COST OF PRODUCTION, GROSS RETURN AND NET PROFIT IN COMMERCIAL EGG PRODUCTION

M. Farooq, Zahoor-ul-Haq[1], M.A. Mian, F.R. Durrani and M.Syed

Faculty of Animal Husbandry and Veterinary Sciences and [1]Department of Agricultural Economics, NWFP Agricultural University, Peshawar, Pakistan

ABSTRACT

The present study was carried out in Chakwal, Pakistan by collecting data from randomly selected 109 flocks to investigate cost of production, gross return and net profit per layer. Majority of the buildings in the study area were rented therefore, rent per layer was added to the total cost of production instead of depreciation on building and equipments. Overall total cost of production, gross return and net profit per layer was Rs. 393.88 ± 5.36, 432.14 ± 8.01 and 38.26 ± 6.66, respectively. Rate of return over the invested capital was 27%. Mean feed cost per layer was Rs. 302.23 ± 5.01, including Rs. 10.27 ± 0.24, 29.19 ± 0.42 and 262.77 ± 5.08 for starter, grower and layer ration, respectively. Feed cost was the major component contributing 76.73% to the total cost of production. Average cost: of labor, day-old chick, building rent, vaccination, therapy, miscellaneous item, electricity, bedding material and transportation was Rs. 19.90 ± 0.45, 19.75 ± 0.05, 16.25 ± 0.26, 12.80 ± 0.10, 10.90 ± 2.32, 4.35 ± 0.09, 3.15 ± 0.07, 2.65 ± 0.09 and 1.90 ± 0.08, respectively, contributing 5.05, 5.01, 4.13, 3.25, 2.77, 1.10, 0.80, 0.67 and 0.48% to the total cost of production. Gross return from the sale of marketable eggs, culled eggs, spent/culled bird, empty bags and manure was Rs. 388.84 ± 7.91, 3.85 ± 0.01, 35.80 ± 0.23, 2.20 ± 0.04 and 1.45 ± 10.01, respectively, contributing 89.98, 0.89, 8.28, 0.51 and 0.34% to the total return. Determining the effect of different parameters on the cost of production and net profit, large flocks, Hisex strain, brood-grow and lay system of rearing, good hygienic conditions of the farm, normal stocking rate and cage system of housing wee found to give maximum gross return as well as net profit.

Key words: Cost of production, gross return, housing and rearing system, hygiene, net profit.

INTRODUCTION

Commercial egg production is one of the important income generation activities of livestock sector resulting in rapid return and reasonable profit. A layer starts egg production at the age of 20-21 weeks (Petek, 1999) and gives Rs. 46 (Nair and Ghadoliya, 2000) to Rs. 55.13 (Zahid *et al.*, 1994) as net profit during 52 weeks of egg production cycle. Numerous factors like size of the operation, mortality, housing, management practices, health coverage, feed consumption and utilization and egg production traits affect cost of production, gross return and the net profit. According to Kumar and Mahalati (1998), size of the operation significantly affected net profit. Ames and Ngemba (1986) reported 500 birds to be the minimal flock size whereas Ascard *et al.* (1995) found 12,000 layers to be an optimum flock size for higher profitability. Nair and Ghadoliya (2000) found that larger flocks yielded higher return/bird (Rs. 62.28) than smaller flocks (Rs. 30.78). Verma and Singh (1997) reported egg as the major sources of income in egg production operation. They indicated that eggs contributed to the extent of 87% towards the gross return. Chung *et al.* (1983) found a positive association of net profit with hen-housed egg production. Mortality adversely affected net profit in commercial egg operation (Asghar *et al.*, 2000; Zahir-ur-Din *et al.*, 2001). Mortality exceeding 8-10% was reported to result in poor economic returns (North, 1984).

Keeping other factors constant, cost of production, gross return and net profit are the major financial concerns of commercial egg operations. Profit is the function of cost of production, gross return and prevalent market price, thereby minimizing cost of production and maximizing gross return would result in higher profit. However, egg price would be another important factor affecting net profit and egg production should be accordingly planned to avail the favorable market conditions. Cost of production includes fixed and variable cost. Fixed cost contributed a smaller fraction (7.33%) to total cost of production (Petek, 1999), however, its efficient utilization at the time of building construction or purchasing equipments would be more helpful in efficient production. Among variable cost components, feed cost was the major item contributing 60-80% to the total cost of production (Hatter, 1983; Qunaibet *et al.*, 1992; Mian, 1994; Zahid *et al.*, 1994) while labor and day-old chick each contributed nearly 6% to the total cost of production (Hatter, 1983; Zahid *et al.*, 1994). A wide variability is reported in the literature in cost of production, gross return and net profit in

commercial layer operations. The present study was therefore, designed to investigate cost of production, gross return, net profit and inter-relationships among various traits of economic importance in commercial egg production.

MATERIALS AND METHODS

Data source and prediction of sample size

The present study was carried out during 2000-2001 to investigate cost of production, gross return, net profit and to study the inter-relationships among various traits. Sample size for the study was predicated by calculating coefficient of variation from the data generated by Tariq *et al.* (2000). Maximum coefficient of variation was found for total number of eggs produced/flock and was therefore, selected as an index for predicting sample size to accommodate both maximum and minimum values of variations in various traits. The following model, developed by Casely and Kumar (1989) was adopted for determining sample size:

$$N = K^2 * V^2 / D^2$$

Where "N" was sample size, "K" the normal deviation at 95% confidence interval, "V" the absolute value of coefficient of variation of the selected variable and "D" the margin of error assumed to be 0.1.

Data collection

Data were collected from 109 flocks regarding flock size, stocking rate, strain of chicken, system of housing (cage vs. floor), rearing system (brood-grow-lay, brood-grow, lay and brood, grow, and lay) hygienic measures, vaccination practice, egg production and cost of feed, day-old chick, medicine, litter, brooding, labor, electricity, transportation, marketing and miscellaneous items. Similarly, data on returns from the sale of eggs, culled birds, manure and empty bags were also recorded. Hygienic status of the farm was categorized as good, average and poor on the basis of floor and house construction, vicinity of the farm, distance between sheds or other dwellings, house conditions, all-in all-out system, cleanliness and sanitation of houses/equipments and disinfecting procedures. Stocking rate in a shed was assessed in terms of number of birds/m^2 and deviation from the recommended level prescribed in breeder bulletin was considered as above or below the normal stocking rate.

Data analysis

The data were analyzed, using relevant statistical techniques of data analysis, namely, weighted means and general linear model (GLM) procedures. To account for the wide variability in flock size, weighted means were calculated instead of simple averages. The effect of stocking rate, hygienic conditions on the farm, strain of chicken, flock size, housing and rearing system on the cost of production per layer was studied, adopting the procedure of Steel and Torrie (1981). The following statistical model was constructed to ascertain the effect of aforementioned variables on cost of production per layer;

$$Y_{ijklmno} = \mu + a_i + b_j + c_k + d_l + e_m + f_n + g_{ijklmno}$$

Where "$Y_{ijklmno}$" was the response variable, "μ" the population constant common to all observations, "a_i" the effect of i-th hygienic condition of the farm (i = poor, average and good), "b_j" the effect of j-th stocking rate (j=normal, below normal and above normal stocking rate), "c_k" the effect of k-th rearing system (k= brood-grow-lay; brood-grow-lay; brood, grow, lay), "d_l" the effect of l-th housing system (l = cage vs. floor rearing), "e_m" the effect of m-th flock size (m=small; ≤ 10,000, medium; > 10000≤ 20000 and large; > 20000), "f_n" the effect of n-th strain of chicken (n=Babcock, Nick-chick, Hyline and Hisex) and "$g_{ijklmno}$" the residual term associated with each $Y_{ijklmno}$ normally, independently and identically distributed with mean zero and unit variance.

RESULTS AND DISCUSSION

Findings pertaining to cost of production, gross return and net profit in table egg production on commercial scale are discussed in the following sections.

Cost of building and equipments

Majority of layer farms located in the project area were run in rented houses. The average rent charged for the building along with the necessary equipments was Rs. 16.25 ± 0.26 per layer/year, contributing to 4.13% to the total cost of production (Table 1). A small number of farms were in owners built houses but the cost was highly variable because of difference in quantity, year of construction and lack of authentic information, and were not considered in the study. The rent of building and equipment, compared on the basis of flock size, showed significant differences. The cost per layer/year was Rs. 17.32 ± 0.45, 16.84 ± 0.52 and 14.58 ± 0.35 for small, medium and large flocks, respectively (Table 1). The rent of building and equipment when examined in flocks with different stocking rate revealed significantly higher cost (Rs. 17.08 ± 0.41) for below normal stocking rate followed by normal (Rs. 16.56 ± 0.37) and above normal stocking rate (Rs. 15.11 ± 0.63, Table 4). Hatter (1983) found negative association of building rent with flock size. Significantly higher ($P < 0.05$) building rent per bird was observed in cage housing (Rs. 16.68 ± 0.31) as compared to floor rearing (Rs. 15.82 ± 0.30, Table 3). The relative higher building rent per layer in cages could be due to the additional charges of better housing and equipments.

Table 1. Overall cost of production per layer, gross return and net profit as affected by flock size

Variables	Overall cost of production		Flock size		
	Cost/Return (Rs.)	Percent contribution	Small	Medium	Large
Building and equipment rent	16.25 ± 0.26	4.13	17.32_a ± 0.45	16.84_b ± 0.52	14.58_c ± 0.35
Day-old chick	19.75 ± 0.05	5.01	19.74 ± 0.01	19.76 ± 0.06	19.75 ± 0.10
Starter ration (a)	10.27 ± 0.24	2.61	10.19 ± 0.45	10.24 ± 0.38	10.38 ± 0.34
Grower ration (b)	29.19 ± 0 42	7.41	28.20_b ± 0.79	29.77_a ± 0.67	29.60_a ± 0.60
Layer ration (c)	262.77 ± 5.08	66.71	269.04_a ± 3.40	267.53_b ± 15.83	251.74_c ± 6.54
Total feed cost (a+b+c)	302.23 ± 5.01	76.73	307.42_a ± 3.70	307.55_a ± 15.84	291.72_b ± 6.39
Labour charges	19.90 ± 0.45	5.05	22.28_a ± 0.83	19.24_b ± 0.84	18.18_c ± 0.56
Vaccination	12.80 ± 0.10	3.25	13.24_a ± 0.17	12.75_b ± 0.23	12.41_b ± 0.13
Medicaments	10.90 ± 2.32	2.77	11.48_b ± 0.02	12.03_a ± 1.19	9.20_c ± 0.35
Miscellaneous	4.35 ± 0.09	1.10	3.77_a ± 0.02	3.70_a ± 0.17	1.99_b ± 0.09
Electricity charges	3.15 ± 0.07	0.80	3.64_a ± 0.03	2.73_b ± 0.14	1.58_c ± 0.09
Bedding	2.65 ± 0.09	0.67	4.82_a ± 0.19	4.88_a ± 0.23	3.51_b ± 0.12
Transportation charges	1.90 ± 0.08	0.48	3.04_a ± 0.02	1.58_b ± 0.02	1.08_b ± 0.10
Total cost of production	393.88 ± 5.36	100.00	406.71_a ± 4.12	400.98_b ± 16.9	374.10_c ± 6.85
Return from marketable eggs	388.84 ± 7.91	89.98	379.70_c ± 13.73	386.35_b ± 23.10	400.46_a ± 10.2
Return from spent/culled birds	35.80 ± 0.23	8.28	35.56_b ± 0.36	35.42_b ± 0.77	36.42_a ± 0.27
Return from culled eggs	3.85 ± 0.01	0.89	4.17_a ± 0.04	3.91_{ab} ± 0.02	3.47_b ± 0.01
Return from empty bags	2.20 ± 0.04	0.51	2.19 ± 0.06	2.25 ± 0.12	2.17 ± 0.05
Return from manure	1.45 ± 10.01	0.34	1.43 ± 0.02	1.42 ± 0.02	1.49 ± 0.01
Gross return	432.14 ± 8.01	100.00	423.02_c ± 13.72	429.37_b ± 23.62	444.04_a± 10.26
Net profit	38.26 ± 6.66	-	18.06_c ± 6.36	29.17_b ± 23.08	67.40_a ± 6.60

Means with different subscripts across the rows are significantly different ($p<0.05$).

Table 2. Cost of production, gross return and net profit per bird (Rs.) as affected by strain of the chicken

Variables	Babcock	Hisex	Hyline	Nick-chick
Building and equipment rent	15.03_b ± 0.38	16.82_a ± 0.73	16.26_a ± 0.40	16.89_a ± 0.51
Day-old chick	20.12_a ± 0.06	19.11_b ± 0.06	19.72_a ± 0.01	20.05_a ± 0.08
Starter ration (a)	10.47_b ± 0.40	9.17_c ± 0.27	10.06_b ± 0.52	11.37_a ± 0.44
Grower ration (b)	29.50_b ± 0.62	27.74_c ± 1.12	28.23_c ± 0.82	31.30_a ± 0.74
Layer ration (c)	269.46 ± 5.17	269.18 ± 12.64	257.68 ± 12.84	254.77 ± 13.5
Total feed cost (a+b+c)	309.43_a ± 5.17	306.08_b ± 12.22	295.96_d ± 17.4	297.44_c ± 13.5
Labour charges	20.20_a ± 0.69	19.99_a ± 1.11	18.77_b ± 0.68	20.64_a ± 1.19
Vaccination	12.48_b ± 0.09	12.91_a ± 0.30	13.30_a ± 0.20	12.52_b ± 0.21
Medicaments	9.70_c ± 0.28	11.49_b ± 0.57	13.33_a ± 0.16	9.09_d ± 0.25
Electricity charges	3.42 ± 0.12	3.17 ± 0.15	3.25 ± 0.16	2.76 ± 0.20
Bedding	2.68 ± 0.13	2.87 ± 0.21	2.62 ± 0.17	2.43 ± 0.26
Miscellaneous	4.68_a ± 0.15	4.58_a ± 0.16	4.58_a ± 0.23	3.74_b ± 0.17
Transportation charges	2.41_a ± 0.16	1.95_{ab} ± 0.27	1.82_{ab} ± 0.14	1.41_b ± 0.16
Total cost of production	400.26_a ± 5.74	398.92_b ± 13.52	389.49_c ± 13.24	387.04_c ± 14.4
Return from marketable eggs	366.94_d ± 9.14	414.60_a ± 20.42	384.80_b ± 21.83	389.03_c ± 13.9
Return from spent/culled birds	36.01_a ± 0.32	35.94_{ab} ± 0.48	35.37_b ± 0.01	35.88_{ab} ± 0.31
Return from culled eggs	3.71 ± 0.01	3.86 ± 0.03	4.07 ± 0.07	3.76 ± 0.02
Return from empty bags	2.26 ± 0.03	2.24 ± 0.09	2.17 ± 0.10	2.14 ± 0.11
Return from manure	1.46 ± 0.01	1.46 ± 0.02	1.42 ± 0.01	1.46 ± 0.01
Gross return	410.24_d ± 9.28	458.24_a ± 20.48	427.82_c ± 22.25	432.26_b ± 16.0
Net profit	10.98_d ± 6.50	58.60_a ± 15.57	38.31_c ± 20.81	44.95_b ± 14.8
Cost benefit ratio	1:1.02	1:1.15	1:1.10	1:1.12

Means with different subscripts across the rows are significantly different ($p<0.05$).

Feed cost

Mean feed cost per layer was Rs. 302.23 ± 5.01, including Rs. 10.27 ± 0.24, 29.19 ± 0.42 and 262.77 ± 5.08 for starter, grower and layer ration, respectively (Table 1). As depicted in Table 1, feed cost was the major component contributing 76.73% to the total cost of production. Hatter (1983; 72.38%) and Qunaibet *et al.* (1992; 70%) reported lower, while Zahid *et al.* (1994; 81.76 %) reported higher contribution of feed cost to the total cost of production. As given in Table 1, feed cost was significantly ($p < 0.05$) lower in large (Rs. 291.72 ± 6.39) as compared to small (Rs. 307.42 ± 3.70) and medium flocks (Rs. 307.55 ± 15.84). Significant differences were found in feed cost among different strains as is evident from Table 2. Brood-grow and lay system of rearing was most favorable from the point of view of feed cost per bird, followed by brood, grow, lay and brood-grow-lay. Normal stocking rate and cage system of housing were significant factors in reducing feed cost and giving higher return and improving the net profit. Based on the values in available literature and the present findings, it is clearly evident that feed cost is the single most prominent factor affecting the cost of production and a saving in this component will have a positive impact in a way not to have adverse affects on production, gross return and net profit.

Cost of day-old chick

Average cost of day old chick was Rs. 19.75 ± 0.05 with a coefficient of variation of 12.35% (Table 1). Its contribution to total cost of production was 5.01%. Hatter (1983; 4.17%) and Zahid *et al.* (1994; 4.56%) reported smaller contribution of the cost of day-old chick to total cost of production than the present findings. The cost of day old chick showed comparatively small variation as compared to other components. This was due to the stable price of day-old chick in the market and procurement of chicks by farmers during the same period. Layer operation in the target area was mostly practiced on a uniform seasonal pattern in accordance with the market forces controlling the egg prices. Farmers were receiving chicks in the months of April through May to get their flocks ready for egg production during September in order to get full benefit of the prevailing higher egg prices during the winter season (October to April).

Labour cost

Mean labour cost per layer was Rs. 19.90 ± 0.45, contributing 5.05% to the total cost of production (Table 1). Hatter (1983) reported higher contribution (6.52%, whereas, Zahid *et al.* (1994) observed smaller contribution of labour cost (3.53%) to total cost of production. Stocking rate, flock size and housing system affected labour cost. Labour cost per layer was significantly higher ($p< 0.05$) in small (Rs. 22.28 ± 0.83) than large flocks (Rs. 18.18 ± 0.56; Table 1). Hatter (1983) also reported negative association of labour cost with flock size. Higher labour cost per layer was also found for floor-reared layers (Rs. 21.13 ± 0.70) as compared to cages (Rs. 18.67 ± 0.69; Table 3). Labour cage housing system was lower because of significantly less labour involved in feeding and management.

Vaccination and medicament cost

Vaccination and medicament cost per layer was Rs. 12.80 ± 0.10 and Rs. 10.90 ± 2.32, contributing 3.25 and 2.77% to the total cost of production in each case, respectively (Table 1). Hatter (1983) reported a little higher contribution of medicament cost (3.88%), whereas Zahid *et al.* (1994) reported its lower contribution (1.76%) to total cost of production than the present findings. Flock size, hygienic conditions, stocking rate and housing system had a significant effect ($P<0.001$) on cost of vaccination and medicaments. Medication cost was higher for medium (Rs. 12.03 ± 1.19) than large flocks (Rs. 9.20 ± 0.35, Table 1). As shown in Table 4, higher ($p<0.05$) cost of medication was found in birds maintained under poor hygienic conditions at above normal stocking rate as compared to good hygiene and normal stocking rate. Significantly higher ($p<0.05$) medicament cost was found for birds reared on floor as compared to those in cages (Table 3). The higher medicament cost in the present study at above normal stocking rate under poor hygienic conditions and for birds kept on floors could be due to substandard rearing environment resulting in stressful conditions and disease outbreaks. Disease outbreaks and stressful conditions will call on for more inputs in terms of medicines.

Electricity and bedding cost

Average electricity and bedding cost per layer was Rs. 3.15 ± 0.07 and Rs. 2.65 ± 0.09, contributing less than 1% to total cost of production in each case, respectively. Flock size and housing system significantly ($p<0.01$) affected cost of bedding material. Higher ($p<0.05$) cost of bedding material per layer was found for small (Rs. 3.64 ± 0.03) than large flocks (Rs. 1.58 ± 0.09, Table 3). The smaller cost of bedding material for large flocks was mainly due to extensive use of cages.

Miscellaneous and transportation cost

Mean miscellaneous and transportation cost was Rs. 4.35 ± 0.09 and Rs. 1.90 ± 0.08, respectively (Table 1). Miscellaneous charges contributed about 1% while transportation charges contributed less than 1% to total cost of production. Farooq *et al.* (2001) also reported less than 1% contribution of the transportation cost to total cost of production. Asghar *et al.* (2000) and Zahir-ud-Din *et al.* (2001) reported a little higher contribution of transportation charges in broilers than the present findings. In case of egg production, most of the major items like feed and chicks were supplied to the farm by the suppliers

Table 3. Cost of production, gross return and net profit per bird (Rs.) as affected by rearing and housing system

Variables	Rearing system			Housing system	
	Brood-grow-lay	Brood, grow, lay	Brood-grow, lay	Cage	Floor
Building and equipment rent	$16.30_a \pm 0.60$	$15.77_b \pm 0.40$	16.68a ± 0.36	$16.68_a \pm 0.31$	$15.82_b \pm 0.30$
Day-old chick	19.72 ± 0.10	19.73 ± 0.07	19.80 ± 0.90	19.82 ± 0.62	19.68 ± 0.63
Starter ration (a)	10.06 ± 0.60	10.15 ± 0.33	10.59 ± 0.37	10.49 ± 0.33	10.05 ± 0.31
Grower ration (b)	29.40 ± 0.92	29.12 ± 0.63	29.05 ± 0.73	$28.85_b \pm 0.62$	$29.53_a \pm 0.72$
Layer ration (c)	$273.88_a \pm 10.95$	$259.15_b \pm 9.17$	$255.29_c \pm 5.16$	$251.99_b \pm 5.59$	$273.55_a \pm 8.89$
Total feed cost (a+b+c)	$313.34_a \pm 10.69$	$298.42_b \pm 9.11$	$294.93_c \pm 4.97$	$291.33_c \pm 6.12$	$313.13_b \pm 7.11$
Labor charges	$22.86_a \pm 0.88$	$19.57_a \pm 0.65$	$17.27_c \pm 0.66$	$18.67_b \pm 0.69$	$21.13_a \pm 0.70$
Vaccination	$13.09_a \pm 0.24$	$12.98_a \pm 0.17$	$12.34_b \pm 0.11$	12.63 ± 0.10	12.97 ± 0.10
Medicaments	$11.64_a \pm 0.38$	$10.95_a \pm 0.70$	$10.11_b \pm 0.20$	$8.71_b \pm 0.13$	$13.09_a \pm 0.21$
Electricity charges	3.49 ± 0.15	3.06 ± 0.12	2.90 ± 0.10	3.24 ± 0.09	3.06 ± 0.07
Bedding	$3.64_a \pm 0.06$	$2.66_a \pm 0.10$	$1.65_c \pm 0.08$	$1.80_b \pm 0.05$	$3.50_a \pm 0.13$
Miscellaneous	$4.91_a \pm 0.19$	$4.58_a \pm 0.15$	$3.73_b \pm 0.15$	4.54 ± 0.12	4.26 ± 0.17
Transportation charges	$2.48_a \pm 0.16$	$1.83_b \pm 0.12$	$1.39_b \pm 0.80$	$1.61_b \pm 0.09$	$2.19_a \pm 1.02$
Total cost of production	$411.36_a \pm 11.12$	$389.45_b \pm 9.57$	$380.98_c \pm 5.38$	$379.04_b \pm 5.82$	$408.82_a \pm 5.93$
Return from marketable eggs	$379.12_c \pm 18.66$	$387.10_b \pm 13.43$	$400.31_a \pm 7.99$	$400.50_a \pm 7.74$	$377.18_b \pm 7.74$
Return from spent/culled birds	$35.53_b \pm 0.43$	$35.55_b \pm 0.44$	$36.33_a \pm 0.03$	$36.04_a \pm 0.22$	$35.56_b \pm 0.21$
Return from culled eggs	$4.42_a \pm 0.02$	$3.70_b \pm 0.01$	$3.42_b \pm 0.01$	$2.30_b \pm 0.01$	$5.40_a \pm 0.02$
Return from empty bags	2.23 ± 0.09	2.23 ± 0.06	2.14 ± 0.03	2.17 ± 0.04	2.23 ± 0.03
Return from manure	1.45 ± 0.02	1.44 ± 0.01	1.45 ± 0.01	1.32 ± 0.01	1.58 ± 0.02
Gross return	$422.79_c \pm 18.8$	$430.01_b \pm 13.63$	$443.62_a \pm 8.04$	$443.21_a \pm 7.75$	$421.07_b \pm 7.57$
Net profit	$13.85_c \pm 11.22$	$40.32_b \pm 11.54$	$60.46_a \pm 6.21$	$60.76_a \pm 6.98$	$15.66_b \pm 6.12$

Means with different subscripts across the rows are significantly different ($p<0.05$).

Table 4. Cost of production, gross return and net profit pre bird (Rs.) as affected by hygiene and stocking rate

Variables	Hygiene			Stocking rate		
	Poor	Average	Good	Normal	Below normal	Above normal
Building and equipment (rent)	16.06 ± 0.42	16.40 ± 0.49	16.29 ± 0.43	$16.56_b \pm 0.37$	$17.08_a \pm 0.41$	$15.11_c \pm 0.60$
Day-old chick	19.69 ± 0.08	19.66 ± 0.10	19.90 ± 0.07	19.88 ± 0.07	19.79 ± 0.07	19.58 ± 0.12
Starter ration (a)	$9.55_b \pm 0.38$	$10.39_a \pm 0.53$	$10.87_a \pm 0.36$	10.49 ± 0.32	10.23 ± 0.45	10.09 ± 0.49
Grower ration (b)	$28.54_b \pm 0.76$	$29.45_a \pm 0.87$	$29.58_a \pm 0.57$	$30.31_a \pm 0.62$	$28.56_b \pm 0.72$	$28.70_b \pm 0.9$
Layer ration (c)	$253.16_c \pm 9.58$	$261.68_b \pm 8.57$	$273.47_a \pm 6.78$	$262.78_b \pm 7.32$	$268.66_a \pm 0.45$	$256.87_c \pm 12.0$
Total feed cost (a+b+c)	$291.25_c \pm 9.39$	$301.51_b \pm 8.33$	$313.93_c \pm 0.64$	$303.58_b \pm 7.02$	$307.46_a \pm 0.72$	$295.66_c \pm 12.0$
Labour charges	$20.78_a \pm 0.70$	$20.04_a \pm 1.11$	$18.88_b \pm 0.68$	$19.71_b \pm 0.70$	$19.93_{ab} \pm 8.28$	$20.05_a \pm 1.00$
Vaccination	13.05 ± 0.17	12.86 ± 0.21	12.50 ± 0.15	18.20 ± 0.13	18.34 ± 0.13	18.60 ± 0.30
Medicaments	$13.21_a \pm 0.59$	$10.38_b \pm 0.69$	$9.11_b \pm 0.19$	$8.70_b \pm 0.18$	$9.15_b \pm 0.18$	$14.85_a \pm 0.20$
Electricity charges	$3.31_a \pm 0.11$	$3.37_a \pm 0.16$	$2.77_b \pm 0.12$	$3.31_a \pm 0.12$	$3.30_a \pm 0.12$	$2.84_b \pm 0.10$
Bedding	$3.38_a \pm 0.09$	$2.51_b \pm 0.18$	$2.06_b \pm 0.12$	$2.41_b \pm 0.13$	$2.21_b \pm 0.14$	$3.33_a \pm 0.10$
Miscellaneous	4.33 ± 0.14	4.55 ± 0.21	4.33 ± 0.15	4.51 ± 0.15	4.49 ± 0.15	4.20 ± 0.18
Transportation charges	$2.21_a \pm 0.13$	1.84 ± 0.19	$1.65_b \pm 0.16$	$1.75_b \pm 0.15$	$1.69_b \pm 0.13$	$2.26_a \pm 0.19$
Total cost of production	$387.14_c \pm 9.88$	$393.13_b \pm 8.97$	$401.52_a \pm 7.34$	$397.39_b \pm 7.51$	$401.70_a \pm 8.90$	$396.48_b \pm 12.00$
Return from marketable eggs	$369.58_c \pm 15.72$	$386.77_b \pm 11.44$	$410.17_a \pm 9.97$	$406.40_a \pm 24.18$	$390.33_b \pm 9.50$	$369.79_c \pm 24.00$
Return from spent/culled birds	$34.87_a \pm 0.46$	$36.08_a \pm 0.33$	$36.45_a \pm 0.25$	$35.84_b \pm 0.69$	$36.06_a \pm 0.33$	$35.50_b \pm 0.70$
Return from culled eggs	$4.07_a \pm 0.01$	$3.77_b \pm 0.02$	$3.71_b \pm 0.01$	$3.22_b \pm 0.02$	$3.55_b \pm 0.01$	$4.78_a \pm 0.02$
Return from empty bags	2.13 ± 0.07	2.21 ± 0.06	2.25 ± 0.04	2.20 ± 0.05	2.24 ± 0.06	2.17 ± 0.10
Return from manure	1.50 ± 0.01	1.43 ± 0.01	1.41 ± 0.01	1.43 ± 0.01	1.38 ± 0.01	1.54 ± 0.02
Gross return	$412.11_c \pm 15.94$	$430.24_b \pm 11.60$	$454.07_a \pm 9.95$	$449.19_a \pm 10.06$	$433.58_b \pm 9.59$	$413.65_c \pm 24.0$
Net profit	$26.68_c \pm 10.66$	$37.24_b \pm 15.09$	$50.71_a \pm 7.65$	$44.97_a \pm 6.84$	$35.53_b \pm 10.63$	$34.13_b \pm 17.4$

Means with different subscripts across the rows are significantly different ($p<0.05$).

at their own expense, which probably lowered transportation cost.

Overall cost of production

Average cost of production per layer from day-old till 52.5 weeks of growth and production period was Rs. 393.88 ± 5.36 (Table 1). Zahid *et al.* (1994) reported a lower cost of production per layer (Rs.277.36) than the present findings. The higher cost of production in the present study could be due to the higher input cost as a result of inflation over the periods.

Flock size, strain of chicken, housing and rearing system had a significant effect ($p<0.001$) on cost of production per layer. Significantly higher ($p<0.05$) cost of production per layer was found for small (Rs. 406.71 ± 4.12) than large flocks (Rs. 374.10 ± 6.85; Table 1). Kumar and Mahalati (1998) also reported smaller cost of production for larger than smaller flocks. Hatter (1983) observed a decrease in building and labour cost with increase in flock size. The smaller cost of production for larger flocks in the present study could be due to efficient utilization of the available resources. Higher ($p<0.05$) cost of production per layer was found for Babcock (Rs. 400.26 ± 5.74) than for Nick-chick (Rs. 387.04 ± 14.46). Non-significant differences were found in cost of production/layer between Nick-chick and Hyline (Table 2). Differences in cost of production per layer between Babcock and Hisex were also non significant (Table 2). Smaller ($p<0.05$) cost of production per layer was found under brood-grow, and lay (Rs. 380.98 ± 5.38) as compared to brood-grow-lay system (Rs. 411.36 ± 11.12). Differences in cost of production per layer were also significant in brood-grow-lay and brood, grow, and lay system (Table 3). The smaller cost of production per bird under brood-grow, and lay system could be due to more efficient utilization of the available space and extensive use of layer cages, because majority of farmers following brood-grow and lay system of rearing were keeping layers in cages during egg laying period.

Hygienic conditions on farm, stocking rate and housing system had a significant effect ($p<0.001$) on cost of production per layer. Significantly higher ($p<0.05$) cost of production per layer was observed for flocks maintained under good hygienic conditions (Rs. 401.52 ± 7.34) as compared to those kept under poor hygienic conditions (Rs. 387.14 ± 9.88; Table 4). Zahir-ud-Din *et al.* (2001) also reported higher cost of production in flocks maintained under good hygienic conditions. Higher ($p<0.05$) cost of production per layer was found at below normal stocking rate (Rs. 401.70 ± 8.90) as compared to above normal stocking rate (Rs. 396.48 ± 12.84; Table 4). Significantly lower ($p<0.05$) cost of production per layer was observed in cages (Rs. 379.04 ± 5.82) as compared to floor (Rs. 408.82 ± 5.93; Table 3). Haartsen and Elson (1989) and Horne-Van and Van-Horne (1996) observed an increase in cost of production by 16.0 and 8.2%, respectively for floor-reared birds. The smaller cost of production per layer in cages could be due to efficient utilization of the available space, minimal feed wastage and smaller labor cost per layer.

Return from marketable and culled eggs

Return from the sale of marketable and culled eggs per layer was Rs. 388.84 ± 7.91 and Rs. 3.85 ± 0.01, respectively (Table 1). Marketable egg is the main produce contributing 90% to gross return. Verma and Singh (1997) reported 87.33%, whereas Farooq *et al* (2001) reported 85% contribution of eggs to the total return. Flock size, strain of chicken, housing and rearing system, stocking rate and hygienic conditions affected gross income from the sale of marketable eggs. Higher return per bird from marketable eggs was obtained for large (Rs. 400.46 ± 10.20) than small flocks (Rs. 379.70 ± 13.73; Table 1). Higher return per layer was found for Hisex (Rs. 414.60 ± 20.42) than for Babcock chicken (Rs. 366.94 ± 9.14; Table 2). Differences in return/bird were also found between Hyline and Nick-chick (Table 2). As shown in Table 4, significantly higher return per layer was obtained under good hygienic conditions (Rs. 410.17 ± 9.97) at normal stocking rate (Rs. 406.40 ± 24.18) as compared to poor hygiene (Rs. 369.58 ± 15.72) and stocking rate above normal (Rs. 369.79 ± 24.18). Higher ($p<0.05$) return per layer was obtained in cage (Rs. 400.50 ± 7.74) as compared to floor rearing (Rs. 377.18 ± 7.74). Higher return per layer from the sale of marketable eggs for large flocks in cages under good hygiene and at normal stocking rate is attributable to good rearing environment, smaller cost of production and better utilization of the available resources.

Return from sale of spent/culled birds, empty bags and manure

Mean return from sale of spent/culled birds, empty bags and manure was Rs. 35.80 ± 0.23, 2.20 ± 0.04 and 1.45 ± 10.01, contributing 8.3, 0.9 and 0.5% to gross return per layer respectively. Flock size, strain of chicken, housing, and rearing system, stocking rate and hygienic condition affected return from the sale of culled birds (Tables 3 and 4).

Gross return and net profit

Gross return included amount realized from sale of eggs, spent/culled birds, empty bags and manure during 52.5 weeks of growth and production period. Gross return and net profit per layer was Rs. 432.14 ± 8.01 and Rs. 38.26 ± 6.66, respectively (Table 1). Rate of return over the invested capital (27%) was lower in comparison with Asghar *et al.* (2001; 80%) in broilers and Farooq *et al.* (2001; 127%) in broiler breeders. Though the return is lower, yet commercial egg production is adoptable under a variety of climatic conditions as against broiler breeders which are mainly restricted to cold locations and the

marketing problems frequently faced in broiler production are not confronted to a greater extent in egg production. Shanmugam and Kumar (1993) also reported wider adoptability for egg production in comparison with broiler production because of the degree of stability in egg marketing.

Flock size, strain of chicken, hygienic condition, stocking rate, housing, and rearing system had a significant effect ($P<0.001$) on gross return and net profit. Significantly higher gross return (Rs. 444.04 ± 10.26) and net profit (Rs. 67.40 ± 6.60) was found for large than small flocks (Rs. 423.02 ± 13.72 and Rs. 18.06 ± 6.36, respectively; Table 1). Ames and Ngemba (1985), Kumar and Mahalati (1998) and Farooq *et al*. (2001) also reported higher returns for large than small flocks. Nair and Ghadoliya (2000) reported higher return/bird for large (Rs. 62.28) than small flocks (Rs. 30.78). The smaller return and net profit per layer in the present study for small flocks could be due to poor utilization of the available resources, higher input cost and substandard management practices. Higher ($P<0.05$) gross return (Rs. 458.24 ± 20.48) and net profit (Rs. 58.60 ± 15.57) was observed for Hisex than for Babcock (Rs. 410.24 ± 9.28 and Rs. 10.98 ± 6.50 respectively). Significant differences were also found in gross return and net profit/bird between Nick-chick and Hyline (Table 2). The strain difference in gross return and net profit per layer could probably be due to genetic variability of these strains of chicken. Significantly higher ($P<0.05$) gross return (Rs. 443.62 ± 8.04) and net profit (Rs. 60.46 ± 6.21) was obtained under brood-grow and lay than under brood-grow-lay system of rearing (Rs. 422.79 ± 18.8 and Rs. 13.85 ± 11.22).

Significantly higher ($P<0.05$) gross return (Rs. 454.07 ± 9.95) and net profit (Rs. 50.71 ± 7.65) per bird was found for flocks maintained under good hygienic conditions than those under poor hygienic conditions (Rs. 412.11 ± 15.94 and Rs. 26.68 ± 10.66; Table 4). Flocks maintained at above normal stocking rate gave smaller gross return (Rs. 413.65 ± 24.64) and net profit (Rs. 34.13 ± 17.49) per layer as compared to those at normal stocking rate (Rs. 449.19 ± 10.06 and Rs. 44.97 ± 6.84; Table 4). Zahir-ud-Din *et al*. (2001) and Farooq *et al*. (2001) also reported better returns for flocks maintained under good hygienic conditions at appropriate stocking rate. Significantly higher ($p<0.05$) gross return (Rs. 443.21 ± 7.75) and net profit (Rs. 60.76 ± 6.98) was found in cages as compared to floor (Rs. 421.07 ± 7.57 and Rs. 15.66 ± 6.12; Table 3). Haartsen and Elson (1989) reported higher returns from layers kept in cages than those on floor. The smaller cost of production per layer in cages could be due to efficient utilization of house, minimal feed wastage and smaller labour cost.

Conclusion

Layers maintained in cages under good hygienic conditions at appropriate stocking rate yielded higher net profit per bird. Large flocks resulted in higher net profit than small flocks. Flock owners following brood-grow and lay rearing system obtained higher net profit than others. Egg prices were higher from October through March in the study area. For maximum profit, flocks should preferably be kept in cages under good hygiene at appropriate stocking rate. Brood-grow and lay raring system should be adopted for efficient utilization of the available space. Chicks should better be procured in April to get flocks in peak during cooler months when market price of eggs is most favorable.

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