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Factors Affecting Decision-Making Process in Renewable Energies Investment in Agricultural Sector, Iran

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ABSTRACT

Considering the importance of investment in renewable energies and the numerous uses of this technology in the agriculture sector, the present research was conducted with the aim of investigating the factors affecting the decision-making process in renewable energies investment in the agricultural sector in Iran. This study is a non-experimental survey research in which structural equations modeling method was used for data analysis (LISREL 8.72). The statistical population consisted of 130 investors of active companies in the area of renewable energies in the agriculture sector throughout Iran. Using Krejcie and Morgan Table as well as simple random sampling method, 97 (n= 97) individuals were chosen as the sample size. The main data collection instrument was questionnaire, whose validity was confirmed by a panel of experts. To measure the reliability of the research tool, 30 copies of the questionnaire were completed by active investors in the area of renewable energies as well as the experts of Iranian Renewable Energy and Energy Efficiency Organization. Then, Cronbach Alpha coefficient was calculated by SPSS 22 for different sections of the completed questionnaire, which showed a good reliability. Based on the results, since the calculated Composite Reliability (CR) index was larger than 0.6 and the Average Variance Extracted (AVE) was larger than 0.5 for each of the five external and internal latent studied variables, the latent variables had convergent and divergent validity. The results indicated that among the studied variables, knowledge of renewable energy technology, a priori beliefs, market policy preferences, institutional pressure, and attitude toward radical technological innovations had the greatest impact on the renewable energies investment decision-making process in the agriculture sector, respectively.

Keywords: A priori beliefs, Energy efficiency, Operational risks.

INTRODUCTION

In today's era, energy plays a significant role in movement towards sustainable development and prosperity of any society. In order to achieve sustainable development, enhancing the efficiency of processes that use sustainable energy resources is crucial (Dong *et al*., 2013). The limited volume of fossil fuel reserves and lack of permanent access to them, the ever-increasing need to energy, existence of different economic costs and environmental damages such as global warming as well as climate change and pollution have encouraged use of renewable energies. In addition to the mentioned points, with the increase in the level of development of a country, the extent of energy consumption grows, which is directly associated with accessibility to energy resources in it. Considering the complications of using fossil fuels, exploiting renewable energies as alternative or complement has attracted a great deal of attention (Mohsenzadeh Karimi, 2017). Use of renewable energies generates considerable short-, mid-, and long-term benefits including security of energy supply,

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sustainable development of local industries, development of employment, and environmental sustainability. However, in addition to being unrenewable, fossil energy resources have various detrimental effects on the health and environment due to emitting greenhouse gases such as carbon dioxide. Sustainable energies, with the potential of developing occupational opportunities and income generation, cause empowerment and reinforcement of self-sufficiency of local communities, which helps in fulfilling poverty alleviation objectives. Renewable energies can replace fossil fuels and pollutant technologies, and by creating new industries, they can provide new job opportunities. Due to its nature, renewable energy generation systems are more frequently used than fossil fuels, with the former being mostly local and native, since the process of installing, launching, operating, and maintaining renewable energies mostly occur in rural and marginalized regions. Such regions have a higher rate of unemployment, and application of these systems can be useful in stabilizing the population living in these regions, thereby yielding a considerable effect on reducing the extent of deprivation of these regions as well as enhancing the productivity of the country (Atwood, 2010). The area of renewable energies has attracted a great deal of attention due to economic and environmental reasons as a key area for investment (Wei *et al*., 2010). The increased interest of investors to invest in renewable energy technologies can be considered an effective instrument to resolve financial crises (Masini and Menichetti, 2012). The increase in investment in renewable energy technologies, alongside energy productivity, can help fulfill energy demand in the future. At the same time, it can cause reduction of problems resulting from energy generation through fossil fuels (Wustenhagen and Menichetti, 2012). Increasing investment in energy generation through renewable energies is crucial (OECD, 2016), and this, according to the arguments of many scholars such as Carley (2009), Kaldellis *et al*. (2012), Masini and Menichetti (2013) and Yin and Powers (2010), can only be achieved through special incentive policies (NorbergBohm, 2000). Investment in most countries in renewable energies is highly dependent on direct governmental subsidies, energy taxes, or feed-in tariffs (Carley, 2009). Iran, as a developing country located in the West of Asia, has an area of around 1648195 km^2 and population of about 81 million inhabitants (Iranian statistics Center, 2018). Due to being located on solar belt and having 2800 sunny hours in the year, it has great capacity to use hydroelectric, wind, solar, hydrothermal, and biomass energies. Exploiting renewable energies also causes increased access to sustainable and secure resources for rural regions and agriculture. The internal heating and cooling of the building of animal husbandries, greenhouses, poultry breeding centers and fish breeding pools can be supplied by renewable energies such as solar energy (Ali Ahmadi *et al*., 2015). The trend of investment in renewable energies in both Iran and the world is discussed further.

Global Trend of Investment in the Technology of Renewable Energies

As shown in (Figure 1-a), the total level of investment in the renewable energies sector in the world in 2017 was around 279.8 billion Dollars, representing 2% increase compared to 2016 (274 billion Dollars) (UNEP, 2018).

As presented in (Figure 1-b), according to the latest statistics in 2017, investment in China, Europe, USA, Asia and Oceania (excluding China and India), America continent (excluding USA and Brazil), India, West of Asia and Africa, and Brazil increased by 45% (126.6 billion Dollars), 15% (40.9 billion Dollars), 14% (40.5 billion Dollars), 11% (31.4 billion Dollars), 5% (13.4 billion Dollars), 4% (10.9 billion Dollars), 4% (10.1 billion Dollars), and 2% (6 billion Dollars), respectively, compared to 2016 (UNEP, 2018).

According to Figure 2, the maximum level of investment was related to solar energy with 161 billion Dollars. The extent of

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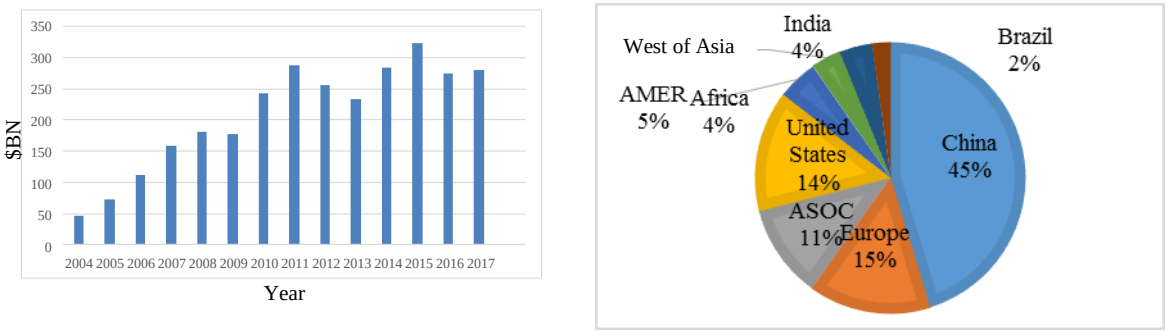

(a) (b)

Figure 1. Global new investment in renewable energy by (a) asset class 2004-2017, $BN (UNEP, 2018). (b) region, 2017, $BN (UNEP, 2018).

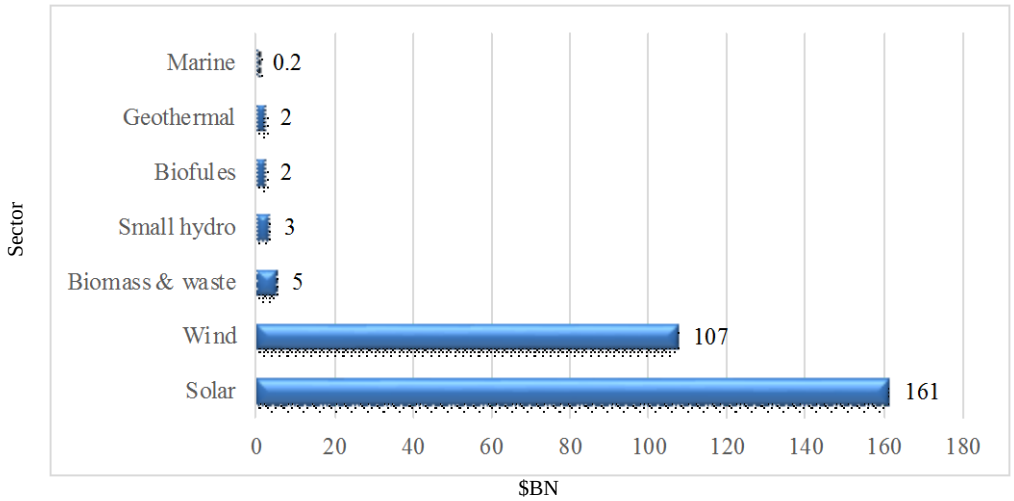

Figure 2. Global new investment in renewable energy by sector, 2017, $BN (UNEP, 2018).

investment in other resources including wind energy, biomass and waste, small hydro, biofuels, geothermal, and marine was 107, 5, 5, 2, 2, and 0.2 billion Dollars, respectively (UNEP, 2018).

Trend of Investment in Renewable Energies in Iran

According to Figure 3, the capacity of generating renewable energies in Iran up to August 2018 was 637 MW (Mega Watt). Similarly, the share of different types of renewable energy plants in the country is shown in the following figure, with wind power plants claiming 46% as the largest sector (SATBA, 2018).

In Iran, in spite of having a high potential for renewable energies, the share of this type of energies in the energy consumption basket of the country has been less than 1% (IEA, 2018). According to Iranian renewable energy and energy efficiency organization report (SATBA), renewable energies in the country up to the late July 2018 were able to generate about 44,115 jobs (directly and indirectly) (SATBA, 2018). Further, according to the statistics of the Bureau for Developing the Renewable Energies Technologies as well as the Renewable Energy and Energy Efficiency Organization of Iran, the number of active companies in the area of renewable energies in the country included 66 knowledge-based companies and 64 non-knowledge-based companies, which indicates mediocre popularity for renewable energy investments. Considering the importance of the agriculture sector as well as the good potentials of producing and

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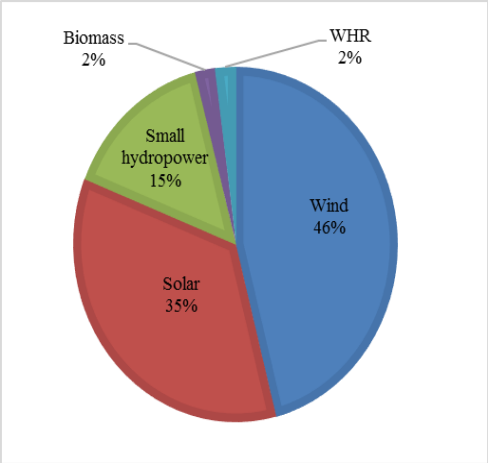

Figure ۳. The share of renewable energy plants in the country (SATBA, 2018).

exporting agricultural crops in Iran, application of renewable and new energies is crucial. The reason is that with use of such energies, it will be easier to overcome such problems as unemployment and higher initial cost, thereby increasing added value and improving exports. By eliminating subsidies for fossil fuels and using solar energy and other renewable energies (wind, biomass, hydropower and geothermal) in the agriculture sector as useful and inexpensive fuel, a great transformation can be witnessed in this sector. Applying new technologies for using these energies as a healthy and safe source including biogas production through livestock and poultry waste, sewage, and different types of sludge and agricultural waste at farm level can respond to 45% of the energy demand in the agriculture sector. Furthermore, considering solar energy, to heat agricultural greenhouses, usage of solar energy by beekeepers as well as solar water pumps is the main application of solar electricity in the agriculture sector. Therefore, creating capacity for developing solar energy is considered a sustainable duty in this sector. The solar energy can be used in two ways in the agriculture sector: benefiting from photovoltaic systems and employing solar panel systems to produce warm water. Wind micro turbines are used to generate electricity in mills. Further, geothermal energy in the agriculture sector can be used to heat greenhouses and aquaculture (Ali Ahmadi *et al*., 2015).

Applications of this type of energy in the agricultural sector include solar desalination system, wind turbines, solar pools and dryers, solar pumps and biogas plants (Mc Cormick, 2007). It has been well established that the energy from fossil fuels has harmful effects on the environment and it will eventually end. With termination of the fossil fuels, human civilization, which has a direct connection to energy, will face a major challenge.

Indeed, development of investment in renewable energies can play a significant role in creating and developing employment and income opportunities. In addition to solving the issue of unemployment, it will have a remarkable role in socioeconomic development of societies. Considering the high potential of the country in renewable energies, one of the solutions to create employment and reduce the problem of unemployment is increasing investment in this area. Indeed, the decision for investment in renewable energies in the agriculture sector will result in increased energy supply security, reduced global warming, stimulation of economic growth, creation of employment, increased annual income, enhanced social equity, and protecting the environment across all areas (Hamdollahi Razd, 2013).

Research Background

Many studies have been conducted to investigate the factors affecting investment decisions. Some of them are mentioned in Table 1:

According to the library and field studies and adapting the model of Masini and Menichetti (2013), the factors affecting the decision-making process of investment in renewable energies (a priori beliefs, attitude toward radical technological innovations, Knowledge of using renewable energy technology, market variables, policy

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Table1. Studies related to investigating the factors affecting investment decisions.

Title	Researchers	Variable
The impact of behavioral factors on the renewable energy investment decision making process: Conceptual framework and empirical findings.	Masini and Menichetti (2012)	A priori beliefs, policy preferences, and attitude toward technological risks
The Process of Decision Making and the Evaluation of Investment Projects in Information Technology	Ali and Younes (2012)	1. Analysis and planning, 2. Evaluation of costs and benefits, 3. Project selection and implementation and 4. Post-implementation evaluation.
Investment decisions in the renewable energy sector: An analysis of non-financial drivers	Masini and Menichetti (2013)	A priori beliefs, institutional pressure, attitude towards radical technological innovations, and the knowledge of the RE operational.
Investment Decisions and Performance: Study on Investors of Colombo Stock Exchange, Sri Lanka variables of Heuristic, prospect, market variables, and Herding variables.	Kengatharan and Kengatharan (2014)	Heuristic, prospect, market variables, and Herding variables.
Country Factors and Investment Decision-Making Process of Sovereign Wealth Funds	Amar *et al.* (2018)	Two dynamic Tobit panel model to test the sustainability of investment decision-making process.
Renewable Energy Investment in Malaysia: An Integrated Model in Evaluating Public Decision Making Process innovations, and the knowledge of the RE operational	Mat Husin and Alrazi (2017)	A priori beliefs ,Institutional pressure, attitude toward radical technological innovations, and the knowledge of the RE operational
Investigating the obstacles against investment in renewable power generation project obstacles, they presented a developed framework.	Hu *et al*. (2018)	Stages of preliminary risk of investment assessment, development, and project progress (including economic assessment and preliminary feasibility study) and access of investors to sufficient capital. Then, if all of the stages were suitable, then the final investment decision is made; otherwise investment is not done.

preferences, and institutional pressure) in the agriculture sector are presented in Figure 4. In this research, Masini and Menichetti (2013) behavioral framework was chosen as the main basis for the investment decision-making process of renewable energies in the agriculture sector of Iran, in which the most important behavioral factors are a priori beliefs, institutional pressure, attitude toward radical technological innovations, and knowledge of the RE operational constitute factors. The reason for choosing this model was its less restriction compared to other models associated with investment decision-making process. However, the variables of this model were not sufficient for the present research. Accordingly, to develop the conceptual framework of the present research, other variables including policy preferences and market were also added to the Masini and Menichetti (2013) behavioral model (Figure 4).

MATERIALS AND METHODS

In terms of the extent of controlling the variables, strategy, objective, and time, the research was nonexperimental, survey, applied, and cross-sectional (due to being conducted at a specific section of time, 2017-2018). The statistical population in the

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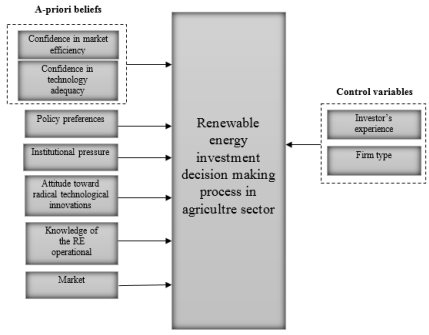

Figure 4. Conceptual model of renewable energy investment decision-making process in agriculture sector.

present research consisted of 130 investors of active companies in the area of renewable energies in the agriculture sector throughout Iran. Simple random sampling method was used. The sample size was determined as 97 subjects according to Krejcie and Morgan Table. The data collection instrument in this study was a questionnaire. In this research, the content and the face validity of the research instrument was reviewed and modified based on the opinions of a panel of experts. To measure the reliability of the designed questionnaire, 30 copies of the questionnaire were distributed among the investors of active companies in the area of renewable energies as well as the experts of the Renewable Energy and Energy Efficiency Organization of Iran (SATBA) through a pilot test. Then, for these completed questionnaires, Cronbach Alpha coefficient was calculated by SPSS, whose results are presented in Table 2. Based on the obtained coefficients, it was found that the questionnaire enjoyed a high reliability, as the Cronbach Alpha coefficient of all sections of the questionnaire was 0.7 or above. Further, considering the problems of Cronbach Alpha method including consideration of the same value for all questions of a construct, in this research, composite reliability method was also used, whose coefficients are provided in Table 2. A construct with a *CR* value above 0.6 has acceptable reliability (Bagozzi *et al.*, 1998). The closer this value to one, the greater its reliability will be. Further, in addition to determining the method of content and face validity, diagnostic validity method through determining the Average Variance Extracted (AVE) index was also employed.

The variables were measured as five-point Likert scale (1= Very low, 2= Low, 3= Moderate, 4= High, and 5= Very high). In this research, the variables of the investment decision-making process, a priori beliefs, attitude toward radical technological innovations, market, knowledge of the RE operational, policy preferences, and institutional pressure variables included 5, 6, 5, 5, 5, 6, and 6 items, respectively (Table 2).

RESULTS

Descriptive Findings

According to the results out of the 97 investors, 91 (93.8%) and 6 (6.2%) were male and female, respectively. Most of them had an age range of 32-41 years old (43.3%), and 65 of them (67%) had nine years and less of experience. The average age of the investors was 36 years old. Considering the level of education of the investors, the maximum number was related to Master's degree [61 subjects (62.9%)]. In terms of investment in different renewable resources, the maximum frequency (75 companies) was related to investment in solar energy, followed by all other renewable resources (Frequency= 9). The maximum frequency for the initial capital of the studied companies ranged between 5,300 and 8,600 Dollars (30.9%). The maximum frequency of the monthly profit of investment of the studied companies was 900 Dollars and less. Further, considering the percentage of share of investment in renewable energies in the agriculture sector, 53.6% of them were within the range of 21 and 37% (Tables 3 and 4).

Correlation coefficients between variables

The results obtained from Pearson correlation (Table 5) indicated that there was a positive and significant (at 99 percentage) relationship between a priori beliefs, market, attitude toward radical technological innovations, knowledge of the RE operational,

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Table 2. Survey items and Cronbach's Alpha, *AVE* and *CR* coefficients.

Variables		Items	Source
		Investment decision making process (α= 0.87, AVE= 0.50, CR= 0.82)	
Decision		1. I will achieve my goals by decision making to invest in renewable energy in agriculture sector	Amar *et al.* (2018); Ali and Younes (2012); Hu *et al.* (2018)
		2. I consider the assessment of the support and after-sales services in my investment decision making process	Amar *et al.* (2018); Ali and Younes (2012); Hu *et al.* (2018)
		3. I have access to enough capital to invest in renewable energy in the agricultural sector.	Amar *et al.* (2018); Ali and Younes (2012); Hu *et al.* (2018)
		4. I consider the initial risk of investment in renewable energy in the agricultural sector.	Amar *et al.* (2018); Ali and Younes (2012); Hu *et al.* (2018)
		5. I consider the economic assessment of investment in renewable energy in the agricultural sector.	Amar *et al.* (2018); Ali and Younes (2012); Hu *et al.* (2018)
		A priori beliefs (α= 0.71, AVE= 0.61, CR= 0.80)	
Belief	Confidence in market efficiency	1. Market forces alone can lead to the use of renewable energy technologies in the agricultural sector.	(Menichetti *et al.* (2010); Masini and Menichetti (2012)
		2. The government can play a significant role in controlling market efficiency.	Menichetti *et al.* (2010); Masini and Menichetti (2012)
		3. I'm sure investment in renewable energy technology in the agricultural sector is profitable	Sarwar and Afaf (2016)
Belief	Confidence in technology adequacy	4. Energy production through renewable energy technologies will increase by 10% every year	Menichetti *et al.* (2010); Masini and Menichetti (2012)
		5. Solar energy can make a big contribution to global energy production	Menichetti *et al.* (2010); Masini and Menichetti (2012)
		6. Energy production will replace conventional fuels over the next 20 years through renewable energy technology	Masini and Menichetti (2013)
		Market (α= 0.91, AVE= 0.56, CR= 0.86)	
Market		1. I look at market price fluctuations for investment in renewable energy technologies in the agricultural sector.	Kengatharan and Kengatharan (2014)
		2. Market information plays an important role in investing in renewable energy technologies in agriculture.	Kengatharan and Kengatharan (2014)
		3. The customer's presence in RET's in agriculture sector is important in my investment decision	Kengatharan and Kengatharan (2014)
		4. The interest rate on investment in renewable energy technologies in agriculture is important to me	Bialowolski and Bialowolska (2013)
		5. The rate of acceleration in government payments to investment decisions in renewable energy technologies plays an important role in the agricultural sector.	Bialowolski and Bialowolska (2013)
		Attitude toward radical technological innovations (α= 0.91, AVE= 0.55, CR= 0.85)	
Attitude		1. The prediction of budget allocation by the government for investing in various renewable energy technologies in agriculture can be effective.	Masini and Menichetti (2013)
		2. Investment in the field of renewable energy technology can be used as a bridge to transfer the country's economy to a less carbon economy.	Yang *et al.* (2016)
		3. Investing in renewable energy technology should be compatible with environmental conditions.	Gamel *et al.* (2017)
		4. Investing in renewable energy technologies at the farm level should not endanger the environment.	Gamel *et al.* (2017)
		5. Investing in renewable energy technology in the agricultural sector will improve the employment situation at the community level.	Yang *et al.* (2016)

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Continued of Table 2. Survey items and Cronbach's Alpha, *AVE* and *CR* coefficients.

Variables	Items	Source
Knowledge	Knowledge of the RE operational (α= 0.89, AVE= 0.58, CR= 0.87)	
	1. Investments in renewables help to attain the CO2 abatement targets indicated by the Kyoto protocol.	Masini and Menichetti (2013)
	2. I have a complete knowledge of the types of renewable energy technologies in the agricultural sector.	Sarwar and Afaf (2016)
	3. I am familiar with the knowledge of solar power energy	Chen *et al*. (2016)
	4. I am familiar with the knowledge of wind power energy	Chen *et al*. (2016)
	5. I am familiar with the knowledge of hydropower energy	Chen *et al*. (2016)
Policy preference (α= 0.93, AVE= 0.69, CR= 0.93)		
Policy	1. Tax incentives/investment grants	Masini and Menichetti (2012)
	2. Tender schemes investment decision making	Masini and Menichetti (2012)
	3. Feed-in tariffs	Masini and Menichetti (2012)
	4. Tradable Green Certificates	Masini and Menichetti (2012)
	5. Duration of the support (Number of years for which the incentives paid)	Masini and Menichetti (2012)
	6. Duration of the administrative process	Masini and Menichetti (2013)
Institute	Institutional pressure (α= 0.92, AVE= 0.57, CR= 0.88)	
	1. NGOs roles	Masini and Menichetti (2013)
	2. Investments by well-known/high-profile investors in the sector	Masini and Menichetti (2013)
	3. Consultants ' opinion	Masini and Menichetti (2013)
	4. Channels and Mass Media	Mirdamadi *et al*. (2015)
	5. Technical reports	(Masini & Menichetti, 2013)
	6. Personal interests of the main shareholder of the company	Adopted from Masini and Menichetti (2013); Ravichandran *et al*. (2009)

The statistical methods used in this research were correlation analysis using SPSS 22 and structural equations modeling by LISREL 8.72.

policy preferences, institutional pressure, and renewable energies investment decision-making process in agricultural sector.

Structural Model of the Research

In the study of the structural part of the model, the relationships between internal and external latent variables were noted.

Here, the goal is to determine whether the theoretical relationship that was made between the variables in the design phase of the conceptual framework considered by the researcher is confirmed by the data or not. In addition, the relative effects of each independent variable on each of the internal latent variables can also be investigated (Kalantari, 2013). The general model of the research concerning the effect of each of the independent variables (a priori beliefs, market, attitude toward radical technological innovations, knowledge of the RE operational, policy preferences, and institutional pressure) on the dependent variable (investment decision-making process) was also tested. Since the general model of the research enjoyed a suitable validity and reliability,

Table 3. Descriptive statistics of respondents.

Variable	Category	Frequency	Percentage	Mode
Gender	Male	6.2	6	Male
	Female	93.8	91	
Educational degree	Bachelor	27	27.8	
	Master	61	62.9	Master
	Ph.D.	9	9.3	
Investment in various renewable sources in the agricultural sector	Solar energy	75	77.3	Solar energy
	Wind power	5	5.2	
	Biomass	3	3.1	
	Hydropower	4	4.1	
	Geothermal energy	1	1	
	All sources	9	9.3	

Table 4. Descriptive statistics of respondents**.**

Variable	Category	Frequency	Percentage	Mean
Age (Years)	$X \leq 32$	33	34	
Max= 50	$X < 41 \leq 32$	43	43.3	36
Min= 23	$63\ X >$	22	22.7	
Experience	$9 \leq X$	65	86.6	
Max= 25	$17 \leq X < 9$	28	11.3	7
Min= 1	$17\ X >$	4	2.1	
Initial investment	$5300 \leq X$	28	28.9	
(Dollar)	$8600 \leq X < 5300$	30	30.9	8200
Max=15000	$11900 \leq X < 8600$	28	28.9	
Min= 2000	$11900\ X >$	11	11.3	
Monthly profit	$900 \leq X$	90	92.8	
(Dollar)	$1700 \leq X < 900$	4	4.1	500
Max= 2500	$1700\ X >$	3	3.1	
Min= 100				
Percentage of investment	$21\% \leq X$	28	28.9	
	$37\ \% \leq X < 21\%$	52	53.6	
Renewable energy in the agricultural sector	$53\% \leq X\ \% < 37$	16	16.5	
	$53\%\ X >$	1	1	28%
Max= 5%				
Min= 70%				

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Table 5. The results of Pearson correlations between the variables of the research.

Variables 1	Variable 2	*r*	Sig
A priori beliefs	Investment decision making process	**0.472	000.0
Market	Investment decision making process	**0.419	000.0
Attitude toward radical technological innovations	Investment decision making process	**0.560	000.0
Knowledge of the RE operational	Investment decision making process	**0.542	000.0
Policy preferences	Investment decision making process	**0.431	000.0
Institutional pressure	Investment decision making process	**0.461	000.0

Non-Normalized Fit Index (NNFI), Incremental Fit Index (IFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) were used. Since the value of relative indices including *IFI* and *NNFI* of the model were above 0.9, the overall model of this research was accepted. Eventually, based on *RMSEA*, which is indeed the deviation from degree of freedom test, the general model of the research enjoyed a good fit (Table 6 and Figure 5). Based on the fitness indices and the extent of variance accounted for by the independent variables, it was found that six external latent variables (a priori beliefs, market variables, attitude toward radical technological innovations, knowledge of the RE operational, policy preferences, and institutional pressure) accounted for 63% of the variance of renewable energies investment decision-making process in agricultural sector throughout Iran (Table 6).

The Total Measurement Model

Table 7 indicates the effect of all variables on renewable energies investment decision-making process. The maximum effects are related to the three variables of knowledge of the RE operational (0.43), a priori beliefs (0.31), and market (0.18), respectively. Indeed, the more people know about renewable energy technologies; their beliefs are stronger in ensuring market efficiency and the technological adequacy of these technologies. Further, knowing the market factors also affects investment decision-making. Other variables of the general fitted model affecting the investment decision-making process are policy preferences (0.10), institutional pressure (0.04), and attitude toward radical technological innovations (0.012), respectively. In the following formula, all of the variables that directly affect the renewable energies investment decision-making process are presented along with their path coefficients.

DISCUSSION

The standardized coefficients indicated that the variables of "knowledge of the RE operational", "a priori beliefs", "market", "policy preferences", "institutional pressure" and "attitude toward radical technological innovations" are the most effective factors in the investment decision making process in renewable energies in the agriculture sector. The results obtained from the fitted model showed that the factor of knowledge of the RE operational directly affects the investment decision-making process in renewable energies in the agriculture sector. In this regard, not having adequate knowledge about technologies of renewable energies influences investment

Table 6. Results of the compliance of the total measurement model with fitness Indices.

Fitness index	Recommended criteria [a]	Results in research **
CFI	Larger than or equal to 0.90	0.96
NNFI	Larger than or equal to 0.90	0.95
IFI	Larger than or equal to 0.90	0.96
RMSEA	Smaller than or equal to 0.08	0.057

[a] Maccallam (1996); ** Significance at 99% level.

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Table 7: Results of the compliance of the total measurement model with fitness Indices.

Independent variables	Dependent variable	Total effect
Knowledge of the RE operational	Investment decision making process	0.43
A Priori Beliefs	Investment decision making process	0.31
Market	Investment decision making process	0.18
Policy preferences	Investment decision making process	0.10
Institutional pressure	Investment decision making process	0.04
Attitude toward radical technological innovations	Investment decision making process	0.012

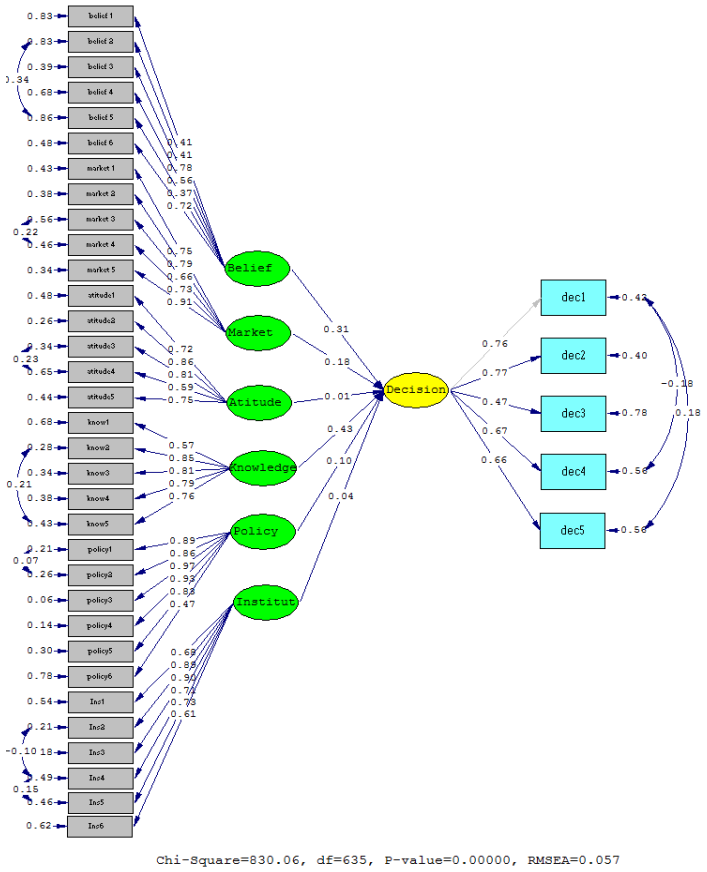

Figure 6. Structural model

decision-making process, and prevents increased opportunity of investment in this regard. Therefore, enhancing knowledge causes improved status of investment. These results are in line with the findings of Masini and Mencgetti (2013). The obtained results also showed that a priori beliefs have a positive and significant effect on the investment decision-making process. Indeed, a priori beliefs can have a positive impact on the willingness of individuals to invest in renewable energies. Therefore, being confident about technical adequacy and efficiency of renewable energy technologies will increase investment. Further, the prosperity of renewable energy technology in the agricultural sector in the market requires adequate profits and government intervention and support. All these will lead to the development of renewable energy technologies in the future. These results are in line with the findings of Menichetti *et al*. (2010). The results obtained from the research suggest that the market factor directly influences renewable energies investment decision-making process. Therefore, identifying the characteristics

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of the renewable energy technologies market can be effective on investment decision-making process, bearing in mind that the renewable energy market is very important for investors. These results are consistent with the findings of Ozorhon *et al.* (2018) and Bialowolski and Weziak-Bialowolska (2014).

Further, the factor of policy preferences directly affects investment decision-making process. Indeed, suitable policy package in the renewable energies technologies can be effective in encouraging individuals to make decision upon investment in this sector. Indeed, the credibility of these results depends on the government's support and employment policies, which encourages the investor to invest by providing sufficient government-owned tariffs and facilities. These results are in accordance with the findings of Ata (2016) and Polzin *et al.* (2015). On the other hand, the factor of institutional pressure directly affects the investment decision-making process. Indeed, investments by well-known/high-profile investors in the sector, consultants' opinion and technical reports about investment in renewable energies can help investors for decision-making and facilitate it. These results are congruent with the findings of Ravichandran *et al.* (2009) and Maghabl *et al.* (2018). The results obtained from this research suggest that the factor of attitude toward radical technological innovations directly affects the investment decision-making process. Generally, considering investment in renewable energies, investors with a high risk taking potential and positive attitude to renewable energies technologies can make better decisions. Having an understanding of the sustainability of renewable energy technologies can help people decide on their investment in this field. These results are in accordance with the findings of Gamel *et al.* (2017) and Naderi Mahdei *et al.* (2018). In the final fitted model, the variable of knowledge of the RE operational had the maximum path coefficient.

CONCLUSIONS

Rrenewable energies can be a suitable substitute for conventional energies such as fossil fuels. With the extensive applications of renewable energies technologies in the agriculture sector, investment in this field in Iran can be an effective step. Based on the results obtained from this research concerning the role of influential factors (knowledge of the RE operational, a priori beliefs, market, policy preferences, institutional pressure, and attitude toward radical technological innovations) affecting the investment decision-making process in renewable energies in the agriculture sector, the following plans can be suggested:

The Proposed Plans

Short-term Proposed Pplans

Considering the role of knowledge of the RE operational on the investment decision-making process in renewable energies in the agriculture sector, it is suggested that providing public education on the process of investing in renewable energy technology related to the agricultural sector can be effective in increasing the level of knowledge of individuals in the field of investment in this area. This can happen through mass media such as radio, television, social networks, visiting successful projects inside and outside the country, and presenting technical and engineering consulting services by successful investors in the field of renewable energy in the agricultural sector. In addition, arranging a curriculum to increase the information and financial literacy of individuals from the beginning of education can be effective in their decision for investment in the future.

On the other hand, there is insufficient data and information on investments in renewable energy sources in the agricultural sector, such as profits, losses, and even the exact number of active investors in this field. Therefore, by creating centers and institutions with the cooperation of active investors in this field, it is possible to increase the knowledge and information of individuals in order to invest in this area. Also, by holding exhibitions of renewable energies throughout the country in the presence of prominent investors and other active companies in this field, and by distributing journals and posters about investment in renewable energies technologies in the agriculture sector, it is possible to improve and facilitate the decision-making process of investment in this field.

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2. With regards to the role of a priori beliefs in the investment decision-making process, it is suggested that investors' thoughts and ideas about the future of the investment market should be strengthened in terms of the efficiency and technical adequacy of renewable projects through collaboration with successful projects. Further, localizing production of the required equipment and their installation to increase use of technologies related to renewable energies, optimization and its application for research, development and promotion of these technologies in this sector can play an effective role in reducing consumption fossil fuels.

Mid-Term Proposed Plans

1. With regards to the role of market variables in the investment decision-making process in renewable energies in the agriculture sector, it is suggested that crowdfunding method be used in renewable energies in the agriculture sector. Indeed, crowdfunding consists of the two words of crowd meaning the mass of people and funding, which means providing capital. Crowdfunding has originally been developed for financial support of entrepreneurs, idea owners, and startups. Crowdfunding can be considered one of the solutions to technologically saving a society. In a crowdfunding project, the entrepreneur or idea owner launches his/her own campaign, and people provide the required capital through their financial supports (even in very slight amounts). In this way, that person no longer needs to go through the excruciatingly difficult process of absorbing capital from governmental and private centers. Thus, the investors can initiate their activities conveniently and with a greater focus on their project. The most important value that crowdfunding creates is the great help to the economic, industrial, and agricultural cycle of a country. Crowdfunding is one of the tactics for increasing capital, which considering the rapid growth of the internet and technology, has been able to claim considerable advantages. Thus, crowdfunding is usually called collective participation by investors who invest jointly, which is done mostly through the Internet in order to support the endeavors of an entrepreneur by the public or organizations (Valanciene and Jegeleviciute, 2013; Mollick, 2014). The crowdfunding models include 1) donation-based model, 2) loan, 3) reward, and 4) participation. In this research, based on extensive study on the available crowdfunding models in this area, for investment in renewable energies in the agriculture sector, the participation-based model is recommended. Indeed, crowdfunding in renewable energies in the agriculture sector can play a significant role in initiation of the life cycle for launching renewable and sustainable projects.

Long-Term Proposed Plans

1. With regards to the role of policy preferences in the investment decision-making process in renewable energies in the agriculture sector, the following suggestions are proposed:

A) Developing a comprehensive plan for energy and the roadmap for clarifying policies

B) Creating encouragement for international cooperation in the products and services related to the products of renewable energies to optimize social advantages

C) Movement towards developing a dynamic and flexible structure in the executive and policy-making sector for developing renewable energies in the agriculture sector

D) Presenting financial incentives as much as possible by the government to absorb investment of the private sector including feed-in tariffs, establishing special investment funds in renewable energies, Quota Obligation, issuing green certificate to support renewable energies, calculating the subsidies of investment in primary stages and donating credits

E) Paying more attention to the necessity of using and investing in renewable energy resources by the authorities and councils policy-makers

F) Arranging contracts to relax the cumbersome rules and regulations and shortening the period of the administrative procedure for obtaining the permission related to investment in the renewable energy technologies.

G) Developing a legal and regulatory framework to develop the structure of tariffs and pricing to support integrating renewable energy in the energy economy and for absorbing favorable investment in this field.

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H) Developing a legal and regulatory framework for integrating independent electricity producers in the current electricity system that contribute to the use of such energies in the country.

2. With regards to the role of institutional pressure in the investment decision-making process in renewable energy in the agriculture sector, it is suggested that suitable measures should be taken to identify and recruit experts and benefit from the necessary cooperation between them and the relevant organizations for complete usage of the potential and capacity of human workforce in the country to consolidate investment in renewable energies in the agriculture sector. Further, supporting research centers and nongovernmental organizations to develop research plans and financially supporting renewable energy projects in the agriculture sector can be effective in strengthening this issue.

3. Considering the role of attitude toward radical technological innovations in the investment decision-making process in renewable energies in the agriculture sector, it is suggested that necessary plans should be made to develop the culture and expand investment in the technology of renewable energies among investors and to improve their attitude. In this regard, the educational programs should be based on raising awareness and developing positive attitude toward renewable energies. The necessary planning to develop the culture and expand investment in renewable energies technologies among individuals and holding seminars as well as workshops about renewable energies can be effective in improving the attitude of individuals to invest in this area.

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عوامل موثر بر فرایند تصمیم‌گیری سرمایه‌گذاری در انرژی‌های تجدیدپذیر در بخش کشاورزی، ایران

س. چراغی، ش. چوبچیان، و ع. عباسی

چکیده

باتوجه به اهمیت سرمایه‌گذاری در زمینه انرژی‌های تجدیدپذیر و کاربردهای فراوان این فناوری در بخش کشاورزی، پژوهش حاضر با هدف بررسی عوامل موثر بر فرایند تصمیم‌گیری سرمایه‌گذاری در انرژی‌های تجدیدپذیر در بخش کشاورزی ایران انجام شد. پژوهش حاضر از نوع تحقیقات غیرآزمایشی پیمایشی بود و برای تجزیه و تحلیل داده‌ها از مدل‌سازی معادلات ساختاری (LISREL 8/72) استفاده شد. جامعه آماری تحقیق شامل ۱۳۰ نفر از سرمایه‌گذاران شرکت‌های فعال در زمینه انرژی‌های تجدیدپذیر در بخش کشاورزی سراسر کشور ایران بود. با استفاده از جدول کرجسی و مورگان و روش نمونه‌گیری تصادفی ساده تعداد۹۷ نفر (n=۹۷) به عنوان حجم نمونه انتخاب شدند. پرسشنامه ابزار اصلی جمع‌آوری داده‌ها بود که روایی آن به تأیید پانلی از متخصصان قرار گرفت. به منظور سنجش پایایی ابزار تحقیق، تعداد ۳۰ نسخه از پرسش‌نامه توسط سرمایه‌گذاران فعال در زمینه انرژی‌های تجدیدپذیر و کارشناسان سازمان انرژی‌های تجدیدپذیر و بهره‌وری انرژی برق کشور تکمیل و سپس برای بخش‌های مختلف پرسش‌نامه تکمیل شده، ضریب آلفای کرونباخ با استفاده از نرم‌افزار SPSS22 محاسبه گردید و نشان داد که پرسش‌نامه از پایایی خوبی برخوردار است. همچنین بر اساس نتایج به‌دست آمده از نرم‌افزار لیزرل برای هر پنج متغیر مکنون بیرونی و درونی مورد مطالعه

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در تحقیق، مقادیر پایایی ترکیبی (CR) محاسبه شده بزرگتر از ۰/۷ و میانگین واریانس استخراج شده (AVE) نیز بزرگتر از ۰/۵ بود. نتایج به‌دست آمده از یافته‌ها نشان داد که در بین متغیرهای مورد مطالعه، به ترتیب دانش استفاده از فناوری انرژی‌های تجدیدپذیر، باورهای پیشین، متغیرهای بازار، اولویت‌های سیاستی، فشار سازمانی و نگرش نسبت به نوآوری‌های جدید تکنولوژیکی بیشترین تاثیر را بر فرآیند تصمیم‌گیری سرمایه‌گذاری در زمینه انرژی‌های تجدیدپذیر در بخش کشاورزی داشتند.

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