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An economic correlation analysis for different production function of broiler production in Kannauj district of Uttar Pradesh, India

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Abstract

Production function analysis has been undertaken to measure the relative importance of different variables as influencing the total quantity of broiler produced. Before identifying the independent variables for the analysis, correlation was worked out. The data of the table indicate to the positive and negative correlation co-efficient which was found to be data either significant or non significant at 5 percent level of significance which is indicating to factors under consideration which has positive and negative influence on production. From the correlation matrix it was seen that the perfect positive correlation co-efficient (0.999999) was observed between meat production and number of chicks in the farm. To estimate the live weight production, step wise multiple regression analysis was carried out. The coefficient of multiple determination (R^2) was 0.9886 which indicated that the four specified variables (X_1, X_2, X_6 and X_7) explained 99.00 percent of variation in kg of broiler produced and the remaining one percent of variation was unexplained which was taken as in the error term. The value of partial regression coefficient for the variable X_5 (Cost of electricity) was also effective (0.9677) and positive significant ($p<0.05$), thereby indicating excess use of this input. Though the electricity was over utilized it was necessary to minimize the rate of mortality during brooding period.

Keywords: Correlation co-efficient, coefficient of multiple determination, independent variables, dependent variables, broiler production, production function

Introduction

The use of mathematical models to estimate broiler production accurately is of great importance for poultry research and management. These models allow for the comparison of poultry production in the different regions of the district, which provides the realistic growth intern helps to analyze the disparity between the regions. This information is important for many management decisions, for facilitating the required infrastructure. Development of poultry mainly depends on the locally available agricultural byproducts which can be used as low cost poultry feed, as more than 70 percent of the cost of poultry production is incurred on feed.

Production function analysis has been undertaken to measure the relative importance of different variables as influencing the total quantity of broiler produced to pre identifying the independent variables for the analysis. This finding is in accordance with the earlier findings of Borah *et al*. (2000) [2] indicating the correlation co-efficient between meat production and size of farm was 0.9876 in the state of Assam. The three nonlinear growth models (Richards, Gompertz, and Logistic) and spline regression models for describing chicken growth curves. Based on the goodness of fit criteria, the nonlinear models fitted the data better than the spline regression model. The four-parameter Richards model was expected to have the best overall fit. The growth parameters predicted with the logistic model were different from those predicted by the Richards and Gompertz models. It was concluded that growth parameters predicted with different models with fixed inflection points are not directly comparable

Nair (2004) [4] used correlation co-efficient and linear regression to study economic reform and regional disparities in economic and social development in India. He showed that agricultural development having a favourable and significant impact on industrial development at the state level particularly in the post reform years. Quantitative assessment of the fit of the models was made using Mean Absolute Error, Mean Square Error, Coefficient of determination R^2 and Akaike Information Criterion.

It was found that among the nonlinear regression models, compartmental model as suggested by McMillan (1986) [3] performed best for describing weekly egg production of white leghorn. Quantitative assessment of the fit of the models was made using Mean Absolute Error, Mean Square Error, Coefficient of determination R^2 and Akaike Information Criterion. It was found that among the nonlinear regression models, compartmental model as suggested by McMillan (1986) [3] performed best for describing weekly egg production of white leghorn. The coefficient with respect to each particular input is the elasticity of production. The elasticity indicated to the percentage change in the total product associated with five percent change in the concerned input factors. In case of broiler production, it is evident that elasticity of feed consumed per lot (Xi) in kilograms resource variable was positive and significant at 5 percent level for all the size groups and at the overall level.

Materials and Methods

I. Correlation coefficient(r)

The Pearson's product moment method suggested by Chandel (1998) [5] for computing correlation coefficient(r) was used in present study to determine the relationship between independent variable and dependent variable. The correlation coefficient gives two kinds of information: (i) Indication of magnitude of the relationship, and (ii) Information about the direction for the relationship (whether positive or negative). For computing the Pearson's product moment correlation coefficient following formula were used while investigating the correlation between independent variable *viz*., Feed consumed by broilers per lot in kilograms, Marketed age of broilers in days, labour cost etc. which was represented as X_1, X_2, X_3………..X_n and dependent variable such as Live weight which was represented by Y of broilers per lot in kilograms in this study.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2]\,[n(\sum y^2) - (\sum y)^2]}}$$

Where,
r = Correlation coefficient
X = Independent variables
Y= Dependents variable
ΣXY = Sum of product of the deviation of X and Y from their mean.
ΣX^2 = Sum of square of the deviation of X from their mean.
ΣY^2 = Sum of square of the deviation of Y from their mean.
n = number of observations.

II. Multiple linear regression analysis:-

An attempt was made to estimate the relationship between dependent factor live weight of broilers per lot with independent factors *viz*., feed fed in kilograms, marketed age in days, feed conversion ratio and medical expenses in rupees by fitting the multiple linear regression model to the sample data separately for three size groups and at the overall level.
The equation used was as under.

$$Y = a + b_1x_1 + b_2X_2 + b_3X_3 + \ldots.\ b_nX_n + u$$

Where,
Y = Live weight of broilers per lot in kilograms
X_1 = Feed consumed by broilers per lot in kilograms
X_2 = Marketed age of broilers in days
X_3 = labour cost
X_n = other variables cost per lot in rupees
a = Constant
bi's = Regression coefficients
u = Error term

Result and Discussion

Production Function Analysis

Production function analysis has been undertaken to measure the relative importance of different variables as influencing the total quantity of broiler produced. Before identifying the independent variables for the analysis, correlation was worked out and is presented in following table.

Correlation coefficient

The data given in the table clearly indicated that the positive and negative correlation co-efficient was found which was either significant or non significant at 5 percent level of significance. So, the factors under consideration had positive and negative influence on production. From the correlation matrix it was seen that the perfect positive correlation co-efficient (0.999999) was observed between meat production and number of chicks in the farm. Therefore, we might consider that number of chicks in the farm was most influential factor on meat production. Similar study was done by Farhan *et al*. (2015) [11], the function as a whole was significant at the level of (1%), and the estimated coefficient signals here were significant at the level of (1%), which is in accordance with the logic of economic theory and is compatible with what is predicted. The variance in the independent variables (labor and capital), which account for 92% of the variation in grill chicken output, was measured using the coefficient of determination (R2). Elasticity of production for variable work was (0.2%), a positive number, and this indicates that, assuming other factors remain stable, an increase in the work item by (1%), leads to an increase in production by (20%) and unit. When it comes to the capital, it should be mentioned that the elasticity of this resource was worth. An extraordinary positive signal of (0.88%) means that a 1% increase in capital would result in a rise of (088%) in total output. Total elastic ties, which add together elastic ties for productivity, were (1.08), indicating that they exhibit constant returns to scale. According to the technical efficiency indicators, the study sample's average technical efficiency for constant scale size was 0.88 and for variable capacity size it was 0.98, with an average size efficiency of 0.90. These findings indicated a 12% overuse of economic resources, suggesting a reduction in resource consumption to maintain present levels of output. On the other side, the capacity findings indicated that four farms had achieved economic size optimization, 7%, whereas 93% of grill farmers are working to scale up their operations, which indicates that there is potential to improve production given current capabilities and without using more of the economy's limited resources. Total elastic ties, which add together elastic ties for productivity, were (1.08), indicating that they exhibit constant returns to scale. According to the technical efficiency indicators, the study sample's average technical efficiency for constant scale size was 0.88 and for variable capacity size it was 0.98, with an average size efficiency of 0.90. These findings indicated a 12% waste of economic resources, suggesting that the current level of output might be maintained by used less resources.

Table 1: Correlation-matrix of production function analysis of broiler production in Kannauj district of Uttar Pradesh, India during 2020-21.

Particulars	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Quantity of broiler Produced in kg. (Y)	1							
Quantity of feed consumed (X1)	0.999964	1						
Number of chicks per farm (X2)	0.999951	0.999999*	1					
Cost of electricity (X3)	-0.97017	-0.96809	-0.96771	1				
Cost of medicine (X4)	-0.9905	-0.98931	-0.98909	0.993991	1			
Cost of labour used per farm (X5)	-0.99714	-0.99647	-0.99635	0.985656	0.997817	1		
Cost of litter material (X6)	-0.98892	-0.98766	-0.98743	0.994884	0.998993	0.997265	1	
Miscellaneous variable cost (X7)	-0.97821	-0.97642	-0.9761	0.999318	0.997345	0.990983	0.997497	1

(* significant at $p<0.05$)

Multiple linear regression analysis

In order to examine the relationship between dependent factor *i.e.* live weight of broilers per lot with independent factors viz., feed consumed in kilograms, No. of chicks, labour cost, litter cost, electricity charge, medical expenses and miscellaneous cost in rupees multiple regression model was fitted to the sample data separately for three size groups and at the overall level.

To estimate the live weight production, step wise regression analysis was carried out. The fitted Multiple Regression Model was as under.

$$\acute{Y} = 2711.49 + 0.689X_1 + 1.982X_2 + 175.970X_3 + 4.514X_4 + 8.330X_5 + 38.345X_6 + 7.286X_7$$

(0.0035) (0.0124) (21.473) (0.3821) (0.968) (1.865) (0.3708)

(R^2 = 0.9886)

Variables	Analytical value of regression					
	Intercept	Coefficient	S.E.	t test	P value	R^2
X1	-151.96	0.689	0.0035	197.025	2.71	0.999
X2	30.55	1.982	0.0124	159.578	3.93	0.999
X3	-1936.29	175.97	21.473	8.194	0.015	0.971
X4	1598.08	4.514	0.382	11.815	0.0070	0.985
X5	3434.25	8.330	0.968	8.608	0.013	0.973
X6	1069.36	7.286	1.865	19.651	0.0025	0.994
X7	-1332.50	38.34	0.370	20.55	0.0023	0.995

(Significant at 5%)

The coefficient of multiple determination (R^2) was 0.9886 which indicated that the four specified variables(X_1, X_2, X_6 and X_7) explained 99.00 percent of variation in kg of broiler produced and the remaining one percent of variation was unexplained which was taken as in the error term. Similar result was obtained by Ukwuaba and Inoni (2012) [9], showed that the research area's small-holder grill farming was profitable. Approximately 35.05% of the total cost and 37.70% of the total variable cost of production were made up mostly by feed costs. While medication, albeit not significantly, and the amount of feed had a beneficial impact on grill output, labour and day-old chicks had the opposite association with grill output. According to efficiency estimates, farmers in the region used resources inefficiently overall, with a mean score of 2.60 indicating that a lack of funding was the biggest obstacle these farmers had to overcome. In order to encourage the effective use of resources in the production of broilers, as well as to boost productivity and profitability

The partial regression coefficient for the variable X_2 (Number of chicks per farm) was 1.982 and for X_1 (Cost of feed) was 0.9999, which were highly significant at 5 percent level of significance. This revealed that an increase in number of chicks per farm and increasing the quantity of feed by one unit increases the kg of broiler produced by 1.982 kg. This showed that there is a high scope for increasing the output of broilers in the sample farms by increasing the number of chicks. This also indicated that in the study area, poultry farms were under utilized in respect of number of chicks per farm. This finding is in accordance with the earlier findings of Rajendran (1987) [12] and Rajendran (1998) [13] which also showed in their study that number of chicks per farm had significant effect on output of broilers. Similar result was obtained by Polycarp *et al*., (2004) [6] in which Results for layer businesses showed that, with the exception of feeds, which showed a declining tendency, all production inputs have a direct impact on egg output. With the exception of medications, all regressors for broilers exhibited positive coefficients, indicating a direct correlation with the production of poultry meat. Furthermore, despite the fact that declining returns to scale are prevalent for both layer and grill firms, the explanatory abilities of all chosen inputs were supported by high coefficient of determination (R^2) values.

The value of partial regression coefficient for the variable X_5 (Cost of electricity) was also effective (0.9677) and positive significant ($p<0.05$) correlation was found, thereby indicating excess use of this input. Though the electricity was over utilized it was necessary to minimize the rate of mortality during brooding period. Similar result was obtained by Azeez and Akbay (2021) [7] point out that four rotations for a full year were the focus of the results. The Benefit-Cost Ratio was 1.28, and among all agricultural categories, feed expenditures accounted for the largest cost (58.3%). In each rotation from 1 to 4, the number of chicks entering, the mortality rate, and the amount of feed consumed all had strong significant effects on production, according to the coefficients of the independent variables. All rotations are negatively and significantly impacted by the mortality rate. The total number of employees significantly affects rotations 1 through 3, but not rotation 4. All variables have a substantial impact on the production of broilers, according to the model in total output from one year.

The value of partial regression coefficient for the variable X_4 (Cost of medicine) was also found positive (4.514) and significant ($p<0.05$). This also indicates that cost of medicines was excess in the study area. The reason for this might be vaccination cost. In broiler production, chicks are generally vaccinated three times, however in adverse climatic condition chicks are vaccinated more than three times. Similar result was obtained by Tung and Rasmussen (2005) [8], in several models, the coefficients of flock size, feed amount per bird, labour amount per bird, household income level, and veterinary costs were all extremely significant, according to the study of production functions. Only among the poultry producers in the Midland region does the size of the garden have a major impact. The outcomes show that farm poultry output was most responsive to the variable feed per bird, regardless of geography or system. However, the impact varied between industrial models and geographical areas. The analysis's key finding is that the estimated production models in the three regions differed significantly from one another. With the exception of the region Highland, there was little distinction between the two production systems within regions.

Elasticity of production

The coefficient with respect to each particular input is the elasticity of production. The elasticity indicated to the percentage change in the total product associated with five percent change in the concerned input factors. Similar result was obtained by Kamruzzaman *et al.* (2021) [10], demonstrated that the primary operating expense for broiler farming was feed. Although grill farming was a financially successful industry, Mymensingh's division performed poorly compared to the others due to high manufacturing costs per unit and lower unit sales prices. While Rajshahi division displayed the best ratio of returns on investment, Dhaka division had the highest net return. However, there was no discernible difference between the research locations in terms of the cost (variable) and net return of broiler farming. Feed, chick, and labour prices had negative and inelastic own price elasticity values of -0.00249, -0.05718, and -0.13101, respectively. Additionally, it was shown that the relationships between feed and day-old chicks and feed and work were complementary.

In case of broiler production, it is evident that elasticity of feed consumed per lot (Xi) in kilograms resource variable was positive and significant at 5 percent level for all the size groups and at the overall level.

The elasticity for number of chicks (X2) per plot, variable was positive and significant at 5 percent level for small and large size groups where as it was positive and significant at 1 percent level for medium size group and at overall level.

The elasticity for the cost of labour (X3), variable was positive and significant at 5 percent level for all the size groups and at overall level.

The elasticity of medical expenses (X4) variable was positive and significant for small size group where as it was positive and significant at 5 percent level for medium size group and at overall level. It was positive and significant at 1 percent level in case of large size groups.

Conclusion

Function chosen was quite appropriate as the coefficient of multiple determination(R^2) was 0.9886 at overall level, indicating there by 98.86 percent of total variation in the live weight explained by independent variables namely feed consumed in kilograms, marketed age in days, feed conversion ratio and medical expenses.

Conflict of interest: NA

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