Chapter-1

Introduction

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Introduction

1.1. Introduction.

Poultry plays an important role in human nutrition, employment and income generation. Poultry is by far the largest livestock group and has been estimated to be about 252.3 million consisting of chickens, ducks and pigeons (BBS 2009). Poultry constitute 30% of animal protein and will increase to 40% within 2015 (IFPRI 2000). In Bangladesh more than 150 hatcheries are producing about 4.56 millions of day old chicks per week, about 70,000 commercial layer farms supplying 4,056 millions of table eggs per year (DLS 2012 Feb).

In hot climates, periods of high temperatures have a negative effect on the health and performance of domestic animals. Poultry farming is no exception and the effect of stress caused by elevated temperatures can result in heavy economic losses from increased mortality and reduced productivity. For birds to perform at their optimum capacity they need to among other factors to be in homeostasis with their environment through the maintenance of thermobalance. Thermobalance is the equilibrium between the heat produced and the heat given out by living organism, and this is at its maximal physiological level within the thermoneutral range of any given specie. Like mammals, chickens are homoeothermic; they produce heat to maintain a relatively constant body temperature and may permit certain variations within their temperature range without significant perturbation.

Normally, the chicken’s body temperature is 41.5°C, but will fluctuate somewhat depending upon the temperature of its environment, while the established thermoneutral zone for birds reared in the sub tropical regions ranges between 35-45^{0}C. Maintaining a constant body temperature is not a problem when air temperature is at least 10-15 degrees less than body temperature, but air movement is critical. A bird can only give off heat to its environment if the temperature of that environment is cooler than the bird. If heat produced by the birds is not moved away from them and out of the poultry house quickly, it will be more difficult for them to avoid heat stress.

The changes in the biomass as result of the continuous global warming has a deleterious effect on domestic animals in general, and birds in particular. Ambient temperature (AT) above 35 is stressful for birds, but more stressful is the fluctuations caused by this environmental thermal changes, especially when it is accompanied by high relative humidity (RH), as this unleash various pathophysiological response in birds. Furthermore, it has been demonstrated that this response induces heat stress in chickens, and thus lead to disturbance in production.

In poultry housing environmental condition mean physical (temperature, humidity, ventilation etc.) and chemical factors (ammonia, carbon dioxide etc.). The “environment” can be defined as the combination of external condition (biological and physiological) which affect or have an impact on animals and human. The external condition such as weather and climate can affect layer production. Poultry producers should control these factors, so that the bird can maintain normal physiological functions and produces at maximum rate.

Environment may affect the performance of birds as well as its well being. Aerial ammonia in poultry houses is usually found to be the most abundant air contaminant. Ammonia concentration varies depending upon several factors including temperature, humidity, animal density and ventilation rate. Chickens exposed to ammonia showed reduced feed consumption, feed efficiency, live weight gain, carcass condemnation and egg production (Charles and Payne, 1966; Quarles and Kling, 1974 and Reece and Lott, 1983).

Again, infectious and non-infectious diseases is one of the major constrains in poultry rearing. Farmers face a wide range of diseases, which reduced the production of the birds. During last few years several emerging diseases like Infectious Bursal Disease, Aflatoxicosis, Avian Influenza, Chicken Anemia Virus and Egg Drop Syndrome and some unknown cause threatened the industry and cause huge damage to the farmers. Viruses, which affect the mucus membranes of the respiratory and reproductive tract, such as Newcastle Disease and Infectious Bronchitis, not only cause a decrease in egg production, but also cause the eggshell to become abnormally thin and pale (Beyer, 2005 and Butcher and Miles, 2003).

Therefore, the present study was conducted to evaluate the effect of environmental condition on the performance of layer.

Table 1: Production of Egg in Bangladesh.

Production (In lac ton)							
Year	05-06	06-07	07-08	08-09	09-10	10-11	11-12 February/12
Egg	54220	53690	56532	46420	57424	42110	40561

Source: Ministry of Livestock and Fisheries

Table 2: Poultry Population in Bangladesh.

Number (In lac)							
Poultry	05-06	06-07	07-08	08-09	09-10	10-11	11-12 February
Chicken	1948.2	2068.9	2124.7	2213.94	2280.35	2346.86	2392.49
Duck	381.7	390.8	398.4	412.34	426.77	441.20	451.15
Total Poultry	2329.9	2459.7	2523.1	2626.28	2707.12	2788.06	2843.64

Source: Ministry of Livestock and Fisheries.

1.2. Justification.

Near about 70,000 layer farms in Bangladesh, and around 1000 layer farms in Rajbari district. At Rajbari sadar under Rajbari district there are 250 recognized layer farms. Almost every year most of the farms face heavy economic loss due to outbreak of several diseases, and production fall. There are different environmental effects like high temperature, humidity, bio-security etc. causes drastic fall in egg production, and increasing mortality rate. There are so many diseases which cause 100% death in a single outbreak. From this point of view research works on environmental effects on layer farming is much needed one. But there is not enough research work on this topic in Bangladesh as well as, at the particular area.

Therefore, to estimate and evaluate the environmental effects on layer farms and impacts of these effects on layer farms at Rajbari sadar this work has done.

1.3. Objectives of the study:

1. To know the environmental effects on egg production.
2. To know the different environmental condition of layer farming.
3. To determine the impacts of environmental effects on layer farms.

Chapter-2

Review of the literature

Chapter-2

Review of the literature

2.1. Introduction.

The Purpose of this chapter is to provide some review of previous studies, which are related with the present study. Because through reviewing of literature a researcher can compare between the past and present study. In the present section, the most common and relevant studies, which have been conducted on the past, are highlighted.

2.2. Studies Conducted in Abroad.

There are some studies on Environmental effect on layer production conducted outside Bangladesh were also reviewed which are discussed below.

Arima *et al.*, (2006), found that the egg quality of older hens was more severely affected by increased temperature than younger hens.

Beyer, (2005), Butcher and Miles, (2003) stated that viruses, which affect the mucus membrane of the respiratory and reproductive tract, such as ND and IB, not only cause a decrease in egg production, but also cause the eggshell to become abnormally thin and pale.

Butcher and Miles, (2003), found that epinephrine, a stress hormone, will cause a delay in oviposition and cessation of shell gland cuticle formation, which can cause pale shelled eggs to be produced. Stressors may include high cage density, loud noise and handling.

Charles and Payne, (1966); Quarles and Kling, (1974); Reece and Lott, (1983), stated that aerial ammonia in poultry facilities is usually found to be the most abundant air contaminant. Ammonia concentration varies depending upon several factors including temperature, humidity, animal density and ventilation rate of the facility. Chickens exposed to ammonia showed reduction in feed consumption, feed efficiency, live weight gain, carcass condemnation and egg production.

Clunies and Jones, (1992), found that hens laying thick shelled eggs retained more dietary calcium than those laying thin shelled eggs. Although there was no difference in egg production between thick and thin shell layers, both egg and shell weight were greater for the thick shelled eggs.

Deaton et al., (1982), reported that 200ppm ammonia for 17 days causes a significant loss in percent egg production and the hens lose a significant amount of weight with a reduced feed intake. Although not satisfactory, it appears that lesser amounts of ammonia (100ppm) can be tolerated for short periods without an immediate drastic loss in laying performance if a choice has to be made between frozen water and cold stress verses atmospheric ammonia in the laying houses.

Merat and Bordas, (1982), worked with Fayoumi fowl at two temperatures- high and low and found that body weight did not differ significantly but feed consumption was lower at the higher temperature, result of stress experienced before the egg reaches the shell gland, subsequently layers are disorganized and thin or soft shelled eggs are a common phenomenon after stress.

Oarad, et al., (1981), showed that higher temperature reduce the productive performance of layer hens (Desert Bedouin fowl, the commercial White Leghorn and the two crossbreds.).

Sterling *et al.,* (2003), showed environmental temperature was corrected with many measures of performance including feed and water consumption, body weight, egg production, feed conversion and egg weight.

Sloan and Harms, (1984), showed that the decrease in feed consumption is probably connected to the loss in live weight at high temperatures observed by many investigators although this is not a constant finding.

Turkoglu *et al.,* (1997); Ellen *et al.,* (2000); Chastain, (2005); Kocaman *et al.,* (2005), recommended temperature and relative humidity values for caged layer houses should be 15-20^{0}C and 60-70% respectively.

2.3. Studies in Bangladesh.

A Few numbers of studies on Environmental effect on layer production have been conducted in Bangladesh they are discussed below.

Islam *et al.,* (1998), found that improper bio-security and dust cause outbreaks of viral diseases in poultry farms.

Talukder *et al*., (2010), stated that High temperature (above 27°C) affects feed consumption, egg weight and eggshell thickness while relative humidity has less impact on egg production, egg weight and feed consumption. Feed consumption and egg weight were decreased markedly when CO_2 and NH_3 concentration were more than 3000 and 37ppm, but not on egg shell thickness.

Chapter-3

Materials and methods

Chapter-3

Materials and methods

3.1. Introduction.

It is an integral part of any research. Without proper and systematic methodology a study never can achieve the ultimate goal. The methodology of the present study is discussed in this chapter.

3.2. Experimental site.

The study was performed at Rajbari sadar under Rajbari district with an altitude between 90-100 meters above sea level, 135 km away from Dhaka and at bank of river padma.

3.3. Selection of the Samples & Period of Selection.

10 layer farms from Rajbari sadar under Rajbari district were selected. The flock was 20-70 weeks of age and the strains were Hyline white and Isa Brown. Total number of birds of the selected farms was 38000 (Farm-1 to Farm-10).This study was conducted for 2 months. The birds were reared in cage system.

3.4. Feeds and Feeding.

The birds were fed commercial layer (mash) feed.

3.5. Bio-security.

Birds were kept in well-dried litter and good hygienic condition. Routine vaccination was practiced with anthelmintics and other probiotics as preventive measure.

3.6. Measurement of different parameters.

Productive performance of the flock was evaluated by measuring egg production, feed consumption and eggshell thickness. Feeding, egg collection and recording were done once daily in the morning from farmer’s record book. Average weight of egg was taken by weighing 30 eggs per week by random sampling. Feed was weighted at feeding time, usually early in the morning and left feed in the feeder was weighed and subtracted from the given during the week.

Housing temperature (°C) and relative humidity (%) were recorded. Concentrations of carbon dioxide (CO_2ppm) and ammonia (NH_3ppm) were determined by utilizing Multiple Gases Detection Instrument (Rosemount Analytical Inc, USA). The levels of the gases were determined in each particular day when the temperature is around 15- 27 °C and the relative humidity is 60-70%. This was done to identify the effect of those gases when the other parameters are normal.

The layer farms were mainly dependent on natural day light. The extra required light was provided by using a 60 W bulb.

Table 3: Lighting Schedule of Layer Birds According to Age.

Age	**Amount of Light (L) and Dark (D) (hours)**
0 to 3 days.	22 (L) : 2 (D)
3 days to 1 week.	20 (L) : 4 (D)
1 to 2 week.	18 (L) : 6 (D)
2 to 3 week.	16 (L) : 8 (D)
3 to 8 week.	14.4 (L) : 9.5 (D)
9 week.	14 (L) : 10 (D)
10 week.	13.75 (L) : 10.25 (D)
11 week.	13.5 (L) : 10.5 (D)
12 week.	13.25 (L) : 10.75 (D)
13 week.	13 (L) : 11 (D)
14 week.	12.75 (L) : 11.25 (D)
15-17 week.	12.5 (L) : 11.5 (D)
18 week.	13.5 (L) : 10.5 (D)
19 week.	14.5 (L) : 9.5 (D)
20 week.	15 (L) : 9 (D)
21 week.	15.5 (L) : 8.5 (D)
22 week.	15.75 (L) : 8.25 (D)
23 week.	16 (L) : 8 (D)
24 week.	16.25 (L) : 7.75 (D)
25week to throughout production cycle.	16.5 (L) : 7.5 (D)

The infectious and non-infectious diseases were evaluated during study period. Post-mortem examinations of dead birds were performed. Specimen like liver, spleen, lung and intestine samples were collected in separate sterile containers for the isolation and identification of causal agents using bacteriological examination.

Table 4: Diseases Record in the Layer Farms during the Study.

Diseases		**Affected number of birds in different farms.**									
		F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	F-10
Bacterial diseases.	**Salmonellosis**	9	10	23	100	98	110	37	10	24	17
	Colobacillosis	5	2	3	9	12	35	6	0	2	4
	Mycoplasmosis	5	2	4	12	10	54	4	6	0	12
	Necrotic enteritis	2	1	0	4	3	5	0	1	0	0
	Infectious Coryza	3	6	1	6	10	20	5	2	1	3
	Omphalitis	3	4	1	7	18	25	5	3	5	0
Viral diseases.	**Gumboro**	7	12	4	20	35	53	8	7	8	11
	Newcastle disease	7	13	6	20	35	45	7	6	10	12
	Avian leukosis	1	2	1	4	5	7	1	0	0	0
	Avian influenza	0	0	0	0	0	0	0	0	0	0
Fungal diseases.	**Mycotoxicosis**	2	3	1	4	11	21	3	4	3	6
	Aspergillosis	0	1	0	2	3	2	1	0	0	1
Protozoal diseases.	**Cocccidiosis**	16	22	9	10	23	25	3	6	7	9
Non infectious diseases.	**Egg bound**	1	3	0	4	6	0	0	3	4	4
	Egg peritonitis	0	0	0	0	1	2	0	0	1	0
	Malnutrition	1	0	0	4	5	5	0	1	0	0
	Cannibalism	1	3	2	5	6	9	0	1	3	2
	Heat strike.	1	3	4	6	7	4	1	0	2	1

3.7. Various equations for calculation.

a. Determination of mortality:

$$\frac{\text{Total no. of dead birds}}{\text{Total no. of birds}} \times 100$$

b. Feed consumption/ bird (g):

$$\frac{\text{(Amount of feed given – Amount of feed leftover)}}{\text{Total no. of birds'}}$$

Statistical analysis Results were expressed as Mean ± Standard Error (S.E.). All the data were analyzed under one way analysis of variance with least significant differences at $p<0.05$.

Chapter-4

Results and Discussion

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Results and Discussion

4.1. Effects of Temperature.

Above 27°C feed consumption gradually decreases. Oarad *et al.*, (1981) stated that higher temperature reduce the productive performance of layer hens. At 35°C there is a remarkable decrease of feed consumption. (Fig 1)

Table 5: Effect of Temperature on Egg Production, Egg Size, Eggshell Thickness and Feed Consumption.

Temperature(^{0}C)	Egg production (%)	Egg weight (g)	Shell thickness (mm)	Feed consumption /hen /day (g)
16	75.1±1.82	57±0.89	0.34±0.11	122±0.41
18	76.83± 0.35	56±1.91	0.34±0.01	118±0.25
21	78.18±2.70	56±1.94	0.33±0.01	114±0.97
24	75.18±1.92	58±1.89	0.33±0.003	114±0.52
26	78.4±1.0	58±1.75	0.34±0.004	113±0.30
30	80.67±1.75	58±2.26	0.34±0.018	107±0.44
32	78.33±0.7	55±2.81	0.32±0.03	103±0.27
35	76.15±0.55	55±1.86	0.30±0.01	90±0.35
SED	0.62	0.51	0.04	3.54
Level of significance	*	NS	NS	*

* indicates significant at 0.05% level; NS = Non-significant

Merat and Bordas (1982) found that body weight did not differ significantly but feed consumption was lower at the higher temperature. (Fig 1)

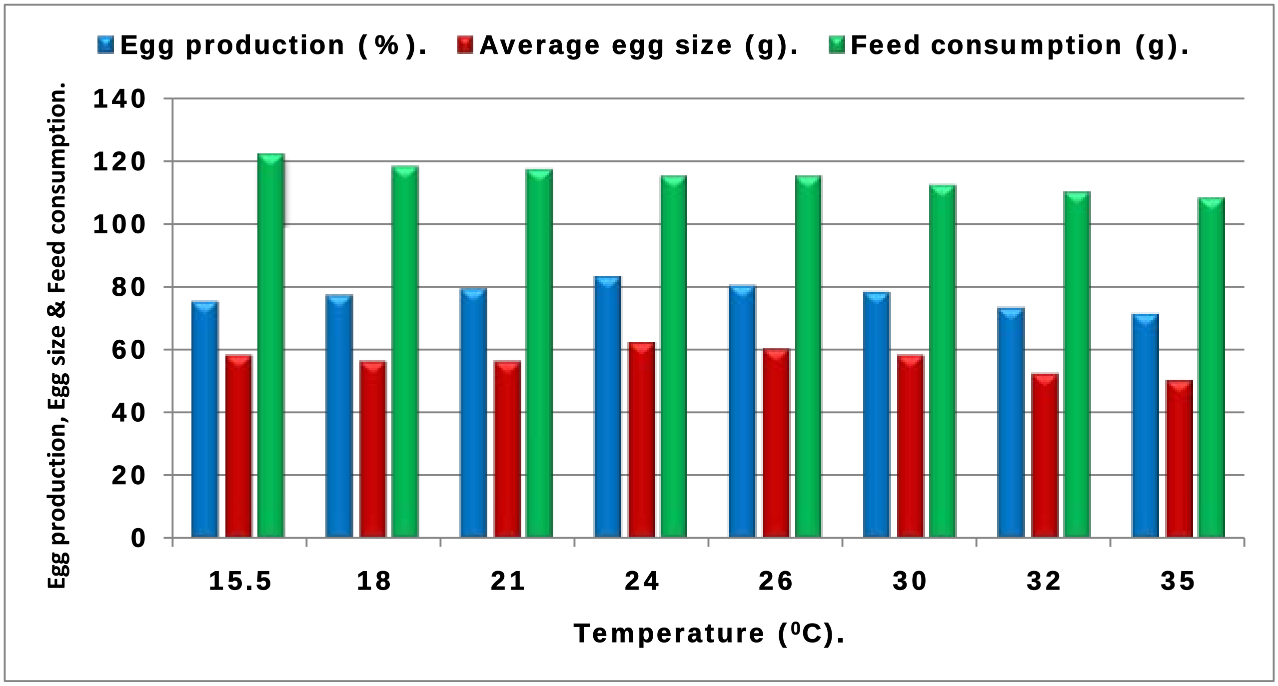

Fig 1: Effect of Temperature on Egg Production, Egg Size and Feed Consumption.

Moreover, high temperature is related to egg shell thickness. In high temperature the shell thickness is decreased, above 40^0C the egg shell become abnormally thin and also causes heat stroke to the birds. While Sloan and Harms (1984) reported that there is no effect of low temperature on egg shell thickness. (Fig 2)

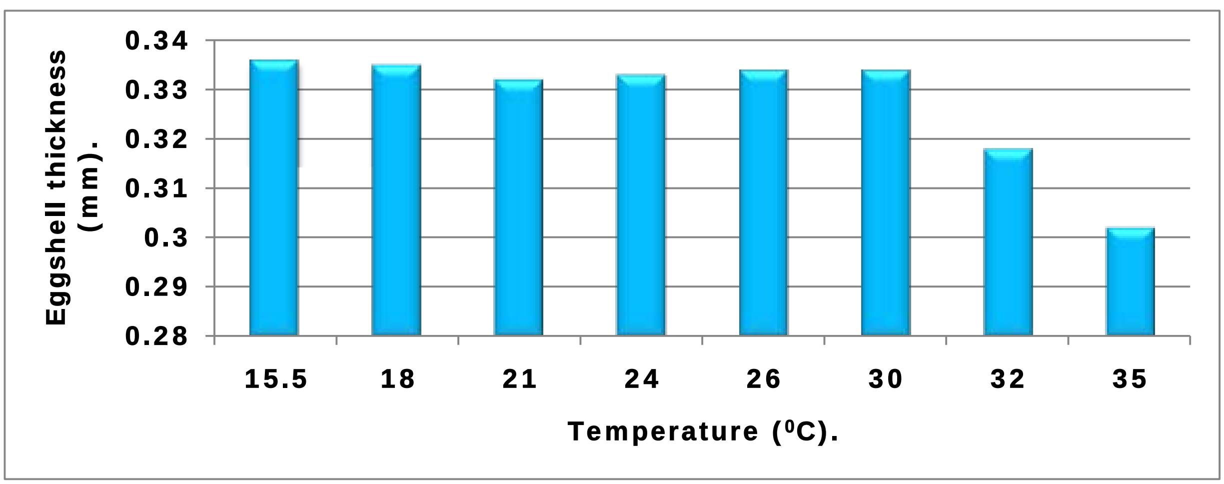

Fig 2: Effect of Temperature on Eggshell Thickness.

A negative correlation between daily feed consumption and temperature in poultry was detected. As the temperature of poultry house increased, feed consumption reduced. In addition to, feed conversion ratio also decreased. The reverse trend was observed in lower temperature. (Fig. 3)

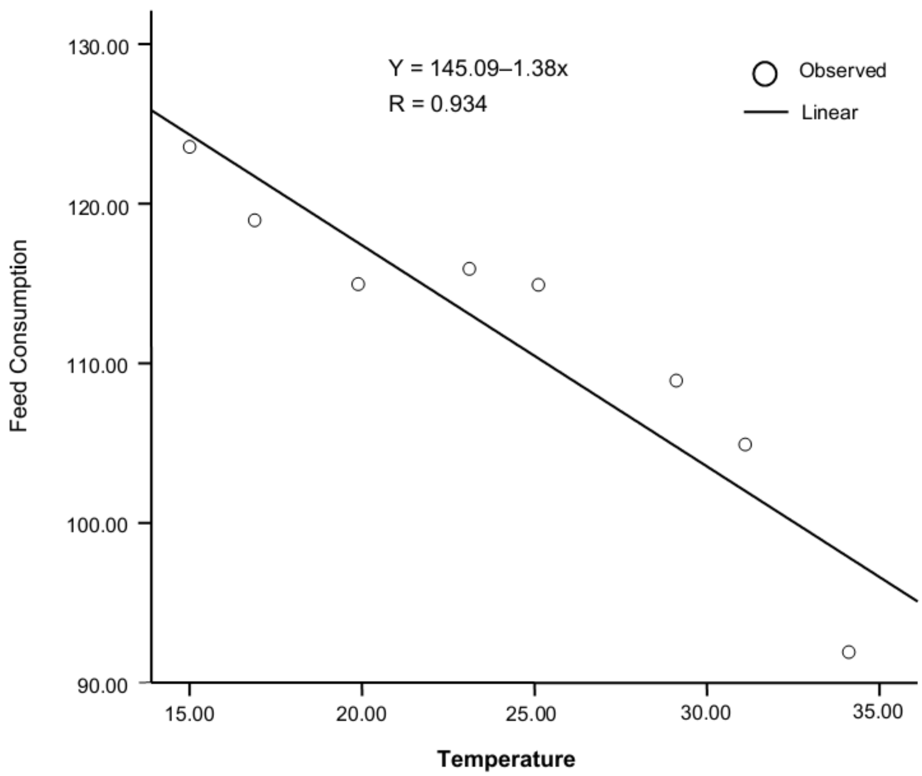

Fig 3: Negative Correlation of Temperature and Feed Consumption.

4.2. Effects of Humidity.

Relative humidity has less impact on egg production, egg weight and feed consumption. it is marked that egg production increased when relative humidity was 60-70% and feed consumption and egg weight gradually decreased with high relative humidity (above 70%). But shell thickness did not vary for relative humidity. (Fig 4)

Table 6: Effects of Humidity on Egg Production, Egg Weight, Shell Thickness and Feed Consumption.

Relative Humidity (%)	Egg production (%)	Egg weight (g)	Shell thickness (mm)	Feed consumption/hen /day (g)
78	76.05±0.11	55± 0.14	.34±0.0	118±1.1
76	75.27±0.14	55±1.51	.33±0.0	119±0.43
72	76.98±0.34	56±0.28	0.34±0.0	119±0.21
68	76.1±0.07	57±0.18	0.34±0.0	121±0.53
64	77±1.07	58±0.24	0.37±0.0	121±0.63
60	77.1±0.45	58±0.39	0.34±0.0	120±1.19
58	76.33±0.14	57±0.22	0.33±0.0	121±1.12
54	76.15±0.24	58±0.25	0.33±0.0	120±0.64
SED	0.86	0.45	0.001	0.40
Level of significance	*	NS	NS	NS

* indicates significant at 0.05% level; NS = Non-significant

The data indicate that egg production is maximum when the relative humidity around 70 %.

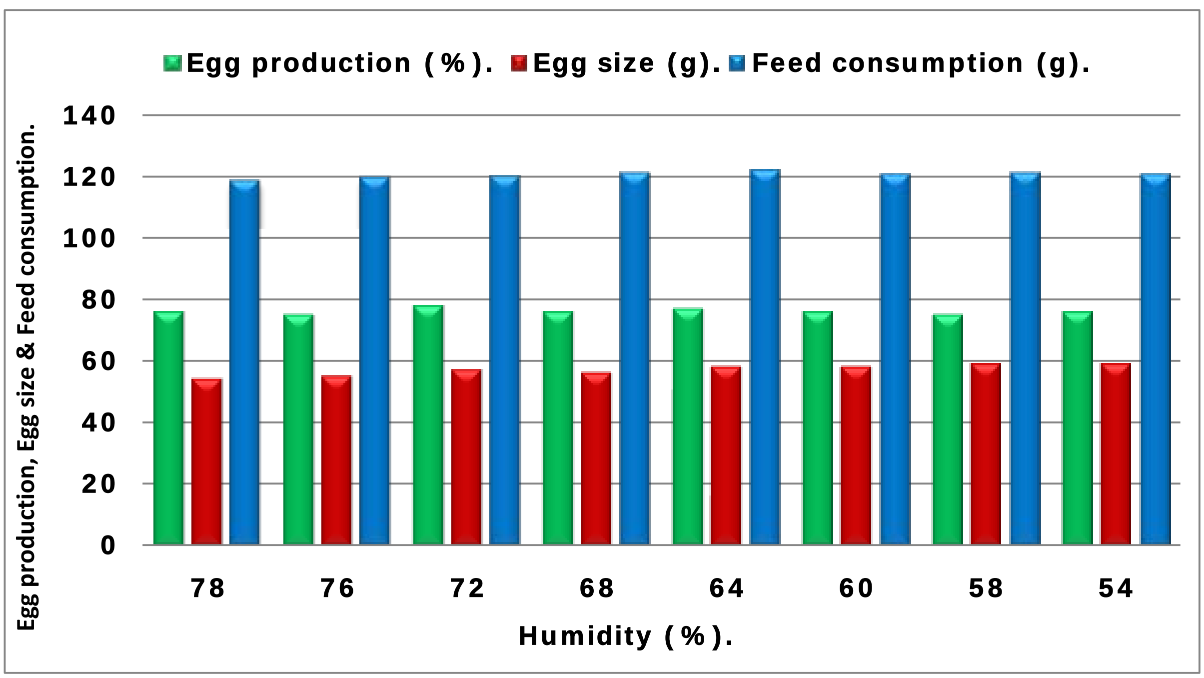

Fig 4: Effect of Humidity on Egg Production, Egg Size and Feed Consumption.

However, the effect of humidity in egg shell thickness, feed consumption and egg weight is not so significant. (Fig 5)

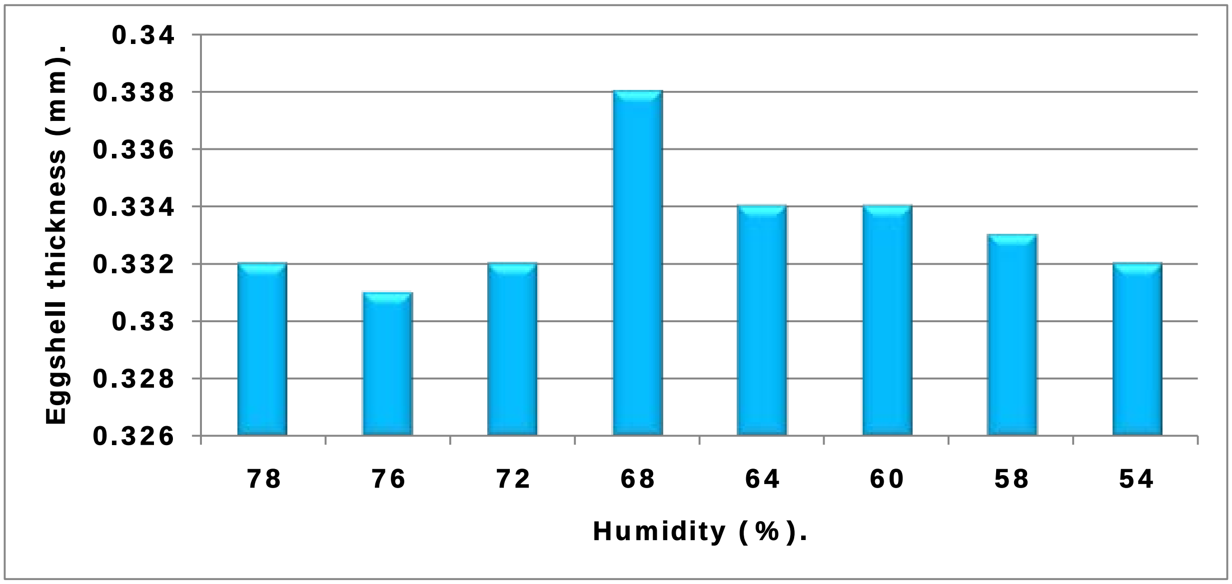

Fig 5: Effect of Humidity on Eggshell Thickness.

4.3. Effects of different gasses.

The CO_2 level in the experimental farm was not more than 3000ppm and NH_3 level was not more than 37ppm (Table 7). It is evident that 3000ppm CO_2 and 37ppm NH_3 level effect egg production. Feed consumption and egg weight were decreased markedly but not on eggshell thickness. Moreover, feed consumption, egg weight and egg production were affected when NH_3 level was above 25ppm. The practical tolerable level of CO_2 is below 10,000ppm and tolerable level of NH3 is below 25ppm. However the higher level of CO_2 is injurious to the birds. Higher level causes significant loss in feed consumption, egg production and serious respiratory trouble. Deaton *et al.*, (1982) reported that 200ppm ammonia for 17 days causes a significant reduction in percent egg production, body weight and feed intake. (Fig 6)

Table 7: Effects of CO_2 and NH_3 Gasses on Layer Performance.

CO_2 (PPM)	NH_3 (PPM)	Egg production (%)	Egg weight (g)	Feed consumption/hen/day (g)
500	22	78.45	57	119
3000	37	72	58	107
750	20.5	77.6	58	121
1240	23	76.1	58	120
1091	27	74	58	117
998	32	72.15	57	116
980	30	73.95	58	116
2488	24	74	58	118
2560	12	73.7	57	118
2989	8	73.2	58	118
1286	15	78	57	120
1199	18	78.8	57	122
895	25	77	58	120
920	13	77.6	58	122
1000	14	76.3	58	121
983	33	73.6	59	117
897	37	73.25	59	116

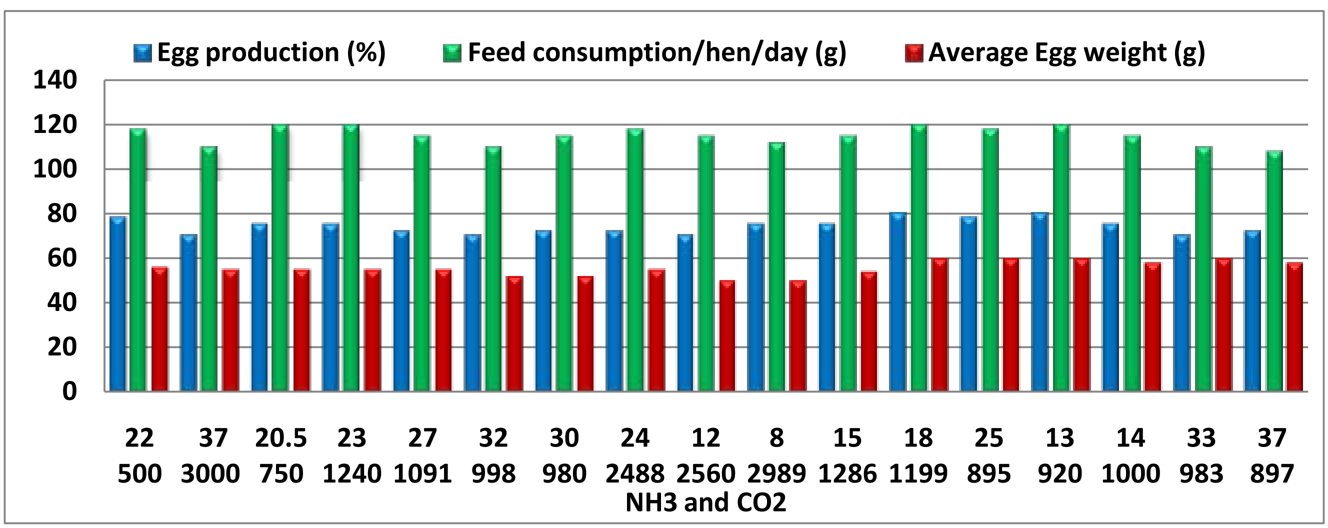

Fig 6: Effects of Gases on Egg Production, Egg Weight and Feed Consumption.

4.4. Effect of floor space.

Egg production, feed consumption or egg weight of flock was not associated with variation of floor space. However, in high density mortality rate was a bit higher. The higher density did not directly influence mortality of layer birds; it made them susceptible to diseases as diseases may transfer highly rapidly in dense population. Campo *et al.*, (2005) and Estevez (2007) reported that high population density per square meter caused fear (stressful reaction) and threatens the benefit of birds. In addition, increased population density of broiler reduces the body weight, worse the food conversion and increase mortality (Skomorucha *et al.*, 2004, 2009).

Table 8: Effects of Floor Space on Layer Performance.

Allotted space(cm^2)	**Mortality (%)**	**Egg production (%)**	**Ave. egg weight(g)**	**Feed consumption/hen /day (g)**
450	3.9	77.9	60.31	121.9
525	3.3	76.4	60.59	122.3
600	0.75	76.7	60.73	121.9
750	1.75	77.25	60.645	121.15

4.5. Effect of biological factor.

Total number of birds of the selected farms was 38000 (Farm-1 to Farm-10). Among these, 1420 were died due to different disease or managemental faults. The percentage of the dead birds due to different reasons is listed in Fig.1 Mortality of laying birds in Bangladesh occurs every year due to outbreaks of several diseases. The data indicate that layer birds are died due to bacterial diseases is about 51%, viral diseases 24%, protozoal diseases 9%, fungal diseases 5% and non infectious 11%. Newcastle disease was the earlier economically important infectious disease for native and commercial poultry (lslam, 1998), where as infectious bursal disease was first reported in 1992 with high morbidity. Among bacterial diseases Salmonellosis in poultry shows about 20% mortality and reduces egg production and hatchability for up to 20-30% (Fehervari, 1994 and Haque *et al.*, 1997).

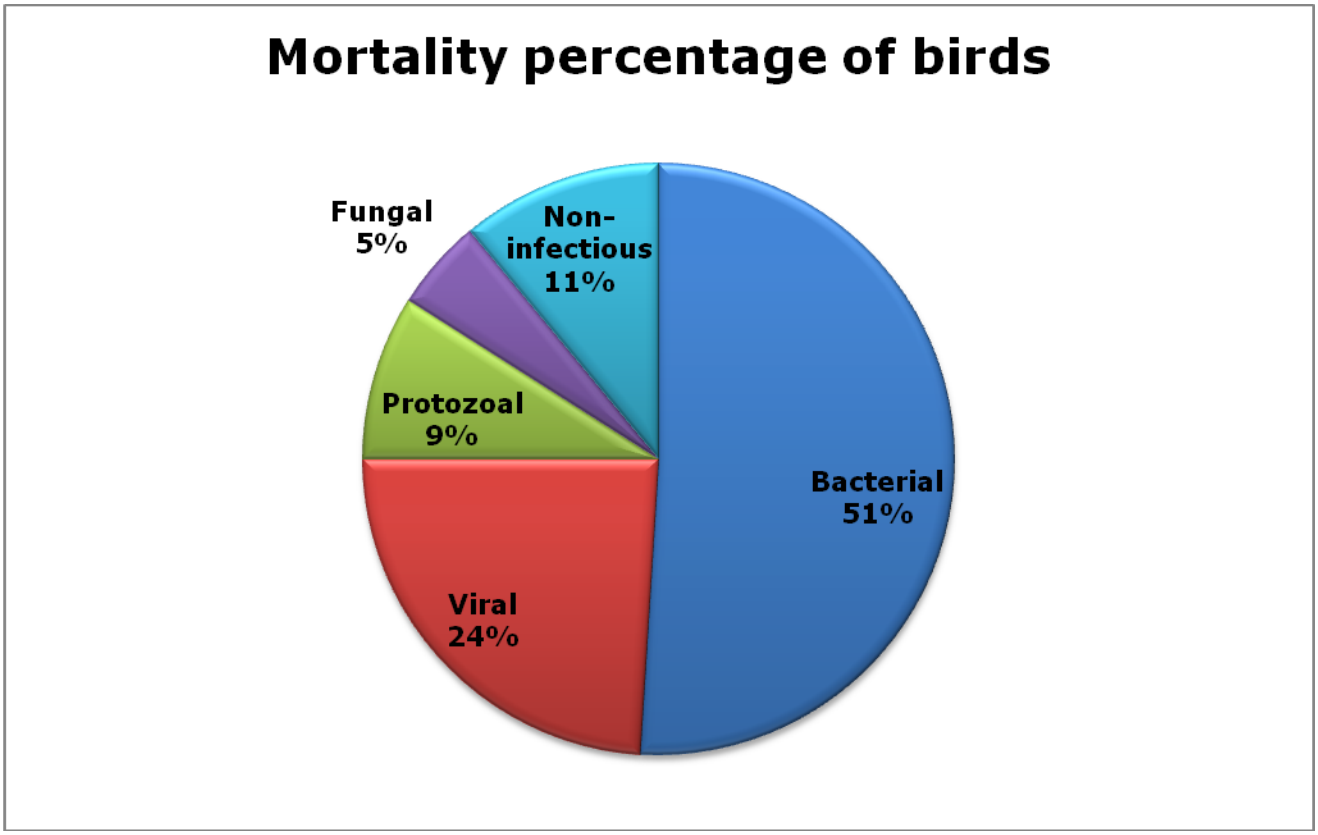

Fig 2: Mortality Percentage of Birds Due to Diseases.

Chapter-5

Conclusion

Chapter-5

Conclusion

The aim in layer production is to obtain the yield in a desirable level at the lowest cost. As layer spent their life in poultry houses, In order to obtain maximum production they should be kept in a good environment condition with a good care as well as genetic feature. An adequate environment within poultry house is a very important requirement for success in the poultry industry. Chicken and their excreta create different forms of air pollution, including ammonia, carbon dioxide, methane, hydrogen sulfide and nitrous oxide gases, as well as dust.(Kocaman *et al.,* 2005). Gases such as carbon dioxide, ammonia and methane can accumulate and reach toxic level if adequate ventilation is not maintained. These different air pollutants may cause health damage to the birds and workers. Poor environment generally does not cause diseases directly but they reduce the immunity of birds and making them susceptible to existing pathogens. If the environment is managed in a proper way, then the production will be maximized.

Laying birds should be kept in a good environment conditions with a good care. In poultry house if environmental temperature is allowed to exceed normal ranges, then egg production, egg size, and growth will be negatively affected. These factors along with others affect the birds' metabolism which in turn is responsible for the output of eggs, meat, and body heat to maintain normal physiological processes and functions. Environmental stressors such as hot temperatures, high air humidity, etc. may affect the bird in an additive manner if these stressors are imposed concurrently. These stressors can negatively affect hen's growth performance, feed intake and efficiency, and physiological status.

Chapter-6

References

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