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Research Article

Designing a Policy-Making Model for Biomass Energy Development Training in the Agricultural Supply Chain Sector

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This basic-applied and hybrid survey aimed to design and validate a policy-making model for biomass energy development training in the agricultural supply chain sector. Creating a supply chain for basic agricultural products by including a wide range of agricultural subsectors from the supply of required production inputs to the final consumer's access to the goods will lead to an increase in the productivity of the agricultural sector as well as the upstream and downstream industries related to it. Therefore, considering the importance of creating an optimal supply chain for various agricultural products, in this study, the situation of the supply chain of agricultural products in the country has been examined. Considering that the lack of appropriate policies regarding the management of the supply chain of agricultural products can lead to the inefficiency of the supply chain of agricultural products in various stages including supply of inputs, production and distribution, and marketing of products, it is suggested that planning and related policies should be implemented in order to improve the infrastructure that leads to increasing the efficiency of some logistics subsystems such as transportation, warehousing, communication, and information systems. Purposive sampling was used in the qualitative part, and stratified random sampling was utilized in the quantitative part. The data were collected by reviewing resources and interviewing ten experts, who were mainly policy-making managers of biomass energy development training and academic researchers. The interviews continued until reaching theoretical saturation, and the samples of the quantitative part included 384 members of the environmental and agricultural Jihad employees, who were selected based on Cochran's formula. The effective components of the education policy of biomass energy development and their factors were identified by the exploratory method and evaluated through descriptive-survey research. The validity and reliability of the components were examined, and Cronbach's alpha of all components was higher than 0.7. The essential components of the effective factors were measured in the education policy of biomass energy development in the agricultural sector. The model validity was verified through the structural equation method, and the selection of concepts, dimensions, and indicators was highly accurate and could provide a suitable framework for developing a policy perspective document for biomass energy education. According to the coding results, the development and acceptance of biomass energy systems by the Ministry of Agriculture Jihad and Environment in the country is unsuitable and sustainable, considering the passage of more than a decade of designing and implementing plans. According to experts, some farmers implement this method in their fields for one or two years and return to traditional methods after accepting this technology. The main achievements are as a core category or phenomenon conditions to casual conditions path with coefficient 0.916 is significant. Strategies to the core category or phenomenon conditions' path with a coefficient of 0.051 are significant. Strategies to contextual conditions' path with coefficients 1.231 are significant. Strategies for intervening condition path with coefficients 2.235 are significant. Consequences to strategies' path with coefficients 0.807 are significant. Therefore, the development of biomass energy is an inevitable necessity, considering the erosion and reduction of soil organic matter, increasing energy costs, and other factors.

1. Introduction

Biomass includes all biodegradable components of products, sewage, and agricultural waste, including plant and animal, as well as forest industries, sewage, and urban and industrial waste. The use of energy in biomass helps reduce waste in the agricultural sector [1]. A huge amount of biomass in Iran is burned or left unused by traditional methods with low efficiency, including rapeseed residues, cotton residues, and olive residues after oiling. Using these biomasses with the gasification technology and conversion of various biomass into combustible gases (synthesis gas) can reduce the need for fossil fuels and save energy costs [2]. Fossil fuels such as oil and its derivatives cause countless environmental pollution as they are nonrenewable resources and are costly. As a result of fossil fuels, toxic gases enter the environment and make it difficult for humans and animals to breathe [3, 4].

On the other hand, the concentration of these gases in the Earth's atmosphere prevents heat from escaping from the Earth and increases the air temperature and causes extensive climate changes and the greenhouse effect [5]. Therefore, experts are looking for an alternative clean, renewable source of energy such as biomass to avoid these risks. The perishability of fossil fuels, diversification of energy sources, sustainable development and energy security, and the clean and renewable nature of new energy resources such as biomass have attracted global attention to their use and increased their share in the global energy portfolio [6]. Therefore, a special role has been assigned to renewable energy sources in international programs and policies, including United Nations programs, but the compatibility of these energy resources with the current global energy system is still complicated [7, 8]. The activities and expenditure of government and company budgets for developing biomass energy reduce the cost of renewable energy and compete with existing traditional systems [9, 10]. These biomass resources can provide for the needs of different parts of human society as the main form of energy such as electricity or energy carriers such as gaseous and liquid fuels [11, 12]. So far, no research studies with this title have been conducted in Iran. The strategic document and roadmap for the development of technologies related to biomass energy are inspired by the twenty-year vision document. The system orientation section (c) of this document mentioned the support of the strategic council of experts in the country's biomass sector and the guidance of research and development activities, evaluation, monitoring, and updating of the activities (2015). The new energy department in the Renewable Energy and Energy Efficiency Organization (REEEO) refers to the measurement, capacity, and Atlas preparation for renewable energy sources, including biomass (2013).

Article 148 of the fifth agricultural sector development program emphasizes the replacement of nonfossil and renewable fuels with wood fuels (2010). The analysis of the current situation of educational programs in the agricultural sector and the presentation of a suitable model that was carried out by the Imam Khomeini Higher Education Center in the second collection of articles of scientific lectures (2010) shows that no research studies on this title have been carried out so far in Iran. This study was conducted considering the importance of educational programs in improving the skill level and awareness of people in the field of improving and developing biomass energy. The comprehensive model of educational policies regarding the duties of the Ministry of Agricultural Jihad in developing biomass energy according to the needs of education in the upstream documents, including the five-year development plans, was included in the sixth development plan in Section 7, Article 31, Clause D and Section 9, Article 38, Clauses Z and F. (2017). The country's comprehensive energy planning strategic document is mentioned in the vision statement and model presentation sections such as MESSAGE, LEAP, NEMS, and TIMES (2016). According to experts, the compilation and validation of this model and its adaptation to standards such as ISO 50001 reduced the emission of greenhouse gases and other environmental consequences. This model ensures energy cost reduction through systematic energy management at a high level of device compliance with ISO 9001 (quality management) and ISO 1401 (environmental management) standards, which are based on the Deming cycle (PDCA) (2018).

Effective training in biomass energy development at the ministry level requires new thinking, models, approaches, tools, and mechanisms. Designing and validating a comprehensive and standardized model for training people related to developing biomass energy improves the organization at the national and international levels and increases productivity and subsequent positive results and consequences. Therefore, designing a comprehensive model according to the following damages and discussing biomass education in the Ministry of Agriculture Jihad is necessary. The reasons for conducting this research are the lack of appropriate administrative structures, the motivation for short-term courses, and the desire to participate in long-term courses, and the harms related to laws and regulations, including the lack of continuous review of laws related to education and lack of attention. It is enough to train in development programs. In addition, the lack of forecasting of executive mechanisms to achieve the education goals and executive guarantees and protective regulations, damages related to creating systems, lack of clarity about the system design and connection between the education system and other personnel systems, and damages related to the biomass energy development training process were effective. The lack of optimal attention to need assessment and codified model, the absence of attention to the mechanisms of program design validation, and creating policy-making models for biomass energy development training in Iran's agricultural sector were the other reasons.

According to the above-mentioned points, the main questions that were considered in this paper are as follows:

Q1- What are the components and subcomponents of biomass energy development education in the agricultural sector?

Q2- What is the current status of biomass energy development training in Iran's agricultural sector?

Q3- What is the appropriate model for the policy-making of biomass energy development education in Iran's agricultural sector?

Q4- What is the credibility of the proposed policy model for biomass energy development education in the agricultural sector?

In response to the above-mentioned questions, the main contributions of this study are as follows:

(i) Designing and explaining the policy model of biomass energy development education in the agricultural sector
(ii) Identifying the policy components and subcomponents of biomass energy development education in Iran's agricultural sector
(iii) Determining the current policy status of biomass energy development training in the Ministry of Agriculture with regard to the components and subcomponents
(iv) Providing a suitable educational model according to the country's high-level documents
(v) Determining the degree of appropriateness (validation) of the proposed model

The rest of the article is organized as follows: Section 2 presents a literature review. Section 3presents research methodology. Section 4 presents research findings. Section 5 presents managerial insights and implications. Finally, Section 6 presents an overall conclusion and suggestion for future studies.

2. Research Literature

2.1. Related Survey Work. Rhofita et al. [13] presented a method to assess the energy production from biomass residue as a primary consideration in its development. Statistical data and field observations have been used to estimate the total availability of residue. Furthermore, to calculate the energy potential of biomass residue, the minimum and maximum value parameters, such as residue-to-product ratio, moisture content, and heating value, were obtained from works of literature. The power potential was also analyzed through three scenarios of the conversion factor efficiency, i.e., low, medium, and high, to provide comprehensive results. Lee et al. [14] discussed the technical and economic analysis of the biomass supply chain. Due to the increasing risk of climate change and the reduction of nonrenewable energy resources, countries around the world are looking for diversification in their energy profile, whereby biomass is one of the attractive options for energy production from raw materials. A comprehensive technical and economic analysis should be performed to attract more interest and investment from industry players in biomass-based industries. In addition, various uncertainties related to the supply chain, including biomass availability, demand changes, and material price fluctuations, should be considered in the evaluation to provide a more accurate and reliable feasibility estimate. The purpose of this review article is to (a) provide an overview of the different types of methods or approaches used in assessing the feasibility of biomass-based industries from a technical-economic point of view and (b) describe the uncertainties of the supply chain that must be used. A Malaysian case study is included to illustrate the impact of this uncertainty in the evaluation model. Apart from that, some uncertainties and unassessable risks are critically examined in this paper. It was found that 78% of the reviewed articles choose the mathematical modeling evaluation method, and majority of them are inclined towards mathematical modeling with optimization (i.e., deterministic and stochastic optimization). Furthermore, only a minority have conducted stochastic evaluations that incorporate the uncertainty of the biomass supply chain. This review discusses six measurable uncertainties. Avcioğlu et al. [10] evaluated the energy potential of agricultural biomass residues in Turkey from information on the characteristics of agricultural biomass residues from 16 EU countries, as well as in India, Cameroon, China, Pakistan, Nigeria, Uganda, and Turkey. Some properties such as the residual crop ratio, moisture level, and lesser amounts of heating calorific dry matter value were considered. In addition, a mathematical model is defined to calculate the residual energy potential of Turkish agricultural biomass. Oh and Park [14] investigated the use of agricultural products as a new biological resource using a mass reduction model to optimize the braking (drying) of biomass through the conversion of products into fuel through the breaking process. Pepper stalk was chosen as a renewable agricultural product for this energy conversion process. Longer retention time and higher temperature and higher mass reduction and higher heating value by inflation showed a correlation between heating value and mass reduction. Calorimetric analysis was performed to obtain the frequency factors and biomass activation energy at different heating rates. The experimental results were in good agreement with the simulated results with the rate of temperature increasing inside the biomass. Aberilla et al. [16] showed that providing energy in general from residual biomass in small farming communities significantly reduces environmental impacts while improving waste management practices. Morato et al. [17] studied the potential of energy production from agricultural residues in Bolivia and concluded that biomass energy could meet the energy needs of 58% of the population, indicating the vast potential of Bolivia to replace fossil fuels with residual biomass in energy production. Bilandzija et al. [18] investigated the energy potential of solid agricultural biomass in Croatia. In 2017, International Finance Corporation's Biomass to Energy Guide for Developers and Investors benefited from a wide range of materials from industry, government, and nongovernmental experts. Wang et al. [19] analyzed the temporal and spatial changes in agricultural biomass and its policy implications as alternative energy in Northeast China-Cyprus using statistical data, simulation modeling, and a dynamic analysis framework for the potential and distribution of regional agricultural biomass in Heilongjiang, China. Gray correlation analysis showed that precipitation, total population, mechanical power, and agricultural planting greatly influenced biomass resources. This study proposed to create a platform for the management and planning of scientific resources to achieve dynamic allocation and planning of agricultural biomass that improves the sustainability of resources. The methods used in this research can be applied to other regions, and it can provide basic data for local authorities to consider a strategy for planning and developing biotechnology. Jahantigh [20] found that it is possible to produce combustible gas and electricity and reduce waste in the agricultural sector by using biomass-to-gas conversion devices. Liquid fuels and chemical fertilizers can also be produced from the output of this device. Sofi et al. (2015) showed that the increase in the price of fossil fuels in Iran could provide the basis for developing renewable systems. Faraji et al. [21] compared several common educational models to examine their strengths and weaknesses and provided the possibility to choose the most comprehensive method for exploitation, stated the effectiveness of the ISO 10015 educational standard as the most comprehensive education system, and provided some effective suggestions for using this standard. Makari et al. [6] prioritized factors based on predetermined indicators using the AHP method and Expert Choice software, and finally, the financial factor was recognized as the most important factor in biomass development. This prioritization can help make important and basic decisions in this area and achieve a successful program for developing biomass energy with rice waste in the province, causing economic prosperity and optimal use of this waste. Mahmoudi Jolfan [22] indicated that environmental education is effective when it targets and intelligently focuses on private-sector investors and public-sector policymakers. Safari and Salimi Valik Bani [23] examined the agricultural biomass gasification methods to produce hydrogen, which has the highest combustion energy among fuels, as a clean energy carrier. Vavrova et al. [24] modeled the biomass potential of agricultural land for energy using high-resolution spatial data regarding food security scenarios to provide national food security strategies. The biomass potential was modeled using the main algorithms allowing compliance with several constraints in nature and soil protection and competition of crops for land. Modeling also showed that biomass potential is nonlinearly dependent on land allocated for energy crops. The analysis results confirmed that the remaining biomass as an energy source in the Czech Republic has a good potential to be used for planning the sustainable development of biomedicine. Babak and Madhoshi [25] pointed out that reducing fossil fuels and increasing energy demand, as well as the rapid growth of population and urbanization and the use of conventional energy sources such as coal, oil, and natural gas, which is on the verge of extinction, has caused attention to biomass, renewable resources, and fuel production, thus turning it into a logical choice to replace oil. Therefore, it is necessary to investigate renewable fuel characteristics and production processes from agricultural waste. Vahidi and Mehnani [23] studied the awareness level of university graduates employed in the oil industry. Rahimi et al. [27] expressed the output of some innovations in the field of renewable energy, including knowledge, policy engineering, and educational techniques of renewable energy, to examine the current education state on this type of energy in Iran and make a comparative comparison with this type of education in Australia, as one of the leading countries and a model in this field. Lucia [28] reviewed the knowledge connection between biomass and bioenergy. Irji Rad [29] examined the current and optimal status of the Ministry of Agriculture Jihad educational programs, and the average status was lower than optimal in all components and subcomponents. Eight final components were extracted by implementing factor analysis, and the proposed model was developed by implementing multivariate regression. Asadi et al. [26] investigated practical solutions for the wider use of some energy from biomass and showed that biofuels, especially biodiesel, have been proposed as an alternative fuel in Europe. In addition, Brown and Quintana [27] examined biofuels for reducing waste in 9th–12th grade students for the National Renewable Energy Laboratory, to provide a curriculum on the production of biofuels based on the content standards of national science education. In this curriculum, the concept of alternative fuels is first introduced to the students, and then the possibility of creating an opportunity to produce biodiesel fuel is given using an analytical method. Healion et al. [28] studied bioenergy training to develop a bioenergy project and investigate the training needs of the bioenergy sector in the Republic of Ireland.

2.2. Research Gap. In the conducted research studies, the topic of biomass and biomass energy development education in the agricultural sector was discussed and the major environmental issues caused by the increasing production of greenhouse gases were pointed out. The goal of the majority of research studies is the development and exploitation of alternative energies such as biomass. In research, the importance of developing education and learning about biomass energy has been discussed, especially in schools and large policy departments. In Table 1, the literature review is categorized.

3. Method

A descriptive-survey study was conducted on data collected through the library-field method using a mixed approach and grounded theory. There is a qualitative research method by which a theory is developed using a set of data based on three main stages of open coding, central coding, and selective coding. In this method, the research never starts from a theory to be proven, but it starts from a study period to show relevant cases. The developed grounded theory model was used to analyze the data, including the stage of open coding, central coding, and selective coding. The researcher conducts, reviews, and reads the data of the interviews concerning the education policy of biomass energy development in the agricultural sector. Similar data with the same semantic load are coded under common codes, and related concepts and categories are assigned to each. The researcher selected a main category (biomass energy education) extracted under the central coding of the data, which can

Table 1: Literature review.

Authors	Year	Goal	Fuel
Rhofita et al.	2022	Assess the energy production	Biomass
Lee et al.	2021	Discuss the technical and economic analysis of biomass	Biomass
Avcioglu	2019	Evaluate the energy potential of agricultural biomass	Agri-biomass
Aberilla et al.	2019	Providing energy from residual biomass	Biomass
Moratoa et al.	2019	Study on potential energy from agricultural biomass	Agri-biomass
This study	2022	Designing and explaining the policy model of biomass energy development education in the agricultural sector	Agri-biomass

find the origin and root of all topics related to the policy of biomass energy development education in the agricultural sector. In the next step, the relationship between the other categories and the main category is examined. Then, the theory related to the policy-making of biomass energy development education in the agricultural sector is created by reviewing, refining, and completing the categories and concepts extracted from the data. In the selective coding stage, biomass energy development education policy in the agricultural sector is described using new categories and concepts to describe the policy of education and development of biomass energy in the agricultural sector.

3.1. Data Analysis Method in the Qualitative Section. The main process in the grounded theory is the process of coding and classifying raw data and extracting the main concepts and categories and their relationships [33]. Therefore, the three stages of coding to analyze the data are as follows:

3.2. Open Coding. The first stage of open coding analysis is to conceptualize and categorize pieces of data under labels that simultaneously describe each piece of data [34]. Codes indicate how the data were selected, separated, and categorized to begin the analysis phase. The themes are at a low level of abstraction and originate from the researcher's initial question, concepts in the theoretical foundations, words that people have uttered in the social context of the event, or the new thoughts resulting from the researcher's immersion in the data [35, 36].

The second stage of data coding is conventional axial coding, which is the "second review" of the data. In the second review, the researcher focuses more on the primary coded themes than the data [35].

Axial coding is defined as creating a dense network of relationships around the "axes" of a category, in which each category can have two characteristics of property and dimension, and their combination leads to a pattern [37]. According to the role of the concepts obtained in the axial coding stage, the total categories extracted from the raw data are expressed in five modes and are linked through the paradigm model [33]. According to Strauss and Corbin, when this model is not used, the basic theory will lack the necessary precision and complexity (Figure 1):

Causal conditions: these conditions create a nucleic phenomenon

Contextual conditions: special conditions in which processes and interactions take place to manage, control, and respond to the phenomenon

Core category or phenomenon conditions: a mental form of phenomena as the basis of the process

Intervening condition: general conditions affecting processes and strategies which work to intensify or weaken the phenomena

Strategies (actions and interactions): behaviors and interactions that take place under the influence of intervening and contextual conditions

Consequences: the result of interactions [34]

3.3. Selective Coding. Selective coding reviews all previous data and codes in detail. At this stage, the researcher selectively looks for items representing the themes to compare them after data collection [35].

At this stage, the researcher analyzes the data in depth and presents them in the form of a theory that is the grounded data theory for understanding the situation. The research process draws other categories around the core category in the form of a paradigm model after determining the core or core category. The grounded or data-based theory should have three dimensions, including conditions, interactions, and consequences [35].

This study was conducted by the grounded theory based on a qualitative study. The data were collected in the framework of the qualitative method with the approach of the grounded theory using three stages of coding and required data with the benefit of semistructured interviews. Data analysis was performed based on Strauss's instructions, including the three main stages of coding: open coding, axial coding, and selective coding, and the hypothetical research model was obtained from the previously mentioned stages. The data were collected from interviews with managers and researchers familiar with education and biomass energy to create concepts for presenting policy-making models for the education and development of biomass energy in the agricultural sector. The interviews continued until reaching theoretical saturation by reviewing sources with ten experts, mainly managers in biomass energy development education and university researchers. Conducting this number of interviews and reviewing the sources showed that the collected information reached saturation, and there is no need to conduct more interviews. Finally, the collected data were

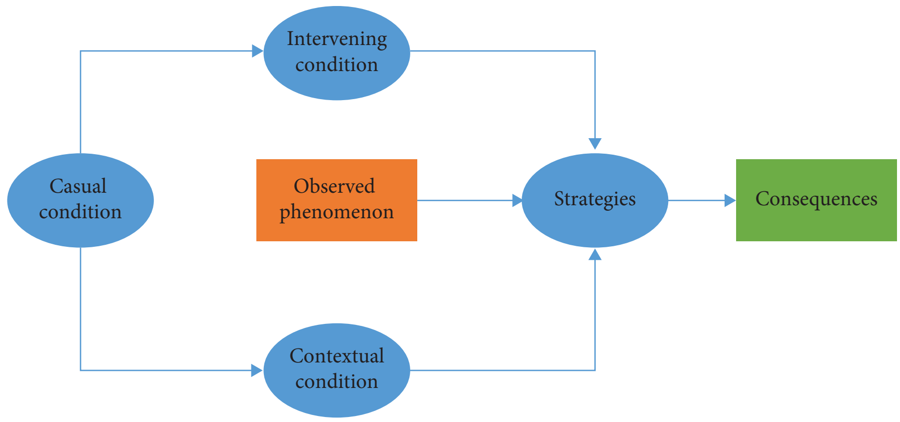

Figure 1: The visual model of the grounded theory [34].

analyzed using grounded analysis. The resulting data and concepts of the study were uploaded to the coding Tables 2–4 to select the main concepts and core categories.

The interviews were implemented, and the articles were reviewed by the method of qualitative content analysis and the two stages of open and case-centered coding to answer the first and second questions of the research study in the components and subcomponents and to determine the current state of education and training for the development of Zepast Tudeh energy in the agricultural sector. The coding process at the textual level was used to organize and manage the data for ease of work. In the open coding stage, the text of the interviews was examined line by line, and conceptualization and initial codes were extracted. Then, the primary codes extracted were compared several times to integrate some codes and create new codes (26 primary codes). In the central coding stage, the initial codes are categorized into seven groups of technical and managerial, structural and institutional, policy and planning, educational and knowledge, attitudinal, financial and credit, service and support components based on similarity, conceptual connection, and common features. According to the approach governing the data analysis process, the results of the literature review and the theoretical foundations of the research were used during the axial coding process to identify the main concepts and classify the primary codes in the form of secondary codes.

3.4. Solution Procedure. In this research, to analyse the data, we used the structural equation model (SEM) using AMOS software. The proposed framework for establishing the considered case study, which is based on structural equations, is generally possible in four stages which are as follows:

(1) Identify effective components and subcomponents of biomass energy development education in the agricultural sector

(2) Determine the impact of each component and subcomponents of biomass energy development education in the agricultural sector

(3) Calculate the degree of relationship between observed and latent factors

(4) Introduce a structural equation model and convert the current situation to the proposed desired situation

Stage 1. Identify effective components and subcomponents of biomass energy development education in the agricultural sector

In this step, we first divide the influencing factors into two groups of observed and hidden variables. Observed variables are those variables that are determined using an internal systematic study such as criteria that can affect the organization's process. Studying the observed variables in organizations is important because it can always be useful for the analyst in identifying the hidden variables of the organization in question. But in order to study and perform statistical analysis, we must divide these variables into groups so that we put the observed variables that are related to each other in one category, which are actually the same hidden variables. In this case, the latent variables cover the observed variables. It should be noted that in conceptual model design, hidden variables are always like model nodes. To achieve these variables, the use of data collection tools is a key factor. Questionnaires in this field can be of great help to an analyst. Before preparing the questionnaire, the necessary information should be collected using the library method. To complete this section, by reading books, articles, and research in the relevant field, the most important obvious variables can be found in this field.

Stage 2. Determine the impact of each component and subcomponents of biomass energy development education in the agricultural sector

This stage is implemented with the aim of providing a conceptual model of the organizational process that can show the relationships between factors well. In other words, at this stage, we seek to determine the logical relationships between the hidden variables and other variables. Latent variables are divided into dependent variables and independent variables. Coefficients are actually what we are looking to calculate, based on which the relationship of variables is measured. The coefficient of an independent latent variable is equal to λ, the coefficient of an independent

Table 2: Initial codes resulting from qualitative data content analysis (policy training for biomass energy development in agriculture).

No.	Initial codes	Frequency
1	Lack and incompatibility of biomass energy with farm conditions	28
2	The traditional attitude of farmers towards plowing and removing plant residues from the soil surface	26
3	Lack of a strategic and long-term plan to develop biomass energy in the country	25
4	Improper management of plant residues at the field level (burning, livestock grazing, etc.)	25
5	Lack of specific and binding laws to support biomass energy	23
6	Farmers' limited access to inputs (herbicides, seeds, fertilizers, etc.)	23
7	Allocation of funds and small credits for developing biomass energy	21
8	Little ability of farmers to train biomass energy due to the complex nature of biomass energy	21
9	Little knowledge and experience of farmers regarding biomass energy education	20
10	Temporary reduction of the economic efficiency of the product in the early years of biomass energy implementation	19
11	The possible risk of crop reduction in the early years and farmers' ability for acceptance	19
12	Having few bank facilities and financial resources to buy tools	19
13	Misunderstanding of planners, researchers, experts, and farmers about biomass energy	17
14	Lack of biomass energy knowledge among researchers, policymakers, managers, and experts	1
15	Weak performance of the promotion system in disseminating biomass energy knowledge and information to users	16
16	Failure to use cooperative and user-oriented models in biomass energy research	15
17	Inconsistency between biomass energy policies and other agricultural sector policies	14
18	Lack of applied research in various fields of biomass energy in Iran	14
19	Inconsistency between relevant organizations and institutions in the process of policy-making and implementation of biomass energy	13
20	Lack of network communication between actors of biomass energy development	13
21	Lack of proper insurance coverage for biomass energy	12
22	Absence of subsidy policies to support biomass energy	11
23	Lack of regulatory procedures to control the effective implementation of policies and programs	10
24	Lack of attention to the teaching of biomass energy concepts in agricultural colleges and conservatories	10
25	Failure to use the capacity of nongovernmental organizations in biomass energy development programs	9
26	Poor structure and low percentage of organic matter in agricultural soils of Iran	8

Table 3: Secondary codes resulting from qualitative data content analysis (biomass energy development education policy in agriculture).

Symbol	Initial codes	Secondary codes
TMB1	Improper management of plant residues at the farm level	Technical and managerial
TMB2	Poor structure and low percentage of organic matter in agricultural soils of Iran	
TMB3	Little skill of farmers in biomass energy training due to the complex nature of biomass energy	
TMB4	Increasing weeds and little experience of farmers in biomass energy management	
SIB1	Failure to use the capacity of nongovernmental organizations in biomass energy development programs	Structural and institutional
SIB2	Absence of specific and binding laws to support biomass energy	
SIB3	Inconsistency between relevant organizations and institutions in the process of policy-making and program implementation	
SIB4	Absence of network communication between actors of biomass energy development	
PPB1	Absence of a strategic and long-term plan for developing biomass energy in the country	Policy-making and planning
PPB2	Lack of regulatory procedures to control the effective implementation of policies and programs	
PPB3	Inconsistency between biomass energy policies and other sector policies	
PPB4	Lack of using participatory and user-oriented models in planning	
EKB1	Lack of applied research in different fields of biomass energy	Educational and scientific
EKB2	Lack of attention to biomass energy education in agricultural colleges and conservatories	
EKB3	Poor performance of the promotion system in disseminating biomass energy knowledge to users	
EKB4	Lack of biomass energy knowledge among researchers, policymakers, managers, and experts	
AB1	The traditional attitude of farmers towards plowing and removing plant residues from the soil surface	Attitudinal
AB2	Misunderstanding of biomass energy by planners, researchers, and experts	
FCB1	Allocation of funds and small credits for the development of biomass energy	Finance and credit
FCB2	Temporary reduction in the economic efficiency of the product in the early years of biomass energy implementation	
FCB3	The small financial ability of farmers to accept the risk of crop reduction in the early years	
FCB4	Having few bank facilities and financial resources to buy tools	
SSB1	Absence of subsidy policies to support biomass energy	Service and support
SSB2	Lack of proper insurance coverage for biomass energy	
SSB3	Limited access of farmers to institutions	
SSB4	Lack and incompatibility of biomass energy machines and tools with farm conditions	

Table 4: Selective coding results.

Category type	Category	Concepts
Casual conditions	The necessity of agricultural development	Lack of understanding of the necessity of developing biomass energy education in the agricultural sector
	Creating and strengthening the intellectual and belief structure in society	Lack of belief in biomass energy training in the agricultural sector among managers and experts Lack of cultural infrastructure for the development of biomass energy education in the agricultural sector Building trust between farmers and agricultural experts Attention to the values and religious beliefs of farmers Creating platforms for the acceptance of biomass energy education in the agricultural sector
	Compilation and implementation of the strategic plan for agricultural development	Lack of strategies to develop biomass energy education Adopting incentive policies for conservation tillage and preservation of remains Adopting policies to prevent plowing, burning, and harvesting of residues
	Increasing agricultural knowledge and awareness	Absence of pathological studies on implementing biomass energy education in the agricultural sector Little knowledge of farmers about biomass energy training in the agricultural sector The importance of changing the attitude and vision of managers, experts, and farmers
Core category or phenomenon conditions	Physical organizations	International Organizations, Ministry of Agricultural Jihad, Ministry of Energy, Agricultural Research Centers in Provinces, Universities and Agricultural Training Centers, Environmental Organization, Ministry of Industry, Mine and Trade, and Energy Organization
	Terms and Conditions	Soil Protection Law Rules for the production and import of agricultural tools and machinery Regulations related to energy and the environment
	Norms and values	The importance of protecting water and soil resources Reviving the sense of moral obligation to protect the basic resources of production Common norms and values of farmers and environmentally friendly traditions
Strategies (actions and interactions)	Creating and strengthening the biomass energy education innovation network	The importance of biomass energy training databases in the agricultural sector Strengthening communication links between the beneficiaries of biomass energy education in the agricultural sector
	Creating and strengthening research, promotion, and education centers	Continuous training of agricultural experts on biomass energy education in the Department of Agriculture in related schools and colleges Establishing centers for applied research, training, and promotion of biomass energy education in the agricultural sector Cooperation of research, extension, and education departments
	Establishing model farms	Establishing biomass energy training research farms in the Department of Agriculture in each region Creating model and demonstrating farms for teaching biomass energy
	Establishment of specialized training offices for biomass energy development	Creation of specialized biomass energy training teams in the agricultural sector The importance of creating specialized biomass energy training offices in the agricultural sector in the provinces

Table 4: Continued.

Category type	Category	Concepts
Contextual conditions	Physical infrastructure	Drought and water crisis Manufacturers of educational tools and machines related to biomass energy in the agricultural sector Limited access of farmers to tools and machines for biomass energy training in the agricultural sector Improper operation of tools and machines in the agricultural sector Lack of independent training units related to biomass energy in the agricultural sector in the agricultural jihad
	Financial infrastructure	Increasing production costs Regulation of agricultural products market
	Knowledge infrastructure	Little awareness of agricultural researchers, researchers, and students on biomass energy education Little knowledge of agricultural sector managers and experts on education related to biomass energy
Intervening Condition	Strengthening communication between institutions and organizations	International organizations Parliament's Agriculture, Water, and Natural Resources Commission Ministry of Agricultural Jihad, Ministry of Energy, Agricultural Research Centers in the provinces, Universities and Agricultural Training Centers, Environmental Organization, Agricultural Service Centers, and Energy Organization Councils and village heads and nongovernmental organizations supporting the environment Strengthening communication links between the beneficiaries of biomass energy education in the agricultural sector
	Taking advantage of informal communication	Councils and village heads and nongovernmental organizations supporting the environment Taking advantage of informal relationships between farmers
	Using the media to increase awareness	Continuous and expertized information through the media
	Monitoring the implementation of biomass energy education	Monitoring the implementation of biomass energy training programs and plans in the agricultural sector Continuous monitoring of biomass energy training farms in the agricultural sector
Consequences	Creating and strengthening an empowering and supportive environment	Localization of tools and machines according to the conditions of each region Providing after-sales services for biomass energy training tools in the agricultural sector Provision of appropriate institutions Allocating subsidies to biomass energy training activities in the agricultural sector Granting loans and low-interest facilities to farmers Giving grants to tarsus farmers Creating and strengthening an empowering institutional environment
	Development of biomass energy education culture	Using the knowledge and experience of biomass energy training experts in the agricultural sector Creating a culture of biomass energy education in the agricultural society Creating the intellectual structure of biomass energy education in the agricultural sector
	Adoption and dissemination of biomass energy education	The importance of showing the results of biomass energy training in the agricultural sector to farmers Dissemination of biomass energy training in the agricultural sector by receiver farmers Creating platforms for the acceptance of biomass energy education in the agricultural sector
	Sustainable agricultural production using biomass energy development training	Sustainable management of water and soil resources Increased performance in the long term

latent variable is equal to the latent dependent variable which is equal to γ, and the coefficient of a latent variable is equal to β. If the coefficient is less than 0.3, the relationship is considered weak and we ignore that relationship. A factor loading between 0.3 and 0.6 is acceptable, and a factor loading greater than 0.6 is considered very favorable [36, 37]. The purpose is to determine the coefficients between the variables identified in the organization. For this purpose, a preliminary conceptual model should be designed at this stage.

Stage 3. Calculate the degree of relationship between observed and latent factors

At this stage, after designing the initial model in AMOS software and running the implementation from the initial model, the coefficients are determined by software if the variables and the model have adequate overlap. At this stage, it is necessary to report the output of software in different modes such as ESTIMATED and STANDARD to check the estimated coefficients.

Phase 1. Introduce a structural equation model and convert the current situation to the proposed desired situation

In this step, according to the output of AMOS software, the value of the *P* statistic for the model is calculated. Considering that the statistical analysis is performed in the 95% confidence interval, if the *P* value is calculated to be less than 0.05, then the model is statistically significant. In general, the lower the value of *P*, the better it is. Therefore, it can be concluded that the estimated model has good accuracy. In the ESTIMATED mode, if the variables have the interval range specified in the second phase, we select and leave the other variables. Finally, the path that leads us to the goal is chosen as the dominant strategy over other strategies.

4. Results

Figure 2 shows the general policy measurement model of biomass energy development education in agriculture using the grounded theory method. Also, Table 5 shows the statistical results of the biomass energy development education model in agriculture.

According to Table 6, the factor load of all the categories of the overall structure is appropriate and more than 0.5. In addition, the *P* value of all the items is less than 0.05, and all the categories related to the general variables significantly affect their measurement. The goodness–of-fit (GoF) indicators of the model have been modified, and the correlation between some categories has been considered for more improvement. Chi-square and REAMREA indicators were as much as 2.660 and 0.066, which are less than 5 and 0.1, respectively. In addition, FI, GFI, and TLI were 0.963, 0.902, and 0.951 (more than 0.9), respectively. AGFI was estimated to be 0.857, which is more than 0.8, but it is within its acceptable limit. Therefore, the model fits well with the data, and all the indicators are in the accepted range. The overall policy measurement model of biomass energy development education is accepted in final agriculture.

4.1. Fitting the Structural Model of the Policy-Making Pattern Related to Biomass Energy Development Training in Agriculture. Figure 3 demonstrates the results of fitting the structural equation model of the policy-making pattern related to biomass energy development training in agriculture.

The policy-making pattern related to biomass energy development training in agriculture is formulated using the significance test of the coefficient of the estimated paths when the quality of the structural equation model is appropriate. According to Table 7, chi-square indicators with a degree of freedom of 2.276 indicate the appropriate fit of the model, and the RMSEA 0.071, CFI 0.941, and TLI 0.929 indicators report the proper fit of the model. Moreover, the GFI (0.906) and AGFI (0.894) indicators are within their acceptable limit and show that the structural equation model fit of the policy-making pattern related to biomass energy development training in agriculture is accepted.

4.2. Relationships between Variables. *T* values and *P* values estimated in Table 8 determine the significance of the relationships between the structures. When the *T* statistic in the significance test of the relationship between two variables is estimated to be greater than 1.96 or smaller than −1.96 or when the *P* values of the paths are less than 0.05, then the relationship between the structures is accurate with 95% confidence.

The test statistic related to the path of causal conditions to phenomenon conditions of the policy-making pattern model related to the education of biomass energy development in agriculture is 12.523, which is greater than 1.96, and its *P* value is less than 0.05. In addition, the coefficient of this path was estimated to be 0.916, which is a positive value. Causal conditions directly and significantly affect the phenomenon conditions of the policy-making pattern model related to the education of biomass energy development in agriculture.

The test statistic related to the path of phenomenon conditions to policy-making pattern model strategies related to the education of biomass energy development in agriculture is 2.424, and the *P* value is estimated to be 0.015, which is less than 0.05. Moreover, the coefficient of this path is estimated to be 0.051, which is a positive value. Therefore, the phenomenon conditions have a direct and significant impact on the policy-making pattern model related to the education of biomass energy development in agriculture.

The test statistic related to the path of background conditions to the strategies was 1.992, *P* value was estimated to be 0.046 less than 0.001, and the coefficient of this path was estimated to be a positive value of 1.231. Thus, the background conditions have a direct and significant effect on the strategies of the policy-making pattern model related to the education of biomass energy development in agriculture.

Intervening conditions directly and significantly affect the strategies of the policy-making pattern model related to the education of biomass energy development in agriculture given that the test statistic related to the path of intervening conditions to strategies is 3.509, its *P* value is less than 0.001,

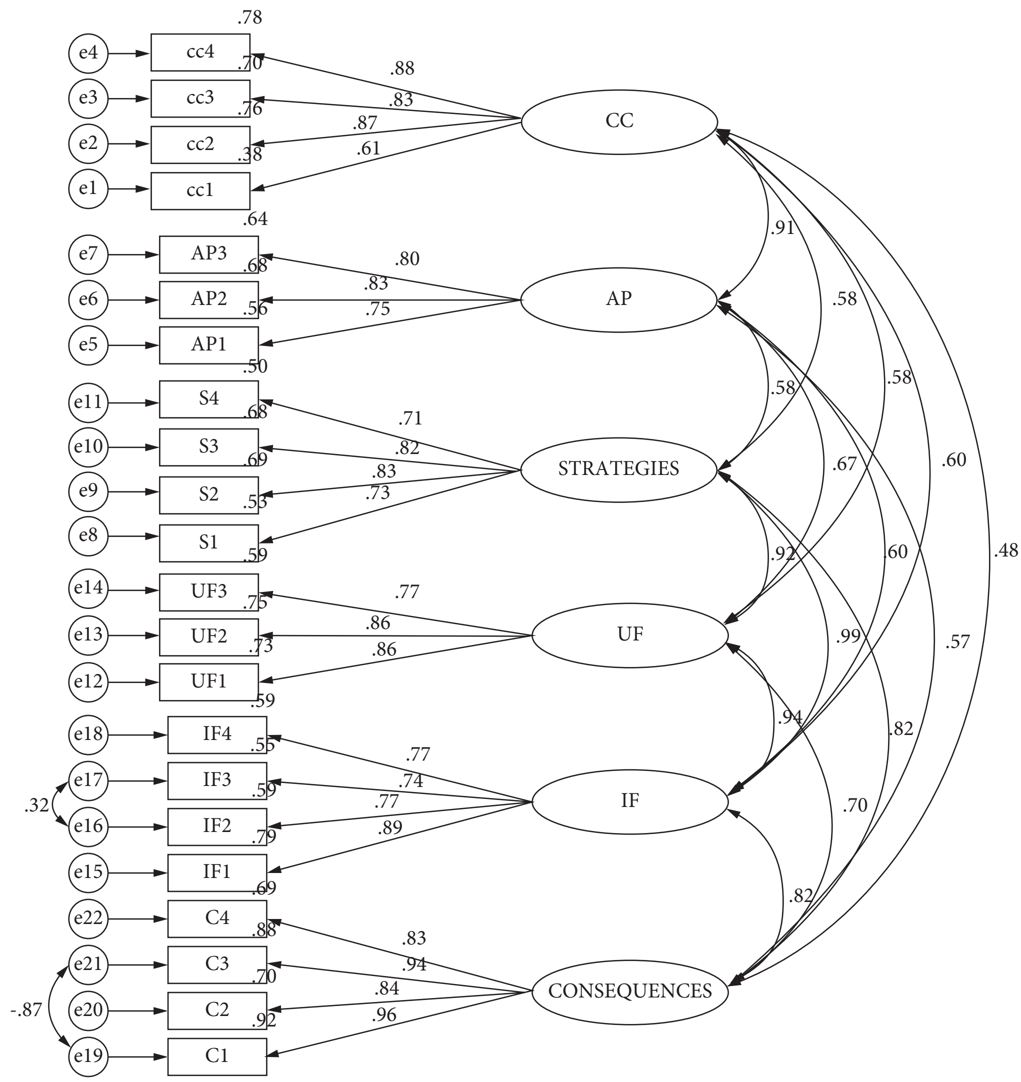

Figure 2: The total measurement model of the policy-making model of biomass energy development education in agriculture.

Table 5: Statistical results of the biomass energy development education model in agriculture.

Statistics	RMSEA	TLI	CFI	AGFI	GFI	Chi-square/df
Value	0.066	0.951	0.963	0.857	0.901	2.660

and the coefficient of this path is estimated to be 2.235, which is a positive value.

The strategies directly and significantly affect the consequences of the policy-making pattern model related to the education of biomass energy development in agriculture due to the path of strategies to consequences (14.406), with a P value of less than 0.001, and the path coefficient being 0.807. Table 9 presents the indirect relationships of the variables.

All relationships in Table 6 are significant, and the intervening, contextual, and phenomenon conditions of the policy-making pattern model related to the education of biomass energy development in agriculture indirectly have a positive and significant relationship with the results. The causal conditions indirectly have a positive and significant relationship with strategies and consequences. Therefore, the final policy-making pattern model related to the education of biomass energy development in agriculture does not need to be modified.

5. Managerial Insights

Important managerial insights and implications of the study are as follows:

Table 6: The total measurement model of the policy-making model of biomass energy development education in agriculture.

Category type	Symbol	Category	Symbol	Factor load	*P* value
Casual conditions	CC	The necessity of agricultural development	CC1	0.613	<0.001
		Creating and strengthening the intellectual and belief structure in society	CC2	0.872	<0.001
		Preparing and implementing a strategic plan for agricultural development	CC3	0.834	<0.001
		Increasing agricultural knowledge and awareness	CC4	0.881	<0.001
Core category or phenomenon conditions	AP	Physical organizations	AP1	0.748	<0.001
		Terms and Conditions	AP2	0.826	<0.001
		Norms and features	AP3	0.8	<0.001
Strategies	STRATEGIES	Creating and strengthening the biomass energy education innovation network	S1	0.729	<0.001
		Creating and strengthening centers for research, promotion, and education	S2	0.83	<0.001
		Establishment of model farms	S3	0.824	<0.001
		Establishment of specialized training offices for the development of biomass energy	S4	0.709	<0.001
Contextual conditions	UF	Physical infrastructure	UF1	0.857	<0.001
		Financial infrastructure	UF2	0.865	<0.001
		Knowledge infrastructure	UF3	0.771	<0.001
Intervening conditions	IF	Strengthening interinstitutional communication and organizations	IF1	0.887	<0.001
		Taking advantage of informal communication	IF2	0.767	<0.001
		Using the media to increase awareness	IF3	0.745	<0.001
		Monitoring the implementation of biomass energy education	IF4	0.77	<0.001
Consequences	CONSEQUENCES	Creating and strengthening an empowering and supportive environment	C1	0.958	<0.001
		Development of biomass energy education culture	C2	0.838	<0.001
		Adoption and dissemination of biomass energy education	C3	0.936	<0.001
		Sustainable agricultural production using biomass energy development training	C4	0.829	<0.001

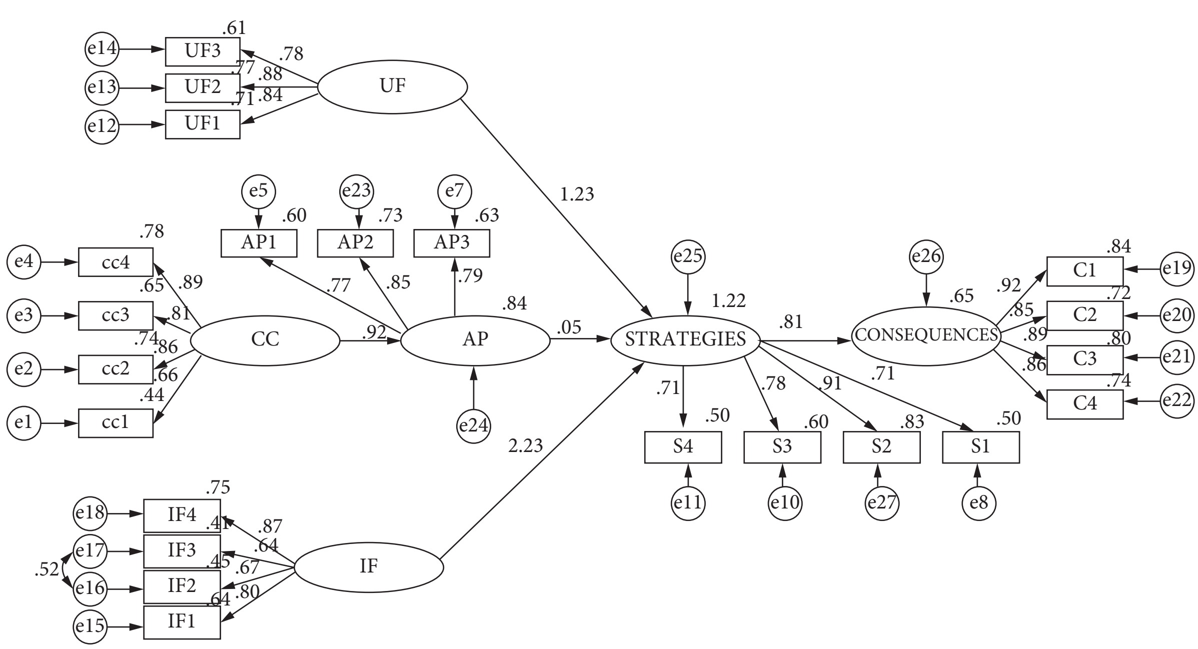

Figure 3: Structural model of the policy-making pattern related to biomass energy development training in agriculture.

Table 7: Statistically fitted model of biomass energy development training in agriculture.

Statistics	RMSEA	TLI	CFI	AGFI	GFI	Chi-square/df
Value	0.071	0.929	0.941	0.894	0.906	2.276

Table 8: Fitting the policy-making pattern model related to biomass energy development training in agriculture to investigate the direct relationships of variables.

Path			Coefficient	Standard error	T statistics	P value	Results
Casual conditions	<---	Core category or phenomenon conditions	0.916	0.091	12.523	<0.001	Significant
Core category or phenomenon conditions	<---	Strategies	0.051	0.015	2.424	0.015	Significant
Contextual conditions	<---	Strategies	1.231	0.535	1.992	0.046	Significant
Intervening conditions	<---	Strategies	2.235	0.58	3.509	<0.001	Significant
Strategies	<---	Consequences	0.807	0.072	14.406	<0.001	Significant

Table 9: The results of fitting the model to check the indirect relationships of the variables.

Variables	Total			Indirect		
	Phenomenon conditions	Strategies	Consequences	Phenomenon conditions	Strategies	Consequences
Intervening conditions	0	2.235	1.802	0	0	1.802
Contextual conditions	0	1.231	0.993	0	0	0.993
Causal conditions	0.916	0.047	0.038	0	0.047	0.038
Phenomenon conditions	0	0.051	0.041	0	0	0.041
Strategies	0	0	0.807	0	0	0

(i) Development has always been associated with increased energy use and rising greenhouse gases. Development without energy is impossible, and renewable energy is the best option to establish a balance. In addition, energy is the key and missing link to sustainable environmental development. Renewable energies imply access to new energy services for people, which is vital for fulfilling the eight millennium development goals. Sustainable development is traditionally analyzed in the three-dimensional economic, social, and environmental model. The relationship between sustainable development and renewable energy can be examined as a set of goals and limitations combined with global, regional, and local considerations. The positive role of renewable energy in promoting sustainable development should be considered at the international level and individually in a detailed evaluation.

(ii) However, the general role of this energy type and its relationship with the concept of sustainable development was investigated. Some of the critical goals are significantly affected by renewable energies, economic and social development, reduction of adverse environmental and health effects, climate change, and access to energy security. Reducing the amount of climate change because of human activities is the main and powerful motivation for using renewable energy technologies worldwide. Reducing the amount of climate change because of human activities is the main and powerful motivation for using renewable energy technologies worldwide. Awareness of capacities and reduction patterns is crucial in this regard, and technological capacities, costs, economic benefits, and energy policies differ from one society to another. The environmental and social effects of such technologies and their economic implications should be considered to ensure that the use of renewable energy is under the goals of sustainable development. In practice, governments have different goals of sustainable development according to their different priorities and levels of development, and the international community cannot be evaluated in a unified manner. For example, creating employment and improving the economic situation are the goals that lead governments to invest more in the use of renewable energy. The costs of electricity production and distribution from renewable energies are considered a determining factor in the desirability and acceptability of these energies. Therefore, an international regime of responsibility sharing can be investigated. Using renewable energy by diversifying energy sources and reducing dependence on specific suppliers guarantees energy security and can support the economy against price volatility.

(iii) In addition, renewable energies, especially for reducing greenhouse gas emissions, should play a role in achieving sustainable development goals. Renewable technologies play a major role in facilitating the fight against air pollution. Electricity production technologies based on renewable energy can significantly reduce the production of local and regional pollution with a significant advantage in improving human health compared to fossil fuels. Other positive effects of renewable energy-based technologies on nature are the effect on water resources and biodiversity. For example, water-cooled thermal power plants can damage this precious resource, while renewable technologies can provide needed services without stressing water resources. In addition, the deadly effect of renewable technologies on animal and plant species is much lower than traditional electricity production methods, with a positive role in protecting biodiversity. The benefits and positive role of using technologies based on renewable energy in helping to advance environmental goals seem more feasible than the role of these technologies in advancing economic and social goals. In relation to the following, the indicators of sustainable development and the relationship with renewable energies will be examined more closely.

(iv) Energy consumption is one of the inevitable necessities of human life. There is no possibility of activity without energy, and even a moment of life on this Earth is impossible. Despite the rapid development of technology, the increase in energy consumption is provided solely by fossil fuels. This style of energy supply raises new issues such as the limitation of oil reserves, the increase in oil extraction cost, and sensitive and limited relationships between certain regions and countries. More diversity in energy supply is one of the solutions to answer these issues, especially when this diversity is in renewable energy. Biofuels are more expensive than fossil fuels, but on the other hand, they have advantages such as not being threatened at an exponential rate and having few harmful effects on the environment.

6. Conclusion and Discussion

More than a decade has passed since the design and implementation of biomass energy system development programs by the Ministry of Agriculture Jihad and Environment, but its development and acceptance in the country are not in suitable and stable condition. According to experts, some farmers implement this method in their fields for one or two years after accepting this technology and then refer to common traditional methods. Considering the state of soil erosion and the reduction of organic matter, the increase in energy costs and other costs of biomass energy development is an inevitable necessity. The findings of the central and selective coding of the integrated institutional model for the development of biomass energy were presented to solve the shortcomings in the literature on the development and adoption of biomass energy. The essential and the most important components of the institutional model of physical organizations include international organizations, large policy-making organizations, research and educational organizations, executive organizations, service-providing organizations, and intermediary organizations, as well as laws, regulations, norms, and values. The biomass energy innovation network at the local level is at the center of this model, where the adoption and development of biomass energy happen because of the dynamic activities of this sector. This institutional framework operates in physical, financial, and knowledge infrastructure. Thus, the main results of the paper are as follows:

(i) Core category or phenomenon conditions to casual conditions' path with coefficient 0.916 is significant
(ii) Strategies to the core category or phenomenon conditions' path with coefficient 0.051 is significant
(iii) Strategies to contextual conditions' path with coefficients 1.231 is significant
(iv) Strategies to intervening condition path with coefficients 2.235 is significant
(v) Consequences to strategies' path with coefficients 0.807 is significant

Also, the main limitations of this paper are as follows:

(i) One of the limitations in the current research is the fear and nonresponse of the respondents to answer the questions; this causes the process of asking questions to be longer.
(ii) The extent of the policy components and indicators of biomass energy development education in the agricultural sector and its final exploitation in the interviews.
(iii) Time-consuming field studies and conducting exploratory interviews in order to extract indicators.
(iv) It is avoided to mention other limitations and implementation problems due to their relative importance.
(v) Hard access to experts according to the criteria set (expertise and experience) to conduct interviews. Another limitation of this research is the lack of resources to compare the results.

Finally, further study in the future suggest that by making tangible the various benefits of these fuels, which affect the lives of farmers themselves, their attitude towards these fuels can be improved. Considering the effect of justice on the moral norm, it is suggested to increase the experts' understanding of the fairness of the production and development of biofuels in rural areas, pay attention to the important role of farmers in this field, and create biofuel infrastructures in rural areas. This method increased people's understanding of the morality of biofuel production.

Through holding specialized courses, workshops, conferences, and seminars in the field of biofuels and emphasizing its advantages and the necessity of replacing them with fossil fuels, the knowledge of experts about the nature and benefits of biofuels and as a result, the desire to increase them in the promotion and development of agriculture increases. By linking fossil fuels with environmental degradation and climate change, it is possible to improve the understanding of professionals towards this innovation and then the attitude and ethical norms.

Data Availability

Data are available upon request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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