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Ghanian, Mansour, Ghoochani, Omid, Dehghanpour, Mojtaba et al. (3 more authors) (2020) Understanding farmers' climate adaptation intention in Iran: a protection-motivation extended model. Land Use Policy. pp. 1-13. ISSN 0264-8377

https://doi.org/10.1016/j.landusepol.2020.104553

Understanding farmers' climate adaptation intention in Iran: a protection-motivation extended model

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Author's preprint manuscript accepted for publication in *Land Use Policy.*

Abstract

Adaptation to climate change is a matter of urgent social scientific analysis. Within the agricultural sector of many developing nations, farmers must make long-term decisions to adapt to climate change impacts in order to provide food security and sustainable livelihoods. However, deeper understanding of farmers' decision-making, as a key stakeholder group, is of vital importance in forming adaptive land use policy 'from the bottom-up'. This study investigates the psychosocial factors that influence farmers' adaptation intention in the critical case of Marvdasht County in Iran – a case that exemplifies agricultural stakeholder decision-making in arid and drought-prone regions. We present a conceptual combination-model grounded in Protection Motivation Theory (PMT), employing a correlational survey among 256 farmer-stakeholders. First, we discuss the relative value of the combined model to understanding adaptation intentions. Second, we find that the factors that represent the externalities of farmers' behaviour need to be more thoroughly integrated in to adaptation planning. Third, we find that farmers' adaptation intention is directly affected by maladaptation, and indirectly by economic disincentives, barriers to belief in anthropogenic climate change and broader risk perceptions.

Keywords: Climate Change; Adaptation; Protection Motivation Theory; Combined Model; Marvdasht Township.

1. Introduction

Climate change influences temperature and rainfall patterns, ocean pH, snow and ice cover, and weather variability - leading to systemic shocks, including natural disasters such as severe drought and famine, hurricane and heat waves (Coumou and Rahmstorf, 2012). It also creates longer-term stresses on ecosystems, upon human infrastructures and resources, including those for energy, transport, potable water, irrigation and sanitation capacity, and upon agricultural productivity (Howden et al., 2007). Anthropogenic climate change thus severely and rapidly impacts upon humans societies through their links to rapidly changing natural systems (Wheeler and Von Braun, 2013).

Agricultural management is a key climate adaptation objective from a human development perspective (Azadi et al., 2015; Bartolini and Viaggi, 2013; Ostwald and Chen, 2006; Thornton et al., 2009). Agriculture sustains rural livelihoods and is a primary growth factor for many developing economies: contributing to poverty reduction, economic development and the supply of environmental services (Ghanian et al., 2016; van Dijk et al., 2016). However, the agricultural sector is inherently sensitive to climate change (Ghoochani et al., 2017; Wheeler and Von Braun, 2013) through biodiversity loss, crop failure, water access loss, disease and pest pressure (Altieri et al., 2015; Howden et al., 2007; Turral et al., 2011). Climate change impacts are felt most acutely within localized food systems, and smallholder farmers are particularly vulnerable (Misra, 2017). Despite recent global progress in improving food security (Abbasi et al., 2016), climate change threatens to increase the challenges of famine and hunger across the developing world (Hanjra and Qureshi, 2010). Thus impacts vary depending upon the changes in rainfall patterns and temperature which are, in turn, differentiated across geographic regions (Vermeulen et al., 2012). This makes national-scale policy responses difficult to implement. Although rapid progress in ending global hunger has been seen in recent decades, climate change currently threatens to slow down or reverse such progress (Wheeler and Von Braun, 2013).

In addition to direct crop-yield effects, climate change also creates knock-on negative impacts on the socio-ecological systems surrounding agricultural practices, such as increased pollution from nutrient transport and sediment loading (Lee et al., 2006; Roesch-McNally et al., 2017). Climate and agricultural impacts are therefore mutually related and self-reinforcing, with agriculture both driving and being influenced by climate change. Current research has demonstrated interactive changes in atmospheric composition through to the extensive modification of Earth's ecosystems as a result of agricultural activity (Cerdà et al., 2016; Foley et al., 2005; Lawniczak et al., 2016; Rojas-Downing et al., 2017; Tilman and Clark, 2015). As such, adaptation responses within the agricultural sector must also remain mitigation-sensitive and thus reduce GHG-related impacts and other eco-systemic disruptive effects.

From a human development perspective, there are multiple agricultural system-properties that must be assessed and integrated with our understanding of global climate change impacts and responses (Janssen et al., 2015). An agricultural system contains myriad social, cultural, political, economic and institutional factors which influence their sensitivity to climate change (Bryant et al., 2000); and also their resilience, vulnerability, and flexibility in the face of it (Folke, 2006). To reduce the risks to farming systems and to combat potential welfare losses, smallholder farmers in particular need to recognize climatic changes and undertake appropriate investments for both mitigation and adaptation strategies (Altieri and Nicholls, 2017; Cooper et al., 2008; Howden et al., 2007; Roesch-McNally et al., 2017; Thomas et al., 2007). Mitigation entails all anthropogenic interventions or policies aimed towards reducing GHG emissions or enhancing the sinks for GHGs. On a global level, mitigation is essential to minimize future negative impacts (Elum et al., 2017). However, at smaller national, regional, or local-community scales, mitigation strategies will differ depending on the level of economic development and their relative growth perspectives. In practical terms, for smallholder farmers *adaptation* responses are of particular concern (IPCC, 2007). Adaptation refers to the adjustments to practices, processes and systems of land use, technology implementation, social practices and policy responses necessary to minimize current, and/or future adverse effects of climate change, and to take advantage of available opportunities to maximize benefits (Ericksen et al., 2011; Hirte et al., 2018). The development of what is often termed *adaptive capacity* for agricultural systems in include changes to (Keshavarz et al., 2014; Smit and Skinner, 2002):

1) Farm production practices, (including planning for land productivity and ecosystem services: e.g. soil quality, water quality, and irrigation water management)
2) Farm financial and physical capital resource management (e.g. farm size, livestock, on-farm structures)
3) Technological developments, (e.g. irrigation equipment and crop varieties)
4) Government programs to reduce farmer vulnerability (e.g. maximising income, savings, credit, and crop insurance).

Adaptation can (and should) occur at many different geographic and governance scales (Ericksen et al., 2011). The best-practice in adaptation planning is commonly recognized to occur from the 'bottom up' at *local scales* of assessment (Adger et al., 2013; Ayers and Forsyth, 2009; Urwin and Jordan, 2008; Van Aalst et al., 2008; Wright et al., 2014), by taking into account governance scale, institutional, technological, economic and political capacities (Rayner, 2010), and livelihood strategies (Rahman et al., 2018). For farmers specifically, adaptation decision-making takes place within the context of planning for their farm business, and the maintenance of livelihood capital over time (Kuang et al., 2019). Such planning necessarily involves changes to land use practices over both short and long-term timescales. This is particularly true of rural communities within developing countries with limited resources and technology (Wang et al., 2019). Adaptation planning strategies include resilience-raising products and changes to production practice: e.g. changes in crop type and variety, changes to fertilizer and seed types (and quality), pesticide use changes, the planting of shade trees, water storage, improved irrigation mechanisms, and farm livelihood diversification (Fahad and Wang, 2018; Grüneis et al., 2018). Adaptation decision-making is also in response to both climatic and non-climatic stimuli, and the broader social, political, and economic system(s) within which they operate (Bradshaw et al., 2004), including cultural, social capital and place-based influences (Khanian et al., 2017; Saptutyningsih et al., 2019).

Given the vulnerability of smallholder farmers' livelihoods to climate change, short and long-term adaptation decision-making amongst farming populations has become an important research topic for land-use and social development research (Burnham and Ma, 2016; Dang et al., 2018; Jamshidi et al., 2015). Moreover, though adaptation decision-making can be assessed at individual, household, community, regional, sectorial, national, and global settings (Bryant et al., 2000), for development practice the individual-farm-level scale remains vitally important.

Generally speaking, public perceptions of climate adaptation are important dimensions of public action towards adopting pro-environmental behaviors and social practices (Adger, 2003; Cotton and Stevens, 2018; Elum et al., 2017; Grothmann and Patt, 2005; Tripathi and Mishra, 2017). However, it is commonly found that climate change is socio-culturally 'invisible' to many public stakeholders (Adger, 2001; Nelson et al., 2002; Wolf, 2011), in the sense that the impacts of climate change (e.g. drought, flooding, biodiversity loss), appear spatially and temporally distant and diffuse, and so are often construed in abstract, rather than concrete terms (Spence et al., 2012a). Given the global nature of climate systems, there is temporal and geographic distance between cause and effect of climate change; perceptions of climate change therefore qualitatively differ from other locally perceptible environmental problems such as water pollution, municipal waste management or urban air quality (Weber and Stern, 2011), and climate change is perceived as an abstract problem for many people (Moser, 2010). Ironically, this perception of climate change as distant or abstract may occur even when individuals directly observe or experience environmental change within their lifetime. In the context of empirical development research, however, regions that have historical experience of extreme weather (such as frequent flooding or prolonged, extensive, and severe drought) will likely have a more concrete understanding of climate change impacts in the region in terms of the increasing likelihood, frequency and severity of such events (Keshavarz et al., 2013). It is, therefore, of interest to climate change, development and land use researchers to understand the relationship between the experience of extreme weather-related impacts, perceptions of climate change and *intentions* to act given this knowledge and experience, i.e. how do vulnerable groups intend to change their production practices and livelihood strategies in the face of climate change stressors (Roesch-McNally et al., 2017)?

1.2 Agricultural adaptation in Iran

The Middle East and North Africa (MENA) region is particularly vulnerable to climate change. It is one of the world's most arid regions, coupled with high dependency on climate-sensitive agriculture and a high proportion of its population and economic activity in flood-prone urban coastal zones (Evans, 2009; Sowers et al., 2011). Within this region, Iran is particularly vulnerable (Karimi et al., 2018) due to its smallholder agricultural productivity driving rural livelihoods and economic development under conditions of climate-sensitive ecological conditions (Nassiri et al., 2006). Agriculture in an essential politico-economic issue for Iranian development outcomes. Since 1980 the Iranian government has prioritized land use towards agricultural productivity to keep food prices low. This protects consumers by guaranteeing food security and ensures greater government stability. To this aim the Iranian government has used barrier-trade policies and direct intervention in the price of foodstuff and inputs (Gilanpour, 2006). However, productivity and food security are threatened by extreme weather events, e.g. Iran has experienced 27 drought occurrences in the last 40 years (Amirkhani, 2009). Iran is an important case from a climate and development perspective, as although the World Bank assigns Iran's economies into upper-middle-income groups, major limitations such as lack of conclusive regulations, educational programs and infrastructure, have contributed to slowing national economic development (Sayyed, 2013). In other words, despite its classification, it still has more in common with developing countries than developed ones.

Our case study is the Marvdasht County in Fars Province. The case study is important for three reasons. Firstly, Marvdasht is one of highest agricultural production regions (e.g. it is ranked first in wheat production within the province). Secondly, both arable and pastoral farming take place, primarily by smallholders. Thirdly, meteorological data show that Marvdasht is one of the highest risk regions Iran for drought (Keshavarz and Karami, 2014). Yet, given a relative paucity of information on farmers' adaptation intentions across the country (Abdollahzadeh, 2017; Esmailnejad, 2017) it is necessary to better understand how farmers within high risk-high impact regions respond to future climate change. Understanding the psychosocial factors that influence Iranian farmers' adaptation intention is essential in this task, and Marvdasht is a critical case within which to explore these dimensions.

This empirical study attempts to address a research gap firstly surrounding Iranian famer adaptation intentions, and secondly to investigate a conceptual model for understanding adaptation decision-making in this sector and this country, built upon *Protection Motivation Theory* (PMT). Understanding the influencing factors on adaptation intention in a non-Western, developing country is essential to assist policymakers to generate bottom-up, locally sensitive policy options for the authorities and regions of Iran's high-risk agricultural communities; and for broader learning about climate and development planning in similarly at-risk locations. Furthermore, the possibility of further PMT applications in the context of climate change and land use decision-making is also discussed.

2. Research Framework

Social and behavioral scientists have devised a range of conceptual models to describe the factors that influence environmental decision-making. Of note is Ajzen's *Theory of Planned Behaviors* (TPB) (Ajzen, 1991). Under TPB, *intention* is the predictor of behavior. Intention is predicated upon three important factors: attitudes toward behaviors, subjective norms, and perceived behavioral control (Ajzen, 1991, 2002). In better understanding subjective norms within this model, the moral dimensions of human decision-making processes and perceived environmental values were explored more thoroughly in the Value-Belief-Norm (VBN) theory proposed by Stern (Stern, 2000). Together, these conceptual models explain the impact of attitude and social pressure on behavior. However, they are less well equipped to understand the predictors of behavior in the context of decision-making under conditions of risk and uncertainty (Le Dang et al., 2014b) This latter factor is highly pertinent to decision-making for climate adaptation.

With regards to risk-based decision-making specifically, *Protection Motivation Theory* (PMT) was first developed by Rogers (1975) to explain the effects of *health hazards* on individuals' attitudes and behaviors. Indeed, the model was initially applied almost exclusively in health/disease prevention cases (Janmaimool, 2017). PMT like TPB, investigates the factors affecting motivation and individual behavior, but it more strongly emphasizes the role of risk perception in motivating an individual to minimize potential negative impacts (Le Dang et al., 2014b). In PMT, it is assumed that an individual's motivation to protect themselves from any risks is the main reason to direct behavior against existing threats (Maddux and Rogers, 1983; Menard et al., 2017; Milne et al., 2000; Witte, 1994). PMT has more recently been applied in fields outside of health risk management (Janmaimool, 2017; Milne et al., 2000; Wolf et al., 1986), notably in research on natural hazards, environmental management and climate change specifically (Brügger et al., 2015; Bubeck et al., 2012; Dang et al., 2012; Grothmann and Patt, 2005; Grothmann and Reusswig, 2006; Lam, 2015; Le Dang et al., 2014a; Truelove et al., 2015).

The risks of climate change, for some, stimulate feelings of fear and anxiety, which under the PMT model would be assumed to influence attitude change and decision-making towards adaptive practices. Three cases stand out. First, Dang et al. (2014) applied PMT to adaptive decision-making amongst farmers, finding that farmers have more adaptation intention when they perceive both higher risks from climate change and greater effectiveness of adaptive measures. In contrast, they are less likely to intend to adapt when they are subject to wishful thinking, denials of climate change risk and fatalism (Le Dang et al., 2014b). Second, Grothmann and Patt (2005) applied PMT to measure risk perception, adaptive capacity and adaptation process in two urban and rural communities in Germany and Zimbabwe, finding that farmers have a higher probability of adapting to climate change when they have a better understanding of the climate risks (Grothmann and Patt, 2005). Third, Keshavarz and Karami (2016) explored PMT applied to Iranian farmer populations, specifically looking at pro-environmental behaviors during a drought. They found that some variables related to PMT such as perceived vulnerability, perceived severity, response efficacy, response costs, and self-efficacy as well as income and the social environment significantly predicted farmers' behavior. Collectively these studies show the value of PMT to assess climate change decision-making amongst affected populations.

In climate decision-making, it is necessary to differentiate mitigating (pro-environmental) behaviors aimed at reducing global risks, and those associated with personal adaptation action to protect livelihoods against future climate-related threats. In the latter case, it is perceived risk, vulnerability, severity of adverse consequences, and potential to minimize those risks through the individual's self-efficacy and response efficacy that are important factors within the PMT model (Janmaimool, 2017). The core assumption is that individuals are more likely to engage in behaviors that minimize risks under conditions of perceived higher susceptibility and severity, as well as high response efficacy and perceived self-efficacy (Janmaimool, 2017). However, in the case of climate change, individuals often underestimate risks. This is due to two factors. Firstly, individuals (may) lack personal experience of environmental hazards against which to imagine and interpret future climate change-related hazards. Secondly, there are cognitive challenges associated with engaging with low probability-high consequence events (Grothmann and Patt, 2005; Swim et al., 2009). As mentioned above, this means that climate change can potentially remain 'invisible' or psychologically distant; it is perceived as something affecting others rather than themselves, and is construed in abstract rather than concrete terms as a result (Spence et al., 2012b). Experiencing extreme weather (such as drought) will augment perceptions of both risk probability and severity, promoting the intention to change in order to be better able to cope with future changes (Jennifer R. Marlon, 2018). It can thus be assumed that given an individual's experience with extreme weather, they are more inclined to adapt to future climate change-related impacts, as the perceived risk more closely mirrors the actual risk probability associated with climate change events. We presume, therefore, that farmers within the droughtstricken Marvdasht region have sufficient experiential knowledge of extreme weather events to conceptualize future climate change-related impacts to the region.

2.1 Protection motivation theory in adaptation decision-making

Focusing on the role of perception and adaptation intentions, Grothmann and Patt (2005) enhance PMT to explain the socio-cognitive processes of risk perception interactions and coping perception that farmers show in the face of climate variability and extreme risks. Individuals would be more likely to engage in adaptive action if they (a) perceive themselves to be capable of performing a relevant action and (b) think that this specific activity is effective (Grothmann and Patt, 2005). People balance different potential benefits and risks. The decision is made based on the results of *coping appraisal* and *threat appraisal* (Janmaimool, 2017). Individuals' adaptive responses can be motivated by the perceptions of severity, vulnerability, and reward. Higher perception of vulnerability and severity is likely to enhance individual motivation to perform risk preventative behavior. In other words, people are less likely to engage in risk preventative behaviors if they perceive more rewards from current practices (Council, 2001; Millstein and Halpern-Felsher, 2002).

There are four core elements in the cognitive mediating processes of PMT: threat appraisal, coping appraisal, maladaptive coping, and protection motivation (Floyd et al., 2000; Rogers, 1975; Taylor and May, 1996). Grothmann and Patt (2005) conceptualized these four factors in climate change context as climate change risk appraisal, adaptation appraisal, avoidant maladaptation, and adaptation intention. Similarly, Dang et al. (2012) framed these factors as risk perception of climate change (which describes how individuals assess the personal threat of climate change in terms of perceived probability and perceived severity), adaptation assessment (consisting of perceived self-efficacy, perceived adaptation efficacy, and perceived adaptation cost), maladaptation (including decision-making under uncertainty, fatalism, denial and wishful thinking), and adaptation intention in another framework (Le Dang et al., 2014b). Therefore, the factors of PMT have been applied and specified in the context of climate change: relabeled as *risk perception of climate change*, *adaptation assessment*, *maladaptation*, and *adaptation intention* in the PMT-based framework introduced by Dang et al., (2014). However, a positive evaluation of self-efficacy and risk perception alone will not necessarily translate to adaptation intention (Berrang-Ford et al., 2011). Grothmann and Patt (2005) account for this by adding three external factors to their model, all of which act on an individual's perception of risks and/or coping capacities: (1) *social discourse*, (2) *adaptation incentives*, and (3) *objective adaptive capacity*, such as power, money, entitlements, knowledge, as well as institutional and social support. Also, Le Dang et al. (2014b) applied these factors as *belief in climate change*, *adaptation incentives/disincentives*, and *subjective norms.*

Issues of discourse and social norms are important as the effectiveness of technological and institutional agricultural adaptations are bound by socioeconomic capacity (Reilly and Hohmann, 1993). Therefore, one of the limitations on the adoption of new technologies such as new crop varieties, irrigation systems or fertilizers has been the removal of government support for agricultural inputs (disincentives) (Kurukulasuriya and Rosenthal, 2013). Moreover, maladaptive coping strategies of farmers (maladaptation) resembled informal *responses* taken by local individuals (Ehara et al., 2018; Suckall et al., 2014). Consequently, Keshavarz et al. (2014) suggest that agricultural extension agencies may contribute to pro-environmental outcomes of adaptation intention by implementing a range of social and economic incentives and social learning programs. Likewise, Aslo and Suckall et al.'s (2014) examination of trade-offs made by local people in their coping strategies with long-term development, climate adaptation, and mitigation in two case studies in villages in Zanzibar, found that villagers who lost forests and farmland tried to shift their activities to more remote areas and/or intensify their labor activities to mitigate these effects. Fishers whose catches are affected by tourism activities may shift their work to deeper waters or expand their plots to ensure minimum productivity. These are examples of maladaptation. Therefore, disincentives and belief in climate change have an impact on maladaptation. In this study, the tripartite framework introduced by Dang et al., (2014) and the three later factors are synthesized to form our novel conceptual framework, shown in Figure 1.

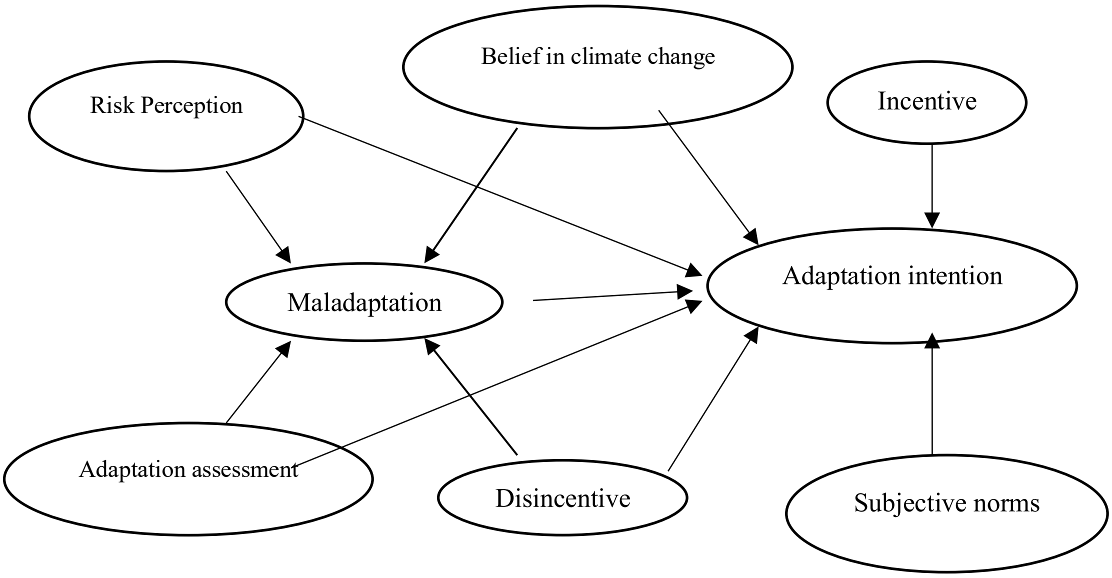

Figure 1. Conceptual framework

3. Materials and methods

A survey approach was conducted to test the hypotheses developed in this study and to determine influencing factors on adaptation intention of farmers. The survey was conducted in the Marvdasht Township. The case study area covers 3687 km^2. It is located in the northern part of the city of Shiraz in the Fars province, shown in Figure 2.

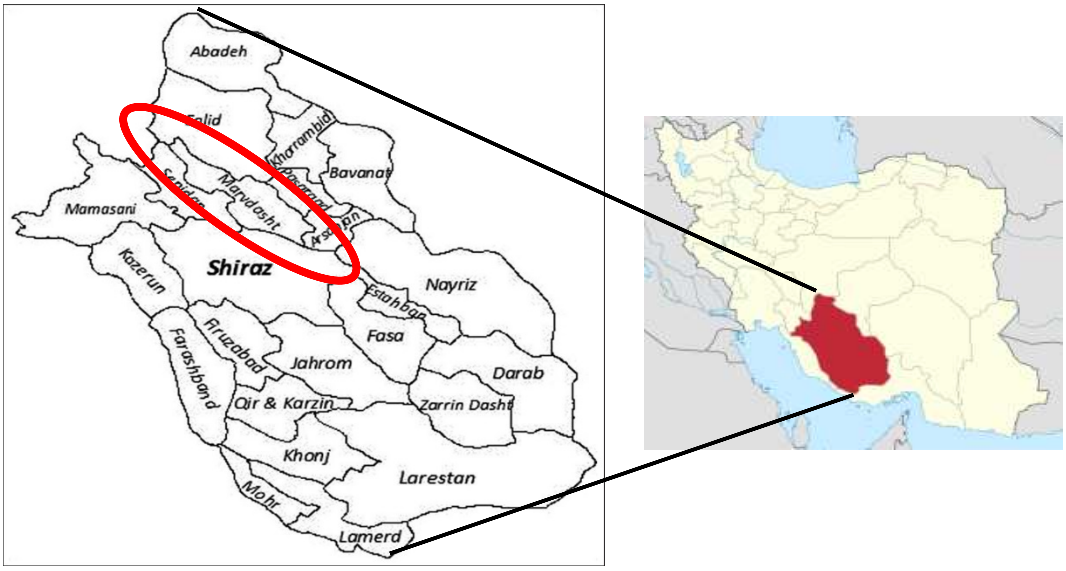

Figure 2. Location of the study area (Marvdasht Township in the Fars province, Iran)

Our critical case study-population is composed of farmers. The survey was conducted in 2017 (local population circa. n=14,000). A sample of 373 farmers was selected based on the Cochran formula (margin error=0.05) using a completely random sampling method. The sample was randomly selected from the list of farmers in the district received from the Agricultural Office of the city. Data collection occurred in 2017. We arranged times and places for met with farmers either in their home or workplace to conduct face-to-face interviews using a prepared questionnaire. Farmers had an ongoing right to decline or withdraw from answering questions and data were discarded in each instance. No incentives were provided. Before starting to complete the questionnaire, we provided a simple definition of climate change: "*Climate change is a change in the usual weather of your place. This could be a change in how much rain in your place usually gets in a year. Or it could be a change in a place's usual temperature for a month or season."* All responses were checked to ensure they were complete. Some participant responses were deemed incomplete, and thus not included in the study. Finally, the return rate of completed and useable questionnaires was 256 – an acceptable return rate of 68% (Nulty, 2008).

The research instrument was a fixed-response questionnaire in two sections. The first contained demographic characteristics of the respondents, including age, gender, agricultural experience, marital status, and education. Eight perceptual factors were constructed in the second section i.e. *adaptation intention, risk perception of climate change, maladaptation, adaptation assessment, belief in climate change, subjective norms, incentives, and disincentives.* These factors are described conceptually and operationally in table 2. The questionnaire contained items similar (but modified based on the panel of experts' comments to fit the context) to those used in past studies (Arbuckle Jr et al., 2015; Feng et al., 2017; Le Dang et al., 2014b). The farmers were asked about the extent to which they agreed or disagreed with the items using a 5-point Likert scale (from Strongly disagree=1 to Strongly aggree=5). The items included in the study's questionnaire are shown in Table 1. The questionnaire used in the study was in Persian (Farsi) and all items in Table 1 have been translated to English.

The validity of the researcher-made questionnaire was tested prior to the launch of the study. Specifically, the questionnaire was reviewed by different related disciplinary experts to ensure the validity (faculty members of rural developments, agricultural extension, agroecology, and agro-climate specialists), who evaluated the interpretation of the questions, the length of the questionnaire, interpretability of the questions, and clarity. Next, to assess the reliability of the questionnaire, a pilot study (fieldwork) was conducted among the farmers of Ahvaz Township. After collecting 30 pilot questionnaires, the Cronbach's alpha coefficient was calculated, showing coefficients that exceeded acceptable rates (more than 0.7) for all the scales used in the study (Table 1). All questionnaire data were initially input into SPSS. SPSS software was used to produce descriptive statistics and their frequency. Also, the values for skewness and kurtosis did not identify any serious violations of normality, as all the coefficients were below ±2. Finally, we applied an SEM[1] analysis through AMOS[2] 20 software to test the model and determine which variables can be used to predict adaptation intention of farmers towards climate change.

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[1] Structural Equation Modeling Arbuckle, J., Wothke, W., 2004. Structural equation modeling using AMOS: An Introduction [EB].

[2] Analysis of Moment Structures ibid.

1. The items included in the study questionnaire and the Cronbach's alpha for the main scales of the study (translated from P

Conceptual Definition	Operational definition	Code[3]	Items	Skewness	Kurtosis	
Adaptation intention includes the behavioral and psychological dynamics of the individuals that adjust the variations in living conditions to improve their survival. It helps individuals to set-up strategies and decision making to maximizing their benefit (Gessesse et al., 2018)	In this study, adaptation intention was measured by asking farmers to what extent they agreed based on 5-point Likert scales ranged from 1 (strongly disagree) to 5 (strongly agree) for all items.	AI1	I will use drought tolerant crop varieties.	0.85	0.51	
		AI2	I will increase the depth of my well.	0.47	0.80	
		AI3	I will use products with lower water requirements.	1.00	0.42	(2
		AI4	I will create variety in cultivating products.	0.81	0.64	e I
		AI5	I will use plants that are resistant to salinity.	0.74	0.03	a
		AI6	I will be looking for a job other than in agriculture.	0.58	0.56	
		AI7	I will use low-tillage techniques.	0.33	0.44	
		AI8	I will insure my products.	1.32	1.75	
Risk perception is defined as people's knowledge performance through information flow, which helps to	In this study, risk perception of climate change was measured by asking farmers to what extent they agreed based	R1	Climate change has increased poverty and unemployment.	1.14	1.34	(e
		R2	Climate change has led to a diminution of religious beliefs among the people.	0.15	1.04	

ve use these codes for showing each question.

foster adaptive actions in responding to the consequences of climate change (Chiang, 2018).	on 5-point Likert scales ranged from 1 (strongly disagree) to 5 (strongly agree) for all items.	R3	Climate change has increased farmers' debt.	0.71	0.01	I
		R4	Climate change has reduced farmers' capital.	1.16	1.21	
		R5	Climate change has lowered land prices.	0.84	0.15	
		R6	Climate change has pushed up prices for agricultural products.	0.43	0.97	
		R7	Climate change has increased pests and diseases in the fields.	0.57	0.24	
		R8	Climate change has reduced product yield.	0.52	0.08	
		R9	Climate change has reduced the amount of water to the farm.	1.52	1.16	
		R10	Climate change has reduced the quality of agricultural products.	0.43	0.42	
Maladaptation describes as an action that results in an undesirable and unintended outcome(s) (Magnan et al., 2016)	In this study, maladaptation was measured by asking farmers to what extent they agreed based on 5-point Likert scales ranged from 1 (strongly disagree) to 5 (strongly agree) for all items.	M1	There is no need for action to be taken in the face of climate change, because these actions will not make any difference.	0.73	0.68	(
		M2	All issues are determined by fate and are unchangeable.	0.63	0.70	I
		M3	God will protect me, my lands, and my family against climate change.	0.03	1.30	
The practice of identifying options to	In this study, adaptation assessment was measured by asking farmers to what	AA1	I have enough motivation and energy to deal with climate change.	0.84	0.23	(

adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility (McCarthy et al., 2001).	extent they agreed based on 5-point Likert scales ranged from 1 (strongly disagree) to 5 (strongly agree) for all items.	AA2	I have enough money and resources to apply strategies for adapting to climate change.	0.32	1.17	I
		AA3	I think I have the ability to deal with the potential dangers of climate change.	0.70	0.18	
		AA4	Climate change is not such a big challenge, and human inventiveness will be able to cope with it.	0.54	0.86	
		AA5	I think there is not enough evidence of climate change taking place that we should take action.	0.36	1.11	
These were measured in terms of three conceptually different beliefs: (a) the belief that global climate change is occurring, (b) the beliefs about its possible causes, and (c) the beliefs of its possible consequences (Heath and Gifford, 2006)	In this study, belief in climate change was measured by four items (B1-B4) on 5-point Likert scales that ranged from 1 (strongly disagree) to 5 (strongly agree).	B1	Climate change is already taking place.	1.44	1.75	(e I
		B2	My farming has been affected by climate change.	1.14	1.41	
		B3	My family has been affected by climate change.	1.18	1.42	
		B4	Climate change will change my lifestyle.	1.39	1.05	
It is a factor, especially a financial advantage that encourages a particular action (Stevenson, 2010)	In this study, incentives, measured by asking farmers to what extent the respective actions influence farmers' adaptive behavior based on 5-point scales from 1	I1	Government support for providing varieties of cultivated herbs in the region will make the region's farmers adapt to the phenomenon of climate change.	1.25	1.09	(I
		I2	Government support for buying agricultural insurance for poor	1.11	0.27	

	(not at all) to 5 (very much).		households will improve the region's farmers capacity to adapt to climate change.			
		I3	Government provision of information and warnings at the time of climate-related risks will improve the region's farmers capacity to adapt to climate change.	1.24	0.98	
It is a factor, especially a financial disadvantage that discourages a particular action (Stevenson, 2010)	In this study, disincentives, measured by asking farmers to what extent the respective actions influence farmers' adaptive behavior based on 5-point scales from 1 (not at all) to 5 (very much).	D1	The increase in electricity prices will improve the region's farmers capacity to adapt to climate change.	0.17	1.34	
		D2	Increasing water prices will improve the region's farmers capacity to adapt to climate change.	0.22	1.40	(I
		D3	The increase in fuel prices will improve the region's farmers capacity to adapt to climate change.	0.02	1.48	
Individual's perception or opinion about what important others believe the individual should do (Finlay et al., 1999)	In this study, subjective norm was measured by 5-point Likert scales ranged from 1 (strongly disagree) to 5 (strongly agree).	S1	My friends, relatives and family expect me to engage in climate change-friendly behaviors.	0.80	0.27	(I
		S2	My friends, relatives and my family are engaging in climate change-friendly behaviors, so I will do so also.	0.69	0.12	

4. Analysis

Respondent demographic attributes are shown in Table 2. Reflecting gender bias within the profession in the case study region, we gained 228 responses from men (89.1%) and only 28 from women (10.9%). The average age of respondents was 43.86 years, and 30.5% held masters-level graduate degrees. Mean agricultural experience of the respondents was 21.22 years.

Table 2. Demographic attributes of the respondents

Demographic attributes	Category	Frequency	Percent
Gender	Male	228	89.1
	Female	28	10.9
Marital status	Single	53	20.7
	Married	203	79.3
Education	Illiteracy	29	11.3
	Elementary	18	7
	High school	42	16.4
	Diploma	58	22.7
	B.Sc.	16	6.3
	M.Sc.	78	30.5
	Ph.D.	15	5.9
Age (year)	Mean	St.D.	Min-Max
	43.86	12.71	19-70
Agricultural experience (year)	Mean	St.D.	Min-Max
	21.22	14.17	2-60

A confirmatory measurement model was tested by AMOS software (V20). The use of CFA was to ensure the uni-dimensionality of the scales measuring each factor. Confirmatory Factor Analysis (CFA) was employed to examine whether measures of a factor were consistent with the nature of that factor or not (Henson and Roberts, 2006). As shown in Table 3, several commonly-used fit indices were employed to assess the overall model fit (Schreiber et al., 2006). The comprehensive goodness-of-fit indices produced a Chi-square of 1172.23, and Chi-square/DF=1.88 (Schreiber et al., 2006), The comparative fit index (CFI) value of 0.91, incremental fit index (IFI) value of 0.88 and Tucker-Lewis index (TLI) value of 0.90, were deemed good fits to the model according to Hu and Bentler (1999) – whereby for these indices a value of 0.7 and above is satisfactory, 0.8 and above is good, and 0.9 and above is very good. The root means square error of approximation (RMSEA) value was 0.07, where an RMSEA threshold in the range of 0.05 to 0.10 is considered an indication of fair fit (Henry and Stone, 1994). Thus, the results of the measurement model indicate an acceptable fit.

Table 3. Measures of the research framework model fit

Items	**Chi square**	**Chi square/DF**	**IFI**	**TLI**	**CFI**	**RMSEA**
Indices	1172.23	1.88	0.88	0.90	0.91	0.07

CFI: Comparative Fit Index
IFI: Incremental Fit Index
TLI: Tucker-Lewis Index
CFI: Comparative Fit Index
RMSEA: Root Mean Square Error of Approximation

All standardized factor loadings should be at least 0.5 and statistically significant. Loadings of this size indicate that observed indicators are strongly related to their associated factors. It also contributes to construct validity (Hair, 2010). In the model, all standardized factor loadings are significant. Most factor loadings are above 0.5, except some values at marginal levels (as shown in Table 4). Taken together, the findings indicate that there was a satisfactory fit between the proposed model and the data. Additionally, convergent and discriminant validity was established for all factors. As shown in Table 4, composite reliability for all factors met the threshold of 0.7, which was suggested by Hair et al., (2010). Average Variance Extracted (AVE) for all factors was greater than the threshold of 0.5 (Hair, 2010). Based on the suggestion of Hair et al., (2010), discriminant validity statistics, i.e. MSV (Maximum Shared Variance) and ASV (Average Shared Squared Variance), should be less than AVE. As can be seen in Table 3, all factors had good discriminant validity. Finally, the values of Skewness and Kurtosis did not identify any serious violations of normality.

Table 4. Factor loadings and convergent and discriminant validity in Confirmatory Factor Analysis

Items' code	Adaptation Intention	Risk perception of climate change	Maladaptation	Adaptation assessment	Belief in climate change	Incentive	Disincentive	Subjective norms
AI1	0.71[a]							
AI2	0.72**							
AI3	0.70**							
AI4	0.71**							
AI5	0.73**							
AI6	0.71**							
AI7	0.70**							
AI8	0.72**							
R1		0.65 [a]						
R2		0.75**						
R3		0.67**						
R4		0.65**						
R5		0.81**						
R6		0.57**						
R7		0.77**						
R8		0.85**						
R9		0.68**						
R10		0.70**						
M1			0.56 [a]					

M2			0.69**					
M3			0.88**					
AA1				0.79 a				
AA2				0.69**				
AA3				0.68**				
AA4				0.74**				
AA5				0.65**				
B1					0.67 a			
B2					0.74**			
B3					0.70**			
B4					0.71**			
I1						0.83 a		
I2						0.63**		
I3						0.65**		
D1							0.71 a	
D2							0.74**	
D3							0.89**	
S1								0.87 a
S2								0.75**
CR	0.89	0.91	0.77	0.84	0.80	0.75	0.83	0.79
AVE	0.51	0.51	0.53	0.51	0.51	0.51	0.62	0.66
MSV	0.08	0.03	0.31	0.31	0.01	0.14	0.08	0.14
ASV	0.03	0.01	0.05	0.06	0.01	0.04	0.02	0.05

(a) Values were not calculated because loadings were set to 1.0 to control factor variance
(**) Significant at 1%

4.1 Factors influencing the adaptation intention towards climate change

The comprehensive goodness-of-fit indices for the path analysis, as shown in Table 5, are the Chi square=4.24 and Chi square/DF=2.12 (smaller than 3) (Schreiber et al., 2006). The other goodness-of-fit indicators i.e. NFI[4], CFI[5], IFI[6], and TLI[7] are below the threshold (according to Hu and Bentler, 1999), values from 0.90 indicate an acceptable fit and that values from 0.95 indicate a good/close fit). Also, the RMSEA8 is within the acceptable threshold. Taken together, the findings indicate that there is a satisfactory fit between the proposed model and the data.

Table 5. Measures of the research framework model fit

	Items	Chi square	Probability level	DF	Chi square/DF	NFI	IFI	TLI	CFI	RMSEA
Path analysis	**Indices**	4.24	0.12	2	2.12	0.98	0.99	0.90	0.99	0.07

Table 6 reports the direct and indirect effects of all variables on the endogenous variables of the study (Adaptation Intention). As shown in table 6, risk perception has a significant negative effect on the maladaptation of farmers towards climate change. This

[4] Normed fit index
[5] Comparative Fit Index
[6] Incremental Fit Index
[7] Tucker-Lewis Index
[8] Root Mean Square Error of Approximation

finding is consonant with the Le Dang et al. (2014b) study of Vietnamese farmer adaptation intentions that found that belief in climate change has a significant negative effect on maladaptation intention. Likewise, Blennow and Persson (2009) found that belief in climate change is a crucial factor for explaining observed differences in adaptation among Swedish forest owners. Our results also show that disincentives have a significant positive influence on the maladaptation intentions of Iranian farmers. This finding corresponds with World Bank findings (Kurukulasuriya and Rosenthal, 2013) which illustrate that disincentives (primarily economic) are primary drivers of adaptation intentions, and the findings of Bagagnan et al. (2019) who find that subsidies will improve resilience amongst Gambia's farmers. Finally, the results show that maladaptation has a significant positive influence on climate adaptation intention of the farmer population. This stands in contrast to the work of other PMT model researchers, such as Rippetoe and Rogers (1987), who investigated health threat and found negative influence between these both factors. Also, it contradicts Le Dang et al.'s (2014) study of adaptation intentions that found maladaptation to have a significant negative influence on adaptation intentions. The proportion of variance that is explained by the predictors of intention was 0.23. This means that 57% of the variance associated with adaptation intention is accounted for by all other variables, from which among them, risk perception, belief in climate change and disincentive had significant effects. Please also refer to figure 3.

Table 6. Standardized indirect and direct effect

Path	**Direct effect**	**Indirect effect**
Risk Perception → Maladaptation	-0.250**	-
Risk Perception → Adaptation intention	0.121	-0.021
Adaptation Assessment → Maladaptation	0.121	-
Adaptation Assessment → Adaptation intention	-0.151	0.010
Belief in Climate Change → Maladaptation	-0.286**	-
Belief in Climate Change → Adaptation intention	0.017	-0.023
Disincentive → Maladaptation	0.246**	-
Disincentive → Adaptation intention	-0.204	0.020
Incentive → Adaptation intention	-0.065	-
Subjective Norms → Adaptation intention	-0.132	-
Maladaptation → Adaptation intention	0.182**	0.000

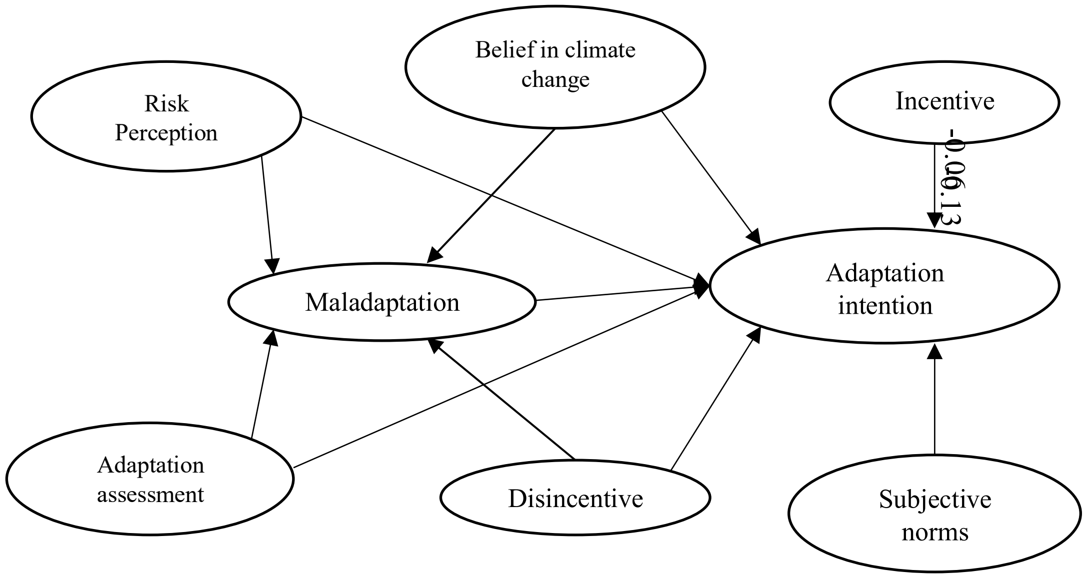

Figure 3. Path analysis of research framework

5. Discussion

We find that the estimated model for farmer climate adaptation intention has a good fit and so has the capacity to predict adaptation intention. The Protection Motivation Theory (PMT), upon which this study is based, is therefore suitable for investigating the underlying factors influencing climate adaptation intention. We augmented and applied PMT to understand adaptation intentions. While PMT has been used to understand the behaviors related to acute personal risks, in this study we applied the model in the context of slow-onset risks over longer temporal horizons. Rogers' original PMT model explained the impact of fear on motivating the specific individual behavioral responses. Within the PMT model, it is assumed that accepting any behavior to ameliorate threat is a direct action of the individual's motivation to protect themselves (El Dib et al., 2008). Though pertinent to understanding the impacts to the individual of health-related concerns, PMT is less able to model for individuals risk decision-making in relation to climate change, simply because climate change is less visible and tangible, due to its psychologically distant nature for many people. We, therefore, augment the model to include the variables that represent the externalities of farmers' behavior, as well as incentives and disincentives. We also bring in broader socio-economic factors and physical resources in understanding farmers' climate change adaptive behavior and investigate socio-cognitive factors under conditions of uncertainty. Thus we began with the conceptual framework developed by Le Dang et al. (2014b) and sought to incorporate economic and psychological dimensions to better understand farmer climate adaptation intentions. The value of such a model is that it has predictive power, making it a useful tool for local adaptation decision-making in the agricultural sector. Specifically, it allows governments to identify the most important obstacles to adaptation practices at the farm and farming-community level, hence better contributing to bottom-up and locally contextualized land use and agricultural policy formulation.

In this study, we investigated the influence of incentive/disincentives and found that disincentives have a positive impact on the maladaptation of farmers towards climate change. In other words, the deterrent factor that has been tested by the region's farmers has had a positive impact on the intention to adapt. We argue that farmers who understand some of the shortcomings or implementation of some of the existing laws (such as the cost of water and electricity) are more likely to display maladaptation intentions towards climate change. In a development context, it is important to remember that adaptation decision-making within the agricultural sector occurs under conditions of severe financial resource constraints (Mertz, 2009). In practical terms, it is important to understand that farmers' unwillingness to adapt by changing their cropping calendar or planting techniques may be simply due to a lack of money or fear of financial hardship as a result of taking action, as seen in other cases of farmer attitudinal assessments (notably Bastakoti et al., 2017).

It is necessary for adaptation planning to facilitate policy interventions that align privately profitable actions (for, in this case, farmers) with socio-ecologically desirable outcomes (Yohe and Tol, 2002). Concerns regarding the complexity and uncertain feedback-mechanisms in social-ecological systems have paved the way for more inclusive decision-making: implementation of adaptation policies is characterized by a learning-by-doing attitude instead of an aspiration to control changes that occur because of climate variability (Biesbroek et al., 2009). Most climate-related policies (Folke, 2006; Lim et al., 2005) allow for locally or regionally targeted adaptation responses within a common policy frame, in the hope that this allows for more specific reactions to climate change. Following the logic underlying our PMT-based study, policies that seek to strengthen individuals' coping capacity are most likely to succeed if they emphasize both individual responsibility and collective environmental benefits. In summary, and based upon no significant influence of incentives on the adaptation intention of farmers, this research shows that a re-evaluation of economic incentive structures might be fruitful in an attempt to construct an effective choice architecture. This is even more crucial considering the degree to which flexibility of decision-making is institutionalized in the environmental and agricultural sectors.

We find that belief in climate change has a negative influence on farmers' maladaptation. In this regard, it should be considered that the likelihood of farmers' maladaptation to climate change decreases when they perceive the related risks of these changes and the effectiveness of adaptation activities. Therefore, it can be said that farmers who have personal experience of the negative consequences of climate change-related events, such as drought for example, and have seen farms that have been affected by climate change phenomena with severe product cuts, will be more cognizant of the threat of anthropogenic climate change, and less prone to denialism or fatalism.

Finally, we find that perceived maladaptation has a positive influence on adaptation intention. By definition, the concept of adaptive behavior is a decision-making and implementation process for a set of measures to maintain the capacity to deal with changes now or in the future (defined here as activities to try to reduce the negative and adverse effects of climate change on agriculture). It must also be remembered that farmers, like any other population, do not universally behave in environmentally sustainable ways. They display skepticism about climate change, or else perceive climate change as temporally and spatially distant, therefore, it is a factor that reduces the propensity for climate change-related action. In short, according to the Carlton and Jacobson (2013) climate change is not a primary concern for people, and this is likely true amongst farming populations. Denialist or fatalistic positions based within religious or cultural beliefs, and a lack of trust amongst farmers in information from different sources may also play a role in influencing adaptation intention (Le Dang et al., 2014b), and this is an ongoing societal and policy challenge.

6. Conclusions

Farmers face considerable socio-economic and psychological barriers to effective adaptation in the face of dangerous anthropogenic climate change. It is necessary for policy authorities to identify and resolve such obstacles to improve livelihoods and ensure sustainable food supplies to meet long-term development outcomes. Many of the most important obstacles to adaptation practices in the agricultural sector occur at the farm level, and so understanding farmers' decision-making around adaptation is essential. The identification of influencing factors can thus help to generate suitable policy solutions. Agricultural policies and targeted efforts must build adaptive capacity (Howden et al., 2007), and improved engagement will be critical in developing strategies to enhance this adaptive capacity for farmers. Successful adaptation typically is cooperative, cross-jurisdictional, and interdisciplinary (Fisichelli et al., 2016). Also, it should be considered that there are differences in the factors that influence farmers' adaptation intention across the regions (Dang et al., 2018). It behooves local authorities to pay attention to the socio-demographic and geophysical characteristics of each region and the corresponding perceptual factors that dominate in each, in order to design appropriate adaptation strategies. The intensity of any management intervention is dependent upon the focal resource's vulnerability to climate change within the management area and may change with management time horizons and rates of climate change (Fisichelli et al., 2016).

Our results show that belief in climate change has a negative effect on farmers' maladaptation intention towards climate change. Information provision is therefore crucial in shaping farmers' perception of climate change risk and the effectiveness of adaptive measures. Inaccurate information may lead to maladaptation which, in turn, influences the adaptation intention and behavioral response. Therefore, it is important to ensure the accuracy and timeliness of information about climate change risk and adaptation responses. The sources and messengers of climate change information are important, not simply the quality of the information itself. As such, agricultural extension services are important in supporting farmers with technical knowledge of adaptive measures. Moreover, our results revealed that disincentives have positive impact on the maladaptation of farmers towards climate change, thus policymakers should investigate farmers' financial conditions as a matter of improving overall livelihood strategies as well as adaptation strategy.

In this case study of Iranian farmer adaptation intentions, it is significant that farming practice takes place in arid and semi-arid regions. Iranian farmer populations have extensive experience of drought. This means that drought may be construed as regular and natural phenomenon, rather than a climate change-related event. However, as with many climate-change related impacts – it is the frequency and severity of such droughts which will increase as global temperatures rise. In Iran, the public sector holds responsibility for educational and extensional support and advisory services in the agricultural sector, and the management of agricultural insurance systems. Public sector organizations, therefore, carry a responsibility towards farmer engagement and education. However, Government policy towards the sector is currently focused upon short-term tangible issues such as increasing the crop yield and pest control; whereas long-term climate adaptation planning is de-prioritized. We conclude, therefore, that farmers' intentions and practices are like to be more strongly influenced by the demands of the public sector than by their social networks of relatives and friends, as the latter mainly requests short-term increases in crop yield. We recommend, therefore, that immediate policy changes are necessary from the top-down: for public authorities to better communicate climate risks and adaptations options, and to better incorporate government-to-farmer mutual engagement on adaptation planning, to establish trust, and to thus improve stimulate adaptation intention and greater success in agricultural outcomes under climate stress. We suggest that a policy of agricultural extension is needed that provides appropriate advisory and educational services designed to prepare farmers for the consequences of climate change, introduce potential solutions and ameliorate the adverse consequences. Furthermore, agricultural extension can incorporate diverse cultural values among Iranian farmers as a strength within an educational program. Adaptation policy through agricultural extension should thus operate at the provincial and/or township level, to foster social and cultural learning amongst farmer networks about climate change, its consequences and the range of potential adaptation responses, and to thus improve adaptation decision-making given ongoing resource constraints experienced by vulnerable farmer groups.

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