

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.

Cost Components (BGN/year)	Group of pigs					
	1	2	3	4	5	6
Barley	369,18	615,30	184,59	246,12	369,18	492,24
Corn	213,58	355,97	106,79	142,39	213,58	248,77
Peas	105,60	175,99	52,80	70,40	105,60	140,79
Wheat	127,78	212,97	63,89	85,19	127,78	170,38

Fig. 1. Input parameters

DESCRIPTION OF THE MATHEMATICAL MODEL

Mathematical model parameters

- Feed ingredients j , where $j = 1, 2, \dots, m$;
- Group of pigs i , where $i = 1, 2, \dots, n$ - $X_1, X_2, X_3, X_4, X_5, X_6$
- X_1 - pregnant mothers;
- X_2 - lactating mothers;
- X_3 - piglets;

- X_4 - adolescent piglets;
- X_5 - fattening pigs up to 100kg;
- X_6 - fattening pigs over 100kg
- C_1, C_2, C_3, C_4 – annual costs of the feed components

The objective function of the model:

$$\text{Profit} = \text{Income} - \text{Expense} \quad (1)$$

$$\text{Income} = 12 \cdot ((X_5 + X_6) \cdot 500) + 0.7 \cdot 150 \cdot X_3 \quad (2)$$

Costs - The total cost of purchasing the feed ingredients for one year in leva

$$\text{Cost} = \sum C_{ij} \cdot X_i \quad (3)$$

j - feed component, group i pigs reared on the pig farm

Model limitations.

Limitation on animal housing capacity
 $\sum X_i \leq \text{Capacity}$ - Capacity is the maximum capacity of a building for keeping pigs.

Limit on the minimum number of pigs per group $LL_i \leq X_i$

Limit on the maximum number of pigs per group $UL_i \geq X_i$

ANALYSIS AND PRESENTATION OF THE SOLUTION

Table 1. Change in indicators

Indicator	Before	After	Change
Profit	41 888,12	118 428,32	2,8 ↑
Cost	46,791.88	69,371.68	1,5 ↑
Capacity	64 %	95 %	1,48 ↑

Table 2. Number of pigs in each group

Group of pigs	Number of pigs	Proposed number of pigs
Pregnant mothers	17	20
Mothers breastfeeding	8	10
Small piglets	18	30
Piglets adolescents	10	10
Fattening pigs up to 100kg	10	20
Fattening pigs over 100kg	1	5

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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