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An Economic Analysis of Poultry Egg Production in Nepal

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Abstract: Poultry is one of the fastest growing segments of the agricultural economy, particularly in developing countries. By using different econometric models, this study estimated the production efficiency and effectiveness of poultry farming. The objective was to examine the socio-economic status, estimate the costs and returns and production efficiency in production of egg. A stratified random sampling technique was applied. Feed conversion ratio, egg-feed price ratio and benefit-cost ratio were analyzed statistically to estimate the production efficiency. Various social factors like age of farmers, family size and number of laying birds were found significantly affecting the poultry business. Various investment patterns in farms their respective values and worked out the level of significance was analyzed. The analysis of net return was differed significantly with farm size with higher net return in large farm. This study concluded that large farm has higher mass of egg production and lower feed conversion rate indicating higher profit margin with enlarge in farm size.

Key words: Poultry, agricultural economy, socio-economic status, cost of production

INTRODUCTION

Egg production, fertility and hatchability are important reproductive traits that determine the success of any poultry industry (Islam *et al*., 2002). Poultry production has long been recognized as one of the quickest ways for a rapid increase in protein supply in the shortest run. The demand and supply gap for animal protein intake is so high. The FAO recommends that the minimum protein intake by an average person should be 65 gm/day; of this, 36 gm should appear from animal sources (FAO, 2009). A large egg yolk contains approximately 60 calories and the egg white contains about 15 calories (Memon *et al*., 2015). Majority of egg consumption is in intensely populated region of Asia where egg serves as major protein source. However, great variety exists in the production, processing and pricing of eggs and egg products (Ernst, 2010). The insufficient land holding, land fragmentation and seasonal agriculture are basic constraint in poultry industry in developing counties. China is leading country in egg production with production of 495.75 billions of eggs (Statista, 2016). Poultry farming can be a viable option for rural poor to address these issues. Poultry can be a good source of supplementary farm income. Not only egg and meat, but also poultry manure, a by-product of poultry which is generally considered to be richer in plant nutrients than manure from any other animal sources.

Nepal is predominantly an agricultural country. Around two-third of the population is engaged in agriculture contributing nearly 34% of national gross domestic product (GDP). Livestock being traditionally integrated with agriculture as a supplementary source of income with contribution of 15% to national agriculture GDP (MoAC, 2013) plays important roles in human food and nutritional security, livelihood, regional balance, gender main streaming and rural poverty alleviation (ILO, 2004). Livestock farming exists in all regions of Nepal, including the mountain, hill and plain belts, with variations based on climate, topography and socio-economic factors. Nepal has largely a smallholder livestock system under which farmers raise small numbers of livestock in small land holdings (Pradhanang *et al*., 2015). The government has adopted an agriculture perspective plan (APP) as a 20-year priority focused forward-looking strategy. The plan aims to accelerate agricultural growth by about 5% per year and increase agricultural income from 0.5 to 3% over that period (Regmi, 1999). There is about 47.96 million fowl population in Nepal with 28.3% laying hen which produces 887.24 million table eggs. Average annual growth rate of hen egg production has been 2.43% during last ten years. Chitwan, one of the districts of Nepal, lies in central development region, has the highest fowl population (13.4%) with highest hen egg production (24.51%) (MoAC, 2013).

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The poultry industry of Nepal has been increasing (MoAC, 2013), however, poultry enterprise is facing various problems in its expansion. Farmers fail to realize substantial return from their poultry enterprises on account of high production cost, lack of technical know-how and efficient management practices. On account of rising cost of chicks, feed and other inputs, the cost of production is proportionately higher than the prices of poultry products. This has led the profitability of the poultry raising farmers in doubt. Feed alone accounts around three fourth of total costs. Therefore, unless the farmers are aware that how efficiently they are feeding their fowls, they cannot estimate their production efficiency. Keeping the above aspects in view the present study we aimed at accomplishing the following objectives:

1: To study of socio-economic characteristics of the poultry egg farms in the study area
2: What are the costs and returns in poultry egg production
3: Is there any relationship between inputs and output obtained in poultry egg production

This study demonstrates socio-economic analysis of poultry egg production, production efficiency and includes benefit cost ratio of different types of poultry farm. This article is the first study in Nepal in poultry industry sector in its production efficiency analysis.

MATERIALS AND METHODS

Study area: The study was carried out in Chitwan district, one of the most potential areas of livestock and poultry production. Chitwan was already the largest poultry production pocket of the country (Bhattarai, 2005) with human population 0.58 million (CBS, 2012). Currently livestock pattern is changing from household sustainable level to commercialization both in poultry and dairy sectors. Chitwan district extend from 27°21' to 27°52' North latitude and 83°54' to 84°48' East longitude with a total land area of 218000 ha, located at an altitude of 141 to 1943 m. The annual rainfall: 1950.7 Mm. Mean temperature: 32.2-18°C and average relative humidity: 83%.

Sampling and source of data: The data used in this study was obtained from the questionnaires administered to the producers at laying hen farms in Chitwan district. Chitwan basically is divided as 3 different zones as Eastern Chitwan, Central Chitwan and Western Chitwan. Within these selected local government areas, a stratified random sampling was used in selecting poultry egg farms. Chitwan district has over 150 registered laying hen farms however, all the farmers/producers did not want to give the information and some farm was closed down, finally 60 registered farms in each local government organization were identified and selected purposively as respondent. These farms were divided into three types according to number of hens type I: less than 3000 birds (36 farms), type II: 30001 to 10000 birds (15 farms) and type III: over 10000 birds (9 farms).

Poultry breeds use in this study

Hyline brown: It is a chicken hybrid breed of American origin produced by crossing Rhode Island Reds rooster with Light Sussex hens. They have soft- brown feathered and white toe nails, yellowish legs and beak. It's fairly medium and has a vertical single comb with five separate points. Hyline brown is hardy, docile and a good egg layer more than 300 eggs per cycle (http://www.hyline.com).

Lohmann brown: It is an egg-laying breed of chicken. It is of hybrid origin, https://en.wikipedia.org/wiki/Lohmann_Brown - cite_note-1 and selectively bred from New Hampshires and other brown egg laying breeds. Lohmann Brown are hardy, they adapt themselves to all climates and environment. It has an egg production rate of approximately 300 eggs per hen in the first laying year (https://en.wikipedia.org/wiki/Lohmann_Brown).

The two chicken breeds have similar egg laying characteristics and does not affect the design of the study.

Data collection: Primary data pertaining to the production cycle falling in the year 2012-13 and 2013-14 were collected from the respondents through personal interview method using a survey schedule developed. The secondary sources of information include textbooks, journals, articles, conference proceedings, bulletins, annual reports and other relevant publications'. Simple descriptive analysis was done to examine the investment pattern on layer farms. Total costs and total returns were computed by using simple statistical tools. Feed conversion ratio, egg-feed price ratio and benefit-cost ratio were worked out to measure the production efficiency.

Costs: Total costs included fixed cost and the variable cost. Fixed cost included depreciation on building and equipments, interest on investment in fixed capital assets etc. Variable cost included cost incurred in the purchase of day old chicks, feed, labour, medicine, interest on working capital and miscellaneous expenses (Electricity, Fuel, Water, Telephone, Litter, Stationery, Bulb, Crate, Plastic etc). Costs of depreciation were calculated for farm buildings and machines capital as described in previous study (Erkus *et al*., 1995) for the building made of concrete 2%; for wood buildings 4%; for stone buildings 1.5% and for the tool-machine capital 5% depreciation was taken into account (Erkus *et al*.,

1995). We analyzed the fixed cost of production and variable cost of production as more than one production activity was carried out with the same tool-machines. In the sharing of common costs, the utilization ratios of tools-machines in the laying hen farming were taken into account. Management cost was considered to be 3% of the variable cost. For egg production calculation the revolving fund interest was not calculated because the egg were produced and sold on a daily basis (Kiral *et al*., 1999). Production values were obtained from the laying farm and variable cost was deducted from it to get the gross profit. We also found the net profit by deducing production cost from gross production value. Finally the relative return was calculated (Erkus *et al*., 1995; Rehber, 1993).

Returns: In order to arrive at total returns, the return from sale of eggs, culled birds, manure and empty gunny bags were added up:

$$\text{Total cost/100 eggs} = \frac{\left[\begin{array}{l}\text{Total cost of production} - \\ \text{Returns from culls, manure} \\ \text{and empty gunny bags}\end{array}\right]}{\text{Total number of eggs produced}} \times 100 \quad (1)$$

$$\text{Gross return/100 eggs} = \frac{\left[\begin{array}{c}\text{Return from} \\ \text{sale of eggs}\end{array}\right]}{\left[\begin{array}{c}\text{Total number of} \\ \text{eggs produced}\end{array}\right]} \times 100 \quad (2)$$

$$\left[\begin{array}{c}\text{Net return/100} \\ \text{eggs}\end{array}\right] = \left[\begin{array}{c}\text{Gross return/100} \\ \text{eggs}\end{array}\right] - \left[\begin{array}{c}\text{Total cost/100} \\ \text{eggs}\end{array}\right] \quad (3)$$

$$\text{Cost/100 birds} = \frac{\text{Total cost of production}}{\text{Number of birds housed}} \times 100 \quad (5)$$

$$\left[\begin{array}{c}\text{Gross return/100} \\ \text{birds}\end{array}\right] = \frac{\left[\begin{array}{c}\text{Returns from} \\ \text{birds}\end{array}\right] + \left[\begin{array}{c}\text{Returns from} \\ \text{sale of eggs}\end{array}\right]}{\left[\begin{array}{c}\text{Total number of} \\ \text{birds housed}\end{array}\right]} \times 100 \quad (6)$$

$$\left[\begin{array}{c}\text{Net return from} \\ \text{100 birds}\end{array}\right] = \left[\begin{array}{c}\text{Gross returns from} \\ \text{100 birds}\end{array}\right] - \left[\begin{array}{c}\text{Cost/100} \\ \text{birds}\end{array}\right] \quad (7)$$

$$\left[\begin{array}{c}\text{Net return over variable} \\ \text{cost/100 birds}\end{array}\right] = \left[\begin{array}{c}\text{Net return/100} \\ \text{birds}\end{array}\right] + \left[\begin{array}{c}\text{Fixed cost/100} \\ \text{birds}\end{array}\right] \quad (8)$$

$$\left[\begin{array}{c}\text{Average egg} \\ \text{production/bird/year}\end{array}\right] = \frac{\left[\begin{array}{c}\text{Total number of} \\ \text{eggs produced}\end{array}\right]}{\left[\begin{array}{c}\text{Total number of} \\ \text{birds housed}\end{array}\right]} \quad (9)$$

Estimation of production efficiency: In order to measure the production efficiency of egg production, feed conversion ratio, egg feed price ratio and benefit-cost ratio were worked out for one production cycle of 18 months in the following way.

Feed conversion ratio: It is an index of production efficiency expressed in terms of kilograms of feed consumed per 100 eggs laid:

$$\text{Feed conversion ratio} = \frac{\text{Feed consumed/bird (Kg)}}{\text{Eggs laid/bird (in hundreds)}}$$

Egg-feed price ratio: Egg-feed price ratio shows the value of eggs produced per unit cost incurred on feed consumed:

$$\text{Egg-feed price ratio} = \frac{\text{Value of eggs produced/bird}}{\text{Value of feed consumed/bird}}$$

Benefit-cost ratio: Benefit-cost ratio is the ratio between the gross returns from eggs, culled birds, manure and empty gunny bags to the total cost of inputs used:

$$\text{Benefit-cost ratio} = \frac{\text{Gross returns}}{\text{Total costs}}$$

Statistical analysis: Data collected in this study were entered, cleaned and coded using MS-Excel and they are converted into Text MS-DOS. Multiple regression analysis was done to study the socio-economic impact of poultry farming. To study the effect different factors on egg production parameters, data were analyzed by Least Square procedure (Harvey, 1990) statistical software package. Statistically significant means were compared using DMRT computer software package.

RESULTS

The study is described into two subsections:

1: Socio-economic characteristics
2: Physical productivities and net returns on poultry eggs farming

Socio-economic characteristics of the poultry farmers: Results of the study showed that 5% of the respondent are within the age 21-30, 68.33% fell within the age range of 31-50 years, 26.67% fall within age 50 above. Majority of the respondents were educated with 63.34% having tertiary education, 28.33 and 8.33% had secondary and primary education, respectively. About 28.1% of the respondent had less than 5 years of experience, 25.0% had 6-10 years of experience, 18.0% had 11-15 years of experience and 28.33% had more than 15 years of experience in poultry egg production. 95% of the respondents had access to veterinary service

and 60% had access to extension services. About 10% of the respondents had less than 1000 layers, 50% had 1001-3000 layers, 25% of the respondents had 3001-10000 layers and 15% of the respondents had over 10000 birds.

Determination of socio-economic factors influencing poultry egg production: A multiple regression Analysis model was used to know how the socio-economic factors can influence the egg production in Chitwan District. Factors like Age, Education attained, experience in poultry farming, access of veterinary facilities, extension facilities, size of the farm, number of family members and male female ratio in family were considered. Finally these data were analyzed factor influencing the egg production was calculated. Numbers of family members was found highly significant ($p = 0.000$) for the poultry farm enterprise, however, age of the farmer ($p = 0.041$), farmers experienced ($p = 0.012$) and size of the farm ($p = 0.05$) were significant factors for poultry egg business (Table 1).

Items of investment on layer raising farms: Capital items are the means of production and contribute to the flow of income for the farm households. Size of building and number of capital items used, determine the size of flock. We choose the basic elementary items of investment as maintained on layer raising farms (Table 2). We analyzed the various items invested over farm per 100 birds and found that number of feed mixture, number weighting balance, number of bucket and electric bulb/tubes were found highly significant ($p = 0.01$); however items like number of feeder, number of sprayer, number of egg nests were found significant ($p = 0.05$) when compared the three different farms. Others investment items like number of drinker, water pump, water pipe line, number of de-beaker, number of generator were different in different farm but these difference were not significant.

We did the valuation of each item that were taken as items used as investment in layers farms and analyzed the valuation statistically (Table 3). Our result revealed that investment over area of building and investment over generator were highly significant ($p = 0.01$) between three types of farm. The cost of building when calculated per 100 birds was found highest large sized farm than small size and medium size farm. Investment pattern over drinker, feed mixture, weighting balance, sprayer, de-beaker, electric bulbs and egg nest were significant ($p = 0.05$) in different farm types however the investment on equipments like feeder, water pump, water pipe line, water tank was found non-significant. No of laying hens was found highly significant ($p = 0.01$) in three types of farms.

Cost-returns and economic indicators on different size of layer farms: An account of various fixed and variable cost items on different category of farms per 100 bird basis was analyzed statistically (Table 4). We included depreciation on building, depreciation on equipments and interest on fixed capital as fixed cost. Nevertheless day old chick's price, feed cost, labor cost, medicine cost, miscellaneous cost and interest on working capital were calculated as variable cost. We found highly significant difference ($p = 0.01$) of all fixed cost with respect to types of farm. The pattern of costing was found significantly higher in small sized farm than medium size farm and large sized farm. Similar model was found in the costing of day old chick's, feed cost per 100 birds and interest on working capital with significant ($p = 0.05$) lower price for large sized farm. Results illustrate difference in the labor cost, medicine cost and miscellaneous cost between three different farms but these results were not statistically significant.

Returns on different size of layer farms: Gross returns along with constituents thereof on small, medium and large farms along with the overall farm situation were analyzed (Table 5). We analyzed return from egg, return from culled birds, return from manure and return of selling empty gunny bags per 100 birds. We found the return from the egg was significantly ($p = 0.05$) lower in small farm as compared to medium and large farms. However the return per others items were different in different types of farm, but these were not statistically significant. We finally analyzed the gross return, net return and net return per variable cost. No significant difference was found in gross return however the net return and net return over variable cost was highly significant ($p = 0.01$) in three farms.

Economic indicators: The economic indicators i.e., total cost, gross returns, net return and net return over variable cost per 100 eggs along with the average egg production per bird was analyzed (Table 6). Result raveled that, the cost of production of 100 egg was significantly lower ($p = 0.05$) in large sized farms. No significant difference in gross return, net return and net return over variable cost per 100 eggs was found. We also analyzed the number of eggs per bird but no significant difference was found.

Production efficiency in egg production

Feed-conversion ratio (F-C ratio): Feed conversion ratio was calculated on the two different bases. The feed efficiency ratio in physical terms and feed efficiency ratio in economic terms. The feed efficiency in physical term in different size of layer farms was analyzed (Table 7) and it was found significantly ($p = 0.01$) better in large

Table 1: Multiple regression analysis showing the socio-economic factors influencing poultry egg production among farmers

Variables	Coefficients	Std. errors	t-value	p-value
Age	0.367	0.03	2.431	0.041
Level of education	61.221	11.50	0.549	0.451
Experienced	11.119	3.12	0.343	0.112
Access to veterinary service	28.807	9.09	1.330	0.111
Access to extension service	27.098	11.12	0.209	0.101
Size of the farm	1.090	0.002	3.412	0.002[a]
Family members	0.021	0.001	8.212	0.004[a]
Family (Male: Female) ratio	12.3.0	1.220	0.919	1.091

[a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 2: Items of Investment on layer raising farms

	---------- LSM±SE ----------				
Particulars	Small farm	Medium farm	Large farm	Overall	p-value
Floor area (sq feet)/100 birds	195.12±1.22[a]	163.21±1.23[a]	196.22±2.87[a]	179.87±1.01	0.021
Feeders/100 birds	3.16±0.04	2.96±0.03	2.52±0.03[a]	2.63±0.02	0.032
Drinker/100 birds	2.12±0.22	2.38±0.98	2.23±0.22	2.24±0.22	NS
Feed Mixture/100 birds	0.05±0.05[a]	0.2±0.01	1.25±0.01	0.50±0.01	0.006
Balance/100 birds	0.55±0.02[a]	0.65±0.02[a]	3.9±0.76	1.70±0.95	0.007
Bucket/100 birds	5.08±0.12[a]	2.81±1.24[a]	10.13±1.12	8.62±1.11	0.002
Water Pump/100 birds	0.08±0.02	0.03±0.33	0.02±0.91	0.02±0.91	NS
Water tank/100 birds	0.18±0.013	0.84±0.08	0.65±0.98	0.68±0.22	NS
Water pipe length/100 birds	22.57±0.45	17.03±0.22	20.27±0.77	20.18±0.16	NS
De-beaker/100 birds	0.01±0.01	0.02±0.01	0.25±0.09	0.09±0.04	NS
Sprayer/100 birds	0.11±0.34[a]	0.04±1.22[a]	0.03±0.99[a]	0.26±1.01	0.046
Electric bulb, Tubes/100 birds	0.82±0.44[a]	0.81±0.03[a]	1.86±0.11	1.61±0.43	0.007
Generator/100 birds	0.03±0.04	0.04±0.23	0.01±0.09[a]	0.02±0.09	0.005
Egg nests/100 birds	2.51±1.23[a]	3.61±1.22[a]	2.69±1.22[a]	2,85.53±1.22	0.031
No of hens	1180±10.23[a]	3574±11.19	14373±10.21	6376±10.29	0.002

[a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 3: Investment pattern on layer raising farms

	---------- LSM±SE ----------				
Particulars	Small farm	Medium farm	Large farm	Overall	p-value
Building/100 birds	36088.70±11.34	18382.82±21.43	9905.22±13.54[a]	12269.47±17.34	0.002
Equipment/100 birds	7727.80±1.23[a]	6835.46±2.22[a]	9612.51±1.78[a]	8976.86±2.22	0.042
Feeder of adult/100 birds	1257.90±1.22	1022.66±2.35	909.83±2.34	952.34±3.54	NS
Drinker of adult/100 birds	851.04±0.34	861.11±0.44	1246.64±1.22	1150.14±1.21	NS
Feed mixture/100 birds	148.31±0.09[a]	258.81±0.12[a]	484.24±0.12[a]	421.38±0.14	0.044
Balance/100 birds	229.66±12.34[a]	79.88±17.44[a]	437.80±14.23[a]	358.06±34.32	0.033
Bucket/100 birds	151.69±33.43	94.99±55.43	274.27±39.86	233.20±22.37	NS
Water pump/100 birds	315.25±12.22	169.42±16.79	167.33±19.09	176.84±33.65	NS
Water tank/100 birds	680.08±8.82	363.46±6.45	577.92±3.33	544.12±4.39	NS
Water pipe/100 birds	338.56±3.47	265.53±2.47	30.44±6.87	93.37±3.54	NS
De-beaker/100 birds	50.85±1.21[a]	16.09±2.22[a]	105.89±2.43[a]	85.71±1.47	0.024
Sprayer/100 birds	237.92±34.43[a]	96.53±33.32[a]	56.08±25.55[a]	74.86±38.77	0.012
Bulb/100 birds	165.68±23.41[a]	115.02±11.23[a]	324.67±19.04[a]	275.67±32.41	0.018
Generator/100 birds	379.66±44.32[a]	655.43±43.23[a]	2592.01±22.40	2093.55±19.89	0.008
Egg nest/100 birds	778.47±10.09[a]	568.69±10.45[a]	390.23±8.51[a]	447.50±11.23	0.021

[a]/ [ab] significant at 90% level [abc] significant at 95% level

farm (F-C ratio = 2.55). It can be concluded that large farmers were more efficient in egg production than their counterparts of small and medium size. Again, the F-C ratio in economic terms was also analyzed and found large farms have significant (p = 0.01) lower F-C ratio (Table 8). The perusal of the table indicates that the feed-egg price ratio for overall farm was 0.68±0.01. The feed-egg price ratio on all the three sizes of farms was less than unity.

Benefit-cost ratio: Benefit-cost ratio is another parameter to measure the efficiency of egg production. The perusal of Table 9 shows that the benefit-cost ratio on all the three size group of layer raising farms was greater than unity. We found significant (p = 0.01) higher B-C ratio in large farm when analyzed statistically. This result reveals that all the three size of layer raising farms were economically viable in egg production.

Table 4: Items of cost on different size of farms

	Category of farms				
Cost of items	Small	Medium	Large	Overall	p-value
Fixed cost:					
Depreciation on building/100 birds	3.75±2.22	1.29±2.22	0.08±2.22[a]	0.31±2.22	0.004
Depreciation on equipments/100 birds	0.84±0.37	0.25±0.33	0.06±0.76[a]	90.15±0.32	0.003
Interest on fixed capital/100 birds	8.94±7.22	1.66±2.22	0.34±8.98[a]	0.85±2.87	0.009
Total fixed cost/100 birds	13.53±11.11	3.21±12.14	0.48±12.12[a]	1.31±12.12	0.004
Variable cost:					
Chick cost/100 birds('00)	122.263±5.55[a]	109.913±6.56[a]	99.191±3.33[a]	102.622±6.65	0.037
Feed cost/100 birds ('000)	125.151±7.65[a]	155.141±2.34[a]	109.011±4.56[a]	119.099±10.23	0.024
Labor cost/100 birds	4574.39±1.11	4435.12±1.11	4039.87±1.23	4146.390±1.91	NS
Medicine cost/100 birds	8918.32±6.12	9475.11±9.08	9446.32±5.57	9410.81±4.45	NS
Miscellaneous cost/100 birds	3385.65±1.23	3625.98±1.01	3081.69±3.34	3354.44±2.34	NS
Interest on working capital/100 birds	7404.12±1.11[a]	6919.78±1.11[a]	6130.54±..1.13[a]	6335.98±1.21	0.042
Total variable cost/100 birds ('000)	161.659±4.44[a]	190.585±4.98	142.356±5.311[a]	152.606±2.34	0.003
Total cost/100 birds ('000)	187.620±3.22	202.034±2.12	149.285±2.06[a]	160.936±4.55	0.005

[a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 5: Returns on different size of layer farms ('000)

	Size of the farm				
Items of returns	Small	Medium	Large	Overall	p-value
Return from Egg/100 birds	1853.9±22.12[a]	1944.81±31.22[a]	1924.92±77.12[a]	1909.22±12.21	0.014
Return from Culled birds/100 birds	187.47±13.32	185.97±10.22	188.49±19.98	190.97±17.91	NS
Return from Manure/100 birds	41.46±4.45	44.73±4.45	31.87±4.41	34.87±4.22	NS
Return from empty Gunny bags/100 birds	9.59±2.23	8.48±1.45	7.77±1.09	8.36±1.81	NS
Gross Return/100 birds	2092.42±11.11	2183.99±11.11	2133.05±11.11	2143.42±11.11	NS
Net Return/100 birds	316.22±14.34	163.65±14.34[a]	640.20±14.34	534.06±14.34	0.002
Net Return over variable cost/100 birds	475.83±21.22	278.14±34.51[a]	709.49±44.33	617.36±13.16	0.002

[a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 6: Cost and return per 100 eggs and per 100 birds on different size of layer farms (NRs)

	Size of farms				
Items	Small	Medium	Large	Overall	p-value
Total cost per 100 eggs	524.28±12.11[a]	565.44±14.09[a]	407.18±11.01[a]	442.18±11.54	0.022
Gross return per 100 eggs	620.03±3.01	617.40±10.21	614.49±11.98	613.90±12.11	NS
Net return per 100 eggs	105.75±1.01	151.96±1.11	206.51±1.29	171.72±1.34	NS
Net return per 100 eggs over variable cost	156.69±2.12	184.57±0.19	228.84±1.01	198.65±1.98	NS
Average egg production per bird in number	294.79±21.22	304.53±12.09	308.38±18.91	309.23±26.11	NS

[a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 7: Feed-conversion ratio per bird on different size of layer farms

Size group	Feed consumed per bird (kg)	Average weight of the egg	Feed-conversion ratio
Small	47.38±0.33	17.45±0.13	2.69±0.15
Medium	47.08±0.33	18.32±0.56	2.56±0.33
Large	46.15±0.12	19.45±0.18	2.36±0.32[a]
Overall	46.92±0.12	18.06±0.09	2.59±0.52

P = 0.005. [a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 8: Egg-feed price ratio on different size of layer farms

Size group	Value of feed consumed per bird (NRs)	Value of eggs produced per bird (NRs)	Egg-feed price ratio
Small	1251.51±6.78	1866.96±9.01	0.70±0.02
Medium	1477.47±9.81	1959.61±7.11	0.75±0.04
Large	1196.41±11.09	1918.93±11.09	0.62±0.01[a]
Overall	1290.99±11.11	1923.32±11.11	0.68±0.01

P = 0.006. [a]/ [ab] significant at 90% level [abc] significant at 95% level

Table 9: Benefit-cost ratio on different size of layer farms

Size group	Gross returns (NRs. per bird)	Total cost (NRs. per bird)	Benefit-cost ratio
Small	2092.42±9.01	1776.20±7.89	1.18±0.11
Medium	2183.99±1.01	2020.34±3.91	1.08±0.01
Large	2133.05±1.01	1492.85±4.12	1.43±0.98[a]
Overall	2143.42±4.11	1609.36±3.01	1.33±0.04

P = 0.005. [a]/ [ab] significant at 90% level [abc] significant at 95% level

DISCUSSION

We analyzed comparative analysis of cost of production between there different types of farms size which were categorized on the basis of significant deference between numbers of hens. From the analysis, it was found that, the overall average crop cycle of poultry farm was around 73.06±1.03 weeks (periods including starter, growing and laying phase). It was found that there was no significant difference between the farm groups in terms of total crop cycle (data not shown). We critically analyzed various social factors that may influence the egg production activities in farm. Family size, age of farmer and experience of farmer were important social factors that could affect the laying hen farming. It was found the family size with average number above five have been raring poultry farming business. It could be logistic to say, more members in family, more care to the business. Most of the farmers were of their middle age between 31-50 years and with experience of more than five years. This shows that a large number of the respondents were in middle aged in their productive years as reported previous study (Nurudeen, 2012). We reported that majority of farmers have higher education with tertiary education as Nurudeen found in his study in 2012. We found majority of the farmers were either small scale farming or medium farming. This results therefore revealed that a high percentage of the poultry egg farmers in the area were medium scale producers similar to the finding of Okonkwo and Akubu (2001).

The investment pattern was found to decrease as farm size increased. The share of total fixed cost and share of total variable cost was significantly affected by the size of the farm. Ratio of these cost were found lower in large farms. These results were consistent with the finding of previous study (Demircan *et al*., 2010). It was found that feed cost was the most important variable cost in any type of laying farm. The overall share of feed cost per 100 birds was 119000.09±10.23 which was 74.03% of the total variable cost. This finding was consistent with (Bostan, 1980) however slightly higher than the finding of Bayaner (1999). Interestingly, we found the high level of feed cost, medication cost and miscellaneous cost in medium size farm. There was no logistic cause that could explain why the feed cost was higher in medium farm but this could depend upon the purchase of various raw materials and feed additives. Also feed cost, may fluctuates due to percentage of corn and soya, the major feed materials, used in the feed formulation. Nepal Poultry industry have to partially depend upon the external source for feed raw materials, feed additives, vaccinations, antibiotics, chemicals and drugs which greatly affects the cost of chicks growing and egg production. The return through sale of eggs was of chief importance in egg production. The returns from egg depend mainly into two factors (i) number of eggs and (ii) market value of egg. Again the number of egg per bird depends upon the keeping time of the hen. In our analysis we found 51.11±1.22 weeks as the overall keeping period of laying hens (data not shown). This

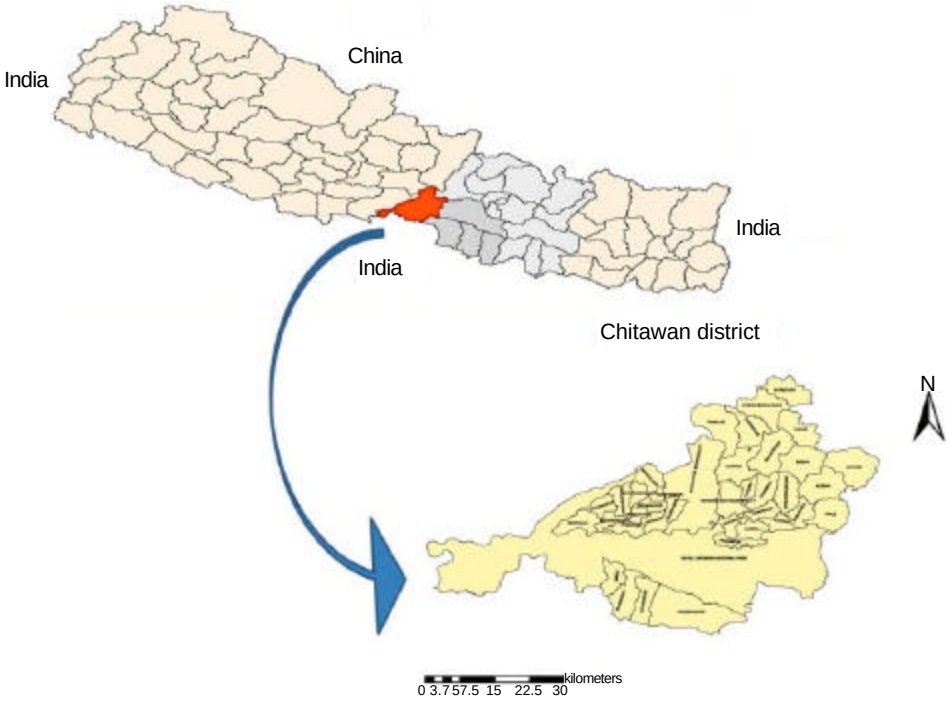

Fig. 1: Map of Nepal showing Chitwan district

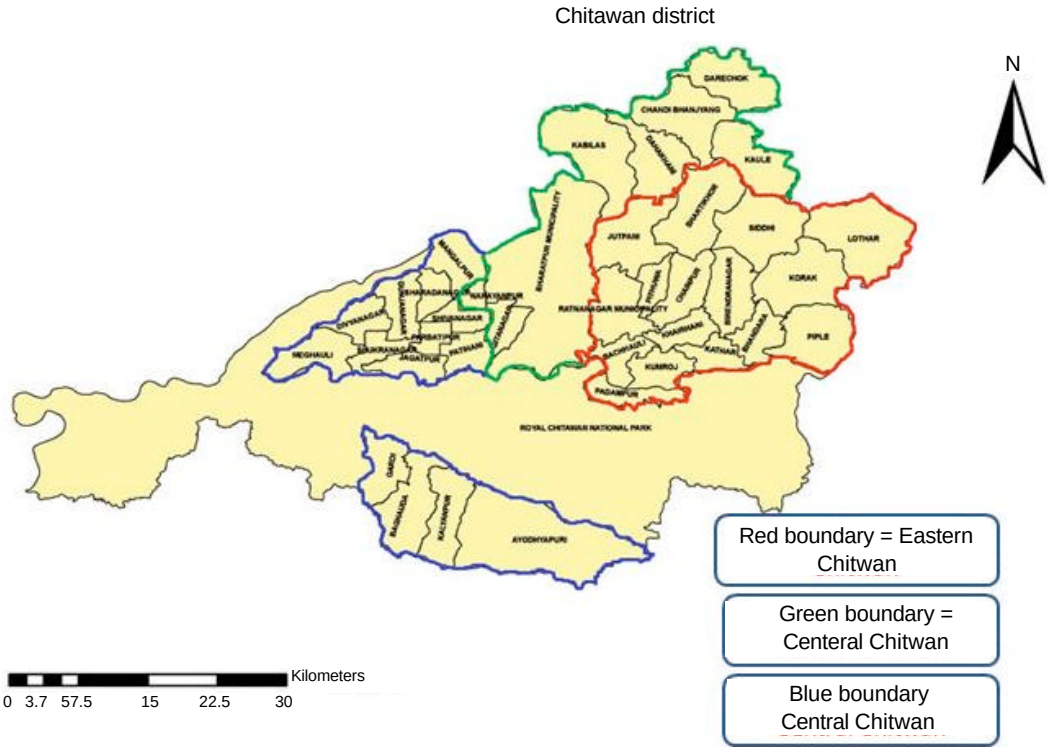

Fig. 2: Map of Chitwan district showing study area

keeping period was lower than previous study (Ozyaltirik, 1987; Bayaner, 1999). The total cost of production was significantly lower in large farms consequently the net return was significantly ($p = 0.01$) higher in large farms. These results suggest that large farms are more efficient in egg production.

Feed conversion ratio in terms of weight and in terms of price is the important factor that determines the profit-loss of the farm, as feed occupies more than 70% of expenses. The overall FCR in physical term was 2.59±0.52 and 0.68±0.01 in economic terms. A significant lower ($p = 0.01$) FCR was obtained in large farms than their counterparts. The feed efficiency ratio in physical terms was found to be 2.71 by Al Awadi *et al.* (1995); 2.77 by Kurtaslan (1997) and 2.33 by Badubi and Ravindran (2004). In the study by Horne and Bondt (2005), it was reported that the average feed efficiency ratio was 2.09 in Germany, 2.11 in France, 2.14 in England, 2.20 in Poland, 2.30 in Ukraine, 2.14 in Brazil and 2.21 in India. Shaikh and Zala (2011) worked out the feed conversion ratio as 1.97 on overall basis. These figures give the core information that, FCR values is being lowered each time in recent years. This might be because of development of cross breed types of laying hens. We also analyzed the FCR values in Chitwan (Nepal) is quite higher than the other countries. The benefit cost ratio was significantly higher in large farm (Table 9). This clearly indicates, the profitability is higher with large size farm.

Conclusion: In this study, we compared different capacity laying hen farms in Chitwan, which partially represent the poultry industry of Nepal. We included chick's price, feed consumption, production cost and profitability of the farm and finally most profitable farm was determined. Our study revealed that large farm has higher mass of egg production and lower feed consumption resulting better FCR value. Thus profit margin was found increases with increase in farm size. For this reason, the farms in the study should peruse a policy of enhancing their capacities. We also figure out that feed was the most important factor of production cost, so for reducing feed costs input of raw feed materials (corn, soya etc.) should best quality with good feed formulation supporting the type, age and breed for laying hen. The study demonstrates socio-economic analysis, production efficiency and benefit cost ratio of different types of poultry farm. As such this study should be of interest to a broad readership including those interested in agricultural economics, poultry farming and entrepreneurship and policy making.

In conclusion we can say poultry egg production is a profitable business in study area which increases with increase in size of farm. This article is the first study in Nepal in poultry egg production sector in its production efficiency analysis. This paper could be a potential breakthrough for researchers, economist, government bodies, scientist and many others having similar

livelihood like Nepal. We recommend that the government and external agencies should actively take part in providing training with all necessary technological packages required to guide farmers on improvement of egg production and minimizing cost of production.

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Author's contributions: RO conceived the study, designed and conducted all experiments/survey and interpreted experimental results. VS and DB participated in the proposal, study area design. RO, ZD, HC and DB contributed in manuscript preparations. All authors read and approved the final manuscript.

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