al. 2021). In recent decades, research on the effects of drought on the agricultural sector and the villagers and assessing adaptation strategies with these changes has become one of the important issues (Dinar et al. 1998; Tao et al. 2008; Gbetibouo and Hassan 2005; Aliabadi et al. 2019). According to the definition suggested by Gupta and Gupta (2003), the ability to adapt to climate change is the ability of a system or individual to adapt to climate change in order to reduce damages or to cope with its consequences.

Salehi and Pazuki Nejad (2014) stated that farmers' knowledge about climate change, beliefs, and support levels of coping policies were overmoderate. Ghambarali et al. (2012) concluded that climate change had unfavorable effects on farmers' lives. Some important impacts are the migration of young people, reduction of crops, unemployment, lower income, reduced water and crop storage, endangered livestock health, reduced soil fertility, and degraded vegetation cover. Azmi et al. (2015) and Aliabadi et al. (2020) state that native methods are a good way to manage natural hazards. They found a significant difference between the effectiveness of native and new knowledge in reducing the vulnerability of natural hazards, and native knowledge had a greater role in managing natural hazards in rural areas.

Fazelnia et al. (2012), Poortaheri et al. (2013), Riyahi and Pashazadeh (2014), and Alipour et al. (2013) have listed drought effects as the reduction of income and savings, changes in the job structure of rural areas, higher willingness to migrate from the village, the reduction of social partnerships and livestock and agricultural production, the loss of crop yields, higher soil erosion, the outbreak of pests and diseases, the loss of quality of pastures, lack or shortage of water and feed for animals, more disease and mortality among livestock, higher unemployment of farmers, sale of property and assets, rising food prices, and increased demand for loans.

Repeated droughts form the main threats to rural resources and the food security of countries. Countries undergo localized drought leading to crop failure and endangering development activities. As a consequence, the livelihood and agricultural practices in rural areas in countries are subject to continuous and comprehensive changes. Vulnerable regions are characterized by features such as low levels of productivity, elevated levels of financing, low crop diversity, agriculture as the primary income source, and a low level of agricultural insurance (Mohmmed et al. 2018). Farmers can adopt farming systems that are ex ante less sensitive to drought as they usually have enough time to identify and implement adaptive measures during the drought event too. Farmer households commonly adopt antidrought strategies by adjusting crop planting structure, production factor input, and intensity of irrigation based on their perception of drought and agricultural production experiences. Li et al. (2018) state that farmers' participation in local village organizations, government financial assistance, local government institutional support, and disaster warnings through multiple media channels positively influence farmers' strategies for drought adaptation. Also, the combined efforts of both farmers and government in mitigating drought as well as labor, production factors, and social capital (local cooperative membership, phone contacts) are the main determinants of agricultural income. In some cases, farmers choose a strategy to deal with a drought event and take a combination of actions as a part of this strategy (Singh et al. 2016). Mutabazi et al. (2015) have proposed typologies of farmers' strategies in the face of drought including intensification, diversification, changing their farming practices, or migration. In other cases, farmers choose actions if and when problems or opportunities arise but without defining a clear strategy at the onset of the drought event.

Drought management strategies should be tailored to the geographical, economic, and social conditions of different regions. Villagers will adopt a variety of adaptation strategies, taking into account their local and environmental conditions and using the local knowledge they have acquired. The frequent occurrence of drought and its severe damage to the economy and natural resources make it possible to develop a strategy and practical plan for managing droughts. In other words, drought leads to establishing various work teams (such as work teams of water and soil protection, cropping pattern, sustainable crop production, etc.) for planning over the short and long terms in the agriculture, industry, and private sectors. The planning makes it possible to design practical strategies for drought mitigation and adaptation. Native knowledge is very important for drought management. Studies have shown that different indigenous strategies are used by farmers, including managing livestock, simultaneously planting complementary crops and early crops, diversifying traditional planting, changing consumption patterns, immigrating, insuring farmland and livestock, using resistant seeds, recycling wastewater, using social capital, using drought-resistant plants and livestock, intercropping, using organic farming systems, changing planting date, planting trees, cultivating vegetables within the rows of trees, and replacing sheep breeding with goats (Niles et al. 2012; Füssel 2007; Mertz et al. 2009; Venot 2010; Ifeanyi-obi et al. 2012).

A new approach to managing natural disasters and reducing vulnerability is the use of indigenous capacities or knowledge of each region. Indigenous knowledge is knowledge generated over time in a variety of communities and enables people to understand their socioeconomic environment or their ecological-agricultural environment. Knowledge and experiences can integrate with new knowledge and enhance the management of natural disasters. Farmers have always tried to cope with unforeseen limitations and incidents and reduce their harmful effects as much as possible. They display different behaviors in the face of drought and can be managed by identifying these behaviors and transferring knowledge

about drought management methods. It means that farmers use strategies for drought adaptation according to their indigenous knowledge. The results of the present study can help authorities identify farmers' indigenous strategies for drought adaptation. Therefore, the main purpose of the study was to identify farmers' drought-adaptation strategies that were based on their indigenous knowledge system.

2. Methods

This research was aimed at identifying strategies based on the knowledge system of farmers in adapting to climate change with a mixed approach. In terms of developmental purpose, the research was carried out using the descriptive phenomenological method and semistructured interview. The qualitative content analysis technique was used to collect data. Research questions were about the proper and normal behaviors, practices, and procedures, and the reasons for the emergence of these norms, which were used to guide the narrative of respondents. The statistical population was climate change–affected farmers in Kermanshah Province (n = 20). The sample was taken by the purposive and snowball technique. The process of data collection was continued until the theoretical saturation level. To analyze the data, the qualitative content analysis based on Colaizzi's method was used in descriptive phenomenology. The refined results were also provided to a group of respondents for narrative. The following formula was used to confirm the reliability (convergence and agreement percentage in coding):

$$\frac{2M}{\mathrm{N1} + \mathrm{N2}},$$

where M = the number of common codes of two encoders N1 and N2.

The compliance rate of coding was 87%. The validity was also confirmed by examining the compatibility of the extracted codes with the conceptions and conceptual patterns on adaptation to climate change. In the quantitative section of the study, the economic, social, and environmental vulnerability of farmers was assessed. The farmers of Fash Districts Center in Kangavar County of Kermanshah Province were selected as the survey population. According to Bartlett et al. (2001)'s table, 225 farmers were selected by a three-step sampling method.

To measure the variables, a self-designed questionnaire was used based on theoretical foundations. The questionnaire was composed of two sections. The first section was related to the respondents' demographic characteristics and the second to vulnerability assessment. The variables were measured on a five-point Likert scale. An expert panel verified the formal and content validity of the questionnaire. A pilot test of 30 questionnaires was conducted among farmers outside the research sample, and Cronbach's alpha confirmed the reliability of the questionnaire. The vulnerability was calculated with the model and formula introduced by Feldbrügge and von Braun (2002) according to which vulnerability is not a static concept, but it is rather changeable because of the activities of those affected.

TABLE 1. Farmers' view on drought (in 2011–16).

Year		Normal	Mild drought	Medium drought	Severe drought
2011/12	Frequency	11	37	132	45
	Percentage	4.8	16.44	58.6	20
2012/13	Frequency	38	10	124	53
	Percentage	17	4.4	55.1	23.5
2013/14	Frequency	21	105	60	39
	Percentage	9.3	46.6	26.6	17.33
2014/15	Frequency	30	18	24	153
	Percentage	13.3	8	10.6	68
2015/16	Frequency	58	33	10	134
	Percentage	25.7	14.6	4.4	59.5

According to this interpretation, vulnerability can be seen as follows: 1) vulnerability V = hazard perception − coping capacity, 2) hazard = H (probability of the hazard or process; shock value; predictability; prevalence; intensity/strength), and 3) coping = C (perception of risk and potential of an activity; possibilities for trade: private trade and open trade).

3. Results

The frequency distribution of the demographic characteristics of the farmers showed that they had an average age of 41 years with a standard deviation of 11.23. They had, on average, 26 years of experience in agricultural activities. This finding reflects their abundant experience in farming. In other words, the studied farmers were experienced people in agriculture. Data showed that the majority of farmers had diplomas in terms of their education level.

The results of the survey of drought severity perceived by the respondents during the studied years were most frequent in 2011/12 and 2012/13, and in the year 2013/14, mild drought was most frequent. In the farmers' view, the most severe drought was in 2014–16 (Table 1). This finding shows that the severity of the drought has increased and, therefore, the negative effects of drought have become more intense. Increases in respiratory diseases are caused by the reduction of rainfall and the occurrence of drought, which will result in increased dust. An increase in dust causes an outbreak of respiratory diseases. The loss of income was another impact of climate change. Reductions in revenue were also attributed to the reduced water supplies, which affected agricultural productivity.

a. Prioritization of farmers' views on climate change impacts

During the interviews, the farmers were asked to identify the negative effects of climate change. Then, the findings of the interviews were presented to the farmers through a questionnaire and the impact of climate change was prioritized from their point of view (Table 2). The findings showed that the negative effects of climate change included reduced water supply, reduced income, reduced vegetation and pastures, and migration. Given the coefficient of variation (CV), increased respiratory diseases, reduced income, and reduced water

TABLE 2. Prioritization of farmers' views on drought impacts (in 2011–16).

Impacts	Mean	Std dev	CV
Reduction of water supply	4.11	0.981	0.238
Loss of income	4.03	0.953	0.236
Loss of vegetation and pastures	3.87	0.934	0.241
Migration	3.71	0.921	0.248
Reduction of the number and health of livestock	3.65	1.08	0.295
More respiratory diseases	3.60	0.813	0.225
Loss of soil fertility	3.42	0.94	0.274
Reduction of yield	3.35	1.254	0.374
Reduction of the number of climate-specific animals	3.26	1.103	0.338
Unemployment	3.13	1.122	0.358

supply were the top priorities for farmers regarding the effects of climate change, respectively.

b. *Vulnerability of the farmers*

The findings indicated that there was little or very little ability in the agricultural system to deal with economic crises during climate change. Based on the averages, farmers have a lower ability to cope with increased family-related costs (mean = 2.09), increased input costs (mean = 2.21), and crop wastes (mean = 2.15). In contrast, the agricultural system faces crises such as higher living expenses (mean = 3.52), lack of savings (mean = 3.42), higher input costs (mean = 3.15), and unemployment (mean = 3.29). The findings illustrated that the farmers were faced with more challenges and problems when drought occurred such as erosion and poorer soil (mean = 3.52), rainfall reduction (mean = 3.52), the collapse of groundwater level (mean = 3.52), and the occurrence of dust phenomena (mean = 3.52). Therefore, the farmers have less ability to cope with the consequences of drought such as natural fires (mean = 1.76), rainfall reduction (mean = 1.80), and air pollution (mean = 1.92). Wall et al. (2011), Miller (2010), and Peshin and Dhawan (2009) also emphasized the importance of these problems in increasing the environmental vulnerability of farmers. The findings also showed that farmers faced social problems such as instability of marital life, lower rural participation, family conflicts, more inequality, increases in crime, addiction and theft, and changes in the average age of farmers. The findings also showed that farmers had a better ability to deal with problems such as child migration, decreased fertility, and job dissatisfaction (Table 3). In other words, drought can influence rural families' livelihood and economic conditions. The inappropriate economic situation of rural families may have negative effects on the stability of their marital life, and it increases family conflicts. On the other hand, drought can inflict social inconvenience on rural communities. The economic and environmental impacts can decrease farmers' social participation in many activities. Also, it can augment social inequality, crime, and drug addiction in rural communities.

TABLE 3. The economic, social, and environmental vulnerability of farmers. Here, ECVI is the expected cross-validation index.

Components	Hazard perception	Coping capacity	ECVI
Economic vulnerability			
Unemployment	3.29	2.34	0.95
Shortage of savings	3.42	2.22	1.20
Increase the living cost	3.52	2.49	1.03
Increase in water sales	2.01	3.25	−1.24
Livestock death	2.42	2.26	0.56
Crop wastes	3.02	2.15	0.87
Increase in input costs	3.15	2.21	0.94
The cost of the family members' illness	1.87	2.09	−0.22
Environmental vulnerability			
Natural fire	1.97	1.76	0.21
Erosion and soil degradation	3.07	1.97	1.11
Decrease in water quality	1.72	2.04	−0.32
Reduction in rainfall	3.27	1.80	1.47
Dust phenomenon	2.19	2.36	−0.17
Drying the air	1.61	1.92	−0.31
Lowering of groundwater levels	2.83	2.10	0.73
Social vulnerability			
Immigration of children	2.22	2.54	−0.11
Instability of marital life	3.27	1.70	1.47
Family conflicts	2.61	2.25	0.36
Future job dissatisfaction	2.19	2.36	−0.17
Decreased fertility	2.08	2.23	−0.15
Changes in the average age of farmers	3.17	1.70	1.47
Increases in crime, addiction, and theft	3.07	1.97	1.11
Reduction of villagers participation	3.56	2.61	0.95
Increases in inequality among villagers	3.32	2.12	1.20

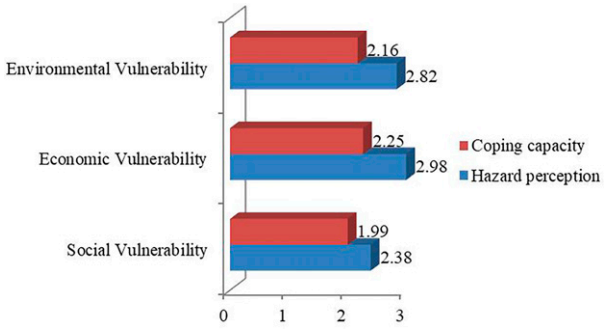

FIG. 1. The status of the farmers' vulnerability during drought.

Based on the findings, in all aspects of vulnerability, farmers' coping ability was less than hazard perception with climate change. This demonstrates the vulnerability of farmers to climate change in all economic, social, and environmental spheres. Figure 1 depicts the vulnerability of the agricultural system.

The status of farmers' environmental, economic, and social vulnerability was assessed by a one-sample *t* test. Before comparing the means of farmers' vulnerability, we examined the normality of the data using a one-sample Kolmogorov–Smirnov test. For the research data to be normal, their significance level should be higher than 0.05 and the test value should be set between +1.96 and −1.96. The results of the test showed that the value of the one-sample Kolmogorov–Smirnov test was set at the range of +1.96 and −1.96 (Table 4). So, it can be argued that the research data were normal. The results of the one-sample *t* test showed significant differences between the means of environmental, economic, and social vulnerability and the scale mean. However, the upper and lower bounds of environmental, economic, and social vulnerability were positive. This means that the means of farmers' environmental, economic, and social vulnerability is significantly higher than the scale mean.

Farmers' actions to deal with climate change were derived through in-depth interviews. Based on the interviews, 30 original codes were identified. Then, by integrating the same items and eliminating repetitive cases, the extracted phrases were formulated in the form of meaningful expressions. In this phase, 11 concepts were obtained as shown in Table 5.

4. Discussion and conclusions

Destructive effects of continuous droughts and various related vulnerabilities make adaptation to the phenomenon inevitable for farmers and rural settlements. Therefore, the investigation of farmers' strategies for drought adaptation has special importance in its effective management because of their dependence on the agrarian economy. This study aimed to recognize the farmers' strategies for drought adaptation according to their indigenous knowledge. The results showed that the farmers applied various strategies to cope with and adapt to drought. According to the findings, it can be concluded that drought had many negative effects and consequences in rural communities including less water supply, lower income, lower vegetation and pastures, and migration. These findings conform to the results of Vanclay (2002), Gupta and Gupta (2003), National Research Council (2006), Alston and Kent (2008), Nagaraja et al. (2011), Ben et al. (2010), Alston (2011), Keshavarz et al. (2013), Keshavarz and Karami (2014), and Bozarjmehri and Javanshiri (2015). This is despite the fact that the intensification of climate change will reduce the agricultural boom and farmers will leave the village. Therefore, it will cause migration from rural to urban areas. Also, the findings showed that the highest level of vulnerability was in the economic dimension, which included higher living costs, saving shortages, higher input costs, and unemployment, which is consistent with Harris (2010) and Chirwa and Dorward (2009).

However, farmers took various measures to deal with the effects of climate change. Their experiences have taught them to protect themselves from damages by creating diverse income sources, including processing industries, seasonal jobs, and beekeeping. At the same time, they appeal to nonagricultural activities as strategies to cope with climate change including retailing their livestock, changing their income source, migrating temporarily, and reducing the cropping area. Reliance on religious beliefs has also been among other psychological actions of farmers. The findings of Coelho (2000) and Knutson et al. (2001) showed that farmers use their families, communities, and beliefs to cope with droughts. Over time, farmers have come to believe that when they face climate change, they must change their cultivation patterns and move toward intercropping. However, changing the crop pattern and using modern agricultural systems should be based on a comprehensive program and should fit with the national and regional situation. Such behavior is perfectly suited to dealing with drought. The optimal use of available water was one of the other methods that farmers used to adapt to climate change. Based on their experiences, they have well understood that optimal water use can be a good way to manage drought.

It is recommended to assess strategies used by farmers to cope with climate change and drought by scientific methods. Then, after they and their likely impacts are examined, they can be provided to other farmers as extension-educational recommendations (the ones with the least adverse environmental impacts and most effective on coping with drought). However, it should be noted that the strategies should be based on vulnerability, socioeconomic conditions, and differences in rural communities and cultures. Among the strategies to cope with

TABLE 4. Means comparison of farmers' vulnerability with scale mean.

Vulnerability	Scale mean	Sample mean	Std dev	Kolmogorov–Smirnov *Z*	*t*	Significance level	Confidence interval
Environmental	21	22.90	1.66	1.32	8.26	0.000	0.83, 1.11
Economic	24	26.31	2.98	0.66	10.16	0.000	1.03, 1.99
Social	27	28.77	3.03	0.89	11.22	0.000	2.88, 3.59

TABLE 5. Important phrases extracted from farmers' actions against climate change.

No.	Selected sentences	Concepts
1	"When there is drought and the mountains do not have grass, I have to cut off poplar and whitewood trees that have high water demand and use them throughout the garden as a fence, feed livestock on their leaves, and sell wood to cover the cost of living."	Removing trees with high water demand
2	"Many years ago, there was a lot of rainfall and I used to grow plants like sesame, blue wheat, walnut, and sour cherry, which were highly profitable. But over the last few years, I could not grow them. Now, I mostly grow wheat, barley, peas, and lentils, which require less water."	Changing cropping pattern
3	"Drought has reduced the number of livestock. There were plenty of grasses in the past years and I could raise about 100 sheep and goats. But with the onset of drought, the conditions became very difficult and no more livestock can be raised. So, I sold most livestock, especially goats."	Reduction of the type and number of livestock
4	"Since the onset of drought, we have removed the weeds from the main canals to facilitate the water stream. Also, we have covered the water channels (especially the water intake) with thick nylon and, in cooperation with other farmers, we have used wastewater to irrigate the land."	Correcting the irrigation method
5	"We cultivate earlier than before to use the minimum rainfall and harvest it sooner. It seems that seasons have been shifted in recent years. We harvest wheat and barley more than 25 days earlier than 10 years ago."	Changing the planting time
6	"Trustworthy people believed that God is giving us and this drought will end. Every year villagers sacrifice a number of sheep for rain and pray for blessing."	Optimism and oblation
7	"In recent years, I have abandoned agriculture, and I have gone to the city and worked as a construction worker. At the time of planting and harvesting, I return to the village. Some people in the village grow bees or paste them up and sell."	Diversity in livelihood
8	"Most garden owners use water jars and clay pipes to keep water cooler and prevent water evaporation."	Water maintenance technique
9	"With the onset of drought, farmers use mulches."	Mulching
10	"Last year we decided to use no-till and keep crop residuals of the prior year. Subsequently, I used less fertilizer and less water."	No tillage
11	"Since the onset of drought, most farmers have started to use intercropping so that they can cultivate peas, beans, and corn together or between gardens."	Intercropping

drought, it seems that guiding farmers toward the adoption of intercropping and the use of low-cost water and soil management methods will be effective. In addition, given the strategies of livelihood diversification, it is recommended to develop nonagricultural activities by providing extension-educational courses and low-interest microfacilities. This can reduce farmers' vulnerability in addition to contributing to resource conservation and the reduction of the burden on natural resources.

We learned from the study that farmers have developed initiatives in response to the scarcity of resources to identify and look for resource management strategies consistent with climate change and drought in addition to preserving their traditional livelihood activities. However, the unfortunate fact is that they have rarely attempted to find nonagricultural income sources. Furthermore, some actions have been passive, such as superstitious beliefs and local microcultures that reflect farmers' frustration. Training and psychological consultation to correct fatalistic beliefs can be effective in the adoption of drought-coping strategies.

Creating linkages and collaboration with stakeholders interested in the research results, as well as others, who are focused on indigenous knowledge programs, will result in a coordinated approach in most respondents relying on indigenous knowledge in their farming practice. The study also looked at the challenges of the effective use of indigenous knowledge including poor documentation and deterioration of its application by the younger generation. This study recommends that indigenous knowledge in different districts of Iran be compiled, documented, and published. Community holders of indigenous knowledge are encouraged to make younger generations aware of the knowledge in order to promote its usage and its movement from generation to generation.

Climate-smart agriculture embodies a blend of innovations, practices, systems, and investment programs that are used to mitigate the adverse effects of climate change and variability on agriculture for sustained food production. Farmers can adopt these technologies to ensure increased productivity under adverse conditions of drought. Climate-smart technology improves water use efficiency and reduces risk in crop cultivation due to weather variability. Hence, this technology is useful for cultivating water-intensive crops in a sustainable way.

Farmers, using upstream wastewater, irrigate their lower lands, and this can be an effective use of low irrigation techniques. However, the quality of wastewater is low and will

negatively affect crop quantity and quality. Therefore, it is suggested that various training programs be executed to learn practices to better create resilience, reduce vulnerability, or adapt to drought. Therefore, it is recommended to rural development and agricultural Jihad authorities to develop measures taken by farmers to deal with climate change through the optimal combination of native and new knowledge.

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