



Economic Analysis of the Factors Affecting the Sheep Production: Case Study of Al-Hasaka District, Syria

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Abstract: Sheep rearing occupies an important role associated with animal production in Al-Hasaka governorate, due to the economic advantages it enjoys. Further, study of the production function is useful in measuring the production process and estimating the economic relations. These are important in determining the extent of production efficiency of the factors achievable that affects the sheep production. Accordingly, the research aimed mainly at measuring productive efficiency. The sample size was 313 rearers, who were chosen adopting a simple random sample method. The results identified the most influencing factors on the estimated production function. The sheep rearer experience and labor wage accounted for about 34% and 17%, respectively. Further, the use of production factors falls in the second stage of the production process, and the total flexibility reached was 1.479, and that the distribution efficiency of all factors of production was greater than one. The study recommends more efforts to increase investment in using factors of production to increase production to an level.

Key words: Total production, return to scale, allocative efficiency, elasticity, sheep products.

Sheep are not difficult animals to raise and are more efficient in the conversion of forage to retail products than beef cattle in Syria. However, they require a higher level of management than beef cattle. In this context, the initial investment required to begin a sheep enterprise is relatively low because expensive sheds and barns are not necessary (Grad, 2004). The sheep sector in Syria is considered as one of the most important sectors in animal production because it is the first source of meat, the second source of milk, and is also an export-oriented sector. Syrian sheep are also famous for their good quality milk, meat, and wool, and their high milk productivity. Syria is famous for Awassi sheep rearing, which is mostly concentrated in Albadia (NAPC, 2007). The number of sheep in Syria during 2015 was 13.7 million heads, which produced about 0.54 million tons of milk. Al-Hasakah however, contributed nearly 11.9% of the total number and 8.4% of the milk produced (NAPC, 2016).

The inability of domestic production to meet the increasing consumption, as a result of the current crisis in the study area experienced after 2011, led to the reluctance of a number of rearers from towards profession, mainly due to the high prices of production inputs

(feed-medicine). Therefore, it was necessary to study and determine the factors that affects sheep production. Consequently, the objective of the present study is to measure production efficiency through estimation of the production function, its economic derivatives, and determination of the factors affecting it and the levels of relative efficiency in the Al-Hasaka district.

Materials and Methods

Rearers (313) were selected using simple random sampling method from 36 villages spread across Al-Hasaka district. For meeting the objectives of the study, primary data related to an average agricultural year 2017-2018 and 2018-2019 were required and they were collected from the sampled farmers according to a questionnaire through personal interview. This covered characteristics of farmers, livestock business sheep description and factors of production.

Production function approach

The production function used to explain the relationship between input and output is the Cobb-Douglas production function. This was used with the reason that after the completion of the Cobb-Douglas function it can easily be transformed to linear form. Other than that,

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the estimation results obtained from the Cobb-Douglas function will generate a regression coefficient reflecting the amount of elasticity. Specifically, the function model the Cobb-Douglas productions used in this study are:

$$Y_i = \beta_0 X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} \quad \dots 1$$

Y_i = Gross return per head per year (in Syrian pound; SP).

X_1 = Expenditure on dry fodder per head per year (in SP); X_2 = Expenditure on concentrates per head per year (in SP); X_3 = Expenditure on veterinary services per head per year (in SP); X_4 = Expenditure on shepherd per head per year (in SP); X_5 = Expenditure on pasture rental per head per year (in SP); X_6 = Expenditure on water per head per year (in SP).

β_0 = constant

The variables were calculated as a monetary value per year and not as a physical amount due to lack of data on the physical amounts used of variables in the farms.

The function was transformed into the double log or log linear form:

$$\begin{aligned} \ln Y_i = & \ln \beta_0 + \ln \beta_1 X_1 + \ln \beta_2 X_2 + \ln \beta_3 X_3 \\ & + \ln \beta_4 X_4 + \ln \beta_5 X_5 + \ln \beta_6 X_6 + U_i \quad \dots 2 \end{aligned}$$

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ = Production coefficient of the respective variable inputs.
 U_i = Error term.

Elasticity of production (EP)

The elasticity of production which is the percentage change in output as a ratio of a percentage change in input was used to calculate the rate of return to scale. This is a measure of a rearer's success in producing maximum output from a set of input (Sanusi *et al.*, 2015).

If $EP = 1$: constant return to scale; $EP < 1$: decreasing return to scale; $EP > 1$: increasing return to scale.

Marginal physical product (MPP)

According to Pawar *et al.* (2016) the MPP of different input was estimated by formula:

$$MPPX_i = \beta_{xi} * \frac{\bar{Y}}{\bar{X}_i} \quad \dots 3$$

where, β_{xi} = Production elasticity's of i^{th} input; \bar{Y} = Geometric mean of output; \bar{X}_i = Geometric mean of i^{th} input.

Allocative efficiency

According to (Sanusi *et al.*, 2015; Cyrilla *et al.*, 2010; Ahmed *et al.*, 2015) resource use efficiency of input was calculated using the basic economic formula:

$$AE = MVP / MFC \quad \dots 4$$

$$MVP = MPP * P_y \quad \dots 5$$

$$MFC = P_x \quad \dots 6$$

where, AE = Allocative efficiency; MVP = Marginal value product; MPP = Marginal physical product; MFC = Marginal factor cost P_{xi} (unit price of input x_i); P_y = Unit price of output; P_x = Unit price of input.

Decision rule

The rules followed for arriving at any decision was as follows:

$AE = 1$ optimum use of a resource, $AE < 1$ excess utilization of a resource, $AE > 1$ underutilization of a resource.

Economic optimum takes place where $MVP = MFC$. If AE is not equal to 1, it suggests that resources are not efficiently utilized. Adjustments could be therefore, be made in the quantity of inputs used and costs in the production process to restore $AE = 1$ and the model is given as follows:

$$Divergence = [1 - (MFC/MVP)] * 100 \quad \dots 7$$

Results and Discussion

Production function

The production function of rearer sheep was estimated by ordinary least square (OLS) wherein gross return is the dependent variable (Y) and expenditure on dry fodder (X_1), concentrates (X_2), veterinary services (X_3), shepherd (X_4), pasture rental (X_5) and water (X_6) are independent factors. The results of the study showed that double logarithmic function is the suitable function based on the evaluation of estimated coefficients and according to the logic of economic theory and statistical tests illustrated by the Eq (8). The estimated coefficients signals were consistent with what is expected, according to the logic of economic theory. Additionally, they were all significant

at the 5% level. This indicates that the sheep production can be increased through increase in the independent factors mentioned. The value of F-test was (57.42)** which was significant at the 5% level. This further indicates that all the regression coefficients are significant and all factor in the model have impact on the production. According to the value of the coefficients of determination (R²), 95% of the variation in the production of sheep rearing is due to variation in the independent variables and 5% of these changes are attributable to other factors not included in the function, which also absorbed the impact random variable. Each of the independent factor parameters are indicated in double logarithmic.

For a further analysis of the important factors affecting sheep production, the following Cobb-Douglas function has been developed:

$$\begin{aligned} \ln Y_i = & 2.745 + 0.125\ln X_1 + 0.155\ln X_2 + \\ & (1.7)** \quad (0.68)* \quad (1.34)* \\ & 0.129\ln X_3 + 0.269\ln X_4 + 0.198 X_5 + \\ & (1.4)* \quad (1.5)* \quad (1.16)* \\ & 0.157\ln X_6 \quad \dots 8 \\ & (1.47)* \end{aligned}$$

$$R^2 = 0.95, \bar{R}^2 = 0.94, F = (57.42)**, D.W = 1.846$$

Return to scale

The results also suggests two important points. Firstly, the coefficient bs, in fact, represent elasticities and suggest that if X₁, X₂, X₃, X₄, X₅ and X₆ are individually increased by 100%, these would increase return, respectively, by 12.5%, 15.5%, 12.9%, 26.9%, 19.8% and 15.7%. Secondly, the additive elasticities of all the coefficients, i.e. b₁+b₂+b₃+b₄+b₅+b₆ is greater than 1 (1.033) in the present case. This suggests that the enterprise has increasing return to scale which, mean an increase in production factors by 100% will lead to an increase in production by 103.3%. Thus, results indicate better opportunities to the farmers of the region for investing more in livestock sector. Therefore more investment in this sector will change the prevailing scenario and will help in improving the socio-economics conditions of the farmers of the area.

Allocative efficiency and resource-use efficiency

Given the level of technology and price of both inputs and outputs, efficiency of resource use was further ascertained by equating the

MVP to the productive MFC of resources. All resources are said to be optimally utilized if there is no significant difference between the MVP and MFC, that is if the ratio of MVP to MFC = 1 (unit), Table 1 reveals that the ratios of the MVP to the MFC were greater than unity (1) for all the input. This implies that X₁, X₂, X₃, X₄, X₅ and X₆ were under-utilized. This also means that sheep production (and hence revenue) was likely to increase if inputs (X₁, X₂, X₃, X₄, X₅ and X₆) are used more, thereby attaining optimal allocative efficiency.

Table 1. Estimated allocative efficiency ratio (AE)

Input	GM	MVP	MFC	AE	D
Y	35813.31				
X ₁	6283.61	0.71	0.088	8.09	87.64
X ₂	9620.97	0.58	0.12	4.8	79.18
X ₃	3388.69	1.36	0.775	1.76	43.13
X ₄	7559.04	1.28	0.95	1.34	25.49
X ₅	1400.8	5.07	1.30	3.9	74.37
X ₆	7853.39	0.72	0.03	23.87	95.81

Source: Computed from lead Eq (3, 4, 5, 6, 7).

The underutilization of X₁, X₂, X₃ and X₄ was earlier reported by Deshetti and Teggi (2016), Venkatesh and Sangeeta (2011) and Pandian *et al.* (2013) in their study. The adjustments in the MVP for optimal resource (% divergence; D) in Table 1 indicates that for optimum allocation of resources, 87% increase in X₁ is required, while approximately 79% and 43% increase in X₂ and X₃ respectively is required. Similarly, 25%, 74% and 95% increase in X₄, X₅ and X₆ are needed respectively.

Conclusion

The production variables used are located in the second stage of production, and thus rearers can increase their income by increasing the use of these variables. Total flexibility indicated an increase in return on capacity, i.e. there is potential for increasing total production progressively while using factors in the proportions communicated in the production function developed. The distribution efficiency of all production resources was greater than one, thus increasing the rate of use of these factors would increase profit.

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