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Assessment of Sustainability of Greenhouse Culture and Identifying Factors Affecting in Alborz Province

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Abstract: The objective of this study was to evaluate the sustainability of the greenhouse culture and identifying factors affecting in Alborz province, Iran. Research data belongs to 2011-2012 production period. The target population for this study consisted of greenhouse owners (N=366) which by Cochran formula, 151 people were selected as sample and using stratified sampling method with proportional allocation data gathered. In this research, economical, social and environmental sustainability of greenhouses were investigated. Total sustainability index, based on the selected 39 sustainability indicators was used to determine sustainability level. Research results revealed that in economic terms, 45.8% of greenhouses were unsustainable, 30.3% were medium sustainable and only 23.9% were sustainable. In environment dimension, only 9% were sustainable and 28.4% and 62.6% were medium sustainable and unsustainable respectively. In social dimension, 59.4% were unsustainable, 31.6% medium sustainable and 9% were sustainable. In overall sustainability, 57.4% were unsustainable, 32.9% medium sustainable and only 9.7 % were sustainable. The result of linear regression showed that 9 entered variable could explain 64.3% variance in sustainability. Also greenhouse's size was the most important variable.

Key words: Sustainable Agriculture · Sustainability · Assessment · Greenhouse Culture

INTRODUCTION

Food security is an enormous challenge for scientists, government managers and policy makers throughout the world, as both population and food demand increase. Scientists from many fields strive to understand agricultural sustainability to ensure food supplies, social consolidation and national prosperity [1-2]. Intensive agriculture, which is characteristic of high-yield farming, has contributed greatly to the crop production increases in recent decades by using irrigation and massive chemical fertilizer and pesticide inputs. However, this has led, at local, regional, national and global scales, to negative environmental consequences, such as degraded land, biodiversity loss and polluted crops and groundwater [3-4]. Hence, the development of more sustainable long-term agricultural alternatives has received much attention [1].

Agricultural sustainability is key to the enhancement of rural and national economies but environmental parameters and the integrity of eco-systems must be preserved [5]. The sustainability of agriculture is an announced target of agricultural policy in international. The problem is that sustainable agriculture is hard to define and especially to make operational in the form of practical policy measures [6].

The World Commission on Environment and Development (1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet those of the future". Since that time, much attention has been devoted toward better defining the concept and developing measures to facilitate its assessment [7]. Despite the diversity of thought, definitions of agricultural sustainability display a notable consistency [1-8]. In most definitions, sustainable agriculture is considered to have at least three key dimensions, namely ecological, economic and social. These dimensions reflect the development of sustainable agriculture, which has occurred from three major perspectives: as a concept of taking care of the environment and natural resources (sustainability as stewardship), as a system of production

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to achieve food self-reliance (sustainability as food sufficiency) and as a vehicle for sustaining rural areas and activities (sustainability as community) [6]. Agricultural sustainability requires achieving all three standards.

Sustainable agriculture implies long-term maintenance of natural systems, optimal production with minimum input, adequate income per farming unit, fulfillment of basic food needs and provision for the demands and necessities of rural families and communities [1-9].

In many of the developing countries, increasing agricultural production has been one of the most important priorities for agricultural development programs [10], But this emphases was with little regard to sustainability [11]. This resulted in increasing production without any attention to preserving basic and natural resources. Therefore, large areas of the world have faced severe soil degradation, water erosion, groundwater pollution and natural resource depletion[12-13-8]. This condition is more obvious in poor and developing countries, which rely on a large extent on agriculture and natural resources for their living [10].

This is no exception for Iran, since agriculture comprises a considerably high percentage of production and employment in economy[14]. Iran, like other developing countries, depends on agriculture sector to fulfill demand for more foods [5]. In order to increase production, a large amount of chemical inputs have been used by farmers in Iran [15]. This problem particularly is very serious in production of greenhouse products. Currently greenhouse producers are consuming more than 64 type of chemical pesticide for producing cucumber, tomato, strawberry and other products [16]. So with regard to importance of sustainabity, this study aimed to assess sustainability of greenhouse culture in Alborz province of Iran.

Objectives of the Study: The major objective of this research is to assess the sustainability of greenhouse culture and identifying factors affecting in Alborz provinces of Iran. Also the specific objectives in the main are to:

- To determine the greenhouse owner's professional and demographic characteristics;
- Identifying suitable indicators for assessing sustainability;
- Assess the environmental sustainability of greenhouse culture;
- Assess the economical sustainability of greenhouse culture;
- Assess the social sustainability of greenhouse culture and;
- The research will seek to identify factors effecting on sustainability.

The Study Area: Alborz Province is one of the 31 provinces of Iran, centered in Karaj covering 503392 ha, situated between 15" 17" to 16" 05' north and 99" 04' to 100" 05' east with an average rainfall of 300 mm, a temperature range from 15.6 to 40.1"C and with an annual mean of 28.8 "C. This province has long history of agricultural production, playing key role in ensuring food security for the entire country. Also by being close to the major market of capital (Tehran) it has high rank in most of the greenhouse production. But lack of research on assessment of sustainability was the motivations for choosing the Alborz province for the study.

MATERIALS AND METHODS

The design of this study was descriptive-correlational that was carried out (in 2011-2012) by a survey method. Based on the latest statistics of Ministry of Jihad Agriculture (MJA), the target population was 366 greenhouse owners which using Cochran formula, 155 greenhouse owners by stratified sampling method with proportional allocation selected. Data were collected through structured questionnaire survey. Content and face validity verified by a panel of experts and a pilot study was conducted with 30 greenhouse owners who had not been interviewed before the earlier exercise of determining the reliability of the questionnaire for the study. Computed Cronbach's Alpha score for different scales was higher than 70%, which indicated that the questionnaire was highly reliable.

Here, we evaluate sustainability of greenhouse culture using an agricultural sustainability index (ASI). The three-dimensional and multi-attribute ASI indicators encompass environmental, economical and social factors.

Establishment of the Composite Index (CI): The main challenge in measuring agricultural sustainability is to define the scope and context at different scales. Definitions of sustainable agriculture agree on three fundamental criteria: ecological soundness, economic viability and social acceptability. However, the importance of each of the primary criteria and of sustainable agriculture indicators is rated differently. Sustainability

Table 1: The applied indicators according to 3 different dimensions and Strategic goal of indicator

Dimension	Applied indicator	Strategic goal of indicator
Environmental Indicators	Size of cultivated area applied biologic control / total cultivated area (%)	To conclude the relative
Environmental viability of	% of area with crop rotation to total	
sustainability of greenhouse culture	Size of cultivated area applied no chemical pesticide(%)	
	Size of cultivated area applied synthetic fertilizer / total cultivated area (%)	
	Size of cultivated area applied chemical fertilizer / total cultivated area (%)	
	Size of cultivated area applied manure / total cultivated area (%)	
	Size of cultivated area applied green fertilizer / total cultivated area (%)	
	Size of cultivated area applied pesticide/ total cultivated area (%)	
Economical Indicators	Ratio of greenhouse income to overall income of owner(%)	To conclude the relative economic
	Total productivity	viability of sustainability of
	Size of rental area / total area (%)	greenhouse culture
	Size of greenhouse with insurance / total area (%)	
	Ratio of family labor / total labor(%)	
	Ratio of personal investment / total investment (%)	
	Net farm income per 1000 m^2	
	Ratio of greenhouse invest capital to off-farm(%)	
Social Indicators	Ratio of job satisfaction (%)	To conclude the relative
	The ratio of asphalted road(%)	Social viability of sustainability
	Level of technical knowledge of organic farming	of greenhouse culture
	Ratio of greenhouses member in supporting institutions	
	Seeking information behavior	
	Use of communication channels	

being a concept, it cannot be measured directly. Appropriate indicators must be selected to determine level and duration of sustainability [17-9]. In sustainability assessments, the selection of a single indicator or indicator set to transform defined principles into measurable parameters is difficult. Moreover, the chosen indicators should reduce the systemic complexity and integrate systematic information [18-1]. In this research for each dimension a group of priority objectives has been identified, so the indicators are selected referring to these objectives. Indicators are implemented on the basis of data which are currently available. The constraint of data availability allows verifying current possibilities of a "sustainability analysis". The overall number of indicators calculated is 22, of which 8 indicators are economic and aim at analyzing production efficiency of the greenhouses and other criteria. The other 8 indicators give information on the environmental issues. Also 6 indicators developed aimed at study of issues related to the social ground. The selected indicators classified according to different dimension are presented in Table 1.

After selecting indicators, by dividing every indicator to its mean, they become free scale. Then, by Principal Component Analysis(PCA) indicators were weighed and after that, The indicators of every dimension were sum and the composite index for economic, social and environmental sustainability, also overall composite index(CI) were constructed.

Based on CI and Using cluster analysis all greenhouses divided into three levels: unsustainable, relatively sustainable and sustainable. Finally, for identifying factors effecting on sustainability, linear regression was employed.

RESULT AND DISCUSSION

The results of descriptive findings showed that 89. 54% of greenhouse owner were male and 10.4% were female. The average age of subjects and work experience was 43.93 and 10.46 years respectively. Other descriptive information showed in Table 2.

Environmental sustainability of greenhouse culture assessed by 8 ecological indicators (Table 1). Based on the composite index, 62.6% of subjects in the study group were unsustainable, 28.4% were relatively sustainable and only 9% were in sustainable condition. Based on result of economic indicators, 45.8% of greenhouses were unsustainable, 30.3% were relatively sustainable and 23.9% were sustainable. In terms of social sustainability which measured with 6 indicators, 59.4% greenhouses were unsustainable, 31.6% were relatively sustainable and only 9% were sustainable. The results of overall CI showed that the 57.4, 32.9 and 9.7% of the samples were unsustainable, relatively sustainable and sustainable respectively.

Table 3: Multivariate regression analysis (Sustainability of greenhouse culture as dependent variable)

Step	Parameter	Tolerance	VIF	R	R^2	Adjusted R^2	F
1	Greenhouse's size	0.920	1.087	0.443[a]	0.196	0.191	**36.668
2	Area under biologic control	0.990	1.010	0.575[b]	0.331	0.322	**36.863
3	Knowledge of sustainable Agriculture	0.955	1.047	0.654[c]	0.428	0.417	**36.949
4	Attitude toward sustainability	0.930	1.075	0.697[d]	0.486	0.472	**34.750
5	Number of skilled Worker	0.890	1.123	0.725[e]	0.526	0.510	**32.400
6	Job satisfaction	0.921	1.085	0.749[f]	0.562	0.543	**30.040
7	Information seeking behavior	0.944	1.059	0.769[g]	0.592	0.572	**29.843
8	Greenhouse's old	0.910	1.098	0.793[h]	0.629	0.608	**30.330
9	Personal investment	0.817	1.223	0.802[i]	0.643	0.621	**28.471

**p<0.01. *p<0.05.

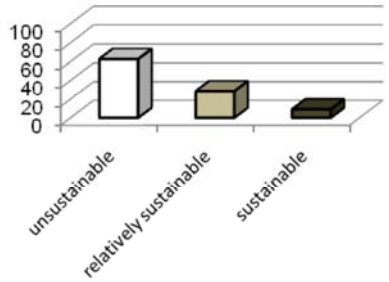

Fig. 1: Environmental Sustainablety

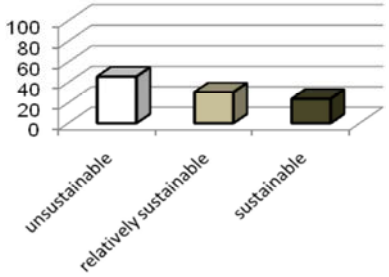

Fig. 2: Economical Sustainablety

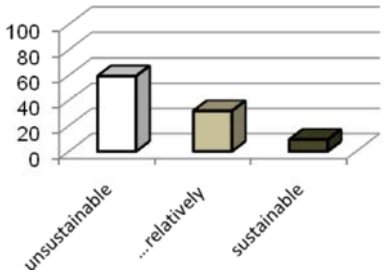

Fig. 3: Social Sustainablety

Table (3) shows the result for regression analysis by stepwise method. Sustainability of greenhouse culture was entered as dependent variable. The result indicates that 9 entered variable could explain 64.3% variance in sustainability.

Among these variables, "area of greenhouse" (Beta coefficient: -0.416, sig.: 0.000) had more effect on sustainability than other variable (Table 4)

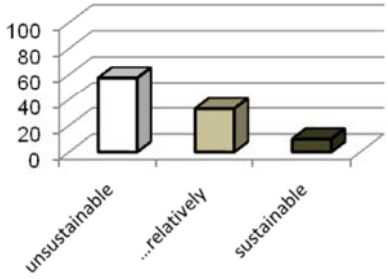

Fig. 4: Total Sustainablety

Table 4: Regression coefficients entered in mo

Parameter	B	Beta	t	Sig
Constant	-3.029		-1.137**	0.000
Greenhouse's size	-0.647	-0.416	8.045**	0.000
Area under biologic control	0.201	0.176	-3.132**	0.002
Knowledge of sustainable Agriculture	0.327	0.157	2.731**	0.007
Attitude toward sustainability	0.290	0.249	4.719**	0.000
Number of skilled Worker	-0.831	-0.199	-3.640**	0.000
Job satisfaction	0.685	0.191	3.670**	0.000
Information seeking behavior	0.141	0.252	4.588**	0.000
Greenhouse's old	0.083	0.150	2.569*	0.011
Amount of personal investment	1.501	0.148	2.381*	0.019

**p<0.01. *p<0.05.

Regard to result and Table 4, linear equation derived from stepwise regression analysis is as follow:

$$y = -3.029 - 0.647\,x_1 + 0.201\,x_2 + 0.327\,x_3 + 0.290\,x_4 - 0.831\,x_5 + 0.685\,x_6 + 0.141\,x_7 + 0.083\,x_8 + 1.501\,x_6$$

Which:

Y= sustainability of greenhouse culture, x_1= Greenhouse's size, x_2= Area under biologic control, x_3= Knowledge of sustainability, x_4= Attitude toward sustainability, x_5= Number of skilled Worker, x_6=Job satisfaction, x_7= Information seeking behavior, x_8= Greenhouse's old and x_6= Amount of personal Investment

CONCLUSIONS

Sustainable agriculture as a practice that meets current and long-term needs for food, fiber and other related needs of society while maximizing net benefits through conservation of resource to maintain other ecosystem services, functions and long-term human development[19]. In other words, to be sustainable, an activity must be viable from both an economic and an environmental point of view, fair at the economic and social level and tolerable from the social and environmental point of view [20].

Greenhouse cultivation system, as one of the manifestations of industrialization and intensive agriculture, is already a major supplier of agricultural products around the world. However, due to the over use of resources and chemical inputs, environmental concerns emerged. Thus, regard to key roles of Alborz province as major producer of greenhouse crops in Iran, The Main purpose of this study was to assessment of sustainability in greenhouse culture and study of factors effecting. Descriptive information showed that the mean age for greenhouse owner was about 43 years. 89% of the owner was male and 49% had bachelor and above degree which indicate that education level of owner were higher than other farmer. This can be a positive point in planning for development of sustainability in greenhouse cultivation system.

Sustainability indices showed that economic viability of greenhouses were at unsatisfactory level in the research area. In terms of economic sustainability, only 23.9% of greenhouses were sustainable. Economic sustainability requires stability and profitability of farm income. So by providing the services and credit facilities and investments, financial security, purchase and guarantee timely, economic stability can increase.

Considering social sustainability, the condition was unsustainable thus; only 9% greenhouses were totally sustainable. By improving job satisfaction, access to infrastructure, increasing in technical sustainable knowledge and Improve access to information, sustainability can be increased.

In this research the environmental sustainability analysis showed that the greenhouses under study have not a good level of sustainability. By analyzing the environmental dimension, it is obvious that 62.6% of greenhouses were environmentally unsustainable. For improving environmental sustainability training courses in the field of biological pest management and Construction of organic pilot greenhouse could be useful.

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