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Assessment of Sustainability Trend of Apicultural Industry: Evidence from Beekeepers in Iran

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ABSTRACT

This study was designed to analyze the sustainability trend of the apicultural industry. The present investigation was conducted with a focus on quantitative aspects and employed the methodology of quantitative-qualitative trend analysis. The statistical population consisted of all beekeepers in Iran. Using multi-stage random sampling method, 453 beekeepers were selected and studied as a sample. The primary instrument employed to gather data is a questionnaire developed by the researcher. The sustainability of Iran's apiculture industry was evaluated based on four environmental, economic, social, and institutional dimensions. The evaluation of the beekeeping industry's sustainability in terms of the environmental aspect involved the assessment of eleven criteria across two categories, both of which exhibited a declining trend. Sustainability was evaluated in the form of 24 criteria and 5 categories in the economic aspect, of which two categories had a negative trend and three categories had a positive trend. The assessment of the social aspect's sustainability was conducted through examination of 19 criteria organized into three distinct categories. These categories represented different trends: one with a negative trend category, another with a stable trend category, and the third with a positive trend category. Finally, sustainability of the institutional dimension was evaluated by 16 criteria in the form of 3 categories, and all three categories had a negative trend. Therefore, reforming the process of environmental and institutional criteria shall be of priority for the planners and policy makers of Iran's apiculture industry. The results of this study can be used as basic information in the foresight of the beekeeping industry, the preparation of the vision document, as well as the strategic planning of the development of this industry.

Keywords: Beekeeping industry, Environmental sustainability, Trend analysis approach.

INTRODUCTION

According to the historical evidence, honeybee has lived on the planet for about 50 million years; however, less than 2 million years have passed since the human species, as we know it today, commenced its dispersion across the planet. Indeed, it is estimated that honey has been part of the human diet from the beginning (Jones, 2009). Beekeeping is a time-honored occupation, as evidenced by the historical records of ancient civilizations such as Egypt, Greece and Rome, which contain a wealth of information and expertise on the subject of bees (Pocol *et al*., 2021). The relationship between mankind and honey bees (bee-keeping) in Asia, dates back to 2000 years ago (Patel *et al*., 2021). In Iran,

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since the Achaemenid period (330-550 BC), beekeeping has been popular and honey has been used instead of sugar. The discovery of a bronze bee-shaped dagger in Lorestan, which belongs to 1200 BC and is now kept in Brussels Museum, shows the ancient familiarity of Iranians with this useful insect (Komeili, 1990; Shahrestani, 2006). In conclusion, beekeeping holds significant economic potential as a lucrative occupation for both rural villagers and urban residents, without any limitations based on age or gender. Moreover, it contributes to the growth of employment opportunities while also fostering additional value through the creation of high-quality products. This, in turn, facilitates sustainable development in both rural and urban areas, encompassing various aspects. (Pocol *et al*., 2021; Altunel and Olmez, 2019; Panta, 2020; Vrabcova, 2020). The global honey production has witnessed a significant increase in recent years, nearly doubling in a span of sixty years. From approximately about 700,000 tons in 1961, the production of honey has risen to about 1,852,000 tons in 2019, marking a growth of almost two and a half times. This trend in Iran has also been remarkably upward, such that with the growth of almost thirty times, the amount of Iranian honey production has reached about 75,000 tons in 2019 from 2,450 tons in 1961. China, Turkey, Canada, Argentina and Iran emerged as the top five honey producing nations in the world in 2019 (FAOSTAT, 2021).

Beekeeping possesses a distinct capacity that can significantly contribute to the accomplishment of 15 out of the 17 goals outlined by the United Nations' Sustainable Development (Patel *et al.*, 2021). Despite the longstanding connection between human being and bees throughout the history, as well as researchers' emphasis on the high capacity of the beekeeping industry in achieving sustainable development, the investigations into the sustainability assessment of this industry from various sources reveal the challenges faced by researchers in evaluating its sustainability. Kouchner *et al*. (2019) have highlighted that the apicultural industry is often undervalued and less studied as a professional agricultural activity. While researchers have attempted to employ sustainability assessment tools utilized in other agricultural sectors, their feedback indicates that these tools lack the necessary efficacy to achieve the desired goal (Kouchner *et al*., 2019). Mogni *et al*. (2009), when assessing the indicators of sustainable development in the beekeeping industry in Argentina, found that the commonly used indicators for evaluating agricultural sustainability were either not utilized or exhibited significant variations when applied to the beekeeping industry.

Understanding this necessity, Rahimi *et al*. (2020) identified the sustainability criteria of the apicultural industry in Iran based on economic, social, environmental and institutional dimensions. In this study, 70 special criteria, which were categorized into 13 general criteria, were proposed to assess the sustainability of the beekeeping industry. Each of these general criteria include some special criteria. These criteria, which can be calculated and assessed in the beekeeping industry, have been identified in a qualitative research and with the consensus of a group of experts in Iran's apiculture industry and in accordance with sustainability studies. Therefore, in this study, the sustainability of the apicultural industry in Iran was evaluated via the indicators identified by Rahimi *et al*. (2021). Since the assessment of sustainability in the world's apicultural industry is rarely done, the most important innovation aspect of this study would be the comprehensive review of the sustainability of this industry. One of the notable innovations of this study involves utilizing the trend analysis approach to evaluate ten-year time periods and forecast the future development of this industry over the next decade.

MATERIALS AND MTHODS

The current investigation adopts a quantitative approach from paradigm perspective: It is applied in terms of purpose,

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and employs an analytical technique in terms of research type. The statistical population of the research consists of all beekeepers who possess over 100 honey bee colonies (The minimum number of the required colonies to separate the ordinary beekeepers from professional beekeepers is 100 colonies) and have at least 10 years of experience in this sector (with the aim of comparing the sustainability trend of the beekeeping industry with the last decade). In order to determine the statistical sample, multi-stage random sampling method was used. Iran was divided into 5 geographical regions of north, south, east, west and center. Then, from each section the province with the largest number of honey bee colonies was selected, based on the census of apiaries in the year 2018. Iran has a population of 85,273 dedicated individuals who engage in beekeeping. These skilled beekeepers collectively nurture 8,434,808 bee colonies. (Ebadzadeh *et al.*, 2019). The sample size was determined as 384 beekeepers, which was increased to 453 beekeepers for increasing the confidence coefficient using the Krejcie and Morgan's table. This sample size was distributed among the selected provinces with proportional allocation (Table1). The researcher-designed survey served as the tool for gathering data, and its credibility was affirmed by a group of university professors and experts in extension and education of agriculture and beekeeping. the reliability of the survey was verified using Cronbach's alpha coefficient, which was estimated as 0.78 from a subset of 35 beekeepers within the statistical sample.

Using the sustainability criteria of the beekeeping industry identified by Rahimi *et al*. (2021), in this article, a questionnaire with 70 items was prepared and given to the statistical sample. They were asked to give their opinion about the level of sustainability of Iran's beekeeping industry at two periods of time, i.e. the past 10 years and now, in the form of a five-point Likert scale. The evaluation at two periods of time is the criterion for analyzing the changes in the sustainability status of this industry over the past years and will provide basic information for the analysis of future trends. Trends are key clues that can be used to identify changes in the environment and an image of the future. In this method, we can evaluate issues and trends and have a full understanding of the environment, infer future potential capacities, and by drawing a vision, make strategic planning while preparing to encounter opportunities and threats (Singh, 2019; Rohrbeck, 2013; Gordon *et al*., 2020). Since the Likert scale used to determine the current situation compared to the last 10 years has five options and option 3 means no change. In order to check the significance of the difference between the current situation compared to the previous 10 years, the one-way t-test was used and the average scores assigned to each factor were compared to the number 3. Therefore, the test hypothesis is defined as follows: the current situation of Iran's beekeeping industry has not changed significantly in the four dimensions of sustainability compared to the last 10 years (H_0: Mean= 3; H_1: Mean≠ 3).

Different methods were used to analyze the trend of time series. In this research, regression was used to determine the slope of the line and the future trend of the time series. When linear regression is used to analyze time series data, the data is entered into the formula $y = mx + b$, where "m" represents the slope of the line/rate of change and "b" represents the width from the origin of the line (Sharad and Kumar, 2012; Kivikunnas, 1998). Based on this, the results of the analysis of the sustainability trend of Iran's beekeeping industry in each of the four

Table 1. Statistical population and sample of the research

Selected provinces	Isfahan	East Azerbaijan	Razavi Khorasan	Khouzestan	Mazandaran	Sum
Population	3178	13321	3052	2988	6377	28916
Sample	60	221	39	42	91	453

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dimensions of sustainability were shown in detail in the form of different diagrams.

RESULTS AND DISCUSSION

Descriptive and Demographic Statistics of the Beekeepers

Based on the information obtained from the descriptive statistics of the interviewees, over half of the participants fell within the age bracket of 30-40 years, and 62% of them kept fewer than 200 bee colonies. Among the beekeepers surveyed, 38% had a high school diploma, while 36% held a bachelor's degree. Also, 47% of the respondents were single-occupant beekeepers, whereas the remaining 53% had other jobs alongside beekeeping. Table 2 presents detailed descriptive statistics of the beekeepers.

Environmental Sustainability Trend of the Studied Apicultural Industry

The environmental sustainability assessment of the beekeeping industry has been performed in the form of two categories and 11 criteria. As shown in Table 3, the average difference between the current situation and ten years ago is negative and significant in 4 cases and positive and significant in 7 cases. This indicates that the average sustainability indexes pertaining to this particular aspect are displaying a negative trend. Also, the analysis of the future trend of this industry in the environmental dimension shows that, if the current conditions does not change and the trend of the last ten years continues in 7 indexes, the situation of the Iran's apiculture industry is far from the desired situation.

According to the assessment of farmers' environmental behavior, based on five criteria, it is evident that four of these criteria have witnessed a decline in the past decade. The difference between the current situation and those of the previous ten years was significant in three specific criteria. Only in the criterion of " the rate of use of biological pesticides and managerial methods instead of conventional and chemical pesticides in farms and gardens" the trend was increasing, the difference between the current situation and the situation of the past ten years was not significant in this criterion too. The second category of the environmental dimension was the environmental behavior category of beekeepers, which was evaluated using six

Table 2. Descriptive and demographic statistics of the respondents (n= 453).

Variable		Frequency	Percent	Cumulative percent
Age	< 30	71	16	16
	30-40	241	53	69
	41-50	85	19	88
	➢ 50	56	12	100
Number of Colony	100-200	280	62	62
	201-300	43	10	72
	301-400	29	6	78
	401-500	51	11	89
	>500	50	11	100
Level of education	Less than a Diploma	42	9	9
	Diploma	170	38	47
	B.Sc. / B.A.	163	36	83
	M.Sc. / M.A. and upper	78	17	100
Other occupations Besides beekeeping	Yes	241	53	
	No	212	47	

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Table 3. The trend of environmental sustainability of Iran's apiculture industry.

Category	Environmental sustainability criteria	Situation of 2011 compared to the desired situation	Situation of 2021 compared to the desired situation	Mean differences	t	Sig.	Trend analysis in 2031
A: Farmers' environmental behavior quality	1. The rate of use of safe or low-risk vegetal pesticides for pollinators	2.83	2.30	-0.53	-5.56	0.00	1.77
	2. The rate of notifications about farm and garden spraying time to beekeepers to reduce honey bee colonies mortality	2.33	2.30	-0.03	-0.40	0.69	2.27
	3. The rate of use of dangerous chemical pesticides for pollinators by farmers	2.54	2.10	-0.44	-4.95	0.00	1.66
	4. The rate of contamination of current and groundwater by spraying and use of fertilizers by farmers	3.31	2.50	-0.81	-8.31	0.00	1.69
	5. The rate of use of biological pesticides and managerial methods instead of conventional and chemical pesticides in farms and gardens	2.16	2.30	0.14	1.59	0.11	2.44
	Total	2.64	2.30	-0.34			1.96
B: Beekeepers' environmental behavior quality	1. The rate of reduction of pesticides and drugs against honeybee colony diseases	2.66	2.80	0.14	1.21	0.23	2.94
	2. The rate of use of non-chemical pesticides and managerial methods in apiaries	1.33	2.30	0.97	10.49	0.00	3.27
	3. The rate of environmental pollution around the apiaries, with waste, chemicals and non-renewables by beekeepers	2.31	2.80	0.49	4.38	0.00	3.29
	4. The rate of prevalence of pests and diseases in apiaries in Iran	4.28	3.00	-1.28	-17.88	0.00	1.73
	5. Environmental crime rate of beekeepers (illegal hunting, destruction of natural resources, etc.)	2.77	3.50	0.74	5.33	0.00	4.24
	6. Genetic diversity of honeybee species in Iran	4.06	2.80	-1.26	-12.75	0.00	1.54
	Total	2.90	2.87	-0.03			2.83

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criteria. In this category, compared to the last ten years, two criteria had a negative trend and four criteria had a positive trend, and the difference in the situation in three criteria was significant.

Figure 1 shows the trend of each of the two sustainability categories of Iran's apiculture industry in the environmental dimension compared to the last ten years and the future ten years. In this graph, the X-axis represents the years of environmental sustainability investigation, namely, 2011 and 2021, while presenting a projection for the following decade (2031). The Y-axis denotes the timeline, while the Y-axis corresponds to the scores obtained by various categories in different year.

As shown in Figure 1, if the current trend continues, the average score of the criteria of the "farmers' environmental behavior (A category)" in the next ten years would be estimated as 1.96. Of course without significant changes in the factors affecting each criterion and without considering the possible future changes.

Economic Sustainability Trend of the Apicultural Industry

The economic sustainability dimension of the beekeeping industry was assessed by considering 24 factors across five distinct categories. Table 4 reveals that within the realm of product marketing and sales, three out of the four criteria assessed exhibited positive trend over the past decade, with two of them being notably significant. To evaluate the category of productivity and production performance, six criteria were considered. Among these, three criteria had a positive and significant trend while the remaining three criteria had a negative and significant trend compared to the previous ten years.

Five criteria were used to evaluate the category of the amount of monetization from pollinations' right, and all five criteria had a negative trend in the past ten years, and in four criteria this negative trend was significant. In the category of the amount of monetization of byproducts and value-added products, all the four given criteria had a positive and significant trend. According to

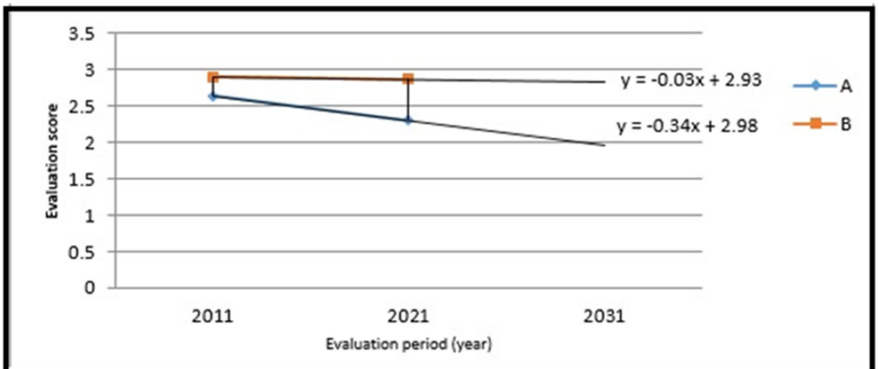

Figure1: The trend analysis of environmental sustainability of Iran's apiculture industry

A: Regression diagram related to the category of farmers' environmental behavior quality
B: Regression diagram related to the category of beekeepers' environmental behavior quality

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Table 4. The trend of economic sustainability of Iran's apiculture industry.

Category	Economic sustainability criteria	Situation of 2011 compared to the desired situation	Situation of 2021 compared to the desired situation	Mean differences	t	Sig.	Trend analysis in 2031
A: The quality of marketing and sales of honey	1. The rate of direct sales and without intermediary sales products produced by beekeepers	3.14	3.30	0.17	1.24	0.21	3.47
	2. Export rate of honey to different countries	2.01	1.80	-0.21	-2.47	0.01	1.50
	3. Usage rate of honey quality control laboratories by beekeepers	1.98	3.00	1.02	10.82	0.00	4.02
	4. The amount of per capita consumption of honey in Iran	1.75	3.10	1.35	16.10	0.00	4.45
	Total	2.22	2.80	0.58			3.38
B: Productivity and performance improvement	1. Average profitability of the beekeeping industry compared to production costs	2.85	2.00	-0.85	-9.94	0.00	1.15
	2. Average yield per colony in honey production	3.09	2.30	-0.79	2.69	0.01	1.51
	3. Average yield per colony in production of other beekeeping products	1.06	2.50	1.44	21.30	0.00	3.94
	4. The application of world-class knowledge and technologies in the farm management of apiaries	1.26	3.00	1.74	15.79	0.00	4.74
	5. Timely access of beekeepers to various inputs and equipment required	2.82	2.30	-0.52	-5.64	0.00	1.78
	6. Mortality rate due to poor management of apiaries	2.52	3.00	0.48	3.85	0.00	3.48
	Total	2.27	2.52	0.25			2.77
C: Amount of monetization from pollinations' right	1. Quality of planning about migration of apiaries for maximum utilization of pollen and nectar resources of farms, gardens and pastures by relevant institutions	2.84	2.00	-0.84	-12.22	0.00	1.16
	2. Cooperation and assistance of farmers, gardeners and rangeland owners in deployment of bee colonies in the vicinity of their farms, gardens and pastures	2.01	1.80	-0.21	-3.12	0.00	1.59
	3. Quality of specific agricultural products development programs using pollination (such as canola)	3.69	3.00	-0.69	-7.17	0.00	2.31
	4. Level of activity and influence of pollination workgroup at different organizational levels	1.56	1.50	-0.06	-0.87	0.39	1.44
	5. The amount of beekeepers' income due pollination	1.75	1.30	-0.45	-9.75	0.00	0.85
	Total	2.37	1.92	-0.45			1.47

Table 4 continued…

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Continue of Table 4. The trend of economic sustainability of Iran's apiculture industry.

D: The amount of monetization of byproducts and value added	1. The amount of per capita consumption of other beekeeping products	1.79	3.00	1.22	14.19	0.00	4.22
	2. Export rate of other beekeeping products to different countries	1.82	2.30	0.48	5.29	0.00	2.78
	3. The rate of packaged and branded products produced in Iranian beekeeping industry	2.63	3.50	0.88	6.18	0.00	4.38
	4. The rate of beekeeping products, purchased by companies producing value added products (such as cosmetics, hygiene, etc.)	2.52	3.00	0.48	4.17	0.00	3.48
	Total	2.19	2.95	0.76			3.71
E: Employment rate and job stability	1. The employment rate of the beekeeping industry compared to the investment made	2.21	2.50	0.29	2.52	0.01	2.79
	2. The proportion of bee colonies in each region relative to the capacity of pastures in that region	4.73	3.50	-1.23	31.56	0.00	2.28
	3. The rate of professional beekeepers (single-occupant beekeepers) compared to the total beekeepers in Iran	2.00	3.30	1.30	9.00	0.00	4.60
	4. The amount of loans granted to renovate beekeeping equipment	3.98	2.50	-1.48	-19.33	0.00	1.03
	5. The amount of loans granted to provide beekeepers annual cash requirement	4.12	2.70	-1.42	-17.20	0.00	1.28
	Total	3.41	2.90	-0.51			2.39

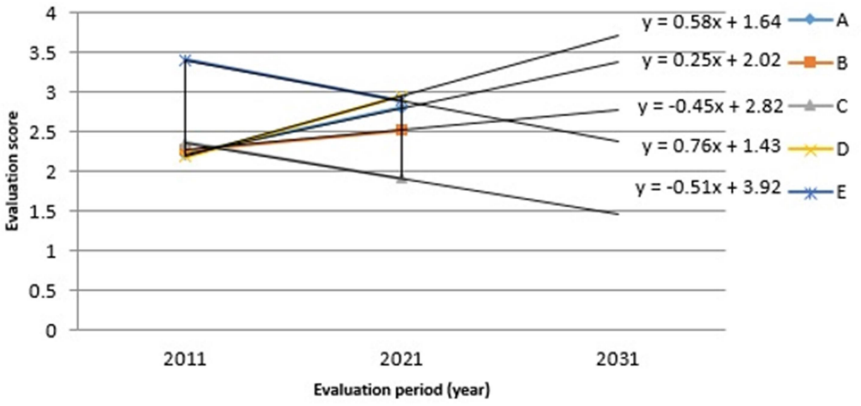

Figure 2: The trend analysis of economic sustainability of Iran's apiculture industry

A: Regression diagram related to the category of quality of marketing and sales of honey
B: Regression diagram related to the category of productivity and performance improvement
C: Regression diagram related to the category of amount of monetization from pollinations' right
D: Regression diagram related to the category the amount of monetization of byproducts and value added
E: Regression diagram related to the category of employment rate and job stability

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the parameters of the job creation and sustainable employment category, it can be observed that among the five criteria associated with this category, three criteria exhibited a noteworthy and unfavorable tendency, while two criteria displayed a favorable and substantial trend over the past decade.

If the current trend continues and there are no significant changes in the factors affecting each criterion, Figure 2 illustrates that the average score of the "A" category (without considering possible future changes) is estimated to be 3.83 in the next decade. This is above the average, showing a positive upward trend in the sustainability of this category. The average score of the "B category" (without considering possible future changes) is estimated to be 2.77 (less than the average) in the next ten years with a very slight positive slope. The average score of the "C category" (without considering future changes) over the next decade is estimated to be 1.47 indicating a very weak performance with a declining trend. All the criteria within this category are exhibiting an unfavorable trend, indicating the need for serious consideration and rectification of the current process. The average score of the "D category" (without considering possible future changes) in the next ten years is estimated to be 3.71 (almost good) with a positive slope. Considering the positive trend of the criteria of this category, paying attention to the strengths of these criteria and attempting to continue this trend can have a significant effect on increasing the economic sustainability of Iran's apiculture industry. The average score of the "E category" (without considering possible future changes) is estimated to be 2.39 (almost weak) with a negative slope in the next ten years. Considering the negative trend of the criteria of this category, it would be necessary to pay special attention to these criteria, which have a direct relationship with the future job of the human resources working in this industry.

Assessment of the Social Sustainability of the Apicultural Industry

For sustainability assessment of Iran's apiculture industry in the social dimension, 19 criteria were used in the form of three categories. The results are depicted in Table 5. As shown, in the category of the level of social development of stakeholders, two criteria out of the five criteria assessed had a positive trend during the last decade, one of which was significant. Also, the sustainability of the criterion of beekeepers' trust in different organizations of the beekeeping sector had a fixed trend.

As shown in the continuance of Table 5, there are seven criteria employed to assess the stakeholders' cultural development. Over the course of the last decade, three of these criteria exhibited a notable and unfavorable trend, while the other three demonstrated a positive and significant trend.

In the continuation of Table 5, seven criteria of the category of providing education and extension and education of new sciences and technologies to stakeholders can be observed. Four criteria, out of the seven criteria assessed in this category had a positive and significant trend and three criteria had a negative trend. The trend of two criteria was significant during the last ten years.

Figure 3 shows trend analysis of social sustainability of Iran's apiculture industry. "A" category shows the sustainability trend of the social development level of stakeholders of beekeeping industry. Based on the current trajectory and in the absence of any significant alterations to the factors impacting each criterion, it is projected that the average score of the social development category for stakeholders (without taking into account potential future changes) will be approximately 2.68. This score falls below the average and demonstrates a negative trend. Therefore, it would be necessary to pay serious attention to the criteria of this category and correct the existing process. "B" category shows future

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Table 5. The trend of social sustainability of Iran's apiculture industry.

Social sustainability criteria	Situation of 2011 compared to the desired situation	Situation of 2021 compared to the desired situation	Mean differences	t	Sig.	Trend analysis in 2031
1. The level of social justice for all beekeepers to have equal access to information, facilities etc.	3.97	2.70	-1.27	-13.08	0.00	1.43
2. The rate of participation of beekeepers in elections and decisions related to the beekeeping industry	4.70	3.30	-1.40	-11.09	0.00	1.90
3. The level of trust of beekeepers to different beekeeping organizations	3.50	3.50	0.00	0.21	0.83	3.50
4. The level of mutual confidence and cohesion of beekeepers to each other in common activities	2.92	3.50	0.58	3.76	0.00	4.08
5. Mutual trust in social relationships between beekeepers and different groups of farmers (gardeners, farmers and rangeland owners)	2.49	2.50	0.01	0.00	0.01	2.51
Total	3.52	3.10	-0.42			2.68
1. The degree of cohesion and empathy between organizations and institutions related to the beekeeping industry	3.04	2.50	-0.54	-5.44	0.00	1.96
2. The quality of farmers' attitudes about the privileged role of bees' pollination in quantitative and qualitative improvement of varieties of agricultural and pasture products	1.65	2.00	0.35	4.55	0.00	2.35
3. Attitudes of different sections of society about the privileged role of beekeeping industry products in nutrition, public health and treatment of diseases	3.08	4.00	0.92	9.10	0.00	4.92
4. Attitudes of authorities and policy makers about the privileged role of beekeeping industry products in nutrition, public health and treatment of diseases	3.57	3.00	-0.57	-5.39	0.00	2.43
5. Attitudes of authorities and policy makers about the privileged role of bees' pollination in quantitative and qualitative improvement of varieties of agricultural and pasture products	2.52	2.00	-0.52	-7.64	0.00	1.48
6. Attitudes of students about the privileged role of bees' pollination in quantitative and qualitative improvement of varieties of agricultural and pasture products	2.78	3.00	0.23	1.62	0.11	3.23
7. The quality of farmers' attitudes about using organic pesticides and fertilizers instead of chemicals	1.89	2.30	0.41	4.20	0.00	2.71
Total	2.65	2.69	0.04			2.73

Table 5 continued…

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Continued of Table 5. The trend of social sustainability of Iran's apiculture industry.

C: The quality of extension and education new sciences and technologies to stakeholders	1. Average education level of professional beekeepers	2.00	4.00	2.00	17.76	0.00	5.00
	2. The amount of training courses provided to different groups of farmers to develop the use of bees in pollination of farms	2.25	2.00	-0.25	-6.36	0.00	1.75
	3. The number of skilled trainers that familiar with the latest apiculture technologies for training beekeepers	1.61	2.50	0.89	9.47	0.00	3.39
	4. The amount of pollination related courses in different fields of agriculture in Iranian universities	2.43	2.30	-0.13	-1.68	0.90	2.17
	5. The amount of training courses offered to retrain and enhance the knowledge and skills of beekeepers to modern science and technology	1.53	3.00	1.47	13.05	0.00	4.47
	6. The amount of training courses for beekeepers about production of lateral products of beekeeping	1.63	3.30	1.67	16.31	0.00	4.97
	7. The amount of training courses for farmers on how prevent damage of spraying and other agricultural activities to pollinators	2.35	2.00	-0.35	-5.22	0.00	1.65
Total		1.97	2.73	0.76			3.34

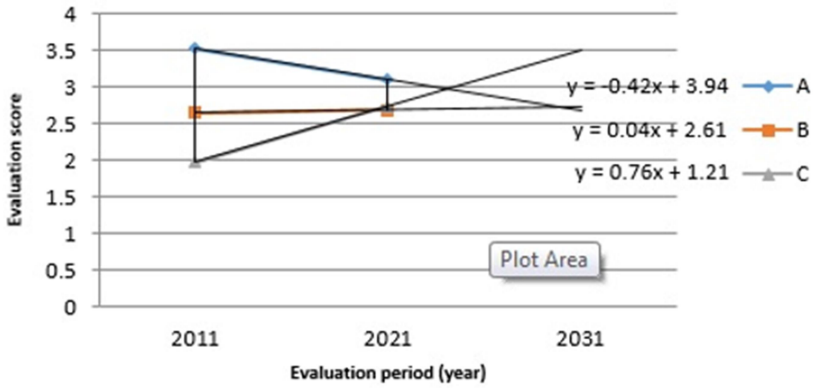

Figure 3: The trend analysis of social sustainability of Iran's apiculture industry

A: Regression diagram related to the category of level of social development of stakeholders
B: Regression diagram related to the category of level of cultural development of stakeholders
C: Regression diagram related to the category of quality of extension and education new sciences and technologies to stakeholders

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trend of the cultural development of stakeholders. If the current trend continues and there are no tangible changes in the factors affecting each criterion, the average score of the criteria of this category would be estimated as 2.73 (about average) with a constant slope in the next decade. “C” category indicates the sustainability trend of the category of providing education and extension and education new sciences and technologies to stakeholders of the beekeeping industry. As shown, assuming that the ongoing pattern persists and no significant alterations occur in the factors affecting each criterion, the projected average score for the criteria within this category would be 3.34, with a positive slope in the next ten years. Therefore, the stability of beekeeping industry in Iran in this category has a positive trend, and by removing the shortcomings and deficiencies in some criteria, the slope of the category's sustainability trend can be increased.

Institutional Sustainability Assessment of Apicultural Industry

The sustainability of beekeeping industry in Iran in the institutional dimension was evaluated by 16 criteria in the form of three categories. The results are indicated in Table 5. As shown, in the category of the quality of rules and programs related to the beekeeping industry, all four criteria had a negative and significant trend during the last ten years. The current status of the criteria of this category is weak and the negative trend of their sustainability is worrying and needs more consideration. As demonstrated, six criteria have been employed to assess the quality category pertaining to the engagement of non-governmental stakeholders in role-playing activities. Out of these, five criteria exhibited a notable and negative trend over the past decade, while one criterion also displayed a negative trend but without statistical significance. Given the overall negative trajectory observed across all criteria in this category, it becomes imperative for planners and policymakers to actively address and rectify the prevailing trend. The quality of role-playing of governmental institutions stakeholders was evaluated by six criteria. Four criteria, out of the six criteria evaluated in this category, had a negative and significant trend and one criterion had a positive and significant trend during the last ten years. Among the criteria of this category, the criterion of the amount of budget and credits allocated to the beekeeping sector compared to other sectors had the most negative slope. Also, the criterion of the amount and quality of research programs related to the beekeeping industry had the most positive slope. Thus, most of the criteria of this category had an unstable trend.

Figure 4 shows the trend of institutional sustainability of Iran's apiculture industry. As shown, at “category A”, if the current trend continues and no tangible changes are made in the factors affecting each criterion, the average score of the criteria of the category of social development of stakeholders is estimated at 1.58 (below weak) with a negative slope in the next ten years. Therefore, it is necessary to pay serious attention to the criteria of this category and correct the existing process. Also, at “category B", the average score of the criteria of this category (without considering possible future changes) is estimated at 2.00 (weak) with a negative slope in the next ten years. Given the downward trend and the projected subpar performance over the next decade in this particular category, it is crucial for Iran's apiculture industry planners and policy makers to place significant emphasis on rectifying the current process. In the following, “category C”, the average score of the criteria of this category (without considering possible future changes) is estimated at 1.59 (below weak) with a negative slope in the next ten years. Therefore, the sustainability of Iran's apiculture industry in this category has a negative trend, and with the continuation of

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Table 6. The trend of institutional sustainability of Iran's apiculture industry.

Category	Institutional sustainability criteria	Situation of 2011 compared to the desired situation	Situation of 2021 compared to the desired situation	Mean differences	t	Sig.	Trend analysis in 2031
A: Comprehensiveness of rules and programs	1. The comprehensive legislation in the fields that relate to the beekeeping industry	3.02	2.30	-0.72	-10.15	0.00	1.58
	2. The quality of law enforcement warranty in the fields that relate to the beekeeping industry	3.21	2.30	-0.91	-12.52	0.00	1.39
	3. The quality of instructions on how to work different organizations with beekeeping industry	3.20	2.50	-0.70	-8.46	0.00	1.80
	4. The quality of short-term and long-term designed plans for the development of the beekeeping industry	2.46	2.00	-0.46	-7.17	0.00	1.54
	Total	2.97	2.28	-0.70			1.58
B: The quality of the role-playing of non-governmental stakeholders	1. The transparency and non-overlapping degree of functions and authority of the beekeeping industry organizations	3.91	2.80	-1.11	-12.77	0.00	1.69
	2. The participation and cooperation degree of the beekeeping industry associations in matters related to this industry	3.81	2.80	-1.01	-11.49	0.00	1.79
	3. The influence and position degree of beekeeping organizations in policy and decision-making related to beekeeping industry	3.18	2.50	-0.68	-7.30	0.00	1.83
	4. The amount of capital and organizational strength of the Beekeepers' Union	2.66	2.50	-0.16	-1.55	0.12	2.34
	5. The membership rate of beekeepers in county beekeeping cooperatives	4.04	3.00	-1.04	-11.04	0.00	1.97
	6. The effectiveness and efficiency of beekeeping cooperatives in meeting the demands of stakeholders	3.59	3.00	-0.59	-4.66	0.00	2.42
	Total	3.53	2.77	-0.76			2.00

Table 6 continued…

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Continued of Table 6. The trend of institutional sustainability of Iran's apiculture industry.

C: The quality of the role-playing of governmental institutions stakeholders	1. The amount of influence and organizational position of the beekeeping industry in the Ministry of Agriculture Jihad	2.94	2.50	-0.44	-4.68	0.00	2.06
	2. The extent of insurance support for bee colonies against all type of inflicted damages	2.75	1.80	-0.95	-16.68	0.00	0.85
	3. The usage rate of beekeeping society from beekeeping social insurance services	3.21	2.00	-1.21	-19.35	0.00	0.79
	4. The quality of research programs related to the beekeeping industry	2.02	2.80	0.78	4.44	0.00	3.58
	5. The amount of budget and credits allocated to the beekeeping sector compared to other sectors	3.96	2.30	-1.66	-26.69	0.00	0.64
	6. The number of active personnel in the public sector of the beekeeping industry compared to other sectors	3.36	2.50	-0.86	-8.56	0.00	1.64
Total		3.04	2.32	-0.72			1.59

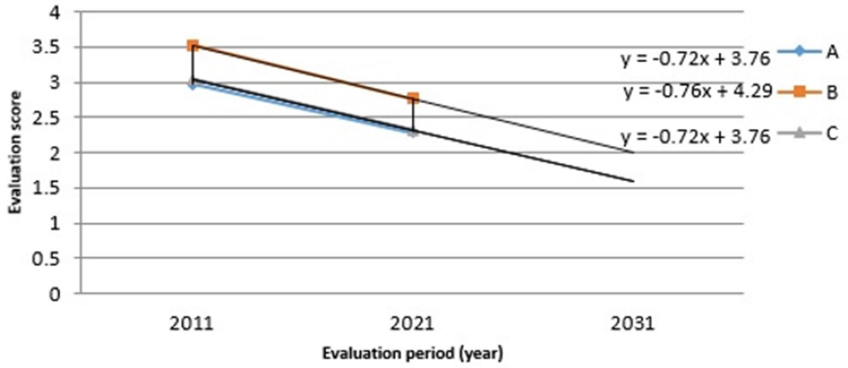

Figure 4: The trend analysis of Institutional sustainability of Iran's apiculture industry

A: Regression diagram related to the category of comprehensiveness of rules and programs
B: Regression diagram related to the category of quality of the role-playing of non-governmental stakeholders
C: Regression diagram related to the category of quality of the role-playing of governmental institutions stakeholders

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the current trend, the condition is estimated to be very unstable in the next ten years.

CONCLUSIONS

The present study aimed to evaluate and analyze the sustainability trend of Iran's apiculture industry. Considering that in the evaluation of the trend of the environmental dimension, both "farmers' environmental behavior quality" and "beekeepers' environmental behavior quality" categories had a negative trend, and in the evaluation of the institutional dimension, all three "comprehensiveness of rules and programs", "the quality of the role-playing of non-governmental stakeholders" and "the quality of the role-playing of governmental institutions stakeholders" categories had a negative trend, therefore, it is recommended that the reform of the criteria of the environmental and institutional dimensions should be on the priority by the planners and policy makers of Iran's apiculture industry. The other dimensions should be reviewed and examined in more details. When comparing with studies conducted worldwide, it can be inferred that the sustainability level of various aspects of beekeeping differs across regions based on their specific conditions (Mogni et al., 2009; Pocol et al., 2012; FAO (a), 2016; MNRT, 1998). Findings presented here offer valuable insights for the planners, policy makers, researchers and involved in the management of beekeeping in Iran with basic information. These insights are crucial for outlining a strategic plan and designing the future trajectory of Iran's apiculture industry. It can also be a model for beekeeping industry activists around the world, so that by using these results and their localization, beekeeping development programs in all parts of the world can be used by a codified and organized method.

Limitations and recommendations for future research

This study has some limitations like other researches. The most important limitation of this study was the impossibility of considering factors affecting the future of beekeeping industry in Iran and presenting an in-depth and foresight-based research at this stage. Based on the employed methodology in this study, the current analysis of Iran's apiculture industry for the upcoming decade is straightforward and does not take into account future influential factors. However, this simplified outlook can serve as a foundation for conducting research that is more comprehensive in order to gain further insights into the future of the apiculture industry. Also, it can contribute researchers to present a more comprehensive vision of the future of this industry by combining other quantitative and qualitative methods. In the forthcoming research and investigations, it is advisable to utilize the results of this study to examine the factors affecting the future of Iran's apiculture industry. Additionally, it is crucial potential scenarios to identify for the future of this industry, allowing the results to serve as a comprehensive guide in the strategic planning process. Finally, it is suggested that the economic obstacles in the categories that have a negative trend and hinder the economic stability of the beekeeping industry be removed. Also, by emphasizing the institutional dimensions, policy makers should strengthen the infrastructure and institutional relations between the stakeholders of this industry. In addition to the sustainability of the beekeeping industry in this dimension, strengthening the institutional dimension might increase the sustainability of other dimensions as well.

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ارزیابی روند پایداری صنعت زنبورداری: شواهدی از زنبورداران ایران

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چکیده

تحقیق حاضر با هدف تحلیل روند پایداری صنعت زنبورداری طراحی شده است. در این تحقیق با تمرکز بر جنبه¬های کمی، از روش تحلیل روند کمی-کیفی استفاده شده است. جامعه آماری تحقیق را کلیه زنبورداران ایران تشکیل می¬دهند. با استفاده از روش نمونه¬گیری تصادفی چندمرحله¬ای تعداد ٤٥٣ زنبوردار به عنوان نمونه انتخاب و مطالعه شدند. پرسشنامه محقق ساخته ابزار اصلی جمع¬آوری داده¬های تحقیق است. در این مطالعه پایداری صنعت زنبورداری ایران در قالب چهار بعد زیست¬محیطی، اقتصادی، اجتماعی و نهادی مورد ارزیابی قرار گرفته است. در بعد زیست¬محیطی، پایداری صنعت زنبورداری توسط ۱۱ معیار در قالب ۲ مقوله مورد ارزیابی قرار گرفت که هر دو مقوله روند منفی دارند. در بعد اقتصادی پایداری در قالب ٢٤ معیار و ٥ مقوله مورد ارزیابی قرار گرفت که دو مقوله روند منفی و سه مقوله روند مثبت داشتند. پایداری بعد اجتماعی توسط ۱۹ معیار در قالب ۳ مقوله ارزیابی شد که یک مقوله روند منفی، یک مقوله روند ثابت و یک مقوله روند مثبت داشت. در نهایت، پایداری بعد نهادی توسط ١٦ معیار در قالب ۳ مقوله مورد ارزیابی قرار گرفت که هر سه مقوله روند منفی داشت. بنابراین، اصلاح روند معیارهای بعد زیست¬محیطی و نهادی باید در اولویت برنامه¬ریزان و سیاستگذاران صنعت زنبورداری ایران قرار گیرد. نتایج این مطالعه می¬تواند به عنوان اطلاعات پایه در آینده¬نگاری صنعت زنبورداری، تهیه سند چشم¬انداز و همچنین برنامه-ریزی راهبردی توسعه این صنعت مورد استفاده قرار گیرد.

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