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Research Article

Application of production function approach to estimate the economics of broiler production in the Rupandehi district of Nepal

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ABSTRACT

A study was conducted in a year 2020 A.D to analyze the application of production function approach to estimate costs and returns, resource use efficiency, and problem in broiler production. A total of 120 broiler farmers were selected representing small, medium and large farms, also 10 number of wholesalers, retailers and consumers were selected for market study and interviewed with a pre-tested questionnaire. The data were collected, entered and analyzed by using SPSS and MS-Excel. The total cost of production per bird was maximum (Rs.372.93) in small and minimum (Rs.340.96) in large farms, it was Rs.361.42 in medium farms. FCR for small farms was 1.67, for medium 1.81 and for large farms 1.89. It was further seen that the B: C ratios 1.27 for small farms, 1.25 for medium, and 1.34 for large farms. It was clear that large farm is more profitable as compare to small farm. Cobb-douglas production function analysis showed that with every other factors remaining constant an increase in 100% in the chicken cost, feed cost, vaccine cost and others cost the gross return was expected to be increased by 3.75, 8.6, 2.6 and 1.7 % respectively. The different agent involve in the marketing of broiler are producer, retailer, wholesaler, dealers, commission agent, middleman and finally consumers. The SWOT analysis was done on the basis of the interview taken by all the stakeholder in the study area of the district. In spite of broiler production potentiality, there were many constraints in production, marketing and research site which need to be addressed by enhancing technology adoption, such as targeted training programs and financial support, could contribute to sustainable broiler farming practices in the research site.

Keywords: benefit-cost, broiler, profitability, SWOT

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INTRODUCTION

The agricultural sector contributes 23.95% to national GDP as per Nepal Rashtra Bank (NRB, 2018). The livestock sector contributes about 11.5% to Nepal's total GDP and 25.7% to its agricultural GDP. The poultry industry contributes around 4% to the national GDP and 8% to the agricultural GDP (CBS, 2021). Total population of poultry in Nepal is approximately 72.24 million and production of poultry meat about 60,122 metric tons (Krishi Diary, 2020). In 2021, Nepal's demand for poultry meat was 63,000 metric tons, and is expected to reach 63,000 metric tons by 2026 (CBS, 2021). Broiler industry is one of the profitable agro-industries which can effectively tackle the problems of unemployment in the rural areas, particularly of small and marginal farmers. Increase in population growth, changing life-style, shifting of food habits, rapid urbanization, increased per capita income, awareness about health care, etc. are contributing towards rising demand of poultry products. The total number of poultry farms in those 64 districts out of 77 where the poultry is raised commercially is 21,953. Among these, 20,483 (93.39%) is broiler farm, 1,337 (6.09%) is layers farm, 128 (0.58%) is hatchery farm and 8 (0.04%) is Giriraj/coiler farm (CBS, 2021). The total number of poultry raised in these farms is 60,826,880 per year among which the number of broilers is 52,666,029. In Nepal poverty alleviating is an urgent need of uplifting economic status of people which can be possible through strategic intervention of broiler business. Number of registered poultry farm in Rupandehi district is 174 out of which 170 broiler farm, 2 layers farms and 2 hatchery (CBS, 2021).

Broiler is a chicken strain as the result of engineered technology which has economic characteristics, characterized by rapid growth as a producer of meat, the short harvest and producing meat with soft fibers, piling the good meat, bigger breasts and smooth skin (North and Bell, 1990). According to Rasyaf (1999), the broiler is a chicken which has rapidly grown at the age of 1-5 weeks. He also explained 6-weeks old broiler has as big as 8-months old general adult chicken. The broiler excellence is supported by the genetic traits and environmental circumstances including food, environmental temperature and maintenance.

Poultry sector is highly prone to production and market risk, which in turn affects the profitability of broiler production particularly on the small farms. But today the broiler industry is faced by so many problems such as ever increasing feed prices, non-availability of day-old chicks, unpredictable market prices for broiler meat are found to be the foremost restraints for rapid growth of broiler industry. Various study has been done in broiler production, but these studies neither considered the relationship between economic variables nor explained the reasons for success and failure of the farms. The marketing aspects of broiler had not been studied sufficiently.

Hence, this research helps to evaluate the application of production function approach to estimate the economics of broiler production by analyzing the profitability, regression coefficient, marketing and SWOT analysis of broiler production at the study area. This study will help the policy makers, academicians, extension and research workers and the broiler farmers.

MATERIALS AND METHODS

Study area

The study was carried out for about 6 months i.e. from June to December, 2020 A.D in all the municipality of Rupandehi district of Lumbini province, is one of the seventy-seven district of Nepal and covers an area of 1,360 km2 (530 sq mi). The district headquarter is Siddharthanagar. It has 1 Sub- Metropolitan Municipality, 5 Municipality and 10 Rural Municipality. It is bordered to the east by Nawalparasi west by Kapilvastu, north by Palpa and south by India. Rupandehi has a

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latitude of 27°37'35.13"N and a longitude of 83°22'44.18"E respectively. The main reason for selection of this location was because large number of farmers are involved in broiler production and marketing. Simple random sampling method was followed for selecting households from the study areas of Rupandehi district.

Sources of Information and Data Collection

Primary data were collected from the interview of farmers by simple random sampling technique from the sampling frame through semi-structured questionnaires and face to face interview. Secondary data were collected from the different articles, reports, journals, books, published materials of MoAD, Agricultre Knowledge Center, Veterinary Hospital and Livestock Service Expert Center , NGOs, INGOs, websites and other institutions working on livestock and poultry production of that area.

Sampling; sampling frame and selection procedure

The study was focused on all the farmers who are practicing broiler farming at a different level. Among the 170 registered broiler farm department of cottage and small Industries, Bhairahawa and from district profile of Rupandehi, a sample of 120 respondents were selected by using simple random technique by using the simplified formula (Yamane, 1967).This formula was used to calculate with a 95% confidence level and p=0.05 level are assumed.

$n=N/1+N\ (e)^2$

Where, n= Sample size
N= Population size
e= Level of precession (0.05)
The list of broiler producers were listed in descending order in term of farm size. These were categorized into three size groups on the basis of the number of birds raised per time via.

Table 1: Categorization of farm size on the basis of number of broiler

Farm Size	Broilers(No.)
Small	<1000
Medium	1000-5000
Large	>5000

(Source: Field Survey, 2020)

From each size group, 40 broiler farmers were randomly selected making the total sample farm 120 which forms the basis for the present study and 10 wholesaler, 10 retailer, and 10 consumer were randomly selected from the different area of Rupandehi district for market study of broiler.

Methods and Techniques of Data Collection and Analysis

The statistical package for social science (SPSS) 2016, version 20 and Microsoft Excel 2013 were used for both qualitative and quantitative data analysis.
Cost and Benefit structure

Total Fixed Cost = Depreciation + Interest on long term loan+ Land rent

Total Variable cost (TVC) = Cc + Cf + Cl +Cef + Cm + Cl + Cmv + Ci + Cise

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Where,
Cc = Cost of day old chick
Cf = Cost of feed Cl = Labor Charge
Cl = Litter cost Cmv = Medicines, vaccines charges Cef = Electricity and fuel cost
Ci = Insurance per bird
Cm = Marketing cost Cise = Insurance of sheds and equipment

Total cost of production = Total fixed cost + Total variable cost

Gross Return= Return from the selling of broiler and byproduct

Return from the broiler = Total quantity of broiler × wt. of birds (kg) × average price of the broiler

Return from the byproduct= Total quantity × per unit price of the byproduct

Net Return = Gross return – Total cost Benefit cost Ratio = Gross Return/ Total cost

Benefit/Bird= Net return/Total no. of birds in the farm
Benefit/Bird/kg= Net return/Total no. of birds in the farm/Wt. of bird (kg)

Production function analysis
Cobb-Douglas production function is the most common and widely used technique in the field of economics to represent the technological relationship between the various inputs used and output produced (Dhakal, 2015). Koutsoyiannis (1977) defined production function as a technical relationship between factor inputs and output. Cobb-Douglas form of production function in the following form was fitted to examine the resource productivity, efficiency and return to scale.

Y= aX1b1 X2b2 X3b3X4 b4eu

Where,
Y = Gross return (Rs. /ha)
X1= Cost of chicken (Rs/200birds) X2 = Feed Cost (Rs/200 birds)
X3 = Vaccine Cost X4 = others cost
e = Base of natural logarithm,
u = Random disturbance term
a = Constant, and
b1, b2, b3 and b4 represent Coefficients of respective variables

The Cobb-Douglas production function in the form expressed above was linearized into a logarithmic function with a view of getting a form amenable to practical purposes using OLS technique as expressed below;

lnY = lna + b1lnX1 + b2lnX2 + b3lnX3

Where,
ln= Natural logarithm, and rest of the other abbreviations are same as previous explanations.

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$$\text{Feed Conversion Ratio} = \frac{\text{Amount of feed consume (kg)}}{\text{Weight gain (kg)}}$$

SWOT Analysis

It stands for strengths, weakness, opportunity and threat. SWOT analysis of the broiler production business was done through interview with different actors.

RESULTS AND DISCUSSION

1. Benefit-Cost analysis

The gross returns from poultry farming comprise of receipts from sale of broilers, manure and empty gunny bags. The gross returns per farm and per bird in the reference to 200 birds were computed and furnished in Table 2. It is seen from the table that the major portion of the total returns were obtained from the sale of birds followed by receipts from the sale of manure and sale of empty gunny bags.It is clear from the table that the gross returns per farm indicated an indirect relationship with the farm size. The gross returns per farm were Rs 94810.96 on small farm, Rs 91633.17 on medium farms and Rs 91533.11 on large farms. Similar type of result was reported by Balamurugan and Manoharan (2014).

Table 2: Returns from the broiler production (Rs/200 birds)

S.N.	Particulars	Size of farm		
		Small(Rs)	Medium(Rs)	Large(Rs)
1	Returns from birds	92656.10	88974.36	88327.50
2	Returns from manure	2019.29	2430.20	2650.49
3	Returns from Gunny bags	135.57	228.61	555.12
4	Total returns	94810.96	91633.17	91533.11
5	Returns per bird	474.05	458.17	457.67

(Source: Field Survey, 2020)

The returns from the sale of birds were Rs 88327.50, 88974.36 and 92656.10 for large, medium and small farm respectively. The return from the sales of manure from large, medium and small farm were Rs 2650.49, 2430.20 and 2019.29 respectively. The returns from the sales of gunny bags were Rs 555.12, 228.16 and 135.57 for large, medium and small farm respectively. Further it was observed that the return per birds per farm for large, medium and small farm was Rs 457.67, 458.17 and 474.05 respectively. Thus, it was observed that the returns per bird per farm showed an inverse relationship with the farm size. Similar type of result was reported by Balamurugan and Manoharan (2014).

The total cost of production per bird was maximum (Rs.372.93) in small farms and minimum (Rs.340.96) in large farms, it was Rs.361.42 in medium farms which was calculated by adding total variable and fixed cost. Production costs per bird indicated an inverse relationship with the farm size. Similar result was also reported by Rajendran *et al.* (2008) and Balamurugan and Manoharan (2014).

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Table 3: Net income from the broiler production (Rs/200 birds)

S.N.	Particulars	Size of farm		
		Small	Medium	Large
1	Total cost	74586	72283	68192.24
2	Cost/birds	372.93	361.42	340.96
3	Net return	20000	19350.17	23340.87
4	B.C ratio	1.27	1.26	1.34
5	Benefit/bird	100	96.75	116.70
6	Weight of bird	2.63	2.58	2.54
7	Benefit/bird/kg	38.02	37.5	45.95
8	FCR	1.68	1.81	1.89

(Source: Field Survey, 2020)

The net returns per farm and per bird are presented in Table 3. The net returns per farmand per bird indicated a positive relationship with the farm size. It was calculated by deducting the total costs from gross returns.

Further, it is observed that the net returns per farm were Rs 20000 on small farms Rs 19350.17 on medium farms, Rs 23340.87 on large farms. The net returns per bird were also calculated and were in the order of Rs 100, 96.75 and 116.70 on small, medium and large farms respectively. It is further seen that the benefit cost ratios 1.27 for small farms, 1.26 for medium farms, and 1.34 for large farms. This indicates, larger farm has high benefit cost ratio as compare to small farm. The results are in accordance with the finding of Singh *et al.* (2010) and Ahmed *et al.* (2010). It is observed from the above table that the Feed Conversion Ratio for small farms was 1.68, for medium farms 1.81 and for large farms 1.89 .The Feed Conversion Ratio indicates that as the farm size increased the FCR also increases due to high feed wastage by larger farmers. So wastage need to be minimize to get higher profit from the farm.

2. Production function analysis

Table 4 shows the production function analysis of broiler production in Rupandehi district. The regression coefficient for chick cost was estimated to be 0.037 which clearly explains that keeping all other things constant, 100% increase in the chick cost the gross return was expected to be increased by 3.75%. Similarly with the increase in 100% of feed cost, vaccine cost and others cost (litter, labor, transportation, marketing etc.) the gross return was expected to be increased by 8.6, 2.6 and 1.7 % respectively.

The coefficient of multiple determinations (R^2) of the production function was 0.52 for broiler production which indicated that about 52.2% of variations in gross return have been occurred due the explanatory variables, which were included in the model. The adjusted R^2 was estimated to be 44.4%. Most of the included variables (the flocked size, feed cost, and cost of medicines, electricity expenditure, litter material and other cost) had positive impact on return which is supported by the findings of Rana *et al.* (2012), Ramana Reddy (2004) and Eze *et al.* (2013).

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Table 4: Production function analysis of broiler production in Rupandehi district

Factors	Regression coefficients	Standard Error	t Stat	P-value
Intercept	2.346	1.2217	8.46	8.41E-14
Ln chick Cost	0.037	0.0610	0.28	0.77
Ln feed Cost	0.086	0.0884	0.97	0.32
Ln vaccine Cost	0.026	0.0617	0.27	0.78
Ln others Cost	0.017	0.05235	0.32	0.74

R^2= 52.2 Adjusted R^2= 44.4

(Source: Field Survey, 2020)

3. Marketing of broiler in Rupandehi district

The marketing of broiler in Rupandehi district is diversified that the broiler farmers sold the broilers through different channel. The different agent involve in the marketing of broiler are producer, retailer, wholesaler, dealers, commission agent, middleman and finally consumers.

The study shows that, the average wholesaler purchased at Rs 160/kg of broiler and sell at Rs 212/kg of broiler of that area. The average retailer purchased at Rs 187/kg of live weight of broiler and sells at Rs 300/kg for processed meat. The average consumer buy at Rs. 301/kg of processed meat. The different channel of marketing of broiler is given below.

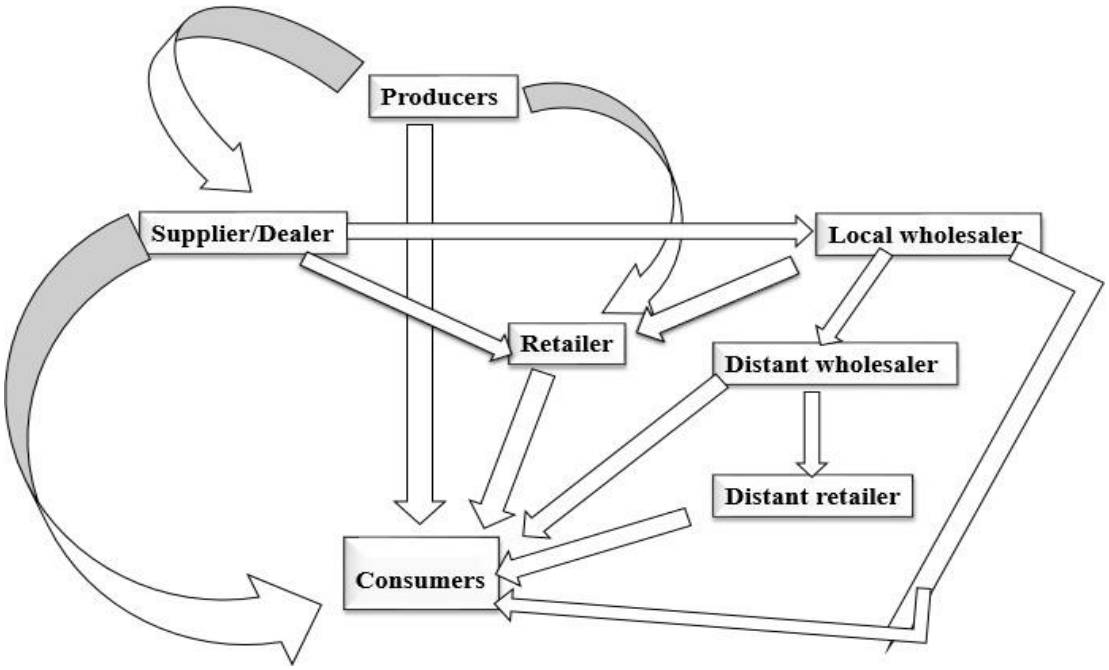

Figure 1: Marketing channel (Source: Field Survey, 2020)

4. SWOT Analysis

The SWOT analysis was done to identify the Strength, Weakness, Opportunity and Threat in the broiler production business in the study area. The SWOT analysis was done on the basis of the interview taken with broiler farmers, wholesalers, retailers and consumers in the study area of the district. They are presented as below:

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Table 5: SWOT matrix of broiler production in Rupandehi district.

Strength	Weakness
• High demand of poultry meat in the market. • Motivation for raising high community broilers. • The abundance of labor in agriculture, especially broilers. • Family attitudes, mutual cooperation and high togetherness. • Climate suitability. • Unique quality and seasonal advantage in the nearby area. • Higher number of unemployed youth. • To some extent there exists the access to market information system, road and transportation facilities. • Availability of the quality feed and chicks within the district. • Income generating business for poor marginalized people	• Increasing cost of production. • Lack of proper knowledge about poultry production. • Improper maintenance of housing. • Lack of maintenance of bio-security throughout the production • Poor association of poultry farmers across the value or supply chain. • Price fluctuation in poultry's meat. • Lack of enforcement of rules, regulations and guidelines. • Lack of grandparent stock farm in Rupandehi. • Religious and cultural restrictions. • Outbreak of different diseases. • Lack of slaughterhouse and processing plant. • Lack of quality feed ingredients
Opportunities	**Threats**
• Import of broiler meat is high as compare to export of meat. • Production of organic fertilizer from broiler manure. • Labor Absorption • Commercial sectors are involving in broiler farming. • Employment opportunity • Marginal land can be utilized for broiler production.	• Price fluctuating. • Lack of good coordination between production and marketing. • Citizens protest due to air pollution. • Request for chicken size must be above 2 kg. • High harvest fish substitution. • Higher competition in broiler farming. • Farmers, especially small farmer do not want to take the risk against food security. • Inflow of the broiler from India and other district. • Lack of quality chicks and feed. • Farmers have inadequate information on marketing of broiler. • Incidence of insect, pest and wild animals.

(Source: Field Survey, 2020)

The information provided by the SWOT is helpful in matching the resource and capability of the firm in the today's competitive advantages. SWOT analysis in chicken was also carried out by Unakitan and Abdikoglu (2016).

CONCLUSION

From the research, it was concluded that investment in broiler farming had found profitable in all farm-sizes. There was higher profit from large size farm as compared to medium and small size farm. Wholesaler and dealers were the active agent for the marketing of broiler. Inspite of broiler production potentiality, there were many constraints in production, marketing channel especially middleman getting more margine as compare to farmers and research site. These constraints should be addressed with on farm research involving the poultry producer along with others entrepreneurs to earn maximum profit from from the broiler farming.

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Authors' Contributions

N. Aryal conducted research, collected and analyzed data as well as wrote the manuscript. B. Dhital, B.K. L. Karna provided guidance in writing the manuscript. J. Lamichhane and S. Khanal contributing data analysis and writing the manuscript. All authors have read and agreed to the publication version of the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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