Development of Optimization Model for Herd Distribution in Animal Husbandry

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GOAL OF THE STUDY

In this study is developed model in which is determinate number of pigs in each group to increase farm income.

Due to the great complexity of the relationships and influences between the different activities on the farm, the solution presented in this paper is limited to the construction of an optimization model for one of the significant problems in pig farming, namely the age organization and distribution of the reared animals and its impact on the farm income.

METHODOLOGY OF THE INVESTIGATION

In the developed mathematical model, a linear programming approach is used to optimize the age distribution of a herd of pigs reared in a farm.

MAIN RESULTS FROM THE STUDY

The input parameters of the optimization problem are the costs in BGN for the different components of the feed for feeding the pigs and the feed ration for the different groups of pigs kept on the farm. Based on date of feed and daily ration, the annual cost of these components for each category of pigs is calculated.

![Fig. 1. Input parameters](image)

DESCRIPTION OF THE MATHEMATICAL MODEL

**Mathematical model parameters**
- Feed ingredients j, where j = 1, 2,..., m;
- Group of pigs i, where i =1, 2,...n - X1, X6
- X1- pregnant mothers;
- X2- lactating mothers;
- X3- piglets;
- X4- adolescent piglets;
- X5- fattening pigs up to 100kg;
- X6 - fattening pigs over 100kg
- C1, C2, C3, C4 – annual costs of the feed components

\[
\begin{align*}
\text{Objective function of the model:} & \quad \text{Profit} = \text{Income} - \text{Expense} \\
\text{Income} = 12^* (X5 + X6) * 500 + 0.7 * 150^* X3 \\
\text{Costs} = \sum C_j^* X_i \\
\text{Model limitations.} & \quad \sum X_i \leq \text{Capacity} - \text{Capacity is the maximum capacity of a building for keeping pigs.} \\
& \quad L_i \leq X_i - \text{Limit on the minimum number of pigs per group} \\
& \quad U_i \geq X_i - \text{Limit on the maximum number of pigs per group}
\end{align*}
\]

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ANALYSIS AND PRESENTATION OF THE SOLUTION

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Before</th>
<th>After</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td>41 888,12</td>
<td>118 428,32</td>
<td>2,8 ↑</td>
</tr>
<tr>
<td>Cost</td>
<td>46,791.88</td>
<td>69,371.68</td>
<td>1,5 ↑</td>
</tr>
<tr>
<td>Capacity</td>
<td>64 %</td>
<td>95 %</td>
<td>1,48 ↑</td>
</tr>
</tbody>
</table>

**Table 2. Number of pigs in each group**

<table>
<thead>
<tr>
<th>Group of pigs</th>
<th>Number of pigs</th>
<th>Proposed number of pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant mothers</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>Mothers breastfeeding</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Small piglets</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Piglets adolescents</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fattening pigs up to 100kg</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Fattening pigs over 100kg</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

CONCLUSIONS

A mathematical model has been developed to help decide the age distribution for farmed animals. The optimum number of pigs to be reared in each group so as to maximize farm profit was determined.

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