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# Evaluation of Economic Losses due to Coccidiosis in Poultry Industry in India

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**Abstract**

Coccidiosis is an old parasitic disease, prevalent all over the country and has a significant impact on poultry production. In this paper, economic loss to poultry industry has been estimated considering the major economic parameters. The estimation has revealed that commercial broiler industry is a major sufferer due to coccidiosis wherein 95.61 per cent of the total economic loss occurs due to the disease. The commercial layer industry shares 3.53 per cent economic loss, mainly due to cost of chemoprophylaxis and reduced egg production. A comparison across economic traits has revealed that loss is maximum due to reduced body weight gain, followed by increased FCR (23.74%) and chemoprophylaxis (2.83%) in the total loss due to coccidiosis in broiler industry of India. The overall comparison of economic traits for all the types of poultry sector it has shown that reduced body wt gain and increased FCR are the major parameters from which 68.08 per cent and 22.70 per cent annual loss has occurred in the total loss from coccidiosis in India during the year 2003-04. The total loss due to coccidiosis has been found to be of Rs 1.14 billion (approx) for the year 2003-04. The study has observed that generation of this data across different geographical regions will be helpful to conclude about the global economic loss due to coccidiosis in the poultry industry.

## Introduction

In India, more than 47.3 billion poultry eggs are produced per year, with per capita availability of 42 eggs. As per the estimates provided by the Food and Agriculture Organization (FAO) for 2007, the annual chicken meat production in India was around 2.2 million tonnes. The value of poultry exports was around Rs 441 crore during 2007-08 (Economic Survey, 2009).

Coccidiosis is one of diseases of poultry that play inhibitory role in the growth of this industry. It is a disease complex of poultry caused by different species of parasite *Eimeria*. It inflicts the birds in both clinical and sub-clinical forms. The clinical form of the disease manifests through prominent signs of mortality, morbidity, diarrhoea or bloody faeces, and sub-clinical coccidiosis manifests mainly by poor weight gain and reduced efficiency of feed conversion and gives rise to highest proportion of the total economic losses (Williams, 1999).

Although coccidiosis is probably the most frequently reported disease of chickens worldwide (Biggs, 1982), there are considerable difficulties in arriving at a reliable figure for the specific financial losses. There are very few reports on the economic losses of coccidiosis (Braunius, 1987; Graat, 1996 ; Oyekole, 1984). The calculation of economic losses by different country differs because of variability in factors included in the study, but no such estimates are available for India. Therefore, in this communication we have estimated the economic losses due to poultry coccidiosis in India.

## Data and Methodology

In this study, we have used the model developed by Williams (1999) to estimate the losses due to poultry

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coccidiosis in India. We have assumed some parameters that are suitable for this geographical location. The data utilized for the evaluation of loss due to coccidiosis were obtained through personal communication with organized and unorganized poultry farms, veterinary professionals engaged in poultry disease diagnosis and management. The costs have been expressed in Indian currency for a better realization in Indian perspectives.

Based on differences in managemental practices and lifespan, commercial broiler birds have been discussed separately, whereas commercial layer, broiler breeder and layer breeders have been discussed in another section.

### Population of Poultry Birds

The number of birds placed per year in respect of each category were considered as population of birds for the year 2003-04 (Table 1). Different parameters considered in this study are given below.

### Types of Birds Considered for Calculation

Four types of birds, viz. commercial broiler, commercial layer, broiler breeder and layer breeder were considered.

### Lifespan of Birds

Generally lifespan of commercial broiler birds is 42-43 days (www.thepoultrysite.com). We considered it as 42 days. In the case of commercial layer and layer breeder, lifespan was taken as 72 weeks. For broiler breeder, lifespan was considered as 68 weeks (www.thepoultrysite.com).

### Overhead Cost

Overhead cost in broiler farming was approx Rs 2.00 per bird up to 3 weeks of their life. It included cost of electricity, management and labour. It did not include cost of chick and feed.

**Table1. Population of different types of birds in the year 2003-04 in India**

| Type of birds | Population (in million) |
|---|---|
| Commercial broiler | 1.62 |
| Commercial layer | 150.10 |
| Broiler breeder | 7.64 |
| Layer breeder | 1.00 |

*Source: Annual Technical Report (2003-2004)*, Venkateshwara Hatcheries Pvt. Ltd., Pune, India

### Market Value of Day-old Chick (DOC), Poultry Meat and Eggs

The market price of chick for commercial broiler, commercial layer, broiler breeder and layer breeder were Rs 12.00, Rs 18.00, Rs 128.00 and Rs 200.00, respectively. The rate of poultry meat was Rs 60.00 per kg of live weight. The market price of table egg was Rs 1.40 each and for hatching egg was Rs 8.00 per egg (www. thepoultrysite.com).

### Use of Coccidia Vaccine and Cost

In India, the only vaccine, i.e. Livacox Q, a live attenuated vaccine containing *Eimeria tenella, E. acervulina, E. maxima* and *E. necatrix* species is used in some of the breeder farms. Coccidia vaccination is not a common practice for commercial layers. Cost of each dose is Rs 4.00.

### Feed Requirement and Cost

Up to 16 weeks of life, the cumulative feed requirement was 8.0 kg/bird for commercial layer, layer breeder, and broiler breeder. The feed consumption for a broiler bird was 960 grams up to 21 days of its life. Cost of feed for the first category bird was Rs 9/kg and for broiler feed was Rs 10/kg.

### Economic Models

#### (A) Commercial Broiler

**Prophylaxis:** Prophylaxis of coccidiosis is generally done by means of chemoprophylaxis and immunization by vaccination. In India, commercial broilers are dependant only on chemoprophylaxis. There are several drugs namely maduramycin, diclazuril, salinomycin are in general use for prophylactic medication. These drugs are used in the feed from day old to 35 days of age. The economic model was:

TCCP (Total cost of chemoprophylaxis) =
N (No. of birds placed) × CFR [Cumulative feed requirement for 35 days for each bird (tonne) ] × MU [ Medicine used, kg/tonne of feed] × CM [cost of medicine (Rs/kg)]

…(1)

**Chemotherapy during Outbreak of Disease:** The prevalence of clinical coccidiosis in commercial broilers

is not exactly known. In a rough estimate, it was assumed that 5 per cent of the flock reared was inflicted to some degree at about 3rd week of age. A standard chemotherapy considered was a combination of amprolium and sulphaquinoxaline @ 1g/L of drinking water for 2 days, then 2 days gap and repeat of same drug @ 0.5 g/L for next 2 days.

The model used for calculation was:

TCCT (total cost of chemotherapy) =
NTB (No. of treated birds) × RW (Requirement of water, L/day/bird) × 2 [M1(medicine mixed with water in first half of treatment, kg/L) + M2 (medicine mixed with water in second half of treatment, kg/L)] × CM ( Cost of medicine in Rs/kg)
…(2)

**Mortality due to Coccidiosis**: Mortality due to a specific pathogen is very difficult to assess as many a times concurrent infections of more than one pathogen cause death of a bird. Coccidiosis occurs along with *Salmonella* sp, IBD or RD (Ruff, 1993). We assumed that 5 per cent of the population suffers from clinical form, out of which 5 per cent die due to the disease. Therefore, model used was:

LM (Loss due to mortality) = BD (No. of birds died) × [VC (Value of day-old chick) + CCF (Cost of cumulative feed consumed by a single bird in 21 days) + OC (Overhead cost)]
…(3)

**Reduced Body Weight Gain:** It is very difficult to assess the effect of coccidiosis on weight gain of a bird. It was considered that 80 per cent of the broiler population suffers from sub-clinical form of coccidiosis and each bird leads to a reduction of 0.1 kg from the final live weight. Therefore, the model used was:

TLRBG (Total loss due to reduced body weight gain) = [{N (No. of birds placed) × RI (Rate of incidence of subclinical form of coccidiosis)} – No. of commercial broiler birds died due to clinical coccidiosis] × RBW (Reduced body weight gain, kg) × RM (Rate of poultry meat, Rs/kg)
…(4)

**Increased FCR:** The Feed Conversion Ratio (FCR) is one of the major economic parameters used worldwide to estimate profit/loss in the broiler industry. It tells the efficiency of broiler bird to convert feed into live broiler weight. In this study, we assumed that in 80 per cent of the birds, FCR increased at rate of 0.1, whereas standard FCR for a broiler is 1.75. So, economic model was:

TLIFCR (Total loss due to increased feed conversion ratio)= (No. of sub clinically affected birds – No. of birds died) × LW (Live weight per bird) × DifFCR (Diffrerence of FCR in affected birds) × CF (Cost of broiler feed, Rs/kg)
…(5)

**(B) Broiler Breeder, Commercial Layer and Layer Breeder**

Lifespans of broiler breeder, commercial layer and layer breeder, their management, medication, prophylaxis and vaccination strategy against coccidiosis are almost similar. Therefore, these three types of birds were considered under one group. The major economic parameters considered in relation to coccidiosis were vaccination cost, expenses on chemoprophylaxis and chemotherapy, egg production loss and mortality loss. The total number of broiler breeder, commercial layer and layer breeder were 7642,000, 150100,000 and 1001,000, respectively for the year 2003-04 (Table 1).

**Vaccination:** The general practice of management is the cage system, but in some cases breeders are kept in deep litter system for first 16 weeks and then transferred to the cage system. In those cases breeders are to be vaccinated, and the model for calculation would be:

CV (Cost of vaccination) = NBV (No. of birds vaccinated × CV (Cost of vaccine per dose)
…(6)

**Chemoprophylaxis:** In this specific geographical region, commercial layer, broiler and layer breeders are maintained mainly in the cage system for which prophylaxis is not required. But, in some of the firms birds are also maintained in deep litter system where chemoprophylaxis is required. In these cases, feed medicated with anticoccidials is to be be provided till 16 weeks of age. The economic model used was given by Equation (1).

**Chemotherapy:** The occurrence of clinical form of coccidiosis in commercial layer, layer breeder and broiler breeder is not uncommon. The most critical time is 3rd and 4th weeks of bird life. The calculation could be made based on water consumption at this period of life. We assumed that 2 per cent of the total population

of commercial layer, layer breeder and broiler breeder manifest clinical form of the disease. Average water consumption during 3rd week of life was 250 L /1000 birds/day. Chemotherapeutic schedule followed was the same as in the case of commercial broilers. The economic model used for calculation was given by Equation (2).

**Egg Production Loss:** In sub-clinical form of coccidiosis it could be considered that at least one egg per bird was reduced due to the particular pathogen. Earlier we considered that 25 per cent of the birds of this category kept under deep litter system up to certain period of their life. Assuming 25 per cent of those birds suffer from sub-clinical form of the disease, the total number of sub-clinically affected breeder birds could be calculated as follows:

No. of female breeder (90% of total breeders) × 25% × 25% and commercial layers would be, total commercial layers × 25% × 25%.

Thus, model for egg production loss was established as:

TLEP (Total loss due to reduced egg production) = [NEH (No. of hatching egg loss) × CEH (Cost of single hatching egg)] + [NET (No. of table egg loss) × CET (Cost of single table egg)]

…(7)

**Loss due to Mortality:** It could be calculated that sub-clinically affected birds under separate category was: No. of birds × 25% × 25%. Of this we assumed that 2 per cent turned to clinical form during the 3rd or 4th week of life. And out of clinically-affected population, we roughly assumed 2 per cent died due to clinical coccidiosis.

Therefore, number of dead birds was: No. of birds under particular category × 25% × 25% × 2% × 2%. Model for economic calculation was:

LM (Loss due to mortality) = BDL (No. of layer birds died) × [VCL (Value of layer chick) + CFL (Cost of cumulative feed up to 21 days of life) + OC ] + BDBB (No. of broiler breeder died) × [VCBB (Value of broiler breeder chick) + CFBB (Cost of cumulative feed) + OC ] + BDLB (No. of layer breeder died) × [VCLB (Value of layer breeder chick) + CFLB (Cost of cumulative feed) + OC]

…(8)

## Results and Discussion

### Cost of Poultry Coccidiosis in India

**Cost of Chemo-prophylaxis**: Using the Equation (1), the cost of chemo-prophylaxis for commercial broiler was estimated as: 162100000 × 0.002535 × 0.5 × 150.00 = **Rs 30819,262**. Assuming 25% of commercial layer and breeder birds maintained in deep litter system up to 16 weeks of age, the number of birds covered under chemoprophylaxis was (No. of commercial layer + breeder birds) × 25%. Thus, total cost of chemoprophylaxis was = [(150100,000 + 7642,000 + 1001,000) × 25%] × 0.008 × 0.5 × 150 = **Rs 23811,450** (using Equation 1)

### Cost of Treatment for Clinical Coccidiosis

The average water consumption of commercial broiler during 3rd week of life is approximately 300 L/ 1000 birds/day. The number of treated birds was: 162100000 × 5% = 81,05,000. The cost of chemotherapy for commercial broiler estimated using Equation (2) was: 81,05,000 × 0.3 × 2 (0.001 + 0.0005) × 2000 (Rs 2000/kg of anticoccidial) = Rs 14589,000. The treatment costs for clinical coccidiosis in commercial layer, broiler breeder and layer breeder were calculated using Equation (2). The total expense under this subhead was: [(150100,000 + 7642,000 + 1001,000) × 2%] × 0.25 × 2 (0.001 + 0.0005) × 2000 (Rs 2000/kg of anticoccidial)= **Rs 4762,290.**

### Cost of Vaccination for Prevention of Coccidiosis

We assumed that 25 per cent of breeder birds were maintained in deep litter for the first 16 weeks of life, out of which 50 per cent were vaccinated. The number of vaccinated breeders was: (7642,000 + 1001,000) × 25% × 50% = 10,80,375. So, the cost of vaccination was: 10,80,375 × 4.00 @ (Rs. 4/ dose of vaccine) = **Rs 4321,500** [using Equation (6)]

### Loss from Mortality in Poultry Coccidiosis

The number of commercial broiler birds died due to clinical coccidiosis was: 162100,000 × 5% × 5% = 405,250. At 21 days of age, the cumulative feed consumption was 960 gram per bird, costing Rs 9.60 @ Rs 10/kg of broiler feed. So, using Equation (3) the loss due to mortality of commercial broiler was estimated as: 405,250 × (12.00 + Rs 9.60 + Rs 2.00) = **Rs 9563,900.** Losses due to mortality in commercial

layer, broiler breeder and layer breeder were calculated using Equation (8) and the total estimate was: (150100,000 × 25% × 25% × 2% × 2%) × [18.00 (cost of commercial layer chick) + 8.10 (cumulative feed requirement 900 g per bird at 21 days of life @ Rs 9/kg of feed) + 2.00] + (7642,000 × 25% × 25% × 2% × 2%) × [128.00 (cost of broiler breeder chick) + 8.10 + 2.00 ] + (1001,000 × 25% × 25% × 2% × 2%) × [200.00 (cost of layer breeder chick) + 8.10 + 2.00] = **Rs 137,087**

### Loss due to Reduced Body Weight gain and Increased FCR

These are important economic parameters for sub-clinical coccidiosis in commercial broiler. The loss due to reduced body weight gain, calculated using Equation (4) was: [(162100,000 × 80%) – (162100,000 × 5% × 5%)] × 0.1 × 60.00 (assuming Rs 60/kg of poultry meat) = **Rs775648,500**. Using Equation (5), loss due to increased FCR was calculated as: Total live weight × FCR = Total required feed. Therefore, loss due to increased requirement of feed was [(162100,000 × 80%) – (162100,000 × 5% × 5%)] × 2.0 × 0.1 × 10 = **Rs 258549,500**.

### Loss from Reduced Egg Production

The loss due to reduced egg production , estimated using the Equation (7), was: (486169 × 8.00) + (9381250 × 1.40) = Rs (3889,350 + 13133,750) = **Rs 17023,100.**

So, the total economic loss involved in coccidiosis of different types of poultry sector in India was: Rs (30819,262 + 23811,450 + 14589,000 + 4762,290 + 4321,500 + 9563,900 + 137,087 + 775648,500 + 258549,500 + 17023,100) = **Rs 1139225,589** or 1.14 billion INR approx (Table 2) for the year 2003-04.

Coccidiosis is an old and well-recognized parasitic disease, prevalent throughout the country and has significant economic impact on poultry production (Allen and Fetterer, 2002). In the poultry industry, several other bacterial/viral diseases get more importance because of sudden attack and high mortality. But, coccidiosis is a type of protozoal disease that causes maximum economic loss and has remained unattended, may be due to sub-clinical form of the disease (Vermeulen *et al*., 2001). In this article, we have suggested some simple formulae to calculate the economic loss with the assumption of related parameters and practical considerations relevant to the country.

The study has revealed that the commercial broiler industry is highly affected sector, suffering 95.61 per cent (Rs 1089170162) of its economic loss due to coccidiosis (Table 2). It could be due to the type of managemental system adopted for broiler chicks. In India, broiler chicks are reared in deep litter system under farm condition which leads to frequent occurrence of the disease. Williams (1999) has estimated that 98.1 per cent loss due to coccidiosis occurs in the broiler industry in UK; it indicates that the broiler industry is highly affected by coccidiosis at the global level. Based on similar observations, Chapman *et al*. (2002) have emphasized that particularly for broiler industry, an alternative and effective control

**Table 2. A comparison of loss (in Rs) between type of birds and in-between economic parameters due to coccidiosis in India for the year 2003-04**

| Economic parameters | Type of birds | | | | | |
|---|---|---|---|---|---|---|
| | Commercial broiler | Commercial layer | Broiler breeder | Layer breeder | Total | Percentage |
| Chemoprophylaxis | 30819262 | 22515000 | 1146300 | 150150 | 54630712 | 4.80 |
| Chemotherapy | 14589000 | 4503000 | 229260 | 30030 | 19351290 | 1.70 |
| Mortality | 9563900 | 105445 | 26384 | 5258 | 9700987 | 0.85 |
| Vaccination | - | - | 3821000 | 500500 | 4321500 | 0.38 |
| Reduced body wt gain | 775648500 | - | - | - | 775648500 | 68.08 |
| Increased FCR | 258549500 | - | - | - | 258549500 | 22.70 |
| Egg production loss | - | 13133750 | 3438900 | 450450 | 17023100 | 1.49 |
| Total | 1089170162 | 40257195 | 8661844 | 1136388 | Grand Total 1139225589 | |
| Percentage | 95.61 | 3.53 | 0.76 | 0.10 | | |

strategy is urgently needed against coccidiosis. The commercial layer shares 3.53 per cent (Rs 40257,195) economic loss, which was mainly due to cost of chemoprophylaxis and reduced egg production.

A comparison across economic traits has revealed that the most important parameters in broiler industry are the reduced body weight gain and increased FCR, both of which come under sub-clinical effect. For calculation of profit/loss of broiler industry, these are two important parameters and coccidiosis affects adversely to these parameters. As per our study, the reduced body weight gain and increased FCR share 71.21 per cent (Rs 775648,500) and 23.74 per cent (Rs 258549,500), respectively in the total loss from coccidiosis to broiler industry. Chemoprophylaxis is another considerable important parameter through which a total amount of Rs 30819,262 (2.83%) has been spent annually by broiler industry of India.

The overall comparison of economic traits for all types of poultry has revealed that reduced body weight gain and FCR are the major parameters due to which 68.08 per cent (Rs 775648,500) and 22.70 per cent (Rs 258549,500) annual loss occured from coccidiosis in India during the year 2003-04. The expenses on chemoprophylaxis, a common practice for commercial broiler and some part of commercial layer, broiler breeder and layer breeder, have been found as Rs 54630,712 (4.80%). Loss due to chemotherapy and mortality during outbreak of coccidiosis are common parameters for all type of birds and have caused loss of Rs 19351,290 (1.70%) and Rs 9700,987 (0.85%), respectively. Reduced egg production, considered only in commercial layer and both types of breeder has caused 1.49 per cent loss (Rs 17023,100) in the total annual loss from coccidiosis for the year 2003-04. The cost of vaccination has been found only Rs 4321,500 (0.38%) in 2003-04. The study has observed that prevention of coccidiosis in India mainly depends on chemoprophylaxis, which is leading to a further problem of drug resistance and drug residue in consumable meat and egg. Thus, for preventive measure, the total expense has been 5.18 per cent in the annual loss from coccidiosis in poultry industry in India. The total loss of poultry industry has been found to be Rs 1139225,589 or Rs 1.14 billion (approx) due to only coccidiosis for the year 2003-04, which shows need of immediate attention to prevent national loss. Stevens (1998) has reported that annual loss due to coccidiosis in poultry industry of USA exceeds 1.5 billion US dollars. This type of data, if generated from different geographical regions would be helpful to find the global economic loss due to coccidiosis in the poultry industry. The study has some limitations also. In the study, some of the parameters could not be considered, like loss due to intercurrent diseases, which generally occur along with coccidiosis.

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