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## Comparative Economic Analysis and Constraints in Egg Production Under Cage vs. Deep Litter Systems of Rearing in India

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**Abstract:** The objective of the present study is to estimate and compare the costs and returns in deep litter and cage systems of poultry rearing and also to identify the constraints, which affect the poultry production in India. Results of this study reveal that the fixed investment per farm is found to be more on cage system of rearing for all the three size groups. In both systems, the feed cost decrease gradually when the stock size increases except in medium size group in deep litter system and accounts for more than 84% of the total cost of production irrespective of stock size and system of rearing. The cost of production per bird reveal that the cost of permanent and family labor and electricity increase with increase in stock size in case of deep litter system whereas in cage system, it is found to decrease with increase in flock size. The cage system appears to be more efficient than the deep litter system in producing eggs and the feed efficiency increases with decrease in stock size in both the system of rearing. Further, the net returns per farm increase as the size of the farm increases in both the systems and the returns per farm is, however, higher in cage system than in deep litter system in all the three groups. The major constraints in egg production are identified and ranked by using Garrett's Ranking Technique and are in the order of high cost of feed, high cost of medicine and vaccine, supply of poor quality feed and feed ingredients, non remunerative price for eggs, lack of disease control facilities and higher rate of electricity tariff.

**Key words:** Deep litter, Cage, Indian poultry

### Introduction

Livestock is important for increased productivity in Indian agriculture. It provides food, fuel, fertilizer and draught power to sustain the rural economy. Livestock farming also serves as a subsidiary occupation to supplement the income of small and marginal farm families. Among livestock-based vocations, poultry occupies a pivotal position because of its enormous potential to bring about rapid economic growth, particularly benefiting the weaker sections. Further, it needs low capital investment and yet assures quick returns within weeks, in case of broilers, and months, in case of layers.

Eggs and poultry meat has emerged next to milk as a contributor to the output from livestock sector in recent years. The percentage contribution of eggs and poultry meat was 4.47 percent in 1951-52, which reached to a little over 9 percent in 1995-96 (Kumar and Pandey, 1999). Poultry has still a long way to go to fulfill its role as an effective instrument of socio-economic upliftment of the rural masses and as a source for meeting the protein requirement. It has also a tremendous potential of contributing to the foreign exchange earnings of the country by way of increased exports of poultry and poultry products.

In the past several studies such as Garewell (1957); Saxena and Gupta (1971); Britto and Maurice (1972); Brown (1974); Singh (1980) and many others have analyzed costs and returns in egg production using deep litter system of rearing, however, there is no detailed study has been conducted on costs and returns

comparison of deep litter and cage systems of rearing. Hence the present study is undertaken to analyze the costs and returns and constraints in egg production under cage versus deep litter systems of rearing in the southern state of India.

### Materials and Methods

Conventional analysis in the form of averages and percentages and tabular analyses are used to study the general characteristics of sample farms in terms of size distribution, educational status of farmers, land use pattern, farm assets and costs and returns in egg production. In addition, Garrett's ranking technique is used to analyze the constraints in poultry production. The poultry farmers are asked to rank the factors that are limiting the poultry production viz. non-remunerative price, supply of poor quality feed and feed ingredients, high cost of feed, lack of disease control facilities, higher rate of electricity tariff and high cost of medicine and vaccine. The order of the merit given by the respondents is changed into ranks by using the formula:

$$\text{Percent position} = \frac{100 (R_{ij} - 0.50)}{N_j}$$

Where  $R_{ij}$  = Rank given for  $i^{\text{th}}$  item by  $j^{\text{th}}$  individual  
 $N_j$  = Number of items ranked by  $j^{\text{th}}$  individual

The percent position of each rank is converted into scores by referring tables given by Garrett and

Woodworth (1969). Then for each factor, the scores of individual respondents are added together and divided by the total number of respondents for whom scores are added. The mean scores for all the factors are ranked by arranging in descending order.

**Data and Estimation:** Primary data for the period of January-March 1999 are collected from Namakkal district of Tamil Nadu, a southern Indian state, to estimate the costs and returns and to find out the constraints in egg production. This district is chosen because of its dominant position in poultry production in the state as well as in India. For the purpose of this study, an exhaustive list of poultry farms operating in the area is prepared. Based on the number of birds, farmers are grouped under small, medium and large size categories and 20 farms in each category are selected by adopting simple random sampling technique in both cage and deep litter systems of rearing. The data are collected by personal interview method with the help of pre-tested questionnaire.

The cost of egg production is categorized into fixed and variable cost. The fixed cost includes interest on fixed capital, depreciation on building, equipment, overhead tank, motor and cages, cost of day old chicks, cost of permanent and family labor and cost of electricity. Similarly, the variable cost includes cost of feed, cost of medicine and veterinary charges, cost of litter and miscellaneous costs.

Labor is an important factor in egg production and it is measured in terms of mandays. In this study, eight hours of work by an adult male is considered as one manday. Women days employed in the farm is converted into mandays on the basis of the ratio of their wages and the ratio is 1:0.75. The questionnaire also had a provision to identify the constraints in poultry production.

## Results and Discussion

As indicated earlier, the poultry farms are prestratified into small, medium and large size groups both in deep litter and cage systems of rearing on the basis of number of birds maintained. Number of farms and average number of birds in each size group are presented in Table 1. As seen from the table, the average number of birds in deep litter system in all the three size groups is 1298, 2150 and 4110 respectively whereas in case of cage system they are 2985, 4850 and 8993 respectively. The educational status of sample farmers is presented in Table 2. In deep litter system, 26.67 percent are illiterate, 23.33 percent has primary education, 31.67 percent has secondary education and 18.33 percent has collegiate education. However, all the farmers rearing birds in cage system are found to be literates with approximately 80 percent with secondary and collegiate education. More interestingly, both in cage and deep litter system, farm size increases with the level of education. For example, out of 16 deep litter farmers

with no education, 10 are small and the remaining 6 are medium farmers whereas in cage system, 22 farmers with college degree, only 4 are small farmers and the remaining 18 are medium and large farmers. This clearly indicates both the farm size and system of rearing are positively related to the level of education.

Next, cost of egg production using deep litter and cage systems of rearing are compared and presented in Table 3 to 5. As shown in Table 3, the investment on poultry shed and store room in deep litter system accounts for a major share of total fixed investment, with 81.06, 79.80 and 83.04% for small, medium and large groups respectively and the investment on equipment and machinery is found to be less. Where as in cage system of rearing, the investment on poultry sheds, cage and storeroom shared a substantial portion and accounted for 90, 89.11 and 87.50% respectively for all three groups. The investment on bore well, overhead tank, motor and equipments and machinery are lower than the deep litter system in terms of percentage.

It can be seen from Table 4 that the investment on poultry shed and store room increases with increase in farm size in deep litter where as reverse is true for cage systems of rearing. The total fixed investment per bird in deep litter was found to be less than cage system and the corresponding values for small, medium and large groups are Rs. 55.68, Rs. 49.08 and Rs. 58.15 respectively. The investment per bird on bore well, overhead tank, motor and equipments and machinery in cage system were found to be lower than the deep litter system for all the size groups in terms of percentage. Finally, the cost of production of egg per bird is estimated and is presented in Table 5. Interest on fixed capital is increased as a fixed cost per bird increases gradually with an increase in number of birds in both systems of rearing except medium size group in cage system. Depreciation cost on buildings increases with an increase in number of birds in deep litter system whereas it decreases in cage system of rearing. Unlike the past studies such as Singh and Rai (1976) and Kothandaraman and Narahari (1982), which concluded that labor cost decrease with increase in number of birds in deep litter system, our results suggest increase in labor cost with increase in number of birds. However, our results support the past finding on inverse relationship between labor cost and stock size in cage system.

In both systems, the feed cost decrease gradually when the flock size increase except in medium size group in cage system and it accounts for more than 84 percent of the total cost of production irrespective of the size of flock and system of rearing. This is relatively higher than many others past studies such as Garewell (1957); Britto and Maurice (1972); Singh (1980), who found that the feed cost to the total cost to be in the range of 50 to 73%. The cost of feed in cage system is less than that in deep litter system and the feed cost for both systems

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Table 1: Group Size, Number of Farms and Average Number of Birds in Sample Farms

System of Rearing	Group	Group Size In numbers	No. of Farms	Average number of birds per farm
Deep litter	Small	370-1650	20	1298
	Medium	1780-2810	20	2150
	Large	2917-6750	20	4110
Total farms			60	
Cage	Small	1375-3765	20	2985
	Medium	3880-5474	20	4850
	Large	6100-18777	20	8993
Total farms			60	
Grand Total	-	-	120	-

Table 2: Educational Status of Sample Farmers

Educational Status	Deep Litter				Cage			
	Small	Medium	Large	Total	Small	Medium	Large	Total
Illiterate	10(50.00)	6(30.00)	-	16(26.67)	-	-	-	-
Primary	4(20.00)	6(30.00)	4(20.00)	14(23.33)	6(30.00)	4(20.00)	3(15.00)	13(21.67)
Secondary	4(20.00)	5(25.00)	10(50.00)	19(31.67)	10(50.00)	8(40.00)	7(35.00)	25(41.67)
College	2(10.00)	3(15.00)	6(30.00)	11(18.33)	4(20.00)	8(40.00)	10(50.00)	22(36.66)
Total	20(100.00)	20(100.00)	20(100.00)	60(100.00)	20(100.00)	20(100.00)	20(100.00)	60(100.00)

(Figures in parentheses indicate percentage to total)

Table 3.: Fixed Investment Per Farm (In Rupees)

Particulars	Deep litter			Cage		
	Small	Medium	Large	Small	Medium	Large
Investment on poultry shed, cage, and store room	22254.41 (81.06)	41571.50 (79.80)	93751.71 (83.04)	149573.31 (90.00)	212113.47 (89.11)	457621.74 (87.50)
Investment on bore well, overhead tank and motor	3751.24 (13.66)	5750.44 (11.04)	9978.71 (8.84)	11900.40 (7.16)	18799.94 (7.90)	46110.10 (8.82)
Investment on equipment and machinery	1450.11 (5.28)	4775.20 (9.16)	9175.12 (8.12)	4712.11 (2.84)	7115.44 (2.99)	19257.56 (3.68)
Total Investment	27455.76 (100.00)	52097.14 (100.00)	112905.54 (100.00)	166185.82 (100.00)	238028.85 (100.00)	522989.40 (100.00)

(Figures in parentheses indicate percentage to total)

are Rs. 179.43, Rs. 180.14, Rs. 177.65, Rs. 177.03, Rs. 175.77 and Rs. 174.61 for the small, medium and large size groups respectively. Medicine and veterinary charges decrease in both systems when flock size increase and indicates significant difference between systems. Ames and Ngemba (1985) and Nair and Ghadoliya (2000) also reported better performance of layers with increase in flock size. This may be due to better management by owners of larger flocks, which supports our results.

Table 6 reveals that the returns from eggs accounts for more than 83 percent to the total returns in deep litter whereas in cage system it is more than 84 percent. This is very similar to a recent study by Narahari (2002) who found that sale of eggs account for approximately 85 percent of total return. There is not much difference in the returns realized through sale of eggs between different size groups in both systems and the returns from sale of eggs per bird is found to increase with increase in flock size. The returns are found to be high in cage system when compared to deep litter system irrespective of the size groups. The returns from the

culled birds show not much of a difference among different groups in cage system and the same has increased in deep litter system as the flock size increased.

In sum, the total returns per bird from egg and other sources is Rs. 217.15, Rs. 218.88 and Rs. 220.25 for small, medium and large groups respectively in deep litter system and in cage system the total returns are Rs. 224.70, Rs. 223.16 and Rs. 222.48 for small, medium and large groups respectively. Similar to the finding of Reddi (1986) who found increasing net return with the increase in farm size for deep litter system, our results also indicate rising net returns per farm with the increase in the size of the farm. In deep litter system, the net returns per bird works out to Rs. 11.10, Rs.10.38, Rs. 14.62 and in cage system of rearing, it is Rs. 14.44, Rs. 16.56 and Rs. 16.63 respectively in small, medium and large groups showing an increase in returns as size of the flock increase. The performance of cage system of rearing appeared to be better than deep litter system in all the size groups, which supports the results of Muthusamy and Viswanathan (1998) and North (1984).

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Table4: Fixed Investment Per Bird (In Rupees)

Particulars	Deep litter			Cage		
	Small	Medium	Large	Small	Medium	Large
Investment on poultry shed, cage and store room	17.15 (81.05)	19.33 (79.81)	22.81 (83.04)	50.11 (89.99)	43.73 (89.09)	50.88 (87.50)
Investment on bore well, overhead tank and motor	2.89 (13.66)	2.67 (11.02)	2.43 (8.85)	3.99 (7.17)	3.88 (7.91)	5.13 (8.82)
Investment on equipment and machinery	1.12 (5.29)	2.22 (9.17)	2.23 (8.11)	1.58 (2.84)	1.47 (3.00)	2.14 (3.68)
Total Investment	21.16 (100.00)	24.22 (100.00)	27.47 (100.00)	55.68 (100.00)	49.08 (100.00)	58.15 (100.00)

(Figures in parentheses indicate percentage to total)

Table 5: Cost of production per bird (In Rupees)

Sl No.	Items of cost	Deep litter			Cage		
		Small	Medium	Large	Small	Medium	Large
I.	Fixed cost						
1.	Interest on fixed capital	3.49 (1.69)	3.84 (1.84)	4.04 (1.97)	8.50 (4.04)	7.80 (3.78)	8.37 (4.07)
2.	Depreciation on buildings	0.88 (0.43)	0.99 (0.47)	1.03 (0.50)	1.30 (0.62)	1.22 (0.59)	1.08 (0.52)
3.	Depreciation on equipment	0.05 (0.02)	0.11 (0.05)	0.13 (0.06)	0.06 (0.03)	0.05 (0.02)	0.14 (0.07)
4.	Depreciation on bore well, overhead tank and motor	0.19 (0.09)	0.16 (0.08)	0.13 (0.06)	0.30 (0.14)	0.30 (0.15)	0.38 (0.18)
5.	Depreciation on cage	NA	NA	NA	2.26 (1.07)	1.92 (0.93)	2.43 (1.18)
6.	Cost of day old chicks	9.16 (4.45)	9.32 (4.47)	9.06 (4.41)	9.22 (4.39)	9.08 (4.39)	9.13 (4.44)
7.	Cost of permanent and family labour	4.39 (2.13)	4.86 (2.33)	5.23 (2.54)	3.92 (1.86)	3.33 (1.61)	2.67 (1.30)
8.	Cost of electricity	1.06 (0.52)	1.66 (0.80)	1.32 (0.64)	1.57 (0.75)	1.38 (0.67)	1.05 (0.51)
	Total fixed cost	19.22 (9.33)	20.94 (10.04)	20.94 (10.18)	27.13 (12.90)	25.08 (12.14)	25.25 (12.27)
II.	Variable cost						
1.	Cost of Feed	179.43 (87.08)	180.14 (86.40)	177.65 (86.39)	177.03 (84.20)	175.77 (85.08)	174.61 (84.82)
2.	Medicine and veterinary charges	6.34 (3.08)	5.77 (2.77)	5.78 (2.82)	5.52 (2.63)	4.80 (2.32)	4.75 (2.31)
3.	Cost of litter	0.87 (0.42)	1.09 (0.52)	0.87 (0.42)	0.28 (0.13)	0.38 (0.18)	0.43 (0.21)
4.	Miscellaneous cost	0.19 (0.09)	0.56 (0.27)	0.40 (0.19)	0.30 (0.14)	0.57 (0.28)	0.81 (0.39)
	Total variable cost	186.83 (90.67)	187.56 (89.96)	184.69 (89.82)	183.13 (87.10)	181.52 (87.86)	180.60 (87.73)
	Total cost	206.05 (100.00)	208.50 (100.00)	205.63 (100.00)	210.26 (100.00)	206.60 (100.00)	205.85 (100.00)

(Figures in parentheses indicate percentage to total), NA: Not applicable

Finally, the major problems faced by the poultry farmers are identified and ranked by using Garrett's ranking technique and reported in Table 7. Similar to the findings of many past studies such as Brown (1974) and Singh (1980), this study also finds that the feed cost to be a major problem faced by the poultry farmers. The poultry farmers in the study area receive the feed ingredients mostly from the neighboring states and hence result in high price because of transportation costs. Starting cooperative feed manufacturing units by poultry farmers itself could reduce feed cost. The second major problem is high cost of medicine and vaccine. As the layers

required periodical vaccination and medication, cost of medicine and vaccine also determines the cost of production of egg. The supply of medicines and vaccinations to the poultry farmers are mostly in the hands of private sectors and hence the state and central governments should undertake necessary steps to regulate the same, so that the poultry farmers can get their supply at reasonable prices. The third problem is supply of poor quality feed and feed ingredients. By supplying quality feed and feed ingredients, the feed efficiency will be increased and there by the cost of production can be reduced to a considerable extent.

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Table 6: Gross and Net Return from Eggs and other Sources per Bird (In Rupees)

Source of Income	Deep litter			Cage		
	Small	Medium	Large	Small	Medium	Large
Eggs	183.21(84.37)	184.10(84.11)	184.92(83.96)	188.72(83.99)	189.11(84.74)	188.52(84.73)
Culled Birds	25.97(11.96)	26.33(12.03)	26.87(12.20)	26.45(11.77)	25.91(11.61)	25.12(11.29)
Gunny bags	6.12(2.82)	6.47(2.96)	6.25(2.84)	6.78(3.02)	6.12(2.74)	6.42(2.89)
Manure	1.85(0.85)	1.98(0.90)	2.21(1.00)	2.75(1.22)	2.02(0.91)	2.42(1.09)
Total Return	217.15(100.00)	218.88(100.00)	220.25(100.00)	224.70(100.00)	223.16(100.00)	222.48(100.00)
Total return	217.15	218.88	220.25	224.70	223.16	222.48
Total cost	206.05	208.50	205.63	210.26	206.60	205.85
Net return	11.10	10.38	14.62	14.44	16.56	16.63

(Figures in parentheses indicate percentage to total)

Table 7: Garrett's Ranking and Constraints in Egg Production

Constraints	Garrett's Mean Score	Rank
High Cost of Feed	89.94	I
High Cost of Medicine and Vaccine	78.17	II
Poor quality of Feed and Feed Ingredients	66.20	III
Low Egg Price	54.12	IV
Lack of Facility for Disease Control	40.22	V
High Electricity Tariff	34.15	VI

Government should enforce strict quality control measures at feed manufacturing units.

The fourth major problem is non-remunerative price for egg as the cost of production of egg has gone up with increasing feed cost. Many times the price received by the farmer is less than the cost of production resulting in negative return. The fifth problem is lack of disease control facilities. The fact that the mortality in birds is high mainly due to Marek's disease, Infectious Bursal disease and Infectious Bronchitis in the study area. By providing proper disease diagnosis and control measures, the mortality rate can be reduced which in turn would increase the farm income. The government and veterinary institutions must take active role in prevention and control of poultry diseases and farmers should be informed well in advance about disease outbreak. The farmers also felt that the electricity tariff is high for poultry farms and it is ranked as the sixth problem. They are of the opinion that the poultry industry also should get the farming status with at least a subsidized electricity charges to increase the income from poultry production.

**Conclusion:** The population explosion and the shortage of food in greater part of India has led to the recognition of importance of poultry production as a means of protein and employment. Poultry farming has come to be accepted as the foremost among the subsidiary occupations of the farmers to augment their income because of its quick return, minimum space requirement, low investment, easy maintenance i.e., managed by even illiterate and ordinary farmers and greater efficiency in conversion of feed into egg or meat than any other livestock enterprise. The present study

suggests that infrastructure facilities like feed quality control laboratory, disease diagnostic laboratories and consultancy centers are absolutely essential for prevention and treatment of poultry diseases in time. It is clear that cage system performs well in the study area, which has to be popularized even among the existing farmers who practice deep litter system of rearing. By changing over to cage system, it could be possible to save feed cost and increase feed efficiency. Concerted efforts have to be taken for reducing the feed cost, as it constitutes more than 84 percent in the cost of production of eggs. Electricity tariff may be reduced at least for certain units of power consumption so that the small and medium farms will benefit in terms of cost reduction.

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