Effect of Different Stocking Densities on the Broiler Production Farms Profitability
Samer S. Ibrahim
Department of Animal Husbandry and Animal Wealth development, Faculty of Veterinary Medicine, Mansoura University, Egypt.

Abstract
This study was carried out to evaluate the effect of different stocking densities in farms on the profitability of broiler production to determine the best density from the economic point of view. Data of 105 production cycles of Cobb and avian breeds were randomly collected from different broiler farms in different localities in Dkahlia governorate in north delta of Egypt of same housing types and ventilation systems. The data include costs of production, returns of production, mortality and livability percentages, marketing age and weight from the records and structured questionnaires. The data were grouped into three groups according to the density, group 1 (5-7 birds/m²), group 2 (8-9 birds/m²) and group 3 (10-11 birds/m²). The data were summarized and calculated for each 100 birds then analyzed by statistical computer program (SPSS/PC, 16). The results of the study revealed that the third group of (10-11 birds/m²) is the best density in broiler farms has a significant effect on the profitability of broiler production.

1. INTRODUCTION
The food insecure in Egypt is the main cause of nutrition problem because of high food prices, low income and low local agricultural production (Unicef, 2012). According to (Taha, 2003) poultry listed as number one in order of importance and participation in Egypt’s total meat production. Broiler industry represents main resource in full-filling human protein requirements (Bengi and Habi, 1998 and Khan et al., 2010).

Broiler production requires relatively less capital and land than dairy, beef and fish production, broiler farming can be an important source of family income and gainful employment to farmers throughout the year. Specially developed breeds of broiler are now available with quick growth and high feed conversion efficiency. Poultry manure can be used for increasing yield of all crops as a fertilizer (Hosne, 2012).

Broilers are somewhat low priced; rapidly reproduce, with a high rate of productivity (FAO, 1999). Meats of broiler has many advantages as its richness with animal protein, low-fat food resources with relatively suitable price and easily available in market. From several past decades poultry has been changed to a large and profitable business (Dasti and Yazdani, 1995). The poultry industry has a relative advantage of easy management, quick returns to capital investment, higher turnover, and more acceptable product for human consumption when compared to beef industry (Haruna and Hamidu, 2004).

In Egypt the poultry industry is one of the main agricultural industries. It supplies a great part of the country’s animal protein. The size of the labour force is about 1.5 million permanent workers and about 1 million temporary workers (Ahlam and Ali, 2006). Broiler production is characterized by its high economic return as a result of its short production, therefore the capital cycle is very quick as compared with that in other animal production types and cycle can be repeated about 6-7 times per year (Grepay, 2009).

Sainsbury (1988) indicated that Lack of space in room of broiler chicks lead to leg problems, injuries and increased mortality. Stocking density has a marked effect on growth of chicken (Shanawany, 2017).
It affects feed intake, feed efficiency, livability (Cocnen et al., 1996) which influence productive and economic efficiency of broiler farms. Body weight, feed conversion, mortality, carcass scratches and breast meat yield were significantly improved when birds were given more space as illustrated in a study examining densities of 0.8, 0.9 or 1.0 square foot per bird (Bilgili and Hess, 1995).

Oluyemi and Roberts (1998) revealed that Growth and feed conversion are inversely related to floor space per bird. High stocking density has been reported to increase ammonia production; footpad lesions, litter moisture and heat stress (Cravener et al., 1992).

Overcrowding broilers results in cannibalism and pecking that induce rapid spread of disease, nervous therapy, lowering feed consumption, feed conversion, and growth and reduce weight (Botten and Blair, 2000 and Olowe, 2001). Whereas, over spacing leads to high activity that lead to reduce feed conversion and growth of birds (Malden et al., 2001). A study conducted by Feddes et al. (2002) revealed that when bird density was reduced live body and carcass weights were decreased. Meanwhile, at high densities bird uniformity was better.

Stocking density is currently expressed as a mass per unit of space instead of numbers of birds being reared in a given area (Thaxton et al., 2006). Because body mass appears to affect bird performance greatly more than number of birds (Feddes et al., 2002).

Maximizing the produced kg weight of chicken per square meter of space and preventing production losses due to overcrowding to achieve an acceptable economic return is the main goal of producers worldwide. (Mtileni et al., 2007; Škrbić et al., 2009) mentioned that Some studies showed large benefits in reducing stocking density on the performance of broilers, while other documented that reducing stocking density have no effect (Thomas et al., 2004) or even have a negative effects on broilers performance (Feddes et al., 2002).

The modern broiler house enables producers to have great control over the house environment. Birds can be placed at higher densities as long as the correct environment is provided (Fairchild, 2005). (Buijs et al., 2009; Ventura et al., 2010) documented that High stocking density results in an increase of foot pad dermatitis, hock and breast lesions as broilers grow, in particular for stocking density above 30 kg of livestock per m2 (Bessei, 2006). Onbaşlar et al. (2008) illustrated that stocking density has an effect on the final body weight of broiler, feed consumption and conversion (kg feed/kg gain). Similarly (Feddes et al. 2002) reported lower body weights in broilers when stocking density increased.

Adeyemo et al. (2016) indicated that Birds on high stocking density had better feed conversion ratio and significantly lower mortality. Up to stocking density 14birds / m2 broiler chickens’ performance and carcass characteristics were not negatively affected

For successful broiler production, it is essential to make correct stocking density and to assess stocking density correctly; factors as climate, housing types, ventilation systems, and welfare regulations should be considered Cobb Management Guide. (2013). Reducing stocking density increases total production costs, and decreases broiler production income (Utnik-Banaś et al. 2014).

This study is carried out to evaluate the effect of different stocking densities in broiler farms on the profitability of broiler production farms in Dkahlia governorate to determine the best density from the economic point of view.

2. MATERIAL AND METHODS

2.1. Data collection
The data collected from a cross-section survey from a random sample of broiler farms in different localities in Dkahlia governorate in north delta of Egypt of same housing types and ventilation systems. According to Atallah, (2000) the data collected using two methods from accurate records in the selected broiler farms and from structured questionnaire method in case of no records. The data were collected about different stocking densities of Cobb and avian breeds as the most common breeds in different broiler farms in the governorate as shown in table (1).

2.2. Data classification
All the production parameters, costs and returns within different densities were calculated for each 100 birds to overcome the variation in the numbers of broilers of the different farms. Data classified according to the methods implied by Osman et al., (2008):
Table (1): Number of cycles for each stocking density in broiler farms.

<table>
<thead>
<tr>
<th>No. of cycles</th>
<th>Stocking density</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>5-7 birds/m²</td>
</tr>
<tr>
<td>36</td>
<td>8-9 birds/m²</td>
</tr>
<tr>
<td>42</td>
<td>10-11 birds/m²</td>
</tr>
<tr>
<td><strong>105</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

1. Production parameters and resources: It include feed amount per bird, mortality percentage, marketing age, average body weight of bird at marketing and marketing price per kg meat.

2. Production costs:
   a. Fixed costs: included the rent of the buildings and equipment depreciation. The depreciation rates were calculated according to (Muhammad, 2002) for the equipment on five year and for the buildings on twenty five year, while the rent value used directly during the calculation in case of the farms not owned (Atallah, 2000).
   b. Variable costs: included drugs cost, vaccines cost, disinfectants cost, veterinary supervision cost, feed cost, chicks cost, labour cost, litter costs, electricity and miscellaneous. costs (Atallah, 2000 and Bano et al., 2011).

3. Returns: the returns from total live body weight sales and litter sales that calculated according to the market prices during the study.

2.3. Data analysis

The data collected, summarized and analyzed using the computer program SPSS/PC (SPSS, 2007) to test the effect of different densities on profitability and economic efficiency of broiler farms using One-way ANOVA and Duncan’s multiple comparisons of the means to compare data obtained. Data were expressed as means standard errors. Differences between treatments were considered significant when P<0.05.

2.4. Measures of economic and productive efficiency

These measures were calculated for about 105 cycles of three different stocking densities of Cobb and avian breeds from different broiler farms. The measures were:
1. Average broiler meat production per kilogram = Number of live birds X Average body weight at the marketing age.
2. Average total costs per EGP (Egyptian pound) (New, 1991): = Average fixed costs + Average variable costs.
3. Average total variable costs per EGP (Atallah, 1997) = Feed cost + chicks cost + Litter cost + drugs cost + Miscellaneous costs.

4. Average fixed costs per EGP (Atallah, 2004 and Omar, 2009) = Building costs or rent + Equipment costs.
5. Average total returns per EGP = Broiler sales + litter sales.
6. Average net income (Rosegrant et al., 2008) = Average total returns – Average total costs.

3. RESULTS and DISCUSSION

3.1. Effect of stocking density on mortality %, Livability % and Marketing age:

The results in table (2) revealed that, there is a significant difference (P < 0.01) of the different stocking densities on the level of mortality %, livability% and marketing age in broiler production farms. The higher level of mortality observed in group 1 stocking density followed by group 2 as the values were 16.77 % and 12.22 % respectively, while the lowest level observed in group 3 of highest stocking density as the value was 8.00 %.

The livability % was higher in group 3 of (10-11 bird/m²) stocking density as the value was 91.99 % followed by group 2 of lower livability level that were 87.77%, while the lowest livability level were 83.22% for group 1 of lowest stocking density. These results concluded that the mortality rate was higher in group 1 and group 2 of lower stocking density than group 3 of higher one, while livability was higher in group 3 than group 1 and 2. This result is similar to that of (Feddes et al., 2002) stated that reducing stocking density even have a negative effects on broilers performance and disagree with (Bilgili and Hess, 1995) who revealed that mortality and thus livability were significantly improved when birds were given more space as illustrated in a study examining densities. Also agree with (Adeyemo et al., 2016) who mentioned that birds on high stocking density had better feed conversion ratio and significantly lower mortality.

The higher marketing age observed in group 3 of higher stocking density as were 46.6 day, while that in group 2 of (8-9 bird/m²) stocking density were 44.02 day and was 39.8 day in group 1 of lower stocking density. The results cleared that the higher
marketing age among different stocking density observed in group 3 of higher stocking density that means prolonged production cycle and increased time till reach the marketing age and this may owed to the reduced conversion ratio and slower growth rate unlike group 2 that have shorter marketing age and group 1 of lower stocking density have the most lower marketing age and also the shorter production cycle. This result agree with (Mtieleni et al., 2007; Škrbić et al., 2009) mentioned that some studies showed large benefits in reducing stocking density on the performance of broilers.

3.2. Effect of stocking density on TVC (total variable cost), TFC (total fixed cost) and TC (total cost):

The results in Table (3) showed that, there is a significant difference (P < 0.01) of the different stocking densities on the values of TVC, TFC and TC. The total variable costs and total costs showed a higher levels in group 1 and group 2 of (5-7 bird/m2) and (8-9 bird/m2) stocking density respectively as their values were 2081.98 EGP and 2141.45 EGP for group 1 and 2094.76 EGP and 2156.65 EGP for group 2.

The lowest total variable costs and total costs observed in group 3 of (10 – 11bird/m2) stocking density as values were 1964.88 EGP and 2059.82 EGP respectively. The results also revealed that the higher total fixed costs among the three groups of stocking densities observed in group 3 followed by group 2 as values were 94.93 EGP and 61.88 EGP respectively, while the lowest total fixed costs observed in group 1 as the value were 59.46 EGP.

These results concluded that group 1 and group 2 of lower stocking density showed the higher values of total costs and total variable costs than group 3 of higher stocking density showed the lowest value. The changes of total variable cost attributed to the changes in drugs cost, vaccines cost, veterinary supervision cost, feed cost, labor cost, litter costs and electricity cost. The differences in total fixed costs among the different stocking densities groups may be attributed to changes of rent costs or building cost and also the length of production cycle or fattening period which differ according to the stocking density. These results agree with (Cocnen et al., 1996) who stated that stocking density has a marked effect on economic efficiency of broiler farms and with (Utink-Banaš et al., 2014) who indicated that reducing stocking density increases total production costs.

3.3. Effect of stocking density on Marketing weight, TR (total return) and NR (net return):

The results in table (4) showed that the higher average marketing weight observed in group 1 stocking density as the value was 2.02 Kg, while the lower average marketing weight observed in group 3 of highest stocking density as was 1.83 Kg then 1.94 kg for group 2. The results cleared that among different stocking densities the higher average marketing weight observed in group 1 of lowest stocking density. Meanwhile the lower average marketing weight observed in group 3 of highest stocking density, this may be owed to the improved growth rate, feed conversion and feed intake in reduced stocking density group whereas in increased stocking density group these parameters reduced. This results agreed with (Bilgili and Hess, 1995) as illustrated in a study that body weight, feed conversion were significantly improved when birds were given more space and also with (Oluyemi and Roberts 1998) as revealed that Growth and feed conversion are inversely related to stocking density. But disagreed with (Malden et al., 2001) concluded that over spacing leads to high activity that lead to reduce feed conversion and growth of birds. Also (Feddes et al., 2002) revealed that when bird density was reduced live body and carcass weights were decreased.

The results of total return and net return values cleared that the higher values of total return were 2687.20 EGP and 2650.73 EGP in group 2 and group 3 stocking density respectively and were 2511.75 EGP in group 1 of lowest stocking density. The results of net return showed that the highest values were 613.31 EGP in group 3 of highest stocking density while the lower value observed in group 1 as value were 369.73 EGP and in group 2 were 541.92 EGP. Although the reduced marketing weight and increased marketing age in group 3 than group 1 and group 2, the higher value of net return in group 3 stocking density is owed to the increased number of birds in such farms that compensates the reduction in weights and the reduced costs in higher densities than the lower density. This result agree with (Utink-Banaš et al., 2014) who indicated that reducing stocking density increases total production costs, and decreases broiler production income.

Table (2): Density effect on mortality %, Livability % and Marketing age
<table>
<thead>
<tr>
<th>Density group</th>
<th>N</th>
<th>Mortality %</th>
<th>Livability %</th>
<th>Marketing age (Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
<td>16.77 ± 3.92 A</td>
<td>83.22 ± 3.92 C</td>
<td>39.80 ± 1.07 C</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>12.22 ± 1.09 B</td>
<td>87.77 ± 5.45 B</td>
<td>44.02 ± 0.98 B</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>8.00 ± 1.65 C</td>
<td>91.99 ± 1.65 A</td>
<td>46.60 ± 2.75 A</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>12.28 ± 0.98</td>
<td>92.37 ± 4.31</td>
<td>45.40 ± 0.84</td>
</tr>
</tbody>
</table>

Group 1 (5-7 chick/m²)  Group 2 (8-9 chick/m²)  group 3 (10-11 chick/m²)
Means within the same column of different litters are significantly different at (P < 0.01)

Table (3): Density effect on TVC (total variable cost), TFC (Total fixed cost) and TC (total cost).

<table>
<thead>
<tr>
<th>Density group</th>
<th>N</th>
<th>TVC (EGP)</th>
<th>TFC (EGP)</th>
<th>TC (EGP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
<td>2081.98 ± 56.93 A</td>
<td>59.46 ± 2.91 B</td>
<td>2141.45 ± 55.96 A</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>2094.76 ± 99.97 A</td>
<td>61.88 ± 4.78 B</td>
<td>2156.65 ± 103.95 A</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>1964.88 ± 57.18 B</td>
<td>94.93 ± 13.17 A</td>
<td>2059.82 ± 50.75 B</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>2079.75 ± 78.96</td>
<td>65.08 ± 4.06</td>
<td>2144.84 ± 81.99</td>
</tr>
</tbody>
</table>

Group 1 (5-7 chick/m²)  Group 2 (8-9 chick/m²)  group 3 (10-11 chick/m²)
Means within the same column of different litters are significantly different at (P < 0.01)

Table (4): Density effect on Marketing weight, TR (total return) and NR (net return).

<table>
<thead>
<tr>
<th>Density group</th>
<th>N</th>
<th>Marketing weight (Kg)</th>
<th>TR (EGP)</th>
<th>NR (EGP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
<td>2.02 ± 0.13 A</td>
<td>2511.75 ± 176.18 B</td>
<td>369.73 ± 44.27 C</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>1.94 ± 0.11 AB</td>
<td>2687.20 ± 134.86 A</td>
<td>541.92 ± 52.03 B</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>1.83 ± 0.16 C</td>
<td>2650.73 ± 134.85 A</td>
<td>613.31 ± 42.08 A</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>1.94 ± 0.14</td>
<td>2664.09 ± 108.47</td>
<td>530.47 ± 46.42</td>
</tr>
</tbody>
</table>

Group 1 (5-7 chick/m²)  Group 2 (8-9 chick/m²)  group 3 (10-11 chick/m²)
Means within the same column of different litters are significantly different at (P < 0.01)
The present study showed that the use of stocking density (10-11 bird/m²) in broiler production farms in the area of study is better than other lower stocking densities from economic point of view as recorded highest net return among different densities although the reduced marketing weights and increased marketing age.

4. REFERENCES


