



Analysis of the Desertification Strategies Derived from the Decision-Making Models Using Social Welfare Function of B&C

Mohammad Hassan Sadeghi Ravesh^{*1}

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Extended abstract

Introduction: Desert ecosystem management includes a set of multiple management measures taken with the aim of optimal control of desertification phenomenon and reducing the economical, social and environmental losses. The issues related to the management of desert areas are complex matters because of the existence of multiple decision-making criteria and indices and there are several solutions to achieve a specific objective, each of which provides different preferences for the various environmental, social, political, economical, and organizational issues. These requirements necessitate using the Multi-Attribute Decision Making (MADM) methods which aim to choose the best answer from among the different solutions. By reviewing the literature, it can be found that the use of the decision-making models in providing the optimal strategies in the management of the desert areas is only limited to some studies such as Grau, Sadeghi Ravesh and Sepehr and Peroyan.

The obtained results from the prioritization of strategies indicated that the conclusions made by the models of AHP, TOPSIS, Electra, Weighted Sum, permutation, BORDA, and etc. are largely similar. However, the obtained numerical values vary from each other due to the structure of these models. Therefore, it is necessary to offer some functions to prioritize the strategies offered in each region by using different models on the basis of logic and strong principles and theoretical foundations. In this paper, it has been tried to achieve this goal using the Social Welfare Functions. In this regard, the function of B&C was used in the present study and the desertification strategies derived from the 13 decision-making models were analyzed in the Khezrabad Rigion of Yazd.

Materials and methods: The assessment method of B&C was first introduced by Asgharpour to provide the best view from the different options. The B & C function is a social welfare function that uses the majority method in priority, in such a way that transferability will be achieved in the process of prioritizing options. In this way, the objective function $d_n(P,L)$ reflects the sum of the "missed opportunity" of choosing the priority-ranking, or, in other words, indicating the total "disagreement with the prioritization with existing privileges" that should be minimized as a result.

In summary, the procedures for using this method are as follows:

- Formation of the matrix P according to Eq.1

1. Assistant Professor, Department of Environment, College of Agriculture, Takestan Branch, Islamic Azad U University, Takestan, Iran; m.sadeghiravesh@tiau.ac.ir

$$\begin{cases} P_{ij} = p_{ij} + \frac{1}{2} p'_{ij}; & i \neq j \\ p_{ii} = \frac{1}{2} \end{cases} \quad (1)$$

- Formation of the matrix L according to Eq.2

$$\begin{cases} l_{ij} = 1 \rightarrow A_i > A_j & ; i \neq j \\ l_{ji} = 0 \rightarrow A_j > A_i & ; i \neq j \\ l_{ii} = \frac{1}{2} \end{cases} \quad (2)$$

-Convex Multidimensional Formation according to Eq.3

$$\begin{cases} l_{ij} = \begin{cases} 1 \\ 0 \end{cases} & ; i \neq j \\ l_{ij} + l_{ji} = 1 & ; \forall i, j \\ l_{hi} + l_{ij} + l_{jh} \leq 2 & \begin{cases} ; \forall i, j, h \\ i \neq j \neq h \end{cases} \end{cases} \quad (3)$$

-Formation of the decision- making function of the majority d (P, L) according to Eq.4

$$d(P, L) = \sum_{ij} O_{ij}(P) l_{ij} = f \left\{ \sum_{ij} d_{ij}(P_{ij}, l_{ij}) \right\} \quad (4)$$

-Prioritize the desired options (strategy) according to Eq.5

$$\min \sum_{ij} O_{ij}(P) l_{ij} \quad (5)$$

Results: In order to comparative compare, prioritizing the strategies was done in the form of 13 multi-criteria models for decision-making in the plains of Khezrabad in Yazd. The results of evaluating the strategies based on the decision-making models showed that although about 70 percent of the results are similar, the rankings obtained are somewhat different, that these results are due to the methods' structures. Therefore, in order to achieve strategic priority as a group and the final solution of the total results of decision-making models, the Social Welfare Functions of B&C was used according to the literature.

Taking in to account the totality of criteria and alternatives and with analysis, in general, that alternative of prevention of unsuitable land use changes (A₁₈), alternative of vegetation cover development and reclamation (A₂₃), modification of ground water harvesting (A₃₁), Livestock grazing Control (A₂₀) and Change of irrigation patterns (A₃₃) are the most important alternative in de-desertification process in the study area, respectively. Therefore, we accept this ranking as a final and collective ranking. So, by the use of these alternatives in de-desertification projects, we can prevent desertification phenomenon in this area and do something for reclamation of degraded land.

Discussion and Conclusion: Detailed assessment of the strategies and choosing the optimal strategies are important factors in increasing the effectiveness of desertification plans, otherwise, wasting the resources such as time, energy and other inputs have serious and destructive impacts on achieving the results. In the meantime, decision-making models are used to achieve the optimal strategies, that for different reasons their results are somewhat different in each region. In order to achieve the group and final strategies, in the present study we used the social welfare function of GRV and the desertification strategies resulted from 13 decision-making models were analyzed in the region of Khezrabad in Yazd. The results showed that the strategy order of A₁₈ > A₂₃ > A₃₁ > A₂₀ > A₂₃ is the best presented strategy order.

Finally, it is recommended that the desertification programs in the study regions should emphasize on these strategies to prevent wasting the limit capitals and increase the output of the control, rehabilitation and reconstruction programs.

The results of the present study enable the managers of the desert areas to use the limited funds allocated to control the desertification process in a Correct and efficient manner to in addition to achieve better results, prevent wasting national wealth.

Keywords: Desertification, Multiple Attribute Decision-making (MADM), Ranking, Social welfare function B&C.