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Decision Support Model for Input Minimization and the Optimal Economic Efficiency of Agricultural Holdings †

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Abstract: This study aims to change land use by implementing a Decision Support Model (DMS) with the goal of reducing water and fertilizer use. The problem is solved by deriving the necessary results of a set of selected pilot fields that belong to a farmer group located in the region of Central Macedonia. In order to define the pilot farms, the necessary data are collected and then processed using multicriteria weighted goal programming in order to develop a Decision Support Model that is related to the reduction of water and fertilizer use.

Keywords: common agricultural policy; input minimization; decision support model

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1. Introduction

The Common Agricultural Policy (CAP) is one of the most important policies of the European Union, comprising a set of regulations, directives and laws relating to agricultural production, the marketing of agricultural products and all the interventions applied. A key tool for achieving the objectives of the CAP is the use of cross compliance rules and standards, which were developed in the late 1990s and introduced in 2005 as a European Union policy [1,2]. Cross compliance is defined as the set of regulatory standards that farmers follow that relate to the environmental management of natural resources, the protection of the rural landscape, public health, plant and animal health and the implementation of good agricultural practices [3]. Following the cross compliance rules is mandatory for both direct single payment and coupled payments, while their violation results in the reduction of payments [4].

This paper focuses on the optimal management of the water and fertilizer amounts used by producers as a plethora of reports in the literature highlight the continuous efforts in the optimal management of inputs that have been carried out in recent years [5,6]. This aim will be accomplished through the implementation of a Decision Support Model designed especially for farmer group needs. This model has been designed to contribute both to the assimilation of the new cross compliance rules and to the optimal management of water and fertilizers with the ultimate goal of enhancing the farm's efficiency and profitability. This research's aim will be achieved by setting up pilot fields of 100 acres and extending the results to an actual farm area. The results obtained using the model will be used as the basis for the creation of an electronic platform, which will be extremely useful for the extraction of economic results for the farm. The development of similar models and platforms has been extensively studied in various countries [7–10] and particularly in Greece [11–15]. Finally, as the literature suggests, platforms are sought to be developed

for use in the agricultural sector in order to modernize it and achieve maximum economic results [16–18].

2. Materials and Methods

This paper aims to enhance the efficiency and profitability of farms while reducing water and fertilizer use through the implementation and use of a Decision Support Model. The scope will be achieved through the optimal allocation of limited economic resources and the land-producers' resources through the establishment of pilot fields by a farmer group, located in the region of Loudia, Thessaloniki. Each producer defines their own individualized production plan with specific limits on irrigation and fertilization, as well as other inputs, in order to obtain their optimal production plan. This leads to the economic upgrade and profitability of the farm and also to the minimization of land fertilization and water use.

The application of a Decision Support Model is required in order to solve, in the best possible way, the problems of the irrational waste of water and fertilizer use in the agricultural sector. At the same time, it is of a great importance to achieve the goals of the CAP, which in this study will be achieved through the application of the cross compliance rules and standards. As the cross compliance rules will become stricter in the coming years, it is crucial to familiarize producers with them.

In order to achieve the research objective, a pilot field of 100 acres will be established by the selected farmer group through the development of a Decision Support Model. The developed model is based on an existing structure created by the Laboratory of Informatics in Agriculture, which belongs to the Aristotle University of Thessaloniki, and is adjusted to the needs of the producers. This process is achieved using the multicriteria weighted goal programming method after the collection of relative data. These data were collected through the use of a specially designed questionnaire based on the literature [19–21]. At the same time, a web-based platform is used by the producers. This platform is also based on the Laboratory in Agriculture's existing infrastructure, is intended to record a set of technical and economic farm data and is essentially used to determine whether the objective of this study has been achieved.

More specifically, this study is carried out in four stages. Firstly, the preparation of the pilot implementation will be achieved through the selection of the pilot fields, crops, location and activities, which are set through the development of a Decision Support Model adjusted to the needs of the producers. Then, a web-based platform will be used, and at the same time, the producers will be taught how to use it properly. During that time, the producers' comments will be used for the optimization of the platform's protocol. This will lead to the creating of a technical and economic database. Then, a technical and economic analysis of the results will take place where the data are evaluated, and the possibilities of utilizing the new methodology and minimizing the inputs will be explored. Finally, the dissemination of the results will be carried out through a set of actions.

3. Expectative Results and Discussion

Connecting farmers to a Decision Support Model and managing their farms electronically has multiple benefits. The main benefit of this research is through rational water and fertilizer use management to reduce production and labor costs, enhance the income and gross profit of producers and increase environmental sustainability regarding farm size [14].

This study will be carried out for the first time and, in parallel, on such a large scale with the aim of spreading its results to the surrounding regions and subsequently to Greece as it includes information on the main crops of Central Macedonia. The above-mentioned process can motivate producers through the reduction of costs in water and fertilizer use to cultivate more efficiently and profitably without eliminating their existing crops.

4. Conclusions

The organization and derivation of an optimal production plan, using a Decision Support Model, will create more efficient farms, based on the challenges linked to the principles of the new CAP. This study is an innovative action as it can motivate producers to follow more efficient ways of cultivation. This will lead to a modernization of farms, thus reducing costs and increasing gross profits. This is the first time that this kind of research will be implemented on such a scale. This fact may lead to its implementation in the surrounding regions beyond Central Macedonia. The present study is also considered innovative as it includes information on the main crops with the aim of managing a set of entire agricultural areas while it is known that alternative crops are limited in the study area. Lastly, the research process encourages producers, by incorporating the new cross compliance rules, to pursue more efficient crops without eliminating existing ones, always looking to increasing their profitability.

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