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An interpretive structural modeling—analytic network process approach for analysing green entrepreneurship barriers

Rahim Sarvari[1] · Younis Jabarzadeh[2] · Azhdar Karami[3] · Masood Jabarnejad[4]

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Abstract
Entrepreneurship is one of the issues that plays a key role in the economic growth and development of countries. This economic development and technological advancement have caused environmental damage, which has led entrepreneurs to move towards sustainable production and green entrepreneurship. There are, however, challenges and barriers in front of green entrepreneurs. Hence, this article aims to identify the barriers and challenges of green entrepreneurship in Iran and explore their Interactions and prioritization. To achieve this goal, two quantitative and qualitative approaches were used. In the qualitative approach, using the Fuzzy Delphi method and using expert opinions in this field, 16 factors were identified. In the quantitative phase, the ISM-ANP combination approach was used. First, Interpretive Structural Modeling (ISM) was used to analyze the Interactions between these factors. Finally, using the ISM output, the analytic network process (ANP) method was used to prioritize these barriers. The results showed that the factor of reducing budget allocations and investing in green entrepreneurship in the first priority and the factor of high investment costs in the last priority. Given that so far few studies have been conducted in Iran on the barriers to green entrepreneurship, this paper provides a basis for understanding the various factors that prevent the implementation of green entrepreneurship. Also the analysis of these barriers by using the ISM-ANP approach is a new attempt and important in the field green entrepreneurship.

Keywords Green entrepreneurship · Barriers · Fuzzy delphi method · Interpretive structural modeling · ANP

Introduction

Entrepreneurship is an essential element in fostering economic development and innovation (Gu & Qian, 2019). It is seen as an important source for reducing unemployment and economic development of countries. It is a driving force for economic and social development, in particular, enhancing productivity and innovation in the

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business environment (Wiklund et al., 2019). Environmental challenges (for example, loss of biodiversity, soil erosion, climate change factors and the increasing fragility of the web of life provided by the natural world) are increasingly being recognized as having a consequential systemic effect on the broader economy. In January 2019, the Institute for Public Policy Research ('IPPR') in the UK warned that climate change, social and economic issues are increasing related and could produce a global breakdown in the form of a systemic collapse reminiscent of the 2008 global financial crisis (Laybourn-Langton et al., 2019). Economic and environmental factors are thus seen as being interconnected rather than separate.

Whilst overall economic progress has been fostered through the process of organizations gaining competitive advantage in their individual markets and sectors, this has often come at the expense of damage to the environment (Palacios-Marqués et al., 2019). The continued degradation to the environment caused by current economic and social pressures needs to be addressed immediately (Gurău & Dana, 2018) with a concomitant need to develop more sustainable methods to preserve natural resources in the future (Kautish & Dash, 2017). As a result, the interaction between business and the environment and consequently green entrepreneurship have been considered as the key research focus for the researchers (Gu & Zheng, 2021; Hall et al., 2010; Mathur & Tandon, 2016; Pacheco et al., 2010). Green entrepreneurship is defined as entrepreneurial activities which results in positive environmental outcomes by delivering green products or services (Lenox & York, 2011).

Green entrepreneurship is both a complex and a topical subject. Entrepreneurs exhibit key characteristics such as a willingness to take risks, maintaining strong internal control and a need for success, which influence the outcomes of commercial ventures positively (Wartiovaara et al., 2019). However, green entrepreneurship also requires these factors to be considered in the light of the impact on the environment itself. This includes a specific environmental orientation, the need for entrepreneurial activities to have a positive cumulative effect on nature, and an alignment of the personal values and opinions of the entrepreneur, which recognize the importance of the environment (Schaper, 2010). It is argued that there is a fundamental difference between the activities of green entrepreneurs in developed and developing countries. The developing countries tend to focus more on entrepreneurship and market needs (Omri, 2018). This research focuses on the developing world, in particular, Iran.

Environmental entrepreneurship emerges as a cross product of the environment and entrepreneurship, which at the same time maintains a sustainable ecosystem and emphasizes the economic aspect (Gu & Zheng, 2021). Therefore, it can be argued that there is a relationship between environmental entrepreneurship and green entrepreneurship. Research on emerging green entrepreneurship examines the extent to which entrepreneurs focus on environmental issues by reducing environmental degradation (Hall et al., 2010). Indeed, researchers believe that green entrepreneurs have considerable potential to help resolve environmental challenges by introducing new and environmentally friendly products (Schaper, 2010). In other words, entrepreneurs can act as important change agents in modernizing the economy (Ali et al., 2020) and they are capable of playing an important role in the transformation and transition to a green economy (Omri, 2018).

Thus, research about green entrepreneurship provides a valuable perspective on the impact of environmental activities in moving beyond a business model focused solely on economic growth. However, the resources devoted to this area are currently limited, and most importantly, there is still a need for research on a large scale. The literature (Hall et al., 2010; Lenox & York, 2011) shows that past research is largely theoretical, rather than experimentally and based on large-scale data. This has hampered progress in this area.

Despite the fact that the potential benefits of green entrepreneurship in different sectors have received a lot of attention from researchers in recent years (Omri, 2018; Yin et al., 2022), the issue has been investigated very little in Iran, despite well documented environmental issues (for example, air pollution, desertification, deforestation and river pollution). Green entrepreneurs face several barriers and challenges in growth and development preventing the adoption and development of technologies, services, and green businesses. This greatly impedes the potential development and prosperity green entrepreneurship offers. Iran, in like other developing countries, faces many challenges to the growth and development of green entrepreneurship and there is a need to explore these challenges and impediments. The main purpose of this study is to identify the barriers of green entrepreneurship in a Iran as a developing country. In recent years, a lot of emphasis has been placed on the development of green businesses in Iran, and this field has been the focus of managers and policy makers. On the other hand, research related to green entrepreneurship in Iran is very limited. Therefore, considering the emerging market of Iran and its role in global CO2 emission (1.88%) (Crippa et al., 2022), examining the barriers of green entrepreneurship in Iran can be a valuable study.

This research seeks to identify the most important barriers to green entrepreneurship and assess their relative importance. Due to the very limited literature in this field, the required data has been collected through interviews with entrepreneurs in Iran and using the fuzzy Delphi method they were analyzed to identify the barriers of green entrepreneurship. This will enable future researchers in the field to build on the present research. In the next phase of the study, the interactions between identified barriers were analyzed using the Interpretative Structural Modeling (ISM) technique and the relative importance of the barriers was assessed using the Analytic Network Process (ANP) method in the last phase. As a result, current research aims to answer two key research questions. First, what are the barriers and challenges of green entrepreneurship? Second, what are the interactions between the identified barriers and challenges and what is their relative importance?

Theoretical framework

Many researchers support entrepreneurship (Huarng & Ribeiro-Soriano, 2014) as a response to widespread socio-environmental problems (Hall et al., 2010) and believe that the innovative power of entrepreneurship can have a positive impact on a more sustainable future. Along with traditional commercially based entrepreneurship, which is focused on profit maximization (Kirzner, 1973) some other types of entrepreneurship such as social entrepreneurship (Bloom & Smith, 2010; Weerawardena

& Mort, 2006), sustainable entrepreneurship (Gu & Zheng, 2021; Parrish, 2010; Young & Tilley, 2006) and green entrepreneurship (Potluri & Phani, 2020; Ulutas & Alkaya, 2012) have been identified in recent years. Although the concepts of green entrepreneurship, ecological entrepreneurship, environmental entrepreneurship, and sustainable entrepreneurship (Dean & Mcmullen, 2007; Pacheco et al., 2010; Parrish, 2010; Schaper, 2010; Ulutas & Alkaya, 2012) differ slightly in their definitions, they all emphasize positive environmental outcomes and benefits.

Nikolaou et al. (2011) argue that green entrepreneurship is the launch of a new company in environmental services or industrial production focusing on natural resources. Dean and McMullen (2007) also argue that green entrepreneurship is the process of exploiting the existing economic opportunities arising from an environmentally friendly approach where the market fails to address environmental needs to the detriment of society. Anderson and Leal (2001) have presented a broad definition of green entrepreneurship with an emphasis on environmental outcomes. They argue that green entrepreneurs use business tools to develop wildlife habitats, and the rescue of endangered species and, in general, the enhancement of the quality of the environment. Whilst researchers continue to seek to understand the phenomenon of green entrepreneurship further, there is a consensus that creating a green business plays an important role in both economic and social development (Hasan et al., 2019). However, the green entrepreneurship concept is hampered by the lack of an agreed universal definition of green entrepreneurship by researchers (Hall et al., 2010; Lenox & York, 2011). This is further complicated by the interaction and combination of the various environmental factors.

Green entrepreneurship literature focuses mainly on three main aspects (Lenox & York, 2011). First, the literature shows that green entrepreneurial activities reduce environmental degradation in ways that are different from other environmental measures (Cohen & Winn, 2007; Craig & Dibrell, 2006; Dean & McMullen, 2007; Pacheco et al., 2010). Secondly, researchers focus on the motivations that underlie the willingness of people to participate in green entrepreneurship (Kuckertz & Wagner, 2010). The researchers point out that the motivations of green entrepreneurs are somewhat different from traditional entrepreneurs, because green entrepreneurs consider both economic and environmental factors in their decision-making. So that they pay more attention to environmental and social issues than economic issues. Finally, researchers have considered the role of private and public institutions for green entrepreneurs (Meek et al., 2010; Sine & Lee, 2009). Green entrepreneurs are referred to as agents of change because they destroy traditional ways and replace new structures and models (Gibbs, 2009). The result could lead to the creation of new jobs.

Schaper (2010) discusses green entrepreneurship using a combination of different ideas from green entrepreneurs. Although green entrepreneurs are diverse, they can be distinguished by using three distinct features. Firstly, all entrepreneurial activities are focused on green objectives. Secondly, green entrepreneurs are distinguished from their commercial peers by the fact that the net effect of their business activities in relation to the natural environment is positive in terms of the direction towards a sustainable future. Finally, all green entrepreneurs share a common a set of ideals and values (Schaper, 2010). Green entrepreneurs, taken as a subset of entrepreneurs, also share common motives that include green values, the ability to identify a market

gap, an emphasis on creating life, a sense of self-esteem and a passion for creating industry products or services (Kirkwood & Walton, 2010). In general, green entrepreneurs are guided by values and beliefs that differ from the conventional beliefs of entrepreneurs (Gregori et al., 2021).

Alonso-Almeida and Álvarez-Gil (2018) have identified four categories of green entrepreneurs. The first group, which they call green laggards are both low active in green practices and in adopting innovation. This group will not react unless they are under pressure from customer demand. The second group are Green followers. Although they have a low level of innovation, they are good at adopting green practices. The third category is grey innovators. These entrepreneurs are always looking for new products and innovations in the organization. However, environmental issues are not their top priority and they only look for green ways to help their business. The last group are green innovators. These Entrepreneurs, who are also called environmentalists, are also keen on environmental issues in addition to always seeking to innovate and create new ways of doing business (Alonso-Almeida & Álvarez-Gil, 2018).

Gu and Zheng (2021) argue that development of green companies as one of the requirements the new era and they believe that entrepreneurship plays an important role in this and helps them to do activities that have positive consequences for the environment. They for describe environmental entrepreneurship, uses a theory that includes social value, economic value, and environmental value (Gu & Zheng, 2021).

The literature on barriers to green entrepreneurship is very limited. The literature review shows that the researchers have identified various barriers to green entrepreneurship to date. Linnanen (2002) provides a framework that includes three categories of barriers to green entrepreneurship. The first barrier is the challenge of creating a market. He argues that consumer behavior is changing slowly as there is lack of awareness among the general public about the environment. The second barrier relates to financing a potential project and the third barrier lies in the nature of the ethical justification that green entrepreneurs adopt. Many green entrepreneurs differentiate themselves with their distinct value sets, which encompass their attitude toward their environment and their moral perspective (Linnanen, 2002). It is argued that green entrepreneurs need to overcome these barriers in order to be successful in offering green products to the market.

Haldar (2019) examined green entrepreneurship in the renewable energy sector. Haldar seeks to identify the barriers to green entrepreneurship in India's renewable energy sector. The results of this study showed that lack of budget, lack of bank risk taking, lack of government support, low education and innovation levels and administrative barriers are the challenges of green entrepreneurship development in India. In another study, Capasso et al. (2019) examined the drivers and barriers to green growth using a combination of papers. They have classified the factors into six categories: skills, technology, markets, physical resources, institutions, and policies. Sher et al. (2019) in their study examined the barriers to green entrepreneurial farming in Pakistan. They identified key barriers in six categories that include: Barriers to development and training, Barriers to entrepreneurial orientation, Barriers to market orientation, Barriers to customer orientation, Barriers to innovation orientation, and Barriers to supporting green suppliers. Cui et al. (2019) examined the important factors of green business failure. The results of their study

identified important factors, the most important of which are: Incompatibility of company business capacity with company development, lack of green technical knowledge, anti-environmental attitude, profit-driven business models and limited access to financial resources. Soomro et al. (2019) conducted an empirical study and examined the factors affecting the inclination for green entrepreneurship among the younger generation. The results of this paper showed that sustainability orientation and sustainability education have a positive and significant effect on the inclination for green entrepreneurship. Also, the effect of self-efficacy variable on the inclination for green entrepreneurship was not confirmed. In another study, lack of job budget, lack of training and the need for a high level of innovation as the main challenges facing green startups (Bergset, 2018). Similarly, Abuzeinab et al. (2017) identified barriers related to government constraints, financial constraints, sector constraints, company constraints and also a lack of demand. A study by Mathur and Tandon (2016) identified the importance of the lack or limited knowledge of green technology, high investment costs, lack of funding, and the inability to understand the potential benefits of the green business as important factors.

In Iran, research on the barriers of green entrepreneurship has been focused mostly on some specific sectors. For example, Rezaee et al. (2018) studied the barriers of green entrepreneurshp in agricultural sector and identified four categories of Infrastructural, economical, technical-managerial and educational barriers and ranked them based on their contribution in describing the variance of total barriers. In another study, Anabestani and Jahantigh (2019) identified four main categories of challenges in lacustrine green entrepreneurship in Sistan region of Iran. They are infrastructural and technical, economical, educational, and socio-cultural, respectively. All the other works have been focused on entrepreneurship in general, without distinguishing green entrepreneurship.

This research provides the following theoretical contributions to the literature on green entrepreneurship. First, this research helps to understand the concept of green entrepreneurship, especially in emerging markets. Researchers in recent research have concluded that green entrepreneurship is not yet known to many organizations, stakeholders, and entrepreneurs (Potluri & Phani, 2020). This research responds to these calls by developing and expanding this concept. In recent years, researchers have shown great interest in green literature (green entrepreneurship, green business, eco-innovation, green entrepreneurial intentions), most of which are experimental studies (Ben Amara & Chen, 2022; Yi, 2021; Yin et al., 2022). In addition, qualitative research on green entrepreneurship is less in number, which is a weakness in this area. This research fills this gap. This research increases the number of qualitative studies that identify barriers to green entrepreneurship in an emerging market. This increases our understanding of the barriers and challenges facing green entrepreneurs.

On the other hand, research in the past few years has been mostly focused on its influencing factors (Soomro et al., 2019). Also, research on the barriers to green entrepreneurship has focused mostly on one specific sector or industry (Haldar, 2019; Sher et al., 2019). In addition, the interactions and relative importance of these barriers are not clear. This paper not only explores the barriers of green entrepreneurship in a comprehensive way, barriers have also been identified from the perspective of entrepreneurs who are directly involved. As a result of these cases, this

research distinguishes it from other studies in this field. Also, the number of companies that have become interested in environmental activities has increased. This research can help them make decisions and give them new insights.

Methodology

In this research we used a three-phase methodology to answer the research questions. Initially, a comprehensive review and evaluation of past research and the results of past studies in the field were carried out to identify a number of important indicators relating to the barriers of green entrepreneurship. Key barriers to green entrepreneurship were then extracted using a qualitative approach, the Fuzzy Delphi method, based on experts, including university professors, entrepreneurs, and industry experts. In this research, businesses that had a history of producing green products or were previously active in this field were selected as samples. Also, among the sample, several entrepreneurs who were unsuccessful in the last one or two years were also selected to have a better understanding of the barriers. The information of these businesses was received from Iran Small Industries and Industrial Parks Organization and Iran organic association. Sampling continued until the saturation of the category; that is, until no new information was obtained during the interviews. In this research, interviews were conducted with 21 specialists, 8 of whom were university professors and experts in this field, and 13 were selected from entrepreneurs in the industry sector. A questionnaire was designed based on the identification of obstacles, in which the obstacles are examined two by two, as is shown in Table 2. In this phase, questionnaires were sent to 33 green entrepreneurs, and finally 24 useful questionnaires were returned. Green entrepreneurs in this sector were selected according to purposeful sampling, all of whom had at least 5 years of experience. In the following quantitative phases, Interpretive Structural Modeling ('ISM') was initially applied to the indicators to analyze the barriers and the relationship between them, which were then prioritized using the Analytic Network Process method ('ANP'). These methods are discussed in more detail in the next sections of the paper.

Fuzzy delphi method

The Delphi method is a process based on the structure of group communication and is used in cases where knowledge is limited and uncertain (Hader, 1995). In this research, the first step was to collect the views of the decision group and allocate the triangular fuzzy number from the viewpoint of the experts, according to the chosen verbal word by experts to each criterion. In order to calculate the value of the evaluation, the triangular fuzzy number of each criterion is given by the experts. In this study, the geometric mean technique is used to find experts' opinion about a criterion, in such a way that the value of the evaluation of criterion j from the expert's view of i is between the n expert Wij = (aij, bij, cij), in which i = 1, 2, …, n and j = 1,2, …, m. Then the fuzzy value of criterion j is calculated as follows:

$$Wj = (a\,j\,, bj\,, c\,j), \quad a_j = \min\{aij\}, \quad bj = 1/n \sum_{i=1}^{n} bij \quad , c_j = max\{cij\} \quad (1)$$

The following mathematical relation is used to defuzzification:

$$s_j = \frac{aj + bj + C_j}{3} \quad j = 1, 2, \ldots, \mathrm{m} \quad (2)$$

In the end, to derive the criteria, if the digitized value of the triangular fuzzy number according to the experts' opinion is near or above 0.7, it is accepted as standard. If not, it is not accepted.

$$s_j \geq \alpha, s_j \leq \alpha \quad (3)$$

Interpretative structural modeling ('ISM')

Interpretative structural modeling was first proposed by Warfield in 1974 to deal with complex issues. The ISM method is commonly used to interpret complex situations together by summing up the course of action to solve a target problem. This method has been used by many reputable companies, such as NASA, to solve complex problems (Meena & Thakkar, 2014). Interpretative structural modeling is a good technique for analyzing the impact of an element on other elements. The interpretative structural modeling method analyses the relationship between indicators by analyzing the criteria at several different levels. The ISM methodology contributes greatly to ordering the complex relationships between elements of a system (Singh et al., 2003). The ISM can be used to analyze the relationship between the multivariable properties defined for a problem (Warfield, 1974). The ISM method has been used in a variety of areas, such as investment barriers, supply chain analysis, training, planning, marketing, etc. (Khaba & Bhar, 2017).

Interpretative structural modeling is an interactive process in which a set of elements are interconnected in a comprehensive systematic model. Researchers believe that if this method is combined with the ANP method, better results can be achieved. This outcome Hs been supported by various empirical studies (Bhadani et al., 2016). The implementation of the ISM technique requires seven steps. First, the criteria related to the problem are identified and then the elements of the Structural Self – Interaction Matrix ('SSIM') are obtained. Then extracted from that initial reachability matrix and then adapted later and the final reachability matrix is obtained. In the next step, partitioning of levels is done using the matrix obtained in the previous step, and then the model is drawn. Finally, the classification of barriers based on dependence and driving power is done using MICMAC analysis. These stages are described in more detail in the next section of the paper.

Analytic network process ('ANP')

In the past years, Multiple-Criteria Decision Methods and Tools ('MCDM') have been widely used to solve complex problems (Wei, 2021). The ANP method is a

more general form of analytic hierarchy process ('AHP') (Saaty, 2004) that enables the researchers to prioritize decisions where multi-criteria decision analysis is being used. Its advantages include simplicity, flexibility, the application of quantitative and qualitative criteria simultaneously and the ability to examine compatibility in judgments. In addition, the ANP technique adds dependency and feedback relationships to AHP and provides a more general framework than AHP to address decision-making problems.

The AHP technique is developed based on the assumption that the relationships between decision-making levels are one-way and hierarchical. But many decision problems cannot be hierarchical due to dependencies and influences between clusters, and ANP is the answer to this problem (Gencer & Gürpinar, 2007). ANP allows the researchers to consider the relationships and interactions among the cluster elements at the decision levels as a network. Therefore, the ANP technique with a comprehensive framework can take into account all the interactions and relationships between decision levels that constitute a network structure.

In the ANP method, to indicate the interactions and relationships between decision levels, the determination of the relative importance of the criteria and the prioritization of decision options issues are used from the super matrix. The super matrix standard form is shown in Eq. 4, c denotes the nodes, and e denotes the elements inside the nodes. Vectors w within the matrix are also weighted vectors derived from the pairwise comparison of the nodes elements.

$$W = \begin{array}{c} \\ C_1 \begin{array}{c} e_{11} \\ e_{12} \\ \vdots \\ e_{1m_1} \end{array} \\ C_2 \begin{array}{c} e_{21} \\ e_{22} \\ \vdots \\ e_{2m_2} \end{array} \\ \vdots \\ C_n \begin{array}{c} e_{n1} \\ e_{n2} \\ \vdots \\ e_{nm_n} \end{array} \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & & C_n \\ e_{11}..e_{1m_1} & e_{21}..e_{2m_2} & \cdots & e_{n1}..e_{nm_n} \end{array} \\ \begin{bmatrix} W_{11} & W_{12} & \cdots & W_{1n} \\ W_{21} & W_{22} & \cdots & W_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ W_{n1} & W_{n2} & \cdots & W_{n2} \end{bmatrix} \end{array} \tag{4}$$

All relationships and interactions between elements of decision levels are evaluated by pairwise comparisons in the Super Matrix method. However, when inserting a pair comparison between the elements of the decision levels in the super matrix, often the sum of columns is greater than 1, which is known as a no weighted super matrix. By multiplying the weight of each cluster in the related elements with them, a super matrix is obtained by weight. Finally, in order to achieve the final weight of the problem alternatives and the decision and problem-solving criteria, the limit

super matrix must be calculated (Gencer & Gürpinar, 2007). The final weight of each element is obtained from Eq. 5.

$$W = \lim_{k \to \infty} W^{2K+1} \tag{5}$$

In addition, if the ANP compliance rate is less than 0.1 then the paired comparison data can be trusted (Saaty, 2004).

ISM-ANP integrated approach

The interpretive structural modeling technique can only show the directional relationships among the factors. This technique helps to understand the factors based on the power of influence and dependency. In other words, the ISM is not able to fully visualize the key barriers that need to be concentrated. However, the ISM, can help the ANP method to create an image of measurable key factors. The integration of ISM-ANP is a two-step process that first focuses on identifying barriers and building a multi-layered structure model. Secondly, the resulting ISM structure is used as an input for the ANP method. The dimensions identified in the preceding steps helps to turn the issue into a multi-criteria decision-making problem. It helps entrepreneurs to prioritize green entrepreneurship barriers so that they can adopt a systematic approach and thus strengthen and improve them.

Research findings

Fuzzy delphi

Researchers first explored the main barriers to green entrepreneurship by reviewing literature. In order to identify these barriers, a questionnaire tailored to the Fuzzy Delphi method was prepared and provided to experts in this field to identify their significance and thereby identify key indicators. In the initial list of factors, 34 factor were developed and compiled. Finally 16 factors were identified as the barriers of green entrepreneurship. Table 1 illustrates the list of identified barriers.

Interpretative structural modelling ('ISM')

To implement the ISM technique, the following steps were followed:

Step 1: Identify the indicators of the barriers to green entrepreneurship

These indicators were identified in the section above.

Step 2: Creating the Structural Self – Interaction Matrix ('SSIM')

After identifying the variables, they were entered into the SSIM matrix. This matrix is a matrix of dimension variables in which the variables are listed in the first row and column. Then the relationships between two variables are determined by the use of the symbols below:

V: Agent i is the basis for reaching the j factor.

Table 1 Identified barriers to green entrepreneurship

Row	Dimensions	Factors
1	Financial and economic barriers	High investment costs
2		High financial risk of green products
3		Unequal competitive conditions with other areas
4		Reducing budget allocations and investing in green entrepreneurship
5	Government policy and regulations	Lack of an appropriate institutional framework to support green entrepreneurship
6		Lack of policy and the green national perspective
7	Organizational barriers	Not important for company image
8		lack of planning for green entrepreneurship
9		Low level of acceptance of innovation in the organization
10		The new concept of green entrepreneurship for shareholders and stakeholders
11	Market conditions	Lack of market demand
12		Lack of consumer awareness of green products and services and the impact of their environment-friendly actions
13	Technical barriers and entrepreneurial capabilities	The difficulty of gaining competitive advantage in green entrepreneurship
14		Lack of knowledge and R&D
15		Lack of experience among entrepreneurs
16		Lack of access to green technology

A: The factor j is the basis for reaching the factor i.

X: There is a two-way relationship between the factor i and j.

O: There is no relationship between i and j.

A questionnaire was used to complete the SSIM. By using the 16 factors in the first row and first column of the Table 2 the experts were asked to identify the relationships using the appropriate symbols (V, A, X, O). The results are shown in Table 2.

Step 3: Create an Initial Reachability Matrix

By converting the symbols of the SSIM matrix relationships to 0 and 1, the Initial Reachability Matrix can be obtained by the following rules. For this extraction, the matrix must replace the numbers X, V and zero with each row in place of the A, O marks in the SSIM matrix. The results are shown in Table 3.

Step 4: Create a Final Reachability Matrix

After the Initial Reachability Matrix is obtained, its internal consistency must be established. Thus, if the index j leads to the index i and the index i leads to the index k, then the index j must be followed by the k index. In this matrix, the power of influence and the degree of dependence of each index are also shown. The results can be seen in Table 4. The numbers marked * indicate that the Initial reachability matrix is zero and has become the number 1 after compatibility.

Step 5: Level partition

In order to determine the relationships between the level of barriers, the output set and input set for each factor were extracted from the received matrix. The output set included the factor itself and the factors that affected it. The set of inputs included the factor itself and the factor of factors that affected it. Then, the set of intersection relations of each of these factors was determined. Factors are ranked according to the obtained sets. Typically, the factors that have the same set of outputs and sets of

Table 2 Structural Self-Interaction Matrix

Factors	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	V	O	O	O	O	O	O	O	O	O	O	O	O	O	O
2		X	X	A	O	O	A	O	A	A	A	A	O	A	A
3			A	A	O	O	O	O	A	A	O	A	A	A	A
4				A	A	A	A	A	A	X	O	V	V	O	O
5					X	O	O	O	V	O	V	O	V	O	V
6						O	O	O	O	O	V	O	V	O	V
7							V	O	O	O	A	O	O	O	O
8								A	A	A	O	O	O	O	O
9									O	O	O	O	O	O	O
10										O	O	O	X	O	V
11											A	V	V	O	O
12												O	V	O	O
13													A	A	A
14														O	V
15															O
16															

Table 3 Initial reachability matrix

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	1	1	1	0	0	0	0	0	0	1	0	1	1	0	0
5	0	1	1	1	1	1	0	0	0	1	0	1	0	1	0	1
6	0	0	0	1	1	1	0	0	0	0	0	1	0	1	0	1
7	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0
8	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
9	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0
10	0	1	1	1	0	0	0	1	0	1	0	0	0	1	0	1
11	0	1	1	1	0	0	0	1	0	0	1	0	1	1	0	0
12	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	0
13	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
14	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	1
15	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0
16	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1

two-way relationships form the top-level factors. Then, the next levels were determined by the same process. The results are presented in Table 5.

Step 6: Constructing the ISM diagram

After determining the relationships and level of factors, a network interactions model was mapped using the data illustrated in Table 5. For this purpose, the factors

Table 4 Final reachability matrix

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Driving power
1	1	1	1*	1*	0	0	0	0	0	0	0	0	0	0	0	0	4
2	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3
3	0	1	1	1*	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	1	1	1	0	0	0	0	0	1*	1	0	1	1	1*	1*	9
5	0	1	1	1	1	1	1*	1*	0	1	1*	1	1*	1	1*	1	14
6	0	1*	1*	1	1	1	1*	0	0	1*	1*	1	1*	1	1*	1	13
7	0	1*	1*	1	0	0	1	1	0	0	0	0	0	0	0	0	5
8	0	1	1*	1	0	0	0	1	0	0	1*	0	1*	1*	0	0	7
9	0	1*	1*	1	0	0	0	1	1	0	1*	0	1*	1*	0	0	8
10	0	1	1	1	0	0	0	1	0	1	1*	0	1*	1	1*	1	10
11	0	1	1	1	0	0	0	1	0	1*	1	0	1	1	1*	1*	10
12	0	1	1*	1*	0	0	1	1*	0	1*	1	1	1*	1	1*	1*	12
13	0	1	1	1*	0	0	0	0	0	0	0	0	1	0	0	0	4
14	0	1*	1	1*	0	0	0	1*	0	1	0	0	1	1	0	1	8
15	0	1	1	1*	0	0	0	0	0	0	0	0	1	0	1	0	5
16	0	1	1	1*	0	0	0	0	0	0	0	0	1	0	0	1	5
Dependence power	1	16	16	16	2	2	4	8	1	7	8	3	12	9	7	8	

are first arranged from top to bottom according to their level. These relationships can be seen in Fig. 1.

Step 7: MICMAC Analysis

In the MICMAC analysis, the factors are classified according to the degree of driving power and degree of dependence power in the four cluster (Fig. 2).

- The first cluster is autonomous factors that have weak driving power and weak dependence. These include high investment cost indices (1), not important for company's image (7), lack of planning for green entrepreneurship (8), Low level of acceptance of innovation in the organization (9), lack of experience among entrepreneurs (15) and lack of access to green technology (16).
- The second cluster is dependent factors that have weak driving power and a high degree of dependence. These include high financial risk of green products (2), unequal competitive conditions with other areas (3), the difficulty of gaining competitive advantage in green entrepreneurship (13) Lack of knowledge and R&D (14).
- The third cluster is a series of linkage factors that have both a high driving power and a high degree of dependence. Any action on these variables can affect other

Table 5 Level partition

Factors	Antecedent set	Reachability set	Intersection set	Level
1	1	1,2,3,4	1	2nd
2	1,2,3,4,5,6,7,8,9, 10,11,12,13,14,15,16	2,3,4	2,3,4	1st
3	1,2,3,4,5,6,7,8,9, 10,11,12,13,14,15,16	2,3,4	2,3,4	1st
4	1,2,3,4,5,6,7,8,9, 10,11,12,13,14,15,16	2,3,4,10,11,13,14 15,16	2,3,4,10,11,13,14,15,16	1st
5	5,6	2,3,4,5,6,7,8,10,11 12,13,14,15	5,6	7th
6	5,6	2,3,4,5,6,7,10,11,12 13,14,15,16	5,6	7th
7	5,6,7,12	2,3,4,7,8	7	4th
8	5,7,8,9,10,11,12,14	2,3,4,8,11.13,14	8,11,14	3rd
9	9	2,3,4,8,9,11,13,14	9	6th
10	4,5,6,10,11,12,14	2,3,4,8,10,11,13,14 15,16	4,10,11,14	4th
11	4,5,6,8,9,10,11,12	2,3,4,8,10,11,13,14	8,10,11	5th
12	5,6,12	2,3,4,7,8,10,11,12,13 14,15,16	12	6th
13	4,5,6,8,9,10,11,12,13 14,15,16	2,3,4,13	4,13	2nd
14	4,5,6,8,9,10,11,12,14	2,3,4,8,10,13,14,16	4,8,10,14	4th
15	4,5,6,10,11,12,15	2,3,4,13,15	4,15	3rd
16	4,5,6,10,11,12,14,16	2,3,4,13,16	4,16	3rd

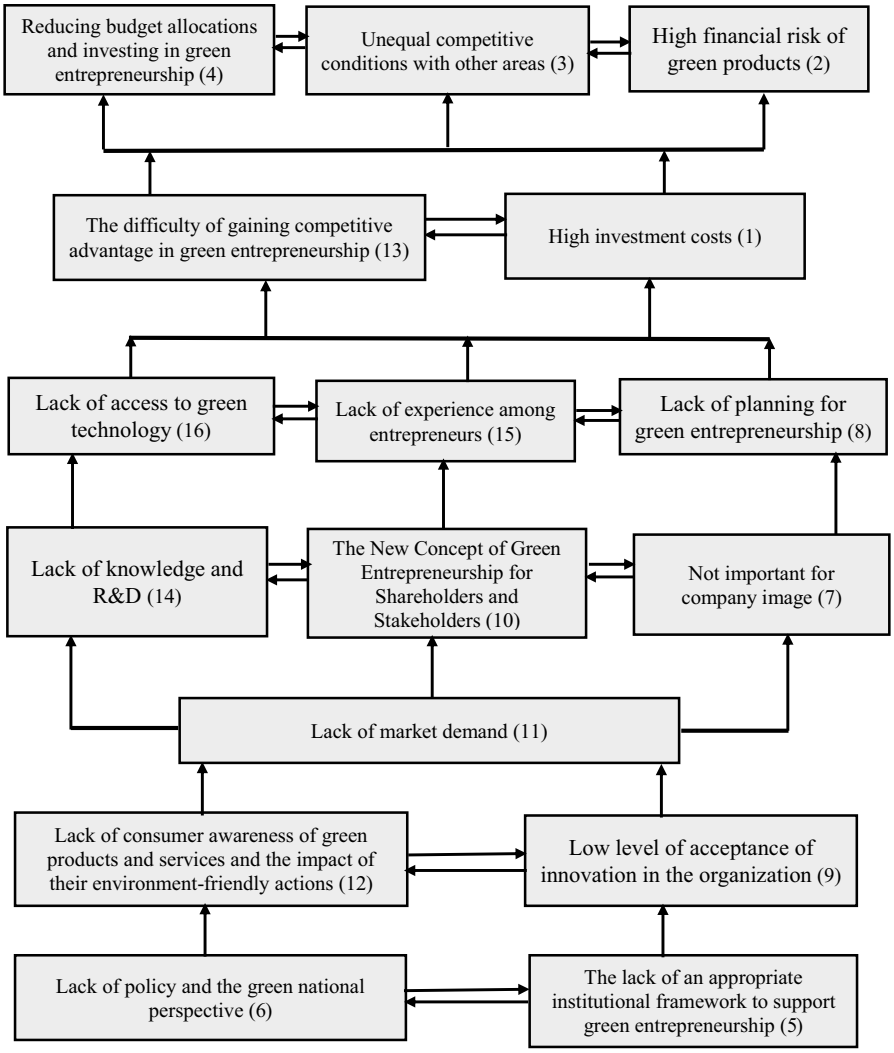

Fig. 1 ISM Model for barriers of green entrepreneurship in Iran

factors. The factor for reducing budget allocations and investing in green entrepreneurship (4) is the only factor in this category.

- The fourth cluster consists of independent factors that have a high driving power and weak dependence. These include lack of an appropriate institutional framework to support green entrepreneurship (5), lack of policy and the green national perspective (6), the new concept of green entrepreneurship for shareholders and stakeholders (10), lack of market demand (11) and lack of consumer awareness of green products and services and the impact of their environment-friendly actions (12).

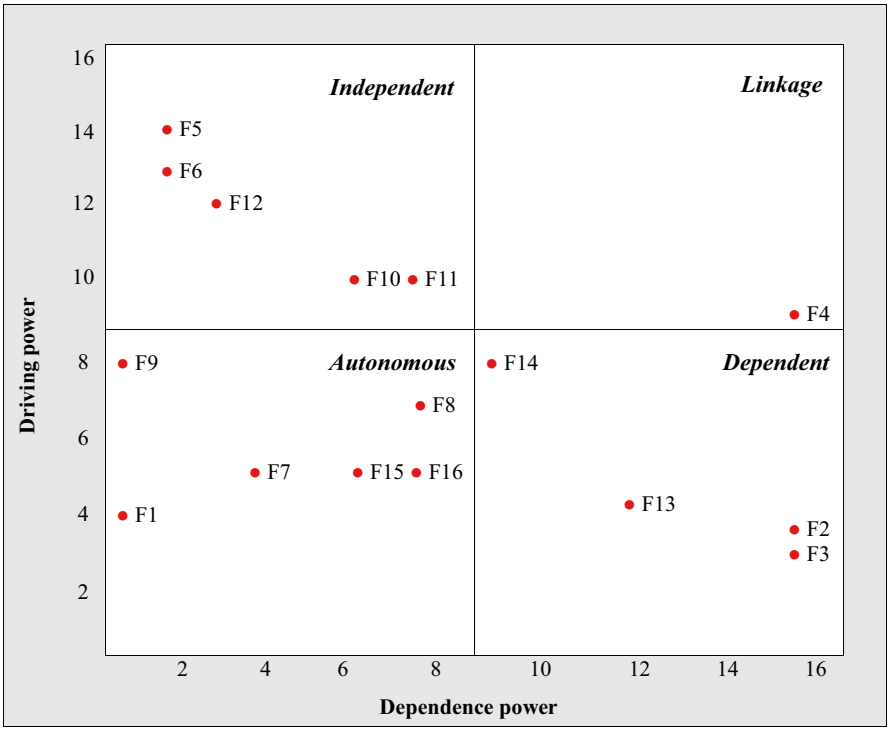

Fig. 2 Driving power and dependence power diagram

Prioritization of factors using the ANP method

In the previous section, the ISM method was used to analyze the relationships between identified barriers. In this section, each of the identified factors is weighted by the ANP method. For this purpose, a matrix was designed with rows and columns including the 16 identified factors. These matrices were made available to experts in this field to make comparisons against these indicators. Finally, all matrices are converted to an equivalent matrix, and the resulting matrix is used to continue the calculations. For weighting agents, super decision software was used.

The present research seeks to analyze the barriers of green entrepreneurship using the ISM-ANP approach, which is presented in two main research questions. The first research question was to address the barriers of green entrepreneurship, which identified these barriers in the previous stages. In total 16 barriers to the green entrepreneurship have been identified. Answering the second research question consist of two steps. In the first step, the interactions between the barriers were examined. At this stage, the objective is to determine which of the factors has a high ranking compared to each other. The analytic network process ('ANP') technique was used to determine the weight of these factors. The ANP used the relationships obtained from the ISM are used as inputs. As the calculated compatibility level for all comparisons is smaller than 0.1, the comparisons are acceptable.

Using the relationships obtained from ism, we can obtain the unweighted matrix and the final matrix using ANP. In the following, the weight of each criterion and priority of the barriers are determined. The results of these calculations are shown in Tables 6 and 7.

As illustrated in Table 7, among the dimensions, the most weight is related to the dimension of financial and economic. Also, the dimension of government policy and regulations has the least weight. The final prioritization of green entrepreneurship barriers can also be found in Table 8. The most important factor among these barriers is the reducing budget allocations and investing in green entrepreneurship. And the least important among barriers is the high investment costs.

Discussion

Nowadays, the environment has become a major component of businesses. The global economy is shifting towards a green economy. Green entrepreneurship is an important phenomenon that has attracted a lot of attention, but there is still comparatively little research in this area. As more natural resources are exploited, as well as climate change and environmental degradation created by businesses, policy makers and researchers have highlighted the urgent need to move towards a more sustainable environmental development path, emphasizing the use of sustainable methods and cleaner technology. In this context, green entrepreneurship has been proposed as an important contribution to protecting the environment in a variety of ways including producing environmentally friendly products (Gregori et al., 2021; Nikolaou et al., 2011).

Adopting green entrepreneurship practices has enormous benefits for the organizations and the society. Entrepreneurs can make a competitive difference by doing green operations, this will help them gain a better market position and gain competitive advantage. Companies by creating a green image, can help improve their company brand (Hasan et al., 2019).

The purpose of this study is to identify the barriers to green entrepreneurship, analyze the interactions between them and finally prioritize them in the context of Iran. The methodological approach used a combination of ISM and ANP methods, which built on the identification of barriers using the fuzzy Delphi method. The total number of 34 factors were initially identified through the literature review and the questionnaire given to experts allowed the researchers to select 16 factor as green entrepreneurship barriers. The study generally classified the identified barriers into five categories. The first category was financial and economic barriers. In general, green entrepreneurs have less incentive to achieve financial goals than traditional entrepreneurs. These incentives also play an important role in fostering green entrepreneurship jobs that can ultimately thrive in the green economy (Soomro et al., 2019). The findings of this research suggest that investing on green technologies leading to offering green products should be the top priority for the firms. This could be achieved by attracting investors in the field of green entrepreneurship. In general, awareness of new technologies and their use reduces the time and cost of production and increases the profitability of the company. Previous findings support these results (Cui et al., 2019; Haldar, 2019; Mathur & Tandon, 2016; Sher et al., 2019).

Table 6 Unweighted matrix obtained from ANP

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	.000	.000	.000	.000	.000	.000	.000	.333	.000	.000	.000	.000	.000	.000	.000	.000
2	1.00	.000	.500	.500	.333	.000	.000	.000	.000	.626	.626	1.000	.626	.000	.800	.800
3	.000	.000	.000	.500	.333	.000	.000	.000	.000	.093	.093	.000	.093	.200	.200	.200
4	.000	1.000	.500	.000	.333	1.000	1.000	.666	1.000	.279	.279	.000	.279	.800	.000	.000
5	.000	.000	1.000	.500	.000	1.000	.000	.000	.000	.000	.000	.750	.000	.500	.000	.500
6	.000	.000	.000	.500	1.000	.000	.000	.000	.000	.000	.000	.250	.000	.500	.000	.500
7	.000	.000	.000	.333	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000
8	.000	.000	.000	.000	.000	.000	1.000	.000	1.000	.000	1.000	.000	.000	.000	.000	.000
9	.000	.000	.000	.333	.000	.000	.000	.500	.000	.000	.000	.000	.000	.000	.000	.000
10	.000	.000	1.000	.333	1.000	.000	.000	.500	.000	.000	.000	.000	.000	1.000	.000	1.000
11	.000	.000	1.000	.100	.000	.000	.000	1.000	.000	.000	.000	1.000	.000	.500	.000	.000
12	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	1.000	.000	.000	.500	.000	.000
13	.000	.000	.544	.666	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.500	1.000	.500
14	.000	.000	.196	.333	.500	.500	.000	.000	.000	.500	1.000	1.000	.333	.000	.000	.500
15	.000	.000	.108	.000	.000	.000	.000	.000	.000	.000	.000	.000	.333	.000	.000	.000
16	.000	.000	.150	.000	.500	.500	.000	.000	.000	.500	.000	.000	.333	.500	.000	.000

Table 7 Weight of dimensions and criteria obtained from ANP

Dimensions	Weights	Factors	Weights	Priorities
Financial and economic	0.34013	High investment costs	0.02143	0.007290
		High financial risk of green products	0.29671	0.100921
		Unequal competitive conditions with other areas	0.11015	0.037466
		Reducing budget allocations and investing in green entrepreneurship	0.57170	0.194453
Government policy and regulations	0.13425	The lack of an appropriate institutional framework to support green entrepreneurship	0.60845	0.081975
		Lack of policy and the green national perspective	0.39155	0.052275
Organizational	0.21518	Not important for company image	0.13178	0.025056
		lack of planning for green entrepreneurship	0.34509	0.065613
		Low level of acceptance of innovation in the organization	0.12570	0.023899
		The new concept of green entrepreneurship for shareholders and stakeholders	0.39743	0.075565
Market conditions	0.14943	Lack of market demand	0.59542	0.088979
		Lack of consumer awareness of green products and services and the impact of their environment-friendly actions	0.40458	0.060460
Technical barriers and entrepreneurial capabilities	0.18557	The difficulty of gaining competitive advantage in green entrepreneurship	0.26043	0.048328
		Lack of knowledge and R&D	0.46516	0.086320
		Lack of experience among entrepreneurs	0.04780	0.008870
		Lack of access to green technology	0.22661	0.042053

Table 8 Final ranking of the barriers

F	Factors	Rank
F4	Reducing budget allocations and investing in green entrepreneurship	1
F2	High financial risk of green products	2
F11	Lack of market demand	3
F14	Lack of knowledge and R&D	4
F5	The lack of an appropriate institutional framework to support green entrepreneurship	5
F10	The New Concept of Green Entrepreneurship for Shareholders and Stakeholders	6
F8	lack of planning for green entrepreneurship	7
F12	Lack of consumer awareness of green products and services and the impact of their environment-friendly actions	8
F6	Lack of policy and the green national perspective	9
F16	Lack of access to green technology	10
F13	The difficulty of gaining competitive advantage in green entrepreneurship	11
F3	competitive unequal conditions with other areas	12
F7	Not important for company image	13
F9	Low level of acceptance of innovation in the organization	14
F15	Lack of experience among entrepreneurs	15
F1	High investment costs	16

The next category of barriers for green entrepreneurship was government policy and regulations. This research suggest that the government should be providing legal support to the entrepreneurial firms to produce green products. According to Potluri and Phani (2020) Government bureaucratic interferences in daily operations reduces the motivation of green entrepreneurs. These results are like the previous results (Abuzeinab et al., 2017; Haldar, 2019). The government can encourage businesses to enter green markets by formulating policies and providing financial facilities for green entrepreneurial projects. Creating support programs for investment in the field of green product production, allocating budget for research and development in the field of green entrepreneurship, as well as financial discounts for buying green products are other effective measures that the government can take. In addition, the government can by reducing taxes for environmentally friendly businesses in contrast to increasing taxes for companies that have a negative impact on the environment, provide the ground for moving towards a green economy.

The next barriers to the green entrepreneurship are those organizational factors. According to the findings of this study, the acceptance level of innovation in organizations is low, which is an important barrier for the organization shift to towards the production of green products and services. Researchers have shown that companies with a high level of innovation are more inclined to research and develop green products (Gu & Zheng, 2021). To overcome this barrier, publicizing the financial and social consequences of green entrepreneurship can to some extent persuade organization managers to do innovative work and produce green products. The results of Sher et al. (2019) confirm this. Market conditions and technical barriers and entrepreneurial capabilities are other factors identified in this study. Developing programs to raise

awareness and support the environment and to develop and expand a green business culture among people and entrepreneurs and to explain green business opportunities can be helpful. Also, developing training opportunities to learn more about green entrepreneurialism for entrepreneurs and business owners can be another effective way to develop green entrepreneurship. According to Capasso et al. (2019), in topics related to green growth, not only training and skills are needed for companies and policymakers; In addition, the general public, including consumers and stakeholders, must have the necessary knowledge and skills. Several studies have been presented in support of these results (Abuzeinab et al., 2017; Bergset, 2018; Cui et al., 2019; Mathur & Tandon, 2016). Currently, due to the increasing problems related to air pollution and environmental problems, people's awareness about green products is growing. However, in some areas, the culture of green entrepreneurship has not been properly formed, and proper advertising about the benefits of green products is not done, and people still tend to buy cheaper products. Therefore, for the growth of the market of green products, not only more information should be provided to people about the benefits of consuming green products, but also efforts should be made for affordable prices. By increasing people's awareness and offering products at reasonable prices, the market for green products can grow further.

The relationships between the identified factors were then determined using ISM and, based on these relationships, the barriers were categorized using the driving power and dependence power as in four clusters. Finally, the ANP method was used to weigh the identified barriers and produce a final ranking of the barriers (shown in full in Table 8 above).

The results of the analysis showed that the most critical barrier to the advancement of green entrepreneurs is reducing budget allocations and investing in green entrepreneurship. Supporting green entrepreneurs is one of the most important factors for achieving sustainable development. By investing in the green products industry, it is possible to combine optimization of the production process, reduction of costs, creation of employment and preservation of the environment. Investing in the production of green products can be used as an opportunity to create business, reduce dependence on foreign products and increase production. Therefore, budget allocation and investment in this sector can be very important for economic and sustainable growth.

This is followed by the high risk (financial and production) of green products and lack of market demand. For this purpose, it is very important to create proper marketing and launch the sales market in a professional manner. Also, cooperation with foreign partners and creating access to international markets helps to increase the sale and export of green products significantly. The Lack of knowledge and R&D and lack of an appropriate institutional framework to support green entrepreneurship are also important. Interestingly the high investment costs associated with green entrepreneurship was given least importance, followed by lack of experience among entrepreneurs and low level of acceptance of innovation in the organization. The lack of experience of green entrepreneurs is one of the important challenges in the field of green businesses. To help green entrepreneurs, training courses and specialized consultations can be used so that these people can get the best experiences, techniques, and skills necessary to start and manage a green business. Also, creating

international networks with green businesses in developed countries can be an effective tool for increasing experience and knowledge.

Conclusion

There are policy implications for the outcomes of this study. Policymakers to offer solutions to eliminate or reduce current barriers to the green entrepreneurship can use the results of this research. These results also help the entrepreneurs overcome the challenges to green entrepreneurship. Both policy makers and green entrepreneurs can benefit from targeting their resources effectively in the areas identified by the research as key policy implications. This should also help to build an effective shared understanding of the relative importance of the obstacles that face green entrepreneurs enabling them to forge a more collaborative relationship in resolving the key issues.

The research also contributes to the literature as the first to focus on the barriers to green entrepreneurship, explore their interaction and prioritize them according to their importance. The use of an ISM-ANP approach to analyze and prioritize the importance of barriers to green entrepreneurship, building on the identification of barriers through the literature review and use of the fuzzy Delphi method, represents a new, innovative approach that may yield further insight in further studies.

Though some of the identified barriers are common with other studies conducted in developing countries (Haldar, 2019; Sher et al., 2019), caution must be taken in generalizing the results to other countries or regions as data were confined to Iran.

To reduce different biases in the research, several measures were taken during research design and execution. To prevent sampling bias, researchers have identified clear criteria for selecting those who could participate in data gathering and contacted the potential participants without any prior judgment or inclination to include or exclude particular people in the study. Also, they did not confine the study to a specific sector or industry and tried to include different sectors without a priori set of industries. In the first phase (fuzzy Delphi), interview questions were reviewed to prevent order effect. Also, during interviews, researchers tried to do their best not to direct the answers of the participants.

Theoretically, the identification of barriers to green entrepreneurship and the analysis of those obstacles in Iran is one of the first studies in this field, and the method used in this research distinguishes it from other researches. The current research aims to improve the theoretical knowledge of green entrepreneurship and proposes a theoretical framework as a basis for future research. Due to technological advances and changes in countries' policies, it is recommended to re-examine this study in different times and countries, and this issue will become a fruitful research area in the future. Researchers can conduct cross-country studies in developing countries to explore common barriers in different countries. By providing a theoretical basis for green entrepreneurship barriers, this study offers an opportunity to expand knowledge about green entrepreneurship barriers through empirical research. It is also possible to examine the relationships between variables through structural equations modeling in future researches and determine the effect rate of each of the identified barriers on the final performance and success of entrepreneurs.

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Authors and Affiliations

Rahim Sarvari[1] · Younis Jabarzadeh[2] · Azhdar Karami[3] · Masood Jabarnejad[4]

✉ Younis Jabarzadeh
y.jabarzadeh@ljmu.ac.uk

Rahim Sarvari
rsarvari11@gmail.com

Azhdar Karami
a.karami@bangor.ac.uk

Masood Jabarnejad
mjabarnejad@dogus.edu.tr

1 Faculty of Economics and Management, University of Tabriz, Tabriz, Iran

2 Liverpool Business School, Liverpool John Moores University, Liverpool, UK

3 Bangor Business School, Bangor University, Bangor, UK

4 Department of Industrial Engineering, Dogus University, Istanbul, Turkey