Investigation of crop planning sustainability based on environmental, social-economic and water resources uncertainty factor

Abstract

The sustainability of farming systems requires an integrated assessment of the interconnected relationship between dimensions of environmental, economic and social attributes. Designing a suitable cropping patterns in a farming system leads to optimizing the resources allocation and increases the productivity. In addition, it improves sustainability condition, and economic and social damage will be reduced. A large number of mathematical programming models have been developed to analyze and evaluate various aspects of the planning and management of farming systems in recent decades. In this study, the achievements of sustainable cropping pattern due to the behavior of variable factors were considered in cropping pattern. For this purpose nonlinear fuzzy optimization model (NFOG) with analyzing ability uncertain behavior of variables was designed in cropping pattern. Then by using this model,we tried to achieve the certain values of the variables affecting the cropping pattern. Initially simulation spatial variability models of performance in relation to the basic factors of production were designed using geo-statistical methods such as kriging and co-kriging. To identify the role of these factors, the relationship of basic vectors affectingproduction were re-evaluated by adaptive neural fuzzy inference system (Anfis).Therefore, spatial distribution of yielded in different classes of soil and water wereevaluated, and then Anfis results were combined with geo-statistic approaches. Thismethod was named as Geo-Statistic Fuzzy (GSF). The results of modeling based on geo-statistical method indicated that the spatialdistribution of yield did not have detectable zones and the specific classes of yield cannot beseparated, even if the correlation coefficients were acceptable between measured anddeveloped yield from the calibration and validation steps. But in GSF method the correlation coefficientof zone the yield and spatial distribution was ranged from 0.76 to 0.84. In agriculture, resource sustainability mostly depends on type of utilization methods and cropping pattern. Therefore, determining and comparing the crop production efficiency of different fields and its potential value could be used for determining the sustainability in the region. Consequently, in this study potential crop water productivity (PCWP) was defined and compared with actual values that were obtained from field measurements. Moreover, a method for evaluating the validity of farm production efficiency was introduced which is essential for identifying the key issues of water resources management. Results showed that an optimum value of water supplying hydro-module is 0.44 L/sc-ha while the current water harvesting are two times more than this value and the average production sustainability risk is about 38%. Analysis of the results creates the vision to improve management practices which will bring the improvement of resources sustainability for planners.

Key words: Crop planning- Modeling- Optimization- Uncertainty- Water resources

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