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Understanding Farmers' Response to Renewable Energy: An Application of Protection Motivation Theory

M. Badsar[1*], and R. Karami [2]

ABSTRACT

The present study tested the Protection Motivation Theory (PMT) in explaining farmers' response to renewable energy in Zanjan County, Iran. The study further investigated the direct and indirect influence of knowledge on motivation to use Renewable Energies (REs) through PMT variables. The target population of this study comprised farmers in Zanjan County. Multistage sampling method was employed for sampling procedures and sample size was determined using G*Power software (n= 287). To test the study hypothesis, a multivariate technique of structural equation modeling was applied. The results indicated that the PMT threat appraisal variables comprising perceived vulnerability, severity, and intrinsic reward had statistically positive relationships with the farmers' motivation to use renewable energies. Also, the results revealed that all PMT coping appraisal variables had a statistically significant relationship with the farmers' motivation to use renewable energies. In addition, the results of full structural model specified that farmers' knowledge directly and indirectly (through PMT variables) had a statistically significant effect on the farmers' motivation to use renewable energies. The model, including knowledge and protection motivation theory variables, explained about 71% of the farmers' motivation to use renewable energies. Therefore, the results revealed the applicability of the PMT in explaining farmers' response to renewable energy in Iran. Thus, it is suggested that the future studies could use the extended model of PMT by considering the pre-influence of knowledge of renewable energies.

Keywords: Coping appraisal, Motivation to use renewable energies, Structural equation modeling, Threats appraisal.

INTRODUCTION

Energy is an indispensable constituent of modern society and civic life (Koyama, 2017). Energy is deeply embedded in economic, social, and environmental needs of the world development (Obeng-Darko, 2019). Human activities in the direction of energy-based development have had different side effects (Lam and Law, 2016). Energy sector is one of the significant contributors to CO_2 production, which is accountable for about 58.8% of the global warming and climate change (Shabani *et al.*, 2020), intensifies poverty, economic inequality, and hunger (Obeng-Darko, 2019). Green energies or REs are composed of solar, wind, hydro (water), geothermal, and biomass energy sources (Lin and Syrgabayeva, 2016) that could reduce nonrenewable energy dependability, move forward for energy security, improve air quality and safety, boost economic development, and even create new jobs (Lins *et al.*, 2014). However, given contemporary technology limitations and high costs in the preliminary stage and the

[1] Department of Extension, Communication and Rural Development, Faculty of Agriculture, University of Zanjan, Zanjan 45371-38791, Zanjan, Islamic Republic of Iran.
[2]Department of Agriculture, Payame Noor University (PNU), Tehran, Islamic Republic of Iran.
*Corresponding author; e-mail: badsar@znu.ac.ir

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risk of commercializing renewable energy initiatives compared with nonrenewable energy, obstacle exists in securing usage of renewable energy projects (Lam and Law, 2016). Thus, research has been in progress in new technologies of REs and different aspects of it (McDonagh *et al.*, 2019) and somewhat on changes in behavior. Public acceptance is a crucial component in transitioning to clean energies (Bayulgen and Benegal, 2019). It is an innovation decision-process where an individual transitions from initial knowledge of an innovation like REs to creating an attitude toward it, to make a decision to adopt or reject the innovation (Rogers, 2003). Indeed, it is broadly believed that to encourage a more sustainable future, changes in behavior are required, which necessitates extra effort and new knowledge (Bockarjova and Steg, 2014) which shapes the perception and motivation and later may lead to new skills. Thus, this study fulfills the gap of the literature by considering a background factor as knowledge on cognitive processes and motivation to use Renewable Energies (REs).

Iran's consumption of energy is three times greater than that of global average, and the share of agriculture and rural area in this consumption is considerable (Afsharzade *et al.*, 2016). Thus, development of REs is a major concern, specifically in the agricultural sector. Taking that into consideration, Iran has significant potential resources for renewable energy development. For example, the installed capacity of Solar photovoltaic (also known as solar PV) in rural areas of Iran in total is 674KW in 16 provinces, with 78KW produced in Zanjan (the location of current study) as the second province with the maximum amount (Ghorbani, Aghahosseini, and Breyer, 2020). According to Parliament Research Center (2012), the first and most important challenge for transition to REs is low price of non- Res, and the second is lack of knowledge regarding REs. The study results of Cheraghi *et al*. (2019) further showed that knowledge had a greatest influence on the REs investment decision-making process in the agriculture sector, while little was written about perception of REs in Iran (Yazdanpanah *et al.*, 2015). More definitely, research conducted in Iran is limited to some counties with different populations and concepts like investigating intention of using renewable energy in the rural areas of Zabol County (Rezaei and Ghofranfarid, 2018), attitude and willingness of agricultural professionals' towards biofuel (Yaghoubi *et al.*, 2019). Since Iran is a large country with different socio-economic and environmental conditions, the question about motivation of farmers' response to renewable energy in Zanjan County remains open. Meanwhile, different kinds of RE sources such as solar water heaters and solar power plants are available in Zanjan Province and, for encouraging people, there is 20-year guarantee to purchase renewable electricity by private and household subscribers (ZRElC, 2020).

Theoretical Background and Hypotheses Development

Protection Motivation Theory

Determinants of pro-environmental behaviors are investigated broadly, in social psychology, theories like norm-activation concentrated on moral norms, although costs and incentives as extrinsic factors limit their results (Turaga *et al.*, 2010). Theory of Planned Behavior (TPB) developed from theory of reasoned action as another related theory states that the most important predictors of behavior are attitudes, subjective norms, and perceived behavioral control (Braakhuis, 2016). TPB is close to voluntary provision of public goods theory in economics, pursuing to incorporate the effects of personal norms. Value-Belief-Norm (VBN) model advocates importance of personal values described as altruistic in pro-environmental behaviors (Turaga *et al.*, 2010).

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The protection motivation theory, that was introduced in 1975 as a result of Roger's research for explaining the consequence of fear appeals, is a theory with broad applicability, which in recent times came to explain the intention of individuals for participation in protective behaviors (Keshavarz and Karami, 2016) such as pro-environmental behavior (Bockarjova and Steg, 2014). Nevertheless, no inclusive empirical analysis of the PMT in the farmers' response to renewable energy has been published yet, to the best of our knowledge, and this study resolves this gap. Bender *et al.* (2007) also suggested that future research should examine the replicability of PMT in different domains. PMT proposed that environmental and intrapersonal stimulus sources of information can instigate two self-regulating appraisal processes including threat appraisal and coping appraisal.

Threat appraisal pathway is related to the factors that raise or lessen the likelihood of maladaptive responses and consist of perceived threat and perceived reward. Perceived threat includes two variables of severity and vulnerability, which are seen to offset maladaptive responses. Indeed, fear intervenes the level of appraised threat and perceptions of persons on two variables of severity and vulnerability (Conner and Norman, 2005). Perceived severity reflects the magnitude of the threat that is felt and anticipated by each individual to tolerate after occurrence of threat. Perceived vulnerability shows the sensitivity of a person to the threat (Keshavarz and Karami, 2016). Perceived reward refers to numbers of intrinsic and extrinsic rewards such as example of pleasure and positive psychological satisfaction for intrinsic and social approval for extrinsic, which could modify the probability of maladaptive responses (MacDonell *et al.*, 2013). The research results showed that perceived rewards from adhering to environmentally unfriendly practices will inhibit adaptive behavior (Bender *et al.*, 2007; Bockarjova and Steg, 2014; MacDonell *et al.*, 2013), while higher perceived reward of safe practice such as using REs would inhibit maladaptive behavior and motivate the person for adaptive responses.

Coping appraisal focuses on the factors that raise or reduce the likelihood of an adaptive response, referring to perceived efficacy and perceived costs. Furthermore, the coping appraisal is related to how a person appraises his/her own ability in responding to the perceived threat, thereby avoiding the threatened danger (MacDonell *et al.*, 2013). Response efficacy is related to the individual perception about the effectiveness of the recommended behavior in reducing the threat. Self-efficacy is related to the individual perception about one's own capability of execution of the recommended behavior. Thus, any increase in individual perception of self-efficacy and response efficacy could increase the intention of adaptation to REs. Response efficacy and self-efficacy indicated a positive relationship with adaptation behavior of farmers' pro-environmental behavior (Keshavarz and Karami, 2016), and willingness to use REs among Iranian students (Yazdanpanah *et al.*, 2015). Other variable of coping appraisal is perceived response costs that, in this study, were conceptualized similar to the study of Keshavarz and Karami (2016), Le Dang *et al.* (2014), and MacDonell *et al.* (2013) involving financial, time, effort, and emotional costs. Thus, it is hypothesized that:

H1 to H7: There is a positive relationship between independent variables including perceived vulnerability, severity, intrinsic rewards, extrinsic reward, self-efficacy, response efficacy, response cost and the dependent variable, namely, farmers' motivation to use REs

Knowledge

Knowledge, as the volume of information held in one's memory, is a very important variable in the study of motivation and the way someone conducts oneself or behaves regarding environmental conservation (Rajaie *et al.*, 2018). Knowledge is a precondition for change providing a basis for self-evaluative reactions (Komendantova

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et al., 2018). Knowledge of what farmers do in response to environmental issues can broaden adaptation options and improve resilience within the sector (Delfiyan *et al.*, 2020). Individuals who are knowledgeable about the threats are more willing to engage in green behavior (Tan, 2011). Studies showed a positive relationship of knowledge on public acceptance and willingness to pay for renewable energy (Lin and Syrgabayeva, 2016; Pagiaslis and Krontalis, 2014). Further, false information may lead to taking on maladaptive behavior and holding down the adaptation intention of farmers (Le Dang *et al.*, 2014). To conceptualize the knowledge, two components of objective and subjective knowledge are recognizable (Tan, 2011). The extent of actual level of knowledge, which is complex to measure, is objective knowledge. Subjective knowledge represents the individual's perceived knowledge reported by him/herself and it is argued to be a more effective variable to predict the environmental behaviors and intention (Rajaie *et al.*, 2018). Thus, in this study, the knowledge is considered as a primary variable influencing individual threat and coping appraisal and in line with the study of Katsuya (2001) and Rajaie *et al.* (2018) subjective knowledge investigated. In this research, as displayed in Figure 1, it is hypothesized that one step should be taken backwards and, first, the magnitude of farmers' knowledge on REs should be found. Then, its relationship with their cognitive processes and motivation should be captured. Thus, the hypothesis is that:

H8. There is a positive relationship between knowledge and farmers' motivation to use REs.

H9. Threat appraisal (including vulnerability, severity, intrinsic and extrinsic reward) and coping appraisal (consisting of response efficacy, self-efficacy, and perceived cost) mediate the relationship between knowledge and motivation to use REs among farmers.

MATERIALS AND METHODS

Sampling and Data Collection

The study location was Zanjan County. Zanjan Province, as presented in Figure 2 is located in Northwest of Iran. The county of Zanjan is located in Zanjan Province and made up of three districts called Zanjanrud, Central, and Ghara Poshtlou.

The target population of this study comprised farmers in Zanjan County (who were 18467 farmers based on Statistical Center of Iran in 2017). Using a multistage sampling method, the participants were selected. In the first step, four rural districts were randomly selected. In the next step,

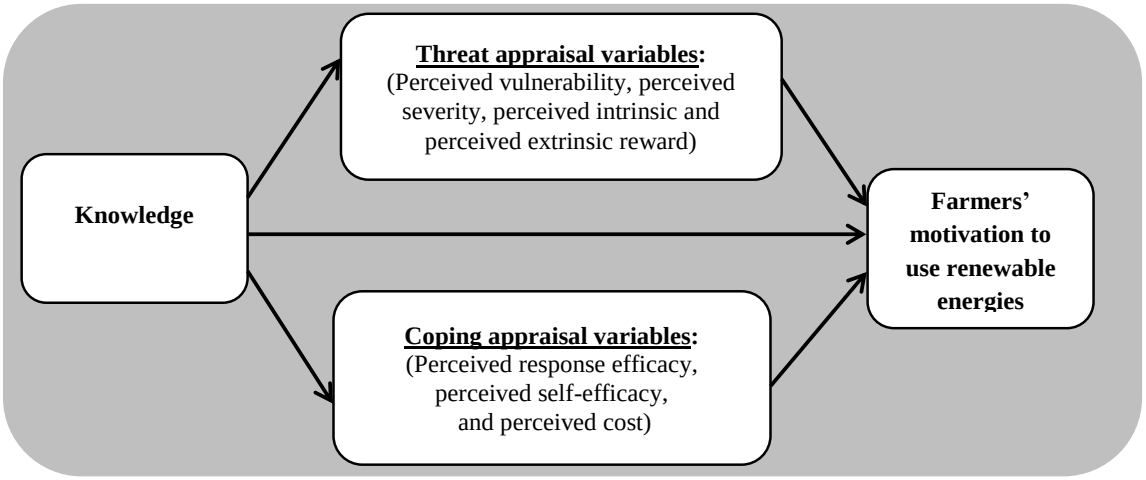

Figure 1. Research theoretical framework.

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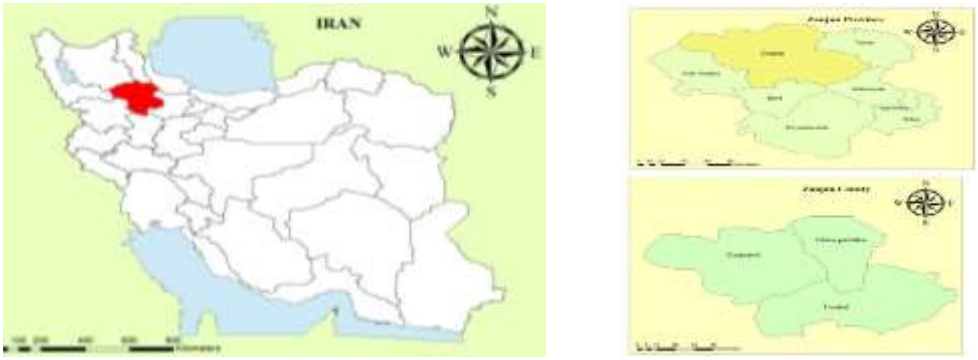

Figure 2. The location of study area in Iran.

villages from the four rural districts were selected using random cluster sampling. The sample size was determined using G*Power software. This software determines the number of samples based on the test type of data analysis, effect size, statistical power, alpha error probability, and number of tested predictors (Schumacker and Lomax, 2010). The number of samples determined by the software was 280 (see Table 1), but to fulfil the required number of samples, 300 questionnaires were distributed given the probability of nonresponse rate. The number of samples in each rural district was determined using proportional allocation. The number of collected questionnaires after excluding incomplete questionnaires was 287. Data were collected using oral interview conducted by a trained interviewer. Oral interview was chosen for data collection since it was predicted that most of target population would be illiterate.

Table 1. The result of sample size determined by G*Power software.

F tests - Linear multiple regression: Fixed model, R^2 increase
Analysis: A priori: Compute required sample size
Input: Effect size f^2= 0.15; α err prob= 0.05; Power (1-β err prob)= 0.95; Number of tested predictors= 36; Total number of predictors= 36
Output: Noncentrality parameter λ= 42.00; Critical F= 1.4657860; Numerator df= 36; Denominator df= 243; Actual power= 0.9501269
Total sample size= 280

Questionnaire Design

An in-depth review of literature was conducted to develop the questionnaire for data collection in this study. The study instrument was segmented to ten parts; respondents' profiles, protection motivation of REs, severity, vulnerability, intrinsic rewards, extrinsic rewards, response efficacy, self-efficacy, response costs, and knowledge. All protection motivation theory items were measured on a 5-point Likert scale (see Table 3). The face and content validity of the questionnaire was confirmed by the comments from panel of experts including faculty members.

Data Analysis

The data was analyzed based on Structural Equation Modelling (SEM) approach. Two-stage procedures were used to perform the SEM analysis through $AMOS_{24}$ statistical software package. In the first stage, based on the first-order confirmatory factor analyses CFA or measurement model convergent and discriminant validity was approved. Finally, a "Bootstrap" method was used to analyze total structural model and the indirect/mediation effect of knowledge on the motivation to use REs through PMT variables.

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RESULTS

Demographic Profile

The demographic attributes of the respondents showed that the respondents' ages ranged from 23 to 67 years, with a mean of 47.12 years (Table 2). The majority of the respondents ages (61.1%) ranged between 31 to 50 years. In terms of educational level, the results revealed that 20.6% of the respondents were illiterate, almost one-third of the respondents (31.2%) had elementary education (1 to 5 years of schooling) degree, and 20.5% had above high school diploma educational certification (Table 2). The farmers' average farming experience was 29.2 years.

Measurement Model Estimation

Results showed that the measurement model based on a set of goodness-of-fit indices provided an appropriate fit for the data (Table 3). The Comparative Fit Index (CFI), Incremental Fit Index (IFI) and Tucker-Lewis Index (TLI) with value greater than 0.90 indicated an acceptable fit (Hair *et al.*, 2010; Schumacker and Lomax, 2010). In addition, the Root Mean Square Error of Approximation index (RMSEA) was .044, which falls between the recommended range (less than 0.08) of better fit (Hair *et al.*, 2010). The results of assessed convergent validity showed that all the items had high standardized factor loading on their underlying constructs (Range: 0.650 to 0.865) and were significant at 0.001 level (Table 3). In addition, the AVE for the entire constructs exceeded the minimum criterion of 0.50 (Range: 0.576 to 0.663), indicating that the majority of the variance was explained by the constructs. The assessment of construct reliability also showed the CR for all constructs were more than 0.70 (range: 0.844 to 0.885) ensuring satisfactory internal consistency among the measured items (Table 3). To establish discriminant validity, square root of correlation among two constructs were compared with AVE for each construct (Hair *et al.*, 2010). The result showed that the square root of correlation among all two constructs was less than AVE for each construct, supporting the discriminant validity among the constructs (Table 3).

Structural Model Estimation

Direct Effects

A structural model was used for examining research hypotheses (Figure 2). The total structural model demonstrates the direct path relationship between knowledge as independent variable and motivation to use REs as a dependent variable. Also, the total structural model establishes the indirect path relation between knowledge and motivation to use REs through PMT

Table 2. Demographic profile of the farmers surveyed (n= 287).

Variable	Frequency (%)/Mean
- Age (years)	47.12 (Mean)
Less than 30	13.4
31-40	31.3
41-50	29.8
51 and higher	25.5
- Education level (%)	
Illiterate	20.6
Elementary education (1 to 5 years of schooling)	31.2
Secondary education (6-12 years of schooling)	27.7
Higher education (above diploma)	20.5
- Average farming experience (years)	29.2

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Table 3. Constructs, measurement items, standardized factor loading, and reliability and validity tests.

Latent (Scale source)	Label	Standardized factor lodging[a]	Average Variance Extracted (AVE)	Composite Reliability (CR)
- Perceived Vulnerability			0.619	0.866
	V1	0.809		
(Delfiyan *et al*., 2020;	V2	0.718		
Horng *et al*., 2014)	V3	0.767		
	V4	0.848		
- Perceived Severity			0.576	0.844
	S1	0.650		
(Yazdanpanah *et al*.,	S2	0.749		
2015)	S3	0.847		
	S4	0.777		
- Perceived Intrinsic reward			0.623	0.869
	In1	0.770		
(Kuvaas *et al*., 2017)	In2	0.808		
	In3	0.779		
	In4	0.800		
- Perceived Extrinsic reward			0.610	0.862
	Ex1	0.769		
	Ex2	0.785		
(Kuvaas *et al*., 2017)	Ex3	0.772		
	Ex4	0.798		
- Perceived self-efficacy			0.659	0.885
(Yazdanpanah *et al*.,	Se1	0.867		
2015)	Se2	0.772		
	Se3	0.866		
	Se4	0.736		
- Perceived Response efficacy			0.576	0.871
	Re1	0.683		
	Re2	0.710		
(Lin and Syrgabayeva,	Re3	0.849		
2016; Shafiei and	Re4	0.721		
Maleksaeidi, 2020)	Re5	0.818		
- Perceived Response cost			0.648	0.880
	Rc1	0.830		
	Rc2	0.805		
(Keshavarz and Karami,	Rc3	0.820		
2016; Le Dang *et al*.,				
2014; MacDonell *et al*.,	Rc4	0.764		
2013)				
- Motivation to use REs			0.606	0.860
	MREs1	0.759		
(Bockarjova and Steg,	MREs2	0.727		
2014)	MREs3	0.790		
	MREs4	0.834		
- Knowledge			0.663	0.871
	K1	0.690		
(Katsuya, 2001; Rajaie	K2	0.834		
et al., 2018)	K3	0.842		
	K4	0.852		
	K5	0.833		
Measurement model goodness-of-fit indices: [χ^2 (629)= 867.108; P= 0.000; Relative *Chi*-Square (χ^2/df)= 1.37; GFI = 0.866; CFI=0 .965; IFI= 0.965; TLI= 0.961; RMSEA= 0.036]				

[a] All factor lading is significantly different from zero at the 0.001 level.

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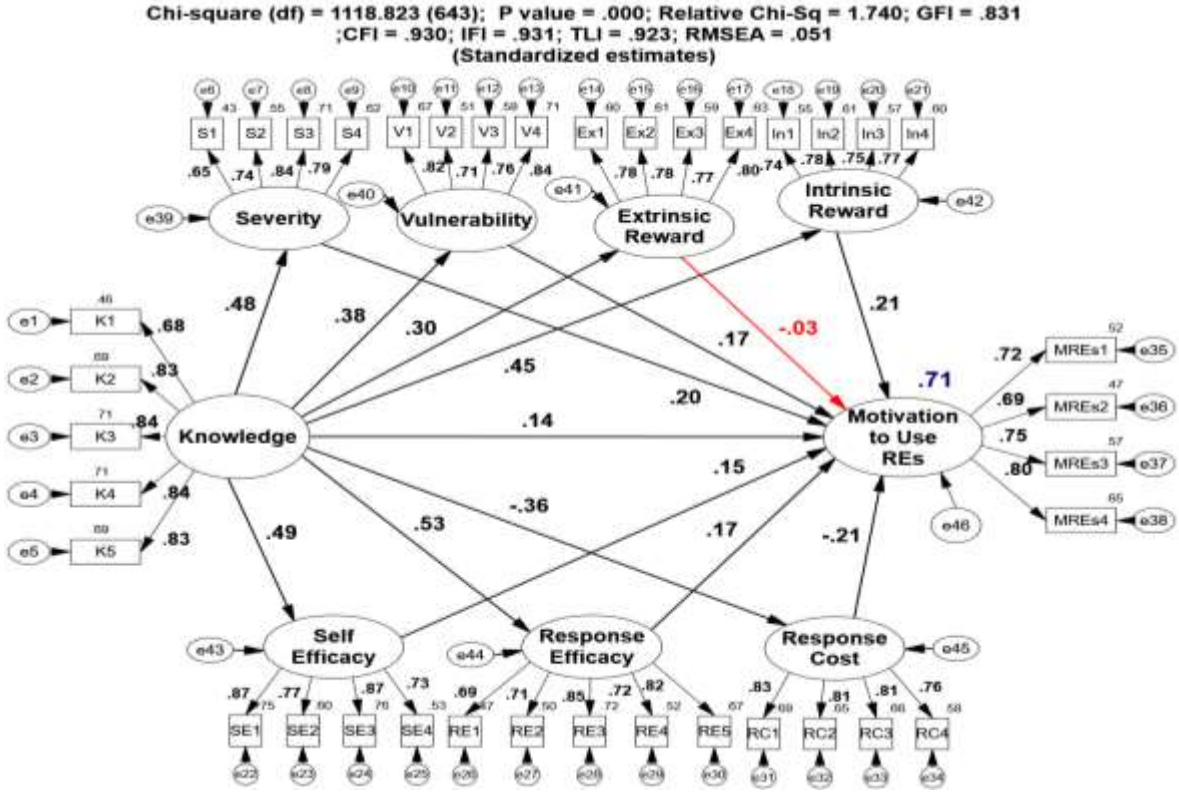

Figure 2. Total structural model with standardized estimates.

variables as mediations (Figure 2).

The goodness-of-fit indices showed that, although the estimated model based on the significant chi-square index lacked a goodness of fit, the model had a satisfactory fit to data based on other indices (Table 4). According to the structural model result, knowledge and PMT variables explain approximately 71% of the variances of motivation to use REs (Figure 2). The hypothesis testing based on total structural model as portrayed in Table 4 revealed the result as follows;

H1: The path relation between perceived vulnerability and motivation to use REs is positive and significant (β= 0.169; CR= 2.152; Sig= 0.031), therefore, H1 is supported.

H2: The path relation between perceived severity and motivation to use REs is positive and significant (β= 0.197; CR= 2.012; Sig= 0.044), therefore, H2 is supported.

H3: The path relation between perceived intrinsic and motivation to use REs is positive and significant (β= 0.212; CR= 2.161; Sig= 0.031), therefore, H3 is supported.

H4: The path relation between perceived extrinsic and motivation to use REs is not significant (β= -0.035; CR= -0.560; Sig= 0.576), therefore, H4 is not supported.

H5: The path relation between perceived self-efficacy and motivation to use REs is positive and significant (β= 0.154; CR= 2.144; Sig= 0.032), therefore, H5 is supported.

H6: The path relation between perceived response efficacy and motivation to use REs is positive and significant (β= 0.168; CR= 2.091; Sig= 0.036), therefore, H6 is supported.

H7: The path relation between perceived response cost and motivation to use REs is negative and significant (β= -0.214; CR= -

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Table 4. The results of estimating the total structural model. [a]

Path/hypothesis	Unstandardized Regression Weights Estimate	SE	Standardized Regression Weights	Critical ratio	Sig	Hypothesis test
H1: Perceived vulnerability → Motivation to use REs	.139	.064	.169	2.152	.031	Supported
H2: Perceived severity→ Motivation to use REs	.185	.092	.197	2.012	.044	Supported
H3: Perceived intrinsic rewards→ Motivation to use REs	.208	.096	.212	2.161	.031	Supported
H4: Perceived extrinsic rewards→ Motivation to use REs	-.028	.050	-.035	-.560	.576	Not Supported
H5: Perceived self-efficacy→ Motivation to use REs	.116	.054	.154	2.144	.032	Supported
H6: Perceived response efficacy → Motivation to use REs	.166	.079	.168	2.091	.036	Supported
H7: Perceived response cost → Motivation to use REs	-.189	.064	-.214	-2.940	.003	Supported
H8: Knowledge→ Motivation to use REs	.107	.054	.138	1.974	.048	Supported

[a] Structural model goodness-of-fit indices: [χ^2 (643)= 1118.823; P= 0.000; Relative Chi-Square (χ^2/df)=1.740; GFI= 0.831; CFI= 0.930; IFI=0.931; TLI= 0.923; RMSEA= 0.051]

2.940; Sig=0.003), therefore, H7 is supported.

H8: The path relation between knowledge and motivation to use REs is positive and significant (β= 0.138; CR= 1.974; Sig= 0.048), therefore, H8 is supported.

Knowledge Indirect Effect

In order to test the indirect effect of knowledge on motivation to use renewable energy or, in other words, to examine mediation effects of PMT variables on the relationship between knowledge and motivation to use renewable energy, a "Bootstrap" method was used. Bootstrap offers an estimate for the extent of the indirect effect, its statistical significance, and determines confidence intervals for the point estimate (Mallinckrodt *et al.*, 2006). In order to run the bootstrap analysis, as recommended by Preacher and Hayes (2008) , 5,000 bootstrap samples with a 95% Percentile-confidence intervals were requested and drawn by default with replacement from the original data set of 287 cases. The results of the bootstrapping method suggested that the sum of indirect effects of knowledge on motivation to use REs through PMT variables was significant (β= 0.484; Sig= 0.002) (see Table 5). In other words, PMT variables mediated the relationship between knowledge and motivation to use REs by farmers in Zanjan County. Further, in addition to having significant direct effect on the farmer's motivation to use REs indirectly through influencing PMT variables, knowledge affected farmer's motivation to use REs.

DISCUSSION

The study results revealed that motivation to use REs by farmers was positively influenced by threats appraisal variables, which included, in order of predictive power, intrinsic reward, severity, and vulnerability, respectively. Greater levels of fear aroused when the study participants perceived the threat of using conventional energy as extreme and perceived themselves to be vulnerable to the threat, therefore, their motivation to engage in action increased. In this regard, the study results revealed a significant effect of severity and vulnerability on motivation to use REs. The

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Table 5. The results of estimating indirect effect of knowledge through PMT variables as mediation.

Variables	Point estimate (Standardized indirect effects - Estimates)	SE	Bootstrap BC[a] percentile 95% CI		
			Lower	Upper	Two Tailed Significance (BC)
Knowledge → PMT variables → Motivation to use REs	[(.479*.197) + (.379*.169) + (.299*-.035) + (.450*.212) + (.487*.154) + (.526*.168) + (-.360*-.214)] = 0.484	0.077	0.327	0.630	.002

[a] BC= Bias-corrected Confidence interval is 5,000 bootstrap samples were requested.

results were consistent with research results of Bender *et al.* (2007) and MacDonell *et al.* (2013). Reward consisting of intrinsic and extrinsic dimensions was another variable of threat appraisal. In this study, the results revealed higher perceived intrinsic reward of practicing Res and stronger motivation to use REs. Superior position of intrinsic rewards in explaining motivation of the studied sample can be related to sense of altruism in preserving the environment and human health, derived from cultural beliefs and values. However, the results on the extrinsic reward were not consistent with the expectation and showed non-significant role, perhaps because of disapproval of society or inadequate support of government showing the action not rewarding extrinsically. The related suggestion is to provide the suitable social condition and more governmental support. Definitely, there are governmental and legislative supports that people are not aware of, and information should be provided on this area.

The coping appraisal variables consist of response and self-efficacies, and response costs were significantly related to motivation to use REs in this study. The highest effect among the coping variables (as well as all PMT variables) belonged to the perceived response cost. The results revealed that farmers were less likely to have an adaptation motivation to use REs when they perceive higher response cost. The largest predictive role of the perceived response cost of this study is consistent with the results reported in the study by Pakmehr *et al.* (2020) who showed that farmers perceive cost of adaptation strategies as the most important factor in their behavior. Efficacy of new practices of REs was the second coping variable positively contributing to motivation prediction to use REs in this study. This finding was consistent with the results of other studies (Keshavarz and Karami, 2016; Verkoeyen and Nepal, 2019).The study respondents assessed their own ability in applying the REs technologies at a high level, raising their motivation for adaptive behavior. The results were in line with the results of another study that found a significant role of self-efficacy in protection motivation (Horng *et al.*, 2014). The suggestion would be providing a small-scale labor-intensive technology requiring more human resources, which are the main asset of the rural people. The other suggestion is financial support of government and other agencies for establishment of the REs technologies in the first stage.

Further, based on the study results on response cost and internal rewards as two variables with highest contribution, it could be discussed that, although internal rewards showed an important and constructive role in motivating respondents to use renewable energy, the negative and strong role of response costs could override intrinsic motivations. In addition, the non-significant role of external rewards due to limited social and governmental supports, could be an explanation for reducing willingness to spend time, effort, emotion, and expenses on

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renewable energy while internal reward exist.

Findings of the study revealed that enhancement of knowledge about REs could directly increase the perceived severity, vulnerability, intrinsic reward, response efficacy, self-efficacy, response costs, and motivation to use REs. Indirect relationship between knowledge and motivation through PMT variables was another unique contribution of the study. The hypothesized role of knowledge was supported by this study results. Previous studies also supported the relationship between knowledge and public acceptance or willingness to pay for renewable energy (Lin and Syrgabayeva, 2016; Pagiaslis and Krontalis, 2014), and prediction of intention (Rajaie *et al.*, 2018). Note that these studies looked at the knowledge only as an independent variable.

CONCLUSIONS

Problems such as environmental pollution, greenhouse gas emission, global warming, and climate change arise from the use of non-renewable energy, and indicate importance of applying Renewable Energy (REs). Transition to apply clean and REs requires a bottom-up approach and understanding public acceptance, in which motivation is a crucial component. Thus, PMT model was applied to fulfill the gap, and knowledge was considered as a background variable that could play a role in shaping motivation indicators. The results of this study originally contributed to PMT and provided a valuable perspective on farmers' knowledge of renewable energies, understanding the threat posed by the use of non-renewable energy, and coping factors influencing the likelihood of an adaptive response. Thus, the results of this study can pave the way for implementation of programs related to development of REs in rural areas.

Regarding policy implications, based on the study results, the main recommendation is policy making for providing relevant knowledge on REs as a nonpolluting, re-useable, and recycling source. Rural people need to have practical information about how harmful non-renewable energy is and how dangerous it could be. It is necessary to provide practical knowledge about appropriate renewable energy sources with respect to conditions of each region, along with cost-benefit analysis, deployment and implementation conditions, and related laws and regulations. A comprehensive extensional program is required to achieve educational goal of motivating the people to use REs. In addition to introducing severity and vulnerability of non-renewable energy usage, this educational program should concentrate on development of efficacy. Making difference in the area of efficacy including self-efficacy, response efficacy and even cost efficacy of responses, needs a time-consuming training program through extension services. Furthermore, as the perceived costs were the strongest predictor of motivation, providing cost-effective renewable energy technologies and paying attention to local capacities, are among other suggestions for agricultural research sector. In this regard, policymakers are expected to support research sector, initial setting up costs, and appropriate rewards.

Our study was limited to investigating the knowledge subjectively, thus, for further research, it is suggested to assess the knowledge objectively. Further studies are required to replicate the conceptualized model of this study to confirm contribution of knowledge in PMT. Moreover, since the study population showed appropriate level of motivation to use REs, it is recommended that the future studies focus on investigation of socio-economic environment, appropriate model of people's participation, along with technical aspect of applying REs in the study context.

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درک پاسخ کشاورزان به انرژی‌های تجدیدپذیر: کاربرد نظریه انگیزش حفاظت

م. بادسار، و ر. کرمی

چکیده

مطالعه حاضر تئوری انگیزش حفاظت را برای تشریح واکنش کشاورزان به انرژی‌های تجدید پذیر در ایران مورد آزمون قراد داده است. مزید بر آن، در این مطالعه تأثیر مستقیم و غیرمستقیم دانش بر انگیزه استفاده از انرژی‌های تجدید پذیر از طریق متغیرهای تئوری انگیزش حفاظت مورد بررسی قرار گرفته است. جامعه آماری هدف این مطالعه را کشاورزان شهرستان زنجان تشکیل داده‌اند. برای نمونه‌گیری از روش نمونه‌گیری چند مرحله‌ای استفاده شده و حجم نمونه با استفاده از نرم‌افزار G*Power تعیین گردید (n=287). برای آزمون فرضیه‌های تحقیق از تکنیک چند معیاره مدل‌سازی معادلات ساختاری استفاده شده است. نتایج نشان داد که متغیرهای ارزیابی تهدید برمبنای تئوری انگیزش حفاظت شامل: درک آسیب پذیری، شدت خطر و پاداش درونی دارای رابطه مثبت و معنی داری با انگیزه کشاورز برای استفاده از انرژی‌های تجدیدپذیر می‌باشند. همچنین، نتایج نشان داد که تمام متغیرهای ارزیابی مقابله برمبنای تئوری انگیزش حفاظت با انگیزه کشاورز برای استفاده از انرژی‌های تجدیدپذیر رابطه معناداری دارند. علاوه بر این، نتایج مدل ساختاری کلی نشان داد که دانش کشاورزان به طور مستقیم و غیرمستقیم (از طریق متغیرهای تئوری انگیزش حفاظت) دارای تأثیر معنی داری بر انگیزه کشاورز برای استفاده از انرژی های تجدیدپذیر می‌باشد. این مدل شامل متغیرهای تئوری انگیزش حفاظت و دانش، حدود 71٪ انگیزه کشاورز را برای استفاده از انرژی های تجدیدپذیر توضیح می‌دهد. بنابراین نتایج قابلیت بکارگیری تئوری انگیزش حفاظت را برای توضیح واکنش کشاورزان به انرژی‌های تجدید پذیر در ایران نشان داد. از این رو می‌توان پیشنهاد کرد که در مطالعات آینده مدل توسعه‌یافته انگیزش حفاظت با درنظر گرفتن پیش تأثیر دانش انرژی های تجدیدپذیر، مورد استفاده قرار گیرد.

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