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A Comprehensive Action Determination Model: A Broad Understanding of Behavioral Intention of Traditional Ranchers to Use Biogas

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ABSTRACT

The present study aimed to explore the intention of traditional ranchers to use biogas in rural areas of Iran conducted among the traditional ranchers in the provinces of Fars, Khorasan Razavi, Kermanshah, and Golestan (N= 91,325). The sample, composed of 383 traditional ranchers, was taken by stratified random sampling. The measurement tool was a questionnaire whose face and content validity was confirmed by a panel of experts and its reliability was estimated in a pilot study by calculating Cronbach's Alpha. The results showed that the indicators used to measure the research variables were consistent enough with the factor structure and theoretical framework of the research. It was found that normative processes had a significant positive impact on the habitual processes and intention of the traditional ranchers. Also, the effect of situational influences was positive and significant on normative processes, habitual processes, and the intention of the traditional ranchers. In addition, habitual processes and attitudes influenced intention to use biogas positively and significantly. It is concluded that the results have significant implications for the use of rigorous theoretical frameworks such as the Comprehensive Action Determination Model (CADM) when attempting to understand the intention to use biogas.

Keywords: Environmental concerns, Normative processes, Renewable energy, Rural development, Situational influences.

INTRODUCTION

Since the beginning of the development thoughts until the 1980s, the development approaches have been economic and industrial. However, industrialization of societies and its detrimental impacts have heightened environmental concerns in the last several decades (Gholamrezai *et al*., 2021; Yaghoubi Farani *et al*., 2021). The limitation of the energy resources and the problems arising from the use of fossil fuels, unplanned growth of urban populations, and their population growth, on the one hand, and the consumption increase, on the other, have exposed human health to the hazards caused by huge amounts of organic garbage (Lei *et al*., 2020; Ghadermarzi *et al*., 2020). Most countries have developed extensive plans for supplying their energy needs through new energies. An example method is energy generation from biomass. This method is divided into several main modes, e.g., burning, ethanol production, and the production of synthetic thermochemical gas and biogas (Luo *et al*., 2020; Nindhia *et al*., 2021). The main resources for biogas production include animal wastes, urban and industrial sewage, garbage, and agricultural waste (Maramura *et al*., 2020). Biogas is produced from animal wastes. Biomass resources contain organic compounds with large-chain molecules that are broken into

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simpler molecules during digestion (the excrements released on the ground, inside specific tanks, or disposed of in nature). The final product is a flammable gas that is called biogas (Ngcobo *et al*., 2020; Roubík and Mazancová, 2020). Every year, over 400 million tons of animal waste and agricultural residuals are produced in Iran, and animal wastes account for 18% of the greenhouse gas emissions of this country (Papzan and Papzan, 2012).

Likewise, energy consumption in Iran has increased to five times as great as the global standard in recent years (Khoshgoftar Manesh *et al*., 2020; Aliabadi *et al*., 2020). Rural families are dependent on various energy resources, such as burning wood, coal, animal residues, and oil sources (Hossain *et al*., 2020). However, the supply of fuel to remote villages is difficult and costly even in an energy-rich country like Iran. Additionally, rural traditional ranchers in Iran, as the main owners of ranches, have mostly no access to energy, and the disposal of animal waste is a big problem for them because these wastes deplete the ozone layer in addition to causing environmental pollution (Khoshgoftar Manesh *et al*., 2020). The biogas energy processing sector is strongly linked to animal husbandry. The decision-making behavior at the farm level is crucially important in the context of biogas diffusion. Therefore, traditional ranchers' behavioral intention to use this form of clean energy will influence the future of biogas consumption development.

The unclear understanding of the specific nature of traditional ranchers' involvement in using biogas highlights the need for further investigation of such behavioral intention. Despite the significance of this issue in agriculture and sustainable development, few studies have focused on rural people's intention to use biogas. The past literature reflects little understanding of the impact of psychological components on traditional ranchers' intention to use biogas and how interventions can affect intention and its psychological antecedents. This study attempts to close this gap by investigating how psychological variables affect traditional ranchers' intention that are known to be predictors of intention to use biogas. By applying a comprehensive and rigorous psychological model, this research also provides insights into the determinants of behavioral intention to use biogas. In other words, few studies have comprehensively examined the intentional process of ranchers based on norms, habits, attitudes, and situational influences. Most researchers have studied a few aspects of behavioral intention. The Comprehensive Action Determination Model (CADM) can be a precious tool to study rural people's behaviors and intentions when investigating the development of renewable energies. Since extensive studies have been done on the development of renewable energies in developing countries, this research specifically focuses on the process of traditional ranchers' behavioral intention to use biogas by using the CADM in an attempt to fill the gap in the literature and determine the promoters of traditional ranchers' behavioral intention.

Mohammadi *et al*. (2013) enumerated some advantages of biogas as the disposal of a great deal of organic waste and energy extraction from them, the use of the produced manure in farming, financial independence, reduction of the waste stink, socio-economic development of rural communities, and new employment opportunities (Demirel *et al*., 2010; Yadvika *et al*., 2004). The development of biogas capacity has been a key pillar of sustainable rural development in China (Chen *et al*., 2014) such that biogas programs in Chinese villages have had economic, social, environmental, and ecological benefits (Ding *et al*., 2012; Van Groenendaal and Gehua, 2010).

Chen *et al*. (2014) assessed the costs of reducing pig waste pollution by biogas and stated that biogas production would be economic for small-scale farms in case of governmental support, and for medium-scale and large-scale farms even without this support. A research study in Ethiopia

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compared biogas-user villagers with non-users and revealed that biogas was quite beneficial to people and was welcomed if it was reliable, i.e. it had elaborate design and correct construction site (Mengistu *et al*., 2016). Researchers have found that different factors are effective in biogas development, such as governmental motivation of farmers to generate biogas (Qu *et al*., 2013; Vilkė *et al*., 2020), farmers' knowledge of biogas, governmental popularization, which is more effective than other resources including friends, relatives, and media (Wang *et al*., 2016), and regulations and policies as to biogas development (Jiang, 2011; Feng, 2012). Wang *et al*. (2016) argue that the construction and implementation of biogas projects can continue with the current biomass reserves, but they should be compatible with the social and agricultural environment. Indeed, changes in villages and agricultural activities can affect the trend of biogas production.

Research shows that biogas development is influenced by the reserves of agricultural wastes, the size of workforces, the distance of the living place, family income, and residents' willingness, which is directly affected by the economy and simplicity of using biogas and its equipment (Qu *et al*., 2013; Li *et al*., 2015). According to Wang *et al*. (2016), the main factors limiting biogas development include technical factors (anaerobic biogas tanks do not have adequate capacity for providing heat all around the year in cold regions), social factors (people and workers of biogas systems are inadequate and their activity does not meet the rapid growth and development of this industry, and their acceptance and development require extensive cultural and social activities), and domestic factors (heavy costs of maintenance, tank protection, and the deficiency of raw material are some constraints of domestic biogas systems versus the larger-scale ones).

Klöckner and Blöbaum (2010) combined the theory of planned behavior, the norm-activation model, and the theory of behavioral habits to develop the Comprehensive Action Determination Model (CADM) for use in the prediction of ecological behaviors. These models seem to overestimate or underestimate the importance of characteristic aspects. The theory of planned behavior focuses on intentions but neglects the role of objective situational constraints and facilitators, as well as habits and personal norms. The norm-activation model focuses on personal norms but underestimates the role of habits, intentions, attitudes, and the situations themselves. Furthermore, the ipsative theory of behavior effectively describes the objective and subjective characteristics of situations as predictors of behavior but completely ignores intentional, habitual, or normative processes (Klöckner and Blöbaum, 2010). Various studies have used CADM and tested its applicability, such as studies on farmers' ecological behavior (Izadi and Hayati, 2014), drivers' behavior (Klöckner and Friedrichsmeier, 2011), recycling behavior (Klöckner and Oppedal, 2011; Ofstad *et al*., 2017), product selection behavior (Joanes *et al*., 2020), environmental behavior (Klöckner and Blöbaum, 2010), and energy-saving behavior (van den Broek *et al*., 2019).

Based on this model, four groups of variables affect ecological behavior, including normative processes (including personal norms, social norms, awareness of consequences, and awareness of need), habitual processes (including schemata, heuristics, and organizational associations), intentional processes (including intention and attitude), and situational influences (including subjective constraints and objective constraints). The situational influences of this model include subjective and objective constraints that influence people's behaviors directly and indirectly. Objective constraints mean the farmer's access to different institutions and his or her ability to afford labor or implements and machinery (Klöckner and Blöbaum, 2010). Many studies (Klöckner and Oppedal, 2011; Izadi and Hayati, 2014; Balundė *et al*., 2020;

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Joanes *et al*., 2020) have shown that subjective constraints can affect people's behavior and intention process. Normative processes themselves include personal norms, social norms, awareness of need, and awareness of consequences and affect the intention and habitual processes, thereby influencing people's behaviors indirectly. Social norms mean the measurement of the degree of the significance of other traditional ranchers' opinions and behaviors. Personal norms mean the measurement of a certain animal farming manner influenced by the person's values and beliefs. Awareness of need means the measurement of the level of the rancher's awareness of the necessity of using biogas in animal farming and how to use it. Awareness of consequences means the farmer's awareness of the consequences of using or not using biogas in animal farming (Klöckner and Blöbaum, 2010). Van den Broek *et al*. (2019) and Nayum and Klöckner (2014) conclude that norms play a key role in the display of behaviors by people. Habitual processes include schemata, heuristics, and associations and affect behavior directly. To define habitual processes, it can be said that if an individual performs a behavior repeatedly, a normal structure will be formed, which will get out of control and turn into a habit over time (Klöckner and Blöbaum, 2010). It has been proven that habits should be considered a key component in people's behavioral process (van den Broek *et al*., 2019; Havlícková and Zámecník, 2020). Schemata deal with the questions as to how much use of energy is enough in the ranchers' opinion, and whether they will use a certain pattern in case there is no access limitation. Heuristics refers to the ranchers' assessment of energy generation from non-fossil resources and whether they assess energy generation from wastes and excrements to be good or bad. Associations show the participation of the individual in social groups, extension courses, and traditional ranchers' gatherings to get informed about new technologies or attendance in educational courses on environment protection (Klöckner and Blöbaum, 2010). Intentional processes encompass intention and attitude and affect behavior directly. Klöckner and Oppedal (2011), Nayum and Klöckner (2014), and Balundė *et al*. (2020) have concluded that if people have a positive attitude towards an issue, their behaviors will be formed on its basis. Behavioral intention is the decision arising from the individual's beliefs, which is for doing a certain activity in a certain situation by considering the constraints and based on his/her knowledge (Klöckner and Blöbaum, 2010).

If policymakers do not have sufficiently detailed knowledge of traditional ranchers' decision-making and behavioral structures, they will run the risk of misestimating biogas developments in rural areas. Therefore, policymakers and local authorities need a better understanding of decision-making structures at the farm level in order to estimate the future investment potential of biogas. This study helps to understand how traditional ranchers make their decisions to use biogas. Therefore, the study contributes to the literature on traditional ranchers' behavioral intention to use biogas in general. In the context of renewables, knowledge of the different determinants of traditional ranchers' decision outcomes is relevant to estimate their future engagement in innovations such as biogas. Understanding individual traditional ranchers' decision-making improves our ability to determine the future development of biogas in rural communities. Therefore, behavioral intention variables should be incorporated into the design of forecasting models for renewable energy policies.

As such, the theoretical framework of the research is depicted in Figure 1. Also, the following hypotheses can be considered in the research:

Hypothesis 1: Normative processes have a positive and significant effect on traditional ranchers' habitual processes.

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Hypothesis 2: Normative processes have a positive and significant effect on traditional ranchers' intention.

Hypothesis 3: Normative processes have a positive and significant effect on traditional ranchers' attitude.

Hypothesis 4: Situational influences have a positive and significant effect on traditional ranchers' normative processes.

Hypothesis 5: Situational influences have a positive and significant effect on traditional ranchers' habitual processes.

Hypothesis 6: Situational influences have a positive and significant effect on traditional ranchers' intention.

Hypothesis 7: Situational influences have a positive and significant effect on traditional ranchers' attitude.

Hypothesis 8: Habitual processes have a positive and significant effect on traditional ranchers' intention.

Hypothesis 9: Attitude has a positive and significant effect on traditional ranchers' intention.

MATERIALS AND METHODS

The present research is an applied study whose results can be used by planners and authorities of rural development. It is, also, a quantitative study in terms of paradigm, a non-experimental study in terms of the control over variables, and a cross-correlation study in terms of statistical operations in which the survey technique was used for data collection. In the first step, the evidence of the biogas system implemented in Iran was studied. Evidence revealed that the biogas system was implemented by traditional ranchers only in the provinces of Fars, Khorasan Razavi, Golestan, and Kermanshah. Therefore, the study population was composed of traditional ranchers in these provinces (N= 91,325). Here, traditional ranchers refers to those ranchers whose livestock is fewer than 50 heads and who depend on animal farming for their livelihood. The sample size was determined to be 383 using Krejcie and Morgan's (1970) table and was taken by stratified random sampling. For this purpose, the study areas were divided into 29 counties (strata were counties where the biogas system was introduced to traditional ranchers or it was set up in rural communities). This process involved participation of the population into multiple strata (each county was considered a stratum), out of which samples were taken

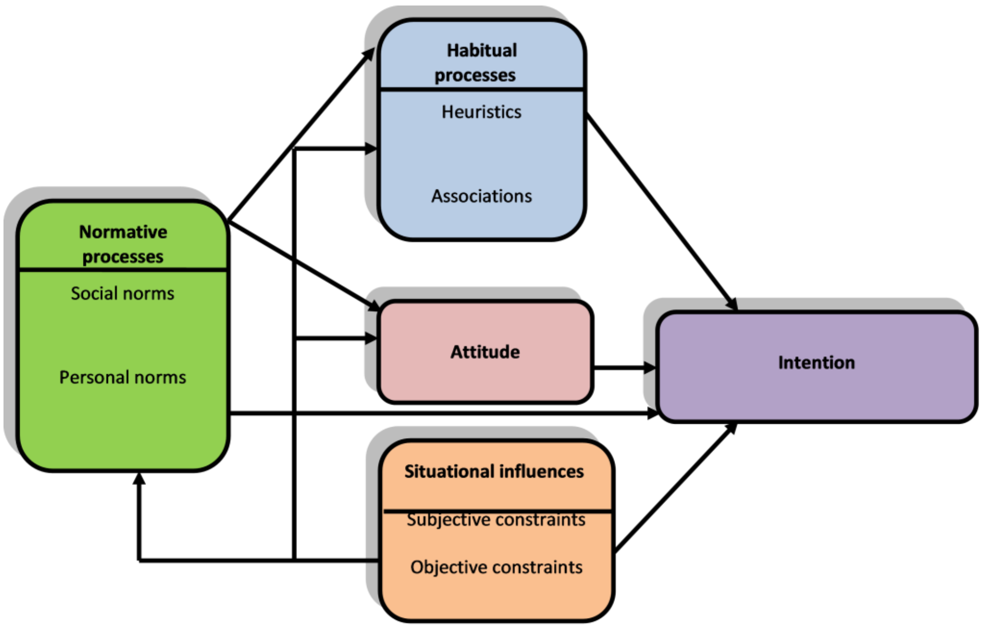

Figure 1. The theoretical framework of the research (Klöckner and Blöbaum, 2010).

proportional to the stratum size (the population of each county), and then simple random sampling was applied within each stratum. A questionnaire was used to check traditional ranchers' intention to use biogas. The items used to evaluate each of the variables in this study were extracted from previous relevant studies (such as Klöckner and Blöbaum, 2010; Klöckner and Oppedal, 2011; Izadi and Hayati, 2014). In the absence of a proper item for measuring the variables, researcher-made items, approved by experts, were included. The questionnaire was composed of two parts: demographic characteristics of the traditional ranchers and the variables of CADM (normative process, habitual process, situational influences, and intentional process). Normative process was investigated based on four criteria including social norms (8 items), personal norms (4 items), awareness of consequences (9 items), and awareness of need (4 items). Habitual process was composed of schemata (6 items), heuristics (8 items), and associations (9 items). Situational influences were measured based on the two criteria of subjective constraints (4 items) and objective constraints (6 items). Intentional process included ranchers' attitude (6 items) and intention (7 items). The research variables were assessed on a 5-point Likert scale. The traditional ranchers' intention was measured based on their intention to use biogas, to encourage others to use biogas, and their plan to apply biogas in the future, etc.

A paper-based questionnaire was administrated to the traditional ranchers in the sample through a face-to-face interview conducted by the interviewers, who were requested to increase the response rate by providing instructions to traditional ranchers. The face validity of the questionnaire was confirmed by an expert panel (composed of six faculty members and two animal science experts with special expertise in biogas who were working in the Ministry of Agriculture Jihad). To estimate the reliability of the questionnaire, a pilot study was carried out on 30 individuals outside the research sample. Then, the coefficient of Cronbach's Alpha was calculated for different sections of the questionnaire (0.81-0.94). In other words, to assess the construct validity and the composite reliability, the coefficient of Cronbach's Alpha, AVE, and CR were calculated.

Finally, all collected data were analyzed by the $SPSS_{23}$ and $AMOS_{22}$ software packages. AMOS is a powerful structural equation modeling software helping research and theories by extending standard multivariate analysis methods, including regression, factor analysis, correlation, and analysis of variance. AMOS creates attitudinal and behavioral models reflecting complex relationships more accurately than with standard multivariate statistics techniques using either an intuitive graphical or programmatic user interface.

RESULTS

Ranchers' Demographics

The descriptive results showed that all traditional ranchers were male. They were aged 26-68 years with an average of 41. The experience of the participants in animal farming was, on average, 21.3 years, reflecting that the target group was mostly experienced in animal farming activities. Crop farming and animal farming are the main sources of revenue for the research population, but animal farming was the dominant source of income for 87.4 percent of the individuals. Among the participants, 81.9 percent had attended biogas training courses. The average area of their ranch was 1,979 m^2 with an average animal population of 167 heads. In terms of animal type, 37.7 percent had beef animals, 40.1 percent had meat cattle, and 22.3 percent had both. Heaters were the main heating source for 93 percent of the traditional ranchers.

Structural Equation Modeling (SEM)

To analyze the relationship of research variables, SEM was employed. Accordingly,

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the measurement section of the model was first assessed to study the validity and reliability of the variables, then, its structural section was dealt with to confirm the theoretical relations between the variables of the conceptual framework. Confirmatory factor analysis was used to test the hypothesis as to whether the indicators considered to explain the construct or latent variables really explained them and how precisely the selected indicators explained and fitted the latent variable. Furthermore, the general fit of the model was checked by various indices to assess the general consistency and conformity of the model with empirical data.

Estimation of the Measurement Model

In this research, the reliability and validity of the questionnaire were checked by Composite Reliability (CR) and Average Variance Extracted (AVE), respectively. Constructs whose CR is greater than 0.6 are acceptably reliable, and the closer this value is to one, the more reliable the construct is (Raykov, 1998). Also, constructs whose AVE is greater than 0.5 are valid enough (Iglesias, 2004). To check the validity of a model, it is also necessary to examine the magnitude and level of significance of the paths between each latent variable and its relevant indicators. To this end, confirmatory factor analysis was used to test the hypothesis as to whether indicators considered for the representation of a construct or latent variables really represented them and how precisely the selected indicators represent or fit the latent variable. Given that parameters with a value of greater than 1.96 are statistically significant (Bentler and Yuan, 1999), the indicators used to measure the studied latent variables were well fitted with the factor structure and the theoretical framework of the research. The reliability of the indicators could also be examined by the square of multiple correlations (R^2). The R^2 value shows how much variance of each indicator is accounted for by the relevant latent variable (Table 1). Furthermore, the fit indices of the measurement model are presented in Table 2.

The measurement model of normative processes showed that the components of awareness of need, awareness of consequences, personal norms, and social norms had the highest standard coefficients of 0.66, 0.57, 0.51, and 0.05, respectively. Situational influences were composed of objective constraints and subjective constraints with standard coefficients of 0.95 and 0.61, respectively. The standard coefficients of the three components of habitual processes including heuristics, associations, and schemata were 0.86, 0.73, and 0.45, respectively.

Estimation of the Structural Model

The conceptual model of the research was assessed by Chi-square per degrees of freedom (χ^2/df), Normed Fit Index (NFI), Incremental Fit Index (IFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). The values of the model fit indices presented in Table 3 show that χ^2/df is 2.49, implying the good fit of the model. The indices for examining alternative models (NFI, IFI, and CFI) are used to check how well a model acts in accounting for an observed dataset, especially when compared to other models. These three indices were found to be 0.90, 0.93, and 0.93, respectively. Finally, to check how the conceptual model combined fitness and saving, RMSEA was used whose value was estimated at 0.06, reflecting the control of the measurement error in the model. Accordingly, most reported indices had acceptable values for the overall fit of the model. Therefore, it can be said that the model is generally compatible with the data used here.

Based on the structural model, normative processes influenced habitual processes and attitudes directly, and influenced intention both directly and indirectly. The effect of

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Table 1. Measurement items and reliability and validity tests.

Latent variables		Observed variables	Standardized loading	AVE	CR	t-Value
Normative processes	Social norms	sn1	0.721	0.51	0.86	Fixed
		sn2	0.884			9.90
		sn3	0.753			9.42
		sn4	Dropped			-
		sn5	0.698			11.53
		sn6	0.589			9.98
		sn7	0.643			10.79
		sn8	Dropped			-
	Personal norms	pn1	0.611	0.51	0.81	Fixed
		pn2	0.746			8.94
		pn3	0.774			9.05
		pn4	0.739			8.91
	Awareness of consequences	ac1	0.504	0.50	0.87	Fixed
		ac2	0.619			8.62
		ac3	0.851			10.03
		ac4	0.678			9.06
		ac5	0.751			9.52
		ac6	0.801			9.8
		ac7	0.662			8.94
		ac8	Dropped			-
		ac9	Dropped			-
	Awareness of need	an4	0.77	0.53	0.77	Fixed
		an3	0.659			11.25
		an2	Dropped			-
		an1	0.757			12.30
Attitude		att1	0.733	0.50	0.82	Fixed
		att2	0.609			10.92
		att3	0.611			10.96
		att4	0.832			14.29
		att5	Dropped			-
		att6	0.717			12.79
Habitual processes	Heuristics	h1	0.722	0.54	0.85	Fixed
		h2	0.686			9.87
		h3	0.788			9.51
		h4	Dropped			-
		h5	Dropped			-
		h6	Dropped			-
		h7	0.802			9.83
		h8	0.681			9.82
	Associations	a1	0.662	0.53	0.87	Fixed
		a2	0.799			13.11
		a3	0.783			12.92
		a4	0.694			11.72
		a5	0.749			12.48
		a6	0.671			11.40
		a7	Dropped			-
		a8	Dropped			-
		a9	Dropped			-
	Schemata	s1	0.744	0.53	0.77	Fixed
		s2	0.828			11.37
		s3	0.615			10.44
		s4	Dropped			-
		s5	Dropped			-
		s6	Dropped			-

Table1 continued…

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Continued of Table 1. Measurement items and reliability and validity tests.

Latent variables		Observed variables	Standardized loading	AVE	CR	t-Value
Situational influences	Subjective constraints	so1	0.526	0.66	0.88	Fixed
		so2	0.906			11.14
		so3	0.918			11.19
		so4	0.852			10.86
	Objective constraints	oc1	0.665	0.58	0.89	Fixed
		oc2	0.703			12.21
		oc3	0.751			12.92
		oc4	0.827			13.97
		oc5	0.826			13.97
		oc6	0.82			13.89
Intention		int1	0.814	0.50	0.83	Fixed
		int2	0.64			14.67
		int3	0.734			9.89
		int4	0.573			13.53
		int5	0.814			10.52
		int6	Dropped			-
		int7	Dropped			-

Table 2. The fitness indices of the measurement model.

Measurement model	The fitness indices						
	Significant x^2	x2/df	RMSEA	NFI	IFI	CFI	GFI
Intentional process	0.000	4.09	0.05	0.91	0.94	0.90	0.90
Normative process	0.000	4.79	0.06	0.92	0.90	0.90	0.90
Habitual process	0.000	4.49	0.06	0.94	0.95	0.94	0.93
Situational influences	0.000	4.01	0.05	0.91	0.92	0.91	0.90

Table 3. The fitness indices of the structural model.

Test	Recommended value [a]	Proposed model
Likelihood ratio Chi-square (x2)	Insignificant x^2 (P> 0.05)	0.000
Normed Chi-square (x^2/df)	x^2/df< 5	2.49
Root Mean Squared Error	RMSEA< 0.08	0.06
Normed Fit Index	NFI> 0.90	0.90
Incremental Fit Index	IFI= Values close to 1	0.93
Comparative Fit Index	CFI> 0.90	0.93

[a] Byrne (2016).

situational influences was direct on habitual processes, normative processes, and attitude and direct and indirect on intention. The intention was also found to be directly affected by attitude and habitual processes. Based on the results (Table 4), normative processes had a significant positive effect on the traditional ranchers' habitual processes (β= 0.36, P< 0.05). This supports hypothesis 1 as to the significant positive effect of normative processes on the traditional ranchers' habitual processes. The results revealed the significant and positive effect of normative processes on the traditional ranchers' intention (β= 0.19, P< 0.01). This is a confirmation of hypothesis 2, which states the significant and positive effect of normative processes on traditional ranchers' intention. But, the variable of normative processes did not have a significant impact on the traditional ranchers' attitude, refuting hypothesis 3 as to the significant and positive effect of normative processes on traditional ranchers' attitude. The effect of situational influences was positive and

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Table 4. Estimation of the structural model's paths.

Independent variable	Dependent variable	Standardized coefficient	t-Value	Standard error	P-value
Situational influences	Normative processes	0.59	7.09	0.03	0.01
	Habitual processes	0.21	2.17	0.06	0.03
	Attitude	0.07	0.17	0.01	0.86
	Intention	0.25	3.83	0.01	0.01
Normative processes	Habitual processes	0.36	2.74	0.37	0.01
	Attitude	0.01	0.29	0.01	0.76
	Intention	0.19	4.36	0.02	0.01
Habitual processes	Intention	0.27	2.01	0.05	0.05
Attitude	Intention	0.46	4.67	0.02	0.01

significant on the traditional ranchers' normative processes (β= 0.59, $P< 0.01$). As such, hypothesis 4 regarding the significant and positive effect of situational influences on traditional ranchers' normative processes is supported. It was found that situational influences had a significant and positive effect on the traditional ranchers' habitual processes (β= 0.21, $P< 0.01$). Thus, hypothesis 5 about the significant and positive effect of situational influences on habitual processes was confirmed. Also, situational influences affected the traditional ranchers' intention to use biogas significantly and positively (β= 0.25, $P< 0.01$). Therefore, this evidence supports hypothesis 6 as to the significant and positive effect of situational influences on traditional ranchers' intention. However, the effect of the variable of situational influences was insignificant on traditional ranchers' attitudes. So, hypothesis 7 regarding the significant and positive effect of situational influences on traditional ranchers' attitudes is refuted. The results showed that habitual processes affected the traditional ranchers' intention to use biogas positively and significantly (β= 0.27, $P< 0.05$), supporting hypothesis 8 as to the significant positive effect of these processes on traditional ranchers' intention. Furthermore, attitudes had a significant and positive effect on the traditional ranchers' intention to use biogas (β= 0.46, $P< 0.01$). Thus, this confirms hypothesis 9 about the significant and positive effect of attitudes on traditional ranchers' intention (Figure 2).

Based on the results, the coefficient of determination (R^2) was estimated at 0.357 for normative processes. This means that 35.7 percent of the variance in this variable is related to the variable of situational influences. R^2 was found to be 0.011 for the traditional ranchers' attitudes, implying that 1.1 percent of the variance in attitude is accounted for by the variables of situational influences and normative processes. R^2 was calculated for habitual processes to be 0.78. This reflects that 78 percent of the variance in habitual processes is captured by situational influences and normative processes. Finally, R^2 was 0.431 for the traditional ranchers' intention to use biogas, meaning that 43.1 percent of the variance in intention is related to situational influences, attitudes, habitual processes, and normative processes.

DISCUSSION

The results showed that normative processes had a significant and positive effect on traditional ranchers' intention to use biogas. It means that higher social norms increase the likelihood of the traditional ranchers' intention to use biogas. In other words, stronger social pressure to use biogas in rural communities strengthens farmers' intention to use this energy resource. This finding further indicates the need to target people's social and normative influences when promoting biogas in rural areas. In addition, traditional ranchers who are aware of the needs and consequences of the use of biogas can make a more reasonable decision on its use. Other researchers (Izadi and Hayati, 2014; Zamani *et al.*, 2016; Chng *et al.*, 2018; Balundė *et al.*, 2020; Klöckner and Matthies, 2009; Klöckner and Oppedal, 2011) have also confirmed that

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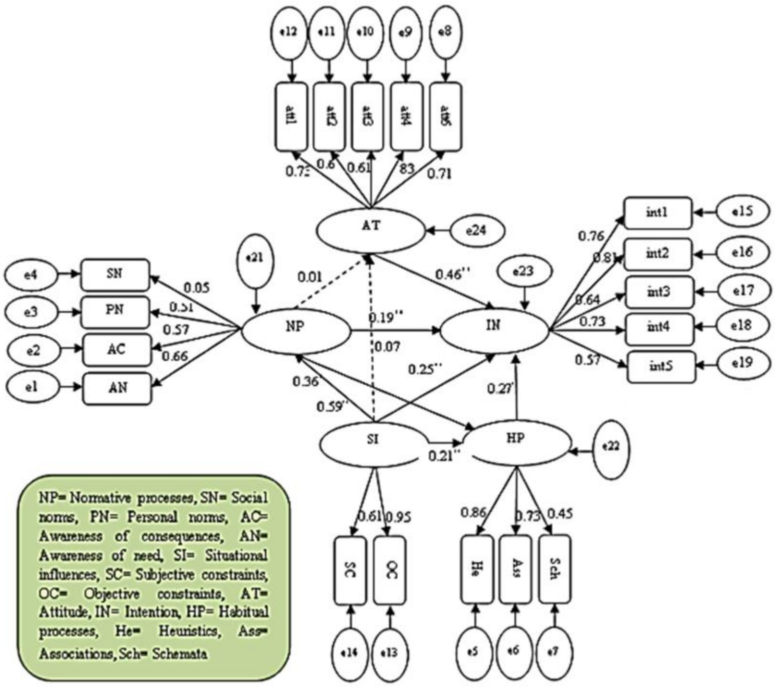

Figure 2. The structural model of the research.

normative processes influence intention. Indeed, group adaptation in social criteria makes people behave like other members of the group. Furthermore, no significant relationship was observed between normative processes and ranchers' attitude, and it was not found to predict their attitude towards biogas. It was anticipated that normative processes (such as personal and social norms) would positively affect ranchers' attitude towards biogas (Chng *et al*., 2020; Balundė *et al*., 2020; Klöckner and Matthies, 2009), but this was not the case, although it was the case in previous studies. This implies that ranchers will not simply change their attitude towards biogas because important others (e.g., families or neighbors) are using it.

The results show the significant effect of attitude on the traditional ranchers' intention to use biogas, meaning that if the traditional ranchers have a positive attitude towards biogas and its use, their intention to use it will be increased. In other words, an individual who believes that biogas use will have positive consequences will have a positive attitude toward this technology. This is consistent with the results of Ofstad *et al*. (2017), Varela-Candamio *et al*. (2018), van den Broek *et al*. (2019), Wang *et al*. (2020), and Yao (2020), who concluded that a more positive attitude towards a certain behavior increases the likelihood of its display.

It was revealed that habitual processes like subjective patterns and organizational associations influence the traditional ranchers' intention to use biogas significantly. Habits are formed by successfully performing stable behavioral patterns in stable situations. It means that previous behavior is a key variable in habit formation. Klöckner and Blöbaum (2010), Klöckner and Friedrichsmeier (2011), Nayum and Klöckner (2014), Ataei and Zamani (2015), Havlícková and Zámecník (2020), Joanes *et al*. (2020), and Ataei *et al*. (2021) have also found that people's habitual processes are influential on their norms, attitude, and intention. Furthermore, they have revealed the role of attending associations and having organizational relations on people's decisions and intentions. Regularly repeated behavior may become habitual and involuntary and automatically determine future behavior. Habits are not adapted behavioral patterns that are performed everywhere and every time, but

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are behaviors performed in rather stable conditions - in the same environment and under the same circumstances.

Situational influences had significant impacts on the traditional ranchers' intention to use biogas. In other words, the traditional ranchers would be more strongly intended to use biogas if the situation is more optimal and the access is less limited. On the other hand, if a rancher perceives that biogas is easy to use and under his or her control, his or her intention to use it will increase. Ranchers believed that they could use biogas if they had access to the equipment of biogas and could easily find them. They had the necessary information from the customer services, support experts, after-sales services, and other sources about what and how to produce biogas. The presence of factors that may facilitate the intention, the ease of performing the behavior, and the feeling of control over the performed behavior are the main components of this psychological determinant (Varela-Candamio *et al*., 2018). A sense of being in control at work is important for behavioral intention change and, therefore, the design and implementation of any changes should focus on creating a sense of empowerment and control. It shows that there is a knowledge gap between promoting innovations and the ability and control of villagers. These results are consistent with the reports of Matthies and Klöckner (2009), Klöckner and Oppedal (2011), Izadi and Hayati (2014), Aazami *et al*. (2019), Yasmin and Grundmann (2019), and Ataei *et al*. (2020). They stated that a decisive factor dictating an individual's intention to use is the individual's situation, access, and familiarity with the innovation and its advantages. Similarly, effect of situational influences on ranchers' attitude was expected (Klöckner and Oppedal, 2011; Izadi and Hayat, 2014), as other studies have found that situational components can change people's attitude towards using new strategies or innovation. However, within this study, no effect of the situational process on the ranchers' attitude was revealed. In general, this implies that in this context, ease of use and access to basic equipment and other energy resources do not change the attitude of the studied ranchers towards biogas.

Traditional ranchers constitute an active part of the agricultural sector and should display a behavior towards the realization of sustainable agriculture. Since traditional ranchers have difficulty in accessing energy and, also, the disposal of animal wastes is costly, this research explored the traditional ranchers' intention to use biogas in some rural communities of Iran. As such, the CADM revealed that the variables of normative processes, attitude, situational influences, and habitual processes were the determinants of the traditional ranchers' intention to use biogas. These results have significant implications for the use of rigorous theoretical frameworks such as the CADM when attempting to understand traditional ranchers' intention to use biogas. The results show that most psychological components that were expected to be predictors of intention to use biogas were significant. The CADM with the best fit presented provides a better understanding of how each of these psychological components mediates and affects traditional ranchers' intention to use biogas. These relations show that, to develop the use of biogas in rural areas, traditional ranchers should feel that they have control over their behavior. Furthermore, social and personal norms should be formed, but their impact on intention is mediatory. These findings support the selected conceptual framework and indicate that the CADM is consistent with the data by providing a good description of the factors underpinning the intention to use biogas. In other words, this model of environmental intention and behavior exploration well specified the determinants and limiting factors to help rural development authorities find ways to improve the traditional ranchers' intention to use biogas.

Based on the results, it is recommended to hold training courses and workshops and resort to advertisements about biogas to improve traditional ranchers' attitude. Indeed, the model of farms field schools in the agricultural extension sector may be performed with this same goal, so that a model can be constructed for traditional ranchers to show how biogas can be produced from animal waste. Another

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determinant of the traditional ranchers' intention to use biogas is organizational associations, for which it is recommended that agricultural extension agents be more active in the region so that they can hold meetings with traditional ranchers to learn their problems and help them solve these problems. Traditional ranchers can keep themselves up-to-date by referring to the Agriculture Jahad Organization, extension agents, or traditional ranchers cooperative. Therefore, empowering non-governmental organizations such as rancher cooperatives and motivating people to participate in these organizations can be very helpful in enhancing their intention to use biogas. Social norms are another factor underpinning traditional ranchers' intention to use biogas. Many studies have pointed out that norms are a major factor determining people's intentions and behaviors, so, people's intentions can be influenced by influencing their norms. Since social norms are formed within the community and in relation with others, the extension service can focus on groups that are traditional ranchers' sources of information and in that they participate. This way, they can identify and strengthen the links of traditional ranchers in the region, such as finding local fiduciaries and explaining biogas application in rural animal farms to them. Habitual processes, e.g., subjective patterns, are another factor determining people's intention. Although this variable is personal and is related to an individual's subjective image of an issue, these images are influenced by factors like the individual's awareness, knowledge, and communicational channels. As such, by enhancing traditional ranchers' knowledge and awareness of the nature of renewable energies and biogas, and explaining the critical status of energy and environmental pollutions, we can prepare them to adopt biogas as a source of renewable energy. Introduction of successful internal and external experiences can be very effective in improving the traditional ranchers' mental image.

Situational influences were included in the model as one of the variables influencing the intention to use biogas. Traditional ranchers should be well aware of the advantages and features of biogas and the easiness of its use; then, they can assess their situation and decide to use it and pay the initial costs. To persuade traditional ranchers to use biogas, it is necessary to employ experts to facilitate the use of this energy resource for them. Also, the infrastructure of biogas should be built within the traditional ranchers' community in such a way that it does not suffer discontinuation or failure in the future. The process of facilitation should be continued as far as the need for the use of biogas is turned into a necessary part of traditional ranchers' lives so that they themselves start promoting biogas in rural areas in the future.

A research limitation was the dispersion of traditional ranchers in Iran, which made it difficult to access them. Documentary reports and information on biogas sites are also far-flung and discontinuous. Also, the distrust of the villagers in the government hinders the growth and development of biogas technology. The main restrictions of the study incorporate wide dispersion of biogas sites, acquiring the ranchers' trust, and absence of inspiration among the ranchers, just as the absence of researches on the outcomes of biogas in Iran.

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مدل جامع تشخیص عمل: درک وسیعی از قصد دامداران سنتی در استفاده از بیوگاز

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چکیده

با توجه به کمبود انرژی‌های فسیلی، نیاز به استفاده از انرژی‌های تجدیدپذیر به‌خصوص در مناطق روستایی بیش‌ازپیش احساس می‌شود، بر این اساس هدف اصلی پژوهش حاضر بررسی قصد دامداران سنتی در به‌کارگیری بیوگاز در مناطق روستایی ایران بوده است. این مطالعه در بین دامداران سنتی استان‌های فارس، خراسان رضوی، کرمانشاه و گلستان در ایران (N= ۹۱۳۲۵) انجام شد. نمونه با استفاده از نمونه‌گیری تصادفی طبقه‌ای ۳۸۳ دامدار بود. ابزار سنجش در این مطالعه پرسشنامه بود که روایی صوری آن را متخصصان تأیید نمودند و برای بررسی پایایی آن نیز یک آزمون راهنما و محاسبه ضریب آلفای کرونباخ انجام شد. یافته‌ها نشان داد که نشانگرهای مورد استفاده برای اندازه‌گیری متغیرهای پژوهش با ساختار عاملی و زیربنای نظری پژوهش تطابق قابل قبولی داشتند. یافته‌ها مشخص نمود که فرآیندهای هنجاری اثر مثبت و معنی‌داری بر فرآیندهای عادتی و قصد دامداران داشته است. همچنین، اثرات موقعیتی تأثیر مثبت و معنی‌داری بر فرآیندهای هنجاری، فرآیندهای عادتی و قصد دامداران داشت. علاوه‌بر آن، فرآیندهای عادتی و نگرش تأثیر مثبت و معنی‌داری بر قصد دامداران برای به‌کارگیری بیوگاز داشتند. می‌توان نتیجه گرفت که قصد دامداران برای به‌کارگیری بیوگاز در مناطق روستایی تحت تأثیر یک فرآیند قرار دارد که در آن هنجارها، عادات، اثرات موقعیتی و نگرش نقش مهمی بازی می‌کنند. نتیجه‌گیری می‌شود که نتایج برای استفاده از چارچوب‌های نظری دقیق مانند مدل جامع تشخیص عمل (CADM) هنگام تلاش برای درک قصد استفاده از بیوگاز ، پیامدهای قابل توجهی دارد.

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