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Measurement and comparison of different dimensions of renewable energy policy implementation in the agricultural sector

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ABSTRACT

The current research aims to measure the different dimensions of renewable energy policy implementation and compare these dimensions with each other, focusing on Iran's agricultural sector. This analysis makes it possible to identify the strengths and weaknesses in implementing existing policies. The five dimensions include "organizational and institutional", "incentives", "investment", "infrastructure", and "human resources development". The statistical population of this research comprised energy policy experts, whose number was 85. The sampling method was random, and 70 persons participated in answering the questionnaire using the Karjesi and Morgan table. A questionnaire was used to collect data. The reliability of the questionnaire was calculated using Cronbach's alpha (0.916). Face validity, content validity ratio (CVR), and content validity index (CVI) were applied to determine validity. In the calculation of CVR, values $\geq$ 0.33 were considered reasonable and appropriate to confirm each item. All CVI values obtained were higher than 0.79. Multi-criteria analysis was used to analyze the data. The results indicated that organizational and institutional policies were at the highest level of unsustainability. The dimension of investment policies showed less unsustainability than other dimensions. The other three dimensions also showed significant deficiencies. It seems that policy development to eliminate the diversity and interference of organizations, fuel subsidies revision, market policy development, attracting capital, and participation of stakeholders is necessary to reduce unsustainability in this field. The development of the resources of expert forces and attention to educational policies should also be considered.

1. Introduction

The global energy landscape has evolved rapidly in recent years. The special importance of this evolution is due to the increasing competitive prices, and price fluctuations in oil and gas resources, as well as the emergence of climate change [1–3]. Governments are constantly striving for development, and these efforts are increasing energy demand [4,5]; planners and policymakers believe that stronger and more appropriate energy choices need to be made to meet this increasing demand [6]. In this regard, many efforts have been made to explain the concept of energy development and the development of policy options, and the attention of planners and decision-makers has been focused on designing processes [7,8] to promote sustainable development [9,10].

For this reason, energy has become a significant economic challenge and can only be addressed through energy policy at all levels of national government and the international level [11]. Therefore, policymakers believe that the measures adopted should be in line with the constant changes in the energy sector [12]. Energy policy is a vital tool for bringing about change [13], and has become increasingly important in recent years due to the growing role of energy and the environment in various societies, economic, political, and social activities [14,15]. Energy policies form the basis for the use of RE, and policy frameworks represent the most appropriate instrument to support the implementation of this type of energy in various economic and social areas [1]. The politics of renewable energies is a new topic in the history of science and is not older than half a century [16]. In this area, governments are trying to solve energy problems as the global energy landscape has evolved rapidly in recent years. Due to development and progress, as well as the increasing energy demand, the need for stronger decision-making about energy is felt more [6]. Developing the right policies by providing the right platform ensures investor confidence and promotes their participation in the energy sector [17]; The path to developing RE will

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therefore be difficult without government support. For this reason, governments are implementing policies to support the development of RE [18]. A favorable policy package takes into account the current state of the global market, technological changes, positioning in the global market, and adapts to changing obstacles [19,20], and if needed, make necessary reforms like what South Korea did in the 1980s and reformed RE policies [21]. Therefore, decision-making needs to be geared toward supporting RE investment on a larger and more integrated scale [1]. At the same time, special attention must be paid to the agricultural sector because of its role and importance in the debate on food security and economic development. One of the challenges for sustainable agriculture is that most farms still rely on fossil energies and therefore agricultural energy consumption is a global problem [22]. Agriculture plays a significant role in global warming caused by greenhouse gases (GHG) resulting from activities such as deforestation, farming methane emissions from livestock, etc [23,24]. At the same time, the cost of agricultural production depends on the price of fuel [25]. Agricultural production requires fuel and fertilizers, the price of which is linked to crude oil [26]. Therefore, reducing the proportion of fossil fuels and increasing the proportion of RE sources, such as biofuels, is one of the most important future goals of the energy industry. Biofuels can help curb global warming and will play an important role in creating jobs in the agricultural sector [27–30]. In addition, renewable sources can guarantee energy security to a large extent and can be used for various applications in the agricultural sector with minimal environmental impact [28,31]. It is noteworthy that the agricultural sector itself can produce RE, such as biofuels [32], and In this field, it can play a key role. Although there are drawbacks to the production of biofuels, such as the high cost of production and decreasing availability and crop productivity in winter, the benefits outweigh the negative aspects [33,34].

Governments continue to support the agricultural sector [35], and the structure of conservation measures has tended to increase the efficiency and agricultural sector productivity [36,37]; this means that for more energy is needed and new energy sources are required [38]. After that, actions should be taken so that these new energy sources enter the production process more easily and quickly. Accordingly, adopting efficacious policies, such as guaranteeing underlying subsidies through tax policies and concessions, facilitates the rapid spread of RE sources among farmers [39,40]. At present, the proportion of RE in Iran's energy mix is minimal [41]; It could be argued that there is a declining pattern where the proportion of RE utilization in total final energy requirement has significantly decreased, dropping from 1.5 % in 1980 to 0.58 % in 2018 [42]. This is despite the fact that Iran has a very high potential for RE [43], and its types, such as solar and wind energy, are highly useable [44]. There are many reasons for this problem, but one of the most important reasons for the lack of RE deployment is ineffective and inadequate policy measures [42,45].

Iran has encountered difficulties in the execution of current policies and the enforcement of laws as a result of a deficiency in policy infrastructure. Despite the issuance of policy guidelines in Iran, there exists no executive assurance for their implementation [14]. An analysis of RE policy in Iran shows that the country lacks a policy framework to define energy supply and that there are ongoing challenges in adopting and implementing the necessary policies [46] This shows that it is necessary to take appropriate measures in this matter. The RE sectors in Iran encounter numerous obstacles. These obstacles encompass issues such as organizational overlap and interference, deficient collaboration between responsible institutions, insufficient consideration of the different requirements and capabilities of various regions, and limited assessment of energy policies, all of which also impact the agricultural industry [47].

There are many innovations in the area of energy, but they require the reform of the supporting policies. In order to have an appropriate policy, it is imperative to have a comprehensive knowledge of all aspects of the primary matter. Furthermore, it is crucial to accurately discern the requirements of the agricultural community, while ensuring minimal deviation within this domain [48]. A scientific and systematic understanding of the current state of RE development policies and the adaptation of these policies to the needs of the agricultural sector, are necessary to address the shortcomings in the policy cycle. Since the agricultural sector is one of the most important pillars of the Iranian economy, accounting for almost 9 % of gross domestic product (GDP) and 18 % of total employment, and the future of the country depends on this sector, the future of the agricultural sector will naturally depend on energy [32,49]. Although policy structures and supportive government policies are crucial for the development of RE technologies in the agricultural sector, the implementation of these policies in agriculture is a complex issue with different dimensions that are influenced by a variety of factors [50,51], and analyzing these dimensions of policies in the agricultural sector is important for several reasons. First, agriculture contributes significantly to greenhouse gas emissions [52], and implementing RE strategies can greatly help reduce these emissions and addressing climate change. Secondly, RE has the potential to provide alternative and reliable sources of revenue for agricultural producers by generating and trading environmentally friendly energy [53]. Furthermore, analyzing policy implementation, while identifying barriers, can enable best practices to refine future policy decisions and improve the effectiveness of RE projects. Increasing the effectiveness of RE policies in agriculture is very important to achieve sustainable development [54] and transition to a low-carbon economy [55]. By evaluating the implementation of RE policies in different dimensions, anyone, especially politicians and decision-makers, can gain insight into the challenges and opportunities related to RE in the agricultural sector and predict strategies to achieve sustainable results, because the implementation of RE policies in this sector is a multifaceted process that requires accurate and long-term analytical planning. In this way, it can be ensured that the agricultural sector can make optimal and appropriate use of RE sources while ensuring that its costs do not impose an additional burden on the farming community.

Therefore, it is a scientific task for the academic community to provide an appropriate framework for analyzing the current situation of policies to determine a set of proper policies and mechanisms to strengthen the RE planning and policy-making in the agricultural sector. Of course, there is a lack of knowledge and information in this field. It is not clear exactly how far the policies have been implemented and in which dimension the policies are weaker. In addition, it is not obvious what the implementation status of these policies is, and this is an important gap and challenge in achieving the desired status of RE development, especially in the farming sector. Managers and policy-makers must have the necessary information to address the shortcomings of the policies that are being implemented. It must be determined whether the decisions made have gone through the right circuit. In this way, the flawed policy-making cycle is avoided, and mistakes are not repeated. This is a critical issue in the current conditions of Iran's RE policies, for which almost no solution has been thought of.

These policies and mechanisms are essential to maintaining Iran's global presence and fulfilling its international obligations, including the Paris Agreement, as well as meeting the challenge of increasing energy demand. Whereas the study of RE policies in Iran is very limited and studies are lacking, the results of the current study can be useful for managers and policy-makers in the field of energy because by applying the opinions of experts in this field, the dimensions of RE policies are analyzed.

This article presents a new approach by addressing several critical and unknown dimensions in the implementation of RE policies in agriculture. This research distinguishes itself not only by focusing on RE policies in general, but also by analyzing the different dimensions of these policies in the agricultural sector. While RE policies in sectors such as industry and urban development have been studied extensively, there is relatively little focus on the agricultural sector. This comprehensive approach allows for a more detailed understanding of the implementation of these policies and their different conditions in different

dimensions in this sector. It fills an important gap, by carefully examining how these policies are implemented in the agricultural area in light of increasing energy demand and sustainability challenges. This is because, RE use in agriculture is closely linked to broader sustainability goals, such as reducing carbon emissions, increasing energy productivity, and improving environmental monitoring.

This article also emphasizes the importance of developing and employing quantitative methods to measure the level of policy implementation. In addition, provides a new tool for policymakers and researchers to evaluate and improve RE strategies in this field by creating criteria or indicators that can appraise how policies are implemented in different dimensions.

The contribution of this study to the progress in the utilization of RE in the agricultural domain will be important in the future and will have an answer to address the problems arising from RE policies. Therefore, the purpose of this investigation is to measure and recognize the current state of RE policies in Iran's agricultural sector. This goal will examine and evaluate the implementation of the mentioned policies in the current situation. This comprehensive assessment seeks to determine whether various dimensions of these policies have been implemented well or not. It also specifies which parts have dearth and weaknesses and which parts need to be improved or reformed.

The null hypothesis (H_0) states that the implementation measures in each of the five dimensions of RE policies, including Organizational and institutional, Incentive, Investment, Infrastructure, and Human resource development policies, have been successful and are in favorable conditions. In addition, all implemented policies have no weaknesses in implementation. To test these hypotheses, this article tries to answer the following questions:

1 What is the current state of implementation in each of the dimensions of RE policies in the agricultural area?
2 Which RE policies exhibit weaknesses during the implementation phase and need reform?

In the literature review section, in addition to examining the energy conditions in Iran, existing studies were reviewed. Afterward, the research method was introduced. Then, in the final section, after analyzing the findings, practical solutions were presented.

2. Literature review

2.1. Energy conditions in Iran

Concerning energy resources, Iran is wealthy and has both fossil and RE sources. Iran stands among the most affluent nations globally, ranking fourth in terms of crude oil reserves and second in terms of natural gas reserves worldwide [56,57] (Fig. 1). As a result, the cost of fossil fuels in Iran is relatively low and covers - approximately 98 % of the nation's energy demands [18,58] (Fig. 2).

Also in terms of renewables, has very plentiful potential for RE resources [60]. Solar and wind energy are among the most crucial forms of energy, characterized by their significant potential to generate environmentally friendly energy (Fig. 3 and 4). Iran has 300 sunny days a year, which is a significant potential in the solar energy field [61] and windy areas such as Yazd [62] and Kermsn [63] can generate wind energy.

Other types of resources, such as geothermal, biofuels, and marine energy, are also significant for energy production and are well distributed geographically according to the size of the country. The

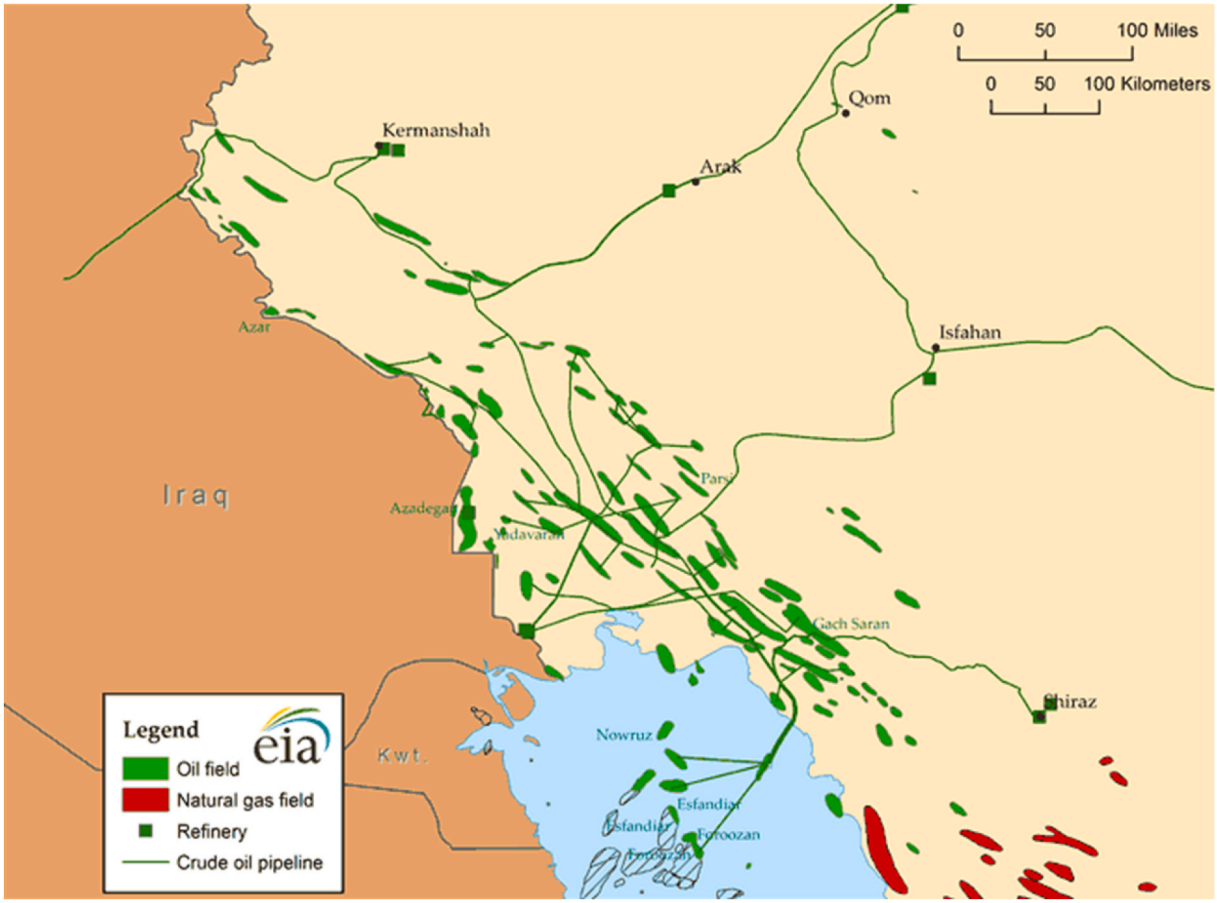


Fig. 1. Iran's oil and natural gas reserves map [59].

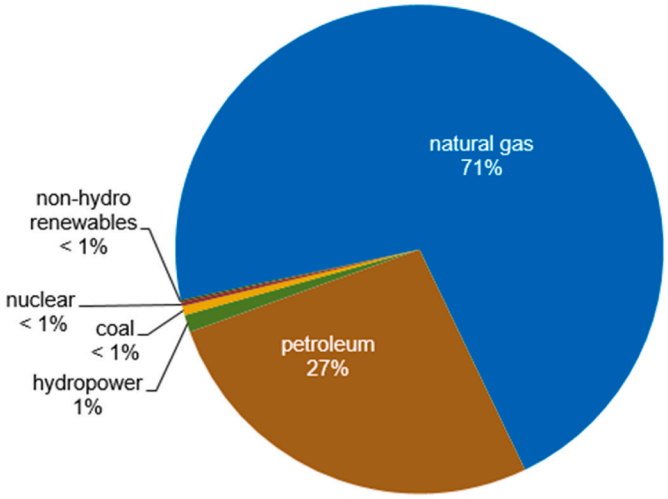


Fig. 2. Iran's total primary energy consumption, shared by fuel, 2021 [59].

northwestern region of Iran, for instance, is regarded as a promising area for geothermal energy due to its notable geographical and geological characteristics and substantial thermal activities, particularly in the Sabalan and Sahand geothermal fields [65] (Fig. 5).

In another type of energy, i.e., biomass, it should be noted that due to extensive agriculture in all regions of the country, a large amount of biomass is produced in Iran, which is a very rich and valuable source for the production of biofuels [66,67] (Fig. 6). Agricultural and forestry waste, animal excrement, urban waste, sewage sludge, and microalgae are among the types of these sources [33,66,68,69] (Fig. 7). Research indicates that the recycling of citrus in Iran alone has the potential to produce 27 million liters of ethanol, 79 million cubic meters of methane, 84.9 million liters of bio-oil, and 17.8 tons of coal [70].

In addition to the types of energy mentioned, marine energy also serves as a reliable source of energy that has minimal environmental ramifications [71,72]. The results of the study by Copping et al. [73] support this assertion. Their research showed that there is no evidence of shock deaths from turbine operations, and the noise generated by the devices is unlikely to cause problems for mammals. Iran, having a long coastline, has great potential for marine energy development. Developing this kind of energy is possible in the Caspian Sea, the Persian Gulf, and the Oman Gulf. However, this potential has not been sufficiently considered by policymakers [60,72,74].

A look at the sources of RE in Iran shows that this country benefits from the majority of RE and further that different types of these energies have a proper distribution throughout the country. That is, if there is a will to use and benefit from these enormous resources, there is no limit to the resources.

2.2. Agriculture and RE policy

The use of fossil energy in various sectors, including industry, transportation, and agriculture, has led to significant amounts of greenhouse gas emissions in the world [75,76]. The agricultural sector accounts for around 14 to 30 percent of these emissions, which is due to the high use of fossil fuels [77]. Since agricultural activities, including irrigation, land preparation, fertilization, livestock operations, food

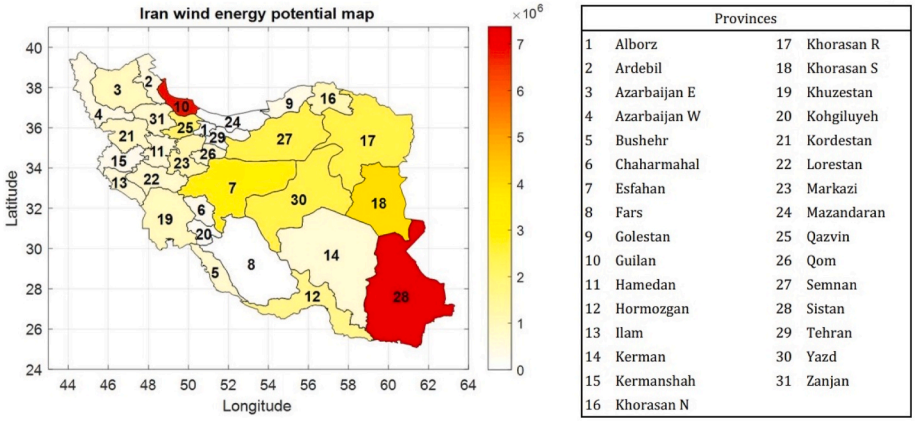


Fig. 3. Iran's wind energy potential map [64].

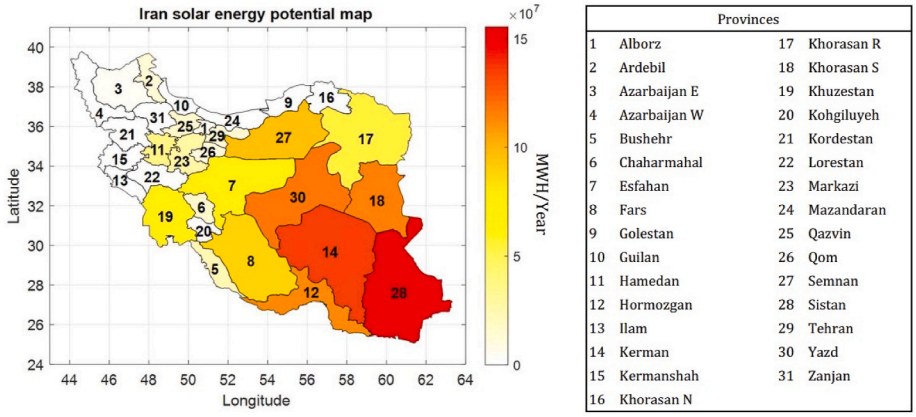
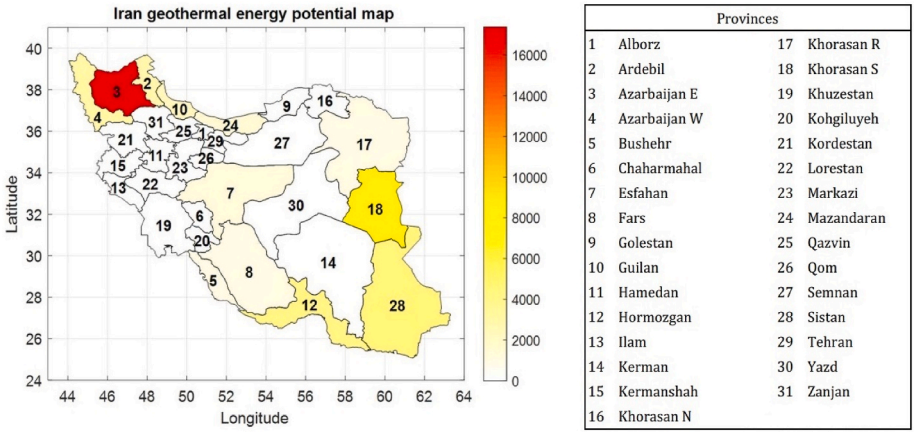
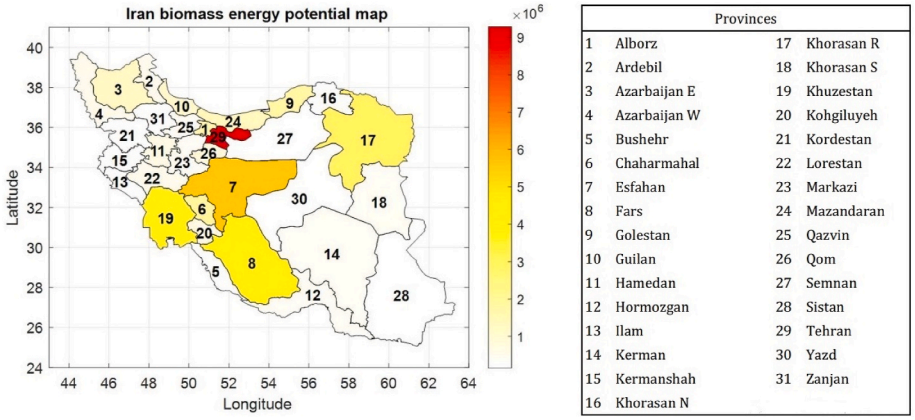


Fig. 4. Iran's solar energy potential map [64].



Provinces			
1	Alborz	17	Khorasan R
2	Ardebil	18	Khorasan S
3	Azarbaijan E	19	Khuzestan
4	Azarbaijan W	20	Kohgiluyeh
5	Bushehr	21	Kordestan
6	Chaharmahal	22	Lorestan
7	Esfahan	23	Markazi
8	Fars	24	Mazandaran
9	Golestan	25	Qazvin
10	Guilan	26	Qom
11	Hamedan	27	Semnan
12	Hormozgan	28	Sistan
13	Ilam	29	Tehran
14	Kerman	30	Yazd
15	Kermanshah	31	Zanjan
16	Khorasan N		

Fig. 5. Iran geothermal energy potential map [64].



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4	Azarbaijan W	20	Kohgiluyeh
5	Bushehr	21	Kordestan
6	Chaharmahal	22	Lorestan
7	Esfahan	23	Markazi
8	Fars	24	Mazandaran
9	Golestan	25	Qazvin
10	Guilan	26	Qom
11	Hamedan	27	Semnan
12	Hormozgan	28	Sistan
13	Ilam	29	Tehran
14	Kerman	30	Yazd
15	Kermanshah	31	Zanjan
16	Khorasan N		

Fig. 6. Iran biomass energy potential map [64].

processing, and storage, are all energy-dependent [78], and moreover, most of the machines in agriculture use fossil fuels [79], this amount of greenhouse gas emissions is conceivable. Still, the Food and Agriculture Organization of the United Nations (FAO) posits that due to the advantages of RE, the emission of greenhouse gases from agricultural areas can be significantly reduced through their use [80–82] (Fig. 8). The results of previous studies also support this claim [83,84].

RE sources are environmentally friendly and economically viable [78]. In addition, renewable energies have the potential to be employed in various devices such as chillers, solar dryers, and water pumps in the agricultural sector [88]. Therefore, the imperative objective in this domain is to decrease the proportion of fossil fuels and augment the proportion of biofuels.

Tailored policy measures serve as the primary catalyst for stimulating investments in the RE sector [89,90] and facilitate the rapid expansion of RE in the agricultural area [91]. Like what happened in Australia, investment in RE production increased significantly. This was due to government policies that reduced the costs of renewable production technology while using appropriate financial incentives. These investments have helped to change the energy mix in Australia [92]. Alternatively, in Japan, the emergence of investment funds primarily transpired after the catastrophic Fukushima nuclear power incident, which compelled the government to suspend the operation of the nuclear power plant due to safety concerns. A considerable number of individuals, particularly those residing in the impacted region of Fukushima, have exhibited a remarkable inclination toward RE sources, such as solar and wind power [93]. Other policies also have been implemented in the RE sector, such as the feed-in tariffs, which is a particular policy mechanism that aims to accelerate investment in RE technologies. This is achieved by providing long-term contractual agreements to both RE producers and investors [94,95]. In addition, policies like setting guaranteed rates minimize investment risk and make the investor more confident [91].

Dehhaghi et al. [47] conducted a study on RE policies in Iran. This study examined various aspects such as organizations and institutions, education and promotion of renewables, international cooperation, etc. Jebli and Yousef [77] investigated the consumption of RE and agriculture. They concluded that the determination to financially support the RE use in the agriculture enables it to enhance its competitiveness in global markets, while reducing pollution and contributing towards the effort of combating global warming. Liu et al. [96] examined the biomass production policies of the agricultural sector and found that a combination of market incentives and policy provisions significantly increased ethanol and electricity production from biomass. They also emphasized infrastructure policies such as markets and regulations.

In addition, Karatayev and Clarke [97], indicators such as the focus on fossil fuels, problems with regulations, and the amount of investment in their study and referred to infrastructure and investment policies. Lo [98] also considers investment in renewables to be important and believes that the government should support small businesses in this area. In another study, Liu et al. [11] also examined RE policies, and their empirical findings suggested that policies such as fiscal and financial incentives, market-based instruments, policy support, and research, development, and deployment played a crucial role in enhancing the capacity of RE. Martin and Rice [99] conducted a study on Queensland's RE development policies. They believe stakeholder participation is necessary for adopted policies and examined factors such as the use of financial and tax incentives, as well as government subsidies. Pischke

Fig. 7. The potential of bioenergy resources in different regions of Iran [60].

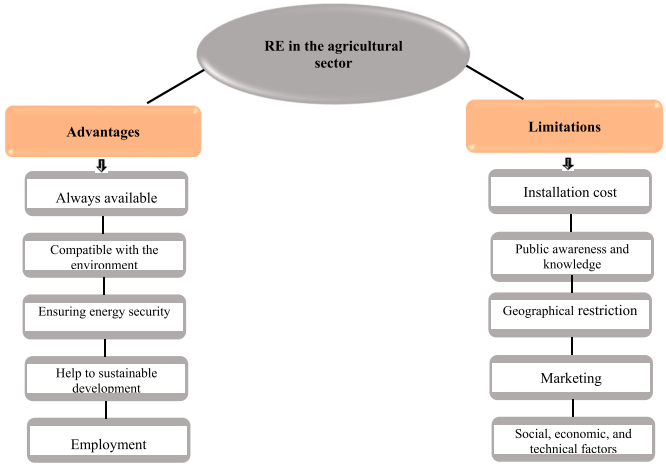

Fig. 8. Advantages and limitations of RE use in the agricultural sector [85–87].

et al. [100] found that countries around the world devote significant resources to energy policy implementation. However, in the absence of effective coordination between various tiers of governance and a lack of concerted efforts to enhance the efficacy of these policies, these resources may ultimately be squandered. Schmid [101] cites tariff policies and private sector participation policies as the key to the development of RE. He believes that greater private sector participation has played a key role in promoting the development of installed RE capacity in nine Indian states Rezaei et al. [102], in their research, have addressed factors such as investment, proper planning, and organizational management. They concluded that Iran is in a state of instability in most of the indicators studied and that the energy policy in this country to reduce environmental impact and promote sustainable consumption has not yet been successful. Onifade [103] also considered renewable market policies necessary. Market development policies fall into the category of infrastructure policies. He concluded that policy combination and improvement could solve traditional policy problems. Stigka et al. [104] studied public awareness and knowledge as an important factor in the development of RE and referred to policies related to the dimension of human resource development. Their study showed that issues such as education have a significant impact on the acceptance of RE. Subsidies are one of the fiscal and incentive policies used in many countries. Widya Yudha and Tjahjono [105] in their study focus on stakeholders and examine different dimensions employing the methodology of Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) analysis. The results of the study show that existing policies in Indonesia are not yet complete, and the government must be able to develop a successful policy that aims to improve the current RE policies make it easy for investors in the RE sector. The implementation of RE policies can be characterized as a multifaceted governance endeavor, encompassing various tiers of governmental authority. Effectuating a transition towards a RE system necessitates not only top-down

initiatives by the central government but also grassroots efforts at the local level. The presence of Ambiguous accountabilities, contradictory regulations, feeble local capacity, insufficient awareness of national objectives, and a lack of consultation all serve as significant political barriers to the successful implementation of RE policies [106]. The interplay between different levels of government and associated synchronization issues have a profound impact on the results of the execution of RE policy. Thus, the relationships between the different levels of government and coordination issues significantly affect the outcome of the RE policy implementation [107]. The more groups and management levels are comprised in the decision-making procedure, the more money must be paid for interaction and coordination between them. Eliminating or ignoring the other people and groups involved can lead to policy failure. For instance, the national government of the Philippines passed the Comprehensive RE Act in 2008, but its execution has been delayed due to the multiplicity and diversity of subnational power groups [106].

In addition, stakeholders play an important function in shaping decision-making regarding implementing RE policies [108]. RE policies implemented in developed and developing countries can make an important contribution to the sustainable development of RE industries. Sometimes these policies face many challenges and their success rate decreases a lot. The issues faced by these policies should be analyzed and recognized in order to have a clear and confident future in renewables [20].

Most of the studies in this field, like the articles reviewed in this research, have not investigated all aspects of RE policies. A set of efficient policies makes every country more successful in exploiting and optimally using RE. Although effective policies are essential for RE development and their optimal use, more important than that is the implementation of these policies, which must be constantly reviewed and reformed. Having accurate information and statistics about the implementation status of the adopted policies is crucial to distinguish the deficiencies and weaknesses. The need for this awareness and information about the status of RE policies in Iran also applies. Since very few studies have been done in this field in Iran, collecting this information through research is doubly necessary. Unfortunately, Comprehensive information is not available to explain how these policies are implemented. It is not clear whether the current state of implementation of these policies is satisfactory. It is also unclear which policies need to be amended or revised. With a brief look at the research and studies, this study's weakness can be realized. Therefore, it is essential to thoroughly revise and analyze the implementation status of all policies that have been adopted and implemented and to determine whether spending all this time and budget has had a positive result or not. Therefore, this study pursues to fulfill this information gap and, unlike previous studies, addresses all aspects of RE policies.

The current study evaluates the implementation status of RE policies in Iran and determines the status in each dimension of policies.

3. Methodology

3.1. Multi-Criteria Analysis method

Policies are an important tool for renewable energy development. Such policies have been developed, but there is not enough information about their effectiveness [100]. However, it is necessary to evaluate all adopted and implemented policies. The utilization of Multi-Criteria Analysis (MCA) appraisal methods has witnessed a notable surge over the past twenty years, particularly in various contexts of energy policies [109] and has attracted increasing interest among researchers and practitioners active in issues such as policy and planning [110]. In this method, the purpose is to show the concealed quandaries behind a collection of alternatives that are evaluated in several criteria so that the stakeholders are informed of the possible gains and losses resulting from the choices [109]. This method is used to produce more accurate, transparent, and democratic evaluations of policies [110]. In addition, the MCA process can make decisions more defensible and acceptable. This method is a comprehensive strategy that can be employed to analyze intricate issues [111], MCA measures each indicator in comparison with the desired goal and conditions and gives values to options evaluated by several criteria. MCA can also provide a platform for participatory planning [112]. This research method is suitable for solving problems related to several aspects. Since energy planning is a very complex decision and involves many factors and actors the MCA method can offer a comprehensive examination of energy-related issues at varying levels of decision-making, ranging from strategic to operational, and encompassing diverse timeframes [111,113]. Sellak et al. [113] confirm this with their research on articles published over 12 years. In the collaborative design of RE tools [114], the comprehensive evaluation of energy analysis [115], multi-criteria methods for analysis were used. Following the increase in the efficiency of the MCA method, Tsoutsos et al. [116] used this methodology in an article with the aim of sustainable energy planning. Ahmed et al. [117] also applied this method to Glasgow's RE planning.

Thus, in the current study, the MCA technique was used to assess the implementation condition of RE policy in Iran's agricultural sector.

3.2. Application of MCA in this study

To analyze the current implementation condition of RE policy in the agricultural sector, dimensions and indicators for evaluating energy policies were extracted using scientific sources review. Then it was provided to RE experts for validation. The determination of the research instrument's validity was conducted through the utilization of face validity, content validity ratio (CVR), and content validity index (CVI). Face validity ascertains whether the visual presentation of the questionnaire aligns with the objectives of the research [118]. During this stage, professionals were consulted to provide their evaluation of the suitability, attractiveness, and logical arrangement of the items, as well as the conciseness and comprehensiveness of the questionnaire. CVR shows that the most important and correct content is selected and used [119]. The CVI additionally ascertains if the items in the questionnaire are situated optimally to effectively assess the content. Every item was compared to the Lawshe table to determine the CVR values (Table 1). In this investigation, values ≥ 0.33 were deliberated as logical and suitable to confirm every item. In the CVI calculation, values greater than 0.70 were considered appropriate to confirm each question according to Lawshe's law [120]. However, in this study, all values obtained were higher than 0.79.

In the subsequent section, the approved indicators were ranked and evaluated in terms of importance on a 5-point scale. These five scales are 1: less important, 3: relatively important, 5: very important, and 2 and 4: average values. Of course, researchers have also used different scales. Choobchian et al. [112] also applied a 5-point scale. Then, based on these rankings, the relative weight of each index was estimated using the formula mentioned in Equation (1).

Table 1
Lawshe table to determine the CVR values [120].

Number of respondents	Validity minimum
5	0.99
6	0.99
7	0.99
8	0.85
9	0.78
10	0.62
15	0.49
20	0.42
25	0.37
30	0.33
40	0.29

$$Wj = \frac{aj}{\sum aj} \quad \text{Eq (1)}$$

in this formula (Eq. (1)) is the average weight of indicator j, and Wj is the relative weight of indicator j. The subsequent analysis evaluated every indicator by assessing their present implementation situation relative to the predicted goal or desired situation. The desired situation was to show a sustainable status of RE policy indicators. In this regard, an MCA method of a 5-point scale is used, following Choobchian et al. [112], with values 1: extremely weak, 2: weak, 3: moderate, 4: strong, and 5: very strong. Next, the Unsustainability Index of Criteria/dimension (USIC) was calculated using the formula mentioned in Equation (2).

$$USIC = \sum Sjaj \quad \text{Eq (2)}$$

where *USIC* is the unsustainability index of criteria/dimension I (dimension named in Table 2), *Sj* is the score of indicator *j,* and *Wj* is the relative weight of indicator j (Eq. (2)).

In this study, for evaluating the current situation of RE policies in the agricultural sector, a set of indicators composed of five dimensions, namely, Organizational and institutional policies (6 indicators), Incentive policies (5 indicators), Investment policies (4 indicators), Infrastructure policies (6 indicators), and Human resource development (5 indicators) were used (Table 2).

The research's statistical population encompassed professionals with substantial experience, expertise, and active participation in the RE policy field, estimated at 85 individuals. The sample size was determined using Karjesi and Morgan's table, resulting in the selection of 70 participants through a simple random sampling method.

The principal instrument employed for data collection constituted a researcher-made questionnaire, subject to rigorous validation and reliability assessments. The Likert scale served as the foundation for the questionnaire design, encompassing two sections dedicated to demographic characteristics and primary research indicators. The aforementioned experts systematically assessed the research indicators based on their perceived importance. Within each policy dimension, the analytical framework involved the computation of four distinct factors: average weight, relative weight, average score, and instability index score. The questionnaires were distributed and completed in face-to-face interviews.

4. Result and discussion

The personal characteristics of the respondents, such as their age, level of education, area of study, and professional background in the field of RE, were subject to examination. The study encompassed a participant pool of 70 people. It is worth noting that all respondents were of the male gender. Furthermore, the average age of the participants was 54.12 years. The age range spanned from 40 to 69 years. Concerning work experience, these people had an average of 15.38 experience years in the RE field. Among the 70 respondents, 64 individuals (equating to 91.4 % of the total) held a Ph.D. degree. On the other hand, six respondents (8.6 % of the total) held a Master's degree (Table 2).

Table 2
Age, gender, and work experience of the respondents (Source: research findings).

Variable	Gender	Age	work experience	Educational degree
Mean	–	54.12	15.38	–
Maximum	–	69	35	–
Minimum	–	40	7	–
–	male	–	–	–
Ph.D.	–	–	–	64
Masters	–	–	–	6
Number	70	70	70	70

The range of academic disciplines was so extensive that approximately 23 academic disciplines were officially recorded. Out of these, 12 individuals (equating to 17.1 %) indicated that their area of expertise lay within the domain of chemistry. Conversely, the disciplines with the fewest number of individuals were those in the realm of management. From this data part, it can be recognized that men still control the policy-making process, and women have almost no activity in this field. Why women are less active in this field should be investigated in the future. Although academic disciplines such as management should have a greater contribution to the policy-making department, it can be seen that there is a shortage of these disciplines in the statistical society. In addition, the numbers and data show that the respondents have a high level of academic degree and the majority of them have a doctorate. This can be very useful scientifically for the policy field.

The first analysis to assess the status of RE policies in the agricultural sector was to produce a set of indicators according to their importance, which were assessed by a group of RE policymaking experts. The next part of this analysis was to calculate the USIC, based on their understanding of the current conditions of policy implementation (Table 3).

In the organizational and institutional dimension, the "the role of the ministry of agriculture in RE policy-making" indicator with a value of 0.181 shows the highest level of unsustainability. This Indicator obtained a higher importance average than other indicators of this dimension. This indicates that despite the necessity and importance that the Ministry of Agriculture should have in developing RE policies in the agricultural sector, in practice, this is not the case. The role of this Ministry has been neglected. At the same time, the Ministry of Agriculture has comprehensive information about the country's agriculture sector and knows the agricultural areas very well. For this reason, it is more familiar with the capacities of this sector than other institutions and organizations. Due to its closer relationship with farmers and rural people, the Ministry of Agriculture knows the needs of this sector better. At least the collection of the necessary information in this field can be done more easily by this organization. However, the results of the research show that policies in this area are very weak.

The next unsustainable indicator was the "necessary policies to prevent organizational interference in the implementation of RE policies," which, with a score of 0.180, showed that there is an overlap between organizations in the implementation of adopted policies. Policies have not been able to prevent this interference, and the existence of several institutions and organizations to implement RE policies causes huge harm in this area. This interference can also lead to the loss of budget and financial resources and even human resources. The exorbitant costs imposed on the energy management system by this interference can be dealt with by adopting or reforming policies. This part of the findings is in line with the findings of Dehhaghi et al. [47]. Their research confirms that the decentralization of policy-making in the united institutions is also one of the deficiencies in the policy-making cycle of renewables in Iran. They believe that the engagement of multiple organizations in policy formulation and implementation, price determination and reform, and other aspects indicate the interference and fragility of the policy-making framework.

The findings showed that the "Necessary policies to prevent organizational interference in RE policy-making" indicator is also a significant challenge in the RE policy path. In Iran, seven institutions are involved in RE policy-making. These organizations are the Vice-Presidency for Science and Technology, Ministry of Petroleum, Parliament Research Center of the Islamic Republic of Iran, Expediency Discernment Council, the Supreme Council of Cultural Revolution, and Parliament Energy Commission. All these bodies must work together to set energy policy goals and priorities. This means that there will be multiple and probably different policies as different mindsets and decisions will be made due to the multiplicity of organizations involved as each institution tries to consider its priorities and needs. This process will lead to chaos and disputes. This large number of institutions and organizations involved in energy policy-making disrupts the policy

Table 3
List of indicators of study (Modified from Refs. [1,47,99,101,121,122])..

Dimension	Indicator	Average weight	Relative weight	Average score	USIC
Organizational and institutional policies	Role of the Ministry of Agriculture in RE policy-making	4.68	0.053	3.42	0.181
	Necessary policies to prevent organizational interference in the implementation of RE policies	4.32	0.054	3.35	0.180
	Necessary policies to prevent organizational interference in RE policy-making	4.27	0.052	2.89	0.170
	Develop cooperation with international organizations	4.32	0.049	3.18	0.155
	Development of agricultural cooperatives for the production of RE	3.15	0.039	2.95	0.115
	Development of agricultural cooperatives for RE consumption	3.65	0.038	2.88	0.109
	Total unsustainability of the organizational and institutional dimension				0.91
Incentive policies	Guaranteed purchase policies in the field of RE	4.88	0.06	3.87	0.232
	Eliminate fossil fuel subsidies	4.12	0.049	3.93	0.192
	Adequacy of subsidies to "produce" RE in the agricultural sector	3.66	0.04	3.82	0.152
	Tax incentives in the field of RE	3.22	0.044	2.93	0.128
	Adequacy of subsidies for the "consumption" of RE in the agricultural sector	3.34	0.041	3.01	0.123
	Total unsustainability of incentive dimension				0.827
Investment policies	The direct government investment in the RE sector	3.76	0.05	2.79	0.139
	Promoting the private sector to invest in RE	3.3	0.045	2.43	0.109
	Policies to attract foreign capital	2.96	0.032	2.96	0.094
	Access to sufficient capital to invest in RE in the agricultural sector	2.15	0.026	3.04	0.079
	Total unsustainability of investment dimension				0.421
Infrastructure policies	The role of government in controlling market efficiency	4.05	0.048	4.05	0.194
	Market development policies	3.73	0.049	3.13	0.153
	Stakeholder participation in policies adoption	3.81	0.042	3.41	0.143
	The simplicity of rules and regulations related to RE	3.49	0.037	2.63	0.097
	Development of biofuel power plants	2.44	0.03	2.95	0.088
	Resources needed to implement RE	2.81	0.03	2.01	0.060
	Total unsustainability of infrastructure dimension				0.735
Human resource development	Conditions of education policies and promotion of RE for rural and farmers	3.74	0.045	3.03	0.136
	Providing the necessary workforce to implement RE policies	2.96	0.037	3.47	0.128
	Development of specialized manpower in the field of biofuels	3.33	0.039	2.53	0.098
	Rural women's education policies in the field of RE	3.14	0.037	2.44	0.090
	Training and educating policy-makers and updating their knowledge	2.78	0.033	2.24	0.073
	Total unsustainability of human resource development dimension				0.525

adoption process. The results of Norouzi et al. [45] study and Emodi and Ebele's [123] findings are also in line with the findings of this part. Norouzi et al. [45] additionally concluded the adoption of a comprehensive and integrated policy of RE that reduces the number of policy documents and centralizes the management of RE in a unified institution is a crucial element in promoting RE success in Iran. Emodi and Ebele [123] also concluded that there are overlaps in some of the activities of ministries and government agencies in the field of Nigeria's RE policies. This indicator was important in the survey of RE experts, but it does not have a good position in the implementation of RE policies, and the findings show that poor performance is observed in this area.

The unsustainability index of the "Develop cooperation with international organizations" dimension was 0.155. Today, the science of RE is changing and evolving rapidly. Research is adding new knowledge to human knowledge every day. International cooperation needs to be developed to achieve modern science and new findings. Qverland and Kjærnet [124] also mentioned that in their study. Of course, international sanctions act as an important challenge and obstacle for Iran; in this regard, the government can reduce these challenges by adopting the right policies. Dehhaghi et al. [121] also concluded that Iran performed

poorly in international cooperation on renewables, although part of this weakness is due to international sanctions.

The "Development of agricultural cooperatives for the production and consumption of RE" was also in the next stage of importance, respectively. Countries like Germany have shown the world expensive experience in this field [125]. They made the development of RE cooperatives a policy priority and achieved brilliant results. Unfortunately, despite the great potential that exists in the number of agricultural and rural cooperatives in Iran [126], this potential has not been exploited. In addition, the amount of agricultural waste production in Iran is very high [127,128]. Moreover, this can provide the initial input of these cooperatives for energy production. The total unsustainability index in the organizational and institutional dimension was 0.91. Dehhaghi et al. [121] also emphasize the review and strengthening of RE development policies in Iran and believe that this is a potential that Iran can benefit from.

The USIC of incentives dimension was 0.827. This dimension consists of five indicators. The "Guaranteed purchase policies" indicator was more unsustainable despite the great importance it gained from experts (USIC = 0.232). Due to its novelty, RE requires more support than fossil fuels to convince society, especially the agricultural and rural communities, to use this type of energy. Therefore, it is essential to pay more attention to the policy of guaranteed purchase. The government should not only focus on renewable electricity in guaranteed purchases but should also pay attention to other types of RE, such as thermal or biofuels. Since the agricultural sector is a source of biomass production and this potential is abundant in Iran, revising policies in this field can be an important step in biofuel production development. In Iran, the government pays many subsidies for fossil fuels. For renewable fuels to replace fossil fuels, subsidies for fossil fuels must be reduced, and support for RE sources must be increased. In this regard, Radmehr et al. [129] also consider the elimination of fossil fuel subsidies necessary. They believe that as long as fossil fuels receive subsidies, the price difference will be in favor of fossil fuels, and the development of renewables will not be possible. Dehghan [130] also believes that the heavily subsidized energy provided by the governance is a major obstacle to RE adoption, and a solution must be found for it.

"Adequacy of subsidies for the consumption of RE in the agriculture " was also one of the indicators that received a high importance score from experts. This means that the issue of subsidizing RE in the agriculture sector should be addressed more. In this context, Nicolini and Tavoni [17], explain in their research results that each one percent increase in financial incentives leads to a 1 % rise in renewables production. Subsidizing the use of RE in the agricultural industry facilitates its enhanced competitiveness within the international markets, concurrently mitigating pollution and contributing to the global effort against the phenomenon of global warming. However, in terms of the current situation, this policy is in a weak position and received an unsustainability index of 0.152. Another indicator was "Tax incentives in the field of RE", with an average score of 2.93 and USIC of 0.128. Experiences have shown that tax incentives in many countries are policies that have been used to develop renewables and, in most cases, have worked well. The study of Oludare and Goryunova [131] also confirms more attention to this policy. Nevertheless, according to experts, this policy has not been very successful in Iran because it has not been implemented properly.

Incentives effectively enhance the amount of RE installed capacity, and studies have indicated that these incentives have had a positive and significant effect on RE deployment capacity in other regions [132]. Some incentive policies that are long-time in nature seem to have a long-term impact too. The application of these policies will enhance the energy companies' financial function [133], and encourage the private sector to invest in RE technologies [134].

Financial incentives fulfill a crucial role in the decision of families to invest these incentives reduce the adoption time and increase the financial benefits available to the adopters [135]. To make financial policies and incentives more effective, the government can provide financial resources and policies according to the economic and climatic conditions of each agricultural region.

The USIC of "The direct government investment in the RE sector" was 0.139. This shows that the government has performed poorly in this area and has not been able to invest as much as the RE area needs in this sector. The government's role in RE development is undeniable and pivotal, but policies in this area need to be revised to be more effective. The findings of Azhgaliyeva's investigation in the year 2019 offered substantiation that governments originating from nations with a greater share of RE investments allocate a greater amount of resources towards the advancement of energy storage technologies [136]. "Encouraging the private sector to invest" is another policy that needs to be reviewed and strengthened. The investor must make sure that their capital is maintained and that they will make a reasonable profit on their investment in the future. Kim [21] concluded that private investment in developing countries is very effective, especially in the RE diffusion phase. Yang et al. [137] also consider government financing is the main driver for the development of RE companies. Based on these findings, the government of China ought to bolster supportive policy in regions with expensive costs of energy transmission, promote investment in RE in large enterprises, and act as a policy leader. "Attracting foreign capital" is also difficult due to international sanctions. The positive impact of foreign capital is best illustrated by the fact that Qin and Ozturk [138] in their study showed that a positive change in the flow of international capital has a beneficial impact on the consumption of RE in Brazil, India, and South Africa. Experts believe that the policies of "attraction of foreign capital" are in a state of disarray (USIC = 0.094). However, attracting this type of capital is very important because it facilitates the access of the agricultural sector to the necessary financial resources and capital. The total USIC of the investment dimension was 0.421.

The investigation results of Cheraghi et al. [139] indicated that in the agricultural sector, factors such as prior beliefs, market policy priorities and preferences, attitudes towards radical technological innovations, and institutional pressure have the greatest effect on the decision-making process for investments in RE. Identifying these factors can guide policymakers to improve the pattern of investment in RE. For example, adopting policies to develop education and increase information and awareness, especially among farmers and companies providing agricultural services, can play a crucial role in encouraging people to invest in RE. Alternatively, they can strengthen the market policies so that investors can enter this sector with confidence.

The infrastructure dimension included six indicators, and the total USIC of this dimension was 0.735. The "The role of government in controlling market efficiency" indicator had an average score of 4.05 and a USIC of 0.194. This finding discloses that the government'sfunction in managing the RE market has been weak. The "Market development policies" indicator, despite its great importance, has not been able to be considered as it should be. However, the market fulfills a basic role in RE development. Failure to pay attention to important infrastructure, such as the market, can act as a major obstacle to the development of RE. Chang et al. [140], in a study on RE policies among East Asian countries, also assessed the state of market policies as weak and suggested that the status of these policies be reviewed and revised. Another indicator that was examined was "Stakeholder participation in policy adoption." This indicator gained an average score of 3.41, which means that the importance of this indicator is high, and it can play a key role in the direction of RE policy. However, in Iran, this indicator is not in a favorable situation. The Findings of Lieu et al. [141] also confirm that stakeholder participation is necessary for all decision-making because they are in the production or consumption sector and can better understand the situation. Governments adopt policies to increase the use of RE, which can lead to possible conflicts between stakeholders and public opposition to such policies. Nevertheless, understanding the values and interests of stakeholders is key to understanding whether stakeholder views present a hazard to implementing energy policy implementation [142]. In this dimension, the

"Resources needed to implement RE" indicator seems to be in a better position than other indicators. The value of its sustainability index is 0.06. However, it is still not in good condition. As can be seen from the analysis of the findings, that the most important infrastructural obstacles to the effective implementation of RE market control are the participation of stakeholders in the process of adopting policies. It is better to take measures to solve these problems. For example, managers and policy-makers can use the experience of successful countries in involving stakeholders in the policy design stages, or use successful examples of market policies as models to design a smoother path for the future.

The last dimension examined was "human resource development" (USIC = 0.525). In this dimension, the highest importance was given to the indicator "Providing the necessary workforce to implement RE policies". Although this index is very important, it is not in a good position compared to other indicators. The results showed that the USIC of this index was 0.128. The next indicator was "Development of specialized manpower in the field of biofuels," which had a USIC of 0.098. This means that there is a shortage of workers and experts in the field of biofuels, so the adopted policies also face difficulties in implementation. As mentioned before, the potential of biofuels in Iran is significant due to the high production of agricultural waste. This potential will not be useable if the necessary labor force and experts in the field of biofuels are not provided. The next important discussion in this dimension was the rural women's education indicator. Because they deal with energy far beyond the farm, rural women must have sufficient knowledge and information about RE and how it works and is used. This is only possible with adequate training, which should be considered for this group of rural. As mentioned earlier, the situation of human resources development in Iran is not as appropriate as it should be, and it is necessary to take better and more up-to-date measures and decisions in this area. This is because the lack of human development and the shortage of skilled labor in this field can cause great damage to the cycle of RE policies, especially in their implementation. Studies have been conducted that showed that there exists a bidirectional causal association between RE and human development [143,144]. According to these studies, the development and management of human resources helps to improve energy efficiency. Human resources go up the consumption of RE in some parts of the world. Therefore, we can hope that it will have the same effect in other countries as well. GDP is positively and significantly related to RE consumption in approximately all realms. As a result, policymakers ought to concentrate on raising the human resources role [145].

In RE development, education is an inevitable path [146]. Reducing carbon emissions requires competent and reliable workforce [147]. It is imperative to enhance the human resources quality education to fulfill the needs of the market. Human resources training is a fundamental matter for organizational advancement and people's work growth, and it should be updated in the form of training and new skills and knowledge for employees. Meeting personal development needs with up-to-date professional skills will encourage workers to act better and as a result, they will have more options for advancement [146]. Nelson and Kuriakose [148] also emphasize this point. The situation of educational policies in this field is unacceptable, but the necessary measures should be considered, and policies should be adopted to make up for this shortcoming. However, a very important point that is less considered is the education of policy-makers in the field of RE. Although this indicator shows better conditions than others, there are still shortcomings and weaknesses in this field. Policy-makers need to be constantly trained and educated because they need to be more familiar with current knowledge, society's needs, and new dimensions of the issue.

Fig. 9 shows a radar diagram of the total unsustainability of policy dimensions. As it is obvious, the dimension of organizational and institutional policies is at the highest level of unsustainability, and the investment policies dimension shows less unsustainability than other dimensions.

The present study was subject to many limitations. For instance, it was very difficult to reach high-ranking managers, and policy-makers. This was one of the reasons why the census was not possible and a random sampling method had to be used. There were concerns that Iran's specific political and economic conditions and international constraints would affect the discussion of the generalizability of research findings. There were also concerns that the long response time of some respondents could affect the accuracy of the responses.

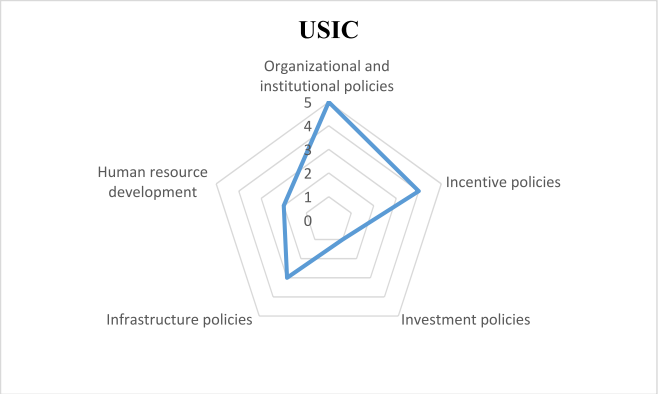

Fig. 9. Radar diagram of total unsustainability of policies dimensions (Source: research findings).

5. Conclusion

The research conducted on measuring and comparing the implementation of RE policies dimensions by focusing on the agricultural sector of Iran has almost achieved a comprehensive understanding of the present position and the challenges facing these policies.

This study's results showed that implementing RE policies in the agricultural realm of Iran in most of the mentioned dimensions faces many challenges and shortcomings. The dimension of organizational and institutional policies is at the highest level of unsustainability, and the investment policies dimension shows less unsustainability than other dimensions. The other three aspects of these policies, which include incentives, investment, and human resource development, still suffer from significant imperfections and crises.

Interference and overlapping of multiple organizations in policy-making and implementation of those policies has become a fundamental problem in the field of organizations and institutions. It is one of the main factors that creates unsustainability in this dimension. At the same time, an important institution such as the Ministry of Agriculture, despite its high potential in RE production and management, is neglected and contributes to decreasing sustainability in the sector. In evaluating incentive policies, weakness in implementing guaranteed purchase policies showed the most negative effect in this dimension. Following that, the results indicated that providing subsidies related to fossil fuels also played an impressive role in creating this unsustainability.

Considering the investment dimension, it can be understandable that the government's debilitated performance in investing in RE has had the greatest impact on this sector. Perhaps the existence of abundant fossil fuel resources is one of the most substantial reasons the government has paid less attention to investing in this sector. Due to the government's neglect to invest in RE, the private sector is not fully convinced to invest.

Policymaking experts have identified the government's role in controlling and developing energy markets as more significant than other factors in determining infrastructure conditions. It can be said that the existence of sanctions and the impossibility of effective communication with other developed countries in RE is one of the most effective elements in the frail infrastructure of the market. In addition, the non-participation of stakeholders in the adopting policies process has also

a negative impact on this sector. This is largely understandable because the country's policy system has been almost top-down. The process of central power making decisions and planning for society without considering the target groups' real needs has always been one of the reasons for the failure of the adopted decisions and policies. One of the reasons for the failure of human resources is the lack of educational policies for the rural and the lack of workforce to implement the enacted policies; so they have recorded the highest share in creating unsustainability in this dimension. Education policies and trained forces are both key elements in RE development in the agricultural sector and directly and indirectly affect the capacity and ability of countries to exploit RE sources. Awareness raising and training in rural can help the faster adoption of these technologies at the level of villages and farms.

A set of efficient policies makes every country more successful in exploiting and optimally using RE. Renewable energies are regarded as one of the principal elements of the country's future development, and the determination and implementation of appropriate solutions in all areas related to energy will facilitate development in the country. By promoting the coordination between institutions, developing international relations, improving market policies, reforming energy subsidies in favor of renewables, reviewing and strengthening investment, creating a platform to attract the participation of individuals and groups, and improving human resources, the management system can make better and use more efficient of the vast potential of renewable energies for support sustainable agricultural practices. Taking these reforms is critical not only for energy security, but also for ensuring Iran's adherence to international commitments and its long-term economic and environmental resilience. Iran can become a main hub for the production and RE exports and to achieve that role it must adopt a logical policy framework. Like most oil and gas-supplying countries, Iran will leave the supply market in the not-too-distant future, and this issue can harm the country's economy; because the energy that is the basis of development will be exhausted unless the political leaders pay enough time and capital to reform RE policies.

The challenges mentioned in this research, if not resolved, can become a considerable obstacle in the future. Therefore, managers and policy-makers should try to remove these impediments. Particular attention ought to be paid to these challenges in the agricultural field since agriculture depends on energy, and it is one of the main shafts of the country's economy. The country's agricultural sector must survive in the future, overcome problems, and compete with the changing world. It must be determined where the weaknesses and issues there are in this path. The gap between what is chosen as a policy and what is implemented needs to be further and expertly analyzed. Managers need to know why these policies have not been appropriately implemented. Perhaps we can talk about the importance of the role of policy evaluation here. If the evaluation is done properly and the results are used well, there is hope that the necessary changes will occur in the future. This study seeks to inform energy managers, and policy-makers that the field of renewables is currently far from the targets set in the framework of energy policies. This study also highlights the weaknesses of the executive branch and states that the causes of these weaknesses need to be identified as soon as possible and in a better way. The challenges and gaps identified in this research can be valuable lessons for other countries. Many countries may be struggling with problems and challenges like those analyzed in this paper, and this research can be used to solve their common problems for the following reasons. First, this study recognizes the need for continuous review and analysis of the policies adopted. It is necessary to evaluate the implementation of policies in order to solve the shortcomings and challenges. Secondly, it highlights the importance of comprehensive planning and coordination between policymakers, government agencies, stakeholders, and the agricultural community. This will ensure the effective implementation of policies and their adaptation to the specific needs of the agricultural sector. Third, it clarifies the importance of capacity building and awareness programs to educate policymakers, managers, employees, and farmers about the benefits of RE and provide skills and knowledge for effective policy implementation. Another reason that makes this research applicable and useful for other countries is that for the design and selection of this research's items, inspiration was drawn from previous studies in other countries and regions, which can make solutions more similar among these countries. For example, the literature review section of this study showed that infrastructure policies are emphasized by researchers, and some have mentioned investment policies. This shows that the concerns of the countries can be similar and then the solution can be alike. By learning from Iran's experience, other countries can avoid similar challenges and create a more efficient and sustainable RE framework. In such circumstances, what policies can best serve Iran's interests in making better use of RE? What immediate action can the government and research departments take to establish or implement such policies?

5.1. Policy recommendations

Based on the findings of the research, it is suggested that:

- Existing policies be reviewed and amended as necessary or changed as needed.
- A suitable financial source from the oil and gas revenue sector is considered for the investment and development of renewables.
- Fossil fuel subsidies should be reconsidered, and subsidy policies changed in favor of RE.
- It is necessary to consider stronger educational policies for all sectors, including policy-makers, farmers, and especially rural women. These courses can be designed and implemented under the management of the Ministry of Agriculture.
- Another important policy is to strengthen the market. In order to be able to produce products that can be consumed, infrastructures such as the market must be strengthened

Access to managers at high organizational levels was one of the problems and limitations of this research. Unfortunately, it must be said that managers are not very interested in participating in research and this issue makes the data collection process difficult. Future research can determine the reason for not adopting appropriate and sufficient policies. It must be clarified why there are weaknesses in implementation or at what stage of policy implementation there is a problem. Studies should also clarify whether human problems are more involved or political and economic issues. Answering these questions can pave the way for the future.

CRediT authorship contribution statement

Somayeh Dehhaghi: Writing – original draft, Conceptualization. **Shahla Choobchian:** Writing – review & editing. **Hossein Azadi:** Writing – review & editing.

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Abbreviations:

RE	Renewable Energy
GHG	Greenhouse Gases
FAO	Food and Agriculture Organization of the United Nations
REP	Renewable Energy Policy
PESTLE	Political, Economic, Social, and Technological, Legal, and Environmental
MCA	Multi-Criteria Analysis
CVI	Content Validity Index
CVR	Content Validity Ratio
USIC	Unsustainability Index of Criteria/Dimension

Data availability

Data will be made available on request.

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