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Original Article

Modeling stabilizing the of orchard managers on the shores of Lake Urmia against late spring frost[1]

Modelo de estabilização dos meios de subsistência dos pomares nas margens do Lago Urmia contra as geadas do final da primavera

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Abstract

Despite the adverse effects of late spring frost on the ecological and economic impact on agriculture, the management of these events are poorly investigated. Therefore, the grounded theory was used for extracting the livelihood stabilization model of orchardists on the shores of Lake Urmia against late spring frosts. The statistical population of this study in the qualitative part included 22 experts in the field of horticulture. In the quantitative study, they included all orchardists in the villages along with Lake Urmia, comprising 341 people, of which 236 were randomly selected. By carefully examining and linking the concepts and subcategories, the most important subcategories that were included six subcategories. The results of all calculated goodness-of-fit indexes (chi-square [P > 0.01], RMSEA = 0.000, NFI = 0.95, CFI = 0.91, and GFI = 0.92) showed the model provided an excellent fit for the data. Standardized regression coefficients showed that interfering factors had the greatest impact on the livelihood of orchardists against late spring frosts (β = 0.47). Also, the background factors (β = 0.43) and causal factors (β = 0.39) were found to affect the livelihood of the orchardists in encountering late spring frost. The results of multiple square correlations of dependent variables also indicated that about 41% of the livelihood variance of small-scale orchardists was explained by the predictor variables (i.e. causal conditions, background factors and interfering factors). The findings of this study can assist policymakers, planners and relevant managers while paying more attention to orchardists in the region, so as to support decisions in order to achieve sustainable development.

Keywords: sustainable livelihoods, late spring frost, orchardists, lake Urmia, grounded theory, structural equation modeling.

Resumo

Apesar dos efeitos adversos das geadas do final da primavera no impacto ecológico e econômico na agricultura, o manejo desses eventos é pouco investigado. Portanto, a teoria fundamentada foi utilizada para extrair o modelo de estabilização dos meios de subsistência dos pomares nas margens do Lago Urmia contra as geadas do final da primavera. A população estatística deste estudo na parte qualitativa incluiu 22 especialistas na área de horticultura. O estudo quantitativo incluiu todos os fruticultores nas aldeias junto ao Lago Urmia, compreendendo 341 pessoas, das quais 236 foram selecionadas aleatoriamente. Ao examinar cuidadosamente e vincular os conceitos e subcategorias, as subcategorias mais importantes que foram incluídas em outras 6 subcategorias. Os resultados de todos os índices de qualidade de ajuste calculados (qui-quadrado [P > 0,01], RMSEA = 0,000, NFI = 0,95, CFI = 0,91 e GFI = 0,92) mostraram que o modelo forneceu um excelente ajuste para os dados. Os coeficientes de regressão padronizados mostraram que os fatores interferentes tiveram o maior impacto sobre a subsistência dos pomares contra as geadas do final da primavera (β = 0,47). Além disso, descobriu-se que os fatores de fundo (β = 0,43) e os fatores causais (β = 0,39) afetam o sustento dos pomares ao enfrentarem geadas no final da primavera. Os resultados de múltiplas correlações quadradas de variáveis dependentes também indicaram que cerca de 41% da variância dos meios de subsistência de pequenos pomares foi explicada pelas variáveis preditoras, ou seja, condições causais, fatores de fundo e fatores interferentes. Os resultados deste estudo podem auxiliar os formuladores de políticas, planejadores e gestores relevantes, dando mais atenção aos pomares da região, de modo a apoiar as decisões a fim de alcançar o desenvolvimento sustentável.

Palavras-chave: meios de vida sustentáveis, geada no final da primavera, pomares, lago urmia, teoria fundamentada, modelagem de equações estruturais.

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1. Introduction

A new approach for achieving a decrease in poverty is the sustainable livelihood approach that has been considered in the field of rural development in recent years (Woyesa and Kumar, 2021). Following the evolution of rural development theories and the sustainable rural development model, livelihood sustainability in rural areas has become very important and necessary. This approach appeared in the late 1990s as a new approach to the theory of modern rural development and had an emphasis on a comprehensive mindset of rural development, as a framework and tool for understanding the complexity of people's livelihoods and appropriate responses to reduce rural poverty (Horsley et al., 2015; Conway, 2022).

According to official figures released by the interior ministry of Iran, in total, around 60 percent of the 84 million Iranians live under the relative poverty line, of whom between 20 to 30 million live in "absolute poverty" (https://www.iranintl.com/en/202301025682). A study on rural Iranian populations showed that about 45% of rural households are deprived in at least two-thirds of poverty indicators, and 62.5% of them live in deprived households (https://link.springer.com/article/10.1007/s10668-021-01977-x). Sustainable living contributes to development activities that are people-centered (focusing on poor people's priorities), responsive and participatory (responding to livelihood priorities identified by poor people), multi-level (working at different levels to poverty reduction), guided themes (with the help of public and private sectors), dynamic aspects (flexible response to people in different situations) and sustainable activity (creating economic, institutional balance and social, environmental sustainability) (Motiei Langroudi et al., 2010; Ogunmakinde et al., 2022).

In rural areas, especially in developing countries, one of the most important and effective ways to advance development goals is to understand the living conditions of households and their access to livelihood capital (Mondal and Mistri, 2021). According to many experts, paying attention to rural society, in addition to increasing GDP, has led to the persistence of productive populations, especially youth and adolescents in these areas, and has prevented the society from the consequences of false jobs, migration and marginalization, poverty and harm (Ghanian et al., 2016). A lack of attention to the economic structure of villages and empowerment of farmers, the consequences of climate change, including late spring frost and slow-progressing programs are among the factors that reduce the income level of families among farmers and orchardists. It had consequences such as rural-urban migration, increase of fake jobs, and inflation, which entail overt and covert damage (Sims, 2021).

Since farmers' livelihood approach includes economic, social, environmental and other aspects that directly and indirectly affect the well-being of the people, the use of such a framework as an analytical tool and practical guide in the design and implementation of more appropriate social policies seems necessary in the field of sustainable livelihood of farmers (Pelletier et al., 2016).

Sustainability of farmers' livelihoods is a system in which, by applying proper management in the use of natural resources, the world's food requirements can be met and environmental degradation can be prevented (Balezentis et al., 2020). In stabilization, reducing the pressures on groundwater resources, agricultural lands, non-excessive use of chemical pesticides and the health of human society is one of the main issues. In order to achieve sustainability, many steps must be taken, and first of all, there must be a balance between product production and the desired environmental changes (Akbarian Ronizi, 2017). Over the past few decades, many factors, including rising living costs, the high cost of agricultural inputs, and widespread climate change, have endangered farmers' livelihoods and incomes (Tulabi Nejad and Tabatabai, 2017). Meanwhile, climate change has more effects on the livelihood of farming households than other components and has affected their food security. In cold regions of Iran, climate change with changing climatic patterns, including late spring frost, has affected the production of farmers and orchardists in different parts of the country every year (Akbarian Ronizi, 2017), which has a direct effect on agricultural development and sustainable livelihood (Thrän et al., 2020; Tulabi Nejad and Tabatabai, 2017).

The history of Lake Urmia in Iran comprises events that have led to a disastrous fate, often regarded as an environmental catastrophe. Many scholars in the world have noted the importance of its drought as an iconic occurrence from which lessons can be learned. Its significance is such that comparative cases of research make reference to the versatility of ideas that can be generated from its unfortunate condition (https://www.mdpi.com/2073-4441/14/19/3005). At present, late spring frost is considered as one of the most important challenges in the sustainability of agricultural livelihood in different parts of the world and has a significant effect on the quantity and quality of crops and horticultural products (Pelletier et al., 2016). Late spring frosts are one of the climatic hazards that cause damage to various activities every year. Among these, the agricultural sector is the most important sector that suffers the most serious damage (Thrän et al., 2020). As one of the main climatic parameters in the field of agricultural climate, it reduces the possibility of producing many agricultural and horticultural products in vulnerable areas (Sangiorgio et al., 2020). Severe frosts and frosts can have devastating consequences for many crops and orchards, costing millions of dollars in some years (Tulabi Nejad and Tabatabai, 2017). The shores of Lake Urmia in northwestern Iran are one of the most important and vital areas both in terms of agriculture and animal husbandry and in terms of various natural habitats, which in recent years has faced serious challenges in terms of cold and frost in the spring. In recent years, this region has faced serious challenges such as temperature changes, late spring cold and negative balance of aquifers (Pelletier et al., 2016).

There are 112,000 hectares of orchards in the city of Urmia and also in the dependent cities, of which 102,000 hectares are fertile. In the event of frost, many orchardists suffer from a decrease in livelihood. The boundaries of Lake Urmia are home to walnut, almond, and sour cherry orchards, while Russian olives

can be found scattered throughout the terrain (https://www.schweizerbart.de/papers/phyto/detail/50/92500/Vegetation_patterns_of_a_rapidly_drying_up_salt_la). In recent years, spring frosts and frosts have caused the most damage compared to other natural hazards on the shores of Lake Urmia (Zolfaghari et al., 2012). Challenges expressed on the shores of Lake Urmia on the one hand, as well as the existence of rich water and soil resources, fertile lands and the location of this region on the transit route of Iran with neighboring countries to access foreign agricultural markets on the other, express the need for efforts to design a model to stabilize the livelihood of farmers and orchardists in the region against late spring frosts and the validation of the pattern of extraction in these areas reveals.

In this regard, to solve the existing problems, the gap between the plans made and the policies pursued must be filled. Since the problems caused by the late spring frost in Urmia have made the situation of orchardists in the region face a complex challenge, the results of existing research show that in 2014 about 22% and in 2020 about 52% of orchard products in Urmia were destroyed by early spring frost. Therefore, this comparative statistic reveals the need to try different, effective methods so as to prevent this hazard (Nusrat, 2016). In this regard, the main objective of the present study was to find an appropriate model that can be used to stabilize the livelihood of orchardists on the shores of Lake Urmia when encountering late spring frost. According to researchers, natural factors such as late spring frosts and drought are the main cause of economic and food poverty and cause instability of farmers and their exit from the agricultural sector (Kenny, 2018).

Savari et al. (2017) examined the design of livelihood stabilization model for small-scale farmers in drought conditions. The results of their research showed that there are more than 60 major challenges in the field of sustainability of farmers' livelihoods. Information, management and capacity building involves cultural, technology, organizations and balance which were designed based on sustainability challenges.

Bagheri Fahroji et al. (2018) also showed the effects of resilience against climate change on food security, indicating the poor state of food security and resilience of rural households against climate change. The results of the analysis also showed that there is a positive and significant relationship between the dimensions of resilience against climate change and the level of food security. Keshavarz et al. (2013) showed several important factors explaining rural livelihood sustainability, i.e. the amount of annual income, the amount of government facilities received by farmers, the amount of compensation received from the Agricultural Products Insurance Fund, the age of the head of the household, the amount of external social relations and the susceptibility of cultivated products. Results by Nowruzi and Hayati (2016) also indicated that five structures, i.e. human, social, economic, environmental and physical aspects, affect the sustainability of farmers' households. Islami et al. (2021) aimed at selecting an optimal strategy of sustainable rural livelihood in the face of environmental hazards, whereby an invasive strategy was identified as the best method to achieve sustainable livelihood in villages.

The most important strategies to overcome environmental hazards in stabilizing the livelihood of small-scale farmers include diversification of livelihood resources and non-agricultural activities with the expansion of greenhouse crops using appropriate infrastructure and the development of appropriate capacity-building plans. Accordingly, agricultural communities can deal with risks by forming rural knowledge clusters and developing infrastructure for maintaining livelihoods (Savari et al., 2017).

According to the mentioned sources, study and research on the management of late spring frost in the study area seems more necessary than before. Since this issue is not taken into account and not considered in Iranian planning, the stabilization of livelihood of orchardists in the study area can hardly be achieved. In such a situation, small-scale orchardists take various measures, including pre-selling their products at low prices, seasonal and permanent migration, selling orchards and agricultural land, and finally creating false jobs and increasing suburbanization. The relationship between experts in the governmental sector and farmers in the private sector is of significance when attempting to optimize farmer performance. These relationships deserve to be approached quantitatively in research. Therefore, in order to achieve sustainable livelihoods for orchardists, the need for their empowerment in various fields becomes apparent. For example, in the field of climate, it is necessary to provide a basis for reducing the damage to this producer by extracting an appropriate and validated model and presenting a strategy to deal with sudden climate change (Ishaqi Milasi and Mahmoudi, 2018). In the meantime, it seems necessary to consider the vital role of agricultural promotion in agricultural development, the need to identify and review various strategies in the region in order to manage and organize the damage caused by this challenge.

Therefore, considering that no comprehensive research has been done in this regard in the study area, this research enabled semi-structured interviews with experts and thematic experts, while categorizing the main points of the model in stabilizing the livelihood of orchardists for dealing with late spring frosts in an area where crop and horticultural production is affected by late spring frosts. Then, extraction patterns were validated so that strategies became appropriate to the potential and ecological potential of the region in the form of a practical, executive program.

2. Research Methods

2.1. Type of the research

In this research, considering the quiddity, goals and method of "exploratory design", the model of developing data tools and theory (Grounded Theory) were used for in-depth analysis and systematic, logical analysis. Exploratory design had two stages that began with a qualitative method. In the first stage, the results of the qualitative method clarify the second method (quantitative method). In other words,

these findings are used as a guide for compiling queries and quantitative instrument scales. Therefore, after the qualitative phase and extracting the livelihood stabilization model of small-scale orchardists on the shores of Lake Urmia against late spring frosts using the Grounded Theory in the next stage and in the quantitative phase to evaluate the validity of the research extract model (validation) for achieving a pattern of stabilization of livelihood of small-scale orchardists on the shores of Lake Urmia against late spring frosts. This involved using SEM analysis (structural equation modeling) using SPSS20 and AMOS20 software and was based on software adjustment indicators for the goodness of fit in the final model.

2.2. Qualitative phase

The participants of this study in the qualitative section consisted of 22 experts in the field of horticulture, including university professors and experts and thematic specialists of the Agricultural Organization of West Azerbaijan Province and environmental experts and activists. In the qualitative part, all members of the statistical population were selected by purposeful method, and by conducting semi-structured interviews, sufficient information was obtained. These interviews continued until they reached theoretical saturation (this continued until no new information was received from the collected data. Information were collected through direct observation, semi-structured interviews and note-taking, and complementary methods of reviewing library and online documents were used.

The duration of the interviews varied between the time range of 35 to 100 minutes (the average of each interview was about 45 minutes per person) and a total of 1300 minutes of interviews were conducted, which resulted in the extraction of 876 significant concepts and propositions.

The systematic approach of Strauss and Corbin was used to analyze and formulate the theory. In the systematic approach, there are three stages of open coding, central and selective. In the open coding stage, each of the items raised by the participants was given a code and the basic concepts were extracted. At this stage, the frequency of people who have acknowledged each of the concepts is also mentioned. In the next step (axial coding), the mentioned concepts were categorized in the form of categories and the link between the categories obtained from open coding is done and from the codes obtained from open coding, whereby more appropriate codes are selected. In order to name the categories, an attempt is made to select a title that has the most logical connection with the data that the category represents, based on common and similar concepts that were obtained from open coding. In the selective coding stage, which is accompanied by a detailed study of the data and coding of the previous two stages, the researcher analyzes the data in depth and presents them in the form of a theoretical model (Creswell, 2007). According to Strauss & Corbin's theory, this model has several dimensions, i.e. causal conditions, core categories (phenomenonal) conditions, background conditions, interfering conditions, strategies and consequences (Straus and Corbin, 2008).

In the present study, the results of data analysis were presented based on the three stages of coding. In the open coding stage, 1023 meaningful general concepts and propositions were extracted from the text of interviews and 83 corresponding concepts were involved. In the axial coding stage, 27 subcategories were extracted from the corresponding concepts. After a more detailed study, relationships were found between subcategories of 6 central categories, i.e. causal conditions, background conditions, interfering factors, core categories (phenomenon), strategies and consequences of stabilizing the livelihood of orchardists on the shores of Lake Urmia against late spring frost (coding selective). Accordingly, a paradigm model of the research was finally depicted (Figure 1). It should be noted that all stages of theory extraction and coding process have been done by MAXQDA18 software. In order to ensure the validity and reliability of the research, the researcher has been in contact with the research environment for a long time and by continuously observing, examining the subject from different angles and using different data collection techniques, all the details were portrayed step by step and continuously. Notes were taken and constantly questioned, reviewed and analyzed against the subject matter (open, central and selective coding). Also, the process of data collection, data analysis, final model and final report was reviewed, reviewed and approved by the researchers' consensus (reviewing the findings using the opinions of several colleagues and participants) and their opinions were also compiled.

The findings indicated that the age range of participants in the qualitative phase of this study was between 46 to 55 years (90.9%). The experts were mostly male (86.36%), and had a master's degree (49.4%). They also had an average of 14.3 years of experience in the field of horticulture (standard deviation = 2.13).

2.3. Quantitative phase

In the next step (in a quantitative phase), the validation status of the research extractive model was investigated using AMOS20 software and based on the software moderation indicators and goodness of fit, so that the final model could be approved. The statistical population in the quantitative part of the study also included 341 small-scale orchardists in the villages along Lake Urmia, from which 236 people were selected using the Krejcie and Morgan table by stratified sampling method with appropriate assignment. To collect information at this stage, a questionnaire was used, which was based on the qualitative findings of the first stage of the research. The apparent validity and content of the questionnaire were evaluated by a group of experts in this field and its reliability was confirmed using Cronbach's alpha.

In the quantitative phase, the age range of the studied orchardists was between 46 to 55 years (50.85%). The orchardists were mostly male (89.41%), and had passed less than higher education in high school (57.6%). They also had an average of 11.7 years of experience in the field of horticulture (standard deviation = 6.25).

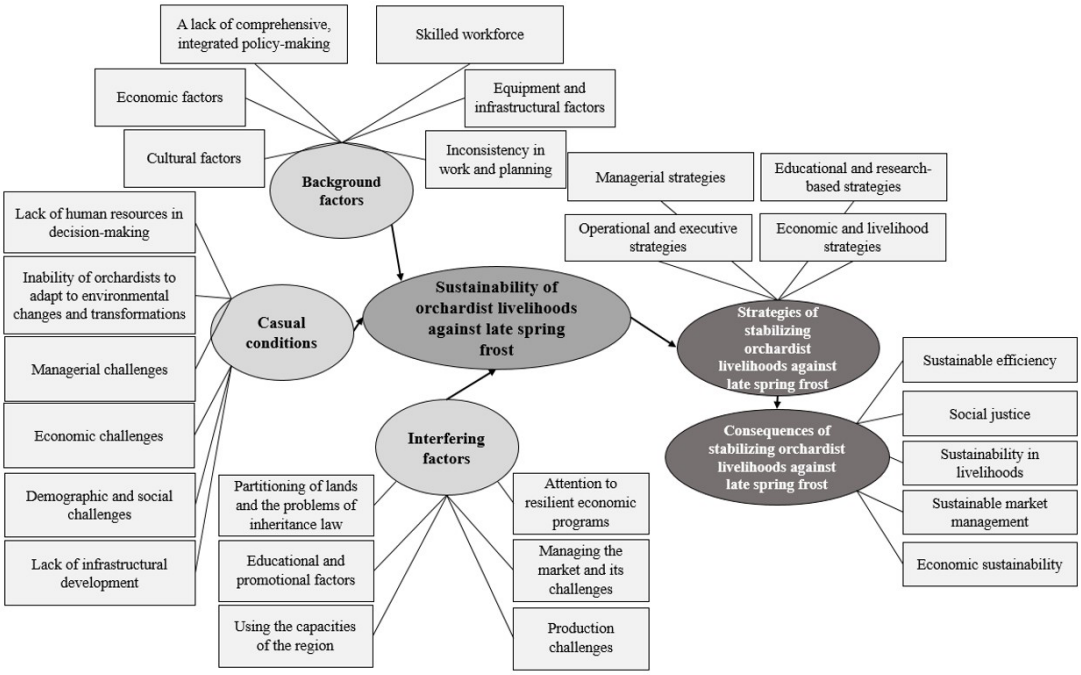

Figure 1. Patterns of stabilization in the livelihoods of orchardists on the shores of Lake Urmia against late spring frost.

3. Results

3.1. Qualitative phase

In the first phase of the research (qualitative phase), after collecting data and information from the study population, the interviews and manuscripts were reviewed and analyzed. Thus, after referring to the text of the interviews and manuscripts several times, using line-by-line analysis technique, an attempt was made to extract appropriate codes and the concepts related to the research topic were coded in three consecutive stages as follows.

First, in the open coding stage, after collecting information from the participants, the interviews and manuscripts were reviewed. Thus, after referring to the text of interviews and manuscripts several times, an attempt was made to extract appropriate codes using a line-by-line analysis technique. Finally, 83 initial codes (key concept) were identified (Table 1).

In the second step, in the axial coding stage, the formed classes were developed so that by comparing the encoded data with each other, the subcategories were organized in the form of clusters appropriate to the classes. At this stage, the concepts that were formed in the open coding stage were compared with each other and those that were similar to each other were placed around a common axis. Finally, 27 comprehensive classes and barriers to the concepts were formed in relation to the stabilization of livelihood of orchardists on the shores of Lake Urmia against the late spring cold and each was named according to the conceptual aspect. These are termed "comprehensive" because they are assumed to reflect the necessary criteria for the representation of classes and barriers. The main concepts of the open coding process along with the development of the formed classes (axial coding) are given in Table 1. As mentioned, analyzing the collected data and reviewing the text of the interviews several times led to the identification of 83 initial concepts / codes. Then, the concepts that had semantic and conceptual similarity were classified into 27 subcategories, which were categorized into Table 1. Finally, the identified subcategories were placed on a more abstract level in the form of the main category and at the center of the central coding process. The term "abstract" is to say that only key points of each level were mentioned for reference, although the entire criteria were considered in detail when introducing and discussing the topic. At this stage, and after establishing the relationship between the wider classes, a model was obtained (Figure 2).

3.2. Quantitative phase

In the second phase of the research (quantitative phase), structural equation modeling was used using AMOS20 software to evaluate the validity of the research model (validation of the livelihood model of small-scale orchardists on the shores of Lake Urmia against late spring frosts) and to determine the relationship between independent and dependent variables. In this study, 7 common goodness-of-fit indicators were used for determining the adequacy of the measurement model. The value of these indicators was calculated for the research path model (Table 2). According to Chi-square index (1.13), the suitability of the model for measuring

Table 1. Results of open and axial coding.

Broad classes	Subclasses	No.
Lack of infrastructure development	Lack of attention to communication infrastructure	1
Social and demographic challenges	Increase in the age of the orchardist population	2
	Belief in determinism among orchardists	3
	Incidence of social shocks	4
Inability of orchardists to adapt to environmental changes and transformations	Unstable weather conditions and late frosts in recent years	5
	Disability of orchardists to adapt to climate change	6
	Instability of climatic conditions	7
Economic Challenges	Lack of liquidity	8
Lack of participation of human resources in decisions	Lack of participation of young people in planning and implementation of programs	9
	Lack of participation of the target community in the design and implementation of programs	10
Management Challenges	Failure to use management models that are appropriate for the region	11
	Lack of comprehensive and integrated programs and policies	12
	Lack of development of plans and programs appropriate to the characteristics of the region (especially with respect to recent climate change)	13
	Failure to use technology appropriate for the region	14
Equipment and infrastructure factors	Availability of required equipment and devices	15
	Development of plans to deal with late spring frost	16
	Development of insurance infrastructure	17
Economic factors	Adequate budget allocation and its proportionality to costs	18
Expert human resources	Existence of scientific research centers for training labor and encouraging research	19
	Existence of efficient and expert managers	20
	Capacity of specialized and young manpower	21
	Illiteracy, insufficient knowledge of local orchardists in their management of orchards when encountering late spring frost	22
Lack of comprehensive and integrated policy-making	Insufficient attention by executive bodies and managers to the stabilization of orchardists' livelihoods	23
	Lack of proper policy among banks for timely allocation of credits to implement the development of projects	24
Lack of coordination in the implementation of affairs and planning	Differences in tastes and attitudes of responsible organizations, including the national agricultural organization and the national organization for environmental preservation in the implementation of communicative policies	25
	Coherence and coordination in various fields of design, planning, organization and implementation of livelihood-stabilization activities for orchardists along the shores of Lake Urmia against late spring frost	26
cultural factors	Attention to cultures and customs of people in the region	27
Using the capacities of the region	Attention to the identity of orchardists in the region and predicting the necessary measures to deal with the late spring frost	28
	Lack of desire of educated youth to work with their fathers in managing the late spring frost	29
Attention to the plans of resistance against economic hardship	Preparing a roadmap for a resilient economy with an emphasis on domestic production to reduce damages caused by late spring frosts	30
	Development of complementary agricultural conversion industries with emphasis on the management of late spring frost	31
Land fragmentation and challenges on the laws of inheritance	Dividing gardens into smaller areas due to inheritance can lead to land fragmentation and problems in managing horticultural activities, increasing the damages caused by late spring frost	32
Production Challenges	Reduction of water quality in the region	33
	Instability of the climate in the region and disregard for climatic recommendations by orchardists in the region	34
	Insufficient skills of orchardists to manage late spring frosts	35
Market management and its challenges	Sudden increase in prices	36
	Failure to pay for the price of garden products on time at the time of purchase	37
	Failure to set guaranteed prices for horticultural goods and products	38

Table 1. Continued...

Broad classes	Subclasses	No.
Educational and promotional factors	Lack of comprehensive implementation of extension-educational programs, appropriate for the needs of orchardists to manage late spring frosts	39
Educational and research strategies	Informing and confidence-building	40
	Using managers and experts in the field of horticulture	41
	Support for applied research	42
	Improving scientific knowledge, attitude and skills of orchardists in the region to manage late spring frosts	43
	Promoting new methods of production	44
	Training for methods of preservation	45
Operational and executive strategies	Use of sprayers in gardens	46
	Use of plastic coatings	47
	management of spraying solutions	48
	Observance of meteorological recommendations by orchardists in the region to carry out gardening activities	49
	Diversity of fruit trees in the garden	50
	Tree resistance to cold	51
	watershed management	52
	Irrigation management	53
	Breeding late flowering cultivars	54
Management strategies	participation by people in managing threats of frost	55
	Using young people and graduates	56
	Use of local capacities	57
	Preparation of comprehensive plan for agricultural and horticultural risk management in the country's management and planning	58
Economic and livelihood strategies	Diversification of horticultural, agricultural and livestock activities	59
	Reducing poverty by providing facilities	60
	monitoring livelihoods at times of damage by late spring frost	61
	Existence of local credit funds in order to improve the resilience of garden households in conditions of damage caused by late spring frost	62
Sustainable market management	Access to the sales market	63
	Development of local markets	64
	Support for exports	65
	Branding and product brand development	66
Economic sustainability	Sustainability and relative stability of income	67
	Increase in the financial power and purchasing power of orchardists	68
	Ability to save parts of one's income	69
	Job stability of orchardists	70
Livelihood sustainability	Domestic business development	71
	Improvements in livelihood	72
	Empowering orchardists	73
	More effective management of environmental hazards by local orchardists	74
Establishment of social justice	Prevention of emigration from agricultural areas	75
	Increase in the social welfare of orchardists in the region	76
	Strengthening local institutions (councils, villages, micro-credit funds)	77
	Increase in job satisfaction of orchardists	78
	Paying attention to the needs of orchardists at the local, national and international levels	79
Sustainable productivity	Development of conversion industries	80
	Efficient garden management	81
	Promote orchardists' resilience and reduce the vulnerability of orchardists in the region	82
	Sustainable management of natural resources	83

the self-sufficiency factor to the data was appropriate. Also, RMSEA index showed that the model has a good fit for the data. In addition, the values for CFI, GFI and NFI indexes were higher than 0.9, which confirmed the reults of other indexes ie. RMSEA and Chi-square. The value of RMR index was 0.016, which it can be judged that the

model as a whole has an acceptable fit. In general, the aforementioned fitness indicators showed that the research path model for measurement has a good fit.

According to Table 3, the standardized regression coefficients were aptly in place, and the interfering conditions had the greatest impact on the livelihood of small-scale orchardists on the shores of Lake Urmia against late spring frosts (β = 0.47). After that, the background factors (β = 0.43) and causal factors (β = 0.39) affected the livelihood of small-scale orchardists on the shores of Lake Urmia against the late spring frost, respectively. Background factors (β = 0.35) and interfering factors (β = 0.27) also affect the livelihood strategies of small-scale orchardists on the shores of Lake Urmia against late spring frosts.

The square of multiple correlations of dependent variables (Table 4) and relevant results showed that about

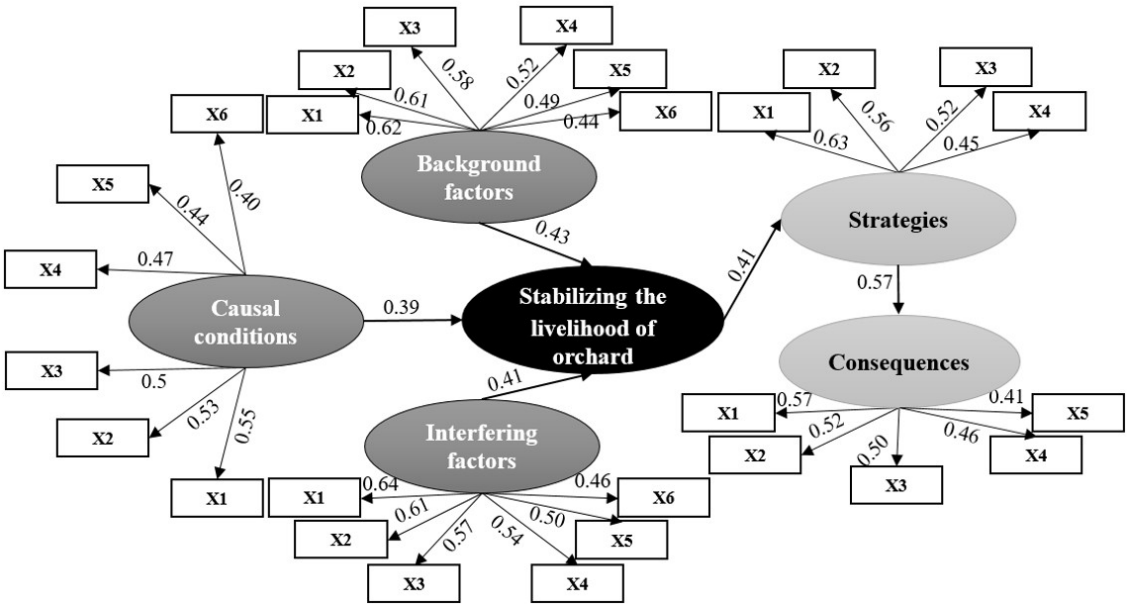

Figure 2. Structural equation model of the research conceptual model.

Table 2. Indicators for goodness-of-fit in measuring the livelihood model of small-scale orchardists on the shores of Lake Urmia against late spring frost.

RMR	GFI	CFI	NFI	P-close	RMSEA	X2/ df	P-value	Chi-square	Index
0.016	0.91	0.92	0.95	0.21	0.0000	1.13	0.11	19.32	value
Smaller than 0.08	Close to 0.95	Close to 0.95	Close to 0.95	Bigger than 0.05	Smaller than 0.05	Smaller than 2	Bigger than 0.05	----	coefficient

Table 3. Parameters in relation to routes with a significant level.

Hypotheses			Estimated parameter	Standard Error	Critical ratio (C.R.)	Level of significance (P)
Causal conditions	→	Stabilizing the livelihood of small-scale orchardists on the shores of Lake Urmia against late spring frost	0.39	0.045	6.15	***
Background factors	→		0.43	0.038	11.35	***
Interfering factors	→		0.41	0.043	11.27	***
Background factors	→	Strategies for stabilizing the livelihood of small-scale orchardists on the shores of Lake Urmia against late spring frost	0.35	0.040	10.36	***
Interfering factors	→		0.27	0.038	10.27	***
Livelihood strategies of small-scale orchardists on the shores of Lake Urmia against late spring frost	→	Consequences of stabilizing the livelihood of small-scale orchardists on the shores of Lake Urmia against late spring frost	0.57	0.035	10.54	***

*** P < 0.001.

Table 4. Multiple correlation squares of research variables.

Variable	Test
Livelihoods of small-scale orchardists on the shores of Lake Urmia against the late spring cold	0.41
Livelihood strategies of small-scale orchardists on the shores of Lake Urmia against late spring frost	0.53

41% of the variance of small-scale orchardists' livelihood were explained versus late spring frosts by the predicted variables (i.e. causal conditions, background factors and interfering factors), along with about 53% of the variance of livelihood strategies of small-scale orchardists on the shores of Lake Urmia against late spring frost within the model.

4. Discussion

Iran is prone to a variety of natural hazards. Earthquakes, floods, droughts and frosts are the most common types. Among these, however, frost is considered as one of the major challenges in the production of horticultural products, which causes significant loss to the horticultural sector every year (Nusrat, 2016). According to a report by the Agricultural Bank, the damage of cold and frost in recent years in all parts of Iran has been several thousand million dollars, which has also been called the Green Earthquake (Jafari Hombari et al., 2021). According to the Food and Agriculture Organization of the FAO, 5 to 15 percent of agricultural production is lost annually due to frost damage. This number reaches more than 40 percent in some sensitive garden products, especially almonds, pistachios and apricots (Zolfaghari et al., 2012). In general, late spring frost in some years has cost millions of dollars to farmers, their crops and horticultural products of West Azerbaijan province (Hosseini et al., 2021). Late spring frost is considered as one of the main and effective factors in the production of horticultural and agricultural products in Urmia (Hesari et al., 2016).

Based on the findings, managerial challenges in this study were identified as one of the causal conditions affecting the stabilization of livelihoods of orchardists in the region against late spring frosts, which was previously studied by Ghanian et al. (2016). Therefore, taking measures that can increase the productivity of orchardists while applying management models appropriate to the region, can empower orchardists to become original producers, produce more and achieve a more stable income.

Based on the findings, the inability of orchardists to adapt to environmental changes and transformations in this study was identified as another causal condition affecting the stabilization of livelihoods of orchardists in the region against late spring frost. According to this finding, one of the most important factors that necessitate the design of a model for stabilizing the livelihood of orchardists on the shores of Lake Urmia against the late spring frost was an environmental challenge in recent years. Therefore, the ability of orchardists to adapt to environmental changes and transformations has been one of the factors affecting their productivity. Researchers believe that the ability to manage the challenge of late spring frost and pursue different livelihood strategies of villagers depends on the social, economic, physical and ecological foundations that are within their control (Li et al., 2020). Therefore, having a comprehensive plan to adapt to such crises helps improve the sustainable livelihood of orchardists in the region and increase their ability to deal with the destructive effects of late spring frosts. This is due to the very long history of farmers in managing and dealing with environmental crises, so that this challenge can be overcome by taking advantage of local capabilities and efficient methods and technologies.

Based on the findings, equipment and infrastructure factors in this study were identified as one of the factors affecting the stabilization of livelihoods of orchardists in the region against late spring frost which, is also known to be essential for achieving any kind of livelihood strategy. Darban Astane et al. (2018) showed that the structures and processes are the most important factor in stabilizing the livelihood capital of farmers. Savari and Zhoolideh (2021) also indicated that infrastructure factors are one of the most important policies for agricultural adaptation to climate change. However, traditional agriculture, due to the manifestations of climate change such as late spring frosts, faces many challenges such as poor communication and inadequate agricultural and horticultural equipment (Savari et al., 2017). These challenges are felt more acutely in Iran's agriculturally prone areas, such as West Azerbaijan Province, which has more traditional farmers and orchardists. This calls for more attention from relevant authorities and stakeholders.

Identification of specialized human resources as another background factor affecting the pattern of stabilization of livelihoods of orchardists in the region against late spring frosts was previously studied by Nowruzi and Hayati (2016). They showed that human capital in agriculture and rural development is the main factor for the adoption of a new technology, including climate forecasting and other natural disasters (Anita et al., 2010). Decisions made at times of crisis are made in the form of short-term tactical decisions, such as product management changes or raw material supply choices, or long-term strategic decisions, such as rotation or natural resource management by expert manpower (Ghadiri Masoum et al., 2015). They reduced the damage caused by tolerating late spring frosts and other crises. Decisions about embracing innovation in rural communities are rooted in the awareness, cost, benefit, and application of new technologies (Adjei et al., 2017). As a result, the collectivity of human populations is an intrinsic and acquired property of individuals in society, which includes their skills, abilities and capabilities. Therefore, with the training of capable human resources, human resources can be promoted. In fact, it is with respect

to the time that people in society spend studying and acquiring knowledge. Many studies show that awareness, knowledge of the process of doing work and training on how to work efficiently had important, significant roles in the rate of acceptance of new technology, development of the agricultural sector and coping with crises and risks (Anita et al., 2010).

A lack of comprehensive and integrated policy-making as another factor affecting the model of stabilizing the livelihood of orchardists against late spring frosts has been previously discussed (Foster and Ait-Kadi, 2012). In recent years, however, climate change, especially the late spring frosts in the northwestern regions of the country, has become a crisis for farmers in the region. The damage caused by the phenomenon has affected the possibility of producing many agricultural and horticultural products in the region. To reduce the destructive and harmful effects of this phenomenon in spring, a suitable and comprehensive model for the region should be defined according to the specific climatic and geographical conditions of this area. In this regard, to solve the existing problems, the gap between the planning done and the policies adopted by managers must be filled. In the meantime, considering the vital role of agricultural promotion in the agricultural development of the country and the need to identify and review different strategies in each region, the challenge should be organized and managed to reduce potential loss as much as possible. Perhaps this is why the need for coordination in the implementation of affairs and planning would entail another factor affecting the model of sustainable livelihood of orchardists in the region. These were identified and proposed earlier in a study by Savari et al. (2017).

In general, planning to sustain orchardists' livelihoods is essential, given the resources available and overcoming barriers against food security, propserity, and environmental integrity (Savari et al., 2017). Most studies have analyzed the status of sustainability and focused on the status of environmental sustainability, the complexity of agricultural activities, thereby guaranteeing the need to design a comprehensive model for assessing sustainability (Xiao et al., 2022).

Achieving livelihood sustainability, especially in rural areas, requires the use of a sustainable strategy that takes into account planning, implementation and evaluation in different periods inside and outside the village. This is because the stabilization of farmers' livelihoods is a process that is possible through long-term cooperation and coordination of different stakeholders both in the village and outside the village, as well as establishing a coordinated relationship between the sectors involved in the long-term sustainability of livelihoods. The realization of this requires strategic planning and the identification of desirable policies (Sajasi Gheidari et al., 2013).

In this regard, the need to pay attention to economic programs in order to increase productivity and reduce environmental risks seems to be a good solution. Risk assessment is one of the interfering factors affecting the stabilization of orchardists' livelihood against late spring frost, which was in line with the results of Kianpour and Mohammad Rezaei Azandariani (2017). Given that the main approach in general economic policies is to promote resilience of the national economy in order to achieve the goals, the issues raised about national resilience in this regard can be explained in these policies for its realization (Bagheri Fahroji et al., 2018). Therefore, creating national resilience and a resilient economy in the process of dealing with global and regional risks has been considered by many researchers (Kianpour and Mohammad Rezaei Azandariani, 2017).

Educational and extension elements were interfering factors affecting the sustainability of orchardists' livelihood (Movahedi et al., 2021; Awidi and Quan-Baffour, 2021)

The reason for this can be related to the effect of participating in training classes on the knowledge and awareness of orchardists and, consequently, on environmental risk management. In fact, the higher the knowledge and awareness of orchardists, the more resilient they are in the process of dealing with global and regional risks. People with higher knowledge and awareness are more aware of environmental issues, understand the training received more effectively, and also better understand the instructions provided for different activities during the activity.

In interpreting the role of land fragmentation, the problems of inheritance law are another manifestation of the interfering condition affecting the stabilization of orchardists' livelihoods against late spring frost. It can be said that the fragmentation of agricultural property and garden lands can assist in appropriate planning. This makes it difficult for those in charge, however, due to the fact that the fragmentation of agricultural and garden lands diversified the presence of farmers and owners with different tastes. The situation meant difficulty in making decisions monotypically, and this renders farm management a challenging endeavor at times of environmental crises.

Fragmentation of agricultural property and garden lands led to wastes in water, problems in irrigation operations, problems in harvesting, and difficulty in using machinery, as well as low productivity, which posed a threat to food security at times of crises and climate change, thereby causing additional problems for orchardists in the area. Therefore, given that climate change, as well as the unsuitability of soil and water are three threats to food security at the international level, priority in the plans of West Azerbaijan province should focus on consolidation and prevention of land fragmentation, expansion of new irrigation systems, strengthening the horticultural production chains, development of greenhouses and improvement of orchards with the aim of ensuring food security of the province and the country. To this end, in order to prevent the fragmentation of agricultural and garden lands, it seems that measures such as the integration of agricultural lands with the establishment of large agro-industrial companies and the establishment of cooperatives could benefit the agenda.

By creating cooperatives, small owners operate in the form of production companies, so that productivity per unit area increases. While preventing land fragmentation, owners can use facilities in the form of cooperative connections and coordination, whereby irrigation can

become more efficient. While farming is under pressure, however, the use of agricultural mechanization and some low-interest and gratuitous facilities of large and integrated lands cannot be used if the land is small. In this regard, Savari and Shokati Amghani (2019) discussed micro dispersion of agricultural land, while considering the facets of Islamic heritage in villages, and grounded basic arrangements for organizing the ownership and use of agricultural areas. Among them, agricultural joint-stock companies in the region were made in order to consolidate small and scattered plots and prevent the fragmentation and division of agricultural lands into small non-economic plots. It increased the area under cultivation, improved agricultural land productivity, increased production and promoted the farmers' income per capita, while also familiarizing farmers with new technologies. Thus, it is suggested that the Central Organization of Rural Cooperation can adopt appropriate strategies and eliminate the challenges and bottlenecks, thereby paving the way for the development of these companies.

The results of this study in terms of operational and executive strategies are consistent with those reported by Davis and Izadkhah (2006) in terms of adaptation to climate and environmental changes in relation to late spring frost. They focused on reducing the vulnerability of orchardists as the most important factors in stabilizing their livelihood. Also, the results of this research confirmed operational and executive strategies that were mentioned in earlier studies by Arkawazi (2013). The centrality was on improving the ability of orchardists to adapt to climate and environmental changes against late spring frost and reduce the vulnerability of orchardists, thereby indicating the impact of the important role of agricultural promotion and education in the implementation of these strategies. In this regard, Dolati Baneh (2018) stated that although spring frost is one of the most important factors that threaten orchards in the country, there are various operational and executive strategies to manage by employing apt methods. Providing correct training and extension to orchardists in the area can modify operational and executive strategies for tackling late spring frosts. The relevant information should be taught to orchardists in the region using extension methods, including selection of the right place for a garden, using late blooming cultivars, for example. Using methods of gardening maintenance such as proper feeding, double pruning, delayed pruning and protective methods such as the use of heaters can act against the damage of spring frost in the orchards of the region. However, finding the effectiveness of such methods are suggested for future research.

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