AGRICULTURAL MANAGEMENT USING THE ADELAIS MULTIOBJECTIVE LINEAR PROGRAMMING SOFTWARE: A CASE APPLICATION

ABSTRACT. This paper presents an application of the ADELAIS multiobjective linear programming software to farm planning problems in agricultural management. This application is illustrated on a Spanish farm case study initially presented by Romero, Amador and Barco as an application of compromise programming. The method employed here generates a sequence of efficient solutions using interactive utility assessment and satisfaction levels. A compromise solution among three conflicting objectives, i.e. seasonal labor, employment and business profitability, is finally obtained.

Keywords: Multiple criteria; linear programming; agricultural management.

1. INTRODUCTION

Most real-world decision problems involve multiple and conflicting objectives. Such problems are in fact semistructured in nature because simultaneous optimization of the objectives is usually unattainable due to their conflicting nature. In light of this situation, multiobjective mathematical programming (MOMP) provides an operational methodology for handling multiple objectives within the frame of traditional mathematical programming. Extensive surveys on MOMP methods can be found in Zeleny [26], Hwang and Masud [12], Chankong and Haimes [2], Evans [9], Cohon [3] and Cohon and Marks [4].

Agricultural planning is a wide management field including important problems of agricultural economics, such as land allocation and redistribution, irrigation, cropping pattern design, machine-hours allocation etc. In these problems MOMP is nearly self-imposed since the objectives under consideration, such as business profitability, employment level in the rural sector, seasonality of labor, environmental benefits and water resources saving, are often competitive and call for implicit or explicit trade-off decisions. An extensive review of agricul-

Several applications of MOMP and related methodologies in agricultural planning problems have been reported in the literature. Hitchens, Thampapillai and Sinden [11] studied a land allocation problem in Australia considering money income and environmental benefits as objectives. They applied the weighting method according to which the original objectives are aggregated into an overall objective (the weighted sum), which is then used to generate the efficient alternatives by systematically changing the weights. In a similar problem Vedula and Rogers [23] considered economic benefits and irrigated cropped area as objectives. In order to define the opportunity cost curve between these two objectives they used the constraint method. According to this method only one objective is optimized at a time the others are being transformed into constraints. Then the efficient solutions and the trade-off curve between the objectives are determined by systematically changing the right-hand sides associated with the binding objectives. Romero and Rehman [18, 19] focus on the role of goal programming and other related approaches (multiobjective programming, compromise programming and generalized goal programming) in farm planning problems. Wheeler and Russell [24] suggest the use of goal programming in a 600 acre farm planning problem involving four objectives of the same priority level: gross margin; seasonal cash exposure; labor utilization in autumn and winter; labor utilization in spring and summer. Further applications of goal programming in agricultural management include, among others, the investigation of optimal fertilization alternatives (Minguez et al. [16]), the investigation and evaluation of agricultural development alternatives (Wit et al. [25]) and the optimal allocation of reclaimed lands to a variety of agricultural activities (El-Shishiny [8]). In the frame of MOLP, Romero et al. [17] studied a real case concerning a cooperative farm planning in the frame of an agrarian reform program in Spain. The problem was to design the farm plans of a cooperative by taking into account three objectives: employment, labor seasonality and gross margin. Romero et al. first used the noninferior set estimation (NICE) method in order to determine the efficient solutions and to plot the trade-off curves for the objectives and then applied the compromise