Evaluation of the Technical and Economic Impacts of High-Density Broiler Production in an Integrated System

ABSTRACT

This study included 35 farmers contracted by a broiler integrator company. Each farmer owned an average of seven poultry houses, housing six flocks per year per farmer, summing up 4.0 million broilers housed. Live performance was evaluated in flocks housed in three densities (D1<12, 12<D2<14, and D3>14 birds/m²), and included the following parameters: market age (MA), average flock weight (AFW), average daily gain (DWG), feed conversion ratio (FCR), livability (LB), production efficiency index (PEI) and carcass yield/m² (CY). Production costs and gross margin were calculated with birds housed at two densities (11.5<D4<12.4 and 14.5<D5<15.5 birds/m²), standardizing MA to 44 days. The economic evaluation included 15 farmers and 1.0 million broilers housed. The average densities obtained for D1, D2, D3, D4, and D5 were 11.80, 13.15, 15.00, 12.02, and 14.98 birds/m², respectively. Density effect was significant on most parameters, with D1 producing the best results in AFW, DWG, FCR, LB, and PEI, whereas D2 and D3 produced different results only in FCR. Despite the reduction in animal performance, carcass yield/m² linearly increased with density. The economic analyses showed higher production costs, despite the higher margin for D5. The greatest impact was the reduction in farmer’s compensation (19.68%) per bird housed. From the farmer’s perspective, the 5% increase in compensation should be enough to cover the investment required to supply the requirements of higher densities.

INTRODUCTION

The pressure of the consumer market for the reduction of chicken prices has led poultry companies to apply strategies to decrease production costs in an attempt to maximize performance with the maximum economic return. Higher bird densities have been used to reduce particularly labor costs and investments in facilities and transport logistics (Lana, 2001). Nevertheless, bird density has been often increased without the required adjustments in facilities, equipment, management, and nutrition.

Despite the controversial literature results, mainly due to differences in environmental conditions, management, nutrition, and flock health status, on the optimal density to obtain the best revenues in broiler production, most studies show a linear decrease in live performance as bird density increases (Hellmeister et al., 1998, Feddes et al., 2002, Mendes et al., 2002; Fascina et al., 2006); however, higher meat production/m² and profitability were also demonstrated (Mendes et al., 2002).

Meat production/m² and production cost per housed broiler significantly increase with density, as well as profitability/m² (Mendes et al., 2002; Goldflus et al., 1997; Stringhini et al., 1997). In order to
understand this apparent paradox, it is necessary to
determined which cost components are influenced by
high bird density. Considering that a company has
an idle processing capacity, higher densities reduce part
of the operational cost and the costs with the
contracted producers due to the increase in volume.
On the other hand, the contracted farmer needs to
invest more to provide conditions that allow housing
more birds per surface area. Therefore, cost-benefit
ratio needs to be evaluated at the farm level.
This study aimed at estimating the effect of bird
density on the technical and economic parameters of
an integration system.

MATERIAL AND METHODS

This study was carried out in an integrator company
with a slaughter capacity of 120,000 broilers/day during
12 months. The study involved 35 contracted farmers,
with 7 broilers houses in average, and housing an
average of 6 flocks at the time of the study, summing
up 4 million day-old chicks housed. All houses were
equipped with tunnel ventilation, automatic feeders,
nipple (60%) or bell (40%) drinkers, foggers, fans, and
an average available area of 1,500 m².
During the study period, different densities were
used among and within farms, and ranged from 11 to
16 birds/m². In order to evaluated the effect of bird
density on live performance parameters, flocks were
housed in three densities: below 12 (D1), between 12
and 14 (D2), and more than 14 (D3) birds/m². The
following performance parameters were evaluated:
market age (MA), mean flock weight (AFW), average
daily weight gain (DWG), feed conversion ratio (FCR),
livability (LB), production efficiency index (PEI) and
carcass weight in kg/m² (CY).
In order to simulate the economic impact,
performance parameters of flocks with densities
ranging between 11.5 and 12.5 (D4), and between
14.5 and 15.5 (D5) birds/m², and market age of 44 days
were used. These restrictions reduced the number of
studied contracted farmers to 15, with an average of
2 flocks and 1 million chicks housed.

Performance and economic parameters obtained
at both densities were used to estimate production
capacity and cost of flocks raised at 12 and 15 birds/
m², considering a broiler house with 1,500 m² available
area. Production cost was estimated considering day-
old chick price, contracted farmer compensation, feed
price, and operational costs (inputs, transport, technical
services, and taxes).

Farmer’s gross margin was calculated based on the
company’s compensation table, which takes into
account production efficiency index (PEI) and average
broiler price. For this simulation, we considered the
average live broiler price in São Paulo stock exchange
(R$ 1.40).
In order to evaluate the effect of density on
performance, 400 flocks were used per density,
whereas the economic evaluation took into account
only 100 flocks per density.
Data were analyzed using SAS (1996) statistical
package, and treatment means were compared by the
test of Tukey.

RESULTS AND DISCUSSION

The estimated means and regression curves of the
studies parameters, according to the different bird
densities, are shown in Table 1.

Mean densities obtained for D1, D2, and D3 were
11.80, 13.15, and 15.00 birds/m², respectively. The
effect if bird density was significant for most
performance parameters, with D1 promoting higher
AFW, DWG, FCR, LB, and PEI, whereas D2 and D3
resulted only in different FCR. These results confirm a
linear reduction of performance levels, which is
consistent with most studies found in literature (Feddes
et al., 2002, Hellmeinster et al., 1996; Mendes et al.,
2002; Fascina et al., 2006). However, meat production

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Regression equation</th>
<th>Bird density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (birds/m²)*</td>
<td>-</td>
<td>D1</td>
</tr>
<tr>
<td>Market age (days)</td>
<td>-</td>
<td>11.80</td>
</tr>
<tr>
<td>Flock weight (g)</td>
<td>AFW = 2.484 – 17.5*Dens</td>
<td>44.52*</td>
</tr>
<tr>
<td>Daily weight gain (g)</td>
<td>DWG = 54.03 – 0.70*Dens</td>
<td>2.306*</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>FCR = 1.53 + 0.03*Dens</td>
<td>51.79*</td>
</tr>
<tr>
<td>Livability (%)</td>
<td>-</td>
<td>1.88*</td>
</tr>
<tr>
<td>Efficiency index</td>
<td>PEI = 333.0 – 5.8*Dens</td>
<td>97.59*</td>
</tr>
<tr>
<td>Carcass yield kg/m²</td>
<td>CY = 25.12 + 0.81*Dens</td>
<td>28.18a</td>
</tr>
</tbody>
</table>

Means followed by the different letters in the same row are significantly different (P<0.01). *Mean values of the evaluated flocks.
Despite the losses in live performance, bird density had a positive effect on gross margin, from the integrator company’s standpoint, the use of high bird density, from the integrator company’s perspective, only D2 was beneficial, provided it is sufficient to pay the investment required to increase density from D1 to D2.

The performance parameters used to estimate economic effects, production capacity, production cost, and margin obtained for D1 and D2 are presented in Table 2. Similarly as to the results obtained in the first phase of analysis, performance parameters suffered a linear reduction as density increased. Farmer’s compensation/bird housed was reduced in 16%, but compensation per flock increased 5.0%. from the contracted farmer’s perspective, only D2 was beneficial, provided it is sufficient to pay the investment required to increase density from D1 to D2.

Density increase elevated broiler production cost in 2.3%, reducing the gross margin per kg in 11.11% and per marketed bird in 11.25%, but the gross margin/m² of broiler house in 10.8% (Table 2). Therefore, from the integrator company’s standpoint, the use of high bird density had a positive effect on gross margin, despite the losses in live performance.

The estimated contribution of the different cost component to the price of the kg of produced broilers indicates that, as density increases, the highest reduction is on farmer’s compensation (19.68%), followed by day-old chick cost (11.80%).

Feed cost increased 3.0%, due to the 5.3% increase in feed conversion ratio, which was 1.88 (D1) and 1.98 (D3). The lowest impact was on operational cost, which was reduced in 2.16%. However, it must be considered that, in this simulation, operational cost was fixed, and did not take into account reductions caused lower logistics costs for technical service, and inputs, which would result in higher economic return to the integrator company.

**CONCLUSIONS**

Increasing bird density at rearing linearly reduced live performance, but increases meat production capacity/m² and net margin per flock housed. The use of high bird density, from the integrator company perspective, depends on the reduction of the integration’s operational costs, particularly of the contracted farmer’s compensation per bird housed, which must be lower than the cost increased caused by worse live performance. An increase of 5% in farmer’s compensation per flock should be sufficient to cover the investments required to fulfill the requirements of higher bird density.

**REFERENCES**

Fascina VB, Muniz EC, Guimarães EB, Carrio AS. Diferentes densidades populacionais sobre o peso corporal e calos de patas em frangos de corte. Revista Brasileira de Ciência Avícola 2006; Supl 8.7.


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Table 2 - Performance parameters, economic indices, and cost and revenue estimates for the densities of 12 and 15 birds/m².

<table>
<thead>
<tr>
<th>Parameters</th>
<th>12</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flock weight (g)</strong></td>
<td>2,306*</td>
<td>2,229*</td>
</tr>
<tr>
<td><strong>Livability (%)</strong></td>
<td>97.59*</td>
<td>96.33*</td>
</tr>
<tr>
<td><strong>Feed conversion ratio</strong></td>
<td>1.90*</td>
<td>1.97*</td>
</tr>
<tr>
<td><strong>Average density</strong></td>
<td>12.35</td>
<td>14.87</td>
</tr>
<tr>
<td><strong>Production efficiency index (PEI)</strong></td>
<td>271*</td>
<td>250*</td>
</tr>
<tr>
<td><strong>Farmer’s compensation/bh</strong></td>
<td>R$ 0.25</td>
<td>R$ 0.21</td>
</tr>
<tr>
<td><strong>Total farmer’s compensation</strong></td>
<td>R$ 4,500.00</td>
<td>R$ 4,725.00</td>
</tr>
<tr>
<td><strong>Production cost/kg broiler</strong></td>
<td>R$ 1.157</td>
<td>R$ 1.184</td>
</tr>
<tr>
<td><strong>Revenue – Cost</strong></td>
<td>R$ 9,843.36</td>
<td>R$ 10,763.09</td>
</tr>
<tr>
<td><strong>Revenue</strong></td>
<td>R$ 56,710.72</td>
<td>R$ 69,760.74</td>
</tr>
<tr>
<td><strong>Marginal/km²</strong></td>
<td>R$ 0.560</td>
<td>R$ 0.497</td>
</tr>
<tr>
<td><strong>Marginal/bird</strong></td>
<td>R$ 0.672</td>
<td>R$ 7.449</td>
</tr>
<tr>
<td><strong>Cost distribution (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day-old chick</td>
<td>16.15</td>
<td>16.07</td>
</tr>
<tr>
<td>Farmer</td>
<td>8.89</td>
<td>7.14</td>
</tr>
<tr>
<td>Feed</td>
<td>68.39</td>
<td>70.46</td>
</tr>
<tr>
<td>Operational cost</td>
<td>6.47</td>
<td>6.33</td>
</tr>
</tbody>
</table>

bh – bird house.
