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# *Evaluation and Analysis of Monitoring of Productivity of Greenhouse Cucumber in Yazd Province*

**Seyyedasghar Nabavizadeh chakeri[1]*, Mohammadreza Eslami[2], Mansour Kalantar[2]**

*[1]Department of Agriculture, Yazd Branch, Islamic Azad University, Yazd, Iran.*
*[2]Associate Professor, Department of Agriculture, Yazd Unit, Islamic Azad University, Yazd, Iran*
*[*]E-mail: seyedasghar_nabavizade@yahoo.com*

## ABSTRACT

*In this context, factors such as low productivity of factors of production, inefficiency and weak management of production units and research aimed to analyze the productivity of greenhouse cucumber in relation to units of Yazd province. This study examines the state of efficiency in greenhouse of Yazd province and by measuring the total productivity of factors of production in these units, increasing productivity and efficiency in these units is trying to be. To measure the efficiency of production factors on greenhouse cucumber in Yazd province, of 4006 units greenhouse the province in 1395 of 30 manufacturing units in the all cities and data finds them to dubel production priod 200 days were collected based on the obtaind data, total factor productivity was measured. The result showed that mean changs without changing in management efficiency (PECH=1) and is equal to 1, mean change in a negative scal efficiency(SECH<1) and the 0.914, mean changes in a positive changing Tecnology (TECHCH>1) and is equal to 1.598. It also produced positive total factor productivity (TFP>1) and is aqual to 1.461. Analysis of the results showed a significant reduction in the amount of 7 % growth rate of management chang, reduce averge growth rate of 16 % chang in scal efficiency and reducsd the rate of growth of total factor productivity has been producsd at a rate of 45 % over the period. The average changes in Tecnological efficiency remains unchanged. The highest rate of growth to total factor productivity during the period under review to Khatam city and Yazd city is the lowest. TFP growth during the period under review reflects the production in productivity priods of this product has not beet better.*

**Key words:** *Productivity Indices, Total Factor Productivity, Malmquist Index, Greenhouse Cucumber, Yazd.*

## INTRODUCTION

Nowadays, the productivity is the best and most effective method for the access to the economic development with regard to the scarcity of production recourses. The level of performance efficiency of different economic sections in the use of production recourses can be surveyed by the calculation and analysis of productivity indices of production factors. Among the economic sections of a developing country, the agriculture section as a factor in facilitating the process of growth and development is of special importance. The access to the sustainable agricultural growth is of fundamental issues with which the countries encounter. This kind of growth is resulted in the food security, job creation, sustainable development, environmental protection and so forth. Despite the technological transformations, the most developed industrial countries (America, japan and Europe union) regard the development of agriculture section not only the complement of industry section but also they evaluate the importance of food production in connection with their national security, too. At present, because of playing vital role in providing the food needed in the country, the agriculture and natural recourses section is considered as one of the most important economic sections of the country. In Iran, planning for the agricultural development follows the goals such as increasing the production capacity of agriculture section, increasing the farmers' income, prevention of migration, decreasing the income difference between city and village, agricultural mechanization and so on. If we take an exact look at these

goals, being lower of the performance of production level in the agriculture section is one of the most significant agricultural problems in Iran. So, the development of this section needs the increase of production which is obtained by two ways :

One is the increase of production by further application of production factors with assumption of fixed technology and, the other method is applying developed technical knowledge in production sections. The later has been knotted with the concept of productivity. The increase in the productivity of production factors causes the reduction of costs at each output unit. So, it emphasizes on further production of the products and paves the way for the competition in the global markets ; the reduction of costs and further production increase the farmers' income and pave the way for further investment on the agriculture. Among the agricultural sections, the greenhouse products section, as one of the biggest purveyor recourses of society food and the place for engagement of noticeable group of workforce who work in this section and because of its use of considerable area of farms under cultivation and so forth, is of special significance and this research aims to evaluate the productivity in this section in Yazd province from 2013 to 2016 and identify the factors effective on the productivity changes in this subsection so that it could take steps to make progress in proper decision- making to reach the development goals and improve the agriculture section of the country by presenting a scientific method. It's worth mentioning that with regard to the study of each city as a decision- making unit (DMU), a homogeneous assumption is considered for the cities. The main purpose of the present research is the analysis of productivity of production factors of cucumber greenhouses in Yazd province. Many studies have been done in regard of evaluation of productivity of agricultural products to some of which we refer :

Abedi Parijani et al., (2016) in a research titled " study of total factor productivity and factors effective on it at silkworm breeding units of Mazandaran province" found that the average of total factor productivity in Mazandaran province has been %87 and the factors such as motivation, applying scientific findings and innovation have had relationship with the level of productivity (at level of 95 percent) [1]. Also, in the research done by Teymouri (2016) about the study of role of educated workforce in the growth of total factor productivity in the agriculture section of Iran from 1981 to 2013, the results revealed that the educated workforce, in short term, had meaningful effect on the growth of total factor productivity in the agriculture section [2]. Behrouz et al., (2014), by evaluating the technical, allocative and economic efficiency and the productivity of watermelon by the use of Malmquist productivity index in 12 provinces of the country from 2005 to 2010, revealed that the average of technical, allocative and economic efficiency of the producers of watermelon during the studied period has been 79.4 percent [3]. Also, the average of allocative and economic efficiencies has been 75.9 and 61.5 percent, respectively. Taki et al., (2012) in a research titled "analysis of efficiency of energy of greenhouse cucumber with use of Data Envelopment Analysis in Shahreza", concluded that the average of technical efficiency, net technical efficiency and scale efficiency were estimated 90.37, 95.09 and 94.6, respectively [4]. Also, the average of technical efficiency of inefficient units based on the Constant Returns to Scale Table was calculated 87 percent. Amus (2007) studied the efficiency and technological changes of farmers of Nigeria by applying Cobb- Douglas Production Function with the use of compost (kg), poison (kg), pruning costs and pesticide costs as inputs and the production of cocoa as output and concluded that the level of education and age of the farmers and the number of family members are of factors effective on the efficiency [5]. Covaci (2006) has studied the growth and productivity of wheat in Slovakia [6]. By applying the Malmquist method, he has concluded that the quality of outputs has close relationship with the quality of inputs and has experienced a positive productivity growth during the time period and the climate conditions has been most effective factor on the function of wheat production. Coelli (2006) has studied the growth of productivity of total factors in the agriculture of Belgic by Malmquist index [7]. He has studied 1728 farms (more than 100 farms every year) ; the inputs are land, capital, labor and so on ; the outputs are corn and the other products. He concluded that the average of growth of productivity for each year is about one percent and the small farms have lower level of productivity growth. Adtola and Sam'on (2013), in economic study of breed of broiler chicken, showed that the chickweed and workforce were the most important inputs effective on the production of each of the three breeds Marshal, Hubbard and Aryour. Furthermore, the average productivity of input of chickweed in these three breeds has been %39, %38 and %37, respectively ; and the average productivity of workforce has been 3.9, 3.62 and 3.62, respectively.

**MATERIALS AND PROCEDURES**

The intended study was done with the purpose of analysis of total factors productivity of cucumber greenhouses in Yazd province. The questionnaire and interview done with 300 producers based on systematic sampling method were the tools of collection of research data. By evaluating the total factor productivity in the mentioned units, the present research aims to pave the way for the increase of productivity and efficiency in the cucumber greenhouses. The cucumber greenhouses of Yazd province are the statistic population of present research. The intended information has been collected by the library method, internet and also the statistics existing in the information banks of ministry of agriculture.

The Data Envelopment Analysis (DEA) has been selected for doing the research. The data envelopment analysis is a non- parametric method which determines, with the help of planning, the frontier of efficiency of decision- making units (DMU) that have similar inputs and outputs. A favorable mathematic form is used in the parametric methods, while a clear and special perception is provided in data envelopment analysis method for different decision- making units (DMU) and despite the parametric methods which emphasize just on the parameters of the society, it is paid more attention to the features of all the observations. This model is based on some optimizations by the use of linear planning. In this model, the efficient frontier curve is created by some points determined by the linear planning that this model can separate the efficient and inefficient cities from each other. In this model, in addition to the evaluation of efficiency, the productivity can be calculated for each city by the use of Malmquist index and the productivity changes can be divided into two parts of changes resulted from the efficiency and technology.

The computer software $DEAP_{2.1}$ is used for evaluating the efficiency and productivity of DEA model that calculates the efficiency by the use of data and software and then measures the productivity changes by the use of Malmquist index. The software outputs are four distance functions for each city that the total technical efficiency changes, management efficiency changes, scale efficiency changes, technological changes and total factor productivity changes have been calculated.

## RESEARCH FINDINGS

### Calculated efficiency

At first, the technical efficiency has been calculated by the use of DEAP2.1 software. As it is observed in Table 1, the average of net technical efficiency of product- city during the crop years 2013-16 has been 98 percent. In fact, the technical efficiency depends on the management methods that acts based on proper combination in the use of inputs. For this reason, the net technical efficiency is regarded as the management efficiency, too; and the management inefficiency in these years is 2 percent.

The scale efficiency refers to the optimal choice of scale size. It is observed in this table that the average efficiency of the product- city scale is 99 percent. In general, it can be said that in the state of variable efficiency in relation to the scale, the average net technical efficiency and the average scale efficiency were 98 percent and 99 percent, respectively. So, the average scale efficiency is more than the average net technical efficiency; it means, the management inefficiency is more than the scale inefficiency.

**Tabele 1.** Measurement of Efficiency of Product- City, In Conditions of Efficiency Variable as Compared with The Scale with Assumption of Maximization of Product During Crop Years 2013- 16

| Product- city | Technical efficiency of fixed output | Technical efficiency of variable output | Scale efficiency | Kind of scale |
|---|---|---|---|---|
| Greenhouse cucumber of Abarkouh | 0.956 | 0.957 | 0.999 | Increasing rating scale |
| Greenhouse cucumber of Ardakan | 0.997 | 1.000 | 0.997 | Increasing rating scale |
| Greenhouse cucumber of Ashkzar | 0.997 | 0.999 | 0.999 | Decreasing rating scale |
| Greenhouse cucumber of Bafgh | 0.997 | 1.000 | 0.997 | Increasing rating scale |
| Greenhouse cucumber of Taft | 0.996 | 0.997 | 0.999 | Decreasing rating scale |
| Greenhouse cucumber of Khatam | 0.968 | 0.968 | 0.999 | Increasing rating scale |
| Greenhouse cucumber of Mehriz | 1.000 | 1.000 | 1.000 | Fixed |

| | | | | |
|---|---|---|---|---|
| Greenhouse cucumber of Meybod | 0.927 | 0.929 | 0.998 | Increasing rating scale |
| Greenhouse cucumber of Yazd | 0.999 | 1.000 | 0.999 | Decreasing rating scale |
| Average | 0.982 | 0.983 | 0.999 | |

**Optimal (target) amounts for product**

In this part, the optimal amounts for the product have been analyzed based on the findings of DEA method. The optimal (target) amounts for the product- city have been determined in Table 2. Of course, these results are based on the assumption of maximization of the product. In this table, some optimal amounts have been suggested for inefficient products- cities. For instance, if the technical and scale efficiencies of the product of Meybod city be promoted, the production of this product can be increased from 1200 to 1291.645. There has been presented no suggestion for the cities which have equal actual and optimal production ; because they produce efficiently.

**Table 2.** Optimal (Target) Amount of Product- City, In Conditions of Efficiency Variable as Compared with The Scale with Assumption of Maximization of Product

| Product- city | Actual production | Optimal production |
|---|---|---|
| Greenhouse cucumber of Abarkouh | 1840 | 1923.583 |
| Greenhouse cucumber of Ardakan | 725 | 810.184 |
| Greenhouse cucumber of Ashkzar | 84000 | 84112.209 |
| Greenhouse cucumber of Bafgh | 750.000 | 750.000 |
| Greenhouse cucumber of Taft | 30300 | 30402.907 |
| Greenhouse cucumber of Khatam | 2300 | 2347.962 |
| Greenhouse cucumber of Mehriz | 20400.000 | 20400.000 |
| Greenhouse cucumber of Meybod | 1200 | 1291.654 |
| Greenhouse cucumber of Yazd | 206400.000 | 206400.000 |

**Determination of target groups by DEA method**

For any efficient product- city which is regarded as a member of target group, one weight is allocated in such a way that the share of each efficient product- city in the formation of pattern (reference) product- city for an inefficient product- city depends on the given weights ; because the improvement of conditions of each inefficient product- city is provided with regard to the combination of these weights. If a product- city be efficient, the sum of its references would be the same product- city. The amounts of these weights for all the cities have been presented in Table 3.

**Table 3.** Determination of Target (Reference) Products- Cities in Conditions of Efficiency Variable as Compared with the Scale with Assumption of Maximization of Product

| Row | Product- city | Target product- city | | | Weight of target product- city | | |
|---|---|---|---|---|---|---|---|
| 1 | Greenhouse cucumber of Abarkouh | 7 | | | 0.094 | | |
| 2 | Greenhouse cucumber of Ardakan | 7 | | | 0.40 | | |
| 3 | Greenhouse cucumber of Ashkzar | 7 | | | 4.128 | | |
| 4 | Greenhouse cucumber of Bafgh | 7 | | | 0.037 | | |
| 5 | Greenhouse cucumber of Taft | 7 | | | 1.491 | | |
| 6 | Greenhouse cucumber of Khatam | 7 | | | 0.117 | | |
| 7 | Greenhouse cucumber of Mehriz | 7 | | | 1.000 | | |
| 8 | Greenhouse cucumber of Meybod | 7 | | | 0.063 | | |
| 9 | Greenhouse cucumber of Yazd | 7 | | | 10.133 | | |

**Ranking product- city with unique efficiency**

In this part, the rank of each product- city has been specified by the target group technique in Table 4 ; it means any product- city which is placed more in the similar groups is more efficient and can be introduced as more optimal pattern. According to the results of efficiency as compared with the scale, the product- city of Mehriz (greenhouse cucumber of Mehriz) with 8 times repetition has been introduced as the best pattern.

**Table 4.** Efficient Product- City Order

| Row | Efficient product- city order | Repetition times as a pattern |
|---|---|---|
| 1 | Greenhouse cucumber of Mehriz | 8 |

**Study of total factor productivity and its components based on Malmquist method**

In this research, the Malmquist index has been applied for the calculation of the productivity. The productivity involves the technology changes in addition to the efficiency changes. The product- cities which are technically efficient may increase their productivity by the use of profits resulted from the scale or the change of technology. So, according to the relations of fourth chapter, the productivity changes can be calculated as following :

Technological Changes (TechCh) × total technical efficiency Changes (EffCh) = total factor productivity changes (TfpCh)

And

Scale efficiency Changes (SeCh) × management efficiency Changes (pech) = total technical efficiency changes (Effch)

And

Technological Changes (TechCh) × scale efficiency changes (Sech) × management efficiency changes (pech) = total factor productivity changes (TfpCh)

If each component of the Malmquist index based on the maximization of product be lower than 1, it means being worsen of the product- city performance and if it be more than 1, it would be indicative of improvement of product- city performance.

**Average of technical efficiency changes of greenhouses of Yazd province during 2013- 2016**

According to Table 5, the average of technical efficiency changes of all the cucumber greenhouses of Yazd province from 2013 to 2015 has been developed 30 percent and the average development in the crop year 2015- 2016 has been -41 percent.

The average of technical efficiency changes of greenhouses of province during the intended period had a positive growth just in Khatam city (44 percent) and it was fixed in Bafgh city and it had a negative growth in the other cities.

**Table 5.** Comparison of Total Technical Efficiency Changes During The Studied Years

| Cities | Second year (2014) | Third year (2015) | Fourth year (2016) |
|---|---|---|---|
| Abarkouh | 0.689 | 0.846 | 0.936 |
| Ardakan | 0.900 | 1.036 | 0.857 |
| Ashkzar | 1.000 | 1.245 | 0.944 |
| Bafgh | 1.000 | 1.000 | 1.000 |
| Taft | 0.990 | 0.967 | 0.999 |
| Khatam | 0.548 | 0.593 | 0.787 |
| Mehriz | 0.955 | 0.973 | 0.973 |
| Meybod | 0.870 | 1.022 | 0.916 |
| Yazd | 0.979 | 10.454 | 0.099 |
| Average | 0.861 | 1.231 | 0.721 |

**Average of technology efficiency changes of greenhouses of Yazd province during 2013- 16**

According to the Table 6, the average of technology efficiency changes of greenhouses of Yazd province during 2013- 2016 has been deceased 35 percent. The most and the least amount of reduction of technology changes of greenhouses of the province during the intended period are related to Abarkouh city (36 percent) and Taft city (18 percent), respectively.

**Table 6.** Comparison of Total Technology Efficiency Changes During The Studied Years

| cities | Second year (2014) | Third year (2015) | Fourth year (2016) |
|---|---|---|---|
| Abarkouh | 2.069 | 1.500 | 1.333 |
| Ardakan | 2.034 | 1.500 | 1.333 |
| Ashkzar | 2.034 | 1.500 | 1.333 |
| Bafgh | 2.034 | 1.500 | 1.333 |
| Taft | 2.032 | 1.500 | 1.333 |
| Khatam | 2.040 | 1.500 | 1.333 |
| Mehriz | 2.034 | 1.500 | 1.333 |
| Meybod | 2.056 | 1.500 | 1.333 |
| Yazd | 2.034 | 1.500 | 1.333 |
| Average | 2.041 | 1.500 | 1.333 |

**Average of total productivity changes of greenhouses of Yazd province during 2013- 16**

According to Table 7, the average of total factor productivity changes in cucumber greenhouses of Yazd province has considerable growth from 2013 to 2015 and it has been decreased 48 percent in the crop year 2015- 16. The most and the least amount of reduction of total factor productivity changes in the greenhouses of the province during the intended period are related to Yazd city (93 percent) and Khatam city (6 percent), respectively.

**Table 7.** Comparison of Total Factor Productivity Changes in Greenhouses of Yazd Province During The Studied Years

| cities | Second year (2014) | Third year (2015) | Fourth year (2016) |
|---|---|---|---|
| Abarkouh | 1.426 | 1.269 | 1.248 |
| Ardakan | 1.831 | 1.554 | 1.143 |
| Ashkzar | 1.938 | 1.876 | 1.259 |
| Bafgh | 2.034 | 1.500 | 1.333 |
| Taft | 2.012 | 1.450 | 1.331 |
| Khatam | 1.117 | 0.890 | 1.049 |
| Mehriz | 1.934 | 1.459 | 1.298 |
| Meybod | 1.788 | 1.533 | 1.221 |
| Yazd | 1.991 | 15.680 | 0.132 |
| Average | 1.757 | 1.847 | 0.961 |

**Average of total factor productivity indices changes**

Finally, the Table 8 presents the average of total factor productivity changes in the greenhouses of Yazd province during the crop years 2013 to 2016 (Malmquist index).

**Table 8.** Average of Total Productivity Indices Changes in Greenhouses of Yazd Province During The Crop Years 2013- 16 (Malmquist Index)

| Year | Technical efficiency changes (Effch) | Technology changes (Techch) | Management efficiency changes (Pech) | Scale efficiency changes (Sech) | Total factor productivity changes (Tfpch) |
|---|---|---|---|---|---|
| second | 0.861 | 2.041 | 1.000 | 0.861 | 1.757 |
| third | 1.231 | 1.500 | 1.000 | 1.231 | 1.847 |
| fourth | 0.721 | 1.333 | 1.000 | 0.721 | 0.961 |
| average | 0.914 | 1.598 | 1.000 | 0.914 | 1.461 |

**DISCUSSION AND CONCLUSION**

The amount of total factor productivity in the crop years 2014, 2015 and 2016 was 1.757, 1.847 and 0.961, respectively. This indicates that the amount of productivity in the cucumber greenhouses of the province in each year did not have positive growth ; so, the first hypothesis of this study was not verified. The amount of technology changes has had a decreasing trend during the crop years 2014 to 2016 ; so, the second hypothesis was verified. It has enjoyed an increasing trend during 2014- 15 but after that, it has had a decreasing trend ; so. The third hypothesis was not verified. The results obtained by the Econometric Method and Eviews software reveal that the investment on the greenhouses, equipment and Human Development Index (HDI) is effective on the amount of productivity. The Human Development Index has the most effect and the credits of agriculture season and equipment have the fewer effect.

**Table 9.** Summary of Results of Hypotheses Test

| Hypothesis | Year | 2014 | 2015 | 2016 | Average |
|---|---|---|---|---|---|
| first | Amount of productivity | 1.18 | 0.884 | 1.023 | 1.521 |
| second | Technological changes | 2.041 | 1.500 | 1.333 | 1.530 |
| third | Efficiency changes | 0.861 | 1.231 | 0.721 | 0.937 |

The obtained results revealed that the amount of productivity of the greenhouses in Yazd province did not have favorable growth during the intended years and the long- term planning is necessary for increasing the productivity. With regard to the role of greenhouse cultivations in providing the food needs, job creation and monetizing, the improvement of production situation is possible by paying attention to the increase of productivity. So, the following items are suggested for the increase of level of development and investment in this section :

1. Presentation of debt instruments with special conditions (in repayment and bank rate).
2. Providing and extending the insurance of agriculture products is of special importance for the reduction of risk and improvement of security level of investment in this section.
3. Prioritization of agriculture section in development of infrastructures of this section.
4. Tax exemption of producers in this section
5. Payment of subsidy and other encouragers depending on the observance of pattern of national- regional optimal cultivation.
6. Moderation of level of tariff of agricultural products imports with regard to support of internal production and observance of producers' rights.
7. Necessity of annual increase of value of guaranteed purchase of the products with regard to the inflation rate.
8. To persuade and encourage the greenhouse- holders specially the pioneer greenhouse- holders to accept and apply the new technologies (non- earth cultivation, use of automation systems and so on).
9. Necessity of use of results of studies of research institutes of the country for the extension, introduction and consumption of the improved inputs like seed for the purpose of optimal use of production factors with regard to climate conditions of the country and specially Yazd province.
10. Obligating the research institutes of the country in producing and providing more efficient inputs for the special climate conditions of the country accordant with different tastes for the access to maximum competition in the market and ultimately the increase of exports.
11. Calculation of sizes of economic units for the productions and making efforts to create these units for the economies resulted from the scale and management and better use of production recourses and applying new technologies in the production and the other services (based on instructions of greenhouse system of the country published by the ministry of agriculture in 2015, the minimum economic level of the greenhouse units of the country is 3838 square meters).
12. Establishment, collection and performance of comprehensive project of greenhouse cucumber including the education of farmers, agricultural operations, establishment of pattern greenhouses, marketing, processing industries, certification of greenhouse cucumber, mechanization of system of producers, exporters and wholesalers and the decrease of unnecessary middlemen and reduction of marketing costs and consequently the increase of market efficiency.

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