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MEASURING THE AMOUNT OF FARMERS' RESILIENCE IN FACING CLIMATE CHANGE IN IRAN (CASE OF: HAMEDAN PROVINCE)

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Abstract

Agriculture has direct relation with climatic variables in arid and semi-arid regions. Natural hazards, such as droughts and dust storm, have increased in recent years in Iran as a result of climate change, and these conditions have a negative effect on the livelihoods of vulnerable villagers and farmers. The present study with the aim of measuring the Amount of Farmers' Resilience Facing with Climate Change in Iran case of Hamedan province was carried out. The statistical population of this study was included 115160 farmers in Hamadan province، the sample size was determined using Kerjesi and Morgan tables (n=384). The sampling method was stratified random sampling and data collection tool was questionnaire. To determine the face and content validity of the questionnaire a panel of experts was used and Cronbach's alpha showed the good reliability of the research tool and its value for different parts of the questionnaire was calculated between 0.7 and 0.8. Based on studies done, among the researches on climate change, no research has been done to investigate the status of farmers' resilience in conflict with Climate Change and their adoptive measures simultaneously which are the innovation of this research. According to obtained results, the status of adaptation measures of farmers facing climate change with a mean of 3.11 was higher than average and had a better situation than the other dimensions of resilience, and socio-institutional, economic-policy and education-extensional dimensions (with means 1.93, 2.32 and 2.33) were lower than average, respectively. This research identifies strategic priorities for tackling climate change.

***Keywords*:** Climate change, Resilience, Natural hazards in Rural Areas, Iran.

Introduction

Increasing the concentration of carbon dioxide will increase the temperature of the Earth's atmosphere and also affect other climatic factors (temperature and rainfall, for example), the set of these factors forms the phenomenon of climate change. The World Bank has announced that the climate has changed and this change is inevitable in the future. Global climate change is widely viewed as one of the most significant challenges facing societies today. Earth warming will have a profound social, economic and environmental impact and will accounted as a serious threat to the health of humans, natural ecosystems and environment. These effects are more profound in the arid and semi-arid regions that Iran is also located in. These devastating effects are most likely to be felt more by rural inhabitants whose main livelihoods are agricultural activities, due to farmers' low incomes and agricultural weak infrastructure. Climate change affects agriculture and food security by affecting crops, soil, insects, weeds, diseases and livestock so the negative effects of climate change over the years on rural and farmers' economies are appeared and its continuity will change the function and rural immigration. The study area of this research is Hamedan province of iran. The phenomenon of climate change shows itself these days more than past in this province and the attention of the authorities has focused on this issue more than ever. One of the areas that have been heavily influenced by climate change in recent years is Hamedan province. Which has caused irreparable damage to the region, especially in the agricultural sector. Climate change is detectable by changes in indicators such as rainfall, temperature, evaporation (Tannya *et al.*, 2018), snow depth (Crocee *et al.*, 2018) and dust (Schweitzer *et al.*, 2018) (Hutter *et al.*, 2011).

In the Hamedan province, during the 2017-1982 period, the average annual humidity dropped from 55.19 to 43.45 percent, the average annual snow depth from 41.83 to 1.43 cm, and the average precipitation per year decreased from 34.06 to 21.37 mm, as well as the average annual evaporation from 0 to 152.40 mm And the number of days with dust increased from 38 days to 48 days (Hamadan Meteorological Administration, 2017).

The following diagrams show the status of some indicators of climate change in Hamadan province. According to the figure (1), the average annual temperature in Hamadan in the period 2017-1982 has been increased.

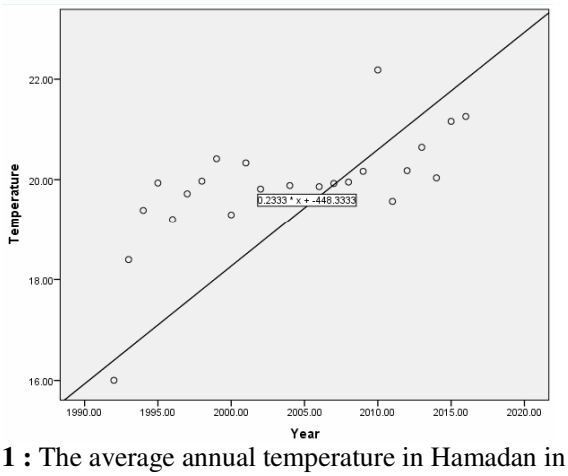

Fig. 1 : The average annual temperature in Hamadan in the period 2017-1982
(Hamadan Meteorological Administration, 2017)

According to the figure (2), the average precipitation in the period 2017-1982 has decreased in Hamedan.

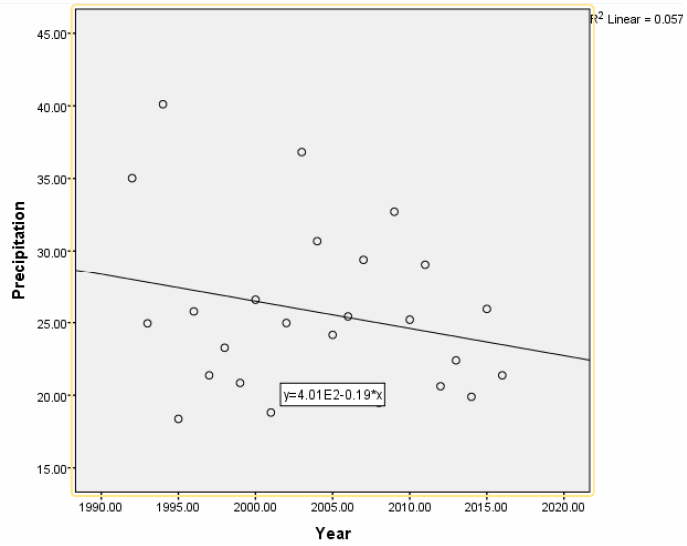

Fig. 2 : The average precipitation in the period 2017-1982

(Hamadan Meteorological Administration, 2017)

According to meteorological data, it can be concluded that climate change has occurred in Hamedan province. Hamedan province is one of the important agricultural poles in Iran, and the agricultural sector is heavily dependent on climatic conditions. Climate change in this province has led to changes in patterns and severity of precipitation and rainfall, and also affected water resources. Also, these changes affect the biodiversity, soil organisms and to a large extent affect the type of cultivation and productivity systems (Smith *et al.*, 2013).

Other impacts of climate change include the migration of individuals, reduced crop, unemployment, reduced income, endangered livestock health, and reduced soil fertility and vegetation loss. One of the reasons for these problems is the lack of farmers' resilience to climate change, which increased their vulnerability to these changes. So, managing to create resilience society increases the probability of ecosystem stability. Therefore, it is necessary to investigate the status of farmers' resilience in order to manage climate change vulnerability in rural areas (Fleming and Vanclay, 2010).

The term "resilience" is often referred to as "back to the past", which is derived from the Latin root of Resilio (jump to the past). Resilience is often discussed in the context of the transition or transformation, crisis, and other disadvantages, first used by Holling in 1973 in ecological studies, from his point of view; the resilience refers to the ability of the system to resurrect itself (Holling, 1973) (Berkes, 2007) (Cutter *et al.*, 2008). After nearly four decades of this concept, a unified definition of it has not yet been provided.(Masten & Powell, 2003) (Whitmarsh, 2005). Many of the differences in the definitions of resilience are due to the various methods and fundamental differences existing in the approaches and perspectives in this area (Fridolin Simon & Kurt, 2007). Being Resilience is defined in various dimensions of social, economic, infrastructural (physical), institutional and ecological (Beckman, 2006) (Rose, 2004). A resilient system or society not only has the ability to absorb disruption, but also has the potential to benefit from change in a way that creates an opportunity for development, innovation, and updating (Rockstrom, 2003) (Dawley *et al.*, 2010). Accordingly, managing to create resilience will increase the likelihood of ecosystems' survival against natural hazards (Esmaeil Nejad and Pudineh, 2017) (Joseph, 2013) (Gaillard, 2007). Many studies have been done on this subject, which are referred to below.

So based on reviews, one can conclude that measuring the resilience capacity is one of the main approaches to managing the effects and consequences of climate change. In this regard, in order to increase the resilience of farmers against the occurrence of these changes, measuring the resilience capacity of farmers is considered as an essential step. Based on previous studies, it has been found that none of the previous studies have addressed the capacities of farmers facing climate change as well as their adaptive measures simultaneously, which this research has been undermined. This research help planners to know in what aspects of facing climate change, farmers face more difficulties and based on that make the necessary planning and policy making. Therefore, based on theoretical and field studies socio-institutional, economic-political, educational-extensional and adaptive measures have been identified as resilient dimensions and the proposed model is presented in the form of the following.

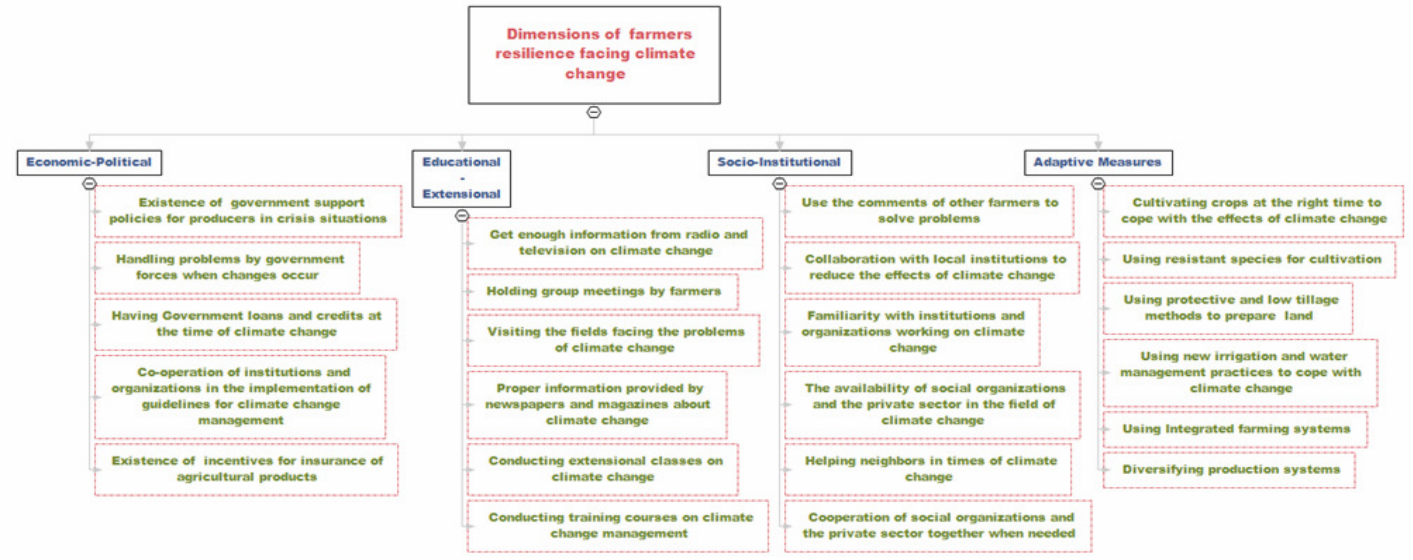

Fig. 3 : Dimensions of farmer's resilience facing climate change

Reference: research finding

Materials and Methods

This research is applied in terms of objectives and is a survey research with respect to methodology, and a questionnaire has been used to collect information. To determine the face and content validity of the questionnaire a panel of experts was used. In order to calculate the reliability of the research tool, pilot test was carried out and the Cronbach's alpha was 0.7-0.8. In this research, the statistical population consists of 115160 farmers in Hamadan province. To determine the sample size, the Krejsi-Morgan table (1970) was used, according to which the sample size was 384 and the sampling method was proportional random sampling (table 2). Variables of the research were consisting of 5 factors each containing some items. Socio-institutional resilience factor (6 items), political resilience factor (5 items), adoptive measures of farmers against climate change factor (7 items), educational-promotional resilience factor (6 items) (Abdulkareem &Elkadi, 2018, Zare and Taleb Bidokhti, 2018, Ali & Rahuta, 2017, Dadashpur and Adeli, 2016, Kafle, 2011and Zobeidi *et al.*, 2016). It should be mentioned that each item in the questionnaire were in the form of 5-point Likert (very small = 1 to very high = 5). Furthermore, the individual characteristics of farmers included 5 variables i.e., age, gender, number of household members, marital status, and education level. Collected data were analyzed using SPSS-22 software.

Results and Discussion

According to the results most of farmers were male and most of them were between 40 and 60 years old (45.6%). In terms of level of education 136 farmer (35.4%) had primary school level, and 35 (9.1%) were illiterate (Tables 3 and 4).

The results showed that the average of farmers' adaptation measures in the face of climate change was 3.11 and in comparison with other dimensions of the resilience was higher than average and had better situation than the other dimensions of resilience. The high level of this dimension is due to the use of suitable coatings for irrigation canals and the prevention of wasting water and cultivation of crops at the right time by farmers. In this regard, farmers are pursuing these activities based on their indigenous knowledge. Also, the educational–extensional dimension of farmers' resilience was 2.33, which is lower than the average, due to the lack of workshops; newspapers and magazines related to natural hazards and climate change for farmers refers. The socio-institutional dimension of farmers' resilience was 2.32, it was lower than the average; the low level of this dimension was due to the lack of cooperation between the private sector and social organizations in dealing with climate change and hazards. The situation of farmers' resilience in the economic-policy dimension was lower than other factors (1.93). This was due to the lack of necessary governmental aid (loans and credits) at the time of natural hazards (Figure 4).

According to the results in the socio-institutional dimension "when the climate changes occur**,** social organizations and the private sector are working together" and "there is enough social and private sector organizations that are active in the field of climate change" had the least position (1.96) it shows that in Iran during the occurrence of climate change and natural disasters, social organizations and the private sector do not have the necessary cooperation. In Economic-Political dimension "loans and government credits are easily available to me when climate change occurs" and "at the time of the change, government forces deal with farmers' problems sufficiently" had the least mean (1.74) these indicate that credit policies needs to be reviewed. in adaptive measures category "I diversify my production systems to reduce risk of climate change" was at the last rank, it shows farmers needs specific training on the use of agro-diversity to reduce the effects of climate change and in Educational-Extensional category "Newspapers and magazines and other press releases are well aware of climate change" and "educational and extensional classes on climate change are helpful in the village" had the least position(1.96) (Table 5) that indicates the newspapers and magazines should pay more attention to climate change and informing farmers in this regard and educational workshops on climate change management were not sufficiently conducted which requires serious attention from the authorities. Also, because climate change is an international problem and human mistakes in one corner of the world destroy the interest of all people and the World, international organizations should also work on this regard.

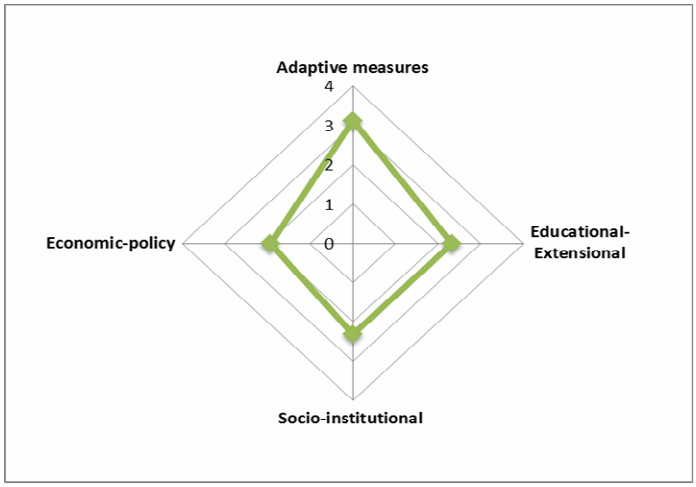

Fig. 4 : Radar diagram of different dimensions of farmers' resilience facing climate change

Reference: research finding

The political resilience of farmers with an average of 1.93 compared to other dimensions of the resilience is in the lowest position in comparison with the average, which is consistent with the results of the research conducted by Sadeghloo and Sajasie-Jidari (2014) and Sharafi and Zarafshani (2010). The socio-institutional resilience of farmers with a mean of 2.32 is lower than the average, which is in line with the research results (Dadashpour and Adeli, 2015). Also the education-extensional resilience of farmers with a mean of 2.33 is lower than the average and is consistent with the research results acquired by Farzad Behtash *et al.* (2013). Adaptive measures of farmers facing with climate change with an average of 3.11 compared to other dimensions of the resilience are in the highest position and also it is higher than the average, which is in line with the research findings obtained by Sadeghloo and Sajasy-e-Jidari (2014).

Conclusion

Climate change is one of the most important threats to human food security and for Iran, which is one of the top 10 countries in the field of greenhouse gas emissions, identifying the dimensions of exposure to climate change can

be an important step in dealing with these threats. Concerning climate change; prevention is better than cure.

In this regard, steps are needed to reduce the effects and consequences of climate change. This is inevitable, climate change has occurred and the world average temperature is rising; the development of new strategies to protect endangered species and habitats that are not adaptable to change is of high priority. To answer these challenges identifying resilient dimensions in facing climate change and providing effective solutions to these changes should be considered.

According to the findings, the lowest level of farmers' resilience was observed in the economic-policy dimension, it is due to lack of appropriate policies for providing services in the event of hazard. In this regard, laws, regulations, policies, long-term plans for monitoring and reporting on plant and animal species, cross-border cooperation, local participation, implementation international agreements, etc., should be reconsidered**.** Acceptance of such tools and approaches is more vital in areas where there is a significant negative impact of climate change on human health and livelihoods like Iran and these approaches should be used within the framework of a realistic strategy. In this context, adopting policies that encourage farmers to promote low external input sustainable agriculture systems (LEISA) can play an important role in this regard, since in times of crisis, one of the problems faced by farmers is accessing to fertilizers and chemical pesticides. Also, policies to encourage farmers to diversify their revenues through different utilization systems such as agro-forestry can greatly offset the risk of exposure. On the other hand, regarding the socio-institutional dimension, safety nets can play an important role; safety nets protect vulnerable population from persistent impacts of natural hazards by providing livelihood support and contributing immediate food security, often through community–driven public works programs. On the educational-extensional dimension, climate information and early warning systems can be very fruitful. So that, by providing the necessary information farmers can be informed of climatic changes and reduces the risk of natural hazards. Concerning adaptive measures most farmers are pursuing the activities on the basis of their indigenous knowledge. It is very important in this regard to provide new and up-to-date knowledge. Also, In Hamedan province of Iran, due to exposure to the wind storm and haze that are result of climate change, positive management measures to restore vegetation through the cultivation of compatible species and implementing carbon sequestration projects can be an effective step in this direction.

Table 1: Studies Related to resilience

Title	Researchers	Comparison	Factors
From engineering to evolutionary, an overarching approach in identifying the resilience of urban design to flood	Abdulkareem &Elkadi, 2018	found that the socio-economic factor has an impact on resilience to natural hazards (floods)	Ecology, socio-economic factor, Nexus between built and ecology
Addressing the threat of climate change to agriculture requires improving crop resilience to short-term abiotic stress	Beacham, *et al.*, 2018	found that development of resilient products needs the preparation of genetic resources to identify useful traits through the development of screening protocols	Crop breeding programs, cultivating resistant species
Policies and governance impact maps of floods on metropolitan Shiraz (the first step toward resilience modeling of the city	Zare and Taleb Bidokhti, 2018	Have found that policy and government indicators are one of the causes of urban flood resilience.	physical, social, and organizational conditions, Policy and governance impact
sustainability analysis of observed climate change adaptation strategies in maize farming in Benin	Yegbemey, *et al.*, 2017	Observed climate change adaptations strategies and found driving forces underlying the sustainability level of maize farming systems but did not assess the current situation of driving forces.	on-farm diversification, land use change strategies, change of activity, migration to another agro-ecological zone access to credit
Coping with climate change and its impact on productivity, income, and poverty: evidence from the Himalayan region of Pakistan	Ali & Rahuta , 2017	Found that the educational-extensional factor (media and press) and income are one of the factors influencing farmers' coping ability with climate change	educational-extensional, economical, demographic
Institutional impacts on the resilience of mountain grasslands: an analysis based on three European case studies	Schermer *et al.*, 2016	It was concluded that one of the important factors in the resilience of these areas was the institutional factor.	institutional
Measuring the Amount of Regional Resilience in Qazvin Urban Region	Dadashpur and Adeli, 2016	Concluded that among different dimensions, institutional and then the physical-spatial dimensions were more inappropriate and in the next levels there are economic and social dimensions respectively	Institutional, physical-spatial, economic and social dimensions

Resilience vs. Adaptation: Framing and action	Wong *et al.*, 2015	concluded that adaptive measures in response to climate change have an impact on the resilience of individuals to these changes	adaptive measures
Impacts of climate change on crop production in Bolivia and Peru A systematic review of evidence	Gonzalez, 2015	Conclude adaptation measures need to consider not only the weather and physical dimensions of climate change, but also its social consequences.	Adaptation measures, social consequences, environmental constraints
Identifying factors affecting farmers' resilience to natural hazards (with an emphasis on drought)	Sadeghloo and Karzaiyani, 2014	Identifying factors affecting farmers' resilience to natural hazards (with an emphasis on drought). In this research, policy -economic dimension include insurance of agricultural products, granting credits and loans, reducing tax and coordination of government force and then the adaptive measures included, irrigation modification, increasing product diversity, development of resistant seeds and species, precision in planting scheduling, paying attention to irrigation canals, conducting zero tillage and integrated cultivation	government policies and support, Economic and social factors and adaptive measures
Climate change and the profitability of indigenous adaptation practices in smallholder agriculture in South East Nigeria	Enete, *et al.* 2012	Found Coping strategies	multiple cropping or intercropping, agroforestry, mulching, harvesting of water for irrigation, cultivating resistant varieties, role of Extension services

Table 2 : Number of samples

Counties	**Statistical Population**	**Samples**
Asad Abad	9166	31
Bahar	10833	36
Toyserkan	11253	38
Razan	12990	43
Kabudrahang	15517	52
Malayer	20530	68
Nahavand	13551	45
Hamedan	16295	54
Famenin	5026	17
Total	115160	384

Table 3 : The frequency distribution of farmers in terms of age, farming experience, and annual income

variable	Variable levels	frequency	percentage	maximum	minimum	mean
Age (years)	20 x≤	18	4.7	89	15	42
	x ≤40‹ 20	162	42.2			
	x ≤60‹ 40	175	45.6			
	x›60	29	7.5			

Reference: the research findings

Table 4 : The frequency distribution of farmers based on gender and level of education

Variable index	**Variable levels**	**frequency**	**percentage**	**mode**
Gender	Male	348	90.6	Male
	Female	36	9.4	
Level of education	Illiterate school	35	9.1	Primaryschool
	Primaryschool	136	35.4	
	Guidance school	96	25	
	Diploma and above	117	30.5	
Total	384	100		

Reference: the research findings

Table 5 : Ranking of items

Category	Items	Mean	Rank	SD
Socio-Institutional	I use the comments of other farmers to solve my problems	2.77	1	1.15
	I work with local institutions to reduce the effects of climate change	2.77	2	1.21
	I am familiar with the institutions and organizations working on climate change	2.41	3	1.12
	Neighbors help me when climate change occurs	2.10	4	1.07
	There is enough social and private sector organizations that are active in the field of climate change	1.96	5	1.97
	When the climate changes occur, social organizations and the private sector are working together	1.96	6	1.08
Economic-Political	The government has the necessary incentive policies to insure crops	2.22	1	0.540
	Institutions and organizations are working together to implement the guidelines for climate change management	2.01	2	0522
	The government enforces consumer protection policies in times of crisis	1.95	3	0.515
	At the time of the change, government forces deal with farmers' problems sufficiently	1.74	4	0.517
	Loans and government credits are easily available to me when climate change occurs	1.74	5	0.519
Adaptive measures	I use the appropriate cover for my irrigation canals to prevent water loss	3.50	1	1.20
	I cultivate at the right time to cope with the effects of climate change	3.47	2	1.20
	I use less sensitive to temperature and resistant species for cultivation	3.38	3	1.16
	I use new irrigation and water management practices to cope with climate change on my farm	3.05	4	1.33
	I use a protective and low tillage method to prepare my land	3.01	5	1.21
	I use LEISA farming systems to farm sustainable and with as little polluting inputs as possible	2.78	6	1.27
	I diversify my production systems to reduce risk of climate change	2.61	7	1.20
Educational-Extensional	Farmers hold group meetings to solve problems caused by climate change.	2.77	1	1.20
	Radio and TV And other mass media provide us with sufficient information on climate change.	2.76	2	1.15
	I visit the farms that have encountered the problems caused by these changes.	2.42	3	1.12
	Educational and extensional classes on climate change are held in the village	2.10	4	1.06
	Newspapers and magazines and other press releases are well aware of climate change	1.97	5	1.08
	Workshops on climate change management in the village are helpful	1.96	6	0.97

Reference: research finding

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