



Publisher homepage: www.universepg.com, ISSN: 2663-7820 (Online) & 2663-7812 (Print)

<https://doi.org/10.34104/cjbis.022.065071>

Canadian Journal of Business and Information Studies

Journal homepage: <http://www.universepg.com/journal/cjbis>

Canadian Journal of
**Business and
Information Studies**



Economic Assessment of Commercial Turkey and Broiler Farming in Bangladesh: An Application of Binary Probit Model

Mashrat Jahan^{1*} and M. Kamruzzaman²

^{1&2}Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, Bangladesh.

*Correspondence: mjahan.aec@bsmrau.edu.bd (Mashrat Jahan, Assistant Professor, Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, Bangladesh).

Received Date: 13 June 2022

Accepted Date: 15 July 2022

Published Date: 22 July 2022

ABSTRACT

A comprehensive and comparative study of Broiler and Turkey has been undertaken in Bangladesh focusing on the stability issues. This research aimed to compare the financial profit of Bangladesh's newly adopted Turkey to those of broilers. A cross-sectional survey of broiler and turkey farmers in the research areas provided the information used in the study. 180 farmers were chosen for the study using simple random and purposive sampling techniques. The data collected were analyzed using STATA and descriptive statistics. Major findings of this study indicate high gross and net return for Broiler 12.32 lac and 3.98 lac respectively although because of low cost the return over per Taka investment or BCR (undiscounted) was calculated and found high for Turkey 2.227 & of broiler 1.47. The study also revealed that farmer's age, education level had a positive and significant effect and experience, occupation, link with extension services and timely vaccination had a negative effect on choosing Turkey production (turkey = 1 and broiler = 0). The core hindrance to the turkey industry was found inefficiency in marketing, veterinary and training facilities turning to a sudden fall in the demand, discouraged farmers to adopt turkey farming. Although both species were found more or less profitable, turkey farmers documented more profit with less risk and therefore investing more in turkey could be a plan for addressing the shortage of animal protein supply as a means of increasing farm income.

Keywords: Comparative analysis, Binary probit regression, Broiler, Turkey production, and Prospects.

INTRODUCTION:

The livestock industry has been an integral agricultural subsector of the Bangladeshi economy considering its contribution to the Gross Domestic Product (GDP) and the importance of animal protein in the diet of the people. The significance of animal protein which is a major constituent of balanced diet in the meal of the people cannot be overemphasized. Chicken meat and eggs are, so far, the cheapest source of animal protein in Bangladesh and it is well accepted by all religious, economic, social, and demographic groups (Simon, 2009). Turkey production is an aspect of the poultry industry which although not much popular like broiler in Bangladesh in last few years which is very popular in many parts of the world especially Europe and America where UniversePG | www.universepg.com

they have a significant impact in the supply of meat and eggs.

This bird was taken in our country as a part of hobby, but within a short time, it got popularity among the countrymen, especially the youths and started turkey bird farming instead of broiler at different parts of the country. Although, turkey production, consumption and trade are much lower than for chicken, they have been affected by many of the same trends that have dominated somewhere the broiler industry (Dale, 2000). Farmers are rearing turkey as an ornamental bird as well as for commercial purpose with a limited extent at a lower cost comparing with broiler farming without having prior experience. But now a day it can be an imperative source of alternative and cost saving

farming against broiler for producer as it can be rear in an open area, not like the poultry farm and on the other hand, turkey disease is very rare whereas broiler industry is threatened to extinct by only a disease named bird flu. There was no concrete data on turkey rearing history in Bangladesh. Farmers are rearing turkey with an inadequate prior experience and it is increasing gradually because of a gamey flavor of meat with lower fat content (Asaduzzaman, 2017). Turkey farming is similar to other poultry birds farming like chickens, ducks, quails, etc. And very enjoyable (Chowdhury *et al.*, 2004). Despite being priced steeply compared to other poultry products, the demand for turkey meat is increasing while first introduced which has prompted various players to set up turkey rearing farms. Turkey production is an important and highly profitable agricultural industry with a rising global demand (Yakubu *et al.*, 2013), and it is adaptable to a wide range of climatic conditions. Ezeano and Ohaemesi, 2018 says profitability ratios showed the Return on Investment (RoI) of 1.53, Net return on Investment (NRoI) of 0.53, and Gross ratio of 0.66 in broiler production as against RoI (1.57), NRoI (0.57) and Gross ratio (0.64) in turkey production. Although both were found profitable, turkey farmers noted more profit. Therefore, farmers and investors should invest more in turkey production as a strategy to bridging the animal protein supply deficit. Besbes (2009) reported that the worldwide poultry sector consists of chickens (63%), ducks (11%), geese (9%), turkeys (5%), pigeons (3%) and guinea fowls (3%).

Turkey grows faster like broiler chickens and become suitable for slaughter purpose within a very short time. Turkey farming for meat production is very popular than egg production in Bangladesh (Siddiky, 2017). Turkey is more resistant to disease compared to other poultry species like chicken, duck, and quail. It has also been reported that mortality rate of turkey is very low compared to other poultry bird (Bekere *et al.*, 2022; Sampath, 2012).

The study identifies how commercial turkey farming could be an option to the protuberate trader of poultry over or along with the broiler production and to recognize the hindrances to set up this new business for the survival of the poultry industry. In this regard we set up the following objectives.

- 1) To estimate commercial profitability of broiler and turkey farming in Bangladesh

- 2) To ascertain the determinants of rearing broiler and turkey, and
- 3) To recognize the constraints in the farming of turkey and broiler.

METHODOLOGY:

Selection of the study region is an important phase for the farm management research. "The area in which a farm business survey is to be carried out depends on the particular purpose of the survey and the possible cooperation from the farmers" (Yang, 1965). Based on area and production, the present study was conducted in one of the highest Turkey and broiler growing districts of Bangladesh. Gazipur, Dhaka, Mymensingh and Tangail. For the present study, the data were collected from primary sources.

Primary data were collected from the respondent farmers through personal interview. During interview, proper care and caution was taken by the researcher to maintain accuracy and reliability of data. The research assistant did all possible efforts to maintain a congenial relationship with the respondents so that the respondent farmers feel free to give accurate data to the researcher. Before interviewing, the major aim and objectives of the study were explained to each and every respondent farmer.

Analytical technique

In this study, we aimed to determine socioeconomic and demographic issues affecting the decision of the customer to produce turkey or broiler. Given the dichotomous nature of the purchaser, a qualitative response model is appropriate. Qualitative response models relate the probability of an event to various independent variables. Such models are often useful when assessing producer characteristics that are associated with farming decisions. In accordance with providing a detailed investigation of the production preferences, either broiler or turkey farming, we applied a discrete choice probit model for binary choice (yes, no) responses to the production preferences question. The probit model is a statistical probability model with two categories in the dependent variable (Liao, 1994). Probit analysis is based on the cumulative normal probability distribution. The binary dependent variable, y , takes on the values of zero and one (Aldrich and Nelson, 1984). The probit analysis offers statistically substantial findings of which demographics increase or decrease the probability of consumption. In the binary probit

model, turkey rearing preference is taken as 1, while broiler farming as 0. It is assumed that the household obtains maximum utility; it has the preference of producing turkey rather than broiler. The probability p_i of choosing any alternative over not choosing it can be expressed as in (2), where ϕ represents the cumulative distribution of a standard normal random variable (Greene, 2011)

$$P_i = \text{prob} \left[Y_i = \frac{1}{X} \right] = \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt \dots (1)$$

$$= \Phi(x_i'\beta)$$

The relationship between a specific variable and the outcome of the probability is interpreted by means of the marginal effect, which accounts for the partial change in the probability. The marginal effect associated with continuous explanatory variables X_k on the probability $P(Y_i = 1 | X)$, holding the other variables constant, can be derived as follows (Greene, 2011)

$$\frac{\partial p_i}{\partial x_{ik}} = \phi(x_i'\beta) \beta_k \dots (2)$$

Where; ϕ represents the probability density function of a standard normal variable. The marginal effect on dummy variables should be estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived from the following (Greene, 2011)

$$\Delta = \Phi(x\beta, d = 1) - (\bar{y}\beta, d = 0) \dots (3)$$

The marginal effects provide insights into how the explanatory variables shift the probability of frequency of turkey production. Using the econometric software LIMDEP (Greene, 2011) marginal effects were calculated for each variable while holding other variables constant at their sample mean values. Factors influencing farmers attitudes towards produce a product may include product attributes, price as well as producer’s social demographic and possible interaction between these factors (Peng, 2006). In this study, we assume that socioeconomic and demographic characteristics of the producer affected the adoption of either turkey or broiler farming. These characteristics are gender, age, education, experience, family size, occupation. The assessment of the cost items was a tough task as the local units had to convert into standard unit. The cost items were classified into variable costs and fixed costs. The variable costs were constructed on the

prevailing market price multiplied with the regarded quantity for individual farmer and so the fixed cost. Input used in the research area was both purchased and family supplied. Thus, the total production costs consisted of cash and non-cash expenses farmers had to pay cash for the purchased inputs and on the contrary, farmers did not pay for home supplied inputs.

RESULTS AND DISCUSSION:

Cost analyses of Turkey and Broiler

The monetary analysis of this research was based on one growing year. **Table 1** shows different cost items like costs of day-old chicks, feed, veterinary medicine, transport, labor, housing, tools equipment, electricity bill, litter and maintenance cost was taken into consideration. The economic statistics obtained from the experiment shows how the broiler farms are more cost intensive than turkey. Construction of houses, Tools and equipment’s, maintenance and transportation are the costs which were made the turkey production expensive. But compare to broiler in total cost turkey can be a low-cost product. The average day-old chick cost was Tk. 25667 per farm per year and it covers 3.07 percent of the total cost compared to the average poultry price per farm per year Tk. 14767 covering 6.11% of total cost. Human labour is needed for performing different operations like feeding and watering, cleaning of farm, medical care, purchasing inputs and selling birds activities. Labour was measured in terms of man-day that usually consists of 8 hours. Labor wage was reported to vary based on different operation and season. Compare to turkey broiler is more labor-intensive costing Tk. 50013 covers the 5.99 percent of the total. Due to maintain the congenial environment inside the house, the farm owner has to repair the house which includes some cost named as repairing cost. Although turkey can be raised in both free range and intensive system, Turkey consumes generally a bigger space than broiler as a giant-sized poultry bird. The average per farm per year housing cost was estimated at Tk. 13005 while for turkey the cost is higher to Tk 18062.5.

Broiler and turkey farms generally used feeder, drinker, brooder, fan, bulb, khunti, and tube-well etc. The average tools and equipment cost is 5 times more in turkey (5.70%) for per farm per year compare to broiler. Electricity was very essential for poultry farms for maintaining temperature while moreover litter cost includes the cost of rice bran,

lime and cement which is an imperative cost for broiler production. So, conveniently the average electricity and litter cost per farm per year was higher Tk. 46107.4 and Tk. 19192.5 than turkey respectably. In the study area, farmers transport their purchasing input such as feed, day old chicks and litter by the means of easy bike, rickshaw, van and pulling cart from feed mill to their farm and constituted a very small proportion of the total cost. Feed

expenses comprised a major part of the entire costs in both. The broiler farm owner uses ready-made feed. The feed cost was estimated by multiplying average quantity of the feed intake by broiler birds to the average per kg price of the feed. In the period of data collection average price of the feed bag containing 50 kg feed was Tk. 2177.

Table 1: Cost of broiler and turkey production.

Particulars	Broiler	% of total	Turkey	% of total
Day old chick price	25667	3.07	14767	6.11
labor	50013	5.99	18400	7.61
Housing	13005	1.55	18062.5	7.47
Tools & equipment	8835	1.05	13787.5	5.70
Electricity bill	46107.4	5.52	12202.86	5.50
Liter	19192.5	2.30	5500	2.27
Transportation cost	2837	0.34	4890	2.02
Feed cost	608795	72.99	132918.4	55.02
Veterinary Expense	57992	6.95	16050	6.64
Maintenance cost	1630	0.19	4996.25	2.06
Interest on operating capital	112707.41	13.51	14680.71	6.07
Total	834073.88	100	241574.55	100

In the present study, feed cost was Tk. 608795 which accounted for the 72.99 percent of the whole cost. When calculated for turkeys which are generally raised by feeding foragers it was just 6th time lower to broiler Tk. 132918.4 accounted for the 52.02 percent of the overall. Farmers in the research area were very careful about the causes of diseases. So, they use medicine and vaccine to protect their farm from diseases outbreak. In the study area farmer do not pay any fees for veterinarian service because this service was provided by the govt. veterinary doctor. Broiler farmers also purchase additives for the broiler production. Here, additives mean feed supplement for broiler which is mixed in the feed so that the broiler birds can get enough nutrients from regular meals. So, the farmers add vitamins, amino acids, fatty acids, minerals, feed energy, antioxidants, acidifier, antimicrobial and growth promoting factor with the feed. The average Medicare and additives cost per farm per year were Tk. 57992 and that covers total cost by 6.95%. Where turkey need only Tk.16050 for veterinary service since the high immunity power. For maintaining purpose broiler farmer spent only 1630 taka while Turkey farmer faced 4996.25 taka of expense. Interest on operating capital includes variable costs in the both production which was calculated for one year period. Interest

UniversePG | www.universepg.com

rate of 8.5 percent per annum was considered for calculation. It was assumed that if the owner of the broiler farm borrowed money from any financial institution, he would have paid interest at the above-mentioned rate. The interest rate on operating capital was Tk. 112707.41 for per farm per year for broiler and Tk. 14680.71 for turkey respectively.

Revenue from turkey and Broiler production

Gross return is the total revenue earned from the production which includes return from the main product and by-product. Following **Table 2** shows that Gross-return from broiler is much higher Tk. 1232786.78 than turkey Tk. 550001.875. For net return the picture told the same. But in the case of BCR turkey farm grows profit more than broiler.

Table 2: Total return of turkey and broiler.

Output	Broiler	Turkey
Gross return	1232786.78	550001.875
Net return	398712.9	308427.325
BCR	1.47	2.277

Benefit Cost Ratio (BCR) considering total cost of production and total return is also presented in **Table 3** for both for turkey and broiler. Return over per Taka investment or BCR (undiscounted) was calculated as a ratio of gross return to total cost. The

BCR or return over per taka of turkey was 2.227 which mean that by investing Tk. 1.00, farmers would earn Tk. 2.227 in return. The BCR of broiler was 1.47 which means that by investing Tk. 1.00, farmers would earn Tk. 1.47 in return. It was clear that although turkey production did not earn higher gross return and net return than broiler but because of lower cost incurred in turkey, it possesses high return to the last dollar invested. On the basis of above discussions, it could be said that production of turkey was estimated more profitable than that of broiler. Cultivation of turkey other than broiler would help growers to increase their income. The need to produce more food for more people with fewer resources will arise more frequently, and in order to meet this growing need for meat protein, we

will need to rely more heavily on the production of high-quality meat.

Determinants of Turkey and Broiler Production

The production of turkey and broiler was likely to be influenced by different socioeconomic factors. Nine variables such as, farmer’s age, gender, farm size, occupation, education level, farming experience, training received, maintenance cost, Link with extension service, Timely vaccinated and Timely sale of output were included in the model. Results shows that farmer’s age, gender, education level, farm size, training, maintenance cost & timely sale of output had positive influences and experience, occupation, timely vaccinated and link with extension services had negative influences.

Table 3: Maximum likelihood estimates and marginal effects of variables determining broiler and turkey production among respondent farmer.

Explanatory variables	Coefficient	Standard error	z-statistics	Marginal effects
Constant	-2.12	1.50	-1.41	-
Age	0.371	0.198	1.87	0.060**
Gender	0.724	0.880	0.82	0.117
Education	0.375	0.216	1.73	0.060**
Occupation	-0.605	0.244	-0.25	-0.009
Experience	-0.22	0.183	-1.24	-0.037
Farm size	0.175	0.261	0.67	0.028
Training	0.25	0.328	0.77	0.041
Maintenance cost	0.00017	0.00013	1.33	0.000028
Link with extension service	-0.47	0.367	-1.29	-0.077*
Timely vaccinated	-0.097	0.909	-0.11	-0.015*
Timely sale of output	0.379	0.405	0.94	0.061

Note: Number of observation = 180; LR chi-square (9) = 94.09; Log likelihood = -51.91; Pseudo R2 = 0.4754.

*** Significant at the 1 percent level (p < 0.01); ** significant at the 5 percent level (p < 0.05); * significant at the 10 percent level (p < 0.10).

In the probit regression, there is an additional step of computation required to get the marginal effects once one has computed the probit regression fit. Marginal effects of the regressors is, how much the probability of the outcome variable changes when one changes the value of a regressor, holding all other regressors constant at some values. Marginal effects are popular in some disciplines (e.g. Economics) because they often provide a good approximation to the amount of change in Y that will be produced by a 1-unit change in X (Cameron and Trivedi, 2009). **Table 3** demonstrates the ML estimates and marginal effects of different variables. It can be seen that farmer’s age and education were positive and significant at 5 percent level. It indicates that 100% increase of age and educational

facility increases the probability of turkey production by 6%. It means that, those farmers who are more educated and aged are eager to adopt turkey production more than broiler production. As turkey requires less hard work it is quietly familiar with the older section to have a taste of new variety. Also being newly introduced this turkey requires new innovative ideas to carry out this production operations, so increase in education level is must to adopt turkey. Experiences of farmers negatively affect the adoption strategies of the farmers. The farmers who doing business with broiler for long time are now have a quiet much more knowledge and seizure on the broiler market, capturing turkey market suddenly may incur less profit for them. Experience led to broiler by almost 4%. If the vaccination and exten-

sion possibilities increase it will increase the possibility to adopt broiler by 1% and 7% respectively. The broiler industry is often threatened by different diseases which the main hindrance of this business. Respondents in the study area believe if vaccination increases and different extension services available it is highly possible that farmers from different poultry business will switch to broiler. Fast foods processed from Broiler are so popular among the young generation and the urban people whose daily schedule is very tiring. So to capture the market through broiler is very easy as a producer. In the study it is found that 76.11% respondent wants to switch to broiler and others 23.9% in turkey.

Constraints Faced by the turkey & broiler Farmers

In the beginning of the turkey production, people bought it out of curiosity. Suddenly the demand almost vanished and the market shut down completely. We are also well-known about the fact of broiler instable market. All these problems put the industry in a deadfall. There were many problems in the research area that affected production as well as profitability of broiler and turkey cultivation. Farmers were asked about the important problems they face often during production of broiler and turkey. Those problems were then ranked and arranged in order based on the priority of the problem. The poultry market in Bangladesh also faces a considerable amount of trouble, price of chicken fluctuate frequently and often it reduced drastically which affected the farmers seriously. Following Fig. 1 represents that, 80 percent of broiler farmer and 75 % turkey farmer reported seriously about this problem. Sometimes the output price decreases drastically as a result farmers cannot cope up with the input cost and faces loss. The turkey farmers spe-

cially faced some problems like lack of medical facility, training facility, incubation problem, lack of pure breed for production and finding customer as farmers buy and sell turkey mainly through personal communication. The broiler farmer has a fear of mortality rate where turkey has a low diseases criterion. High financial problem 65% with high fees cost were very common for broiler.

CONCLUSION:

Compared to the broiler industry, the turkey industry generated a substantially higher profit. Given that turkeys can be raised using a free-range farming technique, Bangladesh has a significant potential for turkey production. It offers the poultry industry new opportunities and a fresh perspective. As a white meat, its quality is superior and it is delicious than any other meat. The turkey industry can be profitable, especially for the poor and marginal farmers, if the climate is suitable as there is natural feed available, and there are enough workers. Moreover, broiler meat has a raising demand in market that influencing the producer for making profit from this business. But comparing the whole situation farmers risk free profitability lies on turkey rearing although broiler has occupied the market with its different phases. Turkey farmers are facing some production and marketing related problems which made the demand for turkey fall suddenly. Taking proper remedial steps specially government intervention, turkey rearing could be a feasible commercial enterprise which could perform a significant role in poultry sector by supplying nutritious food, income generating activities, creating employment opportunities and thus improving the livelihood of the rural people.

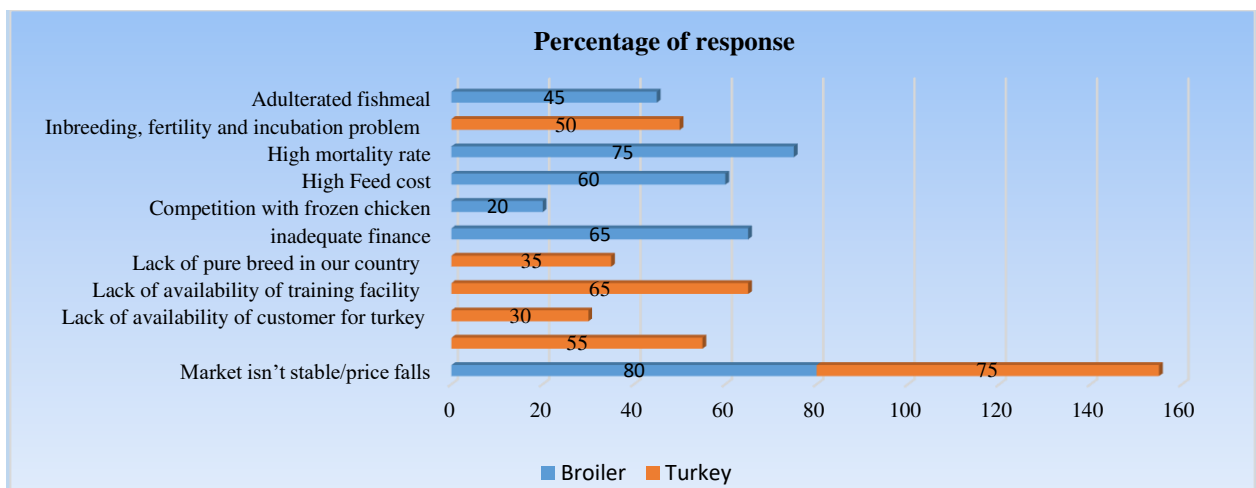


Fig.1: Percentage of the problems faced by the respondents of broiler and turkey.

ACKNOWLEDGEMENT:

The author would like to express deepest appreciation to the respondent for providing the information for this article. The paper highly acknowledges the contributions made by the authors during the development of the manuscript.

CONFLICTS OF INTEREST:

All authors declare no conflict of interest.

REFERENCES:

- 1) Aldrich J H, Nelson F D. (1984). Linear Probability, Logit, and Probit Models, *Sage Publications, Newbury Park, Calif, USA*.
<http://www.jstor.org/stable/2288960>
- 2) Asaduzzaman M, Salma U, Ali HS, Hamid MA, Miah A G. (2017). Problems and prospects of turkey (*Meleagris gallopavo*) production in Bangladesh. *Research in Agriculture, Livestock and Fisheries*, 4(2), 77-90.
<https://doi.org/10.3329/ralf.v4i2.33719>
- 3) Bekere HY, Tamanna N, Hossen MM, Abebe D, Harun MSH, and Yusuf YO. (2022). Identification and affliction of ixodid tick species in domestic animals. *Int. J. Agric. Vet. Sci.*, 4(2), 39-45. <https://doi.org/10.34104/ijavs.022.039045>
- 4) Besbes B. (2009). Genotype evaluation and breeding of poultry for performance under sub-optimal village conditions. *World's Poultry Science Journal*, 65(2), 260-271.
<https://doi.org/10.1017/S0043933909000221>
- 5) Bose T K, Som M G. (1986). Vegetables Crops in India, *Nayan Prokash, Calcutta, India*.
- 6) Cameron A C, Trivedi PK. (2009). Microeconomics Using Stata (1st edition). *Stata press, U. K.* p. 333
- 7) Chowdhury M M I, Ashraf A, Mondal S P, Mondol M, Hasan M M. (2004). Effect of season on the hatchability of duck eggs. *International Journal of Poultry Science*, 3(6), 419-421. <https://doi.org/10.3923/ijps.2004.419.421>
- 8) Greene W H. (2011). *Econometric Analysis*, 7th Edition, Stern School of Business, New York University, *Prentice Hall, USA*.
- 9) Liao TF. (1994). *Interpreting Probability Models: Logit, Probit, & Other Generalized Linear Models*, 101, Quantitative Applications in the Social Sciences, *Sage Publications, Thousand Oaks, Calif, USA*.
- 10) Masud M, Real II. (2013). Economic benefit of farmers from small-scale broiler and layer farming of Thakurgaon District, *Bangladesh Reserach Publication Journal*, 8(4), 191-195.
- 11) Miah M A, Akter M, Bakr M. (2004). Status of pulses varieties adoption in Bangladesh: A farm level study. *Bangladesh Journal of Agricultural Economics*. 27(2). 107-122.
<https://doi.org/10.22004/ag.econ.200384>
- 12) Miah M T H. (1990). *Economics of Commercial Poultry Farming in Bangladesh*, Report No. 21, *Bureau of Socio-Economic Research and Training, BAU, Mymensingh*.
- 13) Peng Y, West G E, Wang C. (2006). Consumer attitudes and acceptance of CLA-enriched dairy products, *Canadian Journal of Agricultural Economics*, 54(4), 663-684.
<https://doi.org/10.1111/j.1744-7976.2006.00072.x>
- 14) Rahman S M, Jang DH, Ju C Y. (2017), Poultry industry of Bangladesh: entering a new phase, *Korean Journal of Agricultural Science*, 44(2), 272-282. <https://doi.org/10.7744/kjoas.20170027>
- 15) Sampath K T. (2012). Turkey farming: A profitable enterprise, *National Institute of Animal Nutrition and Physiology, Adugodi Bangalore, India*, 21, 2.
- 16) Siddiky N A. ed. (2017). *Backyard Poultry Production Systems in SAARC Member States*. *SAARC Agriculture Centre, Dhaka-1215, Bangladesh*.
- 17) Simon P C. (2009). Commercial egg and poultry meat production and consumption and poultry trade worldwide. *Proceedings of the 6th International poultry show and seminar*, Dhaka, Bangladesh.

Citation: Jahan M., and Kamruzzaman M. (2022). Economic assessment of commercial Turkey and broiler farming in Bangladesh: an application of binary probit model, *Can. J. Bus. Inf. Stud.*, 4(4), 65-71.

<https://doi.org/10.34104/cjbis.022.065071> 