UTILIZING MULTIPLE CRITERIA AND DECISION ANALYSIS FOR SUSTAINABLE WALNUT FRUIT FORESTS MANAGEMENT OF KYRGYZSTAN

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ABSTRACT

The management of the walnut fruit forests is one of the key issues of the forest sector in Kyrgyzstan to address the challenges in conserving forest resources, assure socio-economice efficiency and the livelihood of people. However, there is an urgent demand to assess sustainable forest management (SFM), which generally involves the use of Criteria and Indicators (C&I). In our case study Multi-Criteria Analysis (MCA) techniques have been applied following five steps: environmental setting, development of C&I, analysis of preferences, development of management strategies and selecting the best alternative. The approach was applied at forestry management unit. In general, 7 criteria and 45 indicators have been identified using rating, ranking and pairwise comparion techniques within the Analytical Hierarchy Process (AHP). The priorities derived by the individual pairwise comparions were aggregated for all stakeholders groups by using the geometric mean. Futhermore, four different management strategies have been developed and the performances of the strategies were assessed wthin a AHP model. Accordingly, the results in the case study supported the practical use of the MCA approach taken, as the interests and preferences were systematically analysed and the expectations of different stakeholders were identified. However, to adapt the process of MCA it was found that more time and efforts are needed in order to create a participatory environment in the context of Kyrgyzstan. It is discussed that in practical operational planning the government has to initiate and stimulate such a participatory process for sustainable forest management by providing financial subsidies and practical help.

Keywords: multi-criteria analysis, criteria and indicator, AHP, walnut fruit forests, Kyrgyzstan

1. Introduction

Sustainable forest management (SFM) has recently become the primary goal of forestry institutions worldwide (Mendoza and Prabhu, 2000b). After the United Nations Conference on Environment and Development (UNCED) held in Rio in 1992, international efforts towards implementing sustainable forestry at different levels have shown significant progress, including the ecological, economic and social aspects (Brang et al., 2002; Wolfslehner et al., 2005).

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C&I for SFM are tools which can be used to collect and organize information in a manner that it is useful in conceptualizing, evaluating, communicating and implementing SFM (Prabhu et al., 1998). In this context, Multi-Criteria Decision Making Methods (MCDM) are an appropriate and useful approach for supporting the process of generating criteria and indicators (C&I) for monitoring, evaluation and assessment (Mendoza and Prabhu, 2003). MCDM techniques are capable of accommodating diverse views, objectives and perspectives of stakeholders and enable collaboration in planning and decision making (Mendoza and Prabhu, 2000b; 2003). More recently, the Analytical Hierarchy Process (AHP) has been applied in multi-objective forest management and land use planning due to its simplicity, flexibility and high effectiveness in analyzing complex decision making (Mendoza et al., 1999; Vacik and Lexer, 2001). Thus, there is a need to examine the applicability of C&I for evaluating SFM at the national as well as field levels by the use of MCDM. The aim of this contribution is to demonstrate the use of C&I to identity the best management option for a sustainable forest management of the walnut fruit forests in Kyrgyzstan by using the AHP.

2. Walnut fruit forests

The walnut-fruit forests of Kyrgyzstan are regarded as the main source for the livelihoods of the local people. However, due to a socio-economic recession following independence, there have been increased pressures on forest resources due to uncontrolled grazing, firewood collection and the consumption of non-timber forest products. In 1998, the Collaborative Forest Management (CFM) Programme was introduced. The basic concept of CFM is that a working partnership between the key stakeholders in particular the local users and the relevant forest authorities is established (Carter et al., 2003). This partnership could be strongly enhanced by the use of C&I for SFM in evaluating current management activities and formulating sustainability measures. Therefore a case study was conducted including Arstanbap, Kara-Alma, Kaba and Ortok *leshozes*, which cover about 72,760ha of forest area, with 36,304ha covered with walnut tree stands (*Juglans regia*) and other fruit trees species and about 23,810 inhabitants (Abdymomunov, 2003; Forest Inventory, 2003). Moreover, the study focused mainly on five phases: environmental setting, C&I development, analysis of preferences, development of management strategies and comparison of alternatives. The main findings of this case study are presented in this contribution.

3. Application

In total, 7 criteria and 45 indicators were identified by the help of 48 stakeholders comprising foresters, social workers, farmers and employers for evaluating SFM. Rating, ranking and pair-wise comparison techniques were used to derive the preferences on the C&I set by the stakeholders. In this study, for the rating a score between 1-100 was assigned and the ranks were assigned following a nine-point scale (depending on the number of indicators related to each criterion). Pairwise comparisons were done on the base of rating and ranking inputs provided by stakeholders and the priorities were calculated with the eigenvalue method by the use the Expert Choice Software.

Table 1: Preferences of criteria based on rating, ranking and Pairwise comparisons (PWC) methods (n=48)

Criteria	Arith.mean rating	sdv. of rating	Arith. mean ranking	sdv. of ranking	Gmean of priorities (PWC)
C1. Maintenance of forest ecosystems	11.9	1.12	3.90	1.76	9.50
C2. Maintenance of forest biodiversity	12.6	4.40	3.58	1.76	11.0
C3.Enhancement of forest health and vitality	15.8	6.28	2.75	0.89	14.9
C4. Productive functions of forests	17.0	8.50	2.65	1.72	14.3
C5. Protective functions of forests	15.5	8.40	3.10	1.48	13.2
C6. Socio-economic functions and conditions	15.1	6.70	3.15	1.17	13.2
C7.The legal and institutional frameworks	12.1	5.60	3.79	1.03	10.0

The results obtained from rating and ranking (arithmetic mean) and pairwise comparison (geometric mean) derived from the 48 stakeholders for the criteria level is shown in Tab (1). The enhancement of forest health and vitality (C3) and the production functions of forests (C4) were found to be the highly-preferred criteria. The socio-economic function of the forests (C6) has been preferred as the second most important criteria among all.

4. Development and evaluation of management strategies

An expert workshop was organized in order to define the forest management strategies. The experts developed four strategies: the first strategy (MS I) was developed by the foresters' group on the basis of the current management plan. It represents technical issues, as it is more oriented towards forest production, protection and the policy issues of forest management. The second strategy (MS II), which was generated by the researchers' group, concentrates more on socio-economic and ecological measures. MS (III) is a conservation strategy developed by the ecologists, which focuses mainly on biodiversity conservation, forest health and the maintenance of forest ecosystems. Finally, MS IV strategy concentrates on socio-economic and policy issues, and was developed by administrative workers from the forested areas. All management strategies were designed in terms of their practical applicability, incorporating several concepts of SFM and opportunities for forest development. Moreover, an assessment of the four management strategies has been done according to the content analysis of the existing action plans and the collection of base line information.

Furthermore, the AHP technique has been employed to select the best strategy for SFM by comparing the performance of all 45 indicators. The overall performance of a management strategy was determined by utilizing the geometric mean of the preferences expressed by the different stakeholder groups. According to the overall results, strategy MS II was found to be the best management strategy, MS I as the second best alternative, and MS IV had the lowest priority in general (Table 2). Moreover, the results based on the preferences of the individual stakeholder groups' were more or less similar to the overall preferences using the geometric mean, except for the foresters group, whose first priority was to select MS I.

Table 2. General priorities of management strategies based on geometric mean of the synthesized judgment with respect to the different stakeholder groups

Management strategies	Foresters		Social workers		Employers		Farmers		All stakeholders	
	Rank	Priority	Rank	Priority	Rank	Priority	Rank	Priority	Rank	Priority
MSI	1	0.298	2	0.289	2	0.301	2	0.279	2	0.281
MSII	2	0.296	1	0.301	1	0.307	1	0.299	1	0.299
MSIII	3	0.219	3	0.226	3	0.223	3	0.232	3	0.223
MSIV	4	0.187	4	0.183	4	0.169	4	0.191	4	0.191

5. Conclusion

In total, 7 criteria and 45 indicators were identified and four different management strategies have been derived from the identified needs and expectations by various experts and stakeholders. This approach utilized multi criteria decision making techniques and several participatory methods to identify their multi-dimensional characteristics of the current management system. The results of our study supported the practical use of the MCA approach taken, as the interests and preferences were systematically analysed and the expectations of different stakeholders were identified. However, to adapt the process of MCA it was found that more time and efforts are needed in order to create a participatory environment in the context of Kyrgyzstan. Finally to implement this process in practical operational planning the government has to initiate and stimulate such a participatory process for sustainable forest management by providing financial subsidies and practical help.

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