Original Article

Evaluation of Drought Resilience Measures in Reducing the Vulnerability of Rural Households (Case Study: Rostaq Dehestan of Khalilabad County)

Seyyed Amir Mohammad Alavizadeh [1*], **Mahmoud Reza Mirlotfi** [2], **Ali Izadi** [3]

1- Associate Professor, Department of Geography and Rural Planning, Payame Noor University, Tehran, Iran.
2- Associate Professor of Geography and Rural Planning, Zabol University, Zabol, Iran
3- Ph.D. student in Geography and Rural Planning, University of Sistan and Baluchestan, Zahedan, Iran

Abstract

Purpose- Village as a residential system has always suffered a lot of damage due to natural hazards such as drought throughout history, and due to the dependence of the rural economy on the agricultural sector, any threat against this sector leads to the weakening of the economic foundations, the village and eventually the economic stagnation of the country. Therefore, the aim of the current research is to evaluate the drought-resilient measures to reduce the vulnerability of rural households located in Rostaq district in Khalil-Abad City, Khorasan-Razavi Province.

Design/methodology/approach- The type of research is applied research, and the data was collected by applying a descriptive-analytical method by using documentary sources and field studies (questionnaire). The statistical population of the research is comprised of the heads of rural households living in the study area. As a result, 337 people were selected using Cochran's method. For ranking and spatial analysis of the village, Copras and Vicor techniques were used, and Shannon technique and SPSS software were used for statistical data analysis.

Findings- The results showed that among the weights obtained from the paired comparison of the dimensions raised in resilience measures with drought in reducing the vulnerability of rural households, modern irrigation measures with a score of (0.290) have the highest score in resilience measures. Avaram took over with the drought. Finally, in the study area, Niqab village performed better than other villages in terms of resilience measures in dealing with drought.

Research limitations/implications- Not having access to statistical information when referring to Jihad Agriculture and Governorship, as well as filling out the questionnaire depending on the topic at the village level and the costs of conducting this research are among the challenges of the present research.

Practical implications- In the end, according to the obtained results, it is considered necessary to provide solutions for the resilience of rural households at the level of the villages of this district and to implement the solutions.

Originality / value- The present research is significant due to its expression and recognition of different issues surrounding the resilience of households in the face of drought. An important step can be taken in the direction of reducing the vulnerability of rural households to deal with drought in the coming years.

Keywords: Resilience measures, Drought, Vulnerability, Rural households, Rostaq Dehestan.

Corresponding Author:
Alavizadeh, Seyyed Amir Mohammad, Ph.D.
Address: Department of Geography, Faculty of Social Sciences, Payame Noor University, Tehran, Iran
Tel: +989131211905
E-Mail: alavipnu@pnu.ac.ir

1. Introduction

A look at the history of life on earth indicates that mankind has always been exposed to various natural disasters (Saemipour et al., 2017). In recent years, as a result of global climate changes, there has been widespread concern about the phenomenon of drought in terms of intensity, repetition, increase and duration throughout the world (Sivakumar, 2012, Peterson et al. al, 2013). This phenomenon has always drawn human attention to itself more than other natural phenomena due to reasons such as its wider spread, the inclusion of more population, the intangible and long-term nature of its effects, and the continuity and amount of damages resulting from it (Rezaei et al., 2010).The occurrence of drought in the regions of the world shows that all nations are vulnerable to weather events (Pourtaheri et al., 2012). Meanwhile, developing countries are more affected by risks compared to developed countries (Xenarios et al., 2016), and Iran is not an exception to this rule and is always exposed to natural disasters such as floods, earthquakes, and droughts. It has been in such a way that out of 40 disasters that have happened in the world, 31 of them happened in Iran. In the meantime, Iran is in the list of the top 10 most impoverished countries in the world (Bozarjmehri & Javanshiri, 2015). During the last 40 years, 27 droughts have occurred in Iran, because most of Iran is located in the dry and semi-arid climate of the world. Iran alone has more extremely dry, dry, and semi-arid areas than the entire European continent (Gholami and Ali Beigi, 2013). The overview of the drought situation in Iran in the next 30 years shows that the drought in the country will increase and in the years 2025, 2030, and 2035, most parts of the country will face severe and very severe drought. In this regard, the drought situation in 2040 will be far more critical than before (Khazanehdari et al., 2008). Therefore, natural hazards and crises have the capacity to become devastating hazards for human communities in the absence of a risk reduction system (Zhou et al., 2010). This is the reason why natural hazards such as drought and its adverse consequences for natural resources, agricultural production and economic and social development are considered as one of the basic challenges of Iran and the other areas prone to drought, and due to the frequency of occurrence and significant scope of this phenomenon, it is necessary to devise mechanisms and directional measures to deal with it (Tavakolinia et al., 2016).In this regard, one of the basic solutions to reduce the vulnerability of rural households against recent droughts is to increase the resilience measures of rural communities against the disruption and chaos created in their lives (Ghorbani et al., 2015). Due to the dynamic nature of society's response to risks and crises, resilient measures are a form of foresight and help to expand policy options to face uncertainty and change (Keck & Sakdapolrak, 2013). In the scientific community, there is a consensus that resilient actions are a multifaceted concept and have social-cultural, human-individual, governance-management, physical-infrastructural, economic-financial and finally natural dimensions. Each of these dimensions has its own indicators and each of the indicators pays attention to details within human systems and plays an essential role in empowering rural communities (Cutter, S., Finch, 2008, Norris et al., 2009). Therefore, due to the close relationship between the village and agriculture, the negative consequences are also more visible on agriculture (Pourtaheri et al., 2012). For this reason, resilient measures against drought for better performance of crops, livestock, meadows and pastures, and other components of the agricultural sector are effective (Habiba, et al., 2012) and lead to an increase in the quality and quantity of production and income, and improve the lives of the rural households, as a result of enhancing their standard of living (De Silva, 2018). Therefore, it is necessary to take resilient measures by rural households in dealing with drought in order to maintain the stable livelihood of households. In Khalil-Abad City of Kashmar and Rostaq District, agriculture is considered as the main activity and livelihood of rural households. The livelihood of most of the rural households in this region is based on the income from agriculture. Agriculture in this region usually depends on the amount and distribution of rainfall and masses prevailing in the district. The seasonal nature of these masses has increased the amount of drought in this region, and drought and the amount of precipitation have been a long-standing challenge in this region. According to the data of the synoptic stations of Rostaq District (2022), although drought has been intermittent in this region since 1380, but frequent droughts have occurred in this district since 2001 to 2022. The occurrence of droughts and lack of rains have resulted in reduction of underground and surface water, reduction of cultivated area and productivity of crops and most importantly, reduction of the income level of rural households. To reduce vulnerability to drought, rural households can withstand drought to some extent through resilience

measures. Therefore, paying attention to the resilient measures can reduce the level of vulnerability of rural households.Therefore, in this research, the evaluation of drought-resilient measures in reducing the vulnerability of rural households in Rostaq District is discussed. In this regard, the present research is designed to answer the following questions:

- Among the resilient measures in dealing with drought, which one is more important?
- What is the difference between the studied villages in terms of resilient measures in dealing with drought?

2. Research Theoretical Literature

The dependence of the rural economy on natural destabilizing factors has created damages in rural settlements (Rahmani & Taghiloo, 2018, Debanli et al., 2017). Among the natural damages, we can take drought as an example, the meaning of which is the access to water resources in lower than average conditions (Melk-Thabet et al., 2014). This phenomenon is one of the natural hazards that are more common in arid and semi-arid regions (Pirmoradian, 2008). Drought is one of the most destructive hazards that is increasing as a slow or creeping event (Pulwarty & Sivakumar, 2014). It leads to imbalance in the hydrological situation of a specific region (Mariano, et al., 2018). In another definition, drought means a deviation from average or normal rainfall conditions and occurs when the amount of rainfall is less than 75% of the rainfall in a certain period of time (25 to 35) in a region (Rezaei et al., 2010). In the practical definition, drought is a continuous period of lack of rainfall (Heidari Sarban & Bakhtar, 2014). To determine the onset of drought, the deviation of the current situation from the average rainfall over a period of time is considered (Basto, et al., 2018). One of the characteristics of drought is the rapid reduction of surface flows and the decline of underground water reservoirs, lakes and rivers (Riahi & Pashazadeh, 2012). In this connection, the role of agriculture in the main livelihood of rural households and its vulnerability to the phenomenon of drought has given importance to the need for operational policies in order to reduce the vulnerability of rural households (Ahmadi & Manouchehri, 2019, Ebrahimi, 2019). Because the most important category and the most uncontrollable variable in the agricultural sector is rainfall, weather and finally drought, it is the dominant force that strongly affects the trend, volume, time table and place of agricultural production, and sometimes it has its own effect that reverses the effect of other

variables and policy instruments. Therefore, considering that the main sources of food supply for rural households are agricultural and horticultural products and animal husbandry, the vulnerability of rural households increases from natural hazards called drought (Sawari & Khosravipour, 2017), which creates local-spatial challenges and the instability of rural settlements (Wilheit et al., 2014, Khalili et al., 2020). On the other hand, the consequences of droughts are not only affected by the severity, continuity and extent of the drought, but also the vulnerability of societies in this field (Wilheit, 2007). In general, vulnerability is a condition that, in relation to geographical and environmental situations, social forces, institutions and cultural values, makes humans sensitive, weak and defenseless against numerous natural hazards (Afrakhteh, 2017). Vulnerability has different concepts among rural households, this is due to the different understanding and perceptions of rural households in each region. Therefore, based on the different dimensions of vulnerability in each region, special policies for that region should be adopted. At the same time, the vulnerability of people is affected by factors such as social class, religion, ethnicity, gender, age, different networks, access to power sources, climate, political structures, diversity of income, infrastructure facilities, technology, access to the market, and the amount of capital (Domeno and Obeng, 2016, Otto et al., 2014, Paavola, 2008). Vulnerability is defined as the conditions of people at risk, their integration in society, and their access to vital services. Vulnerability is part of the generation of inequalities that have affected the sensitivity of different groups and also have determined their ability to respond to them. Vulnerability includes a variety of concepts and elements, including sensitivity to damage and inability to adapt (Oppenheimer et al., 2014). Carter Finch (2008) suggests that vulnerability is a measure of the population's sensitivity to natural hazards and their ability to respond and recover from the effects of hazards. Fussel (2012) defines vulnerability as the lack of ability of individuals, groups or communities to cope with any external stress that affects their livelihood and well-being. However, most of the development theorists have proposed "diversification approach" in the framework of the sustainable rural development model in order to reduce the vulnerability of rural households in the face of drought. In this theory, in order to reduce vulnerability, the existence of "diversity" in economic activities is considered as one of the necessities of rural communities.

Table 1. Review of Literature
Source: Library studies of authors, 2022

| Title	Authors	Results
Analysis of the drought risk index and its effect on the location of villages located in Qazvin basin	Fazelnia et al., 2014	The results indicate that the cultivation pattern should be changed in the villages with high risk of drought in order to prevent the instability of the villages in the region.
Analysis of economic, social and environmental dimensions of drought crisis and its effects on rural households of Zarin Dasht City)	Namdar, Bozjamehri, 2015	The results showed that the crisis of successive droughts was associated with significant effects in economic, social and environmental dimensions in the villages of the region, among which the economic effects of this phenomenon were more than other dimensions.
Analyzing the behavior of drought and the factors affecting it in the nomads of Darila Region, Gachsaran City	Rashed Nasab et al., 2017	The results of the research show that the behavior of the studied nomads with drought can be separated into two dimensions of technical and non-technical moderators.
Examining methods of dealing with drought by farmers (case study: Shirvan city)	Abedi Sarostani et al., 2017	The results showed that the first priority of the solutions to deal with drought is related to land reform solutions and the last priority is related to storage solutions.
Analysis of the socio-economic effects of drought on the rural communities of Semnan	Karimi, 2017	The results showed that the four factors of livelihood crisis, stagnation of production and weakening of agriculture, cultural and psychological and social participation explain 55.812 percent of the changes in the socio-economic effects of drought on the rural communities of Semnan.
Measurement and evaluation of effective dimensions on improving the resilience of rural communities in the face of drought (case study: Sabzevar city)	Vazirian et al., 2019	Measuring the dimensions of resilience showed that the most effective and important dimensions in the level of resilience belong to the infrastructural and physical dimension and the natural dimension.
Identification of effective factors on increasing the resilience of Sistan Plain farmers in facing soil drought,	Khaki1firouz et al., 2022	The results showed that the lack of knowledge, literacy, and the low level of understanding of farmers and officials regarding drought and how to deal with it, reducing self-confidence and life expectancy are the most important factors in resilience in the face of drought.
Resilience assessment of Zahedan City against water crisis and drought	Yadgari Far et al., 2023	The results showed that the state of economic, social and institutional resilience in Zahedan City is lower than the optimal average (3) and Zahedan City is not in a good state in terms of resilience against drought and water crisis.
Social and economic effects of drought	Edwards, et al., 2019	The results indicated that policymakers should consider these impacts in designing effective responses to future droughts.
Causes and effects of drought in northern parts of Ethiopia	Mekonnen, Gokcekus, 2020	The results showed that most of the researchers who have paid attention to drought and famine have investigated them through a cause-and-effect relationship.
Effects of Drought, Social Organization and Public Policy in Northeast Brazil: A Case Study of the Upper Paraíba River Basin	Dantas, et al., 2020	The results showed that the use of dams for water management in the semi-arid region was identified as the main factor affecting water security and social organization.
Investigating the economic and social effects of drought on the rural areas of Bijar City (Cheng Almas Region)	Zarei, et al., 2021	The results showed that in the social dimension, there has been an increase in immigration, a decrease in rural participation, an increase in poverty, a decrease in the quality of the environment and the standard of living, an increase in family conflicts, and the spread of disease.
Farmers' perceptions of drought severity and its effects on pre- and post-drought adaptation: evidence from maize farmers in China.	Hou, et al., 2023	These findings highlight the need for policymakers to enhance farmers' understanding and differentiation of adaptation options and consider their interrelationships in resource allocation to maximize effectiveness.
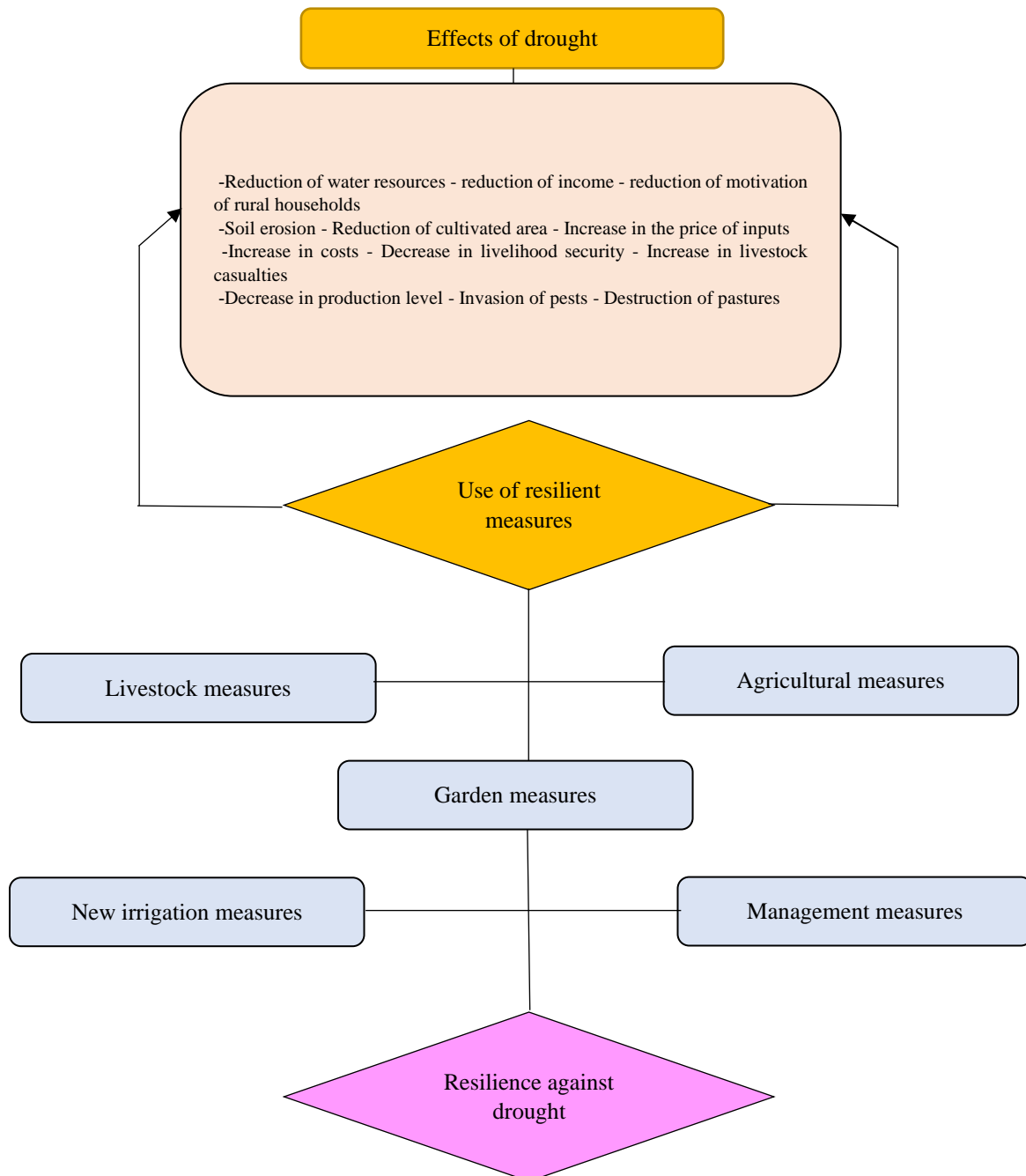
Figure 1- Conceptual model of the research

The application of this approach will facilitate the reduction of the vulnerability of rural households in the face of drought (Alavizadeh, 2009). Based on this, the reduction of the vulnerability of households will appear and finally when the system has many and diverse elements, and the more diverse the system is, the higher the ability to reduce vulnerability and provide conditions for the dynamics of the system, and to preserve it over time in different places not only against internal tensions but also against external tensions (Alavizadeh & Kermani, 2010). In general, the vulnerability caused by drought is classified into four categories: physical, environmental, economic, and social (Nasarnia and Sabeti, 2014); which has direct and indirect effects. The indirect effects of drought on the well-being of other members of the society, due to its effect on product prices and living

costs, are more than the direct effects of drought on production (Dejio, 2017, Badwin et al., 2011).

Due to the fact that drought causes negative consequences on societies in various dimensions, it is of great importance and for this reason, extensive research has been done in this field, and the following can be found from the research conducted in relation to the subject (see Table 1).

However, according to the theoretical background of the research on resilient measures in dealing with drought, it seems that these measures can to some extent curb some of the negative factors affecting the lives of villagers and cause drought to have less impact on the livelihood and life of rural households. On the other hand, not paying attention to drought management and not making people resilient against drought, both in cities and in villages, can lead to negative consequences in the country's villages (Figure 1).

3. Research Methodology
3.1 Geographical Scope of the Research

Khalilabad City with an area of 5.1767 square kilometers is one of the cities of Razavi Khorasan Province. This city is 245 kilometers away from Mashhad, and it is adjacent from the north to the Kohsarakh Region, from the south to Bejestan and Gonabad, from the west to Bardskan City, and from the east to Kashmar. Khalilabad City has a population of 51701 people residing at 27 villages and two parts including the central part with 14 villages and Sheshtaraz District with 13 villages. In the meantime, the central part, its center is Khalil Abad, has smokestacks named Huma and Rostaq. Therefore, Rostaq District was studied from the central part (Figure 2). In the census of 2015, the population of this District was 8441 people and 2748 households, of which, 4328 people, were men and 4113 were women. Agriculture and animal husbandry has been the dominant economy and livelihood at the village level. Therefore, the relevant officials should pay special attention and importance to natural hazards such as drought in this village so that the livelihood of the households is not endangered.
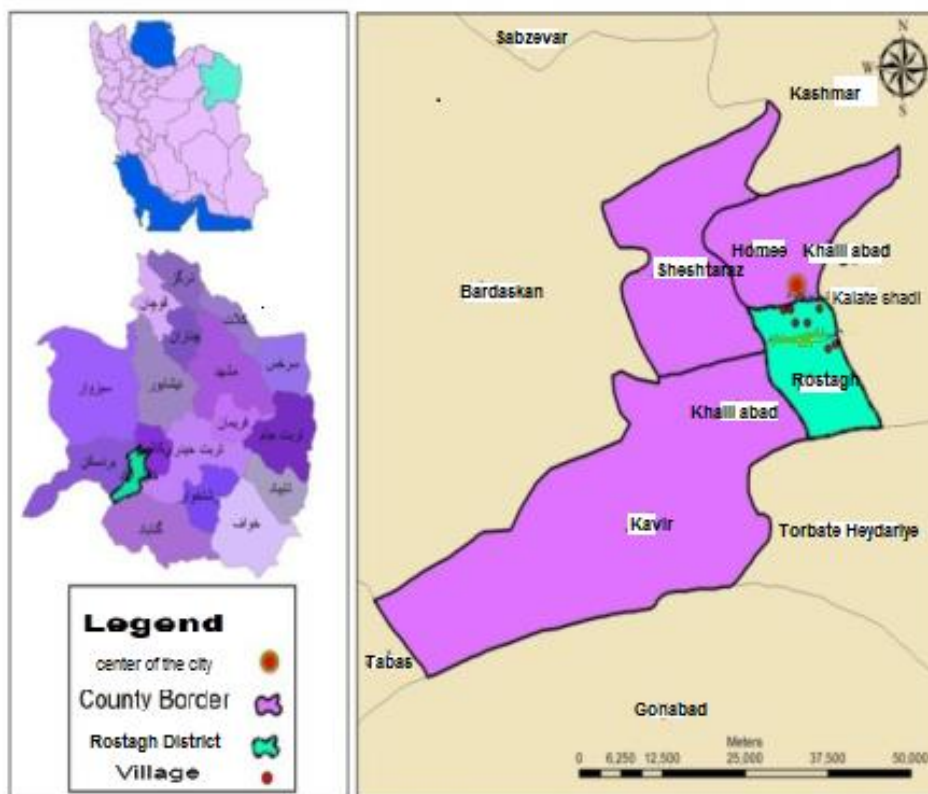

Figure 2. The location of Rostaq Village in Khalilabad City

3.2. Methodology

In order to determine the frequency and severity of climatic drought in the study area, the SPI method was used from the Kashmir synoptic station in the region. The tables are given below. Choosing short-term and long-term scales is because of the effects of drought, which has a short-term effect on soil moisture and agricultural issues, and a long-term effect on water resources. In general, the occurrence of weak type of drought is more frequent than other types of drought in all time scales. In fact, the frequency of drought periods has decreased from the 3-month time scale, but on the other hand, its duration has increased in the studied area in most cases. It is faced with meteorological drought, which is due to the irregularity of rainfall, and also the wet and dry periods have not had much continuity and it is strongly affected by daily rainfall.While in longer time scales, droughts show a slower response to changes in precipitation, the frequency of occurrence of dry periods in long-term time scales is much higher than in short-term periods. According to table (3), there are 31 consecutive droughts in the scale of 3 months, 14 of which are mild droughts and 12 are moderate droughts. In the scale of 3 months (seasonal) in the winter season of 2015, it was -2.28. In the spring season, the most severe drought was in 2018 and 2019, and their severity was -2.40 and -1.9, respectively. There have been 30 droughts in 6 months, 15 of which are weak droughts, 9 moderate droughts, 4 severe droughts, and 2 very severe droughts. According to the table below, 10 cases of drought have occurred in the 9-month scale, 5 of which were mild drought, 4 of which were moderate drought, and 1 was severe drought. The most severe drought was in 2015 with a severity of -2.5. In the 12-month (annual) scale, there have been 12 droughts, 7 of which are mild droughts, 4 of which are moderate droughts, and 1 of which is severe drought

Table 2. Frequency of occurrence of droughts based on SPI index in Kashmer station

Severity of drought perio	SPI–24		SPI–12		SPI–9		SPI–6		SPI–3	
	Percent	Abundance	Percent	Abundance	Percent	Abundance	Percent	Abundance	Percent	Abundance
Weak drought	384	5	59/4	7	48/9	5	58	18	47/1	10
Moderate drought	0	0	33/5	4	47/6	4	27	10	36/7	8
severe drought	0	0	7/1	1	3/5	1	11/6	2	16/2	3
Veryseveredrought	15/7	1	0	0	0	0	3/4	1	0	0
Total	100	6	100	12	100	10	100	31	100	21

The upcoming research is of descriptive-analytical type, which has two major parts in order to investigate the related parameters. The first part was devoted to documentary, library studies and the use of internet facilities to examine issues such as the subject literature, research background, concepts, etc. and the second part was conducted in the form of field research to collect statistical data and complete the questionnaire. For this purpose, according to the basic questions of the research, indexing has been done in two sections: drought resilience measures (Table 3) and vulnerability of rural households in the face of drought (Table 4) in the studied households and finally a questionnaire has been prepared. It should be noted that the studied indicators are selected according to the conditions of the region and from a wide range of indicators related to each sector.

Table 3. Resilient measures in the face of drought
Source: library studies and field observations of the authors, 2022

Row	Dimension	Indicators
1	Agricultural and garden measures	The use of nursery crops, the use of improved seeds, protective plowing, the cultivation of drought-resistant plants (saffron and pistachio), increasing the variety of crops, the use of more resistant vegetative bases, preparing and interpreting the soil profile, reducing the diversity of trees. fighting pests, changing the cultivation pattern, leaving the land fallow,

2	New irrigation measures	Optimal irrigation methods, optimal methods of water transfer, use of covered canals, use of new irrigation technologies, control of floods with the help of earth dams, dredging of canals, irrigation during low evaporation time (night and sunset), waste water control
3	Livestock measures	Use of optimized livestock, compliance with health principles in keeping livestock, reducing the number of livestock, grazing under grass and under trees, manual feeding of livestock, protection of pastures.
4	Management measures	Financial management, local cooperative companies, education and promotion, strengthening local management

Table 4. Significant indicators in the vulnerability of rural households from drought (Source: library studies and field observations of the authors, 2022)

Row	Dimension	Components	Indicators
1	Economic	Employment and income	Employment status, income, banking facilities, property and assets
		The amount of production	The production efficiency, the area under crop cultivation, the number of livestock in the village, the price of agricultural inputs and materials, plant and livestock pests and diseases.
		Investment	The amount of investment in the village, the amount of savings of the villagers
2	social	Migration	The amount of migration of villagers, the interest of young people to continue living in the village environment, job motivations in the migration of villagers
		Participation	The amount of participation of villagers, the escalation of conflicts, the level of interest of farmers in the activity, the level of access to services and facilities in the village.
		Satisfaction	Level of satisfaction with income, level of satisfaction with access to banking facilities
3	environmental	Destruction of the environment	The extent of the destruction of the environment, the loss of plant and animal species, the loss of the natural beauty of the environment (wetlands, etc.), the abandonment and destruction of villages, the change of use of farms and gardens. loss of pastures
		Pollution of the environment	pollution and salinization of water and soil sources, destruction and drying of wells and canals

The number of households in Rostaq District was 2748 in 2015 and according to the latest political divisions of the country, it includes 7 villages. In this research, random sampling was used and the sample size was determined by Cochran's formula.

The statistical volume is estimated to be 2748. N = the number of sample size n = 337. Based on the proportional allocation formula, the number of samples in each village was determined (Table 5).

Table 5. Estimated sample size by villages (Source: Population and housing census, 2015)

Row	Village	Number of households	number of samples
1	Bezanjard	402	49
2	Mirabad	268	33
3	Neghab	780	95
4	Hosianabad	183	23
5	Kalate shadi	281	34
6	Ebrahimabad	681	84
7	Haftkhaneh	183	19
8	total	2748	337

In the next step, to increase the validity of the research, the content and form validity technique was used, and validity of the research was confirmed by the judgment of the experts (experts of the responsible departments) about the research questions. Its value was 0.87 for resilience measures in the face of drought and 0.81 for the vulnerability of rural households to drought (Table 6).

Table 6. Cronbach's alpha of the studied subjects of the research (Source: Research findings, 2022)

Row	Topic	Question number	Cronbach's alpha
1	Resilient measures	30	0/87
2	Vulnerability of rural households	30	0/81

The value of alpha in the variables is higher than 0.70. Therefore, it can be said that the research tools have very good reliability and the research items (questionnaires) have a high internal correlation. Finally, to analyze the data, statistical and spatial analyses such as Shannon's entropy model, Koperas and Vicor models and SPSS software were used

4. Research Findings

According to the supplementary questionnaires, 76.9% of the respondents are men and 23.1% are women, and the highest age frequency is related to the age group of 45 to 60 years (equivalent to 46.5%). Also, the highest frequency of respondents in terms of education level is middle school (equivalent to 38.3 percent). The findings of the research confirm that the annual income from the agricultural sector in 45.2% of the studied households is more than other household incomes and in 4.6% of the studied households, more than 70% of the annual household income was related to the agricultural sector (Table 7).

Table 7. Frequency of studied households by share of agricultural sector income from the total annual household income

Row	The percentage of income of the agricultural sector	Frequency	Percentage
1	10 Less than	22	4/6
2	10- 20	25	6/7
3	21 - 30	43	10
4	31 -40	45	12/5
5	41 -50	48	13/3
6	51 - 60	74	28/1
7	61 -70	60	19/4
8	70 More than	20	5/4
9	sum total	337	100

Also, out of all 337 surveyed households, in 89.6% of the households, the level of carrying out resilience measures has increased compared to the last 5 years, in 6.5% of the households living in the studied villages, the level of carrying out resilient measures has also decreased in this time range (Figure 3).
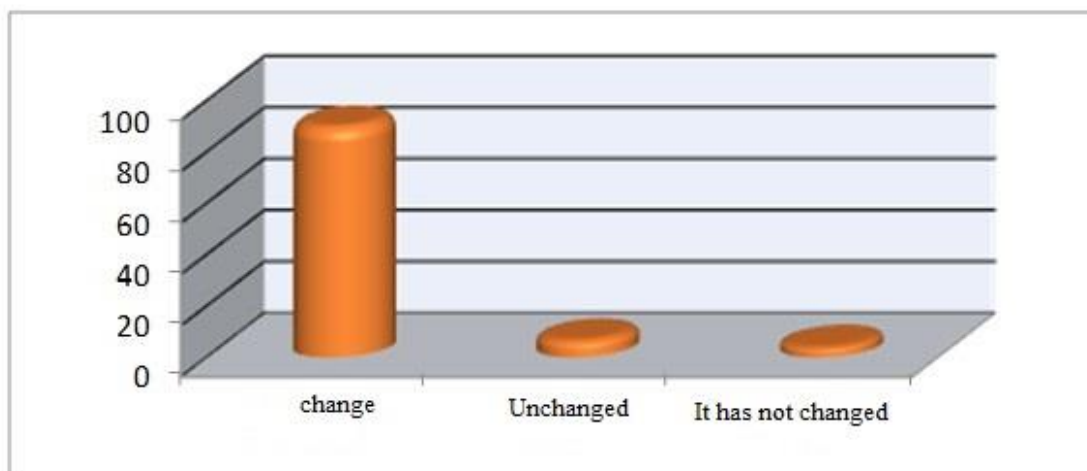
Figure 3. Frequency of resilience of studied rural households compared to the last five years

Summarizing the information obtained from the questionnaires related to the studied households and the statistical analysis of the relevant factors confirm that optimal irrigation methods, optimal water transfer methods, changing the cultivation pattern, leaving land fallow, education and promotion, and strengthening local management have been effective in increasing the level of resilience measures of the studied households.

Regional macro surveys indicate a decrease in the area under cultivation of agricultural crops after the occurrence of drought. In such a situation, it is expected that the cultivated area will become smaller. In other words, the farmers who had a higher cultivated area of the fields, in order to cope with drought conditions, have inevitably reduced the cultivated area. An overview of the findings in table (8) shows that in 2015, 10.2 percent of the cultivated fields were between 2.5 and 5 hectares, while in 1400, this amount reached zero. It is obvious that during the drought period, farms that had enough water were able to continue their activities. Therefore, two hypotheses can be presented regarding the small size of farms during drought. The first hypothesis is that these farms are the previous small farms that have continued to operate due to having enough water, and the second hypothesis is that the remaining farms were part of larger farms that are now limited due to drought. Examining the evidence shows that the second hypothesis is stronger. Therefore, it can be claimed that one of the adjustment mechanisms used by rural households, most of whom are agricultural, to deal with drought is to reduce the area under cultivation.

Table 8. Frequency distribution of agricultural lands and their cultivated area (2016 and 2021)

Area under cultivation	Year 2016		Year 2021	
	Percent	**Frequency**	**Percent**	**Frequency**
Less than 0.5 hectares	5/4	15	23/9	55
0.5-1 hectare	55/6	130	62/4	130
1-5/1 hectare	11/2	60	13/7	60
2-5/1 hectare	10/4	50	0	50
2-5/2 hectares	5/8	20	0	20
5-5/2 hectares	10/8	55	0	55
Bay of 5 hectares	0/8	7	0	7
Total	100	337	100	337

Shannon's entropy model was used to determine the relative importance of effective factors in the resilience measures of rural households in the face of drought. Shannon's entropy method is one of the multi-indicator decision-making methods for calculating the weights of criteria. The results of this survey show that the dimensions of management measures with a coefficient of 0.320 and modern irrigation measures with a coefficient of 0.290 have the highest scores, and agricultural

and garden measures with a coefficient of 0.257, and livestock measures with the coefficient of 0.133 has the lowest score (Table 9).

Table 9. Weights obtained from the dimensions mentioned in the resilience actions of rural households in facing drought with the Shannon entropy model (source: research findings, 2022)

Row	Dimensions	Amounts
1	Agricultural and garden measures	0/257
2	New irrigation measures	0/290
3	Livestock measures	0/133
4	Management measures	0/320

On the other hand, the examination of the dimensions related to the resilience measures of rural households in the face of drought in 337 sample households also confirms that management measures with a value of 15.147 have the highest t value at the level of the studied households. Considering that the average of all indicators was evaluated above the average and, with a confidence level of 99% and a significance level of less than 0.01, significant effect of the indicators of resilience measures of rural households in the face of drought was confirmed in the study area (Table 10).

Table 10. The status of significant indicators in the resilience measures of rural households in the face of drought

Row	Indicators	t amount	Sig (2- tailed)	Std. Deviation
1	Agricultural and garden measures	10/136	0/000	0/420
2	New irrigation measures	13/129	0/000	0/659
3	Livestock measures	8/092	0/000	0/375
4	Management measures	15/147	0/000	0/781

Also, based on the degree of importance of the dimensions related to the resilience measures of rural households in the face of drought (Shannon's entropy model) and their situation in the studied households, the level of resilience measures of rural households in the face of drought was calculated at the level of 337 households, and finally, the rank of resilience measures of rural households in facing drought was determined at the level of each of the studied villages.

In the meantime, among the studied villages, villages such as Niqab due to access to the use of modern irrigation technology, diversification of livelihoods, preparedness in life for harsh conditions (drought), cultivation of resistant and low-water crops, spatial continuity of land parcels and .... performed the most resilient actions at the level of the villages of this district (Table 11).

Table 11. Evaluation results of Copperas model (source: research findings, 2022)

Village	Sj⁺	Sj⁻	Oj	Nj	Rank
Hosianabad	0/3114	0/1725	0/4189	4419/0	7
Neghab	0/9856	0/2792	0/8532	100	1
Mirabad	0/6744	0/2410	0/7128	0/7034	4
Ebrahimabad	0/9437	0/2635	0/8201	0/6971	2
Kalate shadi	0/5247	0/2279	0/6591	0/6246	5
bezanjard	0/9542	0/2782	0/8316	0/9787	3
Haftkhaneh	0/4265	0/1932	0/5470	0/5621	6

The decrease in the price of meat and the increase in the cost of feeding livestock make rural households turn to selling livestock in drought conditions. The results of table (12) show that the number of households with livestock decreased from 337 households in 2020 to 147 households in 202

Table 12. Frequency distribution of households in relation to the number of livestock (years 2016 and 2021)

Area under cultivation	Year 2016		Year2021	
	Percent	Frequency	Percent	Frequency

Less than 10 heads	25	87	0	0
10-20 heads	0	0	147	147
20-30 heads	34	11/6	0	0
30-40 heads	48	14/7	0	0
50-40 heads	147	42/2	0	0
More than 50 heads	83	23/7	0	0
Total	337	100	147	100

On the other hand, the results of comparing different dimensions related to the level of vulnerability of rural households in facing drought in the studied villages show that the economic dimension has the highest degree of importance with a score of 0.425 (Table 13).

Table 13. Weights obtained from the mentioned dimensions in thedegree of vulnerability of rural households in facing drought with the Shannon entropy model (source: research findings, 2022)

Row	Dimensions	Amounts
1	Economic	0/425
2	social	0/205
3	environmental	0/370

On the other hand, the investigation of the dimensions related to the level of vulnerability of rural households in the face of drought in 337 sample households also confirms that economic dimensions with a value of 17.230 have the highest t value in the studied households. Considering that the average of all indicators were evaluated above the average, with a confidence level of 99% and a significance level of less than 0.01, significance of the indicators of the vulnerability of rural households in facing drought in the region was confirmed (Table 14).

Table 14. Status of significant indicators in the degree of vulnerability of rural households in the face of drought

Row	Dimensions	Amount t	Sig (۲- tailed)	Std. Deviation
1	Economic	17/230	0/000	0/890
2	Social	12/534	0/000	0/637
3	Environmental	14/110	0/000	0/760

Also, based on the importance of the dimensions related to the level of vulnerability of rural households in facing drought (Shannon's entropy model) and their situation in the studied households, the level of vulnerability of rural households in facing drought was calculated at the level of 337 sample households and finally, vulnerability rating of rural households in facing drought at the level of each of the studied villages was determined based on Vicor method. In the meantime, among the studied villages, villages such as Haft Khaneh and Hossein Abad were among the most vulnerable at the level of the villages due to the presence of factors such as employment status, income, production efficiency, the area under cultivation, the number of livestock in the village, the migration rate of villagers, the interest of young people to continue living in the village environment, the level of participation of villagers, the escalation of conflicts, the abandonment and destruction of villages, the change of use of fields and gardens, the loss of pastures, and the loss and drying up of wells and aqueducts (Table 15).

Table 15. Evaluation results of Vicor model

Row	village	Q
1	bezanjard	0/123
2	Mirabad	0/147
3	Neghab	0/070
4	Hosianabad	0/230
5	Kalate shadi	0/152
6	Ebrahimabad	0/098

7	Haftkhaneh	0/180

Statistical analysis has been used to investigate the relationship between "resilience measures" and "level of vulnerability in households living in the studied villages". There is no doubt that the existence of distance variable, homogeneity of variances and normal distribution of the used data are necessary conditions in using parametric tests. In this research, due to the existence of the necessary conditions for the use of parametric test, Kendall's correlation test was used to investigate the relationship between resilience measures and the level of vulnerability in households living in the studied villages. The research results confirm that there is a significant relationship between these two variables. The correlation coefficient between resilience measures and the level of vulnerability in households is -0.597, which according to the resulting values, with a confidence level of 99%, it can be said that there is an inverse and significant relationship between these two variables with moderate correlation (Table 16). Based on this, the increase of resilience measures, with a confidence level of 99 percent, has caused a decrease in the level of vulnerability in the households living in the studied villages in the face of drought.

Table 16. The result of Kendall's correlation test in examining the relationship between resilience measures and level of vulnerability of rural households in facing drought

Items	Amounts
The correlation coefficient	-0/597
Significance level	0/000
number of samples	337

In order to provide better results of the contribution of determining indicators of drought resilience measures in reducing the vulnerability of rural households, we used step-by-step regression. (Kalantari, 1385: 173). The results of the step-by-step regression show that in the evaluation of drought resilience measures, among the 4 variables of resilience measures that were included in this model, the management index with a determination coefficient of 0.288 has the largest share in the evaluation of the measures. Resilience with drought has reduced the vulnerability of rural households. (Table 17).

Table 17. Entered indicators and the contribution of each variable in the step-by-step regression model in the evaluation of resilience measures with drought in reducing the vulnerability of rural households

Levels	The variable entered into the model at each step	Coefficients of determination (R_2)	The contribution of each variable in determining the dependent variable (percentage)
step one	Agricultural and garden measures	0/570	20/6
The second step	New irrigation measures	0/397	28/4
The third step	Livestock measures	0/648	19/7
The fourth step	Management measures	0/288	31/3

According to table (18), the beta value obtained for each variable indicates that a change of one unit in the standard deviation of the variables is equal to the beta value of the same variable on the standard deviation of the assessment of drought resilience measures in reducing the vulnerability of rural households and it affects the villages. The beta value of management measures with (0.597) percent is the most important in evaluating drought resilience measures in reducing the vulnerability of rural households.

Table 18. step-by-step regression coefficients for examining independent variables on the evaluation of drought resilience measures in reducing the vulnerability of rural households

variable entered into the model	Regression (B)coefficients	Standard regression (B)coefficients	Standard error	The significance level
Fixed coefficient	–	–	–	-

Agricultural and garden measures	1/059	0/910	0/45	0/000
New irrigation measures	0/760	0/850	0/38	0/000
Livestock measures	1/120	0/935	0/66	0/000
Management measures	0/597	0/943	0/32	0/000

5. Discussion and Conclusion

The vast country of Iran is located in the arid and semi-arid region, and according to the topographical conditions, it has a diverse climate. In the meantime, the increase in population puts a lot of pressure on the excessive and undesirable use of natural water and soil resources to increase agricultural products. The production of agricultural products, especially rainfed cultivation, has a high correlation with the amount of precipitation and some climatic factors. In the meantime, drought is one of the most costly events that has irreparable effects on economic sectors. In this regard, the livelihood of rural households is threatened by drought because the close relationship between the village and agriculture has led to the vulnerability of households and disrupted their economy, and its continuation increases the vulnerability of rural households. Hence, taking resilient measures can be a salve for rural households and to some extent reduces the severity of this vulnerability on the economy of households and villages. Therefore, the aim of the current research was to evaluate drought resilience measures in reducing the vulnerability of rural households (case study: Rostaq District), which in its own way is compared to similar studies related to the resilience measures of rural households. It is significant in the face of drought. From the results of the statistical analysis of the research, it can be concluded that the level of vulnerability in the households living in the villages of Rostaq District will be reduced by taking more resilient measures. In fact, the results of this research are in line with the research findings of Soltani Moghadas (2019) who believes that taking resilient measures has played an effective role in reducing the vulnerability of rural households in the face of drought in al-Qurat Village of Birjand City. In 2015, 10.2 percent of the cultivated fields were between 2.5 and 5 hectares, while in 1400, this amount reached zero. It is obvious that during the drought period, farms that had enough water were able to continue their activities. The results of the research show that it can be claimed that one of the adjustment mechanisms used by rural households, whose occupation is agriculture, to deal with drought, is to reduce the area under cultivation. This part of the findings is consistent with the results of Kanti's (1998) study in Bangladesh.The results of the step-by-step

regression show that in the evaluation of drought resilience measures, among the 4 variables of resilience measures that were included in this model, the management index with a determination coefficient of 0.288 has the largest share in the evaluation of the measures. Resilience with drought has reduced the vulnerability of rural households.Anyway, based on summarizing the results of the household questionnaires (opinions of the heads of the studied households or their spouses), it is necessary to pay attention to the following points in order to promote the implementation of resilient measures in dealing with drought in reducing the vulnerability of rural households in the face of drought. Due to the lack of water, some households living in the villages of Rostaq District choose low-water crops such as saffron for cultivation, because the extremely high price of saffron will bring them significant annual income. Therefore, in order to prevent the departure of human capital from the village to the city, it is suggested to cultivate these income-generating crops with the encouragement and support of the relevant executive bodies.

- The villages of Rostaq District suffer from the presence of irregular and little rains. Therefore, in relation to improving the optimal use of water in the agricultural sector, one of the basic solutions can be the development of new irrigation methods in this sector, and the implementation of operations. Construction projects in the water and soil sector of agriculture is another solution.
- The lack of proper efficiency of agricultural activities of rural households, together with the migration of young and skilled manpower from the production cycle, has caused the environmental destruction to reach its highest level and also the development in the agricultural sector has been damaged. In this regard, the necessary infrastructure should be considered for the adaptation of rural households in the conditions of drought, as well as the preservation and sustainability of experienced and skilled workforce in the rural system. Therefore, it is suggested that educational and promotion systems take an effective and continuous step in line with the mentioned cases.
- Planning and action in order to increase the awareness of rural households regarding the upcoming crises.
- In order to preserve vegetation and prevent wind and water erosion and the loss of animal habitats, increasing the government's supervision over the use of pastures

through conservation units, reviving pastures through weeding, and fodder distribution are necessary. Subsidies among farmers in order to raise livestock and reduce pressure on pastures, construction, restoration and reconstruction of livestock watering holes, establishment of mobile sources of water supply, and fuel supply in rural areas are among the suggestions that can reduce the adverse effects.

Authors' contributions

The authors equally contributed to the preparation of this article**.**

Conflict of interest

The author declares no conflict of interest.

References

1. Abedi Sarostani, A., Ghorbani, K., Khaksar Moghadam, G. (2017). Examining methods of dealing with drought by farmers (Case study: Shirvan city, North Khorasan province). *Journal of Geography and Environmental Sustainability*, 8(28), 13-31 [in Persian] https://ges.razi.ac.ir/article_976.html

2. Mariano, D. A. Dos Santos, C. A. C. Wardlow, B. D. Anderson, M. Schiltmeyer, A. V. Tadesse, T., & Svoboda, M. (2018). Use of remote sensing indicators to assess effects of drought and human-induced land degradation on ecosystem Health in Northeastern Brazil. *Remote Sensing of Environment*, 213(1),129-143. https://doi.org/10.1016/j.rse.2018.04.048

3. Cutter, S.L., & Finch, C. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the national academy of sciences*, 105(7), 2301-2306. https://doi.org/10.1073/pnas.0710375105

4. Afrakhteh, H. (2017). Vulnerability of rural women (case study: Fomanat foothill villages). *Journal of Urban Ecology Research*, 3, 35-51. [in Persian] https://grup.journals.pnu.ac.ir/article_55.html

5. Ahmadi, A., & Manouchehri, S. (2019). An analysis of the effects of environmental hazards (drought) on the sustainability of villagers' livelihoods (case study: a village in Qaenat city). *Journal of Geography and Developmen,*18(58), 175-202. [in Persian]

6. Alavizadeh, S. A., & Kermani, M. (2010). Diversification of economic activities as an approach in sustainable rural development. *National conference on the contribution of agriculture and natural resources in the development of the Islamic Republic of Iran in the horizon of 2025*. Islamic Azad University, Rasht. [in Persian]. https://civilica.com/doc/92372/

7. Alavizadeh, S., A. (2009). *the Role of Diversification of Economic Activities in Sustainable Rural Development (Case Study: Semiram City).* Doctoral Dissertation, Supervisor, Ferdowsi University of mashhad. [in Persian].

8. Basto, S. Thompson, K. Grime, P. Fridley, J. D. Calhim, S. Askew, A. P., & Rees, M. (2018). severe effects of long-term drought on calcareous grassland seed banks. *Climate and Atmospheric Science,* 1(1), 1-7. https://www.nature.com/articles/s41612-017-0007-3

9. Bozarjmehri, K., & Javanshiri, M. (2015). Identify in Indigenous Knowledge and its Application in Rural Crisis Management by Emphasizing Drought, Flood and Earthquake (Case Study: Zuzan in Khaf Province). *Journal of Applied Environmental and Biological Sciences*, 5(8S): 256-263. [in Persian] https://www.academia.edu/download/76506726/1048850.pdf

10. Debanli, I., Mishra, A., & Zekai, S. (2017). Long-term spatio-temporal drought variability in Turkey. *Journal of Hydrology*, 552, 779–792. https://doi.org/10.1016/j.jhydrol.2017.07.038

11. Dantas, J. C., da Silva, R. M., & Santos, C. A. G. (2020). Drought impacts, social organization, and public policies in northeastern Brazil: a case study of the upper Paraíba River basin. *Environmental monitoring and assessment*, 192(5), 1-21. https://link.springer.com/article/10.1007/s10661-020-8219-0

12. De Silva, M. M. G. T., & Kawasaki, A. (2018). Analysis of Socioeconomic Vulnerability to Disaster Risk: A Case Study of Flood and Drought Impact in a Rural Sri Lankan Community. *Ecological Economics*, 152(3), 131-140. https://doi.org/10.1016/j.ecolecon.2018.05.010

13. Djebou, D. (2017). Bridging drought and climate aridity. *Journal of Arid Environments*, 144, 170-180. https://www.sciencedirect.com/science/article/am/pii/S0140196317301064

14. Dumenu, W.K., & Obeng, E. A. (2016). Climate change and rural communities in Ghana: Social vulnerability, impacts, adaptations and policy implications. *Environmental Science & Policy*, 55, 208-217. https://doi.org/10.1016/j.envsci.2015.10.010

15. Ebrahimi, M. (2019). social, economic and environmental vulnerability of farmers to drought (case study: Bekan Euclid plain). *Journal of Agricultural Economics and Development*, 28(109), 171-192. [in Persian] http://aead.agri-peri.ac.ir/article_121580.html

16. Edwards, B., Gray, M., & Hunter, B. (2019). The social and economic impacts of drought. *Australian Journal of Social Issues*, 54(1), 22-31. https://doi.org/10.1002/ajs4.52

17. Fazelnia, G., Hakim Doost, S.Y., & Salarpour, S. (2014). analysis of drought risk index and its effect on rural location selection (case study: Qazvin province). *Village and Development Quarterly*, 18(1), 133-150. [in Persian]. http://rvt.agri-peri.ac.ir/article_59424.html

18. Fussel, H.M. (2012). "Vulnerability to climate change and poverty". In: Edenhofer, O., Wallacher, J., Lotze-Campen, H., Reder, M., Knopf, B., Mu¨ller, J. (eds), Climate change, *justice and sustainability*. Springer, Dordrecht.

19. Gholami, M., & Ali Beigi, A., H. (2014). Identification of local drought management methods (case study: Sarpol Zahab city). *Rural Research Quarterly*, Volume 5(3), 611-638. [in Persian]. https://jrur.ut.ac.ir/article_53183.html

20. Ghorbani, M., Avazpour, L., & Yoosefi, M. (2015). Analysis and Assessment of Social Capital in toward increasing of Local Communities Resilience and Sustainable Landscape Management. *Journal of Range and Watershed Managment,* 68(3), 625-645. https://jrwm.ut.ac.ir/article_56141.html

21. Habiba, U., Shaw, R., & Takeuchi, Y. (2012). Farmer's perception and adaptation practices to cope with drought: Perspectives from Northwestern Bangladesh. *International Journal of Disaster Risk Reduction,* 1(1), 72-84. https://doi.org/10.1016/j.ijdrr.2012.05.004

22. Heidari Sarban, V., & Bakhtar, S. (2014). review of strategies to deal with drought in rural areas from the perspective of agricultural jihad experts (case study: Isfahan province). *Journal of Geography and Environmental Hazards*, 4(15), 19-34. [in Persian]. https://journals.iau.ir/article_598252.html

23. Hou, L., Min, S., Huang, Q., & Huang, J. (2023). Farmers' perceptions of drought-severity and the impacts on ex-ante and ex-post adaptations to droughts: Evidence from maize farmers in China. *Agricultural Water Management*, 279, 108180. https://doi.org/10.1016/j.agwat.2023.108180

24. Karimi, S. (2018). Analyzing the Economic and Social Effects of Drought on Rural Communities in Semnan County of Iran. *Village and Development*, 21(3), 75-95. [in Persian] http://rvt.agri-peri.ac.ir/article_81728.html

25. Keck, M., & Sakdapolrak, P. (2013). What is Social Resilience? *Lessons Learned and Ways Forward.* Erdkunde, 67(1), 5–19. https://www.jstor.org/stable/23595352

26. Khakifirouz, Z., Niknami, M., Keshavarz, M., & Sabouri, M. S. (2022). Drivers of Farmers' Resilience to Drought: A Case of Sistan Plain. *Iranian Agricultural Extension and Education Journal*, *18*(1), 161-179. [in Persian] https://www.iaeej.ir/article_156443.html?lang=en

27. Khalili, N., Arshad, M., Farajzadeh, Z., Kachele, H., & Muller, K. (2020). Effect of drought on smallholder education expenditures in rural Iran: Implication for policy. *Journal of Environmental Management*, 260, In Press. [in Persian].

28. Khazanehdari, L., Zabol Abbasi, F., Kandahari, S., Kohi, M., & Malbusi, S. (2008). A perspective on Iran's drought situation in the next thirty years. *Journal of Regional Development Geography*, 12, 83-98. [in Persian]. https://jgrd.um.ac.ir/article_26344.html

29. Malek-Thabet, M., Zara, M., Mokhtari, M., H., & Kothari, M. (2014). Evaluation of meteorological indices of draught versus remote sensing indices: A case study of Yazd province. *The Journal of Geographical Research on Desert Areas,* 3(1), 118-101. [in Persian]. http://grd.yazd.ac.ir/article_829.html

30. Mekonnen, Y. A., & Gokcekus, H. (2020). Causes and Effects of Drought in Northern Parts of Ethiopia. https://core.ac.uk/download/pdf/304991896.pdf

31. Namdar, M., Bozjamehri, Kh. (2016). Analysis of economic, social and environmental dimensions of drought crisis and its effects on rural households: case study: villages of Zarin Dasht city. *Village and Development Quarterly*, 19(3), 161-183. [in Persian] http://rvt.agri-peri.ac.ir/article_59475.html

32. Nasrnia, F., & Zibaei, M. (2015). Vulnerability assessment to Drought in Various Provinces, approach towards risk management in the country. *Journal of Agricultural Economics and Development*, 29(4), 359-373. [in Persian] https://jead.um.ac.ir/article_33686.html

33. Norris, F., Stevens, S., Pfefferbaum, B., Wyche, A., & Pfefferbaum, R. (2009). Community Resilience as a Metaphor, Theory, Set of Capacities and Strategies for Disaster Readiness. *American Journal of Community Psychology*, 41 (2), 127–50. https://doi.org/10.1007/s10464-007-9156-6

34. Oppenheimer, M., Campos, M., Warren, R., Birkmann, J., Luber, G., O'Neil, B., Takahashi, K., Berkhout, F., Dube, P., Foden., W., Greiving, S., Hsiang, S., Johnston, M., Keller, K., Kleypas, J., Kopp, R., Licker, R., Peres, C., Price, J., Robock, A., Schlenker, W., Stepp, J.R., Tol, R., & vanVurren, D. (2014). Emergent risks and key vulnerabilities. In: Field C.B, Barros, V.R., Dokken, D.J. et al. (eds) Climate change 2014: "impacts, adaptation, and vulnerability". Part A: global and sectoral aspects. *Contribution of Working Group II to the Fifth*.

35. Otto, M., Reckien, D., Reyer, P.O., Marcus, R., Masson, V., Jones, L., Norton, A., & Serdeczny, O. (2014). Social vulnerability to climate change: a review of concepts and evidence. *Regional Environment Change*, 17, 1651-1662. https://doi.org/10.1007/s10113-017-1105-9

36. Paavola, J. (2008). Livelihood, vulnerability and adaptation to climate change in Morogoro, Tanzania. *Environmental Science and Policy*, 11, 624-654. https://doi.org/10.1016/j.envsci.2008.06.002

37. Peterson, T.C., Hoerling, M.P., Stott, P.A., & Herring, S.C. (2013). Explaining extreme events of 2012 from a climate perspective. *Bulletin of the American Meteorological Society*, 94(9), 1–74. https://doi.org/10.1175/BAMS-D-12-00021.1

38. Pirmoradian, N., Shams-nia, S. A., & Bostani, F. (2008). Evaluation of the return period of drought using the standardized precipitation index in Fars province. *New Agricultural Science Journal*, 4(13), 7-21. [in Persian] https://journals.iau.ir/article_515030.html

39. Pourtaheri, M., Ruknuddin Eftekhari, A., & Kazemi, N. (2012). The role of drought management approach in reducing the economic-social vulnerability of rural farmers. *Journal of Rural Research*, 4(1), 1-22. [in Persian] https://jrur.ut.ac.ir/article_31969.html

40. Pulwarty, R. S., & Sivakumar, M. V. K. (2014). Information systems in a changing climate: Early warnings and drought risk management. *Weather and Climate Extremes*, 3(6), 14-21. https://doi.org/10.1016/j.wace.2014.03.005

41. Rahmani, F., & Taghilo, A. (2018). Analysis of the role of spatial elements in economic resilience (case study: Cheshme Sera village, Shut city). *Rural Development Strategies Journal*, 6(3): 231-251. [in Persian]. https://rdsj.torbath.ac.ir/article_102764.html

42. Rashid Nasab, Kh, Gha, Ahmadvand, M., & Sharifzadeh, M. (2017). Analysis of drought behavior and factors affecting it in Ashar of Darila region, Gachsaran city. *Journal of Rural Researches*, 9(1), 91-100. [in Persian] https://jrur.ut.ac.ir/article_66216.html

43. Rezaei, R., Hosseini, S., M., & Sharifi, A. (2010). Analysis and explanation of drought in rural areas of Zanjan city (case study: Haj Arash village). *Rural Research Quarterly*, 1(3), 109-130. [in Persian] https://jrur.ut.ac.ir/article_22182.html

44. Riahi, V., & Pashazadeh, A. (2012). Economic and social impacts of drought on rural areas in Germi (Case study: Rural district of Azadlu). *Journal of Studies of Human Settlements Planning*, 8(25), 17-37. [in Persian] https://jshsp.rasht.iau.ir/article_513799.html

45. Saemipour, H., Ghorbani, M., Malekian, A., & Ramzanzadeh Lesboi, M. (2018). Evaluating local beneficiary's resilience encountered with prolonged drought condition (Case study: Nardin village,

Mayamey county, Semnan province). *Marta scientific-research journal,* 12(1), 62-72. [in Persian] http://rangelandsrm.ir/article-1-559-fa.html

46. Sawari, M., & Khosravipour, B. (2017). Analysis of the effects of resilience on the vitality of rural households in drought conditions in Divan-Dareh. *Journal of Spatial Planning*, 8(3), 19-40. [in Persian] https://doi.org/10.22108/sppl.2018.113150.1291

47. Sivakumar, M.V.K. (2012). High-level Meeting on National Drought Policy. CSA News, *December American Society of Agronomy, Madison, Wisconsin*, USA (2012). https://doi.org/10.1016/j.wace.2014.01.002

48. Soltani Moqadas, R. (2021). Evaluating the effectiveness of anti-drought measures to reduce the vulnerability of rural settlements: A case study of Alghorat District of Birjand County in South Khorasan Province. *The Journal of Geographical Research on Desert Areas*, 8(2), 297-318. [in Persian] http://grd.yazd.ac.ir/article_2064.html

49. Tavakolinia, J., Paknehad, M., Riesi, H., & Aghaei, P. (2016). Assessment of social challenges caused by drought crisis on sustainable rural development (case study: Miandreh district of Shibkoh district, Fasa city). *Sarzemin Geographical Journal*, 13(49), 27. [in Persian] https://journals.srbiau.ac.ir/article_9660.html

50. Vazirian, R., Karimian, A. A., Ghorbani, M., Afshani, A., & Dastorani, M. T. (2021). Measuring and Evaluating the Dimensions Affecting the improvement of Resilience of Rural Communities in the Face of Drought (Case Study: Sabzevar County). *Journal of Rural Research*, 11(4), 630-645. [in Persian] https://jrur.ut.ac.ir/article_78289.html?lang=en

51. Wilhite, D., Sivakumar, M., & Pulwarty, R. (2014). Managing drought risk in a changing climate: The role of national drought policy. *Weather & Climate Extremes*, 3, 4-13. https://doi.org/10.1016/j.wace.2014.01.002

52. Wilhite, D.A., Svobada, M.D., & Hayes, M.J. (2007). Understanding the complex impacts of drought: A Nebraska case study. *Natural Hazards*, 25, 37-58. https://doi.org/10.1023/A:1013388814894

53. Xenarios, S., Nemes, A., Sarker, G. W., & Sekhar, N. U. (2016). Assessing vulnerability to climate change: Are communities in flood-prone areas in Bangladesh more vulnerable than those in drought-prone areas? *Water Resources and Rural Development*, 7(2), 1-19. https://doi.org/10.1016/j.wrr.2015.11.001

54. Yadgari Far, F., Pudine, M., & Ismail Nejad, M. (2023). Evaluating the resilience of Zahedan city against water crisis and drought. *Journal of Applied Research in Geographical Sciences*, 23(68), 364-345. [in Persian] http://jgs.khu.ac.ir/article-1-3573-fa.html

55. Zarei, A., Rezaei, F., & Mohammadi, M. (2021). Investigating the economic and social effects of drought on rural areas of Bijar city (Cheng Almas Region). *Geography and Human Relationships*, 4(2), 319-335. [in Persian]. https://www.gahr.ir/article_139732.html?lang=en

56. Zhou, W., Liu, Q., Zhu, Z., & Zhang, J. (2010). Preparation and properties of vanadium-doped TiO2 photocatalysts. *Journal of Physics D: Applied Physics*, 43(3), 035301. https://iopscience.iop.org/article/10.1088/0022-3727/43/3/035301/meta

Original Article

ارزیابی اقدام‌های تاب آورانه با خشکسالی در کاهش آسیب‌پذیری خانوارهای روستایی (مطالعه موردی: دهستان رستاق شهرستان خلیل‌آباد)

سیدامیرمحمد علوی‌زاده*۱- محمودرضا میرلطفی۲- علی ایزدی۳

۱-دانشیار جغرافیا و برنامه‌ریزی روستایی، دانشگاه پیام نور، تهران، ایران

۲-دانشیار جغرافیا و برنامه‌ریزی روستایی، دانشگاه زابل، زابل، ایران

۴-دانشجوی دکترای جغرافیا و برنامه‌ریزی روستایی، دانشگاه سیستان و بلوچستان، زاهدان، ایران

چکیده مبسوط

پژوهش به ارزیابی اقداماهای تاب آورانه با خشکسالی در کاهش آسیب‌پذیری خانوارهای روستایی در دهستان رستاق پرداخته می‌شود.

۱.مقدمه

دور نمای وضعیت خشکسالی ایران طی ۳۰ سال آینده نشان می‌دهد که خشکسالی در کشور رو به افزایش خواهد بود و در سال‌های ۲۰۲۵، ۲۰۳۰، ۲۰۳۵ بیشتر نقاط کشور با خشکسالی شدید و بسیار شدید روبه رو خواهد بود. در این راستا، وضعیت خشکسالی در سال‌های ۲۰۴۰ به مراتب بحرانی‌تر از قبل خواهد بود. در این راستا، یکی از راهکارهای اساسی کاهش آسیب‌پذیری خانوارهای روستایی در برابر خشکسالی‌های اخیر، افزایش اقدام‌های تاب اورانه جوامع روستایی در برابر اختلال و آشفتگی ایجاد شده در زندگی آنان است. از این رو، ارتباط تنگاتنگ روستا و کشاورزی، پیامدهای منفی آن نیز بر کشاورزی بیشتر نمایان می‌شود. به همین خاطر اقدامات تاب آورانه در مقابل خشکسالی برای بهتر عملکرد محصولات، دام‌ها، مراتع و چراگاه‌ها و دیگر اجزای بخش کشاورزی تاثیرگذار بوده و منجر به کاهش کیفیت و کمیت تولیدات و درآمد خانوارهای روستایی، در نتیجه کاهش سطح استاندارد زندگی آنان را به دنبال داشته است. لذا، انجام اقدام‌های تاب آورانه توسط خانوارهای روستایی در مقابله با خشکسالی برای حفظ معیشت پایدار خانوارها ضروری می‌باشد.

خلیل‌آباد کاشمر و دهستان رستاق نیز کشاورزی به عنوان فعالیت اصلی و ارتزاق خانوارهای روستایی محسوب می‌شود. تامین معیشت اکثر خانوارهای روستایی این منطقه بر پایه درآمد حاصل از کشاورزی است. کشاورزی در این منطقه معمولا به میزان و توزیع بارش‌های و توده‌های حاکم در سطح دهستان بستگی دارد. فصلی بودن این توده‌ها بر میزان خشکسالی در این منطقه افزوده است و خشکسالی و مقدار بارش، به عنوان چالشی دیرین در این منطقه بوده است. بنابراین، توجه به این اقدام‌های تاب آورانه می‌تواند سطح آسیب‌پذیری را بر خانوارهای روستایی کاهش دهد. لذا در این

۲. مبانی نظری تحقیق

وابستگی اقتصاد روستایی به عوامل ناپایدار ساز طبیعی آسیب‌هایی را در سکونتگاه‌های روستایی پدید آورده است. از جمله آسیب‌های طبیعی، می‌توان خشکسالی را مثال زد که مفهوم آن دسترسی به منابع اب از شرایط متوسط پایین‌تر است. این پدیده یکی از مخاطره‌های طبیعی است که فروانی آن در مناطق خشک و نیمه خشک زیاد می‌باشد. خشکسالی یکی از مخرب‌ترین مخاطرات است که به عنوان یک رویداد آهسته و یا خزنده در حال افزایش است. خشکسالی را معلول یک دوره شرایط خشک غیرعادی در نظر می‌گیرند که به اندازه کافی دوام داشته و منجر به ایجاد عدم تعادل در وضعیت هیدرولوژی یک منطقه خاص گردد. در این ارتباط، نقش کشاورزی در معیشت اصلی خانوارهای روستایی و آسیب‌پذیری آن از پدیده خشکسالی، لزوم سیاست‌گذاری‌های عملیاتی را دراستای کاهش آسیب‌پذیری خانوارهای روستایی اهمیت بخشیده است. زیرا، مهم‌ترین مقوله و متغیر غیرکنترلی در بخش کشاورزی، بارندگی، آب و هوا و در نهایت خشکسالی است که نیروی غالب به شدت تاثیرگذار بر روند، حجم و جدول زمانی و مکانی تولیدات بخش کشاورزی است و گاهی چنان اثر خود را می‌گذارد که اثر سایر متغیرها و ابزارهای سیاست‌گذاری را معکوس می‌کند. بنابراین، باتوجه به اینکه، منابع اصلی تامین مواد غذایی خانوارهای روستایی، تولیدات زراعی و باغی و دامداری است. آسیب‌پذیری خانوارهای روستایی از مخاطره طبیعی به نام خشکسالی افزایش می‌دهد که زمینه ساز چالش‌های محلی- فضایی و ناپایداری سکونتگاه‌های روستایی می‌شود. از طرفی، پیامدهای ناشی از خشکسالی‌ها نه تنها از شدت، استمرار و گستره خشکسالی تاثیر می‌پذیرد، بلکه میزان آسیب‌پذیری جوامع نیز دراین زمینه تاثیر گذار است

* نویسندهٔ مسئول:

دکتر سیدامیرمحمد علوی‌زاده

آدرس: گروه جغرافیا، دانشکده علوم اجتماعی، دانشگاه پیام نور، تهران، ایران.

پست الکترونیکی: Email: alavipnu@pnu.ac.ir

۳. روش تحقیق

پژوهش پیش رو از نوع توصیفی – تحلیلی است که جهت بررسی پارامترهای مورد بررسی سود جسته، دارای دو بخش عمده بوده است. بخش اول را مطالعات اسنادی، کتابخانه‌ای و استفاده از امکانات اینترنتی جهت بررسی مواردی چون ادبیات موضوع، پیشینه تحقیق، مفاهیم و غیره به خود اختصاص داده و بخش دوم در قالب پژوهش‌های میدانی جهت جمع‌آوری آماری اطلاعات و تکمیل پرسشنامه انجام گردیده است. بدین منظور با توجه به سؤالات اساسی تحقیق اقدام به شاخص‌سازی در دو بخش اقدامات تاب آورنه با خشکسالی و آسیب‌پذیری خانوارهای روستایی در مواجهه با خشکسالی در خانوارهای مورد مطالعه و نهایتاً تهیه پرسشنامه شده است. تعداد خانوار دهستان رستاق ۲۷۴۸خانوار در سال ۱۳۹۵ بوده و بر اساس آخرین تقسیمات سیاسی کشوری شامل ۷ روستا می‌باشد. در این پژوهش از نمونه گیری تصادفی استفاده شده است و با فرمول کوکران حجم نمونه تعیین گردید است. حجم آماری N=۲۷۴۸ تعداد حجم نمونه n=337 برآورد شده است. براساس فرمول تخصیص متناسب تعداد حجم نمونه در هر روستا مشخص شد. در نهایت برای تجزیه و تحلیل داده‌ها از تحلیل‌های آماری و فضایی مثل مدل آنتروپی شانون ، مدل کوپراس و ویکور و نرم‌افزار, SPSS استفاده گردیده است.

۴.یافته‌های تحقیق

مروری بر یافته‌ای، نشان می‌دهد در سال ۱۳۹۵، ۱۰/۲ درصد مزارع سطح زیرکشت بین ۲/۵ تا ۵ هکتار بوده‌اند، این در حالی است که در سال ۱۴۰۰ این میزان به صفر رسیده است. بدیهی است که در طول دوران خشکسالی، مزارعی توانسته‌اند به فعالیت خود ادامه دهند که از آب کافی برخوردار بوده‌اند. نتایج این بررسی نشان می‌دهد که ابعاد اقدام‌های مدیریتی با ضریب ۰/۳۲۰ و اقدام‌های آبیاری نوین با ضریب ۰/۲۹۰، دارای بیشترین امتیاز و اقدام‌های زراعی و باغی با ضریب ۰/۲۵۷ و اقدام‌های دامی با ضریب ۰/۱۳۳، کمترین امتیاز برخوردار هستند. در این میان، از بین روستاهای مورد مطالعه، روستاهایی همچون نقاب به دلیل دسترسی به استفاده از تکنولوژی آبیاری نوین، متنوع نمودن معیشت، امادگی داشتن در زندگی برای شرایط سخت(خشکسالی)، کشت محصولات مقاوم و

کم آب بر، پیوستگی مکانی قطعات اراضی و ....، بیشترین اقدام‌های تاب‌آورانه در سطح روستاهای این دهستان را انجام دادند. نتایج تحقیق مؤید آن است که بین این دو متغیر رابطه معناداری وجود دارد. ضریب همبستگی بین اقدام‌های تاب‌آورانه و سطح آسیب‌پذیری در خانوارها ۰/۵۹۷- می‌باشد که با توجه به مقادیر حاصل، با سطح اطمینان ۹۹ درصد می‌توان گفت که بین این دو متغیر، ارتباط معکوس و معنادار با همبستگی متوسط برقرار می‌باشد

۵.بحث و نتیجه گیری

کشور پهناور ایران در منطقه خشک و نیمه خشک قرار گرفته و با توجه به شرایط توپوگرافی، دارای اقلیمی متنوع می‌باشد. در این بین افزایش جمعیت، فشار بسیاری را بر استفاده بی‌رویه و نا مطلوب از منابع طبیعی آب و خاک برای افزایش محصولات کشاورزی وارد می‌سازد. تولید محصولات کشاورزی به ویژه کشت دیم، همبستگی بالایی با مقدار نزولات جوی و برخی از عوامل اقلیمی دارد. در این میان، خشکسالی از جمله پرهزینه‌ترین حوادثی است که اثرات جبران‌ناپذیری را بر بخش‌های اقتصادی وارد می‌سازد. در این راستا، معیشت خانوارهای روستایی را خشکسالی به مخاطره می‌اندازد چرا که ارتباط تنگاتنگ روستا و کشاورزی، آسیب‌پذیری خانوارها را در پی داشته است و اقتصاد آن‌ها مختل کرده است و تداوم آن، شدت آسیب‌پذیری بر خانوارهای روستایی را دو چندان کرده است. از این رو انجام اقدام‌های تاب‌آورانه می‌تواند مرهمی بر دل خانوارهای روستایی باشد و تا حدودی از شدت این آسیب‌پذیری بر اقتصاد خانوارها و روستاها بکاهد. لذا، هدف پژوهش حاضر، ارزیابی اقدام‌های تاب آورانه با خشکسالی در کاهش آسیب پذیری خانوارهای روستایی(مطالعه موردی: دهستان رستاق) می‌باشد که در نوع خودش در مقایسه با مطالعات مشابه در ارتباط با اقدام‌های تاب‌آورانه خانوارهای روستایی در مواجهه با خشکسالی قابل توجه می‌باشد.

کلیدواژه‌ها: اقدامات تاب آورانه، خشکسالی، آسیب‌پذیری، خانوارهای روستایی، دهستان رستاق.

تشکر و قدردانی