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Understanding Iranian Rural People's Intention to Use Renewable Energy Technologies: Pro-Self or Pro-Social Orientations?

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ABSTRACT

The increasing need for energy resources and the threat of shortage of available fossil fuels in the future along with the adverse environmental issues arising from consumption of these fuels, especially climate change, have led countries to pursue sustainable and eco-friendly modes of producing energy. Meanwhile, in recent years, many researchers have considered renewable energies and their related technologies. However, the evidence indicates that social or public acceptance of Renewable Energy Technologies (RETs) is low and people, especially in rural areas of developing countries, are less likely to adopt and use such technologies. Accordingly, the current study was undertaken to investigate the factors influencing Iranian villagers' intention to use RETs through two socio-psychological models with pro-self and pro-social motivations and to integrate them into one comprehensive theoretical framework. A questionnaire survey was conducted for 393 villagers in Zanjan County in northwestern Iran. The study results disclosed that personal norm, attitude, social norm, and perceived behavioral control had significant positive impacts on the intention to use RETs. Most importantly, the findings confirmed the effectiveness of the original models of Norm Activation Model (NAM) and Theory of Planned Behavior (TPB) in explaining the villagers' intention. However, the utility and applicability of an integrative model of TPB-NAM were superior to the original models. Additionally, the original NAM contributed considerably more to the integrative model than the original TPB. Collectively, the pro-social orientations outweighed the pro-self motives in the case of explaining the behavioral intention regarding the use of RETs among Iranian villagers. Overall, this study's findings contribute to the theory and practice around sustainable energy development in Iran and other developing countries.

Keywords: Clean and sustainable energy, Integrative perspective, Pro-environmental behavior, Pro-self and pro-social orientations, Rural areas.

INTRODUCTION

Evidence shows that there is an unsustainable energy system in the rural areas of developing countries. In Iran, there is enormous potential of renewable energy application and the need to use Renewable Energy Technologies (RETs) in rural communities, but their contribution to the current energy supply is negligible compared to fossil fuels (Yazdanpanah *et al*., 2015b). Indeed, the renewable energies and related technologies are not sufficiently accepted and used by public, particularly the villagers in Iran (Rezaei and Ghofranfarid, 2018). Therefore, since the public acceptance of RETs is obviously vital for the successful process of energy transition (Huijts *et al*., 2012), the lack of community acceptance and of willingness to use renewable energy is presumed as a major barrier for deployment of RETs in Iran

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(Komendantova *et al*., 2018). Despite the importance of this issue, a comprehensive literature review of the renewable energy in Iran shows that most research have concentrated on the technical, economic, and political aspects of renewable energies and related technologies (Bahrami and Abbaszadeh, 2013; Zareei, 2018; Alizadeh *et al*., 2020; Safieddin Ardebili, 2020). Limited empirical studies have been conducted on the behavioral and human factors associated with renewable energy usage in the country (Yazdanpanah *et al*., 2015a; Rezaei and Ghoranfarid, 2018). To the best of researchers' knowledge, no study has assessed socio-psychological predictors of Iranian villagers' intention to use RETs based on the integration of the Theory of Planned Behavior (TPB) and the Norm Activation Model (NAM) as a comprehensive framework. Hence, there is a clear research and evidence gap in this context. It should be noted that prior studies implemented in renewable energy field in Iran have principally focused on policymakers and program planners such as agricultural advisors (Yaghoubi *et al*., 2019), and professionals (Bakhtiyari *et al*., 2017), or university students (Yazdanpanah *et al*., 2015a,b; Komendantova *et al*., 2018), and very little consideration has been given to villagers' viewpoints as the major potential stakeholders in RETs' application (Rezaei and Ghofranfarid, 2018). Thus, in order to fill these gaps, the following questions should be addressed:

(1) What socio-psychological factors affect Iranian rural people's intention to use RETs?

(2) Do the models of TPB and NAM have appropriate efficiency for explanation of Iranian villagers' intention to use RETs?

(3) Does the integration of the TPB and NAM models in a single model enhance their effectiveness in predicting Iranian rural people's intention to use RETs?

(4) Is the Iranian villagers' intention to use RETs mainly driven by either pro-social or pro-self motives?

Hence, the general purpose of this investigation was to examine the determinants of intention to use RETs among Iranian villagers using a new integrated model combined from both TPB and NAM models.

Renewable energy technologies

Renewable Energy Technologies (RETs) are energy-providing technologies that make use of energy sources in a way that prevents natural resource depletion via an eco-friendly manner. These technologies are sustainable due to the fact that they can be managed to ensure that they are permanently usable without environmental degradation (United Nations, 2010). RETs are promising technologies that are able to make modern energy services globally accessible and could facilitate economic and social development in all communities, particularly in rural societies (Demirbas and Demirbas, 2007; Blenkinsopp *et al*., 2013) where the decentralized use of RETs has been proven to be an efficient and viable energy alternative (Mahapatra and Dasappa, 2012). The use of RETs is not only a necessity to preserve fossil fuel resources, but also it has the capacity to diminish many adverse effects of conventional energy production, such as climate change, deforestation, and local air pollution (Mahapatra and Dasappa, 2012; Blenkinsopp *et al*., 2013).

RETs include a wide variety of devices and systems that can be typically divided into two categories: (1) Those which are utilized for domestic energy supply (mainly heating and cooking), and (2) The ones that are used to supply electricity (United Nations, 2010). The first category would act by using modern fuels or exploiting conventional fuels through new and improved techniques. The second category can perform as a grid-based system or part of a stand-alone power system by connecting to the national grid

Table 1. Renewable energy sources and related RETs.

Energy source	RETs	
	Energy for domestic use	Electricity
Elemental renewable		
Solar	Solar pump, solar cooker, solar water heater	Solar PV
Water (Including wave/Tidal)	-	Micro and pico-hydroelectric generation plant
Wind	Wind-powered pump	Wind turbine generator
Geothermal	-	Geothermal generating plant
Biological renewables		
Energy of the crops	-	Biomass generating plant
Standard crops and by-products	-	Biomass generating plant
Forestry and its by-products	Improved cook stoves	Biomass generating plant
Animals' by-products	Biogas digester, Improved cook stoves	Biogas digester

or a mini-grid. Table 1 demonstrates the renewable energy resources defined by the United Kingdom Renewable Energy Association (2009), as well as related RETs enabling access to electricity and modern energy services.

Theory of Planned Behavior

The TPB is a powerful and applicable model for understanding pro-environmental behaviors (Hansmann *et al*., 2020). In more detail, within the domain of pro-environmental behaviors, some recent empirical studies focused on energy use and conservation behavior, benefitted from the TPB as the backbone of their theoretical framework (Chen, 2016; Tan *et al*., 2017). However, the theory has rarely been employed in the field of RETs' acceptance (Yun and Lee, 2015; Irfan *et al*., 2020), particularly to explore villagers' viewpoints (Liu *et al*., 2013).

The TPB assumes that the intention is the most immediate antecedent and best predictor of actual behavioral performance (Rezaei and Mianaji, 2019; Sok *et al*., 2020). However, the intention is a function of attitude, social norm (SN) as well as Perceived Behavioral Control (PBC) (Wang *et al*., 2019). In this respect, previous studies have shown that attitude is an important determinant of different pro-environmental intentions and behaviors (Han and Hyun, 2017; Valizadeh *et al*., 2021) including energy-saving behavior (Yun and Lee, 2015; Rezaei and Ghofranfarid, 2018; Wang *et al*., 2018). Accordingly, if villagers perceive that the use of RETs is valuable and useful and provides positive consequences for them, they will intend to use those technologies. Similarly, several empirical studies suggest that PBC positively affects individuals' intention in the field of RETs' usage (Yazdanpanah *et al*., 2015b; Yun and Lee, 2015; Tan *et al*., 2017; Ji *et al*., 2019). In other words, villagers' intention to use RETs will be stronger when their PBC is greater. Finally, different studies have indicated that strong SN related to RETs usage would enhance individuals' intention to use those technologies (Saleh *et al*., 2014; Ji *et al*., 2019). Overall, according to the TPB principles, the present study hypotheses include the following cases (Figure 1):

H_1: Villagers' attitude toward using RETs affects their intention to use the technologies.

H_2: Villagers' PBC of using RETs affects their intention to use the technologies.

H_3: Villagers' SN of using RETs affects their intention to use the technologies.

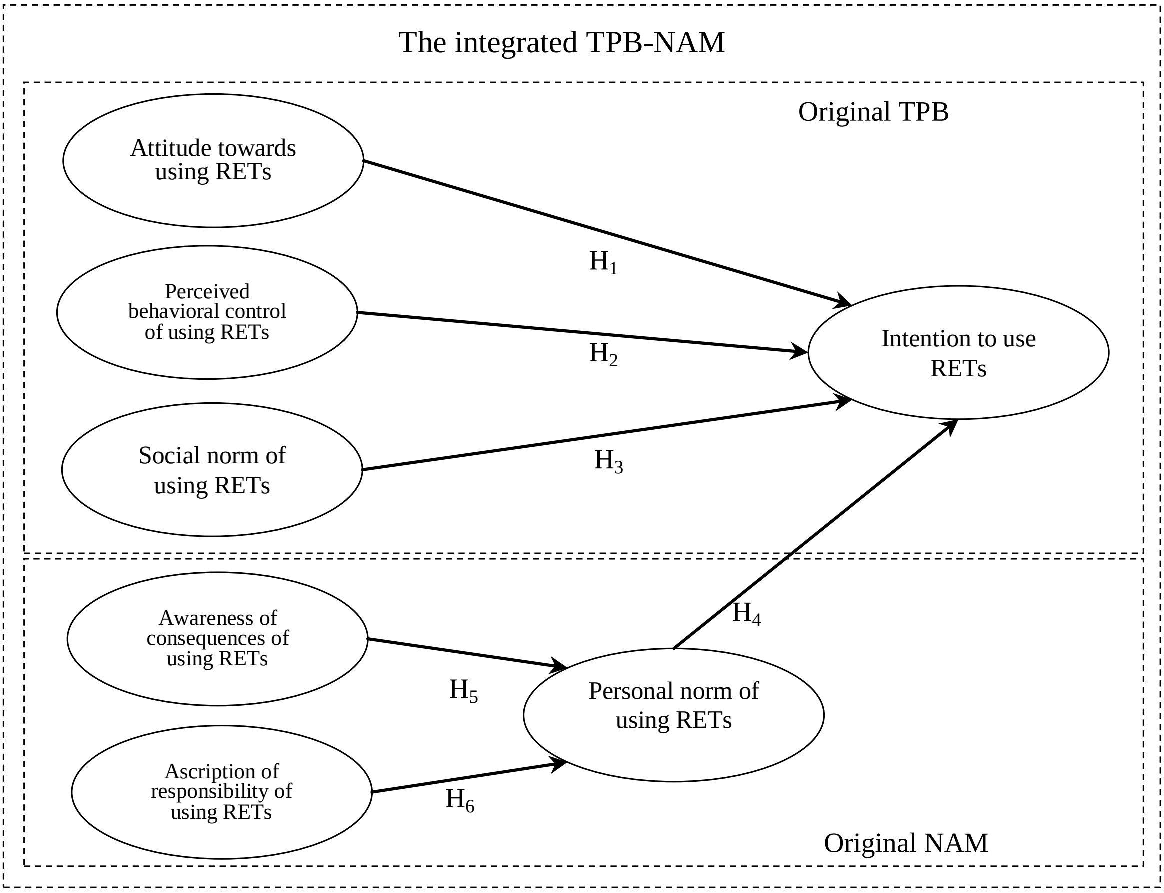

Figure. 1. Theoretical research framework. (RETs: Renewable Energy Technologies; TPB: Theory of Planned Behavior; NAM: Norm Activation Model).

Norm Activation Model

NAM (Schwartz, 1977) is a valuable theoretical model aiming at explaining pro-social and altruistic behaviors (Hoang, 2017). Personal Norm (PN), which is defined as the moral obligation to fulfil, or not perform a specific action, is the main variable of NAM. In keeping with the model, altruistic behaviors are a function of PNs triggered by two components: Awareness of Consequences (AC) and Ascription of Responsibility (AR) (Schwartz, 1977). The AC refers to whether or not people are cognizant of the adverse effects of not doing pro-social behaviors for others. In the same way, AR is described as a sense of responsibility for the adverse effects of not conducting pro-socially (De Groot and Steg, 2009).

Overall, the results of various empirical studies suggest that NAM is a valid and suitable model in predicting different pro-environmental intentions/behaviors (Valizadeh *et al*., 2019) such as environmental complaint (Zhang *et al*., 2018), willingness to pay for recycled paper products (Guagnano, 2001), and general pro-environmental behaviors (Harland *et al*., 2007). This is also true in the field of energy behaviors (Zhang *et al*., 2013; Lv *et al*., 2016) such as RETs acceptance (Wittenberg *et al*., 2018). Therefore, according to the NAM analytical framework, it can be posited that villagers who are aware of conceivably detrimental consequences to overuse fossil fuels and assign responsibility for the consequences to themselves, will feel more moral obligation to use RETs. This, in turn, may result in forming a stronger intention to apply those technologies. In the light of the above discussion, three hypotheses can be derived (Figure 1):

H_4: Villagers' PN of using RETs affects their intention to use the technologies.

H_5: Villagers' AC of using RETs affects the PN relevant to their use.

H_6: Villagers' AR of using RETs affects the PN relevant to their use.

Integrating TPB and NAM

The use of fossil fuels not only contributes to irreversible and threatening environmental consequences, particularly greenhouse gas emissions and climate change, but also endangers the health of humans and the environment through pollution of ecological resources (Yazdanpanah *et al*., 2015b). However, such environmental consequences can be mitigated by the promotion of RETs. Therefore, the use of RETs includes some altruistic and pro-social motivations. Moreover, using RETs, individuals, especially in rural areas, can reduce their dependence on fossil energy sources and earn more money by decreasing their production costs. Additionally, the use of RETs improves rural people' quality of life and makes their farms more sustainable (Shabanali Fami *et al*., 2010). Hence, the use of RETs also contains some self-interest motives and preferences. Accordingly, the use of RETs as a type of environmentally friendly measure is probably best perceived as a combination of pro-self and pro-social drives (Bamberg and Möser, 2007; Rezaei *et al*., 2019). Therefore, to better understand the determinants of rural people's intention to use RETs, this research employed two well-known socio-psychological theories of NAM and TPB, aiming at developing a mixed theoretical framework (Figure 1).

MATERIALS AND METHODS

The present study was designed as a cross-sectional survey. The target population for the study involves all heads of households in the rural areas of the central district of Zanjan County, Zanjan Province, Iran. The population included 25,863 villagers (Statistical Center of Iran, 2016). Using the formula proposed by Bartlett *et al*. (2001), the required sample size for this study was estimated to be 378 participants, which was increased to 400 participants for better results:

$$n=\frac{\dfrac{Z_{\frac{\alpha}{2}}^{\,2}pq}{d^2}}{1+\dfrac{1}{N}\left[\dfrac{Z_{\frac{\alpha}{2}}^{\,2}pq}{d^2}-1\right]}$$

Where, N= Size of population (25,863 villagers), n= Required sample size, z= Confidence level at 95% (z= 1.96), d= Margin of error at 5% (standard value of 0.05), p= Proportion in the target population (p= 0.5), and q= (1−p) (i.e., q= 0.5). Given the distribution of households' heads in different rural districts of Zanjan County and the representativeness of the sample, a 3-stage multistage sampling design was used to select the surveyed respondents. To this end, at the first stage, out of the 13 rural districts of the county, four rural districts including Soharin (in the Qareh Poshtelu District), Taham and Mojezat (in the central district), and Qanibeyglu (in the Zanjanrud District) were chosen randomly. Collectively, the selected rural districts consisted of 81 villages of which 30 villages were considered to obtain the samples from. Then, a random sample was taken with a proportional number of stratum size (i.e., village) as compared to the target population. Quantitative data were obtained through in-depth, personal interviews with villagers, employing a survey questionnaire distributed from December 2019 to February 2020. Each interview lasted for an average of about 30 minutes. This study recorded a response rate of 98.2% and 393 successfully completed questionnaires from 400 distributed ones.

The questionnaire used for this study had two independent subsections. The first part probed for villagers' personal characteristics including sex, age, education, family size, occupation, and so on. The second part consisted of 28 items quantifying seven constructs/latent variables of the integrated TPB-NAM, including intention to use RETs, attitude toward using RETs, SN of using RETs, PBC of using RETs, PN of using RETs, AR for using RETs, and AC of using RETs (Table 2). In this study, the villagers were requested to complete a self-assessment regarding various items on a 5-point Likert scale with endpoints of 'strongly disagree' and 'strongly agree'. The wording was kept as simple as possible to facilitate understanding among respondents.

The Structural Equation Modelling (SEM) was applied with maximum likelihood estimation using AMOS software in order to test the hypothesized relationships. A two-stage model building strategy was adopted to assess the research model. First-order CFA with all the items in the model was initially performed to assess the model fit, composite reliability, discriminant validity, and convergent validity in order to ensure effectiveness and quality of the measurement model. Then, the structural model was evaluated to test the hypotheses proposed in the research model (Rezaei *et al*., 2017; Safa and Mohammadian Saghinsara, 2020). Regarding the model's fit, the following seven common criteria were used in the present research: (1) The Root Mean square Residual (RMR) and the Root Mean Square Error of Approximation (RMSEA < 0.08) in which being smaller than 0.08 suggests an appropriate model fit (Marcoulides and Schumacker, 1996; Chen, 2007), (2) the Goodness-of-Fit Index (GFI), the Adjusted GFI (AGFI), the Incremental Fit Index (IFI), and the Comparative Fit Index (CFI), at values equal to or greater than 0.90 (Bagozzi and Yi, 1988); and (3) the relative Chi-square (χ^2/df), where a value lower than 5 indicates acceptable fit (Marsh and Hau, 1996). Moreover, the chi-square difference ($\Delta\chi2$) is also applied among the models to examine substantial improvement over the competing models. In general, a significant value of the $\Delta\chi2$ shows that the model contains an appropriate predictive ability (Chen, 2016). As a final point and based on the suggestion of Cohen (1988), the f^2 effect size (namely, the R^2 change effect [Computed as: (R^2incl −R^2excl)/ (1-R^2incl)] was employed to compare the power of original TPB and NAM in intention variance advancement of the integrative TPB-NAM model (Wang *et al*., 2019). To categorize the effect size of f^2, the values of 0.35, 0.15 and 0.02 were considered as large, medium, and small, respectively (Cohen, 1988).

RESULTS

Sample Descriptive Statistics

Descriptive statistics for the main personal characteristics of the surveyed villagers are summarized in Table 3. Among the respondents (393 individuals), 94.8% were male and 5.2% were female. The average age of respondents was 51.1 years, with the minimum and maximum age of 19 and 78 years old, respectively. The 41–50-year age group was largest (32.4%) (Table 3). Regarding respondents' education, the villagers with elementary education had the highest prevalence in the sample (41.7%). The average family size was 4.9 individuals. Concerning the main occupation, 78.6% of the respondents were farmers. The average farming experience was 28.3 years. In terms of the ownership, 92.2% of the farms were owned and 7.8% were rented by the villagers. As Table 3 presents, the mean farm size of the respondents was 8.4 ha and the average number of land parcels was 4.1.

Assessment of Measurement Model

In this stage, a series of first-order CFA was conducted to examine three measurement models, including original TPB (Model 1), original NAM (Model 2), and integrative model of TPB-NAM (Model 3). Tables 3 and 4 present the results of the measurement models. Although the chi-

Table 2. Standardized factor loadings and fit indices of the measurement models.

Construct and item	Standardized factor loading (t- value)		
	Model 1	Model 2	Model 3
- **Intention**			
I intend to use RETs at my home or farm in the near future (INT_1).	0.82 (Fixed)	0.83 (Fixed)	0.82 (Fixed)
I will put more effort into using RETs at my home or farm in the near future (INT_2).	0.91 (21.74)	0.91 (21.93)	0.91 (21.89)
I am actually planning to use RETs at my home or farm in the near future (INT_3).	0.84 (19.47)	0.84 (19.59)	0.84 (19.57)
I will strongly recommend that others villagers and farmers use RETs at their homes or farms (INT_4).	0.79 (17.91)	0.79 (18.13)	0.79 (18.05)
- **Attitude**			
For me, using RETs at home or farm is good (ATT_1).	0.72 (Fixed)	-	0.69 (Fixed)
For me, using RETs at home or farm is valuable and useful (ATT_2).	0.76 (13.66)	-	0.76 (13.36)
For me, using RETs at home or farm is wise (ATT_3).	0.66 (11.97)	-	0.66 (11.73)
For me, using RETs at home or farm is beneficial (ATT_4).	0.75 (11.86)	-	0.76 (11.85)
Overall, I think that more installation of RETs is needed at my home or farm (ATT_5).	0.77 (13.70)	-	0.78 (13.67)
- **PBC**			
The decision to use RETs at home or farm is under my control (PBC_1).	0.74 (Fixed)	-	0.74 (Fixed)
Whether I use RETs at my home or farm is entirely up to me (PBC_2).	0.83 (15.78)	-	0.83 (15.78)
I have adequate resources (cost) to use and maintain RETs at my home or farm (PBC_3).	0.86 (16.35)	-	0.87 (16.42)
I have the knowledge and skill about the installation requirement for RETs at my home or farm (PBC_4).	0.75 (14.32)	-	0.75 (14.24)
I am confident in my ability to maintain RETs at home or farm (PBC_5).	Dropped	-	Dropped
- **SN**			
My social environment (i.e., friends, family, extension agents, and mass media) expect me to use RETs at my home of farm as much as possible (SN_1).	0.70 (Fixed)	-	0.71 (Fixed)
Important people to me would largely support me in using RETs at my home or farm (SN_2).	0.94 (14.21)	-	0.94 (14.53)
People whose opinions I care about would approve the use of RETs at my home of farm (SN_3).	0.71 (13.11)	-	0.71 (13.19)
- **PN**			
I feel morally obligated to reduce my consumption of fossil fuels using RETs at my home or farm (PN_1).	-	0.82 (Fixed)	0.82 (Fixed)
No matter what other people do, my own environmental principles and values tell me the use of RETs is right (PN_2).	-	0.77 (14.68)	0.77 (14.75)
For environmental reasons, I have a bad conscience when I use too much fossil fuel at my home or farm (PN_3).	-	0.73 (14.01)	0.73 (14.04)
- **AC**			
I think that using RETs and decreasing fossil fuel consumption reduce greenhouse gas emissions and prevent climate change (AC_1).	-	0.79 (Fixed)	0.79 (Fixed)
In my opinion, overuse of fossil fuel leads to pollution of environmental resources such as air, surface and ground water, and soil (AC_2).	-	0.95 (21.55)	0.94 (21.48)
I believe that using RETs reduces the reliance on limited fossil fuels and prevents energy crisis in the future (AC_3).	-	0.90 (20.52)	0.90 (20.52)
I think that overconsumption of fossil fuels can endanger human health (AC_4).	-	0.69 (14.70)	0.70 (14.76)

- Fit indices of the measurement models:

(1) Model 1: χ^2/df= 3.295; AGFI= 0.869; GFI= 0.906; IFI= 0.938; CFI= 0.936; RMR= 0.031; RMSEA= 0.077

(2) Model 2: χ^2/df= 3.382; AGFI= 0.878; GFI= 0.914; IFI= 0.946; CFI= 0.946; RMR= 0.038; RMSEA= 0.078

(3) Model 3: χ^2/df= 3.047; AGFI= 0.822; GFI= 0.858; IFI= 0.907; CFI= 0.906; RMR= 0.038; RMSEA= 0.072

Continued…

Continued of Table 2. Standardized factor loadings and fit indices of the measurement models.

Construct and item	Standardized factor loading (t- value)		
	Model 1	Model 2	Model 3
- **AR**			
I feel responsible for the consequences resulting from overusing fossil fuel (AR_1).	-	0.71 (Fixed)	0.73 (Fixed)
In my opinion, the use of RETs is not only the responsibility of other villagers, but me too (AR_2).	-	0.92 (16.33)	0.89 (16.92)
I believe that all villagers are jointly responsible for the problems potentially caused by overconsumption of fossil fuel (AR_3).	-	0.87 (16.08)	0.87 (16.55)
I think that the government bears the most responsibility for negative consequences of overuse of fossil fuels, particularly environmental pollution (AR_4).	-	0.54 (10.13)	0.55 (10.52)

- Fit indices of the measurement models:
(1) Model 1: χ^2/df= 3.295; AGFI= 0.869; GFI= 0.906; IFI= 0.938; CFI= 0.936; RMR= 0.031; RMSEA= 0.077
(2) Model 2: χ^2/df= 3.382; AGFI= 0.878; GFI= 0.914; IFI= 0.946; CFI= 0.946; RMR= 0.038; RMSEA= 0.078
(3) Model 3: χ^2/df= 3.047; AGFI= 0.822; GFI= 0.858; IFI= 0.907; CFI= 0.906; RMR= 0.038; RMSEA= 0.072

Table 3. Sample descriptive statistics (n= 393).

Variable	Frequency (%)	Mean
- Sex		-
Male	94.8	
Female	5.2	
- Age (Years)		51.1
From 19 to 30	8.9	
From 31 to 40	18.1	
From 41 to 50	32.4	
From 51 to 60	24.7	
Older than 61	15.9	
- Education		-
Illiterate	19.9	
Elementary school	41.7	
Intermediate school	16.5	
High school	10.3	
Academic degree	11.6	
- Family size		4.9
- Main occupation		-
Agriculture	78.6	
Non-agriculture	21.4	
- Farming experience (Years)		28.3
- Ownership of farming system		-
Owned	92.2	
Rented	7.8	
- Farm size (ha)		8.4
- Number of land parcels		4.1

square statistics were statistically significant, the values computed for other indices indicated that the models achieved satisfactory fit (Table 2). As Table 2 presents, except the item of PBC_5 in Model 1 and Model 3, other standardized factor loadings were larger than 0.5 and significant at P< 0.001.

As the results in Table 4 show, the values of AVE and CR all surpassed the recommended threshold of 0.5 and 0.7, respectively. Accordingly, the convergent validity and CR of the three models was considered satisfactory. The values of ASV and MSV were lower than AVE, satisfying the requirement of discriminant validity in the models (Table 4). Certainly, it is worth mentioning that owing to the proximity of the validity and reliability indicators values in the three estimated measurement models, the results are only reported for Model 3 in Table 4.

Assessment of Structural Models

After validating the measurement models through CFA in the preceding section, the focus here is now placed on estimating the structural models. For this purpose, three consecutive structural models were run to test the hypothesized paths in the proposed model. Concerning Model 1 (i.e., original TPB), most indices were within the acceptance range, showing that the structural model fitted the data adequately (Table 5). The R^2 value computed for the model were equal to 0.46, representing that 46% of the variance in the dependent variable (i.e., the intention to use RETs) can be predicted by the variables of attitude, SN, and PBC (Table 5). The findings also disclosed that all three complements had significant positive effects on the intention to use RETs. Therefore, all hypotheses in the original TPB were supported.

Similar to Model 1, the findings of the second structural model showed that Model 2 (i.e., original NAM) had a reasonably good fit (Table 5). Based on the value of R^2 in Model 2, it can be stated that three predictors in the original NAM, including PN, AC, and AR explained 39% of the variance in the intention (Table 5). Furthermore, the results indicated that PN significantly and positively affected the intention to use RETs (Table 5). Similarly, two variables of AC and AR showed significant positive effects on PN. These results clearly indicate that Hypotheses 4, 5, and 6 are supported by the data in the original NAM (Table 5).

After estimating the structural models of original TPB and NAM, the effects of the predictors' variables in the proposed model were tested by running a more comprehensive model, which included the main constructs of both original TPB and NAM models. As Table 5 shows, most fit indices were within acceptable fit limits. Therefore, Model 3 (i.e., integrative TPB-NAM) exhibited an appropriate fit. The model explained 55% of the variance in the intention, being higher than those in Models 1 and 2 (Table 5). In more detail, comparison of the three models using the $\Delta\chi^2$ index indicated a significant increase from Models 1 and 2 to Model 3 in terms of predictive power. This illustrates that the integration of the constructs of the two models of TPB and NAM have significantly enhanced the integrative TPB-NAM

Table 4. Model 3 indicators of validity and reliability and multicollinearity diagnostics.

Constructs	Validity and reliability				Correlation matrix						
	AVE	CR	MSV	ASV	Intention	Attitude	PBC	SN	PN	AC	AR
Intention	0.708	0.906	0.387	0.248	-	-	-	-	-	-	-
Attitude	0.537	0.852	0.501	0.274	0.622	-	-	-	-	-	-
PBC	0.634	0.873	0.274	0.135	0.430	0.482	-	-	-	-	-
SN	0.627	0.832	0.216	0.123	0.465	0.418	0.237	-	-	-	-
PN	0.602	0.819	0.377	0.154	0.614	0.434	0.209	0.374	-	-	-
AC	0.703	0.903	0.163	0.104	0.327	0.404	0.136	0.335	0.318	-	-
AR	0.596	0.851	0.501	0.204	0.466	0.708	0.523	0.202	0.267	0.350	-

predictive power. Moreover, the findings revealed that the effect size of Model 1 for Model 3 was 0.200, while that of Model 2 was 0.356. In other words, the effect size for Model 1 in Model 3 was medium, while the effect size for Model 2 was large (Table 5). Therefore, the original NAM contributed considerably more to the integrative model than the original TPB. Finally, similar to Models 1 and 2, all hypothesized paths (from Hypothesis 1 to Hypothesis 6) were reliably confirmed by the data in Model 3 (Table 5).

DISCUSSION

The findings of the present study showed that Hypothesis 1 was supported, and the variable of attitude had a positive significant impact on the villagers' intention to use RETs. This result is in agreement with prior studies on energy-saving behavior, suggesting attitude as a driver of intention and behavior (e.g. Yun and Lee, 2015; Rezaei and Ghofranfarid, 2018; Wang *et al*., 2018). In this regard, Shaw *et al*. (2015) argue that positive attitudes are indispensable for any behavioral change, and individuals' favorable attitude can contribute to improve their intention and, consequently, their actual behavior like using RETs (Rezaei *et al*., 2018). This was arguably because individuals with an appropriate attitude generally regard themselves as environmentalists (Han *et al*., 2009). Under such circumstances, individuals are concerned with the protection of the environment and subsequently they may form a higher intention to perform eco-friendly behaviors, including using RETs.

Table 5. Results of structural models.

Paths	Model 1		Model 2		Model 3	
	Coefficient	t-Value	Coefficient	t-Value	Coefficient	t-Value
Hypothesized paths						
H_1: Attitude → Intention	0.461	7.083^b	-	-	0.331	5.591^b
H_2: PBC → Intention	0.144	2.725^a	-	-	0.165	3.285^a
H_3: SN → Intention	0.230	4.447^b	-	-	0.170	3.563^b
H_4: PN → Intention	-	-	0.624	10.196^b	0.408	8.154^b
H_5: AC → PN	-	-	0.322	5.356^b	0.252	4.223^b
H_6: AR → PN	-	-	0.186	3.123^a	0.203	3.348^b
R^2 value	46%		39%		55%	
$\Delta\chi^2$ (Δdf) with the Model 3	$624.006 (210)^b$		$632.964 (221)^b$		-	
f^2 Effect size in the Model 3	0.200 (Medium)		0.356 (Large)		-	

- The structural models fit indices:
(1) Model 1: χ^2 (df)= 333.950 (97); χ^2/df= 3.443; AGFI= 0.862; GFI= 0.901; IFI= 0.934; CFI= 0.933; RMR= 0.033; RMSEA= 0.079
(2) Model 2: χ^2 (df)= 324.992 (86); χ^2/df= 3.779; AGFI= 0.863; GFI= 0.902; IFI= 0.932; CFI= 0.932; RMR= 0.046; RMSEA= 0.080
(3) Model 3: χ^2 (df)= 957.956 (307); χ^2/df= 3.120; AGFI= 0.818; GFI= 0.852; IFI= 0.903; CFI= 0.901; RMR= 0.045; RMSEA= 0.074

Notes: ^{a} *p < 0.01*, ^{b} *p < 0.001*

Consistent with prior studies (e.g. Yun and Lee, 2015; Yazdanpanah *et al*., 2015b; Tan *et al*., 2017; Ji *et al*., 2019), PBC was found to be another main variable of the TPB that significantly and positively affected the villagers' intention to use RETs, thus confirming Hypothesis 2. However, this result is not in accordance with some earlier studies (Wang *et al*., 2018; Wittenberg *et al*., 2018). In this respect, Pilling *et al*. (2008) argue that a key prerequisite for increasing behavioral intention is to bolster individuals' behavioral control by providing essential conditions, resources, and facilities. In fact, when the villagers feel that they have access to the necessary resources and opportunities (i.e., high controllability) and they have enough knowledge, skills and experience (i.e., high self-efficacy) to use RETs, they obviously perceive greater self-confidence and show a more deliberate intention to use the technologies. However, the evidence shows that the majority of people in rural areas of Iran, including Zanjan County, have poor financial ability and they are not able to purchase different RETs due to their high prices (Zomorodian and Tahsildoost, 2019). This, in turn, has led to villagers' lower controllability on using RETs. Additionally, as discussed by Razzaghi *et al*. (2012), one of the main barriers to development of RETs in rural areas of Iran is associated with weaknesses of villagers' knowledge and skills in installing, using, and maintaining RETs. The importance of this subject is increased by the fact that some RETs have complicated technical features (Ji *et al*., 2019).

The findings of the present research revealed that SN, as the third main component of the TPB, significantly and positively affected the villagers' intention to use RETs, thus confirming Hypothesis 3. This result is in agreement with the findings of Saleh *et al*. (2014), Yun and Lee (2015), and Ji *et al*. (2019), but it is inconsistent with those of Tan *et al*. (2017) and Rezaei and Ghofranfarid (2018). One of the possible explanations for the direct impact of SN on intention to use RETs might be that SN could provoke negative moral emotions such as embarrassment and shame, which could discourage similar behaviors in the future (Nugier *et al*., 2007). However, it is interesting to note that the effect of SN on intention is significantly culture-specific, where individual behavior in collective society can be more possibly influenced by others (Taufique and Vaithianathan, 2018). In this respect, Iranian rural community is also considered as a collective society where the villagers have established a clear inter-personal communication network among themselves. Therefore, they would form a more deliberate intention to use the mentioned technologies in accordance with others only when they feel social pressure to use RETs.

The findings of this study confirmed Hypothesis 4, since the construct of PN significantly and positively affected the villagers' intention to use RETs. Huijts *et al*. (2012), Wittenberg *et al*. (2018), and Ji *et al*. (2019) have reported similar findings. In this respect, Onwezen *et al*. (2013) discuss that the PN impact on intention or behavior is based on anticipated emotions. These anticipated emotions guide behavioral choices and influence intention or actual behavior. In fact, while violation of PN leads to self-deprecation, loss of self-esteem, or guilt, correspondence results in pride, security, or enhanced self-esteem (Schwartz, 1973). Accordingly, conformity with PN is a positive source of personal efficiency (Turaga *et al*., 2010) and may guide individuals' intentions or behaviors. Moreover, Ji *et al*. (2019) believe that PN includes the social responsibility and environmental concern, which can persuade individuals to engage in pro-environmental behaviors such as RETs' usage. Most importantly, the evidence indicates that Iranian villagers always have friendly and close interactions with the ecosystem and strong religious environmental values (Rezaei and Ghofranfarid, 2018). This can serve as a good starting point to promote villagers' pro-environmental behaviors including the use of RETs.

The current study results indicated that both AC and AR significantly and positively affected PN, thus supporting Hypotheses 5 and 6. These findings have been confirmed in previous studies as well (Wang *et al*., 2018; Wittenberg *et al*., 2018). Moreover, these results are in line with the Schwartz's (1977) original proposition of NAM in the sense that if people are well aware of the adverse environmental consequences and increase their sense of joint responsibility for such environmental problems, PNs are likely to be activated (Han and Hyun, 2017). In other words, AC and AR are essential in shaping and reinforcing the PNs, and only if these conditions are met, PNs will affect pro-social intentions (such as the use of RETs) conform to these norms. Accordingly, since excessive use of fossil fuels have many adverse consequences such as climate change, air pollution, and loss of biological diversity, the strategies adopted for deployment of RETs should focus on increasing villagers' awareness of such consequences and reinforce their responsibility.

CONCLUSIONS

The findings of this research disclosed the fact that, although the original TPB and NAM have appropriate efficiency in explaining rural people's intention to use RETs, the integrative TPB-NAM is even more powerful and applicable for explaining the target group's intention. Additionally, the original NAM contributed considerably more to the integrative model than the original TPB. Also, the PN variable was identified as the strongest determinant of villagers' intention. In other words, the findings of the research exposed that the use of RETs among Iranian villagers was mostly driven by their pro-social orientations rather than pro-self motives. In general, these results have had a substantial contribution to understanding of RETs' acceptance in Iran. Eventually, the key policy and managerial implications emerging from this research were as follows: (1) Launching the publicity campaigns in order to recognize and highlight the use of RETs as a powerful moral value and norm among the people through applying different media, particularly national and local radio and television programs; (2) Promoting villagers' awareness of negative environmental consequences of fossil fuels' consumption via large-scale training programs and direct focus on agricultural extension services, particularly RETs related educational courses; and (3) Creating supportive and favorable conditions in rural communities by offering stronger opportunities, acknowledgements, and incentives for the villagers to use RETs.

The present study confronted some major limitations that should be considered in future research. First, the integrative TPB-NAM predicted 55% of the variance of villagers' intention to use RETs, indicating that other constructs presented by different relevant theories, specially technology acceptance model, value-belief-norm, and protection motivation theory, affect to a notable extent the villagers' intention and behavior concerning the RETs. These additional constructs are suggested to be included in the theoretical framework of further studies to increase the model robustness and its explanatory power. Second, although the intention is intimately linked to the behavior (Armitage and Conner, 2001), this study was restricted to the measurement of villagers' intention to use RETs and did not precisely consider the actual behavior. Certainly, this is a common weakness of TPB studies (Olsen *et al*., 2010). Therefore, further research is expected to apply the integrative TPB-NAM for actual behavior prediction of RETs' application. Third, since the current study was a cross-sectional survey, it is suggested that future studies replicate and extend these findings longitudinally. As the last limitation, since this study focused on the villagers of only one county of Iran, one major restriction of the study was the limited geographical coverage. Hence, findings could not be generalized to all villagers of the country and further and more comprehensive research is required to involve greater number of participants in different provinces.

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درک قصد روستاییان ایرانی در استفاده از فناوری‌های انرژی‌های تجدیدپذیر: جهت‌گیری‌های خودخواهانه یا دگرخواهانه؟

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چکیده

نیاز فزاینده به منابع انرژی و تهدید کمبود سوخت‌های فسیلی موجود در آینده همراه با مسائل زیست-محیطی نامطلوب ناشی از مصرف این سوخت‌ها، به ویژه تغییرات آب و هوایی، سبب شده است تا کشورها به دنبال شیوه‌های پایدار و سازگار با محیط‌زیست برای تولید انرژی باشند. در این میان، توجه بسیاری از پژوهشگران در سال‌های اخیر به انرژی‌های تجدیدپذیر و فناوری‌های مرتبط با آنها جلب شده است. اگرچه، شواهد حاکی از آن است که پذیرش عمومی و اجتماعی فناوری‌های انرژی‌های تجدیدپذیر پایین است، و افراد به ویژه در مناطق روستایی کشورهای در حال توسعه، تمایل پایینی برای پذیرش و استفاده از چنین فناوری‌هایی دارند. بر این اساس، هدف این پژوهش بررسی عوامل تأثیرگذار بر قصد روستاییان ایرانی برای استفاده از فناوری‌های انرژی‌های تجدیدپذیر با استفاده از دو مدل اجتماعی- روان‌شناختی با انگیزه‌های خودخواهانه و دگرخواهانه و تلفیق این مدل‌ها در قالب یک چارچوب تئوریکی جامع بود. داده‌ها با استفاده از پرسشنامه از ۳۹۳ نفر از روستاییان در شهرستان زنجان در شمال‌غربی ایران گردآوری شد. نتایج پژوهش نشان داد که هنجار شخصی، نگرش، هنجار اجتماعی و کنترل رفتاری درک شده اثر مثبت و معنی‌داری بر قصد استفاده از فناوری‌های انرژی‌های تجدیدپذیر داشتند. به طور مهمتر، نتایج این پژوهش اثربخشی مدل-های اولیه فعال‌سازی هنجارها و رفتار برنامه‌ریزی شده را در تبیین قصد روستاییان تأیید کرد. با این حال، سودمندی و قابلیت کاربرد مدل تلفیقی فعال‌سازی هنجارها- مدل رفتار برنامه‌ریزی شده از تک تک مدل‌ها بیشتر بود. افزون بر این، مدل اولیه فعال‌سازی هنجارها در مقایسه با مدل رفتار برنامه‌ریزی شده نقش پررنگ-تری در مدل تلفیقی داشت. روی‌هم‌رفته، جهت‌گیری‌های دگرخواهانه نسبت به انگیزه‌های خودخواهانه در مورد تبیین قصد رفتاری برای استفاده از فناوری‌های انرژی‌های تجدیدپذیر در بین روستاییان ایرانی پراهمیت-تر بود. به طور کلی، یافته‌های این پژوهش از مشارکت نظری و کاربردی در حوزه توسعه انرژی‌های پایدار در ایران و دیگر کشورهای در حال توسعه برخوردار بود.