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Educational-Extension Model of Farmers' Adaptation to Climate Change in Ilam Province: A Qualitative Study based on Grounded Theory

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Abstract:
The occurrence of climate change and its effect on surface water flows and groundwater resources, along with improper management of water resources, have increased the vulnerability of human communities to these changes. Therefore, all societies need to learn how to deal with these unforeseen conditions. The purpose of this study is to provide an educational-extension model for farmers' adaptation to climate change in Ilam province through the benefit of experts in the agricultural sector. To achieve the stated goal, through purposeful sampling, information was collected from 20 agricultural experts through semi-structured interviews. Then, using the grounded theory method, an educational-extension model of farmers' adaptation to climate change was presented. The findings of this qualitative study show that the model has six components such as economic and production conditions of the farm, man-made activities in agriculture and industry, farmers' adaptation to climate change, implementation of educational, economic, management, infrastructure and agricultural strategies, financial and administrative problems, success and motivation of farmers in adapting to climate change and hope for the future of the profession. The results showed that the educational-extension model of farmers' adaptation to climate change can be classified into 46 concepts, 30 sub-categories, and 6 main categories.
Key Words: Climate change, Agriculture, Adaptation, Ilam province, Grounded theory

Introduction:
Climate change, especially drought, has created one of the most important and complex concerns of the present and future centuries in terms of severity and duration (Esmailnejad, M., and Alijani, B., 2017). The phenomenon of climate change can be defined as changes in climate and its impact on the natural environment, which is directly or indirectly attributed to human activities (Marston, J. M. C., 2010; Barak. B., 2006). The occurrence of climate change and its effects on surface water flows and groundwater resources, along with improper management of water resources, have increased the vulnerability of human communities to these changes (Jamshidi et al., 2015). Climate change directly affects agricultural production, on the other hand, the agricultural sector is naturally sensitive to climatic conditions. Thus, it is considered one of the most vulnerable sectors to the risks and effects of global climate change (Maponya, P., and Mpandeli, S., 2012). There is no doubt that climate change is occurring due to human activities. Therefore, all societies need to learn how to deal with these unforeseen conditions (Adger et al., 2003).
In the last two decades, Iran has consistently faced water shortages, with drought affecting various regions and provinces across the country.
Ilam province, one of the western provinces of Iran, is strongly affected by climate change such as the drying of oak trees, uncontrolled natural fires caused by rising temperatures, and the widespread influx of fine dust (Jihad Agriculture Organization of Ilam Province, 2017). Ilam Province is located in the drought belt and has been the eighth province in the country in terms of drought problems during the last 10 years (The Bureau of Meteorology

of Ilam Province, 2015). Meanwhile, according to the latest published statistics, the city of Ilam has faced a 51% decrease in rainfall compared to the long-term average of 30 years (Jamshidi et al., 2015). Based on a study conducted on the forecast of climate change and based on the model for predicting its effects on the sustainable development of the environment in Ilam province, in the next 20 years, the temperature will increase and precipitation and relative humidity will decrease. These changes will harm soil, vegetation, agricultural resources, food security, and the health of the region's residents (Baratyan A., and Rezaei M., 2013).

Since climate change has been known, its adaptation, especially in the agricultural sector, has been an important topic of scientific research and studies. These studies, while examining the factors affecting adaptation to climate change in the agricultural sector, have emphasized the need to improve adaptation strategies and strategies (Deressa et al., 2011; Below et al., 2012; Dang et al., 2014; Jamshidi et al., 2015). Accordingly, one of the ways to reduce the effects of this phenomenon is farmers' adaptation to climate change. Research conducted in some cities of Ilam province shows that some farmers do not take appropriate approaches to adapt to climate change, which may be due to their understanding of the dangers of climate change, some fatalism attitudes to these events, the type of adaptive measures appropriate to each of the climate threats (Jamshidi et al., 2015). It should be noted that the lack of knowledge and awareness of farmers in the field of climate change is one of the challenges of the extension system in the face of climate change, but structural and human constraints are the main deterrent to the extension system to adapt to climate change (Keshavarz & Moayedi, 2016).

The agricultural extension system and extension agents must be prepared to deal with climate change. The fact is that in domestic and foreign sources, the issue of educational-extension modeling of farmers' adaptation to climate change has not been addressed much and is considered a new applied knowledge in Iran, so there is significant theoretical development capacity in this area. Therefore, the main issue of this study is to provide a theoretical educational-extension model of farmers' adaptation to climate change, through grounded theory. Also, the most important question of this research is what theoretical model explains this model?. In other words, the results of this study will determine in what context the phenomenon of climate change; By whom; when; how severely, and for what reason does it occurs? what are its action strategies? and what will be the consequences of these strategies?. According to the above, the main purpose of this study is to provide an educational-extension model of farmers' adaptation to climate change in Ilam province.

1. Review of Literature:

1.1. Theoretical literature:

1.1.1. *The concept of climate change:*

In the general sense, climate change is a change in climatic parameters such as temperature, precipitation over time, which is the result of human activities, biological biothermal changes, the formation of greenhouse effects, planetary motion, and solar variability (Akbari et al., 2017). Various factors, including internal factors due to interactions between the components of the climate system and natural external factors due to solar radiation, volcanic activity, an abnormal increase in greenhouse gases, lead to disruption of the conditions of the system (Mitchell et al., 2012). An increase in greenhouse gases is the most important factor that abnormally affects the Earth's climate system. After the Industrial Revolution in the mid-18th century, the balance of greenhouse gas emissions in the Earth's atmosphere was disturbed due to the increasing use of fossil fuels (Klocke et al., 2009). Global warming affects the state of other components of the climate system and causes climate change. This phenomenon is called climate change (Massah Bavani, A. R., and Morid, S. 2006).

1.1.2. *The effects of climate change on the agricultural sector:*

Due to the wide and interactive effects of climate in various sectors of production, environment, and human societies, climate change is mentioned as one of the most important environmental challenges of the 21st century, which has serious economic consequences (Hosseini et al., 2013). Although various economic sectors such as agriculture, forestry, water, industry, tourism, energy, and financial and insurance markets are affected by climate change (Kemfert C., 2009), among them, agriculture is the most dependent on climate and climate is the main determinant of agricultural productivity and resources (Deressa et al., 2011). Climate change causes changes in the duration, intensity, shape, and timing of rainfall in different parts of the world, which can lead to droughts and floods (Stroosnijder et al., 2011). Increasing the concentration of carbon dioxide in the atmosphere leads to

changes in agricultural potential and water use efficiency of different crops, as well as the expansion of agricultural-ecological potential to higher poles and latitudes (Hatfield et al., 2011).

In the face of such conditions, the development and improvement of water resources management policies to minimize the negative effects of climate change is essential. Effective management of agricultural water resources depends on having sufficient information about crop water needs, water use efficiency, and water productivity that these factors can be affected by the phenomenon of climate change (Lal et al., 2011). However, rural communities always manage their resources and livelihoods in the face of environmental challenges, social and economic conditions. Villagers can determine their livelihood strategies in ways that can be adapted to unpredictable climates, severe pest infestations, and changes in global, national, and local policies (Mitchell et al., 2012).

2.1.3 *Adaptation to Climate Change*: Climate change is challenging for the agricultural sector and therefore, farmers' incomes are declining; Therefore, farmers' livelihoods are vulnerable due to climate change (Keshavarz M. and Karami E., 2008). One of the most important ways for farmers to react to climate change is the adaptive behavior of farmers towards this phenomenon (Below et al., 2013). Adaptation to climate change is one of the priorities that has been seriously considered by farmers. Farmers' adaptation methods help to better cope with severe meteorological conditions and climate variability. Compatibility is the interventionist, regulator, and manager of a place to miss opportunities and compensate for climate change (Adger et al., 2003). The choice of agricultural adaptation method is made on a local, regional and global scale. Choices at the local level such as crop diversity, irrigation time change, and market reactions can help adapt to climate change. The government can also help strengthen people's adaptation to climate change by eliminating subsidies, improving agricultural markets, developing technology, and educating people to adopt (Burpee et al., 2015).

Adaptation involves a change in a system, activity, sector, community, or region as a result of responding to climatic stresses or stimuli. Describing an adaptation process requires answering questions such as "Who or what adapts? What are the drivers for adaptation? What are the processes and forms of adaptation? (Elfaigh A. H. I., 2000).

Adaptation strategies can take many different forms. Types of compatibility can be classified based on several characteristics (Vento et al., 2010). Common classifications are based on purposefulness and timing. Independent adaptation refers to the type of adaptations that occur in response to climatic stimuli and after their initial effects occur without the intervention of a public organization (Maddison D., 2007). Estimation of this type of adaptation has received a great deal of attention in studies evaluating the effects of climate change and the resulting vulnerability. In planned adaptation techniques, a reaction or prediction takes place before the effects occur, and are often the result of policies from a part of a government agency (Habiba et al., 2010; Shewmake Sh., 2008). In natural systems without management, adaptation is independent and spontaneous and means the change that species or communities make in response to the conditions created in them. In such cases, the compatibility assessment is necessarily equal to the assessment of the effectiveness of the natural system. In this section, the main focus is on man-made adaptations that are active in the economic, urban, community, regional, and managed ecosystem sectors (Maddison D., 2007; Burpee et al., 2015; Vento et al., 2010).

Adaptation in human systems can be motivated by personal or public motives. Personal decision-makers include individuals, families, employees, and large private companies, and public decision-makers at all levels include government officials (Gandure et al., 2013). Farmers and residents of rural areas must have the ability and capacity to cope with the risk of climate change. Although the costs of adapting the agricultural sector to climate change are high and the effectiveness of some adaptation strategies is not very clear, but information can be considered as a vital factor in supporting the agricultural sector in the face of climate change (Gholami M., and Alibeygi A., 2014). Extension systems play an important role in providing information to farmers. Because the agricultural extension is considered as a set of communication interventions that help solve problematic situations (Keshavarz M., and Moayedi M., 2016). This definition of agricultural extension empowers the institution to consider climate change and adaptation as one of its tasks (Hosseini et al., 2016). Agricultural extension systems can prepare farmers to deal with climate change fluctuations and uncertainties, introduce strategies to deal with the growing risks of this phenomenon. And reduce the adverse consequences of climate change by providing appropriate consulting services. In addition, extension systems can reduce the adverse consequences of climate change by providing appropriate consulting services. This support is especially important, especially in Iran, where a significant proportion of farmers are smallholders, because smallholder farmers have a lesser role in shaping

climate change, but are more vulnerable to it (Keshavarz M., and Moayedi M., 2016). On the other hand, delayed and untimely agricultural extension activities in response to climate change can lead to increased environmental and social damage. Therefore, the agricultural extension system must have the ability and readiness to respond to the challenges posed by climate change. Extension agents, as the most important assets of the agricultural extension system, have a significant role in fulfilling this mission. This means that not only must the agricultural extension system be prepared to deal with climate change, but also that extension agents must have the professional competencies needed to increase farmers' adaptation to change.

2. Experimental literature:

In a study conducted by Hosseini et al. (2016), three categories of economic, environmental, and socio-psychological consequences were identified. In the study of Shewmake (2008), selling livestock, borrowing from relatives, obtaining loans, migrating, seeking non-agricultural work, and reducing food consumption were some of the strategies used by farming households in the face of drought. The results of the study by Naveen et al. (2014) in the semi-arid regions of Asia showed that the occurrence of drought has many social and economic effects such as declining agricultural yields, unemployment, reduced capital, declining incomes, malnutrition, and increasing vulnerability of society. In a study conducted by Ghanbari et al. (2012), it was found that farmers use managerial measures such as pre-season seeding, mulching, crop rotation, insurance use, Cultivation of drought-resistant crops. The results of the study conducted by Habiba et al. (2012) showed that farmers use methods such as farm management, water resources discovery, cultivation of resistant cultivars, job change, livestock sales, migration, and borrowing from relatives to deal with water scarcity. A study conducted by Bryan et al. (2009) found that planting trees, reducing the number of livestock, and managing soil and water are ways for Kenyan farmers to adapt to drought. The Research conducted by Teresa et al. (2011) has pointed out the need to increase the productivity and efficiency of irrigation water, increase technical knowledge, attitude, and skills of farmers in the use of correct methods of agricultural water management. The study of Vento et al. (2010) showed that farmers use management modifiers such as crop diversification, changing the crop calendar, postponing cultivation, livestock sales, migration, and improving irrigation practices to combat drought.

Elfigh (2000) studied the behavior of Sudanese farmers and concluded that the use of drought-tolerant cultivars, early sowing to use unexpected rains, increasing the distance between rows and the use of intercropping have been effective in reducing farmers' vulnerability. Findings from the study of Knutson et al. (2010) showed that farmers seek help from their family, community, and religious beliefs to adapt to climate change. Maddison (2007) in his research concluded that the level of agricultural experience, social and economic status of individuals, access to credit and resources as well as access to extension services will increase the possibility of farmers adapting to climate change. In the study conducted by Smucker and Wisner (2008), the use of the natural and social environment, market use and activities such as livestock and land sales, job change, migration were the most important mechanisms for farmers to adapt to climate change. The results of a study conducted by below et al. (2012) showed that factors of production, natural and physical capital, educational status and gender of the head of the household, and social capital were significantly associated with farmers' capacity to adapt to climate change. Campbell et al. (2011) in their research showed that the most important way to adapt to climate change is activities such as water purchase, water division, use of plant fertilizers, search for non-agricultural work, work on other farms, temporary migration, and reducing the acreage.

Bagheri et al. (2017) conducted a study entitled the role of agricultural extension in the application of drought management operations in tafresh county. The results showed that four variables of the effectiveness of contact with agricultural experts, the use of extension publications, participation in extension visits, and participation in training-extension classes, had the greatest impact on the variable of the use of drought.

3. Research methodology

Given that the present study is based on qualitative data, it seeks to provide a new extension model compatible with climate change. Thus, this study is applied based on the purpose of research, and in terms of a philosophy of research is interpretive. The present study is inductive in terms of the approach used. This research has been conducted by the qualitative method. qualitative data are collected to carefully study the phenomenon under study. The qualitative strategy of the present study is based on the grounded theory method. The grounded theory based on the systematic scheme of Corbin and Strauss (2014) has been used to analyze the data from semi-structured

interviews and analysis of the texts. This study seeks to identify the requirements, strategies, and consequences of establishing a new extension model compatible with climate change based on theoretical foundations and semi-structured interviews in the contextual and institutional conditions of Iran. This research seeks to provide a model based on theoretical foundations in the contextual and institutional conditions of Ilam province, emphasizes a systematic design and a linear approach with a procedural approach, it puts the categories into six categories in a regular manner and leads to the necessary precision and complexity in the model and leads the research path towards providing the correct answer to the main research question. Hence, the systematic design of Strauss and Corbin has been used.

In this study, there is no prior theory about the nature of the main research problem. Therefore, these conditions justify the need to use the grounded method in this study. Because qualitative research is exploratory and requires the participation of a small number of respondents, for the selection of the sample, non-probable purposive judgment sampling with a snowball sampling approach was used. Select samples continued until the adequacy and theoretical saturation stage. Because qualitative research is exploratory and requires the participation of a small number of respondents, the sampling strategy in the qualitative approach is non-random and in the form of a snowball sampling. The criterion for sample size is theoretical adequacy; This means that in an interview with the statistical community of elites, a new index or instrument should not be identified. Therefore, the criterion of sample adequacy is theoretical saturation. 18 staff managers of Ilam Jihad Agricultural Organization, university professors in the field of water resources management and agricultural education, as well as several farmers in the region with at least 10 years of experience in the field of agriculture with theoretical adequacy were selected as statistical samples of this study. It should be noted that communication with the above-mentioned experts was done through electronic communication (e-mail) and in some cases with the help of virtual networks, and in other cases, face-to-face interviews were also conducted. The choice of the semi-structured interview was since, in addition to the exchange of views, the discussion on the subject can be directed to achieve the objectives of the research. It is also possible to observe the feelings, beliefs, and convictions of the interviewees during the interview.

Table 1 shows the characteristics of the members of the research statistical sample.

Table 1 The characteristics of the members of the research statistical sample

No	Educational level	age	Gender	No	Educational level	age	Gender
1	Ph.D. (Agricultural Extension and Education)	49	women	10	Master (Meteorology)	44	man
2	Ph.D (Irrigation)	48	man	11	Ph.D. (Natural Geography)	37	women
3	Master (Irrigation)	46	man	12	Master (Agricultural Management)	49	man
4	Ph.D. (Natural Geography)	50	man	13	Expert (Agronomy)	48	man
5	Master (Agricultural Management)	43	women	14	Diploma (Agriculture)	55	man
6	Master (Agricultural Extension)	49	man	15	Expert (Agricultural Extension and Education)	52	man
7	Master (Irrigation)	47	man	16	Diploma (Humanities)	60	man
8	Ph.D. (Agricultural Extension and Education)	45	man	17	Expert (Agronomy)	53	man
9	Master (Natural Geography)	55	man	18	Expert (Animal Science)	48	man

In this study, three main methods of interviewing experts, documentary studies, and field studies were used to collect information. In the documentary method, the documents were reviewed and various theories along with the research background were reviewed and the opinions of the relevant thinkers were concluded and exploited step by step based on the objectives of the research. Then, research experts were interviewed by asking the main questions taken from the research literature. The research model was designed based on the grounded theory with the help of Atlas TI software and performing three stages of open, axial, and selective coding. At the beginning of the interview, the purpose of the study was to emphasize that the interviews will be used for research purposes only and that the identities of the individuals will not be mentioned in the research reports. interviews with each participant were conducted over 20 to 40 minutes. The most important interview questions were:
What strategies do you think should be used to adapt to climate change? What are the implications of applying these strategies for agricultural systems and farmers? What are the most important underlying factors affecting farmers' adaptation to climate change? What are the most important intervening factors for adapting to climate change? What are the most important causes and implications of adapting to climate change? 18 people were interviewed in this study, which was repeated in the information received from the 16th interview, but to ensure data adequacy continued until interview18.
Reliability refers to the consistency of the results of the interview, the credibility, and the ability of the interviewee to measure the intended goals. Validity is said to be the ability of a method to measure the purpose of the study. In the present study, the reliability of the two coders was used to calculate the reliability of the interviews. To this purpose, a university professor who was aristocratic on the research subject was asked to participate as a researcher (coder) in this research. Then, The researcher along with the research colleague coded three interviews and calculated the percentage of the intra-subject agreement as a measure of research reliability. To extract the amount and the number of agreements, a questionnaire containing themes, along with open coding samples, was provided to the research participants and the degree of agreement was questioned through the choice questions of high, medium, and low concordance. If the participant chooses the low or medium option, it means disagreement, and if the participant chooses the high option, it means an agreement. As be seen in Table 2, the reliability between the two coders for the interviews was 0.81. Thus, it can be argued that the reliability of the interview analysis is appropriate. The usual size of acceptable reliability coefficient is 80 to 100 percent for most research and research with a reliability coefficient of less than 70% will have difficulty interpreting their achievements and replicating research.

Table 2 Calculation of reliability between two coders

No	Interview code	Number of codes	Number of Agreements	Coefficient of agreement
1	I1	21	8	0.86
2	I2	26	11	0.85
3	I3	22	8	0.73
Total		69	28	0.81

4. Results and discussion

4.1. Demographic description of respondents

15 experts were male and 3 were female. Their average age was 48.7 years. The maximum age was 60 years and the minimum age was 37 years. 6 of the experts had a doctoral degree and 6 had a master's degree.

4.2. *Analysis process*

Open coding: In the first step, the researcher recorded the interviews by the ethical principles of qualitative research and with the full consent of the interviewees. first, the first interview was translated precisely into text, and the coding was done paragraph by paragraph. After reaching the saturation point in the comments provided by the interviewees, the initial data was entered into Atlas TI software and with the help of this software, the initial codes were created. At this stage, 223 initial codes were obtained. Then, according to the secondary coding rule, 72 secondary codes were obtained and based on the closeness between the secondary codes, 46 conceptual codes were obtained.

Axial Coding: Axial coding links categories and subcategories according to their dimensions and specifications. The purpose of this step is to establish a relationship between the produced classes. This activity is based on the paradigm model and helps the theorist to facilitate the theory process. During the axial coding process, the researcher used analytical tools and theoretical comparisons between concepts, categories, and attributes that appeared in open coding to develop relationships between concepts and categories. Categories and concepts derived from qualitative data are shown in Tables 3 to 8.

Casual conditions: These conditions lead to the formation of core categories. These conditions are a set of classes and their characteristics that affect the core category. Causal conditions include categories that significantly affect the process of adaptation to climate change. In this study, two sub-categories include man-made activities andchange of agricultural processes as well as biodiversity reduction are factors that affect farmers' adaptation to climate change. The categories related to causal conditions are shown in Table 3.

Table 3 Conceptual codes, sub-categories, and main categories related to causal conditions

Secondary codes	Conceptual codes	Subcategory	General category
Change of agricultural activities to livestock	Farm management	Man-made activities and changing agricultural processes	Casual conditions
Change of rainfed lands to water land			
Changing the consumption pattern of households	Changing the consumption pattern		
Decreased biodiversity	Decreased biodiversity	Decreased biodiversity	

Context conditions: Context conditions represent a specific set of features related to the phenomenon that generally refers to the location of relevant events and happenings. The most important sub-categories of the context conditions of the present study were: Personal problems of farmers, financial-institutional problems, poor planning and implementation in government institutions, costly production for farmers, the Decreased area under cultivation, low investment power, increasing trend in the purchase price of inputs. The categories related to context conditions are shown in Table 4.

Table 4 Conceptual codes, sub-categories, and main categories related to context conditions

Secondary codes	Conceptual codes	Subcategory	General category
Lack of capital	Individual challenges	Farmers' problems	Context conditions
Low financial ability			
lack of credit	Financial-institutional problems	Financial-institutional problems	
Problems getting loans and credits			
Unfair distribution of services and facilities	Bureaucratic problems governing government agencies	Weak planning and implementation in government institutions	
Improper planning of lending executive organizations			
Lack of proper sales market			
Increase product production costs	Increase production costs	Costly production for farmers	
Rising prices for agricultural water			
Reducing the purchasing power of farmers			
Reducing the area under cultivation	The decreased area under cultivation	The decreased area under cultivation	
Depreciation of farmers' assets			

Reducing the amount of investment in the production of products Decreased financial ability to repay loans	Reduce investment in production	Low investment power
Rising prices of livestock and agricultural products	Increase in the purchase price of inputs	The upward trend in the purchase price of inputs

Core categories: The core category resulting from causal conditions is the customer's perception and expectation of the service and its provider. The analysis of the interviews leads the researcher to conclude that the heart of adaptation to climate change, climate change, disease crisis, the prevalence of socio-psychological harms, food insecurity warnings, the dominance of false jobs in the economy, is the core category of the present study. The categories related to the main phenomenon are shown in Table 5.

Table 5 Conceptual codes, sub-categories, and main categories related to the core category

Secondary codes	Conceptual codes	Subcategory	General category
Increasing climatic fluctuations	Climatic fluctuations	Climatic fluctuations	Core categories
Mortality crisis and diseases	Disease crisis	Disease crisis	
Incidence of social anomalies Mental stress Increasing differences and conflicts between local people Increased delinquency in the region Seasonal unemployment	Socio-mentality anomalies	Prevalence of social-psychological injuries	
Incidence of food insecurity	Food insecurity	Food insecurity alert	
Job change and leaving the agricultural sector	Turning to fake jobs	The dominance of fake jobs over the economy	

Intervening conditions: Intervening conditions are constantly influenced by strategies. Groundwater depletion, farm production conditions, temperature changes, economic conditions, access to specialized climate information and awareness, lack of adaptation knowledge, farmers' need for government, religious beliefs, and government inability to create rural jobs are the most important subcategories of intervening conditions of the present study. The categories related to the intervening conditions are shown in Table 6.

Table 6 Conceptual codes, sub-categories, and main categories related to intervening conditions

Secondary codes	Conceptual codes	Subcategory	General category
Salinity and decrease in groundwater levels Changes in soil structure and reduced plant diversity	Groundwater depletion and soil structure changes	Groundwater depletion	Intervening conditions
Land fragmentation Agricultural problems	Crop problems	farm production conditions	
Existence of wind and dust Temperature change	Climate temperature changes	temperature changes	
Declining incomes and economic woes Financial-economic challenges of farmers	Economic challenges	economic conditions	
Access to specialized consultants Development of forecasting methods	Climate awareness knowledge	access to specialized climate information and awareness	

Lack of adaptation knowledge	Lack of appropriate adaptation knowledge among farmers	lack of adaptation knowledge
Dependence on the government in meeting the needs	Government dependency	farmers' need to government
Farmers' religious beliefs	The religious spirit of the farmers	religious beliefs
The inability of the government to create rural jobs	Lack of alternative jobs in the village	government inability to create rural jobs

Strategies: Strategies are the output of the core category of the model and lead to consequences. Strategies are a set of measures taken to manage and respond to the main phenomenon. In this study, the categories of educational-extension strategies, economic-financial strategies, management strategies, institutional-infrastructure strategies, farming strategies are the strategies that provide the necessary conditions for the realization of the main phenomenon under study. The categories related to strategies are shown in Table 7.

Table 7 Conceptual codes, sub-categories, and main categories related to strategies

Secondary codes	Conceptual codes	Subcategory	General category
Utilization of new technologies	Gain knowledge of up-to-date technologies	Educational-extension strategies	Strategies
Promoting and transmitting findings	Promoting the culture of consumption and transmitting its findings		
Promoting sustainable consumption culture			
Improving the perception of climate change	Improving the perception of climate change		
Water pricing	Balanced water pricing	economic-financial strategies	
Banking - Financial support	Innovative support of banks to farmers		
Creating job security	Establish job security for affected farmers		
Development of new irrigation methods Increase water resource efficiency Water resource management	Managing Water resource productivity		
Development of watershed management activities	Development of watershed management and aquifer management activities	management strategies	
Underground aquifer nutrition management			
Smart activities	Relying on precision agriculture and its requirements		
Evaporation management	Evaporation management		
Government monitory	Government monitory		

Rangeland management	Rangeland management	
Indigenous knowledge and local potentials	Utilizing the principles and rules of indigenous knowledge	
Policy and legal requirements	Enforcement of legal requirements and incentive-punitive policies	
Developing incentive and punishment policies		
Improvement and rehabilitation of infrastructure	Improvement and rehabilitation of infrastructure	institutional-infrastructure strategies
Organizational synergy	Organizational synergy	
Development of forecasting methods	Development of forecasting methods	
Plant production management Changing the Appropriate cultivation pattern Managing technological farm production	Plant production management	
Nutrition management	Nutrition management	farming strategies
Increase the water storage capacity	Increase the water storage capacity	

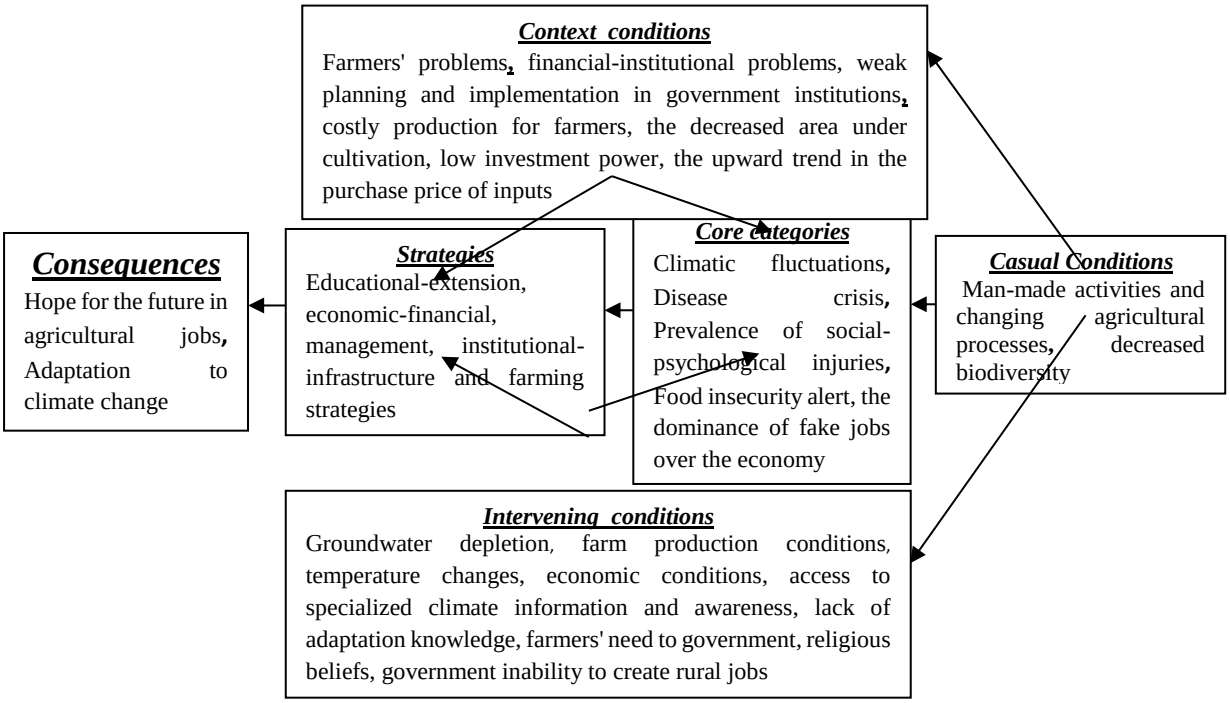
Consequences: Consequences are the last part of the axial coding paradigm model that includes the tangible and intangible results of the extracted model. The most important categories representing the consequences in this study include the categories of Hope for the future in agricultural jobs and adaptation to climate change. The categories related to consequences are shown in Table 8.

Table 8 Conceptual codes, sub-categories, and main categories related to consequences

Secondary codes	Conceptual codes	Subcategory	General category
Hope for the future in agricultural jobs Adaptation to climate change	Hope for the future in agricultural jobs Adaptation to climate change	Hope for the future in agricultural jobs Adaptation to climate change	Consequences

In fact, it can be acknowledged that the substantive theory of adaptation to climate change in Ilam province has 30 sub-category, including hope for the future in agricultural jobs, adaptation to climate change, Educational-extension strategies, farming strategies, institutional-infrastructure strategies, management strategies, economic-financial strategies, government inability to create rural jobs, religious beliefs, farmers' need to government, lack of adaptation knowledge, access to specialized climate information and awareness, economic conditions, temperature changes, farm production conditions, groundwater depletion, the dominance of fake jobs over the economy, food insecurity alert, prevalence of social-psychological injuries, disease crisis, climatic fluctuations, the upward trend in the purchase price of inputs, low investment power, decreased area under cultivation, costly production for farmers, weak planning and implementation in government institutions, financial-institutional problems, farmers' personal problems, decreased biodiversity and man-made activities and changing agricultural processes. In the selective coding stage, the different classes expressed in the axial coding stage are merged, and then a general analysis is performed. Narrative analysis based on paradigm model relationships around the core category and providing theoretical theorems based on the paradigm model are two main ways of class integration

(Haghgoyan, Zarei matin, Jandaghi & Rahmati, 2015). Selective coding uses the results of the previous coding steps, selects the main categories, systematically relates them to other categories, Validates communications, and develops categories that need further closure and development. At this stage, the researcher, according to his understanding of the text of the studied phenomenon, or the paradigm model framework, presents it in a narrative form or breaks down the paradigm model and graphically represents the final theory. The paradigm model of this research was designed based on the paradigm model of Strauss and Corbin. Axial coding, based on the research paradigm model, is shown in Fig. 1.



Compilation of research theorems: Research theorems refer to the relationships between categories. Theoretical theorems express generalized relations between a class and its concepts with certain classes. Theorems imply conceptual relations, while hypotheses require measurable relations. In this research, 6 theoretical theorems based on the paradigm model are presented for the selective coding process.

Theorems1. Man-made activities and changes in agricultural processes and biodiversity reduction are causal factors that can affect all players adapted to climate change (p1).

Theorems 2. Climatic fluctuations, Disease crisis, Prevalence of social-psychological injuries, Food insecurity alert, the dominance of fake jobs over the economy form the core of farmers' adaptation to climate change (p2).

Theorems 3. Groundwater depletion, farm production conditions, temperature changes, economic conditions, access to specialized climate information and awareness, lack of adaptation knowledge, farmers' need to government, religious beliefs, government inability to create rural jobs are intervening conditions that affect the phenomenon of adaptation to climate change (p3).

Theorems 4. Personal problems of farmers, financial-institutional problems, poor planning and implementation in government institutions, costly production for farmers, the Decreased area under cultivation, low investment power, the increasing trend in the purchase price of inputs are the major contextual conditions (p4).

Theorems 5. Educational-extension, economic-financial, managerial, institutional-infrastructural, and farming strategies affect adaptation to climate change (p5).

Theorems 6. The output of the strategies introduced under the interventionist conditions and contextual conditions is farmers' hope for the future in agriculture and adaptation to climate change (p6).

Fig. 2 shows the paradigm model of implementing a climate change adaptation model.

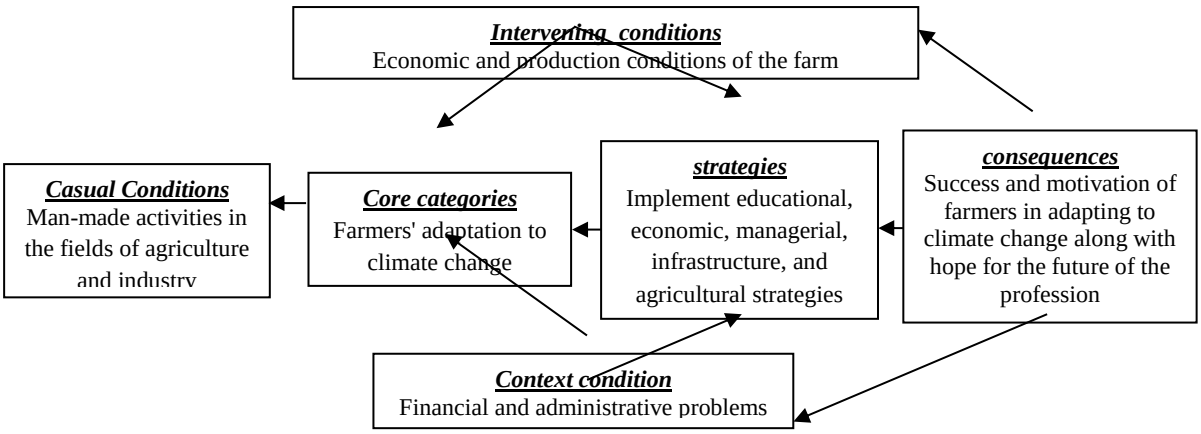


Fig. 2 Paradigm model of adaptation to climate change

5. Conclusion

Since climate change has been known, its adaptation, especially in the agricultural sector, has been an important topic of scientific research and studies. These studies, while examining the factors affecting adaptation to climate change in the agricultural sector, have pointed to the need to improve adaptation strategies and strategies. Accordingly, one of the ways to reduce the effects of this phenomenon is farmers' adaptation to climate change. Research conducted in some cities of Ilam province shows that some farmers do not take appropriate approaches to adapt to climate change. One of the most important reasons for this can be due to their understanding of the dangers of climate change, some appreciative attitudes toward these events, the type of adaptive action appropriate to each of the climate threats. It should be noted that the lack of knowledge and awareness of farmers in the field of climate change is one of the challenges of the extension system in the face of climate change, but structural and human constraints prevent the extension system to adapt to climate change. The agricultural extension system must not only be prepared to deal with climate change but also the extension agents must have the professional competencies needed to increase farmers' adaptation to change. In this study, based on grounded theory strategy, an educational- extension model of adaptation to climate change in Ilam province was presented.

The basis of this study was to focus on the grounded theory strategy in three stages of open coding (creating concepts and categories), axial coding (identifying the core category, causal conditions, intervening conditions, contexts, strategies, and consequences), and selective coding (creating the theory). In the open coding stage, after extracting and coding all the key points of the interviews, 46 concept codes, 30 sub-categories, and 6 main categories were identified. In the axial coding process, the categories obtained from the open coding process were divided into six categories, including the core category (farmers' adaptation to climate change), causal conditions (man-made activities in the fields of agriculture and industry), intervening conditions (economic and production conditions of the farm). Contextual conditions (financial and administrative problems), strategies (implementation of educational, economic, managerial, infrastructure, and agricultural strategies), and consequences (success and motivation of farmers to adapt to climate change along with hope for the future of the profession). The elements and components of the model are compared with the experimental and theoretical literature of the research subject in Table 9. The comparison action in this section can indicate the innovations presented in this study.

Table 9 Comparison of components of the model with the experimental and theoretical literature

Extension pattern of adaptation to climate change	Theoretical background in the subject literature	Lack of theoretical background in the subject literature
Casual Conditions Man-made activities in the fields of agriculture and industry	(Burpee et al., 2015) ؛ (Elfigh, 2000) ؛ (Nagaraja et al., 2009)	The first Interview, Third Interview, Fourth Interview, Seventh Interview, Eleventh Interview, Fourteenth Interview,

		Seventeenth Interview, Eighteenth Interview
Core categories Farmers' adaptation to climate change	Hosseini et al., 2016 (Ghambarali et al., 2012 ؛ (Habiba et al., 2012) ؛ Gholami & Alibeygi, 2013	The first Interview, Second Interview, Third Interview, Fifth Interview, Sixth Interview, Fifteenth Interview
Context condition Financial and administrative problems	----------	The first interview, third interview, sixth interview, seventh interview, ninth interview, twelfth interview, thirteenth interview, sixteenth interview, eighteenth interview
Intervening conditions Economic and production conditions of the farm	----------	The second interview, Sixth interview, Twelfth interview, Sixteenth interview, Seventeenth interview, Eighteenth interview
strategies Implement educational, economic, managerial, infrastructure, and agricultural strategies	(Deressa et al., 2011) ؛(Vento et al., 2010) ؛(Knutson et al., 2010) ؛(Jamshidi et al., 2015)	The first interview, fourth interview, fifth interview, sixth interview, seventh interview, ninth interview, tenth interview, eleventh interview, fourteenth interview, fifteenth interview
consequences Success and motivation of farmers in adapting to climate change along with hope for the future of the profession	----------	The third interview, fourth interview, sixth interview, seventh interview, eighth interview, ninth interview, tenth interview, fourteenth interview

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