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Research Paper

An Assessment of Management Indicators in Ornamental Plant Greenhouses

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Abstract

Greenhouse culture plays a significant role in driving the agricultural development process by providing artificial conditions for production and/or neutralizing environmental variables. Obviously, planning for developing this production system requires understanding effective and limiting variables. Accordingly, the present study was conducted in 2018 in order to evaluate management indicators of ornamental plant greenhouses in Guilan province, Iran. The research was an applied study in a survey design in which data were collected with a questionnaire. The statistical population was composed of 107 selected greenhouses of which 84 greenhouses were taken by simple randomization technique using Cochran's formula. Data were statistically analyzed by mean, standard deviation, linear regression, the Kolmogorov-Smirnov test, and one sample t-test in the SPSS.21 software package. The results of t-test revealed a significant positive relationship of individual skill and knowledge with optimum management of the selected greenhouses. Also, a significant positive relationship was observed between individual attitude to sustainable development and optimum management of the selected greenhouses and between management technical and professional indices and the optimum performance of the selected greenhouses.

Keywords: Assessment, Greenhouse, Managerial indices, Rasht County.

INTRODUCTION

Given climate change and growing environmental constraints upon the production of flowers and ornamental plants in Iran, it is growingly recommended to apply modern intensive agriculture and greenhouse planting practices. This technique will allow more production from less area owing to the use of more desirable planting medium and improved management practices. This higher productivity is, indeed, an advantage of this method so that yields can be increased by even ten folds (Barton, 2003). Another advantage of this technique is off-season crop production, which boosted initial investments in this system.

Clearly, the knowledge as to how to manage these systems should also be spread in parallel. However, the construction of greenhouses has some drawbacks such as excessive energy use and low efficiency. This is especially a case in Iran. Producers consume high rates of energy for crop production and this is even higher with higher wastage in Iran because farmers are provided with energy subsidy. The achievement to such goals as higher production efficiency, lowest waste, and higher crop quality in greenhouses can be made possible by continuous improvement of production knowledge and skills (Barton, 2003).

Productivity indices can be enhanced by technical and economic management of greenhouse utilization units and the recruitment of experts (Fakoya *et al*., 2007). It should be noted that the only way for commercial production of plants with a high quantity and quality and the viability of this profession that needs relatively high initial investment is that producers observe all scientific, practical and economic principles of greenhouse construction and provide the plants with optimal growth conditions by sound and technical management so that crops with a high quantity and quality that can be marketed in global marketplaces are produced. Any failure and inattention, e.g. inappropriate location of the greenhouse, unsuitable cover and skeleton, lack of required equipment, and above all, lack of sound and technical management practices (at planting, cultivating, and harvesting phases), overuse of pesticides and chemical fertilizers, and so on, will impair the productivity of capital and facilities and will impose huge losses to producers (Liu *et al*., 2007).

The management of a flower and ornamental plant production greenhouse is composed of three phases (Worley, 2011). The first phase is the management of greenhouse construction. This encompasses locating a construction site and selecting structure, equipment, and facilities. The second phase is related to the technical management of the greenhouse, including the selection of flower and ornamental plant species, planting method, and all technical management practices to improve production quantity and quality. The third phase is related to financial management, investment, and the marketing of flowers and ornamental plants (Hulsbergen *et al*., 2002).

Obviously, managerial indices of a greenhouse management practitioner can play a significant role in the viability of the system (van Thanh and Yapwattana Phun, 2015). These indices are composed of personal, economic, social and technical characteristics that can improve the productivity of a greenhouse. The present study aims to study the status quo of flower and ornamental plant greenhouses in order to evaluate managerial indices and provide approaches to improve the performance of greenhouse units. So, it tries to answer the question as to how effective best management practices are in improving the performance of flower and ornamental plant greenhouses.

MATERIALS AND METHODS

Greenhouse refers to an enclosed space whose environmental conditions can be controlled to provide appropriate conditions for plant growth in different regions and seasons (Kittas *et al*., 2012). By this definition, a greenhouse is said to perform well if it can produce flowers and ornamental plants at a very high quantity and quality in accordance with the requirements of a target market. Meeting environmental requirements of a flower or ornamental plant (technical management) and making maximum profit requires optimum management. The present study evaluates managerial indices including personal, skill, technical, and economic characteristics.

The statistical population is composed of all greenhouse owners and practitioners in Guilan province, Iran that amount to 107 individuals (N=107) according to the statistics of Jihad-e Agriculture Organization of Guilan in 2018. Eighty-four individuals were randomly selected using Cochran's formula as follows:

$$n = \frac{Nt^2 pq}{Nd^2 + t^2 pq}$$

in which *n* represents sample size, *N* represents statistical population size, *t* is the percent of the standard error of the acceptable coefficient of confidence, *p* denotes the proportion of a population that lacks a certain trait, *q* is 1 - *p*, and *d* shows the optimal confidence level or desirable level of precision (Adeola, 2010).

According to the above equation, if one wants to determine the sample size with a population gap of 0.5 (i.e. a half of the population possess the trait in question and the other half lacks it), then *p* and *q* are set at 0.5. The *z* value is usually 96.1, and *d* can be 0.01 or 0.05. So, we have:

$$n = \frac{107(1.96)^2 p.q}{107(0.05)^2 + (1.96)^2 (p.q)} = \frac{107 \times (1.96)^2 \times 0.5 \times 0.5}{107 \times (0.05)^2 + (1.96)^2 \times 0.5 \times 0.5} = 83.8606$$

Data were collected with a questionnaire in survey design. The questionnaire encompassed the variables listed in table 1.

Table 1. The variables included in the questionnaire.

Variable	Item number
Planting management	1-7
Technical	8-13
Personal skill and knowledge	14-18
Labor management	19-21
Market and sale management	22-25
Sustainable development management	26-28

Source: Research findings.

The items of the questionnaire were scored on a five-point Likert scale in which 1 = very low, 2 = low, 3 = moderate, 4 = high, and 5 = very high.

Cronbach's alpha shows the group proportionality of the items that measure a construct. The alpha range of 0.7-1 is excellent, 0.4-0.7 is good, and <0.4 is weak.

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} S_i^2}{s^2}\right)$$

in which *k* is the number of items, S^2 is the overall variance of items, is the variance of individual items (Aceleanu, 2016).

Cronbach's alpha was estimated at 0.896. The data were analyzed by statistical (descriptive and inferential) techniques including mean and standard deviation in the descriptive section and the one sample t-test in the inferential section to support or refute the hypotheses. Also, the linear regression technique was used to evaluate managerial indices in greenhouse units. All data were processed using the SPSS.21 Software Package.

RESULTS

The management practices of the greenhouse units were studied by seven managerial indices. The results are presented in table 2. The frequency distribution of these indices from the perspective of the respondents shows that the index 'management of crop selection' was perceived by greenhouse owners to be the top priority in planting management for greenhouse performance improvement. It obtained a mean of 7.4 and a standard deviation (SD) of 0.554.

Table 2. Frequency, mean and standard deviation of planting management indices.

Indices	Frequency percentage of items					Mean	SD
	Very high	High	Moderate	Low	Very low		
Knowledge of crop planting time	22.6	67.9	9.5	0	0	4.13	0.554
Crop selection management	57.1	42.9	0	0	0	4.57	0.497
Use of planting technology	46.4	40.5	13.1	0	0	4.33	0.699
High knowledge of managers about pest and disease control	34.5	48.8	16.7	0	0	4.17	0.696
High knowledge about irrigation methods	16.7	42.9	40.5	0	0	3.76	0.721
High knowledge about fertilization	46.6	35.7	17.7	0	0	4.30	0.744
High knowledge about seed selection	40.5	53.6	6.0	0	0	4.54	0.609

Source: Research findings.

The indices for greenhouse management included 'technical management', 'personal skill and knowledge', 'labor management', 'market and sale management', and 'sustainable development management'. These indices were divided into some sub-indices whose frequencies are reported in table 3.

The index 'personal skills and knowledge' was studied by six variables. The frequency distribution shows that the index 'the academic specialty of greenhouse owners' (mean = 4.85; SD = 0.352) was perceived by the respondents to be the most important sub-index in improving greenhouse performance. The index 'labor management' was studied in the greenhouses with three variables whose frequency distribution shows that the sub-index 'continuous monitoring of personnel by greenhouse managers' (mean = 4.58; SD = 0.506) was voted by the respondents to have the most important role in improving the performance of the greenhouses. Four variables were considered to study the index 'market and sale management'. According to the frequency distribution of these four variables, 'crop marketing' (mean = 4.63; SD = 0.617) was found to be the top priority in improving the performance of the greenhouses. The index 'sustainable development management' was examined in the context of three variables. The frequency distribution derived from the respondents' responses showed that the sub-index 'the use of environmentally-friendly practices' (mean = 4.51; SD = 0.720) was the top priority in improving the performance of the greenhouses.

Table 3. Frequency, mean and standard deviation of managerial indices.

Indices	Frequency percentage of items					Mean	SD
	Very high	High	Moderate	Low	Very low		
Technical management							
Management of structure, bed preparation, and greenhouse construction	40.5	53.6	6	0	0	4.34	0.590
Greenhouse cover management	44	27.4	28.6	0	0	4.15	0.843
Greenhouse area and planting area	28.6	38.1	33.3	0	0	3.95	0.790
Heating system type	29.3	60.7	0	0	0	4.39	0.491
Correct irrigation system	23.8	64.3	11.9	0	0	4.11	0.589
Applied implements and machinery	64.3	7.1	28.6	0	0	4.35	0.800
Personal skill and knowledge							
Academic specialty of greenhouse owners	85.7	14.3	0	0	0	4.85	0.352
Work experience of greenhouse owners	25	66.7	8.3	0	0	4.16	0.556
Attendance in extension courses	31	8.3	20	10.7	0	3.59	1.04
The use of experiences and knowledge of others	27.4	11.9	45.2	15.5	0	3.51	1.05
The use of professional engineers and labor in greenhouse	0	63.1	36.9	0	0	3.63	0.485
Labor management							
Technical training of personnel	21.4	59.5	19	0	0	4.02	0.640
Appropriate payment to personnel	71.4	58.6	0	0	0	4.71	0.454
Continuous monitoring of personnel by greenhouse managers	58.3	41.7	0	0	0	4.58	0.506
Market and sale management							
Cash purchase of inputs	15.5	19	41.7	23.8	0	3.26	0.995
Forward sale of crops	28.6	33.3	38.1	0	0	3.90	0.816
Crop marketing	70.2	22.6	7.1	0	0	4.63	0.617
Low-interest facilities	70.2	26.2	3.6	0	0	3.67	0.545
Sustainable development management							
Appropriate planting area of greenhouse with respect to management potential	23.8	60.7	15.5	0	0	4.08	0.625
The use of environmentally-friendly practices	64.3	22.6	13.1	0	0	4.51	0.720
Biological control of greenhouse to reduce pest damages	34.5	35.7	29.8	0	0	4.05	0.805

Source: Research findings.

Table 4. Analysis of linear regression of greenhouse management indices.

Model	B	SE.B	Beta	t-statistic	Sig.
y-intercept	1.085	0.102	0.956	10.620	0.000
Planting management index	0.708	0.24		29.655	0.000
y-intercept	1.550	0.183	0.619	8.458	0.000
Technical index	0.629	0.042		14.812	0.000
y-intercept	0.284	0.223	0.691	1.271	0.204
Skills and knowledge of managers	0.973	0.054		17.941	0.000
y-intercept	1.215	0.081	0.969	14.947	0.000
Labor management	0.650	0.018		35.961	0.000
y-intercept	1.774	0.167	0.841	10.651	0.000
Market and sale management	0.620	0.044		14.059	0.000
y-intercept	1.994	0.69	0.959	28.771	0.000
Sustainable development management	0.500	0.016		30.697	0.000

Source: Research findings.

The role of each individual managerial index in improving the performance of the selected greenhouses was examined by linear regression. The regression analysis revealed that the standardized coefficient of the index 'planting management' with a value of 0.24 had a t-statistic of 29.655. Its significance level was not only smaller than 0.05 but also smaller than 0.01. So, the linear relationship between the variables was confirmed. Also, the index 'planting management' with a regression coefficient of 0.956 had an effective role in improving greenhouse performance. The standardized coefficient of the technical index with a value of 0.042 had a calculated t-statistic of 14.812. Its significance level was smaller than 0.01. This confirms the linear relationship between the variables. Also, Table 4 shows that 'technical management' with a regression coefficient of 0.619 had a significant role in improving greenhouse performance. Also, the standardized coefficient of the index 'personal skill and knowledge of managers' with a value of 0.054 had a calculated t-statistic of 17.941. Its significance level was observed to be smaller than not only 0.05 but also 0.01. So, the linear relationship between the variables was confirmed. Similarly, Table 4 shows that the index 'personal skill and knowledge of managers' that had a regression coefficient of 0.691 played an effective role in improving the performance of greenhouses.

The standardized coefficient of the index 'labor management' was 0.018 with a calculated t-statistic of 35.961. It significance level was smaller than 0.01, confirming the linear relationship between the variables. In addition, showing a regression coefficient of 0.969, the index 'labor management' plays a significant role in improving the performance of greenhouses (Table 4). With respect to the index 'market and sale management', the standardized coefficient was found to be 0.044 with a t-statistic of 14.059. Its significance level was, also, smaller than 0.01. This means the confirmation of the linear relationship between the variables. In addition, the index 'market and sale management' showed a regression coefficient of 0.841, implying its significant role in improving the performance of greenhouses (Table 4). The standardized coefficient was estimated at 0.016 for the index 'sustainable development management' with a t-statistic of 30.697. Its significance level was smaller than 0.01. This confirms the linear relationship between the variables. Also, the regression coefficient of 0.959 for the index 'sustainable development management' (Table 4) implied the significant role of this index in improving the performance of greenhouses.

Normal distribution of the data was checked by the nonparametric Kolmogorov-Smirnov test. The results in table 5 present that the error level is >0.05 for all variables. The results imply the normality of data for all six studied variables.

At the next step, the parametric one sample t-test was run to estimate the role of the managerial indices on performance improvement of greenhouses. The numerical optimum level was set at 3 considering the average spectral range of the components that fluctuated in the range of very low (1) to very high (5) based on the Likert scale.

Table 5. Results of Kolmogorov-Smirnov test for research variables.

Nominal names	Number	Mean	SD	Test statistic	Error level
Planting management	84	4.26	0.381	2.675	0.241
Technical management	84	4.22	0.430	2.364	0.130
Personal skill and knowledge	84	3.71	0.455	2.230	0.070
Labor management	84	4.44	0.375	2.154	0.97
Market and sale management	84	3.75	0.446	2.206	0.086
Sustainable development management	84	4.21	0.488	2.82	0.102

Source: Research findings.

DISCUSSION

Greenhouse production constitutes an important part of the agricultural sector that producers use to ensure minimum use of production resources and earn an adequate income. Because of its specific climatic conditions and limitations of its water resources, Iran urgently requires a fundamental restructuring of its cropping system. In this respect, greenhouse development is a possible approach that is now interested in by many.

The present study evaluated six managerial indices, as well as their sub-indices, with statistical techniques. According to the findings for frequency distribution of managerial indices from greenhouse owners' perspective, the performance of greenhouses is most effectively influenced by the sub-index 'management of crop selection' (mean = 4.7; SD = 0.554) from the index 'planting management', the sub-index 'heating system type' (mean = 4.39; SD = 0.491) from the index 'technical management', the sub-index 'the academic specialty of greenhouse owners' (mean = 4.85; SD = 0.352) from the index 'personal skill and knowledge of managers', the sub-index 'continuous monitoring of personnel by greenhouse managers' (mean = 4.58; SD = 0.506) from the index 'labor management', the sub-index 'crop marketing' (mean = 4.63; SD = 0.617) from the index 'market and sale management', and the sub-index 'the use of environmentally-friendly practices' (mean = 4.51; SD = 0.720) from the index 'sustainable development management'.

As well, the results of linear regression of the research variables indicated that the indices 'planting management' (regression coefficient = 0.956), 'technical management' (regression coefficient = 0.691), 'labor management' (regression coefficient = 0.969), 'market and sale management' (regression coefficient = 0.841), and 'sustainable development management' (regression coefficient = 0.959) were influential on improving the management status of greenhouses in Rasht county. Hypotheses testing by one sample t-test, on the other hand, showed a significant positive relationship between 'personal skills and knowledge' and optimum management of the selected greenhouses. Similarly, a significant positive relationship was observed between sustainable development and optimum management and between managers' technical and professional indices and optimum performance of the selected greenhouses. The results of the present study are in agreement with Rahmany *et al.* (2012), Adib and Rousta (2015), and Rajabi Tehrani *et al*. (2017).

RECOMENDATION

Given the role of education in improving the performance of a greenhouse and its impact on better management of the greenhouse, it is recommended to use people majored in agriculture from universities as supervisors of greenhouses or to delegate a part of management tasks in greenhouses where the management practitioners do not have specialty to these experts.

Since an important index in greenhouse management is to consider sustainable development managerial indices, it is recommended to agriculture policymakers and officials to provide greenhouse owners with such equipment as pest hunting traps and sticky plates, natural pest predators (bracon), and organic herbicides like biturin.

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