

**EFFECT OF EGG WEIGHT ON HATCHABILITY AND CHICK HATCH-WEIGHT OF  
COBB 500 BROILER CHICKENS**

**BY**

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**DISSERTATION SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR  
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## **DECLARATION**

I declare that this dissertation hereby submitted to the University of South Africa for the degree of Master of Science in Agriculture is the result of my own work and has not been presented elsewhere for a higher degree. All sources of information have been acknowledged by references.

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## **DEDICATION**

This dissertation is dedicated to my lovely mother Fridah Chuene Ramaphala; father Piet Ramaphala my grand mother Machoene Manyelo for their support in giving me education.

## **ABSTRACT**

This study was conducted to determine the effect of egg weight on hatchability and chick hatch-weight of Cobb 500 broiler chickens. A total of 396 Cobb 500 hatchable eggs classified according to three different egg weight groups as small: (<49 g) medium: (50-59 g) and large: (60-69 g) were used in the experiment. A complete randomized design of three treatments with three replicates and each replicate having 44 eggs was used for the experiment. Simultaneously a linear type equation was used to determine the relationship between egg size and responses in hatchability values and chick hatch-weight. Results indicated that large-sized eggs produced chicks with higher ( $P<0.05$ ) hatch-weight than medium and small-sized eggs. However, no differences were detected with fertility rate percentage, hatchability percentage and percentage hatch of fertile. It was therefore concluded from the result of the present study that sorting of Cobb 500 broiler chicken breeder eggs by weight prior to incubation might be advantageous in producing uniform size Cobb 500 broiler chicken hatchlings to meet specific market demands with improved efficiency.

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**CHAPTER 1**  
**INTRODUCTION**

## 1.1 Introduction

The modern broiler chicken has been reported to be able to achieve the same body weight in less than a third of the time as compared to their random bred predecessors (Harvenstein *et al.*, 2003). However, while the time spent on the farm may be decreasing, the embryo has been found to still require 21 day incubation period, which translates into a greater percentage of the life of the broiler chicken being spent in the incubator. This places a greater emphasis on the egg under which this embryonic period of growth occurs. As a result, knowing the effect of egg weight on hatchability and chick hatch weight has become very important. At present, studies have nonetheless demonstrated conflicting evidence indicating that performance in broiler chickens in terms of hatchability and chick-hatch weight may be closely related to the weight of the eggs (Wilson, 1991; Uluocak *et al.*, 1995; Kalita, 1994; Abiola, 1999; Donald *et al.*, 2002; Rashid *et al.*, 2005; King'ori *et al.*, 2007). Due to this conflicting and inconsistent findings, interest in determining the effect of egg weight on hatchability and chick-hatch weight of Cobb 500 broiler chickens has become very important. Beyond this, because as suggested by King'ori (2011) that chick weight, fertility and hatchability are interrelated heritable traits that vary among breeds, variety or individuals in a breed or variety it therefore becomes very important to understand the effect of egg weight on these traits in Cobb 500 broiler chickens. This study was therefore designed to determine the effect of hatching egg weight on hatchability and chick hatch-weight of Cobb 500 broiler chicken.

## **1.2 Problem statement**

Poultry production contributes a lot to the household nutrition and income in Rustenburg area of North West province. Most of the poultry in this area are exotic breeds such as the Cobb 500 chickens. Though farmed commercially, however, limited information exists on the effect of the hatching egg size on hatchability and chick weight of Cobb 500 broiler chickens. This implies that their contribution to the household protein food security may not be fully realized without appropriate management and husbandry interventions as suggested by Abiola (1999) that egg size typically affects hatching size in birds because the main effect of egg size lies in the mass of the residual yolk sac that the chick retains at hatching. In this regard, extensive research has not been done to determine the effect of egg weight on chick weight and hatchability potential of Cobb 500 breed. Thus, it is envisaged that improving chick- weight and hatchability potentials of these chickens would help to enhance food sufficiency and economic empowerment of the Rustenburg people and the nation at large.

## **1.3 Motivation**

Data on the effect of egg weight on the performance of Cobb 500 chickens is limited particularly on hatchability and chick-hatch weight. Knowing the egg weight to optimize these factors will help in optimizing productivity of the birds. This will improve the economic, social and nutritional status of the Rustenburg farming households.

## **1.4 Objectives**

The objectives of this study were:

1. To determine the effect of egg weight on hatchability and chick-weight of Cobb 500 broiler chickens.
2. To determine the relationships between Cobb 500 broiler chicken egg weight and responses in hatchability values and chick-hatch weight.

## **1.5 Significance of the study**

Results from this study will help to make a contribution towards a better understanding of the effect of egg weight on hatchability and chick-weight of Cobb 500 broiler chickens.

**CHAPTER 2**

**LITERATURE REVIEW**

## 2.1 Introduction

Poultry production is practised at all levels in South Africa and elsewhere ranging from subsistence to large scale commercial operations. Usually, commercial operations rely on exotic chicken breeders like Ross 308 broiler chickens, Anak broiler chickens, Ross 508 broiler chickens and Cobb 500 broiler chicken breeders for the supply of hatch-able eggs to the hatcheries for their day-old chicks while the subsistence farmers hatch their eggs by natural incubation. In either of these two operations, Stromberg (1975) suggested that fertility and hatchability are major variables of reproductive performance associated with eggs which are most affected by environmental and genetic influences. Hence, fertility refers to the percentage of incubated eggs that are fertile while hatchability on the other hand is a function of number of chicks hatched. Furthermore to this, Sapp *et al.* (2004) reported that fertility and hatchability have a low heritability estimate of 0.06 - 0.13 and thus suggesting that non-genetic factors have a stronger and more pronounced influence on these traits. But because fertility and hatchability are interrelated heritable traits that vary among breeds, variety or individuals in a breed or variety (King'ori, 2011) it therefore becomes very important to understand the effect of egg weight on these traits in Cobb 500 broiler chickens. Wilson (1991) reported a higher hatchability for intermediate sized eggs compared to too small or too large eggs in Anak broiler chicken eggs. In another study with Anak broiler chickens, Abiola (1999) reported that egg size typically affects hatching size in birds because the main effects of egg size lies in the mass of the residual yolk sac that the chick retains at hatching. In contrast, there is a paucity of information on the effect of egg weight on fertility percentage, hatchability and chick weight of Cobb 500 broiler chickens



## **2.2 Cobb 500 broiler chicken:**

Often, the companies producing high performances broiler chicken breeds provide to poultry industry certain technical data describing hybrid performance, nutritional requirements and management parameters. Thus, according to Cobb-vantress (<http://www.cobb-vantress.com/products/cobb500>), Cobb 500 broiler chicken is the world's most efficient broiler chicken and has the lowest feed conversion, best growth rate and an ability to thrive on low density, less costly nutrition. These attributes combine to give the Cobb 500 the competitive advantage of the lowest cost per kilogram of live-weight produced for the growing customer base worldwide.

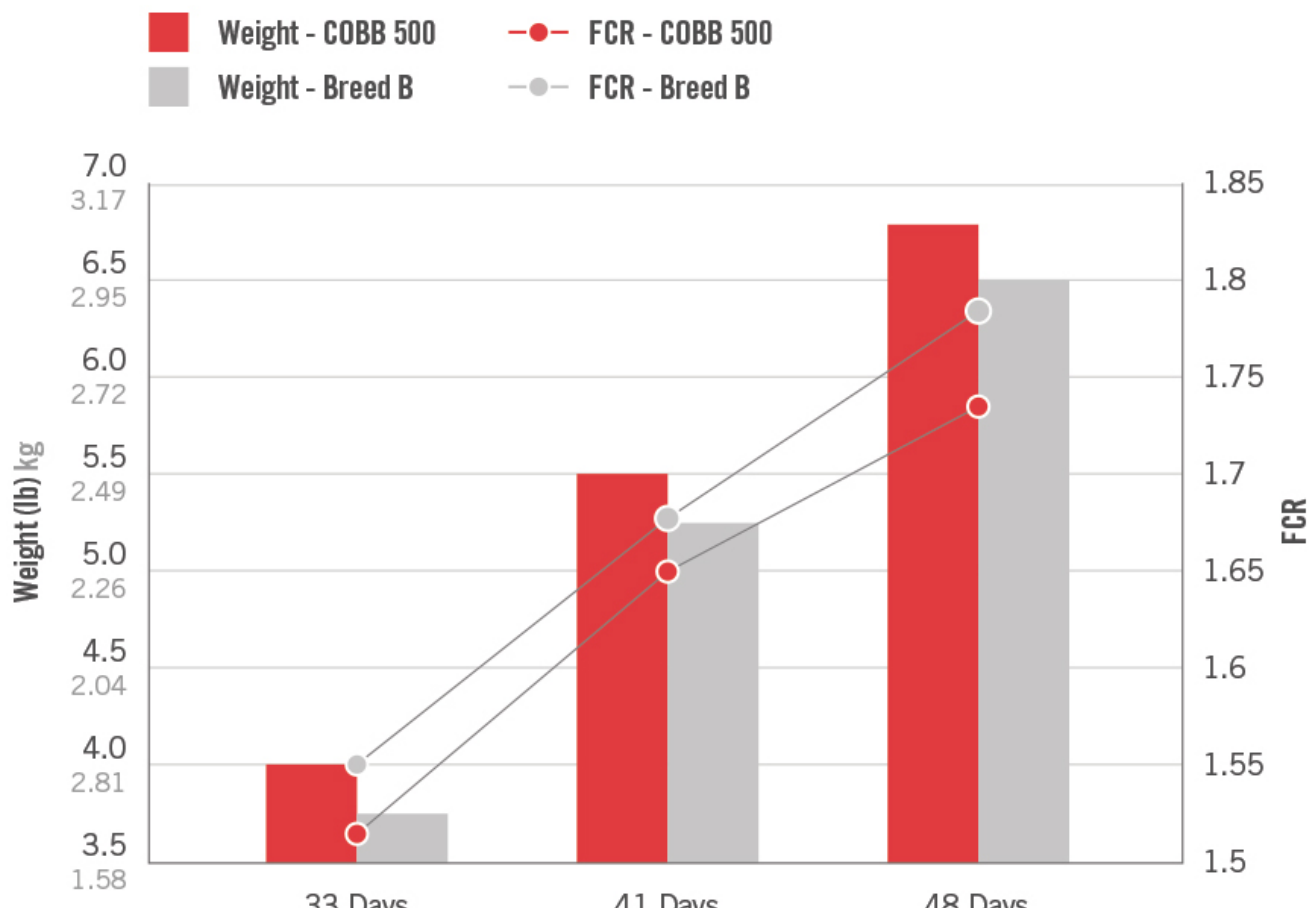
These competitive advantages include but are not limited to

1. Lowest cost of live weight produced
2. Superior performance on lower cost feed rations
3. Most feed efficient
4. Excellent growth rate
5. Best broiler uniformity for processing
6. Competitive breeder

Furtherance to the above advantages, other qualities of the Cobb 500 broiler chickens over the other breeds are summed up by the cobb-vantress company in the following selected parameters:

### **2.2.1 Feed Conversion**

Feed is now 60% of the total cost of producing a broiler chicken. Therefore, feed costs are forecast to remain high for the next 1-2 years (Global Insight, 2007) and hence efficient feed utilization becomes the most influential input in the management of livestock production cost. In this regard, Cobb selection programs have emphasized efficiency and feed conversion as high priorities in the development of the Cobb 500 broiler chicken breed and this has helped Cobb to achieve the lowest cost of producing a kilogram of meat in markets around the world. Furthermore, efficient feed conversion and excellent growth rate assist in the customer's goal of achieving a target weight with the competitive advantage of lowest cost. Cobb combines both attributes in the world's most successful broiler, the Cobb 500.



**Figure 3:** Comparison of weight and feed conversion ratio between the Cobb 500 broiler chicken breed and another breed “B” type of broiler chicken.

**Breed “B” = other chicken breeds which might include Ross, Arbor acres, and Hubbard.**

**Source:** (<http://www.cobb-vantress.com/products/cobb500>)

### 2.2.2 Feed Cost

Lowest feed conversion ratio together with the ability of the Cobb500 to thrive on lower density, less expensive feed, reduces the cost of producing chicken meat. Thus, when lower density feed with reduced nutrient levels is fed to the Cobb 500 broiler chicken it decreases feed ingredient costs without affecting performance. According to the Cobb Company, the following table illustrates feed cost savings by feeding a lower density feed from a one million bird/week operation due to efficient feed utilization by the Cobb 500 broiler chicken breed. Thus, the company estimates that the saving are over \$2.8 million/year.

**Table 3:** Feed cost savings by feeding a lower density feed from a one million bird/week operation.

	Low Density Ration	High Density Ration
<b>Feed/week(kg/lbs in 000's)</b>	<b>4,138/9,124</b>	<b>4,119/9,080</b>
<b>Feed Cost(kg/lb)</b>	<b>0.194/0.888</b>	<b>0.205/0.093</b>
<b>FCR</b>	<b>1.665</b>	<b>1.657</b>
<b>Feed cost/bird</b>	<b>\$0.803</b>	<b>\$0.844</b>
<b>Total feed cost/week</b>	<b>\$802,930</b>	<b>\$844,473</b>
<b>Savings per year</b>		<b>\$2,160,282</b>

**Source:** (<http://www.cobb-vantress.com/products/cobb500>)

### **2.2.3 Cobb 500 Breeder**

The Cobb500 is a competitive breeder, providing excellent egg and chick numbers to complement the superior performance of the world's most efficient broiler (<http://www.cobb-vantress.com/products/cobb500>).

**Table 4:** Global Cobb 500 breeder performance in comparison to global output among other chicken breeder strains to 65 weeks - ranked according to total eggs per Hen hatched.

	Average	Top 25%	Top 10%
<b>Total Eggs</b>	<b>162.2</b>	<b>177.0</b>	<b>182.8</b>
<b>Hatching Eggs</b>	<b>157.4</b>	<b>170.3</b>	<b>174.8</b>
<b>Chicks</b>	<b>131.2</b>	<b>129.8</b>	<b>142.3</b>
<b>Mortality %</b>	<b>9.5</b>	<b>5.9</b>	<b>4.7</b>

**Source:** (<http://www.cobb-vantress.com/products/cobb500>)

Since the production and availability of day-old chicks is influenced by total eggs produced, mortality percentage, fertility and hatchability percentage respectively, the above table becomes very important. Thus, as suggested by Wilson (1991) hatchability is a typical fitness trait with low heritability which may indicate that improvement by selection will take a long time to produce measurable results and hence optimization of hatching total eggs produced and hatchery management therefore seems to be the most promising route for improvement.

#### **2.2.4 Production characteristics of Cobb 500 broiler chickens in comparison to other chicken breeds:**

Although the above competitive advantages as outlined by cobb-vantress.company are straight related to the technological conditions provided by farmers, it remains contestable based on results of experimental evaluation of production performance parameters of Cobb 500 broiler chickens and other breeds. Therefore, the following review will emphasise on the results achieved during the intensive husbandry of different meat-type hybrids of chicken mainly Arbor acres, Cobb 500, Hubbard and Ross broiler chicken breeds focusing on those performances concerning dressed weight, slaughtering efficiency, proportion of the main cut parts in whole carcass structure and growth dynamics.

Skrbic *et al.* (2007) compared body mass and dynamics of growth of broiler chickens of different genotypes namely Cobb 500 line broiler chicken and an Arbor acres broiler line in improved rearing conditions. The results of their study indicate initial differences in growth dynamics of these broiler chickens with an initial more intensive growth of Cobb chickens which reached the maximal values of average daily gains in the fifth week of age (67.40 g) and then with a tendency to decrease in daily gains after the fifth week of age. However, this growth dynamics was contrary to those of chickens of Arbor acres genotype which had continuous growth, so the highest daily gain was achieved in the last, sixth week of age (75.60 g). Though in spite of these initial established differences in growth dynamics, final body masses of Cobb and Arbor Acres chickens weren't statistically significant (2175.67 and 2153.90 g) at 42 days of age. The authors concluded that initial differences in growth dynamics among the two chicken genotypes were probably as a result of differences in selection programme applied to these chicken breeds.

Also, in another separate study with Cobb 500 and Ross broiler chicken breeds, Chepete *et al.* (2008) found that there were no significant differences between production performance parameters of the Cob 500 and Ross broilers. However, these authors concluded that in general for all parameters studied, the trends of the production performance parameters showed that Cobb broiler chicken breeds had slightly higher values which were not significantly different than the Ross broiler chicken. Souza *et al.* (1994) showed that some breeds have presented a continuous genetic progress in traits of economic interest. In this evaluation, the breeds Ross, Cobb and Hubbard had a higher breast yield than Arbor Acres breed. Vieira and Moran Jr. (1998) evaluated the carcass yield of 49-day-old chickens from four different breeds and found no difference in the yield, but differences of up to 20% in the amount of abdominal fat were verified between different commercial breeds. Flemming *et al.* (1999) compared the yield of the carcass and of parts of five commercial breeds: Ross, Cobb, Hubbard, Arbor Acres and Isa Vedette, and registered differences only between Ross and Cobb from the others, which showed a smaller yield. Comparing Ross with Cobb, the first had the best yield of boneless leg. On the other hand, in another evaluation, Moreira *et al.* (2003) and Stringhini *et al.* (2003) verified no difference in the yield of carcass or cuts between Ross and Cobb breeds. In relation to the productive performance, these authors observed that

both breeds showed a similar satisfactory performance. Moro *et al* (2005) compared the productive performance of Ross and Cobb breeds with two Embrapa breeds and no significant difference was detected at the age of 56 days for any productive parameter.

Apparently, the above observations support the fact that different breeding companies started to apply their knowledge in quantitative genetics differently towards the selection of meat type chickens (Havenstein *et al.*, 2003). In most cases, this selection programs focused on the differences in growth dynamics, increment of growth rate, increasing muscle yield, improvement in feed conversion, and decreased age to slaughter of commercial broiler chickens. The result was “high-yield” chicken strains that require approximately 1/3 of the time and over a threefold decrease in the amount of feed consumed to reach desired slaughter weights as compared to what existed five decades ago (Havenstein *et al.*, 2003). Furthermore, in 2004, Tona and colleagues compared incubation parameters, one day old chick weight, chick quality, and broiler growth to 7 and 41 d of age, as well as heat production, corticosterone and T3/T4 levels in plasma in 3 different commercial lines of broiler breeders. The differences in heat production before day 18 of incubation and the different levels of corticosterone in plasma after hatch suggested different metabolic rates between the three lines. With their research results it has become accepted that the embryos from high-yield broilers have different physiological characteristics and therefore different incubation requirements than classic or genetic lines of previous generations.

Again, the above observations on lack of statistically significant differences in final growth rate of Cobb and Arbor Acres chickens at 42 days of age by Skrbic *et al.* (2007), and the results of Chepete *et al.* (2008) who found that there were no significant differences between production performance parameters of the Cob 500 and Ross broilers as well as the findings of Moreira *et al.* (2003) and Stringhini *et al.* (2003) who verified no difference in the yield of carcass or cuts between Ross and Cobb chicken breeds contradict the above claim of the Cobb 500 broiler breeder company as the breed with the “best growth rate” and therefore makes the above competitive advantages of Cobb broiler chicken breeds as outlined by the Cobb company questionable.

### **2.3 Effect of incubation environment on hatchability of chickens**

The modern broiler chicken such as Cobb 500 broiler chicken has been reported to be able to achieve the same body weight at slaughter age in less than a third of the time as compared to their random bred predecessors (Havenstein *et al.*, 2003). However, while the time spent on the farm may be decreasing, the embryo has been found to still require a 21 day incubation period, which translates into a greater percentage of the life of the broiler being spent in the incubator. This places a greater emphasis on the conditions under which this embryonic period of growth occurs. As a result, controlling and optimizing the physical environment namely temperature, egg turning and humidity that the egg will be exposed to during incubation have become very important in order to stimulate embryonic development until hatching (French, 1997).

Lourens *et al.* (2005) in their studies reported that environmental temperature is one of the most important factors among the three for incubation efficiency and hence as suggested by Lourens (2001) a constant incubation temperature of 37.8°C is the thermal homeostasis in the chick embryo and gives the best embryo development and hatchability (Lourens *et al.*, 2007). In addition, an increase in environmental temperature may cause metabolizable energy to be diverted from growth and development to functions involved in homeothermy (Maijerhof and Albers, 1998). Thus, a constant temperature of 38.6°C during incubation initially accelerates embryonic growth, utilization of nutrients and energy from the yolk and albumen reserves, but later decreases embryonic development as a result of limited metabolic process by insufficient exchange of oxygen (Lourens *et al.*, 2005).

These authors also reported significant embryo mortality and lower hatchability in chicken eggs when they were subjected to incubation temperature of 38.9°C. Incubation humidity is also another important factor. Always make sure that fertile incubating eggs are stored in a clean place at 13-16°C and 70-75% humidity. Often, humidity levels lower than 40% can decrease hatchability dramatically in a very short period of time. Similarly, egg turning during incubation is important for successful hatching and influences hatchability. No turning of eggs during incubation results in low hatchability and delays hatch by a few days (Yoshizaki and Saito, 2003).

## **2.4 Effects of egg weight on hatchability of chickens**

Egg size has been widely studied in the context of the bird's life-history theory because it can be highly variable. Mbajorgu (2011) studied the relationship between hatching egg size on hatchability and chick hatch weight of indigenous Venda chickens and came up with variable results. Results from that study indicated that percentage hatchability ranged between 28.1 - 48.3 %. Percentage hatchability among the three egg size groups used in the study was much lower than the near 100 % reported for Nigerian local chickens (Atteh, 1991). A number of factors including egg age (Tarongoy *et al.*, 1990), storage condition (Brah and Sandhu, 1989), age of flock (Rogue and Soares, 1994; Buhr, 1995), system of husbandry and rearing technology (Weis, 1991), mating system (Gebhardt-Henrich and Marks, 1991), incubation relative humidity and egg turning angle (Permsak, 1996) have been shown to influence the hatchability of poultry eggs. As such, Mbajorgu (2011) concluded that the low hatchability values recorded for the three egg size groups may however, not be a true reflection of the genetic potential of the indigenous Venda chicken breed, as most of the embryos died few days prior to hatching. Such a late embryonic mortality is not uncommon in poultry and hence may decrease hatchability.

Wilson (1991) suggested that hatchability is a typical fitness trait with low heritability which may indicate that improvement by selection will take a long time to produce measurable results and hence optimization of hatching egg weight and hatchery management is therefore the most promising route for improvement. In the same study, large sized-eggs had a higher hatchability value of 48.3 % than medium and small-sized eggs. Hatchability of the incubated eggs increased as egg weight increased to large egg-size group of 60-69 g suggesting that egg-size group of 60-69 g were best suited for incubation. Thus, it is possible that egg quality and storage conditions might have caused these differences as similarly observed by Seker *et al* (2004). Contrary to this finding, Wilson (1991) and Kalita (1994) reported higher percentage hatchability for intermediate sized eggs compared to too small or too large eggs in broiler chickens.



## **2.5 Effects of egg weight on chick-hatch weight in chickens**

It is known that a positive correlation exists between egg size and chick weight in broiler chickens (Abiola *et al.*, 2008; Shananwany, 1987) and poults (Bray, 1965), in another study with broiler chickens, Abiola (1999) reported that egg size typically affects hatching size in birds because the main effect of egg size lies in the mass of the residual yolk sac that the chick retains at hatching. Furthermore, Mbajorgu (2011) in studying the effect of egg size on hatchability and chick hatch-weight in indigenous Venda chickens found that medium-sized eggs produced chicks with significantly higher hatch-weight than small and large sized eggs. In addition, results from the study indicated that hatchability was optimized at hatching egg weight of 67g ( $r^2 = 1.000$ ) and chick-hatch weight at 60 g ( $r^2 = 0.998$ ), respectively. This the author concluded may imply that the egg weight for optimum hatchability in indigenous Venda chickens is higher than that for optimum hatch-weight and may suggest that an alteration of tissues takes place, particularly muscle and fat deposits, which may differ in nutrient contents (Moran and Bilgili, 1990). However, the values of 67 g and 60 g for optimum hatchability and chick-weight obtained in that study were higher than the average egg weight of 52.81g obtained for all the three egg size groups used for the experiment and hence indicating that improvement in egg size would be needed in order to maximize the hatchability and chick-hatch weight in indigenous Venda chickens. In contrast, there is a paucity of information on the effect of egg size on hatchability and chick weight in Cobb 500 broiler chickens. Therefore, improving the hatchability of these eggs will help to improve the productivity of these chickens.

## **2.6 Effects of egg weight on subsequent growth indices in chickens.**

There is evidence that egg weight has effect on subsequent growth indices of chickens. Tuft and Jensen (1991) and Wyatt *et al.* (1985) reported that egg weight had effects on subsequent chicks' performance of broiler chickens. In the same manner, Alabi *et al.* (2012) in another study on the effect of egg weight on hatchability and subsequent performance of Potchefstroom Koekoek chicks from one to seven weeks of age found that the weight of Potchefstroom Koekoek eggs influenced all parameters measured except the mortality rate percentage. Thus, results from that study indicate that chickens hatched from large-sized eggs had higher daily live weight gain and live weight at seven weeks than those hatched from medium and small-sized eggs. Those hatched from medium-sized eggs also, had higher daily live weight gain and live weight at seven weeks than those from small-sized eggs. A similar trend was observed with daily intake per bird. Chickens hatched from large-sized eggs had better feed conversion ratio than those hatched from small-sized eggs although similar ratio was observed between large and medium-sized eggs.

Extending the experimental period to 13 weeks of age, Alabi *et al.* (2012) found that chickens hatched from large-sized eggs had higher daily live weight gain, daily feed intake and live weight gain at 13 weeks than those from medium-sized eggs. Similarly, chickens hatched from medium-sized eggs had higher daily live weight gain, daily feed intake and live weight gain at 13 weeks than those hatched from small-sized eggs. The feed conversion ratio between eggs hatched from large and medium-sized eggs were similar, however, chickens hatched from large-sized eggs had better feed conversion ratio when compared to those hatched from small-sized eggs. Nevertheless, the study found that egg weight had no effect on chicken mortality between 8 and 13 weeks of age. Similarly, egg weight of Potchefstroom Koekoek hen had no effect on the chicken's carcass weight, drum stick, wings and fat pad. However, the breast meat and the thigh weight were influenced by the weight of the eggs. Contrary to the present findings, Abiola *et al.* (2008) reported that dressing percentage of large chicks was higher compared to the small and medium sized chicks.

Most importantly, Hearn (1986) suggested that if eggs were segregated by size in the hatchery and the chicks rose separately, the variability at slaughtering age would be reduced and the growth of each group optimized. Thus, from the above studies it can be seen that egg weight has been observed to be an important factor on pre-hatch and post-hatch performance of chickens. Presently, however, there is little or limited information on the effect of egg weight on hatchability and growth performance of Cobb 500 broiler chickens. Therefore, the objective of this study was to determine the effect of egg weight on hatchability and chick weight of Cobb 500 broiler chickens.

## **2.7 Summary**

Hatchability, post-hatch performance in terms of chick-weight and growth parameters in chickens is influenced by egg weight. Presently, however, there is little or limited information on the effect of egg weight on hatchability and growth performance of Cobb 500 broiler chickens. Therefore, the objective of the study was done to determine the effect of egg weight on hatchability and chick weight of Cobb 500 broiler chickens.

**CHAPTER 3**

**MATERIAL AND METHODS**

## **MATERIAL AND METHODS**

### **Study area**

The study was conducted at Rustenburg hatchery, North West; South Africa in 2012. The hatchery was located at about 18 km North West of Rustenburg. The average temperature around the study area was 27.5°C. Annual rainfall is between 456.8mm and 489.3mm.

### **Experimental procedure**

A total number of 396 hatchable eggs of different sizes produced by Cobb 500 broiler hens, aged 55 weeks of age were used to determine the effect of egg size on hatchability and chick hatch-weight. All the hens used for egg collection were maintained under similar environmental and management conditions and feed and water was offered ad libitum. All the eggs used in this study were collected between 10:00 and 11:00 hours. At commencement of the study, the eggs were numbered and weighed individually using sensitive weighing scale (Mettler-Toledo sensitive weighing balance) and later grouped into three egg size categories as follows: small (< 49 g), medium (50-59 g) and large (60-69 g) thus, ending up with three different incubating egg size groups with three replicates per group with an average egg weight of 54.60 g. Each egg size group had 132 eggs with 44 eggs per replicate. Thereafter, the eggs were fumigated with formalin on potassium permanganate in the ratio of 1:2 for 15 minutes and then were randomly set into a forced-draft single stage incubator at dry bulb temperature of 37.5 °C and wet bulb temperature of 28.3 °C with the broad ends pointing upwards. On the 18 day of incubation, all eggs were candled and those with evidence of living embryos transferred from the turning trays to hatcher baskets. Number of eggs that hatched per replicate within each egg size group was recorded at 21.5 day of incubation.

## Data collection

The hatchability percentage was determined in each replicate by dividing the number of hatched eggs per replicate by the total number of eggs set in each replicate and then multiplying by one hundred. The hatchling weight was measured by weighing the chicks in each replicate immediately after hatching.

$$\text{Fertility rate \%} = \frac{\text{Number of fertile eggs}}{\text{Number of egg incubated}} \times 100$$

$$\text{Hatchability \%} = \frac{\text{Number of chicks hatched}}{\text{Number of fertile egg incubated}} \times 100$$

$$\text{Hatch of fertile \%} = \frac{\% \text{ hatchability}}{\% \text{ fertility rate}} \times 100$$

## Statistical analysis

Effect of egg weight on hatchability and hatch weight of Cobb 500 broiler chickens were analyzed by using the General Linear Model (GLM) procedures of the statistical analyses system (SAS, 2008). The statistical model used was

$$Y_{ijk} = \mu + T_1 + \sum_{ijk}$$

Where:  $Y_{ijk}$  = the overall observation (hatchability, chick weight, fertility rate and Hatch of fertile percentage)

$\mu$  = population means

$T_1$  = Effect of different egg weights (small, medium and large)

$\sum_{ijk}$  = Residual effect

Duncan test for multiple comparisons was used to test the significance of differences between treatment means at 5 % significance level ( $P < 0.05$ ). The relationships

between responses in hatchability values or chick hatch-weight to egg size were modeled using a linear regression equation (SAS, 2008) of the form:  $Y = a + bx$

Where;  $Y$  = Hatchability value or chick hatch- weight,  $a$  = intercept,  $b$  = coefficients of the linear equation;  $x$  = egg weight. The linear model was fitted to the experimental data by means of NLIN procedure of SAS (SAS, 2008). The linear model was used because it gave the best fit.

## **CHAPTER 4**

### **RESULTS**



## RESULTS

Results of the effects of egg weight on fertility rate percentage, hatchability and chick hatch weight of Cobb 500 broiler chickens are presented in Table 1. Results indicate that egg weight has no significant effect ( $P>0.05$ ) on fertility rate percentage and hatchability of Cobb 500 broiler chickens. However, fertility rate percentage ranged between 92.40 - 90.90% while percentage hatchability ranged between 90.89 - 92.43 %, respectively. Large-size eggs produced chicks with higher ( $P<0.05$ ) chick hatch-weight than medium and small sized eggs but there were no significant differences ( $P>0.05$ ) in percentage hatch of fertile eggs among the three egg size groups.

Table 2 and Figure 1 and 2 present a series of linear regression that predict the relationship between hatching egg weight and hatchability and chick hatch-weight of Cobb 500 broiler chickens. Result indicate that hatchability was inversely correlated with egg size ( $r^2=0.555$ ) and chick hatch-weight was moderately and positively correlated with egg weight ( $r^2=0.995$ ), respectively.

**Table 1:** Effect of egg -size on hatchability and chick-hatch weight of Cobb 500 broiler chickens

Variables	Hatching egg sizes			SE
	Small	Medium	Large	
Fertility rate (%)	92.40	90.90	90.90	2.321
Hatchability (%)	92.43	90.89	90.92	2.325
Chick hatch weight (g/bird)	42.33 <sup>c</sup>	44.13 <sup>b</sup>	49.01 <sup>a</sup>	0.336
% Hatch of fertile	100	99.98	100	2.368

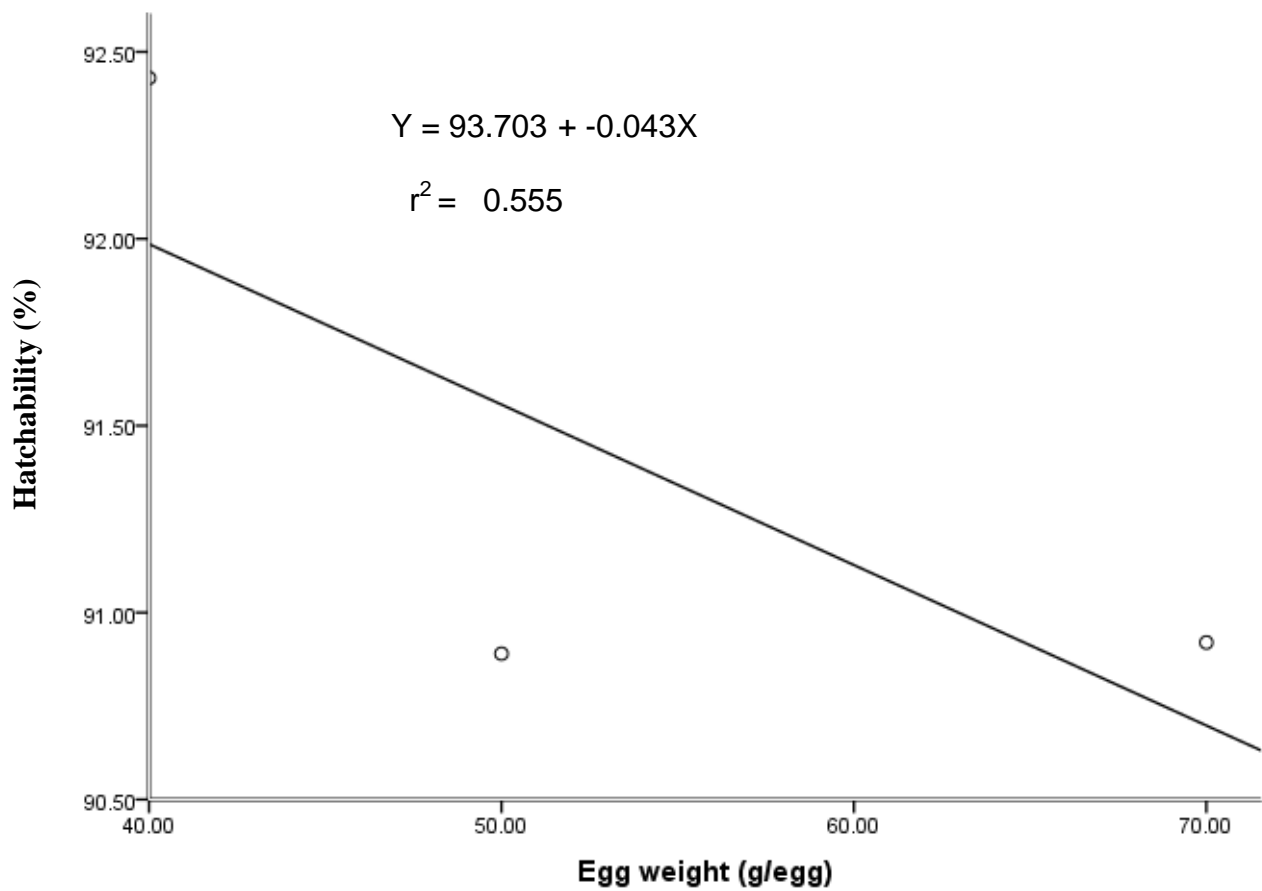
<sup>a,b,c</sup> : Means in the same column not sharing a common superscript are significantly different ( $P< 0.05$ )

SE= Standard error

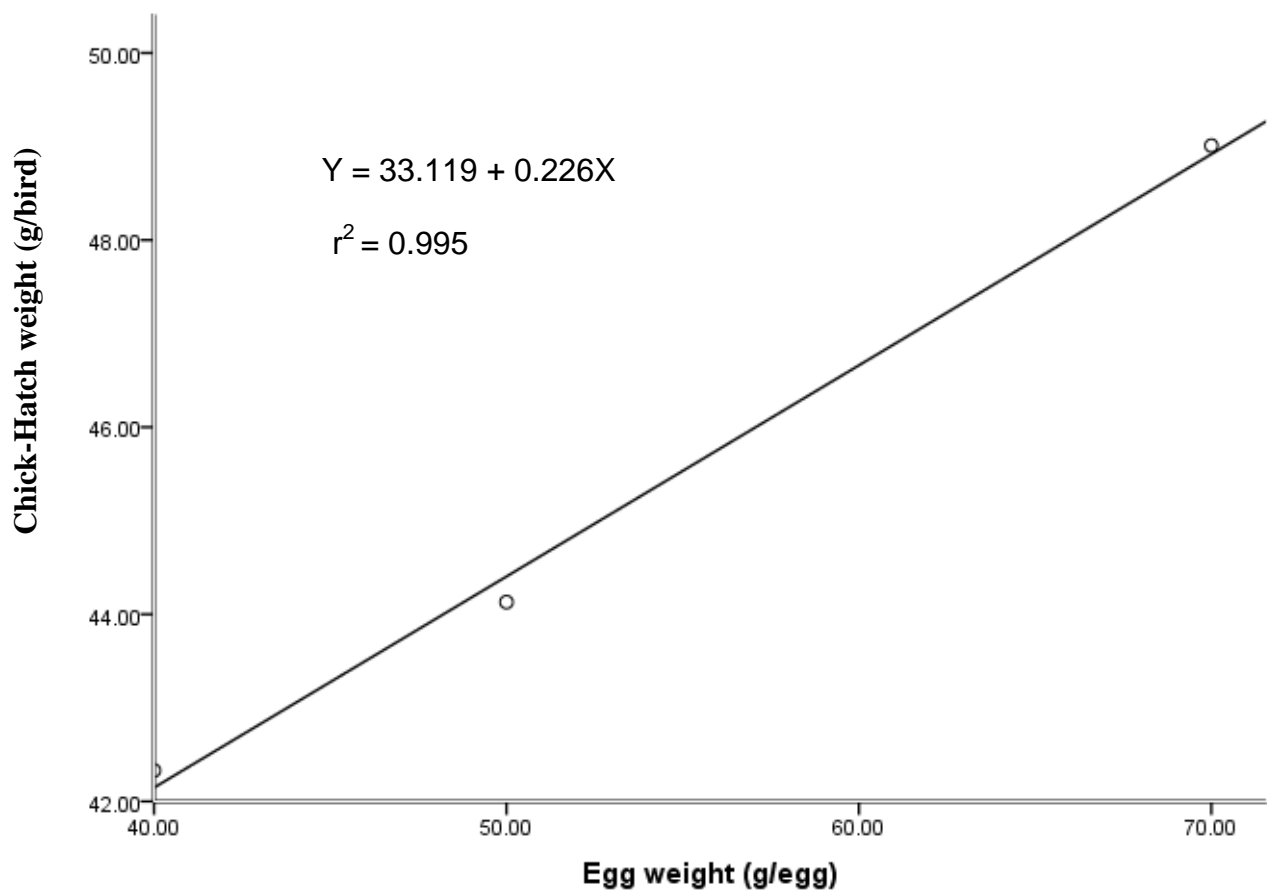
**Table 2:** Relationships between Cobb 500 broiler chicken egg weight (g/egg) and responses in hatchability values (%) and chick-hatch weight (g/chick).

Trait	Formula	$r^2$	P-value
Hatchability	$Y = 93.703 + -0.043X$	0.555	0.465
Chick –hatch weight	$Y = 33.119 + 0.226X$	0.995	0.045

$r^2$ : Correlation coefficient



**Figure 1:** Relationship between egg weight and responses in hatchability of Cobb 500 broiler chickens



**Figure 2:** Relationship between egg weight and responses in chick-hatch weight of Cobb 500 broiler chickens

## **CHAPTER 5**

### **DISCUSSION**

## DISCUSSION

The egg weights used in the present study ranged between < 49 g - 69 g with an average egg weight of 54.60 g. The average egg weight value of 54.60 g is slightly higher than the average egg weight of 52.81 g of Mbajorgu (2011) and 52.2 g of Fourie and Grobbelaar (2003) reported for indigenous Venda chicken eggs but lower than the average egg of 60 g that supported optimum hatchability in indigenous Venda chickens as observed by Mbajorgu (2011). These differences in average egg weight sizes were not unexpected and could be attributed to breed differences. However, as revealed in the present study, very high fertility rate ranging from 92.40 - 90.90 % were observed in the present study. This rate is similar to those reported by Kamanli *et al.* (2010) and Islam *et al* (2002). It was also observed in the present study that the egg fertility rate percentage was not affected by egg size of Cobb 500 broiler chickens. The non-significant effect of egg weight on fertility rate percentage in Cobb 500 broiler chickens is similar to the observations made by Petek *et al.* (2005) in quils, Sahin *et al.* (2009) in breeder hens and Kamanli *et al* (2010) for ATAK-S Brown layers but contrary to the findings of Caglayan *et al.* (2009) in rock partridge.

On the other hand, the non-significant effect of egg weight on percentage hatchability might imply that effect of egg weight was similar on this parameter regardless of the different egg sizes used in the study. Contrary to the present findings, Mbajorgu (2011) observed differences in hatchability values of indigenous Venda chicken eggs. Similarly, the very high hatchability percentage values ranging from 90.89 – 92.43 % obtained in the present study are different from the 88.57 % observed in Fayumi chickens, 80.77 % observed in dual purpose Rhodes Island Red RIR and 60.00 % observed in Desi chicken as reported by Farooq *et al.* (2001) on

the basis of fertile eggs set. Perhaps, the improved percentage hatchability values associated with the Cobb 500 broiler chickens could be attributed to their genetic make up for better propagation and reproductive ability than the Fayumi, RIR and Desi chickens, respectively. Moreover, Desi chicken according to Farooq *et al.* (2001) is indigenous non-descript with no well documented characters for better hatchability.

Beyond this, because Farooq *et al.* (2001) suggested that hatchability is reduced with reduced fertility. Taking this further might also mean that hatchability will be improved with improved fertility. Thus, the very high hatchability percentage values ranging from 90.89 – 92.43 % obtained in the present study might indicate that hatchability was limited by fertility of the eggs incubated and not by the hatcheries ability to effectively hatch eggs. This fact is supported by the similar percentage hatch of fertile eggs recorded for the three egg size groups. Such a high percentage fertility rate is not uncommon in poultry as similarly observed by Kamanli *et al* (2010) and Islam *et al* (2002) and hence may improve hatchability.

Results of the present study indicate that large-size eggs produced chicks with higher chick hatch-weight than medium and small sized eggs. This observation is not unexpected since it is known that a strong and positive correlation exists between egg size and chick hatch-weight in broiler chickens (Tullet and Burton, 1982; Abiola *et al.*, 2008; Shanaway, 1987) and in poults (Bray, 1965). Furthermore, it is also known that heavier eggs contain more nutrients than small or medium sized eggs (Williams, 1994) and hence as a result, chicks from heavier eggs tend to have more yolk attachment at hatching (Hassan *et al.*, 2005; Woanski *et al.*, 2006).

Thus, this yolk attachment is utilized by the chick after hatching and the potential performance of day-old chicks may depend on the quality and quantity of this yolk. Applying this to the present finding, may explain the differences in chick hatch weight among the different egg size groups. Similarly, Narkhede *et al.* (1981) also reported positive correlation ( $r^2=0.93$ ) of egg weight with hatching chick weight in crossbred chicken (Rhode Island Red x White Leg Horn).

On the other hand egg weight was found non-significantly but inversely correlated ( $r^2=0.555$ ) with hatchability. This suggests that increased egg weight would result in decrease of hatchability. Farooq *et al.* (2001) and Narkhede *et al.* (1981) also found negative correlations between egg weight and hatchability in crossbred chickens.

As shown in their studies, heavier eggs tended to result in lower hatchability. However, comparison of percentage hatchability values in the present study in relation to egg weight revealed non-significant differences. Thus, findings may lead to a valid conclusion here because percentage hatch of fertile was similar for all the incubated eggs irrespective of differences in egg weights. However, keeping in view findings of Kalita (1994) whose report suggested that too large eggs must be discarded while setting eggs in the incubator, which is true because too large eggs may create problems in incubation process.

Egg weight was also found significantly and positively correlated ( $r^2=0.995$ ) with hatching chick weight suggesting that increased egg weight will result in increased hatching chick weight. This biochemical reason for this phenomenon as suggested by Williams (1994) is that heavier eggs contain more nutrients than small eggs and hence, developing embryos from heavier eggs tend to have more nutrients for their growth requirements. The present findings are similar to the findings of Narkhede *et*



*al.* (1981) who also reported a positive correlation ( $r^2=0.93$ ) of egg weight with hatching chick weight in crossbred chicken (Rhode Island Red x White Leg Horn). Tona *et al* (2002) also observed similar findings in broiler chickens. However, contrary to the present findings, Asuquo and Okon (1993) reported that egg size within the intermediate weight range of 45 to 56 g hatched heavier chicks than small or large eggs.

**CHAPTER 6**

**CONCLUSION AND RECOMMENDATION**

## **Conclusion and recommendation**

The range of egg sizes used in this study had a non- significant effect on percentage fertility rate and hatchability of Cobb 500 broiler chickens. However, large-sized eggs produced chicks with higher hatch-weight than medium and small- sized eggs. It is therefore concluded from the result of the present study that sorting of Cobb 500 broiler chicken breeder eggs by weight prior to incubation might be advantageous in obtaining higher day-old chick weight in Cobb 500 broiler chickens. This will help to produce uniform size Cobb 500 broiler chicken hatchlings to meet specific market demands with improved efficiency. It is also recommended that future work may also address the effect of egg quality parameters on hatchability and chick-hatch of Cobb 500 broiler chickens

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## **APPENDICES**

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### Appendix 8.1 “ANOVA for dependent Variable: Number of fertile eggs”.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.88888889	0.44444444	0.14	0.8697
Error	6	18.66666667	3.11111111		
Corrected Total	8	19.55555556			
	R-Square	Coeff Var	Root MSE	NOFERT Mean	
	0.045455	4.385223	1.763834	40.22222	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
treat	2	0.88888889	0.44444444	0.14	0.8697
Source	DF	Type III SS	Mean Square	F Value	Pr > F
treat	2	0.88888889	0.44444444	0.14	0.8697

### Appendix 8.2 “ANOVA for dependent Variable: No eggs hatched/hatch of fertile”

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.88888889	0.44444444	0.14	0.8697
Error	6	18.66666667	3.11111111		
Corrected Total	8	19.55555556			
	R-Square	Coeff Var	Root MSE	NOHATC Mean	
	0.045455	4.385223	1.763834	40.22222	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
treat	2	0.88888889	0.44444444	0.14	0.8697
Source	DF	Type III SS	Mean Square	F Value	Pr > F
treat	2	0.88888889	0.44444444	0.14	0.8697

### Appendix 8.3 “ANOVA for dependent Variable: chick hatch weight”

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	71.81046667	35.90523333	105.86	<.0001
Error	6	2.03513333	0.33918889		
Corrected Total	8	73.84560000			

	R-Square	Coeff Var	Root MSE	CHWT Mean	
	0.972441	1.289635	0.582399	45.16000	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
treat	2	71.81046667	35.90523333	105.86	<.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
treat	2	71.81046667	35.90523333	105.86	<.0001

## Appendix 8.4 “ANOVA FOR Dependent Variable: Hatchability”

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	4.6526000	2.3263000	0.14	0.8693
Error	6	97.3278000	16.2213000		
Corrected Total	8	101.9804000			
	R-Square	Coeff Var	Root MSE	HAT Mean	
	0.045622	4.405726	4.027568	91.41667	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
treat	2	4.65260000	2.32630000	0.14	0.8693
Source	DF	Type III SS	Mean Square	F Value	Pr > F
treat	2	4.65260000	2.32630000	0.14	0.8693

## Appendix 8.5 Relationships between Cobb 500 broiler chicken egg weight (g/egg) and responses in hatchability values (%).

**Variable: Hatchability**

**Linear**

Model Summary			
R	R Square	Adjusted R Square	Std. Error of the Estimate
.745	.555	.109	.831

The independent variable is VAR00003.

**ANOVA**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	.860	1	.860	1.245	.465
Residual	.691	1	.691		
Total	1.551	2			

The independent variable is VAR00003.

**Coefficients**

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
VAR00003	-.043	.038	-.745	-1.116	.465
(Constant)	93.703	2.107		44.463	.014

## Appendix 8.6 Relationships between Cobb 500 broiler chicken egg weight (g/egg) and responses in chick-hatch weight (g/chick).

**Variable: Egg weight**

**Linear**

**Model Summary**

R	R Square	Adjusted R Square	Std. Error of the Estimate
.998	.995	.990	.342

The independent variable is VAR00003.

**ANOVA**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	23.775	1	23.775	203.158	.045
Residual	.117	1	.117		
Total	23.892	2			

The independent variable is VAR00003.

**Coefficients**

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
VAR00003	.226	.016	.998	14.253	.045
(Constant)	33.119	.867		38.183	.017