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Developing criteria and indicators for evaluating sustainable forest management: A case study in Kyrgyzstan

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ABSTRACT

The management of the walnut-fruit forests is one of the key issues in the forestry sector of Kyrgyzstan as it has to address the challenges related to the conservation of forest resources, socio-economic efficiency and the livelihoods of people. The demand for an assessment of the current forest management, which generally involves criteria and indicators (C&I) at all levels, from local to national has increased in the last decade. Therefore a case study has been done, applying a combination of a top-down and bottom-up approach with multi-criteria analysis (MCA) to identify a set of C&I with different groups of stakeholders in selected sites at the forestry management unit level (*leshoz*). Six workshops and a series of discussion meetings were conducted to perform a sound analysis of the preferences of four different stakeholder groups. A final set of C&I that consists of seven criteria and 45 indicators has been identified for evaluating sustainable forest management (SFM) in the walnut-fruit forests. Forest health and vitality was found to be the most important criterion, while the maintenance of forest biodiversity was found to be the least prioritized among other criteria. Furthermore, four different management strategies were developed by foresters, research groups, ecologists and forest administrators in order to overcome the present challenges in forest management. By utilizing the Analytic Hierarchy Process (AHP), one particular management strategy (MS II) was identified by all stakeholder groups as being the overall best alternative strategy. It was shown that the consideration of non-timber forest products and other options for income generation can improve the livelihood of the people, increase the productivity of resources as well as conserving the gene pool for maintaining forest biodiversity. The findings of this study highlight the importance of a C&I evaluation and its further policy implications. Moreover, it is discussed how the involvement of local stakeholders in the decision making process and their participation in forest management could be stimulated by the C&I development process in the walnut forests of Kyrgyzstan.

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1. Introduction

Sustainable forest management (SFM) has recently become the primary goal of forestry institutions worldwide (Mendoza and Prabhu, 2000b), although the concept has a long tradition of over two centuries (Wiersum, 1995; Farrell et al., 2000). 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 ecological, economic and social aspects (Castañeda et al., 2001; Rametsteiner, 2001; Brang et al., 2002; Purnomo et al., 2004; Wolfslehner et al., 2005; Mrozek et al., 2006).

Criteria and indicators (C&I) 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., 1996, 1998). The general concept of C&I was developed according to an international, political and scientific consensus and therefore provides the most comprehensive and current definition of sustainable forestry (Prabhu et al., 1999; Woodley et al., 1998). There have been various kinds of initiative adopted for the development, testing and implementation of C&I for SFM at the international level (e.g., the International Tropical Timber Organization (1992) and the Montreal Process (1995)) as well as at the regional and local levels. Among these initiatives, the Near East Process (1996) was developed in Cairo by the Food and Agriculture Organization (FAO, 1998, 1999) and the United Nations Environmental Programme (UNEP), of which Kyrgyzstan is also a member country. C&I could provide a framework for the formulation of policy options, help to advance international cooperation and also provide an assessment of the positive and negative changes in forest conservation and management at different levels (Kondrashov, 2004). Thus, there is a need to develop and examine C&I for SFM at the national as well as field levels. Cornet and Rajapbaev (2004) have developed a preliminary set of C&I for SFM for the Juniperus forests of South Kyrgyzstan

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on the base of "mixed model" conceptual framework. However, in spite of such initiatives, Kyrgyzstan has not yet adopted its own national C&I set for SFM. For the identification and evaluation of C&I for SFM there are two approaches described in literature: top-down and bottom-up (Prabhu et al., 1996; Mendoza et al., 1999; Reed et al., 2006). In the top-down approach, a previously generated set of C&I is used as an initial set and a team of experts adapts and modifies this initial set with the support of local users. The bottom-up approach is organized in a way that allows the direct involvement and participation of various stakeholders at the forest management unit level (Mendoza et al., 1999). The approach of the Center for International Forestry Research (CIFOR) has been to complement these processes by field testing C&I at the forest management unit (FMU) level. At this level, measurements can be more precise and the impact of forest management practices on the forests and the local populations are more evident and visible (Prabhu et al., 1998).

The walnut-fruit forests of Kyrgyzstan are considered to be important remaining areas of this particular forest type and therefore to be of global significance for biodiversity conservation (Ashimov, 1998; Venglovsky, 1998; Fisher et al., 2004). Moreover, the forests play a great role being a source of income for the livelihoods of the local people. Due to the socio-economic recession following independence, there have been increased pressures on forest biodiversity observed because of uncontrolled grazing, firewood collection and consumption of non-timber forest products. However, the future of these forests is uncertain and there is a special need to develop sustainable forest management strategies based on an integrated approach utilizing C&I for SFM. Thus, in this study, the walnut-fruit forests of Kyrgyzstan serve as a case study for identifying C&I at the field level and facilitate the evaluation of different management strategies with regard to SFM by adopting a multi-criteria analysis approach. This approach will aim to find out whether there are differences and similarities of perception regarding SFM between different stakeholder groups as well as how the use of C&I for sustainable forest management could help to stimulate sustainable development in the walnut-fruit forests of Kyrgyzstan.

2. Kyrgyz forest policy and management

Kyrgyzstan's forests account for about 4.3% of the country's total area. The forests play an important role in water regulation and soil protection, as well as in the livelihoods of local people (Ashimov, 1998; Kolov, 1998; Venglovsky, 2006). The forests are fully owned by the Government (Kyrgyz Forest Fund) and the State Agency on Environmental Protection and Forestry is the body responsible for the implementation of forest policy and forest management, national parks, reserves and biodiversity conservation. At the regional level (*oblast*), seven management units are in charge of forest management. Locally, more than 40 *leshozes* (forest enterprises) are responsible for all forest activities, including the management of other types of land-use (arable or pasture).

Following the country's independence, the formerly highly-centralized and technically-oriented forest management system has faced various difficulties due to the transition to a more market-oriented economy. Economic recession has increased the enormous pressures on forest resources (Kouplevatskaya, 2006). Therefore, there has been a need to formulate a new forest strategy for the country. Within a short period of time, a long-term strategy has been developed as well as measures and actions for its realization and mechanisms for their practical implementation (Kouplevatskaya, 2006). In this regard, the "Forest Code" of the Kyrgyz Republic (1999) is a legal framework for the orientation of the short- and long-term forest policies in the country. The general concept was developed on the foundation of three abstract goals reflecting the priorities of the Kyrgyz Forest Policy at the national level (Kouplevatskaya, 2006). The Forest Code doesn't consider all aspects

of the New National Forest Policy, and therefore the existing legislation does not fully meet the requirements of the changing national and international conditions (State Forest Service, 2004). However, it includes political statements in favor of sustainable forest management as a means of ensuring forest conservation, as well as the participation of local people and the private sector in forest management (Schmidt, 2007). Although sustainability is increasingly understood in a way which encompasses social, ecological and economic dimensions, forest management activities and plans do not often make reference to the concept and aspects of SFM (Schmidt, 2007). Therefore the need for tools to support the implementation of the key concept of SFM rises. Such tools should be applied and disseminated among the public of Kyrgyzstan to promote active involvement, as well as the establishment of mutually beneficial collaboration stated in the National Policy (Schmidt, 2007). International experiences have shown that national-level indicators provide a framework for evaluating and updating policy instruments while local standards support and prescribe management options (Woodley et al., 1998; Prabhu et al., 1999; Wijewardana, 2008). The approach should not mean to define a set of C&I only, but rather allow an initial approximation of values, expectation and needs of local stakeholders (Khadka and Vacik 2012).

In the context of the walnut-fruit forests, a Collaborative Forest Management (CFM) program was introduced in 1998 (Carter et al., 2003). 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). The CFM approach was particularly designed to promote biodiversity conservation, empower local people by giving them a greater responsibility for forest management, and improve the local livelihoods through sustainable resources use and income generation opportunities arising from this. As heavy population pressure causes a major threat to the forests local collaboration is essential for their continued existence (Carter et al., 2010). CFM has become widely accepted as a means of enabling local people to engage in forest management. However, due to the current lack of an operational analysis framework for evaluating forest management activities the CFM concept could be strongly enhanced by the use of C&I for SFM in formulating sustainability measures.

3. Research design

3.1. Description of study-sites

The walnut-fruit forests are located on the slopes of Fergana and Chatkal mountain ridges in Southern Kyrgyzstan between 41°18′30″ N and 72°57′21″ E, at 700 m to 2200 m above sea level (Fig. 1), (Blaser et al., 1998; Venglovsky, 2006)). The four selected study-sites for C&I development (Arstanbap, Kara-Alma, Kaba and Ortok *leshozes*) cover about 72,760 ha of forest area, whereas 36,304 ha are covered with forests dominated by walnut trees (*Juglans regia*) and other fruit trees species (Abdymomunov, 2001; Forest Inventory, 2003). The sites are located in relatively core zones, which can serve as a good test case for most of the other parts of the walnut-fruit forests. Furthermore, with about 23,810 inhabitants living in this area, and the sites are different in terms of population density and the availability of forest resources. The most populated *leshoz* is Arstanbap (0.45 ha/person) followed by Kaba (1.39 ha/person), Karalma (4.9 ha/person) and Ortok (7 ha/person) (Abdymomunov, 2001; Forest Inventory, 2003).

3.2. Methodological approach of the study

The methodological approach taken in this study can be classified into five steps (Fig. 2). In the first stage, the study environment was described by collecting background information in context studies
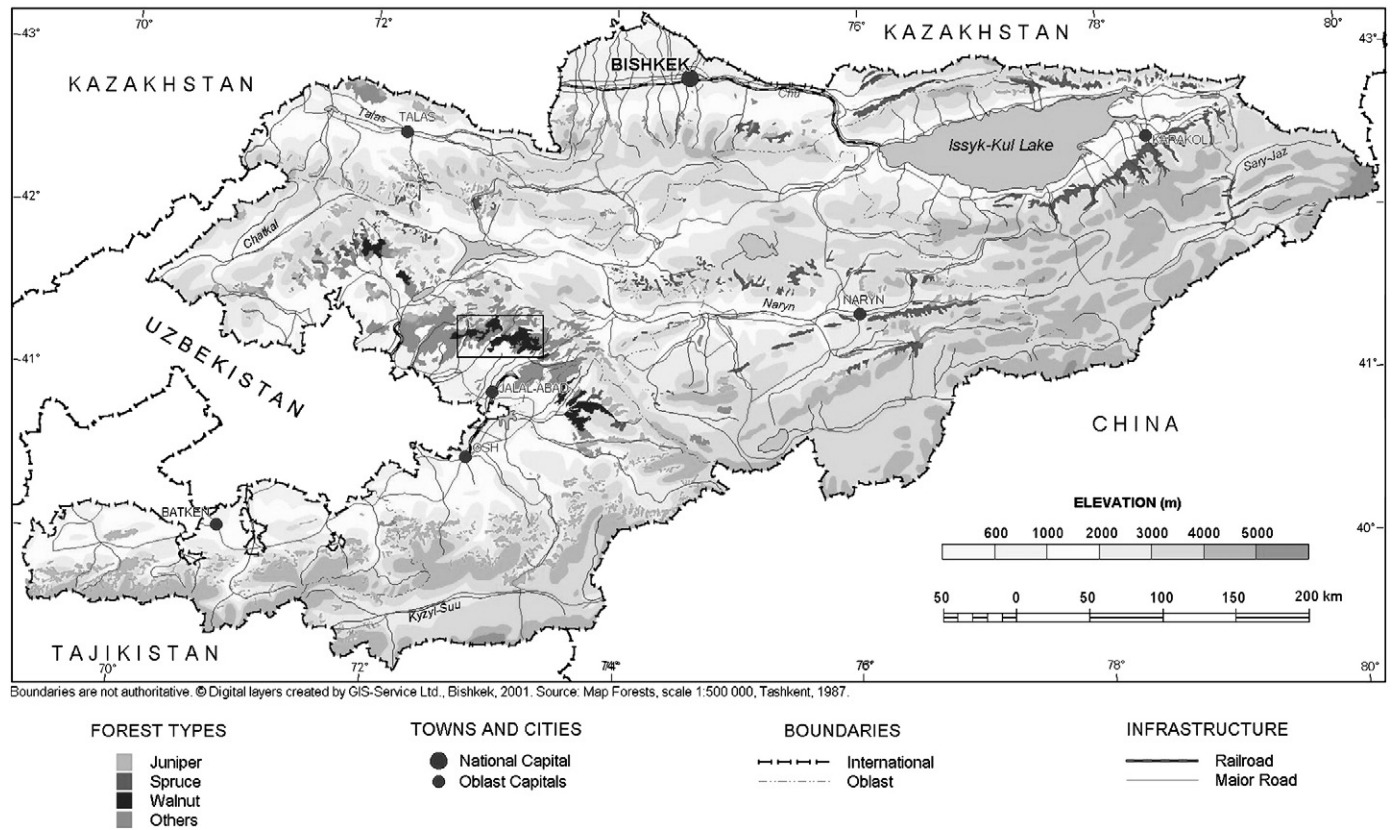
Forests

Boundaries are not authoritative. © Digital layers created by GIS-Service Ltd., Bishkek, 2001. Source: Map Forests, scale 1:500 000, Tashkent, 1987.

FOREST TYPES
Juniper
Spruce
Walnut
Others

TOWNS AND CITIES
● National Capital
● Oblast Capitals

BOUNDARIES
⊢ ⊢ ⊢ International
⋅⋅⋅⋅⋅⋅⋅ Oblast

INFRASTRUCTURE
—— Railroad
—— Major Road

Fig. 1. Map of Kyrgyzstan. The study area is marked with a rectangle.
Source: GIS-Service Ltd, Bishkek.

(i.e. policy, socio-economic, and bio-physical assessments) and establishing contacts with different stakeholders. The analysis helped to understand rules and regulations regarding decision-making procedures about resource distribution (e.g. provisions for enhancement of livelihood of local people, opportunities for income generation activities). The bio-physical data described the forest systems (i.e. protection, management and utilization) including bio-diversity conservation and other environmental protective measures.

In the stage of the C&I development process a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) and a resource
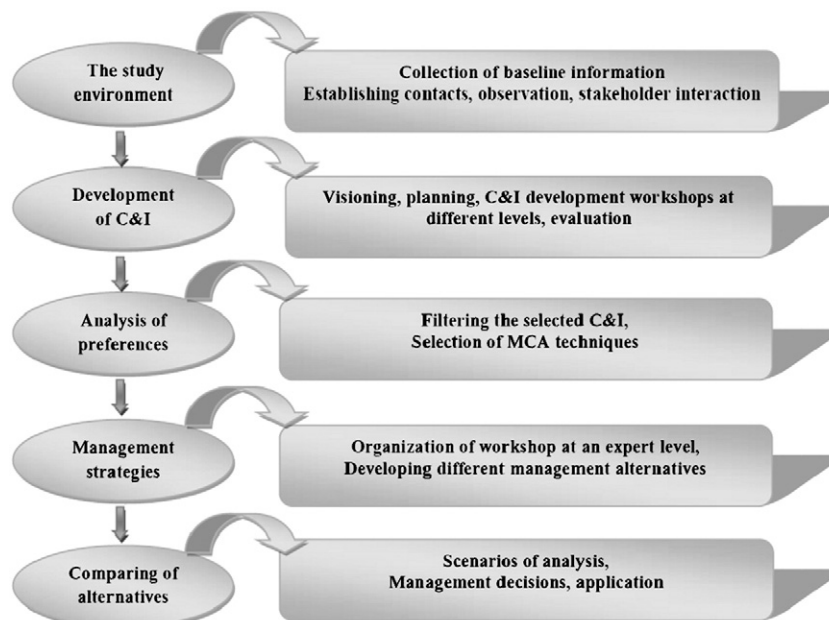

Fig. 2. Methodological approach for developing C&I for evaluating sustainable forest management (SFM) strategies.

assessment were employed, which allowed the formulation of problems and the development of a vision statement, a set of objectives and criteria through a series of workshops. The objectives of the top-down process were to ensure that the right conceptual information was retained and that the information from the field was not lost (c.f. Prabhu et al., 1996). In total 112 participants from different stakeholder groups participated in the C&I development process at the local level and shared their perspectives to develop a common vision for a sustainable management of the walnut fruit forests. Local facilitators rephrased the statements of the stakeholders in order to translate the vision, goals and objectives into meaningful and measurable criteria and indicators. Furthermore, the C&I set has been developed based on mixed bottom up and top down approach elements. In the top-down approach an initial set of C&I was generated referring to different internationally and nationally initiatives as Montreal Process (1995), Near East Process (FAO, 1998; FAO, 1999) and CIFOR (Prabhu et al., 1998). In 5 different regional and local level workshops the participants adapted the C&I to the local condition. As a result of this process, the participants were able to generate the local standards for the case study based on the proposed top down criteria. Moreover, the bottom-up approach in our study was purposely organized in a way that accommodates the direct involvement and participation of various stakeholders within the leshoz to secure their long lasting commitment (c.f. Mendoza et al., 1999).

In the third stage of our research, various Multi Criteria Analysis (MCA) techniques have been applied. MCA supports decision making with complex multi-criteria problems that include qualitative or quantitative aspects (Mendoza et al., 1999). MCA is an appropriate and useful approach for supporting the process of generating C&I (Mendoza and Prabhu, 2003; Wolfslehner et al., 2005) and allows to capture the diverse views, objectives and perspectives of stakeholders. Moreover, strong technical and theoretical support for MCA procedures exists, and they are mostly still simple, intuitive, and transparent (Mendoza and Prabhu, 2000a,b, 2003). In this study three different methods were used for supporting the stakeholders in expressing their preferences and for comparing alternatives. Ranking and rating techniques were applied in the field during the workshop for C&I evaluation and the Analytical Hierarchy Process (AHP) was used for the comparison of management strategies, as those methods are most commonly used in C&I assessment studies (c.f. Schmoldt and Peterson, 1997; Mendoza et al., 1999).

According to Mendoza et al. (1999), ranking assigns a rank to each element that reflects at perceived degree of importance contributing to a decision being made. The elements can then be ordered according to their rank. The relative importance or weight can be calculated according to the ranks assigned to each C&I element (Mendoza et al., 1999; Mendoza and Prabhu, 2000a,b). For rating, the decision elements are very often assigned a score of between 0 and 100. In some applications, the scores for all elements being compared add up to 100. Thus, to score one element high means that a different element must be scored lower (Mendoza et al., 1999).

The Analytic Hierarchy Process (AHP) by Saaty (1977, 1980) is one of the most widely used popular techniques for structuring C&I sets. More recently, the AHP has been applied in multi-objective forest management and land use planning due to its flexibility and high effectiveness in analyzing complex decision problems (Mendoza et al., 1999; Vacik and Lexer, 2001; Wolfslehner and Vacik, 2008; Dhar et al., 2008). This interactive method allows a decision maker (or a group of decision makers) to express their preferences to the analyst and support the discussion of the outcomes (Proctor, 2000; Wolfslehner et al., 2005). Generally, the AHP is based on the principle of decomposition, a construction of a series of "pair-wise comparisons" (which are used to compare criteria and alternatives to one another) and the principle of additive synthesis of preferences (Saaty, 1995). This method can also be used to assign priorities to the criteria, as well as to indicators (Mendoza et al., 1999; Mendoza and Prabhu, 2000a,b; Proctor, 2000).

However, independently from the technique applied, there are several possible ways to aggregate information when more than one individual judgment is made by individual stakeholders. Treating the group as a new 'individual' with aggregating individual judgments requires satisfaction of the reciprocity conditions for judgments (Forman and Peniwati, 1997) and it is often recommend to use a geometric mean in representing an average ratio (Aczel and Saaty, 1983; Aczel and Roberts, 1989; Saaty, 2008).

In the fourth stage, different management strategies were developed by different experts and discussions about the performance of the strategies with regard to the C&I set was held. Furthermore, the developed strategies were outlined according to its main elements in order to translate the vision and goals for the walnut fruit forests. Each stakeholder group had the chance to describe and clarify their own strategies in details which helped to understand the potential impacts of the strategies and allowed an overall assessment respectively. Therefore in the last stage, the generated strategies were assessed qualitatively and judged according to the selected C&I with the help of experts. The study combined the socio-economic, policy and technical information and integrated the values of each stakeholder group participants to identify the best performing strategy and potential trade-offs with regard to different preferences using the AHP.

4. Application

4.1. Definition of the study environment

After the collection of base line information on socio-economic, bio-physical, policy and development issues of the selected locations, individual meetings were arranged with foresters and researchers from the Forest Research Institute and Department for Forestry and Hunting. The main goal of these meetings was to introduce the C&I concept of SFM and to support a common understanding of the C&I development approach. During the meetings, the specialists discussed with the participants how progress should be made from an organizational perspective and shared their opinions regarding general management plans/activities and their weaknesses and strengths at the implementation level — all from an ecological, socio-economic and political perspective.

4.2. C&I development

As C&I were developed by utilizing elements of top-down and bottom-up approaches various workshops at regional and field levels were conducted. Within the top-down process at regional level a group of 15 stakeholders from different organizations participated. The stakeholders were selected so as to achieve an appropriate balance in terms of representation, professional background, knowledge and experience of the administrative, technical, scientific and historical perspectives regarding forest management activities (c.f. Balana et al., 2010). The experts selected have been involved in forestry issues and can therefore understand the current situation of the study-sites and their problems. The C&I development workshop was held over 2 days. The main idea of this workshop was to generate an initial set of C&I for SFM by reflecting the contextual factors of the current management problems. The general procedure of the workshop followed the Guidelines for Developing, Testing, and Selecting Criteria and Indicators for Sustainable Forest Management (Prabhu et al., 1999) and the Criteria and Indicators Generic Template (CIFOR, 1999). The initial selection of a preliminary C&I set was based on the Near East Process (FAO, 1998; FAO, 1999) and also partly on the ITTO (1992) and the Montreal Process (1995). As a result of the workshop, a preliminary set of 7 criteria and 73 indicators was listed for further discussions.

Within the bottom up process four different workshops at the field level were held, each with a different number of participants:

Arstanbap (29), Kaba (20), Kara-Alma (24) and Ortok (24). The participants of the one day workshop were carefully selected according to their occupation, background, gender and individual interests on forests. The main groups of stakeholders were foresters, social workers, farmers (tenants) and other kinds of employers.

At the beginning of the workshop, a brief introduction about C&I development and SFM was given and the stakeholders were grouped according to their background (in order to reduce the dominance of working groups). Each group concentrated on a selected set of C&I and expressed their experiences, interests and priorities. Presentations were prepared by each group and discussions were held to adapt or synthesize individual indicators. The main working language was Kyrgyz, but Russian and Uzbek languages were also commonly used in order to clarify and understand terms and definitions. In total, 7 criteria and 60 indicators were selected (from the initial 73 top down indicators) according to the following conditions: relevance to the assessment and monitoring goal; potential to deliver meaningful information that reveals trends in the ecological and social systems; usefulness for policy/management responses; and critically assessed to develop more meaningful and measurable indicators.

4.3. Analysis of C&I preferences of stakeholders

All selected 7 criteria and 60 indicators have been ranked and rated by all workshop participants. The pair-wise comparison method was not used at the field level due to its complexity as other studies have described problems related to its time consuming nature (Mendoza and Prabhu, 2000b; Khadka et al., 2008; Gomontean et al., 2008). During preference elicitation, some stakeholders were quite confident about expressing the importance of indicators, while others felt some difficulties in understanding the terms as well as methodologies on how to evaluate the indicators. However, during the workshops the researchers tried to keep a balance among all participants by dividing into several groups according to their professional backgrounds, interests and perceptions as : a) foresters, who are involved in the forestry sectors; b) social workers as teachers, medical doctors and other related occupations; c) other employers, who are engaged in private business, small scaled enterprises, tourism or other related fields; and d) farmers/tenants, who are involved in agricultural management or who have the CFM leased plot in the forests. Furthermore, at the end of each workshop, all stakeholders have evaluated all C&I individually.

According to the evaluation results of the workshops low scored and redundant indicators (those representing similar issues), as well as inconsistent ones, were eliminated from the initial C&I set. As a result, 7 criteria and 45 indicators were identified as final C&I set for the final evaluation. A short description and the means of verification are listed in Table 1. Based on the stakeholder groups present in the workshops (foresters, social workers, employers and farmers), 12 representatives from each leshoz (in total 48) were selected for further analyses Pairwise comparisons have been among between the remaining C&I building on rating and ranking inputs provided by those stakeholders.

4.3.1. Criteria level

The results obtained from rating and ranking (arithmetic mean) and pairwise comparison (geometric mean) derived from the 48 stakeholders for the criteria level are shown in Table 2. 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) and protective functions of forests (C5) were equally preferred as the second most important criteria. Moreover, the maintenance of forest biodiversity (C2) and the legal and institutional frameworks (C7) were rated lower than the other factors, while the maintenance of forest ecosystems (C1) was perceived as the least important criterion for SFM.

Table 1
Criteria and indicators selected for the evaluation of sustainable forest management (SFM) by different stakeholder groups.

Criteria and indicators	Measures
Criterion 1: maintenance of forest ecosystems	
1 Extent of forest areas and their change over time	% (ha)
2 Maintaining ecosystem types (area of dense, open and shrub forests)	% (ha)
3 Extent of forested area diverted to the land use	% (ha)
4 Balancing the stand volume and biomass	m^3/ha
5 Balancing the age and structure of forest species	%
6 Maintaining carbon cycling	ton/ha
Criterion 2: maintenance of forest biodiversity	
7 Extent of protected areas	Verifier (ha)
8 Existence of coarse wood debris and snags at a functional level	Verifier
9 Employ Red List species	Verifier
10 Ensuring forest dependent species	Verifier
11 Controlling introduced species	Verifier
12 Ensuring seed provenance	Verifier
13 Maintaining and enhancing the management of genetic resources (genetic fund)	Verifier
Criterion 3: maintenance of forest health	
14 Ensuring natural regeneration capacity	% (ha)
15 Promoting secondary forests	% (ha)
16 Controlling degraded forests, soil and landslides	Verifier
17 Controlling forest disease, pests, fire and wind	Verifier
18 Controlling cattle grazing	Verifier
19 Developing mechanisms for firewood consumption	m^3/ha (verifier)
Criterion 4: productive capacity of forests	
20 Promoting non-timber forest products (walnut, honey, plants etc.)	Verifier
21 Preparing and developing demonstration and experiment research plots	Verifier (ha)
22 Balancing wood consumption and wood increment annually	m^3/ha
23 Promoting plantation area and reforestation	%/ha
24 Extent of growing stock changes of forest tree species	m^3/ha)
Criterion 5: protective functions of forests	
25 Identifying the protection areas	Verifier (ha)
26 Extent of forest-managed area for soil protection	Verifier (ha)
27 Maintaining and extending watershed areas	Verifier (ha)
28 Extent of forest area for scenic and amenity purposes	Verifier
Criterion 6: maintenance of socio-economic functions	
29 Rate of improved livelihood of local communities in forests	Verifier
30 Share of benefits from the forests in the family income of local people	Verifier
31 Job opportunities and employment generation in forest sectors	Verifier
32 Grass root participation and equity in decision-making	Verifier
33 Access of local communities to ecological education	Verifier
34 Interest and contribution of local people in conservation, media etc.	Verifier
35 Consumption and distribution of timber and non-timber forest products	Verifier
36 Degree of contribution of forest management activities (tax, payment)	Verifier
Criterion 7: the legal and institutional frameworks	
37 Respecting national policy, legislation and regulations	Score
38 Improving forest tenure and ownership of forests	Score
39 Conservation of local tradition and religion	Verifier
40 Respecting management plans	Score
41 Mechanism for monitoring, evaluation and accounting	Verifier
42 Investment in forestry technical staff, education and science	Verifier
43 Mechanism for reducing conflicts (laws) for tenure and ownership systems	Score
44 Investment in forest management activities	Score
45 Increasing linkage to the market	Verifier

Concerning the individual stakeholder groups' preferences derived by the geometric mean of the pairwise comparisons, the forester group gave the highest preference to forest health (C3) and socio-economic conditions (C6), while forest health (C3) was also identified

Table 2
Preferences of criteria based on rating, ranking and pairwise comparisons (PWC) technique (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	0.095
C2. Maintenance of forest biodiversity	12.6	4.40	3.58	1.76	0.110
C3. Enhancement of forest health and vitality	15.8	6.28	2.75	0.89	0.149
C4. Productive functions of forests	17.0	8.50	2.65	1.72	0.143
C5. Protective functions of forests	15.5	8.40	3.10	1.48	0.132
C6. Socio-economic functions and conditions	15.1	6.70	3.15	1.17	0.132
C7. The legal and institutional frameworks	12.1	5.60	3.79	1.03	0.100

as the most important criterion by the social workers (Table 3). Furthermore, the employers evaluated the productive functions of forests (C4) with the highest priority. The farmers group gave the highest importance to the protective functions of forests (C5) and a comparatively high preference was also given to the legal and institutional frameworks (C7).

4.3.2. Indicator level

In total, 45 indicators were assessed, since the number of indicators varied from 4 to 9 under each criterion (Table 3). In prioritizing the relative importance of indicators, a consistent trend was observed amongst the preferences derived from ranking and pair-wise comparisons. Accordingly, indicators such as maintaining carbon cycling (6), employing Red List species (9), ensuring natural regeneration capacity (14), promoting non-timber forest products (20), the rate of improved livelihood of local communities in forests (29), improving forest tenure and ownership of forests (39) were ranked as "highly important" by both methods. In the following section, the relative importance of indicators under each criterion is presented.

4.3.3. Indicators under C1 and C2 (maintenance of forest ecosystems (1–6) and biodiversity (7–13))

Extending area diverted to land use (3) and maintaining carbon cycling (6), employing the Red List species (9) and extending protected areas (6) were identified as the most important indicators in general. Extent of forest areas (1) and ensuring seed provenance (12) were rated with lower preferences than other indicators. However, balancing the age and structure of forest species (5) was ranked the highest by the forestry and employers' groups.

4.3.4. Indicators under C3 (maintenance of forest health (14–19) and C5 (protection functions (25–28))

Ensuring natural regeneration capacity (14) and controlling degraded forests, soil and landslides (16) were found to be the highly preferred indicators (followed by the indicator on promoting secondary forests (15)) by all stakeholder groups, except the farmers' group, which gave the highest preference to controlling cattle grazing (18). According to criterion 5 (protection functions), indicators on identifying the protected area (25) and the extent of forest area for scenic and amenity purposes (28) were highly ranked indicators.

4.3.5. Indicators under C4 (productive capacity and functions of forests 20–24)

Promoting non-timber forest products (20) and promoting the plantation area and reforestation (23) were ranked as the most important indicators in general for all stakeholders. However, the extent

of growing stock changes of forest tree species (24) was found as the least important criteria, amongst others.

4.3.6. Indicators under C6 (socio-economic functions and conditions 29–36)

The rate of improved livelihood of local communities (29) as well as job opportunities and employment generation in forest sectors (31) were assigned as the most important indicators when assessing the long- and short-term social and economic wellbeing of local people. The degree of contribution of forest management activities (36) and share of benefits from the forests in the family income of local people (30) was ranked as second and third important indicators by all stakeholder groups.

4.3.7. Indicators under C7 (the legal and institutional frameworks 37–45)

Improving forest tenure and ownership of forests (38) and increasing links to the market (46) have been found to be important indicators, and are followed by the second highest priority indicator, respecting management plan under the policy frameworks (41). Nevertheless, the mechanism for reducing conflicts for tenure and ownership (44) was ranked as the most important indicator by the foresters' and farmers' groups.

4.4. Development of management strategies

As discussions and stakeholder workshops provided sufficient information for the understanding of the existing forest management system and the local socio-economic and environmental conditions, a final workshop of experts was organized in order to define forest management strategies which are capable of improving the overall situation for the local people. 18 experts from 6 different institutions (Forest Research Institute, Forestry Department, Ecology Department, Directors of selected *leshozes*, Municipalities and Administration) who are directly or indirectly related to forest management activities collaborated in the workshop. The experts developed four strategies, each with a different focus: technical forest aspects, research driven measures, biodiversity conservation issues and policy/administration orientation. 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 on more socio-ecological measures, but still tries to explore income generation activities related to non-timber forest products (NTFP). MS (III) is a conservation strategy developed by the ecologists, which focuses mainly on maintaining biodiversity, forest health and forest ecosystems in general. Finally, the MS IV strategy concentrates on socio-economic and policy issues by raising the general awareness, and was developed by administrative workers of the forested areas concerned. All management strategies were designed in terms of their practical applicability, incorporating several concepts of SFM and opportunities for forest development.

The four strategies are briefly outlined in Table 4 with reference to the main management elements, namely: incorporation of principles of SFM, forest development regime, conservation of biodiversity and special sites, utilization of non-timber forest products, livestock promotion and the firewood management regime.

A qualitative assessment of the four management strategies has been done by the local facilitators and researchers according to the results of the content analysis of the existing action plans and the collection of base line information. Table 5 shows the performance of management strategies with respect to all 45 indicators. The assessment has been made for each alternative in four categories with regard to its potential for future improvements in relation to the current situation: +++ (situation is highly improved); ++ (situation

Table 3
Relative weight of criteria and indicators based on geometric mean of the synthesized stakeholder group judgments.

Criteria and indicators	Synthesized priorities of stakeholders				
	Foresters	Social workers	Employers	Farmers/Tenants	All stakeholders
Criterion 1: maintenance of forest ecosystems	*0.103*	*0.096*	*0.104*	*0.079*	*0.095*
1 Extent of forest areas and their change over time)	0.119	0.122	0.149	0.098	0.118
2 Maintaining ecosystem types (area of dense, open and shrub forests)	0.124	0.168	0.149	0.158	0.147
3 Extent of forested area diverted to the land use	0.165	0.164	0.128	0.182	0.158
4 Balancing the stand volume and biomass	0.131	0.18	0.157	0.129	0.148
5 Balancing the age and structure of forest species	0.169	0.126	0.167	0.092	0.134
6 Maintaining carbon cycling	0.159	0.159	0.140	0.188	0.160
Criterion 2: maintenance of forest biodiversity	*0.089*	*0.096*	*0.124*	*0.141*	*0.110*
7 Extent of protected areas	0.138	0.142	0.116	0.170	0.140
8 Existence of coarse wood debris and snags at a functional level	0.089	0.169	0.139	0.095	0.119
9 Employ Red List species	0.144	0.142	0.138	0.160	0.151
10 Ensuring forest dependent species	0.155	0.119	0.130	0.120	0.130
11 Controlling introduced species	0.092	0.106	0.109	0.107	0.103
12 Ensuring seed provenance	0.097	0.084	0.087	0.085	0.088
13 Maintaining and enhancing the management of genetic resources (genetic fund)	0.109	0.106	0.130	0.143	0.121
Criterion 3: maintenance of forest health	*0.190*	*0.162*	*0.139*	*0.118*	*0.149*
14 Ensuring natural regeneration capacity	0.183	0.193	0.150	0.160	0.170
15 Promoting secondary forests	0.154	0.144	0.168	0.151	0.154
16 Controlling degraded forests, soil and landslides	0.163	0.153	0.178	0.142	0.159
17 Controlling forest disease, pests, fire and wind	0.145	0.182	0.141	0.134	0.150
18 Controlling cattle grazing	0.145	0.121	0.133	0.169	0.141
19 Developing mechanisms for firewood consumption	0.129	0.136	0.126	0.135	0.132
Criterion 4: productive capacity of forests	*0.119*	*0.136*	*0.221*	*0.118*	*0.143*
20 Promoting non-timber forest products (walnut, honey, plants etc.)	0.269	0.212	0.199	0.241	0.229
21 Preparing and developing demonstration and experiment research plots	0.142	0.189	0.177	0.180	0.171
22 Balancing wood consumption and wood increment annually	0.142	0.150	0.167	0.180	0.159
23 Promoting plantation area and reforestation	0.202	0.201	0.250	0.170	0.204
24 Extent of growing stock changes of forest tree species	0.134	0.179	0.125	0.135	0.142
Criterion 5: protective functions of forests	*0.115*	*0.153*	*0.110*	*0.158*	*0.132*
25 Identifying the protection areas	0.249	0.308	0.219	0.254	0.256
26 Extent of forest-managed area for soil protection	0.249	0.245	0.236	0.226	0.239
27 Maintaining and extending watershed areas	0.222	0.184	0.233	0.226	0.215
28 Extent of forest area for scenic and amenity purposes	0.215	0.219	0.219	0.239	0.223
Criterion 6: maintenance of socio-economic functions	*0.154*	*0.136*	*0.110*	*0.133*	*0.132*
29 Rate of improved livelihood of local communities in forests	0.162	0.156	0.102	0.126	0.134
30 Share of benefits from the forests in the family income of local people	0.114	0.117	0.097	0.126	0.113
31 Job opportunities and employment generation in forest sectors	0.128	0.131	0.137	0.119	0.129
32 Grass root participation and equity in decision-making	0.085	0.093	0.103	0.126	0.100
33 Access of local communities to ecological education	0.075	0.093	0.097	0.100	0.091
34 Interest and contribution of local people in conservation, media etc.	0.090	0.098	0.097	0.119	0.100
35 Consumption and distribution of timber and non-timber forest products	0.114	0.104	0.130	0.100	0.111
36 Degree of contribution of forest management activities (tax, payment)	0.121	0.117	0.137	0.119	0.123
Criterion 7: the legal and institutional frameworks	*0.097*	*0.096y*	*0.082*	*0.133*	*0.100*
37 Respecting national policy, legislation and regulations	0.090	0.126	0.094	0.102	0.102
38 Improving forest tenure and ownership of forests	0.101	0.141	0.112	0.105	0.114
39 Conservation of local tradition and religion	0.052	0.089	0.100	0.088	0.080
40 Respecting management plans	0.113	0.100	0.100	0.102	0.103
41 Mechanism for monitoring, evaluation and accounting	0.080	0.077	0.106	0.086	0.086
42 Investment in forestry technical staff, education and science	0.101	0.097	0.116	0.096	0.102
43 Mechanism for reducing conflicts (laws) for tenure and ownership systems	0.120	0.084	0.084	0.108	0.098
44 Investment in forest management activities	0.095	0.074	0.100	0.108	0.093
45 Increasing linkage to the market	0.095	0.12	0.111	0.121	0.112

is moderately improved); + (situation is slightly improved); − (strategy allows no change).

4.5. Comparing management alternatives

The AHP technique has been employed to select the overall best management strategy in comparing the performance of each alternative regarding all 45 indicators. Pairwise comparisons have been done based on the qualitative assessment of the potential impacts of each strategy with regard to each indicator and in using the preferences of the various stakeholder groups for the C&I set. According to the overall results of the AHP, strategy MS II was found to be the best performing management strategy, MS I as the second alternative, and MS IV had the lowest priority in general (Table 6). Moreover, the results based on the preferences of the individual stakeholder groups' were more or less comparable to the overall results, except for the foresters group, whose priority was given to MS I.

Table 7 shows the preferences of the management strategies according to the criteria level. Strategy MS II was highly ranked in relation to the maintenance of forest ecosystems (C1) and the socio-economic functions (C6). Meanwhile MS I was the best strategy with regard to forest health (C3), productivity function (C4) and the legal and instructional frameworks (C7), and was followed by MS III. MS III was the best choice for forest biodiversity (C2) and the protection function (C5). However, strategy MS IV had the lowest priority among all strategies. However, it still was the second best alternative strategy for socio-economic functions (C6).

Looking closely at how stakeholder preferences and options are assigned to management strategies, we can derive a quite different picture based on conflicting interests among stakeholder groups (especially in socio-economic functions (criterion 6) and the legal and institutional framework (criterion 7)). Fig. 3 shows the preferences of stakeholder groups regarding the socio-economic function (criterion 6), where foresters and social workers have given highest

Table 4
Characteristics of the management strategies.

Elements	MS I	MS II	MS III	M IV
Forest development	Sanitary cutting, light thinning. Plantation	Sanitary cutting, light thinning. Multi-purpose species plantation	Wilderness, nursery establishment, seedling distribution to individual households	Nursery establishment, plantation of fast growing species
Biodiversity conservation	Assessment of species, identification of important species, identification of management system for species	Assessment and monitoring of ecosystem types. Protection of woody debris, seed trees, birds, mammals, water sources	Awareness building, demonstrate reserves of site, ecosystem, species and gene conservation, identify the endangered, rare and threatened species and their management	Awareness building
Enhancement of livelihood through use of NTFPs	Group formation, training on enterprise development and business plan and formation of enterprise development and Juice and Jam making	Feasibility study of NTFP use and production, innovative project development for income generation activities, certification process of NTFPs	Study for enterprise development	Awareness building, collaboration with government agency and company
Livestock promotion	Assessment of pasture land, distribution the pasture land to each forest enterprise on equity basis (HH/forest area and number of livestock). Restriction of grazing in the forests	Improve rotation grazing, quality of livestock, limit the number of livestock in each household, improve partnership between foresters and people, improvement of income sources	Zero grazing, identify other types of income sources	Attention to quality of livestock Livestock promotion projects
Firewood management	Allocate fire collection area and fix the time period, development of firewood collection guidelines, improve heating system	Feasibility study for demand and supply of firewood, development guidelines for firewood collection, introduce solar energy as alternative energy	Control illegal cutting and collection. Plantation of fuel wood species	Search for alternative to firewood (plantation of fuel wood and fast growing species)

priority to MSII, while farmers and employers have chosen MS IV as the best strategy of all. Moreover, MS III was the least preferred strategy by all stakeholder groups.

5. Discussion

Our analyses provide important insights into the C&I development process and its application in identifying management problems in the walnut-fruit forests in south Kyrgyzstan. The results show that the recent management of walnut-fruit forests has focused on more ecological issues and has paid less attention to socio-economic issues, including livelihood improvement, poverty reduction and participation. In this respect the C&I development approach was able to identify, monitor, and evaluate local challenges and problems in order to improve the sustainable forest management concept.

A MCA approach has been considered a promising approach when supporting the participation of stakeholder groups and incorporating multiple perceptions throughout different case studies (c.f. Sheppard and Meitner, 2005; Mendoza and Martins, 2006; Diaz-Balteiro and Romero, 2008) Furthermore, the MCA process could potentially increase the quality of decisions by balancing interests and thereby allowing solutions which result in a higher level of overall stakeholder satisfaction. The interaction among stakeholders was supported by a high number of meetings and direct public participation during a shorter period as it has been shown in other studies as well (Nordström et al., 2010; Khadka and Vacik, 2012). Aside from the opportunity for all stakeholders to express their own objectives and visions, it was also possible to accurately structure the problem, increase transparency and thereby improve the quality of decision making process (from a societal perspective) which could help facilitate implementation (c.f. Nordström et al., 2010).

In total, 7 criteria and 45 indicators were identified for the evaluation of the management strategies. Although stakeholders often have similar perceptions, the importance of the criteria and indicators was seen to vary accordingly. For instance, the social workers and employers group have shown comparatively similar preferences towards C&I, but the group of foresters and farmers have had slightly different perceptions. Many case studies have shown that it is very important to explore how different stakeholders understand or conceptualize appropriate forest management (Purnomo et al., 2004). However, Cornet and Rajapbaev (2004), Purnomo et al. (2004), Tashakori and Lexer (2008), Biswas et al. (2011), have found out that the differences in stakeholders' preferences might be due to the interpretation of indicator verifiers.

In general, participants in local workshops felt quite comfortable with discussions and group work, but it seemed that some of the stakeholders (except foresters) were confused with the forest-related terms and definitions. When expert knowledge was limited, some stakeholders had difficulties in properly expressing their preferences for C&I. This could indicate that the preferences were not judged in an equally critical way in each case by all stakeholder groups and individuals. In addition, the working procedure was not maintained by all participants, as the overall evaluation for each criterion was often done before going through the individual indicators in detail. Moreover, a significant amount of time was required to identify and evaluate criteria and indicators. As all interests and values of all stakeholders had to be taken into account it turned out that this aspect was one of the most difficult and challenging tasks to be completed. However, trade-offs based on different stakeholder preferences allowed to identify an overall compromise solution according to varying interests (c.f. Khadka et al., 2008).

Concerning the preferences for the SFM criteria it became evident that forest health, productivity, and socio-economic functions were found as highly preferred, while forest biodiversity, ecosystems and policy issues were the least preferred criteria in general. In context of the stakeholder groups, it is – in surprising contrast to the general

Table 5
Qualitative assessment of management strategies with respect to each indicator.

Criteria and indicators		Management strategies			
		MS I	MS II	MS III	MS IV
Criterion 1: maintenance of forest ecosystems					
1	Extent of forest areas and their change over time)	+	+	++	−
2	Maintaining ecosystem types (area of dense, open and shrub forests)	++	+++	+++	−
3	Extent of forested area diverted to the land use	+	++	+	+
4	Balancing the stand volume and biomass	++	++	+	+
5	Balancing the age and structure of forest species	++	++	+	+
6	Maintaining carbon cycling	+	+	+	−
Criterion 2: maintenance of forest biodiversity					
7	Extent of protected areas	+	++	++	+
8	Existence of coarse wood debris and snags at a functional level	++	+++	+++	+
9	Employ Red List species	++	+++	+++	+
10	Ensuring forest dependent species	++	+	+	++
11	Controlling introduced species	++	++	++	++
12	Ensuring seed provenance	+	+	+++	−
13	Maintaining and enhancing the management of genetic resources (genetic fund)	++	++	+++	+
Criterion 3: maintenance of forest health					
14	Ensuring natural regeneration capacity	+++	+++	+	+
15	Promoting secondary forests	++	++	+	+
16	Controlling degraded forests, soil and landslides	++	++	+++	+
17	Controlling forest disease, pests, fire and wind	++	+++	+++	+
18	Controlling cattle grazing	+++	++	+++	+
19	Developing mechanisms for firewood consumption	+++	++	+	+
Criterion 4: productive capacity of forests					
20	Promoting non-timber forest products (walnut, honey, plants etc.)	+++	+++	+	+
21	Preparing and developing demonstration and experiment research plots	+	+++	+	−
22	Balancing wood consumption and wood increment annually	+++	++	−	+
23	Promoting plantation area and reforestation	+++	++	+	+++
24	Extent of growing stock changes of forest tree species	++	++	+	+
Criterion 5: protective functions of forests					
25	Identifying the protection areas	+	+	+	−
26	Extent of forest-managed area for soil protection	+	+	++	−
27	Maintaining and extending watershed areas	+	++	++	+
28	Extent of forest area for scenic and amenity purposes	−	−	−	+
Criterion 6: maintenance of socio-economic functions					
29	Rate of improved livelihood of local communities in forests	++	++	−	++
30	Share of benefits from the forests in the family income of local people	+++	+++	+	++
31	Job opportunities and employment generation in forest sectors	++	++	−	+
32	Grass root participation and equity in decision-making	++	++	+	+++
33	Access of local communities to ecological education	+	+	++	++
34	Interest and contribution of local people in conservation, media etc.	+	++	++	++
35	Consumption and distribution of timber and non-timber forest products	++	++	+	++
36	Degree of contribution of forest management activities (tax, payment)	+++	+++	+	+++
Criterion 7: the legal and institutional frameworks					
37	Respecting national policy, legislation and regulations	++	++	+	++
38	Improving forest tenure and ownership of forests	+++	++	−	+++
39	Conservation of local tradition and religion	+	++	+	+
40	Respecting management plans	++	++	+	+
41	Mechanism for monitoring, evaluation and accounting	+++	+++	++	++
42	Investment in forestry technical staff, education and science	++	++	+	++
43	Mechanism for reducing conflicts (laws) for tenure and ownership systems	+++	+++	+	+++
44	Investment in forest management activities	++	+++	+	+++
45	Increasing linkage to the market	+++	+++	+	++

Table 6
Overall priorities of management strategies with respect to all stakeholder groups based on the geometric mean of their synthesized priorities.

Management strategies	Foresters		Social workers		Other 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

Table 7
Overall priorities of management strategies with respect to all criteria based on the geometric mean of the synthesized priorities of all stakeholder groups.

Management strategies	Criteria 1		Criteria 2		Criteria 3		Criteria 4		Criteria 5		Criteria 6		Criteria 7	
	Rank	Priority	Rank	Priority	Rank	Priority	Rank	Priority	Rank	Priority	Rank	Priority	Rank	Priority
MSI	2	0.298	3	0.222	1	0.297	1	0.376	3	0.244	3	0.281	1	0.306
MSII	1	0.333	2	0.267	3	0.261	2	0.349	2	0.291	1	0.301	2	0.305
MSIII	3	0.267	1	0.351	2	0.291	4	0.101	1	0.327	4	0.124	4	0.109
MSIV	4	0.128	4	0.163	4	0.151	3	0.174	4	0.138	2	0.295	3	0.281

assumption – the foresters' group which gave more priority to socio-economic conditions (C6) rather than to the legal and institutional framework (C7). It seemed that one reason for this might be that the issue was relatively new for them and all were quite ambitious to discuss it. The study of Schmidt (2007) also stated that particular challenges for a successful implementation of a SFM concept lie since the former system could not provide enough institutional capacity or address urgent social questions.

Regarding biodiversity conservation all stakeholders considered a very low priority in general. A previous study on the perception of local people on biodiversity in the walnut fruit forests has identified that local people have a clear picture and positive intentions for conservation in general, but seem to prefer socio-economic aspects due to the shortage of alternative income sources for their daily needs (Jalilova and Vacik, forthcoming). Nevertheless, most people believed that large state subsidies for income generation, poverty reduction and public support may help to raise the attention about conservation management in the long run. Other studies (Baral and Heinen, 2007; Silori, 2007; Vodouhe et al., 2010) support these findings as they promote alternative income-generating activities to reduce the dependence on forest resources and cause a positive response from local people regarding biodiversity conservation activities.

Furthermore, according to the indicator analysis, the key indicator 38 (related to improved forest tenure and ownership) was quite new to participants but its importance was realized by all participants. Some of the participants claimed that the forest leasing system for forest users was not complementarily developed and a number of challenges have arisen between leaseholders (tenants) and foresters in taking responsibilities for forest activities. Moreover, among other important indicators, the firewood consumption issue was highly debated by the workshop participants and different ideas were discussed. A number of stakeholders claimed that firewood consumption

is the main reason for forest degradation due to the lack of alternative energy sources. In the C&I case study by Cornet and Rajapbaev (2004) similar indicators related to socio-economic aspects have been identified as relevant. This should be considered in further discussions on SFM implementations. Considering socio-economic conditions of the local people were stated as important driving factors in other case studies in developing countries also (Shackleton, 1993; Badola, 1998; Jalilova, 2007; Balana et al., 2010).

The four different management strategies and the evaluation framework were derived from identified needs and expectations by foresters, researchers, nature conservationists and administrative workers. In this context the MCA technique applied was able to bring together different views and strategies of all stakeholder groups, which is to support the implementation of a compromise management choice. The AHP allows the use of both qualitative and quantitative information in comparing the performance of alternatives (Saaty, 1980). However, the use of qualitative expert assessment of management strategies is quite common, since quantitative information about productivity and revenue of different management strategies is scarce. As other case studies have shown (e.g. Ananda, 2007), it is difficult for the stakeholders to evaluate each management strategy according to all criteria and indicators in practice. For instance, regarding MS III, stakeholders were hesitant to discuss socio-economic and policy criteria and to provide new solutions. Moreover, in the case of MS IV, administrative workers were not much concerned about the forest ecosystem and biodiversity issues. Additionally MS I, which was developed according to current management operational plans, was already improved a lot during the strategy development process, in order to incorporate all elements of C&I for SFM.

The results of our study indicate that management strategy MS II, which was proposed by the team of researchers, was found to be one
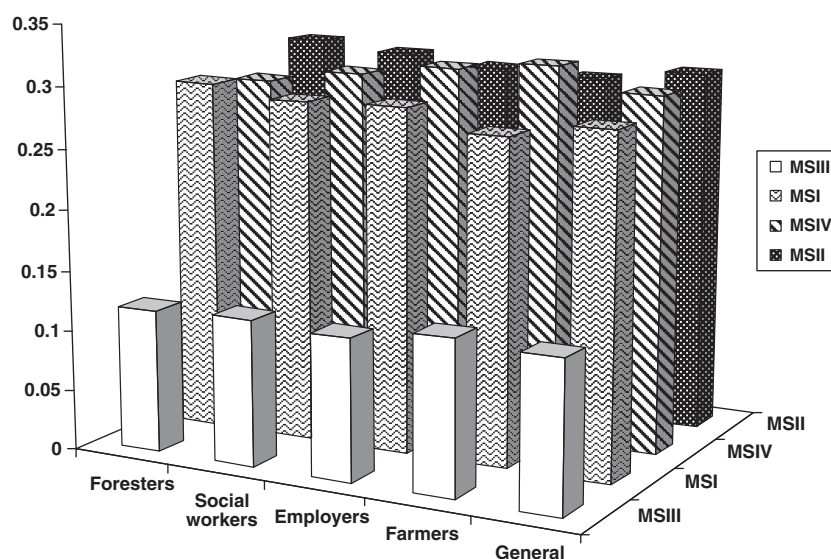
Fig. 3. Overall priorities of management strategies with regard to the socio-economic functions and conditions (criteria 6) based on the geometric mean of the synthesized judgment of all stakeholder groups.

of the best performing strategies for the sustainable management of the walnut-fruit forests. The strategy combines different forest management aspects in a holistic way and could improve the general situation for most of the criteria. For example, multi-purpose species plantation incentives at the household as well as *leshoz* levels, in combination with similarly-focussed strong partnership schemes between local people and foresters, will reduce the pressures on forest resources. In addition, economic incentives (such as the development of monitoring projects for certification of NTFP, improved access to the market and the creation of income generating projects) will help to improve the livelihoods of local people. Moreover, MS I, which, like MS II, reflects all principles of SFM, was ranked in second place. In this management strategy, elements of forest productivity and policy issues (such as forest tenure, monitoring etc.) were more strongly developed than in MS II.

6. Conclusion

As this is the first time that C&I for assessing SFM have been developed for the walnut-fruit forests of Kyrgyzstan, the set should be further improved. Due to a shortage of time for field work and limited access to reliable data resources, the study was limited to a certain extent. Detailed information about the forest ecosystems, as well as field testing in an increased number of *leshozes*, might be helpful in further assessments. Indeed, this study has been analyzed on the basis of the preferences stated by stakeholders from only four different *leshozes*. The performance of the management strategies might be different in other *leshozes* of the walnut-fruit forests, where conditions are slightly different and differing views of stakeholders might be present. Nevertheless, our study findings present some recommendations for future policy options: measures related to forest health, productivity and socio-economic functions of forests are the most important criteria on which to concentrate (especially NTFP development, which is the basic requirement for improving the livelihood of the people). More emphasis might be given to support a wider range of products not only from the forests, but also adjacent territories. Different income-generating activities and measures for adding value to forest resources by increasing access to markets could support the improvement of livelihood by reducing human pressure on forest biodiversity e.g. on the gene pool for the whole walnut fruit forests. Moreover, forest policy should take into account how the involvement of local stakeholders in the decision-making process (and their genuine participation in forest management) could be developed with the ultimate goal of stimulating the C&I development process in the walnut forests of Kyrgyzstan.

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