LINEAR PROGRAMMING MODEL – THE CASE OF VEGETABLE PRODUCTION PLANNING IN REPUBLIC OF MACEDONIA

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Abstract

The changing environment in which farmers operate represents a big challenge in the decision making and improving their production. Farmers should make simultaneous decisions concerning the production, procurement, marketing and financial management. To increase economic efficiency and to support decision making, different tools could be applied, that beside the natural, technical and technological conditions, consider also the economic aspects.

In this research we focus on Macedonian farms specialised in vegetable production. The aim is to develop an optimization model for analysis of decision-making on Macedonian family farms, based on mathematical programming paradigm. It enables in-depth analysis of production planning, based on neoclassical view of decision maker. Optimal production plan is determined through LP, maximising expected gross margin, subject to a set of different constraints.

The constructed general production model is set in MS Excel and Visual Basic, and contains 162 decision variables divided into four groups. The first group of activities refers to the most representative vegetable crops thus reflecting the typically diversified production structure on Macedonian vegetable farms. In this regard, ten vegetable crops are included: tomato, pepper, cabbage, carrot, watermelon, potatoes, lettuce, broccoli, onion and beans. Input related activities are presented in the second group of decision variables. The third group of activities captures the infrastructure capacity of the farm. Balance activities, as a fourth group, are determined in order to assure integrity of the solutions.

Farmers are expected to make decisions under a number of constraints, dealing with production factors scarcity, agronomic limitations and constraints capturing the external factors that affect the production.

A combination of different sources of data was used for supporting the model. Basic data for calculating the enterprise budgets were obtained by a panel of relevant experts: researchers, crop technology specialists, input suppliers and vegetable farmers, supplemented with the Farm Monitoring System for 2010. Model was applied on "typical vegetable farms" that were determined through cluster analysis (in SPSS 17).

The developed model for optimisation of vegetable production proved to be useful when analysing a farm management problem in Macedonia. The tool for optimisation of vegetable production with an objective function of maximising the expected gross return is functional and gives plausible results in reference to the available working capital, farm size, production structure as well as the technological, market and policy constraints. The findings reflect to a large extent the situation in practice. The model revealed that the labour is not a binding constraint; however, in the peak seasons the family labour cannot fulfil all requirements, and hence additional seasonal labour is hired. Sensitivity analysis has shown on available working capital as an important binding issue on analysed Macedonian farms. Its influence on optimal production structure as well as on expected return, land and labour was further analysed with parameterisation.

Developed model is flexible, enabling different crop enterprises to be added additionally. It could be also applied for optimising the farm situation in the countries in the region, considering the similar structure of their agricultural production as well as similar production technologies.

Keywords: linear programming, vegetable farms, production planning