



Where are We Standing and Where Should We Be Going? Gender and Climate Change Adaptation Behavior

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Accepted: 20 February 2020 / Published online: 9 March 2020
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Abstract

Climate change poses as one of the greatest ethical challenges of the contemporary era and which is rapidly affecting all sectors and ecosystems, including natural ecosystems and human and social environments. The impacts on human societies, and societies' ability to mitigate and adapt to these changes and to adhere to ethical principles are influenced by various factors, including gender. Therefore, this study aimed to design a model of climate change adaptation behavior among rice farmers in Mazandaran Province, northern Iran, based on gender analysis (IUCN, UNDP and GGCA in Training manual on gender and climate change, 2009) and using the developed model of protection motivation theory (Bockarjova and Steg in *Glob Environ Change* 28:276–288, 2014). For this purpose, 173 female and 233 male rice farmers in Mazandaran Province were selected through stratified random sampling. The results showed that threat and coping appraisal had positive and significant effects on climate change adaptation behavior in both groups. Additionally, men's and women's perceived severity had the greatest impact on threat appraisal, and response costs had the greatest impact on their coping appraisal of climate change. Given that climate change adaptation behavior has been largely dependent on the development of ethical principles and the behavior of men and women toward climate change and based on the research findings, some suggestions are recommended at the mega (international), macro (governmental and legislative), meso (related organizations) and micro (rice farmers) levels for male and female rice farmers to adapt to the climate change phenomenon.

Keywords Climate change · Adaptation · Gender · Protection motivation theory

The present article is taken from Imaneh Goli's thesis entitled "Designing Behavioral Adaptation of Mazandaran's rice farmers to climate changes Based on Gender Analysis Approach" under the supervision of Dr. Maryam Omid Najafabadi and Dr. Farhad Lashgarara.

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Introduction

Climate Change in the World, Iran and Mazandaran Province

Currently, we are living in a world in which climate change is a clear and undeniable reality. It is a phenomenon involving changes in precipitation, rising temperatures (Luber and McGeehin 2008), floods, droughts (Arunrat and Pumijumnong 2015) and frost that influences agricultural production (Kontgis et al. 2018) and food systems (Battisti and Naylor 2009) and produces many (direct and indirect) devastating and damaging consequences (Singh et al. 2010) for individuals and groups living in developing countries (Fig. 1). Over the past 50 years, some countries, such as Iran, have experienced many climatic events (Amirkhani and Chizari 2010; Habiba et al. 2011). Iran is a low-rainfall area in which more than 85% of its regions are located in a desert belt (25° N–40° N) (Madani 2014). By 2050, it will have experienced a 20% to 25% reduction in average rainfall, and it will face an increase in temperature of 2.6 °C and various climate events, such as severe and prolonged droughts (Faramarzi 2010) and floods (Madani 2014). Clearly, the phenomenon of climate change in Iran is undeniable. Preliminary evaluations of atmospheric indicators of Mazandaran Province (which is located in northern Iran) show a specific type of rainfall over the course of each type of atmospheric rainfall, especially in the plain area, an increase in temperature (Jahanbakhsh et al. 2010), and the occurrence of continuous agricultural droughts, floods, thunderstorms, cold and frosts (Meteorological Organization of Iran 2018) (Fig. 2).

Due to its climatic situation, good dispersion and vast ample plains, Mazandaran Province is one of the agricultural sources of Iran, with more than 600 thousand hectares of land under crop and garden cultivation (Mazandaran Agricultural Jihad Organization 2018). Additionally, with approximately 75% of Iran's paddy fields, it plays an important role in producing more than 37% of the rice consumed in the country (Mazandaran Agricultural Jihad Organization 2018). Failure to adhere to ethical and behavioral principles in the management of these lands can lead to contamination of surface and ground level waters, loss of natural habitats, and increased methane emissions, which help to accelerate climate change in the region. Regarding the employment of most of the Mazandaran agricultural labor force in rice

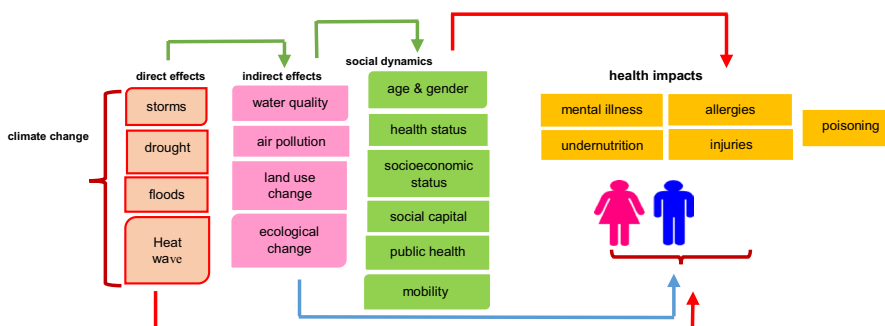


Fig. 1 Climate change impact

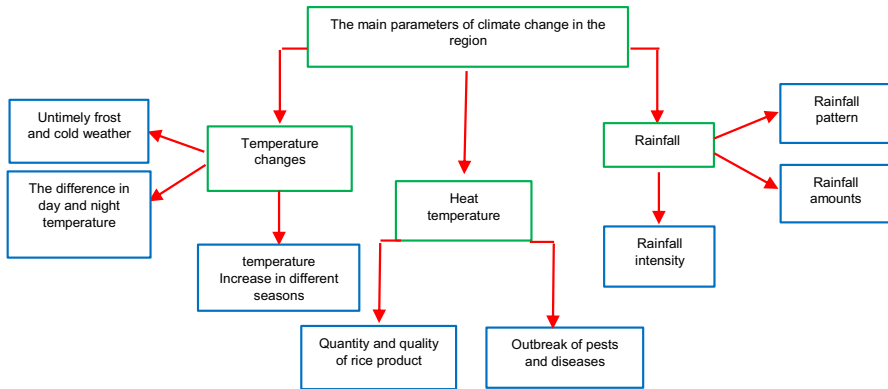


Fig. 2 The main parameters of climate change in the study area, derived from in-depth interviews with farmers in Mazandaran Province

production, the livelihoods of these farmers have been largely dependent on the water and soil resources in the region. An increase in evapotranspiration as a result of rising temperatures and drought (Widawsky and O'Toole 1990; Singh 2003; Rezaei and Nahvi 2007), as well as the lowering of temperatures below 12–18 °C and the occurrence of cool weather (Vergara and Visperas 1971; Kabaki and Yoneyama 1982; Zia et al. 2004), will result in a reduction in photosynthesis, preventing the transfer of minerals and nutrients to plants, increasing the number of scratches and lamina discoloration, and reducing the leaf area; this will result in dry matter accumulation, reducing the number of grains per panicle and the 100-seed weight and leading to the low growths of plants and, ultimately, a low crop yield (Rezaei and Nahvi 2007). Therefore, climate change, which affects the topologies and periods of rice growth (Fig. 3), is of great importance in this province and demonstrates the need to apply ethical behaviors to adapt to these changes.

Gender and Climate Change

As one of the greatest (Salehi et al. 2015) ethical challenges (Hattingh et al. 2009) and environmental changes of the present era (McCright 2010), climate change is not just a technical problem. It has strongly influenced various social aspects, including gender-specific aspects (Dankelman 2002). Gender does not



Fig. 3 Images related to the effects of climate change on the paddy fields of Mazandaran province taken in September 2017 by the researchers

refer to differences in biological structure (such as being female or male). Rather, it refers to structured social roles (McCright 2010; World Bank 2009) and the relationships between men and women (World Bank 2009). These roles change over time in the culture of a community (FAO 2015) through cultural and social norms (FAO 2015) and are usually unequal in terms of power and decision-making, control over operations, freedom of action (World Bank 2009), and ownership of and access to useful resources, facilities and opportunities, such as land, livestock, finance and education (FAO 2015); thus, they unquestionably influence people's ethical decisions (Madar 2016). Accordingly, climate change is not a gender-neutral issue (Habtezion 2013; IPCC 2014). It has expanded and extended to include gender-related, gender-specific issues stemming from women's social roles, poverty, and discrimination (Kisauzi et al. 2012). The potential impacts of climate change have exacerbated these problems and pose a greater challenge for women, especially women in rural areas, who are responsible for bringing water, collecting wood for fire, and handling crops and small animals in their home environment (Adger et al. 2007), thus increasing their sensitivity to climate change. These factors also affect the lives of rural women in Iran, including women and girls living in Mazandaran villages, whose lives are heavily dependent on nature. They will be severely affected because their economies and livelihoods are dependent on land, agriculture and livestock, which will suffer under climate change. Consequently, they will have serious problems in their livelihoods, such as economic dependence on men and migration. There are also social and psychological damages rooted in the emotional and caring role of women and maternal self-sacrifice, especially in times of food shortage, as a result of which women donate their share of food and health to other family members (Iran News Agency 2019). Therefore, the gender dimensions of climate change, as important factors in climate change discussions, need to be further explored.

Taking into account the importance of rice cultivation in Mazandaran Province and the special importance of men and women from the planting to the harvesting stage of this important crop, some of the gender roles of men and women in rice cultivation include the following: (1) demarcating, tilling, and preparing the paddies, which have usually been performed by men and are still men's responsibility; (2) building a partition wall (the complete elimination of clogs and making the field smooth), which is an activity performed exclusively by men and is normally not undertaken by women; (3) slapping the field, which is a kind of field preparation for the replanting stage and is performed exclusively by men; (4) preparing the seeds for seed replanting, which is mainly an activity performed by women, sometimes with the help of men; (5) preparing the transplanting nurseries, which is undertaken by women; (6) replanting, which has customarily been performed by women, although where mechanized cultivation is available, the field requires the power of men; (7) weeding, which is performed by women; (8) harvesting, which is traditionally undertaken by women, although men carry out the task with a combine harvester; (9) gathering the remnants of rice, which is also performed by women; (10) drying and storing, which previously were performed by women in greenhouses but currently, with the advent of technology, are the responsibility of men; and, finally, (11) supplying the rice to the market, which since time immemorial has been



Fig. 4 The role of male and female rice farmers in rice cultivation in Mazandaran (images taken by researchers in March and April 2019)

performed predominantly by men, although women in local markets also assist their husbands in selling their products (Fig. 4).

Adaptation to Climate Change

Because agriculture is inherently sensitive to climate and is extremely vulnerable to climate change (Parry and Carter 1989; Reilly 1995; Smit and Skinner 2002), much of it has come under the influence of human misconduct, and adaptation to climate change has become an important issue in recent years (Adger et al. 2003). Adaptation refers to a group of targeted actions in response to real or anticipated climate stimuli aimed at mitigating damage (McCarthy et al. 2001), changing ecological and social systems, coping and cultivating durability (Barner 2001) or exploiting opportunities (Adger et al. 2009; Nielsen and Reenberg. 2010) to prevent the adverse effects of climate change as a preventive measure (IPCC 2014). According to the Intergovernmental Panel on Climate Change (IPCC 2007), since humans are responsible for climate change, changing human behaviors as an ethical imperative can help mitigate climate change and its impact. Therefore, as a large group that has the potential to contribute to climate change, individuals worldwide must seek ethical ways to increase adaptation to climate change, which in turn can reduce these adverse effects or maintain them at the minimum level possible.

Gender and Adaptation

Gender, poverty and vulnerability are the key issues in climate change adaptation, and the livelihoods of smallholder farmers are subject to gender considerations in terms of rights and responsibilities (Doss 2001), demonstrating the asymmetry of power in access to land, work, leisure activities (Jerneck 2018) and education among female and male farmers. Vincent et al. (2014) believe that social differentiation can express vulnerabilities and various capacities to adapt to climate change. According to the World Health Organization, in terms of health and life expectancy, women are at greater risk than men; they are exposed to heavy rainfall, heat, drought, erosion and water scarcity (WHO 2014), and their access to essential information about adaptation patterns and meteorological warnings is much lower than that of men (WHO 2014). The bottom-up approach to sustainable development is sensitive to gender; therefore, women are one of the key elements of development in developing countries such as Iran (Gururani 2002). Numerous studies in Iran have also shown

that women are more concerned with the environment and the recovery and conservation of natural resources such as energy and water than men are (Lahsayizade and Mohammadi Nia 2007; Mirzayi et al. 2009; Rahmani and Bijani 2009; Sabziyan and Khosravi poor 2011; Salehi 2009, 2011, 2012). Therefore, taking into account the adverse impacts of climate change on women (Alston 2013), research on gender as an important factor in climate change discussions and adaptation behaviors is indispensable and inevitable.

Numerous studies have been conducted to determine the factors influencing farmers' adaptation behavior to climate change in agriculture (Bryan et al. 2009; Acquah and Onumah 2011; Kurukulasuriya and Mendelsohn 2006). Most of these studies have been performed in developing countries, where agriculture plays a key role. In fact, the behavioral model is a schematic paradigm that utilizes several theories and the practical results of other research, providing the conditions needed to better understand the subject and to achieve the expected results more easily and accurately (Glanz et al. 2008). Some studies partly describe farmers' decision mechanisms regarding adaptation behavior, but the physiological barriers to adaptation to these changes, especially in developing countries, have often been overlooked (Below et al. 2012; Gebrehiwot and Veen 2015). Therefore, various models and theories have been proposed to predict the attitudes, outlooks, and behaviors of individuals, including the theory of reasoned action (Ajzen and Fishbein 1980), the theory of planned behavior (Jung Lee et al. 2010), and protection motivation theory (PMT) (Rogers 1975). In this study, PMT is used to determine the factors influencing climate change adaptation behavior among male and female rice farmers in northern Iran. This model is compared to other behavioral models, such as the theory of planned behavior, the norm activation model and value-belief-norm theory, which can enhance our understanding of the motivations underlying environmental protection behaviors (Bockarjova and Steg 2014), such as climate change adaptation behavior. PMT focuses on not only the individual costs of adaptation behavior but also aspects of collaborative activities such as response efficacy, which is one of the key factors in the norm activation model and value-belief-norm theory. PMT has been widely used in research on health (Greening and Stoppelbein 2000; Houlding and Davidson 2003; Plotnikoff et al. 2009), natural hazards and environmental problems (Bender et al. 2007; Grothmann and Reusswig 2006; Mulilis and Lippa 1990; Zaalberg and Midden 2010), social problems and food security (Cates et al. 2003; Cox and Bastiaans 2007; Henson et al. 2008, 2010), water conservation (Kantola et al. 1983), and climate change (Grothmann and Patt 2005; Osberghaus et al. 2010; Gebrehiwot and Veen 2015; Dang et al. 2014; Truelove et al. 2015). Therefore, PMT is an effective model for explaining and understanding the factors influencing climate change adaptation behavior. The purpose of this study is to explain the adaptation behavior of rice farmers in Mazandaran Province based on a gender analysis approach using the PMT model (Fig. 5).

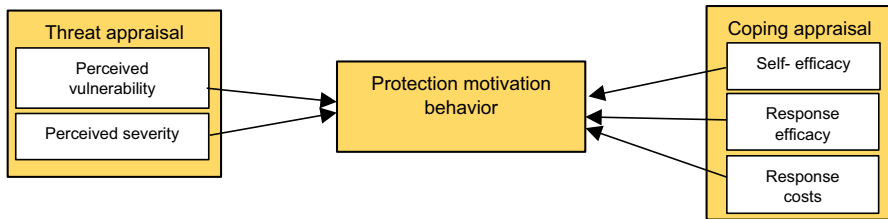


Fig. 5 Motivational Protection Behavior Model taken from (Bockarjova and Steg 2014)

Ethics in Gender Adaptation to Climate Change

While the causes and impacts of climate change have been identified and understood in the modern era, relatively little attention is given to challenges, values, beliefs and ethics related to climate change or to positive and negative policies of reform or adaptation to these changes (Byrne 2011). Thus, it is important to examine ethics-based behaviors in the context of adaptation, which requires people to adhere to ethical values to respond to these changes (Markowitz 2012). Ethical issues focus on what is right or wrong, useful or harmful, and fair or unfair (Byrne 2011), and ethical behavior seeks to understand how people behave in the face of social dilemmas (Bazerman and Tenbrunsel 2011). The United Nations Educational, Scientific and Cultural Organization (UNESCO) states that climate change not only destroys the sustainability of the earth's ecosystems and the services they provide but also threatens people's future life and livelihood, especially among local communities. Some of these threats are potentially irreversible. Therefore, governments and all those involved must do what they can. To this end, in 2017, UNESCO outlined a list of ethical principles related to climate change adaptation, including preventing harm; using preventive approaches; respecting the equality of men and women and the establishment of social justice; maintaining ethical values to achieve sustainable environmental development; increasing solidarity; developing scientific knowledge and integrating decision making; using new science, technology and innovation; assessing and managing risk and identifying vulnerable groups; focusing on education; raising public awareness; and increasing international cooperation (UNESCO 2017). UNESCO believes that these principles should be recognized and understood as important ethical principles in climate change adaptation behavior (UNESCO 2017).

Since ethics is a major factor in human social behavior (Haidt 2008), the recognition of climate change as an important ethical issue may cause individuals to become more motivated to deal effectively with this problem (Markowitz 2012; Shwom et al. 2010), whereas neglecting this issue can be an important barrier (Markowitz 2012) to adaptation behavior. Adaptation to the negative effects of climate change entails numerous social problems, including ethical issues. At the heart of climate justice, unethical human activities will have unforeseen and unknown consequences. Since men and women differ in their roles in society, they perceive ethical problems differently (Gilligan 1982). Furthermore, women often adhere to ethical behaviors

while men oppose them (Gattiker and Kelley 1999; Kreie and Cronan 1998; Loch and Conger 1996; Solomon and O'Brien 1991). Social and cultural norms have a direct effect on ethical standards (Turiel 1994) through the identification of moral roles and responsibilities, which in turn influence behavior (Turiel 1994). Furthermore, the moral values and principles that men and women use in their behavioral decisions have roots in their gender (Gilligan 1982). Therefore, it is important to examine adaptation behavior based on ethical principles and values among men and women as part of a major contribution to these changes.

In the second part of this article, we review the research literature, introduce PMT as the theoretical framework for this research and state the study hypotheses. The following section describes the characteristics of the study area, the research design, and the data analysis method. In the fourth section, the results are presented and discussed, and finally, the conclusions, limitations and suggestions for future research are presented.

Literature Review

Considering the different aspects of the impacts of climate change (Bryant et al. 2000; Cash et al. 2006), adaptation studies necessarily involve different dimensions. Behavioral theories and gender play a significant role in the development of adaptation behaviors as an important and influential factor; however, studies show that relatively little research on these variables has been conducted and that further research is needed. One of the theories that can be conducive for predicting adaptation behaviors, especially in regard to climate change, is PMT. Therefore, to determine the research variables and theoretical framework of this study, the results of previous studies were investigated using Google Scholar. These results show that there are a total of 18,500 studies on adaptation behavior and motivation protection and 1,940,000 studies on the role of gender in agriculture. Some results are given in Table 1.

Protection Motivation Theory

PMT, which was first proposed by Rogers in 1975 and 1983, combines psychological constructs to help clarify how people behave to protect their health (Scarpa and Thiene 2011). It is an overall model of decision-making regarding environmental concerns (Karrer 2012) and an important social and psychological model (Haer et al. 2016). Although the original model was developed to study health care behaviors (Rogers 1975, 1983), it is currently used to explore other areas, including technical, environmental, and natural hazards (Bubeck et al. 2013) and individuals' adaptation to climate change (Truelove et al. 2015). According to Keshavarz and Karami (2016), in this model, the main assumption is that people adopt a new behavior by considering its benefits and cost-effectiveness when making decisions, by identifying barriers and facilitators when accepting protective behaviors (Bockarjova and Steg 2014) and by balancing risks and benefits at the time of selection. The core

Table 1 Literature review

Name(s) of the scholar(s)	Research findings
Grothmann and Patt (2005)	When farmers have a better understanding of the risk of climate change and the effectiveness of adaptation measures, they are more likely to behave consistently with climate change; additionally, farmers who deny the risk of climate change based on wishful thinking are less likely to show climate change adaptation behaviors
Dang et al. (2014)	When farmers have a greater understanding of the risk of climate change and of policies and regulations such as increases in the price of water and electricity or when they are pressured by family, friends or neighbors, they better understand effective adaptation measures and are more likely to behave consistently with climate change phenomena
Esham and Garforth (2013)	Perceived severity and self-efficacy are important factors in the adaptation behavior of farmers
Keshavarz and Karami (2016)	Response efficacy, perceived severity, response costs, perceived vulnerability, and self-efficacy significantly affect the environmental behavior of farmers during drought
Partey et al. (2018)	Men and women share a similar understanding of climate change, but men accept responsibility for climate change risk mitigation because they are more capable of accessing and using smart devices than women are
Ampaire et al. (2019)	While gender responses are improving, there are gender differences in adaptation, budgeting, and budget allocation
Eastin (2018)	Climate change and natural disasters have a significant negative impact on gender equality because the increase in climatological disasters is accompanied by a decline in the economic and social rights of women, especially in states that are relatively democratic and are more dependent on agriculture
Omidi Najafabadi (2013)	Gender influences farmers' attitudes toward organic farming but does not have an effect on experts' attitudes toward organic farming
Salehi et al. (2015)	While women's behavioral participation in coping with climate change is high, men show a higher level of awareness and understanding in the face of climate change
Portman (2018)	If women constituted the majority of food producers worldwide, agricultural policy would be a feminine affair; however, as long as patriarchal social relations continue throughout the world, changing agricultural policies will require explicit attention to gender inequality
Filson (1993)	Female farmers are more concerned about the environment and related issues
Adger et al. (2017)	People constantly use ethical reasons to explain their views on climate change adaptation. Emphasizing the ethical arguments in adaptation provides evidence that ethical issues are key to addressing climate change issues
Valentine et al. (2009)	Women are better at displaying ethical behavior than men, and women demonstrate increased ethical judgment and a tendency to behave ethically
Fang Chen (2015)	In addition to one's attitude and subjective norms, ethical duty plays an important role in reducing climate change problems and in adaptation

idea of PMT is that people are exposed to the hazards of two major cognitive processes through adaptation measures (Keshavarz and Karami 2016; Truelove et al. 2015), namely, *threat appraisal* and *coping appraisal* (Tapsuwan and Rongrongmuang 2015).

Threat appraisal assesses the factors that increase (i.e., benefits) or decrease (i.e., severity and vulnerability) the likelihood of maladaptive reactions (Tapsuwan and Rongrongmuang 2015). In other words, threat appraisal is an individual's assessment of the level of threat that is understood in describing the circumstances of severity and vulnerability. If a threat is considered to be high risk, then individuals are motivated to protect themselves (Truelove et al. 2015). Kim et al. (2012) suggest that threat appraisal involves a person's perceived severity and perceived vulnerability to a risk. Accordingly, the first hypothesis of this research is as follows:

H₁ The threat appraisal of female and male rice farmers has a positive and significant impact on their climate change adaptation behavior.

Coping appraisal is composed of response efficacy, response costs, and self-efficacy (McDonald 2014), which increase (i.e., self-efficacy and response efficacy) or decrease (i.e., response costs) and generate adaptive reactions (Tapsuwan and Rongrongmuang 2015; McDonald 2014). Accordingly, the second hypothesis of this research is formulated as follows:

H₂ The coping appraisal of female and male rice farmers has a positive and significant impact on their climate change adaptation behavior.

Perceived vulnerability reflects one's vulnerability to an existing threat (Keshavarz and Karami 2016). In other words, perceived vulnerability, which results from adverse outcomes, refers to one's mental perception of risk (Cismaru et al. 2011). Accordingly, the third hypothesis of this research is as follows:

H₃ The perceived vulnerability of female and male rice farmers has a positive and significant impact on their threat appraisal of climate change.

Perceived severity refers to a person's perception of the degree of difficulty in negative events (Cismaru et al. 2011). Accordingly, the fourth hypothesis of this study is formulated as follows:

H₄ The perceived severity of female and male rice farmers has a positive and significant impact on their threat appraisal of climate change.

Self-efficacy is one of the key concepts in health-related research (Ung et al. 2015). It refers to a person's belief in his or her ability to accept recommended behaviors to take appropriate action for the desired outcome (Truelove et al. 2015; Cismaru et al. 2011). Accordingly, the fifth hypothesis of this study is as follows:

H₅ The self-efficacy of female and male rice farmers has a positive and significant impact on their coping appraisal of climate change.

Response efficacy refers to one's belief that recommended behaviors will be effective in reducing or eliminating risk (Kuruppu and liverman 2011). In other words, it is an effective prediction of an action taken for risk reduction (True-love et al. 2015). Accordingly, the sixth hypothesis of this study is proposed as follows:

H₆ The response efficacy of female and male rice farmers has a positive and significant impact on their coping appraisal of climate change.

Finally, **response costs**, such as financial costs, time, and effort, reflect all the perceived costs associated with protection actions (Bubeck et al. 2013). Accordingly, the seventh research hypothesis is formulated as follows:

H₇ The response costs of female and male rice farmers have a positive and significant impact on their coping appraisal of climate change.

Due to the importance of gender in adaptation behaviors, the final PMT model of female and male farmers' climate change adaptation behavior that is considered in the present study is established and shown in Fig. 6.

Research Methodology

Study Area

Mazandaran Province, which has an area of 24,091 km² and a population of approximately 2,602,008, is one of the major provinces in northern Iran and the southern coast of the Caspian Sea (Iran Statistical Center website 2018). Because of its location on the southern coast of the largest lake (Caspian Sea) in the world (Fig. 7), its proximity to four coastal countries, and its border with northern Tehran,

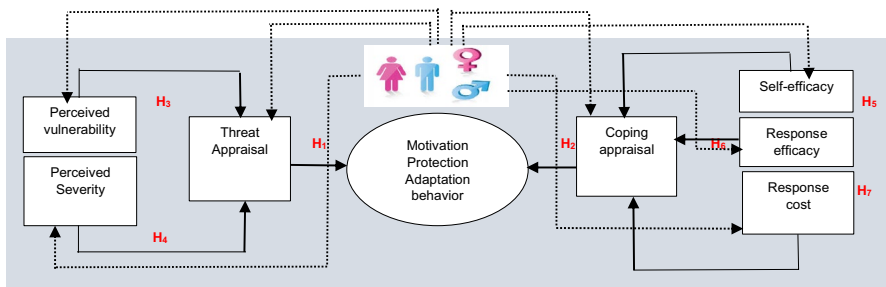


Fig. 6 Theoretical model of adaptation behavior female and male rice farmers against climate change taken from research

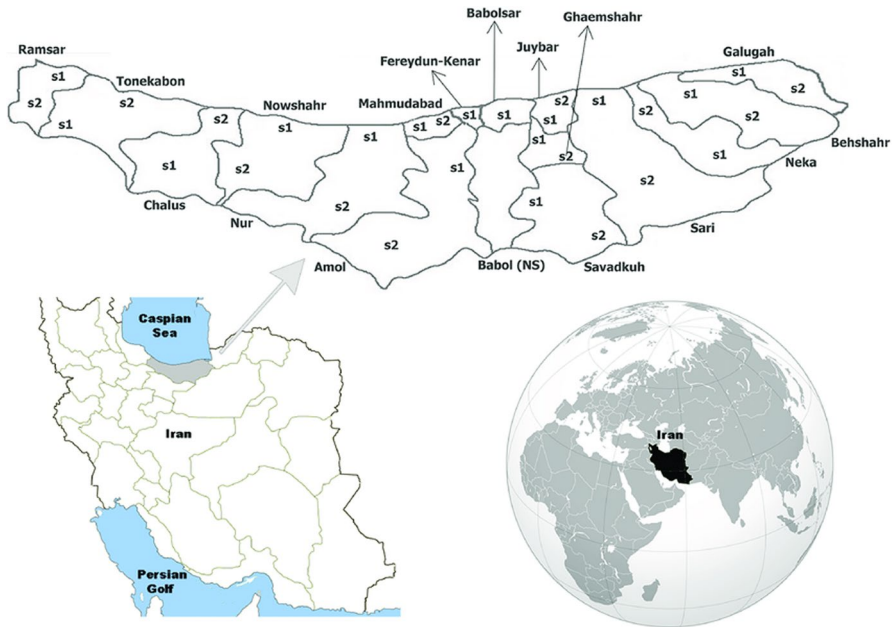


Fig. 7 Geographical location of Mazandaran Province (2018). *Source:* <https://doi.org/10.1371/journal.pntd.0005835.g001>

Mazandaran Province has a strategic geographical location (Mazandaran Cultural Heritage Organization 2018). Mazandaran Province is home to unique plant species due to its diverse geography, including grasslands, meadows, forests and jungles, and it has a diverse climate covering the sandy beaches of the lowest point to the rugged and permanently snow-capped mountains of Alborz. Additionally, Mount Damavand, which is one of the most famous volcanoes in the world, is quite well known. The southern part of the province is mostly mountainous, whereas the northern part is mostly plain and coastal. According to Domartan's classification, the western regions are very humid, the central parts are humid, the eastern parts have Mediterranean weather, and the mountainous areas enjoy a semihumid climate (Meteorological Organization of Mazandaran 2018). The average annual temperature in the province is 17.6 °C, and the average annual rainfall over the last 10 years (2009–2019) has been approximately 700 mm (Meteorological Organization of Mazandaran 2019). Approximately 78% of the province's population is engaged in agriculture, and the most important crops in the province are rice and citrus. Approximately 220,000 hectares of land in the province are under rice cultivation. Accordingly, the province ranks first in rice cultivation nationwide (Mazandaran Agricultural Jihad Organization 2018). Fluctuations in temperature (especially in recent years), changes in the pattern, intensity, time and location of precipitation, the rise in temperature, the significant reduction in the volume of water resources, the population density due to migration from adjacent provinces, changes in land use purposes, the construction of villas, overgrazing in the highlands and the population

boom in the suburbs have been major crises for Mazandaran Province, the agricultural hub of the country (Meteorological Organization of Mazandaran 2019). These issues have also caused irreparable damage to rice cultivation. Given that more than half of the province's economy comes from the cultivation of this crop, climate crises have had a devastating impact on the livelihoods of the rural population. Therefore, adaptation to climate change seems essential to enhance agricultural flexibility, to protect the livelihoods of farmers, especially smallholder farmers, and to ensure food security in the province.

Sampling Method

The research method used in this study can be described based on different aspects. In terms of purpose, it is a type of deductive applied longitudinal future research (experimental theory) and quasi-experimental research, and because it examines the causal relationship between variables, it is a causal-relational study. The sampling method was stratified sampling with proportional assignment. The statistical population of the study includes all male and female rice farmers in Mazandaran Province who planted rice in the 2016–2017 crop year but suffered damage caused by climate change. The sample was randomly selected (Mazandaran Agricultural Jihad Organization 2017; Mazandaran Agricultural Insurance Fund 2017). To determine the sample size of the study, the number of male and female rice farmers in Mazandaran Province, the rice cultivation level, and the percentage of damage to paddy fields in the province caused by climate change during three consecutive crop years, i.e., 2014–2015, 2015–2016 and 2016–2017, were used. Another indicator, the fraction of area under cultivation, was calculated as the percentage of damage. Using this index, the average percentage of damage during the three crop years was calculated. Additionally, the sample size of male and female rice farmers for each city was calculated using the Cochran formula. The final sample consisted of 173 female and 233 male rice farmers in 21 cities in Mazandaran Province who were studied separately. The descriptive results of this study reveal that among the men and women studied, the average age of women was 52 years and the average age of men was 60. Regarding marital status, of the 173 female rice farmers studied, 75.1% were married, and of the 233 male farmers studied, 92.3% were married. In terms of educational level, for the majority of women (34.6%) and the majority of men (29.2%), the highest level was primary education. The minimum length of rice cultivation recorded in this study was 2 years, while the maximum was 41 years. Regarding people's main occupation, for approximately 65.3% of the women and 67% of the men (women = 113 and men = 156), the occupation with the highest frequency was rice farmer. The minimum number of men and women in the paddy fields in Mazandaran Province was 1, while the maximum was 7. In terms of the type of ownership, approximately 69.4% of the women and 74.7% of the men in this study had personal property. The lowest cultivated areas of rice for the men and women studied were 0.5 ha and 2.5 ha,

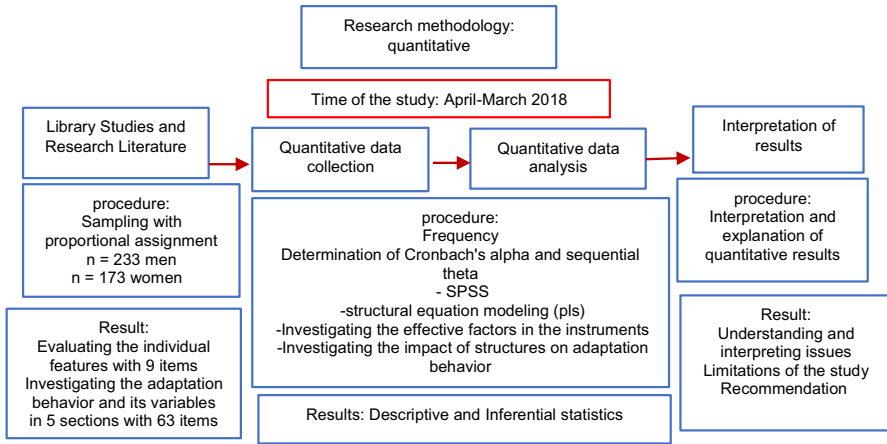


Fig. 8 A summary of research process

respectively, and the highest cultivated area was 6 ha for women and 10 ha for men. The lowest annual yield of rice in the study was 1 t/ha, the highest was 5 t/ha, and the average annual yield of rice for the women and men studied was 2.78 t/ha and 3.5 t/ha, respectively. A summary of the research methodology is presented in Fig. 8.

Survey Instrument

To answer the research questions and to fulfill the aims of this study, a quantitative questionnaire was designed as the main research tool, and data for this study were collected using this self-designed questionnaire. To determine the validity of the questionnaire, the viewpoints and suggestions of the study advisor and supervisor, accompanied by researchers and experts from the Mazandaran Province Agricultural Organization, were used. After applying the necessary corrections, it was ensured that the questions raised were capable of being used for measurement with respect to the content and characteristics of this research. To assess the reliability and validity of the questionnaire, a pilot test was conducted in which 30 copies were distributed and completed by 15 female and 15 male rice farmers from Sari (the pilot test was conducted in villages that were not examined in the final evaluation). The completed questionnaires were assessed using SPSS 19 software to calculate Cronbach's alpha and the sequential theta. The Cronbach's alpha coefficient was 0.850 (threat appraisal=0.824; coping appraisal=0.713; adaptation behavior=0.907), and the result for the sequential theta was 0.924 (threat appraisal=0.850; coping appraisal=0.956; adaptation behavior=0.931).

The PMT Structural Model of Climate Change Adaptation Behavior

While PMT is widely used in empirical studies, there are still difficulties in determining the direction of causality between relevant structures (perceived vulnerability, perceived severity, response efficacy, self-efficacy, and response costs) (Keshavarz and Karami 2016). Most PMT-based studies examine only the direct effect of traits on protection motivation behavior through linear regression analysis (Bockarjova and Steg 2014; Bubeck et al. 2013; Scarpa and Thiene 2011), and only a few studies have designed structural models to evaluate the direct and indirect effects. (Dang et al. 2014; Ifinedo 2012; Plotnikoff et al. 2009). These linear and structural models often fail to identify the interfering effects of each PMT structure. The lack of knowledge about the causal relationships between PMT and non-PMT structures makes it difficult and problematic to determine the causal pathways. To solve these problems and to determine the causal pathways, other models, such as partial least squares (PLS) (Wu 2010), have been used. PLS path modeling is a structural equation approach for modeling the relationships between latent variables (Tenenhaus et al. 2005). It is an appropriate procedure for structural predictive models, especially when the number of indicators per factor is high and there are multiple alignments between them (Chin 1998); therefore, it is more suitable for exploratory model analysis. Thus, in the design of the structural model of the present study, the PLS approach was developed to estimate the factor loads and the path coefficients.

Results and Discussion

Threat Appraisal

As Table 2 shows, the threat appraisal of female ($\beta=0.526$; T-value=6.203) and male rice farmers ($\beta=0.697$; T-value=17.158) had a positive impact on the incidence of climate change adaptation behavior; thus, this research hypothesis is confirmed with a 99% confidence level and at the significance level of 0.001. In other words, the greater an individual's appraisal of his or her perceived severity and vulnerability is, the greater his or her acceptance of adaptation behaviors. Alternatively, if threats are considered high risk, individuals will become more motivated with regard to protection and will develop more adaptive behaviors to protect themselves.

Coping Appraisal

The results show that the coping appraisal of female ($\beta=0.183$; T-value = 2.023) and male rice farmers ($\beta=0.186$; T-value = 3.568) had a positive effect on the incidence of protection motivation adaptation behavior. Therefore, this research hypothesis is accepted and confirmed with a 99% confidence level and at the significance level of 0.001. This result suggests that the greater an individual's ability to assess his or her ability to cope, the greater his or her acceptance of adaptive behaviors will be. Furthermore, gender does not affect an individual's coping appraisal behaviors. In other

Table 2 Linear impact of the effects of the research variables to test the general research hypotheses

Research hypotheses	Path coefficient (β)		(T-value)		df		(P value)		Confirmation and rejection at 0/05 level	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
	Threat appraisal adaptation behaviors	0/697	0/526	17/158	6/203	0/043	0/085	0/001	0/001	Confirmed
Perceived vulnerability threat appraisal	0/958	0/957	134/027	105/962	0/008	0/002	0/001	0/001	Confirmed	Rejected
Perceived severity threat appraisal	0/961	0/958	157/230	114/037	0/009	0/006	0/001	0/001	Confirmed	Rejected
Coping appraisal adaptation behaviors	0/186	0/183	3/568	2/023	0/056	0/094	0/001	0/001	Confirmed	Rejected
Self-efficacy coping appraisal	0/910	0/930	57/007	65/323	0/017	0/011	0/001	0/001	Confirmed	Rejected
Response efficacy coping appraisal	0/920	0/944	82/830	122/723	0/013	0/008	0/001	0/001	Confirmed	Rejected
Response cost coping appraisal	0/933	0/952	70/303	96/993	0/933	0/952	0/001	0/001	Confirmed	Rejected

words, the greater the individual's assessment of response efficacy, self-efficacy, and response cost, the greater his or her motivation will be with regard to protection and to developing more adaptative behaviors to a threat.

Perceived Severity

As the results show, for male ($\beta=0.961$; T-value = 157.230) and female rice farmers ($\beta=0.958$; T-value = 114.037), perceived severity had the greatest impact on their threat appraisal of climate change. These results indicate that this research hypothesis is confirmed. The results of the perceived severity subscales show that climate change heavily impacts the physical assets (such as home, land, furniture, agricultural machinery) of men ($\beta=0.922$; T-value = 71.627) and the products of women (such as productivity, product quality, production costs and food security) ($\beta=0.920$; T-value = 63.543). Regarding female rice farmers, the severity of the problems and the impacts of climate change are more important threats to the production aspects of their lives because women are more likely to be labor powered in paddy fields. Additionally, since women are largely not the primary owners of their farmland, they are seriously concerned about the lack of compensation for production costs following the impacts of climate crises on the quality and quantity of their crops. Furthermore, because women have the primary responsibility for arranging and preparing food for family members, they are concerned about the food security of their family members, especially children and elderly members, in the wake of these changes. Based on these results, due to the increase in perceived severity among male and female rice farmers, their threat appraisal will be more effective, and their higher threat appraisal will lead to better and more effective coping behaviors. The literature review shows similar results, and most studies show a positive impact of perceived severity on protection motivation behavior (Bockarjova and Steg 2014; Bubeck et al. 2013; Plotnikoff et al. 2009), although some studies indicate a negative impact (Ifinedo 2012; Keshavarz and Karami 2016).

Perceived Vulnerability

The results show that the perceived vulnerability of female ($\beta=0.957$; T-value = 105.962) and male rice farmers ($\beta=0.958$; T-value = 134.027) had a positive and significant impact on their climate change threat appraisal. Thus, this research hypothesis, which states that perceived vulnerability has a positive impact on the threat appraisal of female and male rice farmers, is confirmed (Table 2). In fact, rice farmers who have higher perceived risk and concern will have higher adaptation behaviors because those who believe that climate change will have severe impacts and high economic damage on their income and will threaten their health will take the necessary measures to mitigate these effects, and these measures can serve as appropriate adaptation behaviors. The results of this research also show that the subscales of perceived vulnerability,

including men's financial aspects ($\beta=0.917$; T-value=67.941) and women's financial aspects ($\beta=0.928$; T-value=72.018), such as income, living expenses, and investment in agriculture, have a greater effect than other factors on their perceived vulnerability to climate change. These results indicate that the threat appraisals of female and male rice farmers are strongly influenced by their perceived vulnerability, and men and women have similar vulnerability to the effects of climate change on their lives. Additionally, regardless of the financial aspects of this vulnerability, the longer men and women are affected by climate change crises, the better they will be at assessing these threats, which will lead them to make more positive appraisals of adaptive behaviors and lead to greater acceptance of climate change protection practices.

Response Costs

According to the results of this research, the response costs of male ($\beta=0.933$; T-value=70.303) and female rice farmers ($\beta=0.952$; T-value=96.993) had the greatest impact on their coping appraisal of climate change in relation to the other two factors of coping appraisal (self-efficacy and response efficacy). Therefore, this research hypothesis is confirmed with a 99% confidence level and at the 0.001 significance level. The most important subscales of response costs that have the greatest impact on reducing adaptation costs for men are modifying cultivation techniques ($\beta=0.803$; T-value=34.719) and for women are enhancing the safety of human beings and property ($\beta=0.826$; T-value=27.018). Men will spend money, time, energy and effort to modify their cultivation techniques as a cost-effective and economical way to address climate change, while women will spend money, time, energy and effort to enhance the safety of humans and assets. Therefore, perceived costs such as financial costs and more time and effort lead to better coping strategies and, therefore, greater protection and adaptation by female and male rice farmers.

Response Efficacy

As shown in Table 2, the response efficacy of male ($\beta=0.920$; T-value=82.830) and female rice farmers ($\beta=0.944$; T-value=122.723) had positive and significant impacts on their coping appraisal of climate threats; thus, this research hypothesis is confirmed. Additionally, the results of the subscales of response efficacy show that for men ($\beta=0.857$; T-value=46.693) and women ($\beta=0.873$; T-value=58.584), the diversification of income sources has the highest impact on their response to protection measures. In other words, for female and male rice farmers, diversifying their income sources will reduce or eliminate risk and increase their coping appraisal, enhancing their protection behaviors and adaptation.

Self-efficacy

For male ($\beta=0.910$; $T\text{-value}=57.007$) and female rice farmers ($\beta=0.930$; $T\text{-value}=65.323$), the aspect of self-efficacy has a positive impact on their coping appraisal of climate change, which confirms the research hypothesis. However, it is less effective than the other two factors (response efficacy and response costs). As the results show, for men, water management ($\beta=0.845$; $T\text{-value}=59.340$) has the greatest impact on their self-efficacy to deal with climate change, but among women, enhancing human and asset safety and protection ($\beta=0.844$; $T\text{-value}=33.413$) has a greater impact on their self-efficacy. This means that men believe they will be more capable and empowered to cope with and adapt to climate change in terms of water management consumption, while women believe they will be more effective in enhancing human and asset safety and protection as a response to climate change adaptation and coping, resulting in more desirable outcomes. Therefore, with regard to the adaptive behavior of male and female rice farmers, their coping appraisal depends on their confidence in their ability to take protective measures. Previous studies (Bockarjova and Steg 2014; Keshavarz and Karami 2016) present similar results.

Adaptation Behavior

Agriculture is recognized as one of the contributing factors to climate change; at the same time, it is strongly influenced by climate change and its consequences. Therefore, in this study, the most important behaviors for coping with climate change for both men and women were studied. The results show that for men, the most important behavior is conservation agriculture ($\beta=0.945$; $T\text{-value}=88.323$), while for women, attending training sessions on mechanisms to prevent damage from floods, storms and other climate events ($\beta=0.902$; $T\text{-value}=29.274$) is the most important behavior. Therefore, for male rice farmers, conservation agriculture is a good way to manage drought to preserve water on land, reduce agricultural production costs and increase soil organic matter, which will be very helpful in preventing drought, dehydration and floods. However, women believe that education is the most important way to adapt because it helps people become more aware of new techniques and technologies to adapt to or cope with climate change; as a result, they will have better management when faced with climate crises. Adherence to these ethics will ultimately affect and challenge vulnerable systems, preventing them from moving in a direction that leads to unacceptable consequences, and will produce ethics-based behaviors in response to climate damage by revising existing ethical standpoints and perspectives.

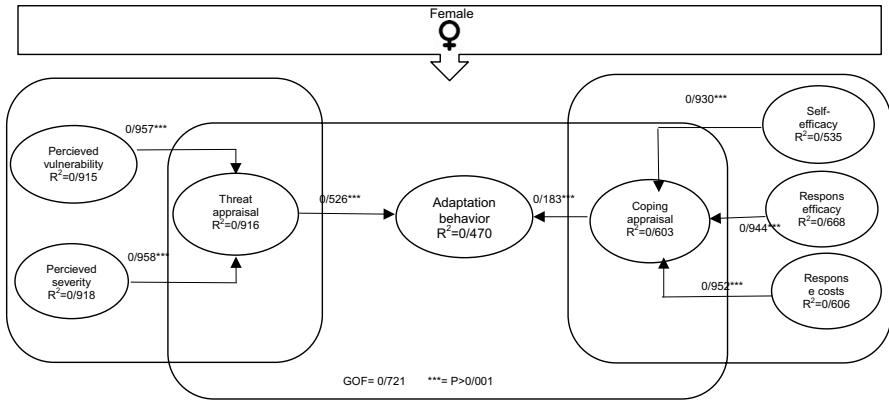


Fig. 9 Adaptation behavior field model of female rice farmers of Mazandaran province toward climate change

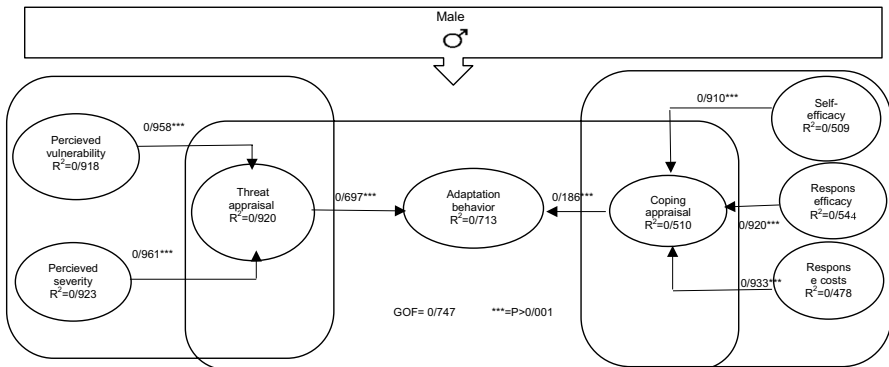


Fig. 10 Adaptation behavior field model of male rice farmers of Mazandaran province toward climate change

Determining the Quality of the Model’s Goodness of Fit

The quality of a model’s goodness of fit (GOF) is an important criterion of divergent validity. The acceptable divergent validity of a model implies that a construct in the model interacts more with its indices than with other constructs; in other words, it answers the question of whether the model has an appropriate GOF. For this purpose, the goodness of fit index is used to check the model’s GOF. If the GOF value of an endogenous structure is in the range of approximately 0.02, then the model has poor predictive power; 0.15 indicates average predictive power; and 0.35 indicates strong predictive power. Given that the GOF values for men and women are 0.747 and 0.721, respectively, the quality of the model is very high, and its predictive power is very strong.

The structural model of the climate change adaptation behavior of female (Fig. 9) and male rice farmers (Fig. 10) in Mazandaran Province is presented below.

Conclusions and Suggestions

Gender equality may not serve as a prerequisite for environmental sustainability. Women's participation in social campaigns to maintain survival and to build a fair structural relationship between men and women in a society reveals the functions and results that the environment produces for each gender. Since climate change has adverse effects on both men and women, it is sometimes impossible to determine the constraints on men's and women's access to different resources due to the influences of the different experiences and responsibilities resulting from gender segregation. Thus, particular attention to gender is required in planning for long-term adaptation.

Since adherence to ethical principles in behavioral decision making, policy formulation and other climate change adaptation measures is of particular importance, individuals, groups, national, local and scientific authorities, indigenous communities, international organizations, the United Nations, public and private institutions and corporations at all levels and in all sectors should be called upon to make ethical decisions and take appropriate actions to respond and adapt to climate change at the international, regional, national and local levels. The purpose of this study was to evaluate the climate change adaptation behavior of female and male rice farmers based on a gender analysis approach using PMT and structural equation modeling. To conclude this research, based on the results and the application of some UNESCO ethical principles (2017), suggestions are recommended at the mega (international), macro (governmental and legislative), meso (related organizations) and micro (rice farmers) levels for men and women to adapt to climate change.

Micro Suggestions

Micro suggestions are factors at the individual and personal levels that include male and female rice farmers. Considering the positive and significant impact of *threat appraisal* on the adaptive behavior of women and men with regard to climate crises, it is suggested that male and female rice farmers work together through a variety of strategies, such as using virtual networks, enhancing social interactions between men and women to exchange knowledge and experiences, attending workshops on climate crises, health and hygiene at the time of the crisis, increasing attention to meteorological warnings, maintaining relationships with rural-based experts in rural areas, and understanding and promoting awareness of climate change and ethical best practices that increase or decrease the severity of threat assessment and their adaptive and protective behavior as important ethical measures to reduce the extent of harm.

Since the results show that the *coping appraisal* of female and male rice farmers had a positive impact on their climate change adaptation behaviors, it is

recommended that both male and female rice farmers should take measures such as modifying the planting calendar, modifying cultivation techniques, including the timing and mode of irrigation, crop diversification, the use of compatible or tolerant cultivars, water use management and the use of new irrigation techniques, diversifying their income sources, enhancing their health and well-being, using guaranteed crop insurance services and changing cropping systems to enhance their effectiveness to increase the effectiveness of adaptive and protective strategies and reduce costs (money, time, energy and effort). Importantly, once these protective and adaptive behaviors are successful and effective, local communities should strive to adapt without discrimination or gender-based perspectives, and rural women and men should be supportive and allied. These factors are important ethical principles in climate change adaptation behavior.

According to the results, *perceived severity* had a positive and significant effect on the threat appraisal of female and male rice farmers. Therefore, efforts should be made to improve the physical assets of men through off-farm income, thus improving agricultural production capacity. Therefore, it is recommended that male rice farmers should take measures to equip, rebuild and secure their physical assets (home, land, furniture, farm machinery) to avoid facing any problems in the event of a crisis. Additionally, to reduce climate threats to production (productive capacity, product quality, production costs and food security), women and girls need to be trained and educated through the creation of appropriate workshops on diversified production activities, such as carpet weaving, handicrafts, vermicomposting, mushroom growing, and fattening. Additionally, based on the desire of women to empower themselves through rice cultivation, it is recommended that they should participate in training, extension, awareness-raising and capacity-building programs, familiarize themselves with entrepreneurial ideas on how rural women can be more involved in productive activities, engage in quality improvement to increase their production using protective behaviors, participate in healthy product modeling sites and increase food security in such conditions.

The results indicate that the *perceived vulnerability* of female and male rice farmers had a positive and significant effect on their threat appraisal of climate change. Regarding their attitude, financial aspects (income, living expenses, and investment in agriculture) are important, and men and women have equal vulnerability to the effects of climate change on their lives. Therefore, it is recommended that to alleviate the damage caused by climate crises on the financial aspects of men's and women's livelihoods, first, jobs other than agricultural work should be created to compensate for these crises; second, the management of finances and incomes should receive more attention. Additionally, women should create additional and more varied income sources through the creation of microtribal women and tribal funds so that they can apply more protective behaviors to reduce financial losses.

Considering the positive and significant effect of *response costs* on coping appraisal, men believe that spending resources (in terms of money, time, energy, and effort) as a strategy for coping with climate change will be cost-effective and beneficial, while for women, spending resources on enhancing safety and human assets seems more practical. Therefore, it is recommended that men should move toward adopting smart and mechanized farming, conservation agriculture, and multicrop

cultivation. Preventive approaches, as one of the ethical principles of climate change adaptation, assert that in cases where there are serious or irreversible threats, scientific uncertainty should not be used as a reason to delay cost-effective measures to predict, prevent or mitigate the adverse effects of these changes. It is also suggested that to reduce the costs of adaptation, women should focus on training, developing and improving human capital and should take steps to improve mental health and food security by reducing the use of pesticides and chemical inputs and replacing them with biological control mechanisms to reduce damage as much as possible.

The results confirm the research hypothesis that there is a positive and significant effect of *response efficacy* on the coping appraisal of male and female rice farmers. For both male and female rice farmers, diversifying their sources of income is important and will be the most effective and useful way to reduce vulnerability and deal with climate crises. Therefore, it is suggested that men and women should move toward the management of climate-sustainable agricultural systems using forest-based agro-development methods and multidisciplinary integrated systems, such as diversifying crops, raising livestock and poultry, developing aquaculture, and creating rural ecosystems that are in line with the capacities and potentials of rural women.

The results show that *self-efficacy* had a positive and significant impact on the coping appraisal of men and women. For men, their greatest capability to cope with and adapt to climate change is realized in the case of water management, while women believe they are most capable of enhancing human and property safety. Therefore, it is suggested that for men to deal with climate change, they should first seek training in water management and then replace modern irrigation systems with traditional methods. Additionally, to cope with climate change, women need to increase human and animal safety through vaccination against contagious diseases, participate in training courses, have a greater desire to produce healthier and more nutritious food products, receive education on and pay attention to the household food basket, and diversify their income sources to their highest potential.

According to the results of this study, the most important *adaptation behavior* from the perspective of men is the use of conservation agriculture methods, while for women, it is participation in training classes. Therefore, it is recommended that at the time of harvest, rice farmers should pay attention to correct harvesting and the proper use of equipment to minimize soil mechanical damage, maintain the permanent soil cover, avoid burning plant debris, engage in crop rotation, plant cover crops based on a schedule and strictly avoid single-product cultivation of their land. Since the application of the best available scientific knowledge and evidence is one of the ethical principles in climate change adaptation behavior, it is recommended that female rice farmers should attend workshops and classes to increase their awareness and skills to cope with climate change.

Meso Suggestions

Meso suggestions are related to the organizations involved in the study, including the Agricultural Jihad Organization, the Natural Resources Organization, the

National Meteorological Agency, the Disaster Management Agency, the National Agricultural Insurance Fund and the Environmental Protection Agency.

Based on the results of this study and the confirmation of the research hypotheses (discussed in detail in the previous section), it seems that the role of public and private organizations and agencies in the tendency and incidence of the more conservative and adaptive behaviors of male and female rice farmers is very important. Therefore, the following recommendations are made. (1) The Agricultural Jihad Organization is responsible for raising the awareness of local communities and facilitating their ethical performance in climate change adaptation behavior through training workshops (for men and women), especially for assistants, facilitators and leading farmers, who interact more with their local communities. (2) Greater connections between research, extension and training should be provided for male and female rice farmers with a view to introducing new, adaptable and tolerant varieties as well as new ways of managing water use and irrigation. (3) Meteorological and crisis management organizations should take preventive actions to reduce the consequences of these crises through the development of local hazard maps, early warning systems, environmental assessments and science-based technology and the appropriate management of climate change and natural disaster risks as principles of adaptation to these crises while expanding the timely and accurate information available to women and men. (4) Attention should be paid to ethical responsibilities in grants or low-interest lending policies to establish an income stabilization fund (pricing and purchasing guarantees) and develop agricultural insurance to address climate change impacts, with particular attention to women as a marginalized gender who have received less attention as active players in agriculture. (5) Interconnected food-water-energy programs should be provided by related organizations, especially for women, to maintain the food security of family members.

Macro Suggestions

The macro suggestions are mainly intended for governmental and legislative bodies, including the Ministry of Agriculture, the Ministry of Interior Affairs and the Consultative Assembly. The following recommendations are made. (1) Laws and regulations should be developed to ensure adequate and equitable access for women in rural households to health services and production resources, such as land, water and agricultural equipment, and to provide training in regard to coping, immunizing, and increasing the production of healthy products, especially to strengthen the human capital of women. (2) The pricing and purchasing guarantees of agricultural products should be improved with special attention to gender equality and with a focus on women's empowerment and intermediary rights that are involved in achieving the ethical goals of adaptation, promoting the well-being of all people, contributing to the economy, enhancing health, and improving the nutrition of women and their family members. (3) Planners and policymakers should be required to pay attention to gender differences in the region and to move to reduce existing differences and gaps. (4) Government entities should review the laws involved in the process of issuing permits for surface

and groundwater harvesting and ensure the fair issuance of these licenses without any prejudice or any discrimination in agriculture. (5) Various job opportunities should be provided, especially for women and girls, and their economic needs should be met through improvements in rural development laws and strategies that lead to income-generating and employment-sustaining programs. These programs should encourage to become involved in entrepreneurship and provide support for proper employment, improving the living standards of villagers, improving the structure of markets and creating a favorable environment for investment. (6) Laws for conservation agriculture should be adopted, such as laws prohibiting the burning of plant residues; executive supervision should be performed by the Consultative Assembly, which should approve the necessary appropriations in this regard. (7) Strategies should be developed to support the integration of scientific research in addressing climate change issues to disseminate and promote the application of ethics in adapting to these changes. (8) Consideration should be given to the rigorous evaluation and development of technologies, infrastructures and their associated risks as the ethical principles of climate change adaptation. (9) It is important to promote public awareness and the ability of the public to critically and ethically analyze adaptation behavior with the help of the media, public and nongovernmental organizations, educational institutions and universities. (10) Lifelong learning opportunities should be provided in accordance with national law for all people regardless of gender, age, or ethnicity and for persons with disabilities, immigrants, and indigenous people, especially those in vulnerable situations, to allow them to acquire and update the knowledge, skills, values and ethical attitudes necessary to adapt to climate change and to contribute to sustainable development based on maintaining ethical values.

Mega Suggestions

Mega suggestions are recommendations that are internationally evaluated and implemented. It is recommended that international organizations such as the Intergovernmental Panel on Climate Change, the United Nations Framework Convention on Climate Change, the World Meteorological Organization, and the United Nations Environment Program should move toward the following recommendations. (1) The strategic development of international partnerships to train young people to exchange experiences and transfer new technologies as well as bio- and nanotechnology and to ethically justify their use as adaptation measures, focusing particularly on educating female and male farmers, experts and extension agents with an emphasis on the active presence of women. (2) Ethical policies, measures and behaviors should be formulated and implemented to mitigate and adapt to climate change phenomena by increasing resistance to these changes, helping to reduce greenhouse gas emissions to avoid posing a threat to food production, and applying conservation tillage by prioritizing ethical issues with respect to the country's climate and biological capacity and with the assistance of international organizations. (3) International financial and technical assistance should be provided to mitigate the adverse effects

of climate change, especially by protecting women as the most vulnerable group and emphasizing developing countries. (4) An international contract should be prepared to address the issue of climate change caused by international policies and the sharing of best international practices of adaptation between female and male farmers. (5) An official website should be designed by the United Nations that emphasizes environmental ethics, including climate change as a suitable place to internationally document and share current and future events, access to educational information and opportunities, open data and resources related to challenges and ethical solutions to climate change, and reports and documentation for both men and women at every level of society. (6) The participation of researchers and scientists of all developing countries in climate-related science should be increased as much as possible. (7) Developing countries should be supported by enhancing educational and scientific capacity as well as financial and facilitation tools for technology development aimed at establishing gender equality and preserving ethical values in environmental protection. Finally, it is hoped that ethical reflections will lead to public and political acceleration to make the responses more ambitious, ethical, and accountable. However, for this to happen, people must decide to act in a spirit that is more courageous and ethical than has been achieved so far.

Limitations and Suggestions for Future Research

An inherent limitation of a conceptual analysis such as the analysis performed in this paper is that empirical support for the proposed theory is provided only by the findings of this study. Therefore, testing the proposed relationships and structures in subsequent empirical research would be interesting and relevant. Possible mediating variables that may influence the effects of the intention, motivation and volition to support, enhance and sustain climate change adaptation behaviors can also be investigated. Since some mediating variables, such as intention, attitude, motivation, and volition, which were not investigated in this study are important for the continuity and sustainability of climate change adaptation behavior among female and male rice farmers, the mediating effects of these variables should be investigated in future studies.

Acknowledgements Special thanks for the male and female rice farmers who participated in this study. We appreciate the thoughtful suggestions and comments from two anonymous reviewers which helped in improving the quality of this research.

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