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Comparison of the Efficiency of Traditional and Industrial Milk Production Units in Khuzestan Province

M. A. Sabaghi, H. Badavi, A. R. Ommani
Respectively Assistant Professor, MSC Student and Assistant Professor of Agricultural Management Department, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran

One of the most important measures, in order to increase animal products and reduce imports, is the industrialization of animal husbandry units, specially the dairy cattle. The condition of milk production would be improved by this industrialization, which is in the direction of increasing the efficiency of milk production units. The purpose of this study is calculate , the efficiency of the traditional and industrial milk production units of Khuzestan province in 2011. The method of research was causal comparative. Data envelope analysis, in both forms of constant and variable return to scale, was used to calculate the types of efficiency. The needed information of industrial and traditional cattle houses was gained using capitation and random sampling from 384 production units, respectively. According to the results, the rate of total efficiency among the milk producers of traditional and industrial milk production units of Khuzestan is significantly different. In addition, the size of cattle house, manger`s level of education and experience, having a secondary job, animal`s race, and the production method are factors affecting the efficiency of units. **[M. A Sabaghi et al. Daily Comparison of the efficiency of traditional and industrial milk production units in Khuzestan province. International Journal of Agricultural Science, Research and Technology, 2011; 1(4):177-183].**

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1. Introduction

Food security is considered as one of the fundamental elements in providing the political, economical, and social security in most of country. Animal husbandry sector, as the provider of the most important food needs, animal protein, has a special stage in providing the society`s food security. According to the studies carried out by WHO and FAO, it is suggested that animal protein should be 50 percent of one`s daily total protein consumption. This quantity is about 28g of animal protein everyone needs per day. This quantity, is about 23g in Iran. That 20g of this quantity are provided from domestic production and 3g imports from other countries(Agriculture Statistics, 2008), These statistics shows that although the country`s per capita consumption is lower than the global standards, domestic production is not an adequate quantity for the current consumption of the country. In the other hand, increase of demand resulted from the population growth and increase of per capita consumption will widen this gap in future. This gap have caused some measures to be carried out in the country for increasing the animal husbandry units. One of the most important measures in this area is the industrialization of the animal husbandry units in the country, specially the dairy cattle houses (Iranlozadeh, 2007). Previously, cattle housing was mainly considered as a subsidiary agriculture activity but, today, it is a main activity of this sector. By using the extended genetic and animal race modification evaluations, high-producing cattle are entered in the production field. So their preservation and nurture is a scientific and professional issue (Iranlozadeh, 2007).

Statistical evaluations indicate that, until 1981s, no suitable process of industrial unit establishment and equip has been observed in the country. Since 1991, according to the new policies, theses units have shown a progressive process, as more than65 percent of the milk, according to the ministry of agriculture Jihad, in 2009, was produced in the industrial and semi-industrial units (statistical center of Iran, 2010).The limited production inputs, increase of demand for milk production and the low production of the traditional units are three reasons for substitution industrial unit instance traditional units. But the truth is that turning the traditional units into industrial ones can increase the production and reduce the gap only when this change is a step in order to increase the efficiency of using the production inputs. The importance of increasing the production efficiency in the situation of production input shortage is an issue to which several studies have been carried out in the field of efficiency calculation and identification of factors affecting it.

Shirzad Kebriyaee et al (2006), mentioned the size inefficiency as the cause of the unprofitability of Fars province`s cattle houses. Akbari etal (2007) evaluated the efficiency of animal husbandry industry using data envelope analysis approach in different Iran`s provinces. Results indicated that Ardebil and Boshehr provinces have the highest and lowest efficiency in the field of dairy cattle, respectively; in addition, Khuzestan and Chaharmahalo Bakhtiyari provinces have the highest and lowest efficiency in the field of cattle- fattening units, respectively. Kiyani Abari et al (2000) find the reasons of production reduction and the inefficiency of the production factors , evaluated and analyzed the efficiency of Isfahan province`s bee keepers. Results showed that factors such as age, literacy, number of hive, and beekeeping as a main or secondary job affect the efficiency. Candemir and Koyubenbe (2006), using data envelope analysis, studied the efficiency of 80 dairy cattle house units in Turkey .Mean of these units` efficiency indicator ,under both assumptions of constant and variable return to scale were 0/934 and 0/954 ,respectively . Yusef and Malomo (2007), using data cover analysis, evaluated the technical efficiency of egg production units in one of the Niger`s states. This study`s results showed a significant relationship between the capacity of egg production and the rate of efficiency of each unit. According to the mentioned subjects, however, evaluation of differences or indifferences in the efficiency of traditional and industrial milk production units is considered in the present study. Because of the importance of Khuzestan`s animal husbandry sector and its share in the country`s animal productions, this province`s milk production units (in 2010) were studied as the statistical society of this study.

2. Materials and methods

The method of research was causal comparative. Data envelop analysis (DEA) was used to calculate the different types of efficiency .in 1978, this method ,giving universality to Farrell method , as including production process`s feature with several production factors and several products ,was added to economical literature. Linear programming technique is used in this method and the efficiency of each unit is separately calculated by optimization. In this method, there are different measurement units for the production factors and products. In addition, DEA is able to calculate the efficiency of units with several products and inputs (Emami Mybodi, 2000). First, in this method, efficient stochastic frontier curve is defined by the linear programming and, then, the unit`s situation to this curve is evaluated. Linear programming`s theorem for this model can be written as maximizing the product with input limitation or minimizing the input with the limitation of a determined rate of product (Moazeni and Karbasi, 2008). This model is executable with the assumptions of constant return to scale and variable return to scale.

DEA model with the assumption of Constant Return to Scale (CRS)

Creatively, DEA method turns the multi-product and multi-input state into a mono-input and mono-product one. If there is information concerning the K of input and m of the product for each N of the unit, the calculation process would be as follow (Emami Mybodi, 2000):

$$\begin{aligned} &\max \ \frac{U'Y_i}{V'X_i} \\ &\frac{U'Y_J}{V'X_J} \le 1 \\ &U \ge 0 \qquad (1) \\ &V \ge 0 \\ &\qquad J = 1, \cdots, N \end{aligned}$$

In the relation above, U is a M × 1 vector including the product weights and V is a K×1 one including the production factors; V' and U' are the reverse mode of V and U. these two matrixes indicate all information regarding the N of the unit (Emami Mybodi,2000). In the relation above , the goal is to gain the optimal quantities of V and U in a way that the weight sum of the products is maximized to the weight sum of the production factors (unit`s rate of efficiency), only if the size of each unit`s efficiency is smaller or equal to the unit. The fraction relation above has many solutions. In addition, this model nonlinear and non-convex. To solve this problem, in this method, the theorem is transformed by maximizing the sum of the product weights in a state of total weights of production factors normalization and preserving all constraints:

$$\begin{aligned} &\max \ \mu'Y_i \\ &v'X_i = 1 \\ &\mu'X_j - v'X_j \le 0 \qquad (2) \\ &v \ge 0 \ \ \mu \ge 0 \\ &\qquad J = 1, \cdots, N \end{aligned}$$

Because of the linear transformation, μand v are replaced with U and V .this theorem can be solved using current linear programming techniques. Using linear programming to solve Dual theorem indicates the need for less constraints compared with the first method ,so Dual`s form can be written for the theorem above as follow:

$$\begin{aligned} &\min\ \theta \\ &-Y_i + Y\lambda \geq 0 \\ &\theta X_i - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (3)$$

Each unit`s technical efficiency can be separately provided by Dual`s form (Sadat Moazeni and Karbasi, 2008). In the relation above, λ is a N×1 vector including constant numbers which indicates weights of the reference set. Scalar values for θ would be the efficiency of units which provides the constraint of $\theta \leq 1$. In addition, constraint 1 asks that can the quantity of products produced by the i^{th} unit be more than this quantity. The second constraint explains that the quantity of production factors used by this unit should be as much as the values use by the reference unit. The linear programming should be solved N times and each time for one unit so that the efficiency of θ would be gained for each unit. If θ=1, there is a point on the production identical curve or the border production function, so the unit is 100% efficient. In the DEA method, for each efficient unit, one efficient unit or a combination of two or more units are introduced as reference or pattern called reference set (Emami Mybodi, 2000).

DEA model with the assumption of Variable Return to Scale (VRS).

VRS is usable when units work at an optimal scale, but issues such as limitations and competitions cause a unit's non-optimal work. Data envelope analysis with VRS provides gross technical efficiency; efficiency resulted from management, and scale efficiency. For instance, to evaluate the effects, change and modification of the structure of the information related to the scale efficiency is needed. For this, in formulizing Dual theorem in linear programming, with CRS, the calculations with VRS are carried out by adding the limitation of $NI'\lambda = 1$ (Convexity constraint) to the linear mathematical relation. Statistical society of the study is Khuzestan`s dairy cattle husbandry units; based on the information given by Khuzestan statistical yearbook, 85254 dairy cattle houses in 18 cities are working. According to the statistics of Khuzestan organization of agriculture Jihad, 23 one are industrial and the rest are traditional. Information of the industrial units is gained through capitation, but to gain the information of the traditional ones, random sampling method was used. Using Morgan method, the number of the sample volume was 384.

3. Results and discussion

Before providing the results of efficiency estimation, some of the features and properties of the industrial and traditional cattle houses are compared in Table 1.

Table 1. Features and properties of the industrial and traditional cattle houses

Description	Industrial	Traditional
Cattle`s race	Foreign cattle (*Holstein*)	Usually native and hybrid cattle (93 percent)
Number of the cattle	More than 52 percent have more than 75 cattle	More than 90 percent below 40 cattle
Air condition systems and all animal husbandry equipments	83 percent of the units have these equipments	Only 26 percent of the units have these equipments
Unit`s width to the number of cattle	52 percent have extra installations to the cattle	55 percent of the units have extra installations to the cattle
Location of the unit	8 percent are located in countryside and the rest are located outside the villages	94 percent are located in villages
Units` installations	All are working based on the animal husbandry system standards	80 percent do not have the animal husbandry system standards
Consumption of the unit`s foodstuff and provender	80 percent of optimal consumption based on the food ration	80 percent of non-optimal consumption

It is illustrated in the Table 1 that unlike the traditional units having native and hybrid races, the industrial ones have foreign cattle. Keeping native or hybrid cattle in the villages or traditional units is regularly in order to use the farms and pastures in addition to reduce the nutrition expenses. However, the modified cattle (foreign) does not need any pasture or rangeland and ,because of their high productive capability , if the production conditions such as suitable nutrition ,use of cooling equipments ,and all industrial tools increasing the production and efficiency of a unit ,are kept in a closed system. Number of the cattle in the industrial units is more than the traditional ones. Industrial units are better equipped than the traditional ones. Generally, as a subsidiary activity, traditional units are established beside other agriculture activities in a village. Due to the situations of villages, these units are small and, based on the country`s animal husbandry system standards, a maximum capacity of 15 productive cattle or 30 ones (all of the drove) is considered. This is a limitation for the traditional units, while, in the industrial ones, determining the capacity is unlimitedly possible, which is based on the applicant request and having economical justification with

regarding all the standards. In the industrial units, food ration is regulated by technical experts and based on the cattle`s need, provender and production inputs cost, and by regarding the economical gain. Input-oriented pattern was used to calculate the production units` efficiency. In addition, according to unclearness of the return to scale in the milk production units, the study was carried out with both assumptions of constant and variable return to scale. To determine the efficiency as Input-oriented, annual rate of milk production and consumed provender, units` width, number of dairy cattle and work force are considered as the product and consumptive inputs, respectively. Rate of efficiency in both states of constant and variable return to scale is indicated in Table 2.

Table 2. Statistical Description of Milk Producers` Efficiency in Both States of Constant and Variable Return To Scale

Scale	Variable Return To Scale		Constant Return To Scale	
Producer	Industrial	Traditional	Industrial	Traditional
mean	78.5	64.4	68.6	33.7
max	1	1	1	1
min	33.9	24.4	32.5	10.9
Standard deviation	0.23	0.21	0.23	0.14

Results of the table above indicate that the mean of efficiency in the state of constant return to scale is 68.6 and 33.7 among the industrial and traditional producers, respectively. These numbers show an apparent difference of efficiency among the industrial and traditional milk producing units of the province in the state of constant return to scale. In addition ,for the traditional producers in the state of variable return to the efficiency scale , the mean of efficiency is 64.6 ,which has a considerable distance with the 5.78 mean of efficacy of the industrial ones. In the table below, the total efficiency is compared for both groups.

Table3. Descriptive statistic of the total efficiency of milk producers

producers indicator	industrial	Traditional
mean	78.2	54.5
max	1	1
min	56.5	11.4
Standard deviation	0.12	0.18

It is seen in the table above that performance difference among the traditional units is considerable to the industrial ones. Efficiency mean of 54.5 percent for the province`s traditional producers indicates a possibility of a 45 percent increase in these units` efficiency, while this possibility is averagely 13 percent for the province`s industrial ones. T statistic, in table4, was used to evaluate the difference between the industrial and traditional groups

Table4. Comparison of the mean of efficiency in the traditional and industrial milk producing units

Return	total	VRS1	CRS1
Traditional producers` mean of efficiency	0.54	0.64	0.33
industrial producers` mean of efficiency	0.87	0.78	0.68
Mean differences	0.33	0.14	0.34
Standard deviation	0.09	0.061	0.12
T statistic	3.66	2.3	2.83

Result of calculating this statistic indicates the statistical significance of the groups` difference at all three states. Evaluating the efficiency in both states, there is an appropriate potential for increasing the production efficiency of the province`s milk producing units .In the table below, to a more accurate evaluation of the evaluated units` efficiency difference, rate of input consumption `s deviation from the optimal consumption values was evaluated.

As Table 5, in both groups, there are deviations in input consumption from their optimal values. But table above show that these deviations are more in the traditional milk producers. Factors affecting the efficiency of the traditional and industrial units are evaluated in Table 6. Management characteristics which were seen to have effect on efficiency including age, experience, level of education, and having secondary job were entered the model. The variable of the cattle house size, in order to evaluate the rate of size effect on the efficiency, was entered the model, too. According to the difference in the production rate of native and hybrid (motley) cattle , the race variable , in order to evaluate the difference in the efficiency rate of units using these two races , was entered the model. In addition, this variable was entered the model to evaluate the difference between the traditional and industrial units` efficiency. Superstitious variable was used to evaluate the performance difference between Khuzestan`s southern and northern regions.

Among the entered variables, producer's experience and level of education have a positive effect on the efficiency of the production units. In other words, averagely, the experienced ones have a

higher efficiency than those with a lower experience. In addition, being educated increases the production units` efficiency. These two variables` coefficient is statistically significant at a 1 percent level. Moreover ,there is a positive and significance sign of 1 percent level for the variable of unit`s size meaning that theses units can use increasing return to scale and the larger ones would have a higher efficiency. As it is illustrated, having a secondary job has a negative effect on efficiency, which means that ones having a job (in addition to milk production) in the agriculture, industry, or service sectors have a lower efficiency than those who just produce milk. There is also a negative and significant number for the variable of dominant race (native) indicating the higher efficiency for units using hybrid races. The variable which was entered the model to evaluate the efficiency difference between the traditional and industrial units has a positive and significant coefficient meaning that Khuzestan industrial milk producing units have higher efficiency than the traditional ones and this difference of the units` efficiency is statistically significant. This variable has the biggest coefficient which is significant at 1 percent level meaning that the type of production-traditional or industrial- has the highest effect on explaining the studied units` efficiency differences. In this model, because of having a linear relationship with the variable of experience, the variable of age was deleted .the variable of the unit`s location (southern or northern cities of the province) was also deleted from the model due to the statistical insignificance.

4. Recommendation

Results of the present study indicate a significant difference between Khuzestan industrial and traditional milk producing units. In other words, milk producing units` industrialization increases the efficiency of using the inputs. Consequently, the main suggestion of this study is to use policies and strategies in order to industrialize the milk production in Khuzestan for increasing the efficiency of consuming scarce inputs in this industry. In other words, providing amenities and facilities in order to industrialize the milk production in Khuzestan can be a step toward an efficient consumption of production inputs. Educational level of the unit`s manager affect the efficiency of dairy units` production. This is confirmed by Kiyani Abari etal (2000), Syedan(2004), Isfahani et al (2010), Fetros and Solgi (2002), Yousef and Malermo (2007), Torkamani (1997), Shajari (1997), Rahmani (2001), Rahmani(2006), and Berym Nejad (2007); so, any kind of education for the traditional cattle –keepers and using technical experts or using others` experiences at the management level of the industrial units can increase the cattle houses` efficiency. Size of the cattle house is a factor affecting the traditional and industrial units` efficiency (larger ones are more efficient). This is also confirmed by, Shajari (1997), Mosa Nejad etal ( 1999) Dehghanian et al( 1999) ,Shirvanian and Mehregan ( 2008). This result indicates that Khuzestan`s milk production units can take advantage of using returns to scale. Thus, it is suggested that cattle –keepers, to Prorate theoverhead costs, develop their units and use the maximum capacity of production. Results of the study show that the type of the cattle`s race has an effect on the units` efficiency. This is supported by Shajari and Najafi (1996), Mosa Nejad et al (1999) Dehghanian et al (1999), Shirvanian and Mehregan (2008). So, it is suggested that the units` managers consider the use of hybrid and foreign cattle having more efficiency than the native ones. Having secondary job is a factor with negative effect on the production efficiency. This is confirmed by Torkamani (2000), Kiyani Abari et al (2000), and Sydan(2004). Thus it is suggested that cattle –keepers, instead of increasing their income through secondary job, consider the use of the maximum capacity of production. Findings of the study showed that there is not any significant difference between the southern and northern units of the province which is opposite to the findings of Dehghanian et al (1999) and Rahmani (2007). So, it seems that the concern of the cattle –keepers resulted from the southern milk producing units` inefficiency (because of the hot weather`s effect on the cattle production) can be solved by having a proper management in controlling the expenses, increasing the capacity of the unit, and suitable mixing of provender and consumptive inputs.

Table 5. Rate of Input Consumption Deviation From The Optimal Consumption Values

Input	Traditional producers				Industrial producers			
min	food	Work force	land	cattle	food	Work force	land	cattle
max	0	0	0	0	0	0	0	0
mean	73417.2	15.8	45106.05	169.8	84507.1	11.07	4892.3	308.3
min	18224.2	4.09	3080.7	38.88	4699.95	2.32	124.61	13.99

Table 6. Evaluation of the Management Variables` Effect on the Efficiency of Khuzestan Milk Producers

Variable	Description	Estimated coefficient	Standard deviation	Static t
ECU	Level of education	*0.035	0.0081	4.31
EXP	Experience	*0.0016	0.0007	2.17
Oj	Secondary job	*-0.043	0.017	-2.46
NEJAD	Cattle`s dominant race	*-0.3	0.149	-2.01
LAND	Cattle house size	*0.23	0.11	2.09
KIND	Type of production(traditional or industrial)	*0.37	0.07	5.22
CONSTANT	Constant coefficient	*0.5	0.026	18.7
***10percent level of significant		**5percent level of significant		*1percent level of significant

R2=%57.5

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