

## **A DECISION MAKING MODEL FOR COMPATIBLE MANAGEMENT OF FORESTER LOCAL COOPERATIVES IN THE NORTH OF IRAN**

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### **ABSTRACT**

The aim of current research is to determine effective criteria in management of forester local cooperatives and the best alternative to manage the cooperatives. The research has been done in northern forests of Iran to solve the local people's problem and answer their needs. Participation of the local people in order to better manage forester local cooperatives and receive some facilities from civil institutions will assist in solving most of the economic and social problems. Alternatives of the system are governmental management; management by elected agents of cooperatives; combinative model with attendance of the people and civil institutions; and collective management of the cooperatives according to all of the member's aspects. A hierarchy is used to prioritize benefits, opportunities, costs and risks (BOCR) using the Analytic Hierarchy Process (AHP) ratings approach. To evaluate the "control criteria" of the system, a control hierarchy is also created and prioritized by applying the Analytic Network Process (ANP). This way, a total of four major control criteria in the system are prioritized where each one controls a decision network evaluated using ANP. The final synthesis of the system shows collective management of the cooperatives according to all of the member's aspects has the highest priority.

Keywords: AHP, ANP, compatible management, foresters' cooperatives, sensitivity analysis.

### **1. Introduction**

Preservation and revival of natural resources area depends on human's behavior who are living or enjoy from benefits and positive effects of these area (Taleb, 1992). Foresters' cooperatives are not developed due to natural resources extension, problem statement, problem solving, drawing public participation, attaining spontaneous lasting development, and meeting the demands of foresters and local people. They are developed due to acute social-economic problems and destructions in northern forests of Iran by State Forests and Pastures Organization as an inevitable necessity and an initial strategy to draw forester's participation in destructed forests. This policy has somehow resulted in employment, improvement of

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incomes, poverty elimination and villager's immigration prevention. To be added, poorness of these forests is another cause leading to establishment of forester's cooperative in 1986. Due to non tendency of private section to primitive investment, cooperative system was elected as the best choice to manage of the forests inevitably, and enjoyed government supports until to reach independence. Since, generation of these cooperatives was not based on research and development thereby they did not obtain systematic organization and they have inductive system (Habibpour, 2001). If people cooperate with civil institutions in managing forester's cooperatives, noticeable positive outcomes can be expected. The main objective is to develop guidelines for strategic planning, based on the appropriate decisions made by adopting this approach. Development of reliable and stable cooperatives management needs long range planning; it is not wise to consider only short term planning which is mostly established on the basis of availability. In long range or strategic planning we need to consider various criteria influencing the decision. In current research we need to provide a pattern for suitable management of the cooperatives. Several desirable and undesirable indices should be taken into account for each decision. Many of the indices are definitive and some of them which are less important are probable. Definitively desirable indices are called benefits and definitively undesirable ones are called costs. On the other hand, probably desirable indices are called opportunities and probably undesirable ones are called risks. In this paper we apply AHP (Saaty, 1999) and ANP (Saaty, 2001) as the tools for selecting the best choice in field of cooperatives management in Iran. Of course there are many researches which have been used ANP as a proper decision making method in there. We indicate some of them. The aim of the paper is to present an influence of chosen factors, which results from initiating and certification of quality management systems, on costs, benefits, opportunities and risks in quality improvement of food products. The Analytic Network Process was applied allowing for complex formulation of a given problem. The choice of this the best alternative of improving the quality management was confirmed by two mathematical formulae: multiplicative and additive negative (Greda, 2008). Intangible assets effects are hard to be appropriately included during decision analysis. AHP/ANP methodology allows to address both tangible and intangible assets and actions effects uniformly (Dvtzak and Ginda, 2008). The research proposes a model for the selection of countries to export products taking under consideration that the globalization had influenced the growing interest in expanding companies to foreign markets. The model was build in order to support small and medium size companies' producers of goods in their internationalization process using the Analytic Network Process approach (Lesmes and Castillo, 2008). Selecting the best options for the supply of raw material to feed paper producing plants is goal of the research. The decision-making is examined within the framework of benefits, opportunities, costs, and risks (BOCR); using the Analytic Hierarchy Process (AHP) ratings approach. The final synthesis of the system shows external procurement is the best choice (Azizi and Modarres, 2008).

## **2. The analytic network process (ANP)**

The Analytic Network Process (ANP), a generalization of the Analytic Hierarchy process (AHP) method for multi criteria decision making, provides an even broader framework for decision making in complicated environments. The advantage of this new theory over the AHP (Analytic Hierarchy Process) is its ability to extend to cases of dependence and feedback and generalization of the super-matrix approach. It allows interactions and feedback within clusters (inner dependence) and between clusters (outer dependence). Feedback can better capture the complex effects of interplay in human society. The ANP provides a thorough framework to include clusters of elements connected in any desired way to investigate the process of deriving ratio scales priorities form the distribution of influence among elements and among clusters. The ANP is a coupling of two parts. The first consist of a control hierarchy or network of criteria and sub-criteria that control the interactions in the system under study. The second is a network of influences among the elements and clusters. The network varies from criterion to criterion and a super-matrix of limiting influence is computed for each control criterion. Finally, each of these super-matrices is weighted by the priority of its control criterion and the results are synthesized through addition for all the control criteria. A problem is often studied through a control hierarchy or system of benefits, a second for costs, a third for opportunities, and a fourth for risks. The synthesized result of the four control

systems are combined by taking the quotient of the benefits times the opportunities to the costs times the risks to determine the best outcome. Other formulas may be employed at times to combine results.

The following are some of features of the ANP that distinguish from the AHP (Saaty, 2001):

Rather than a hierarchy, the basic structure of a network consists of clusters and nodes and logical connections between them. The judgment process is carried out by creating matrices of pair wise comparison judgments for nodes in a cluster linked to the same parent node.

Sub-networks can be created for and attached to nodes in a network, and they sub networks have the same structure as any network. There can be many layers of sub-networks. The sub networks at the bottom contain the alternatives of the decision.

Super matrices are created in the sub-networks and the results integrated with the higher levels of networks.

### **3. The ANP model**

The ANP model is developed to plan the compatible management of forester local cooperative in the north of Iran. The alternatives are evaluated by merits of benefits, costs, opportunities and risks (BOCR). We design a three level network representing this problem. The top level consists of a control sub model with four nodes, benefits, costs, opportunities, and risks.

#### **3.1 The Alternative**

There are four alternatives as potential management for forester local cooperative in north of Iran, collective management under supervision of all members, hybrid management model including people and civil institution, management by cooperative's elected representative and governmental management.

#### **3.2 Overall Factors**

In this research the merits of benefits, costs, opportunities, and risks are influenced by following overall factors:

- Social and cultural: included two sub-criteria: Level of scholarship and public culture; population growth.
- Economical: included three sub-criteria: yield rate of investment; increased value and fruition; effectiveness.
- Technical and exploitation: included three-sub criteria: amount of mass; amount of harvest; protection and reconstruction.
- Governmental laws: included two sub-criteria: governmental management; executive politics.

#### **3.3 Prioritizing BOCR**

Since benefits, opportunities, costs and risks have not equally important rate, it is necessary to prioritize them. To do that, they are rated with the lowest level of each criterion of the hierarchy and then summing up. Five possible rating from very high to very low be used.

#### **3.4 BOCR Merits**

In macro-decision making selecting the most appropriate site for the best management of local cooperative, the best approach is to divide the criteria into favorable and unfavorable categories. The decision maker considers the favorable criteria as benefits and the unfavorable criteria as costs. The possible events are also divided into opportunities and risks criteria, depending whether they are considered to be positive or negative (Saaty, 2001).

Following the concept of BOCR merits, decisions are most generally approached by breaking them up to merits: benefits, costs, opportunities, and risks. For each merit a sub-network is created with control criteria, and for these control criteria in turn decision sub-networks are designed. From the point of view of costs and risks, two alternatives are compared by asking which one is more costly or more risky. The reciprocals of the result are also in synthesizing the result for the final answer. Four hierarchies for the merits of benefits, costs, opportunities, and risks are introduced. We described in more details each hierarchy which is included objectives (benefits, costs, opportunities, and risks) and related sub-criteria.

### ● **Benefits to forester local cooperatives**

1. Boosting local economic Statue: It seems that executing various forestry projects and diversifying cooperatives' activities, improvement of farming methods and traditional animal husbandry and also starting modern activities, businesses and careers lead to improvement of families' income level and life statue and decrease of local unemployment rate. This index is divided into three sub indices: poverty elimination, improvement of local people's income, and employment.

2. Natural resources extension: Foreseers' cooperatives project is proposed as a pattern to extend and promote natural resources. This issue may appear as forest preservation, forest poverty elimination; cattle exit organization and reformation of forest exploitation methods.

3. Drawing public participation: Cooperatives' activities have promoted collective work; align the old demands of foresters and foster authorities' inclination to utilize public force in natural resources management. This index is divided into 3 sub-indices: observing typical social rights of the locality, linkage of executive perspectives, traditional and living expectations, and boosting cultural statue of the locality.

### ● **Opportunities to forester local cooperatives**

Social statue improvement: This is attained through some sub-indices: executing of civil projects, prevention of villagers' immigration, accumulation of diffuse villages, and instruction of skilled by the cooperatives.

Drawing initial and infrastructural investment: Since the income level of foresters is low, infrastructural investment of the localities are limited or lacking. This is an effective factor in management method. The cooperatives can draw capital through an optimal managerial method covering such indices as road construction, forestation, and forests revitalization and reconstruction.

Support from supporting organization: The cooperatives can support some of trade unions in order to fulfill their duties well and to play active roles in improving local statue.

Attaining suitable mechanization level at revitalization, maintenance and exploitation of the forests: Ineffective relations among the cooperatives of a locality in technical and executive terms and exploitation of machinery have caused 80% of the cooperatives' wood harvested to firewood. By employing optimal management and reciprocal relations with other cooperatives in the localities, the cooperatives not only can decrease the percentage, but also can establish small industries to convert wood to more valuable products.

### ● **Costs to forester local cooperatives**

1. Lack of cooperation and relation with other sections and organizations: Lack of suitable and reciprocal relationship among different organizations and institutions and cooperatives in terms of the responsibilities and duties granted by the organization and institutions to the cooperatives can cause various problems.

2. Difficulty of coordinated operation of cooperatives: This index can be studied through three sub-indices: difference level in managers' specialty and members' specialty, weak participation of managers and members in cooperative administration, and heterogeneity of cooperatives' members.

3. Delay or error in respective programs: If the cooperative lacks a well-contemplated plan when commencing performance or the managing director is not familiar with work environment or the members are unaware of modern conditions, execution of the respective programs will face delay or error.

● **Risks to forester local cooperatives**

1. Non absorption of competent and skillful manpower: Due to employing local people, arbitrary employment of special people by cooperatives' management, and also racial tendencies, cooperatives are deprived of competent local forces.

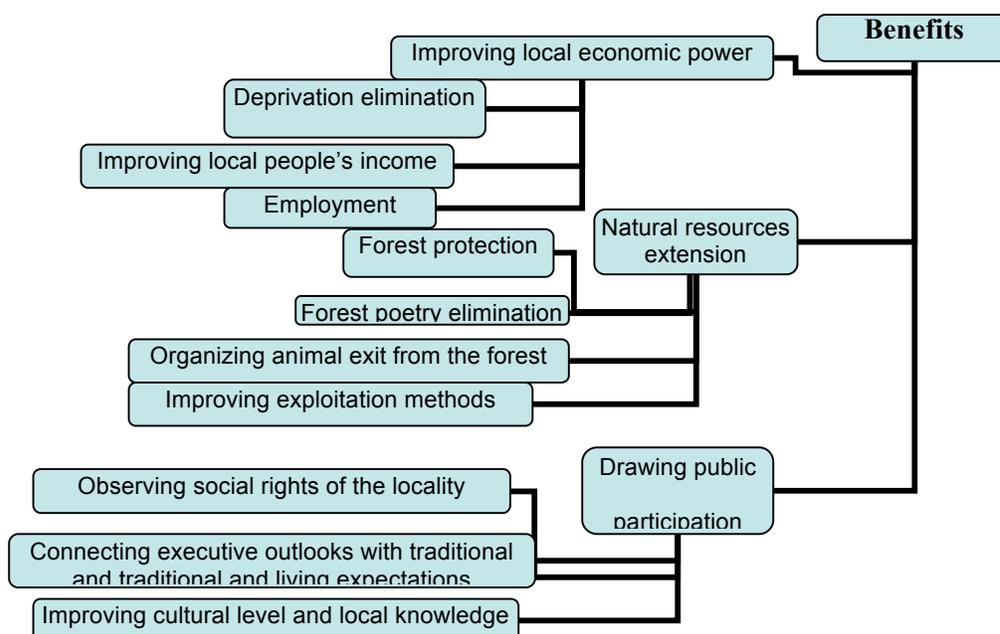
2. Extended destruction of natural resources: Unsystematic and mal-systematic management can facilitate destruction of natural resources.

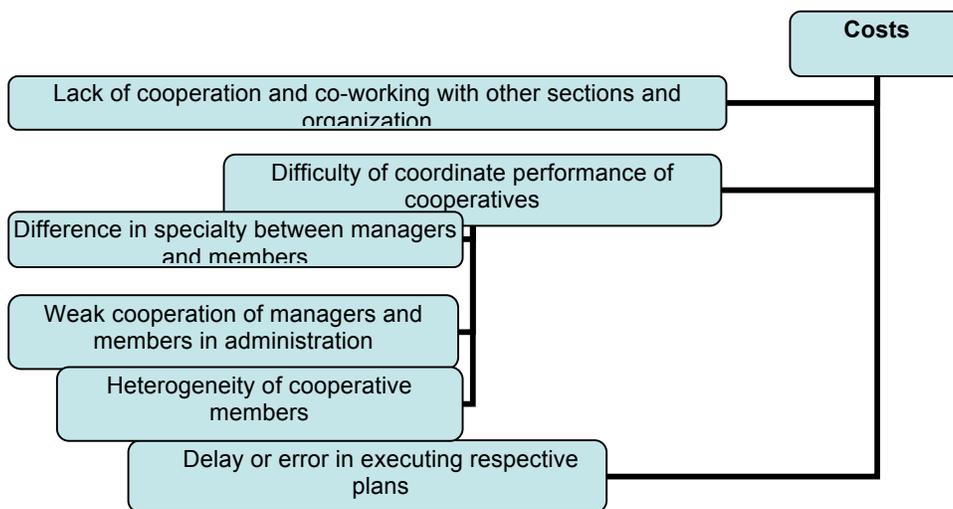
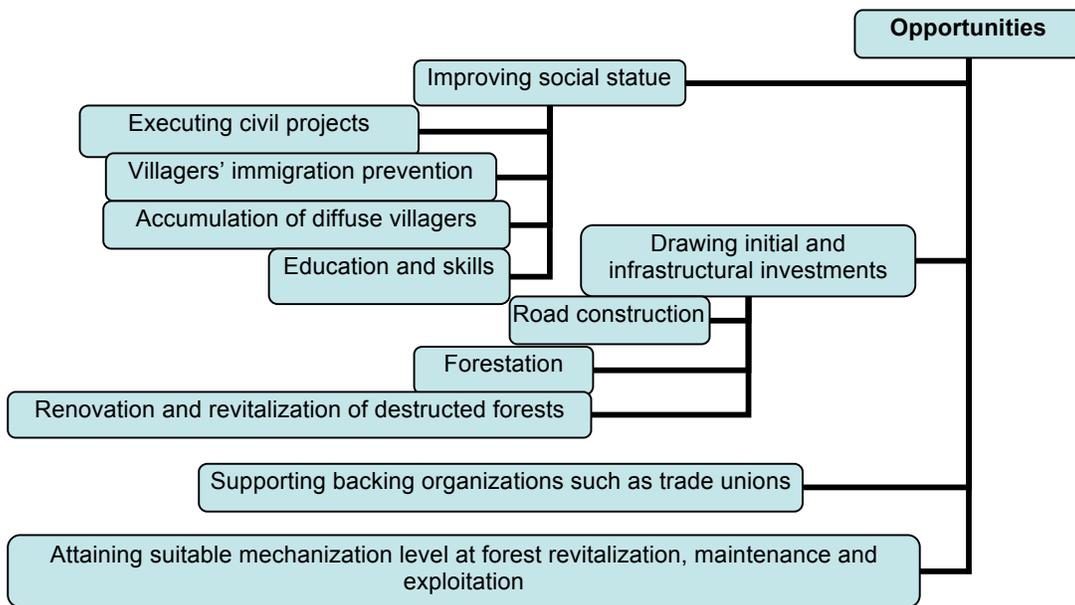
3. Conflict between national benefits and foresters' benefits: Natural resources plans have a look on national and long-term objectives. These plans can be in conflict with private benefits of foresters, farmers, stock keepers and other villagers who subsist on the forest. Sub-indices are removing job opportunities of foresters and incapability of cooperatives in fulfilling their objectives.

4. Local social stress: Lack of due attention to ethnic composition of a village and the effect of ethnic and tribal group on subjects like election, civil projects, etc. can lead to stress. This index can be divided into 3 sub-indices: deepening of class's difference in rural societies, lack of attention to various racial composition, and conflict among villages covered by cooperatives.

5. Not exploiting from other existing talents and potentials: This index has two components: specialty & skill and facilities.

Hierarchies of the above indices are as follows (Figure 1):





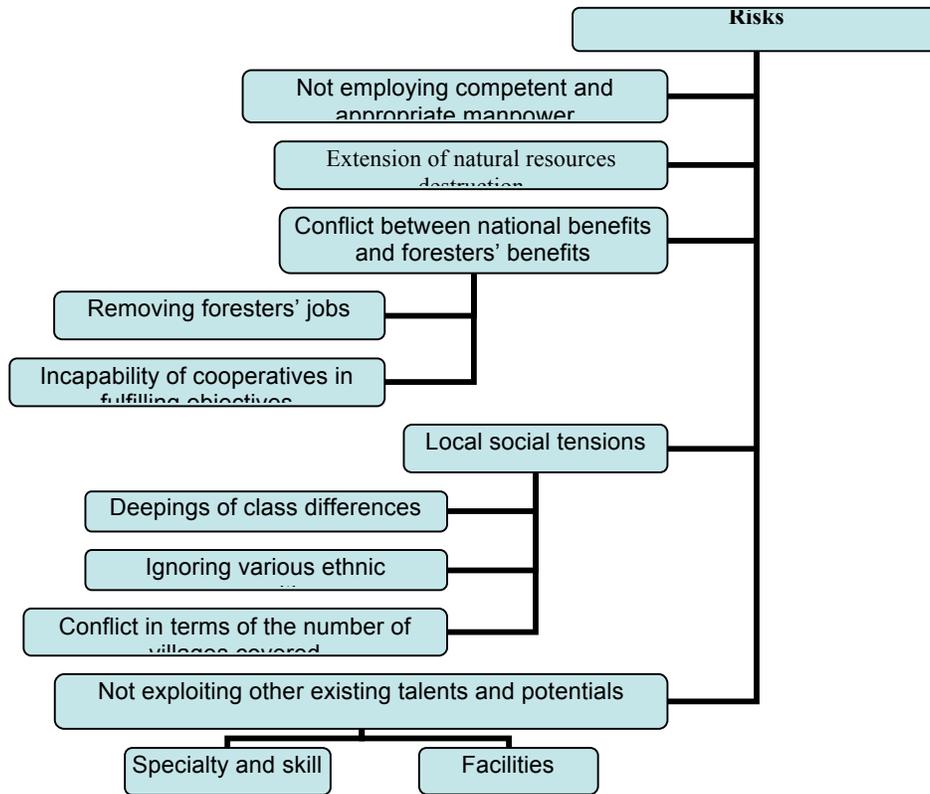


Figure 1: Hierarchy of the merits with their sub criteria

#### 4. Theoretical Fundamentals

First of all, the alternatives were studied in terms of activity and administration of foresters' cooperative, public participation rate in cooperatives administration, relationship between civil institution and cooperatives and the effective sub-indices on cooperative administration in the form of BOCR. Based on study, a questionnaire was devised and sent to localities. On the other hand, other effective overall factors on BOCR were identified by interviewing experts and their weighing values were determined using AHP. Then with influencing of overall factors on BOCR, weighing values of BOCR were calculated by rating. In BOCR structure, the following formula was used for calculation (Saaty, 2001).

$$SP(\text{benefits}) * \{\text{benefits}\} + SP(\text{costs}) * \{\text{costs}^{-1}\} + SP(\text{opportunities}) * \{\text{opportunities}\} + SP(\text{risks}) * \{\text{risks}^{-1}\}$$

Candidate items for optimal management of foresters' cooperatives were devised in BOCR structure and a separate questionnaire was devised and distributed. Finally the replies were analyzed with ANP method and Super Decision Software and the most suitable choice was determined. In the end, in order to test reliability, sensitivity analysis test was performed.

#### 5. Results

Weighting values of the merits, the alternatives ranking, sensitivity analysis and final outcome are put forward here as results of AHP and ANP with the aid of Expert Choice software 2000 and Super Decision software.

The result of the influence of the overall factors on merits of benefits, costs, opportunities, risks and the priority of the above mentioned merits are reported in table 1.

Table1. Overall factor and priority rating for the merits

very high 1 (.900)	high 2 (.700)	medium 3 (.500)	low 4 (.300)	very low 5 (.100)
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Distributive mode		RATINGS		
Alternative	Total	I Social and cultural Level of scholarship and public culture [L: .500 G: .203]	I Social and cultural population growth [L: .500 G: .203]	I Economical yield rate of investme [L: .333 G: .069]
<input checked="" type="checkbox"/> benefits	.327	very high	very high	high
<input checked="" type="checkbox"/> opportunities	.302	very high	high	very high
<input checked="" type="checkbox"/> costs	.127	medium	very low	very low
<input checked="" type="checkbox"/> risks	.244	very high	high	medium

very high 1 (.900)	high 2 (.700)	medium 3 (.500)	low 4 (.300)	very low 5 (.100)
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Distributive mode		RATINGS		
Alternative	Total	I Economical increased value and fruition [L: .333 G: .069]	I Economical effectiveness [L: .333 G: .069]	I Technical and exploitation [ amount of mass [L: .333 G: .049]
<input checked="" type="checkbox"/> benefits	.327	medium	high	medium
<input checked="" type="checkbox"/> opportunities	.302	medium	medium	high
<input checked="" type="checkbox"/> costs	.127	very low	very low	very low
<input checked="" type="checkbox"/> risks	.244	low	medium	low

very high 1 (.900)	high 2 (.700)	medium 3 (.500)	low 4 (.300)	very low 5 (.100)
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Distributive mode		RATINGS		
Alternative	Total	I Technical and exploitation [ amount of harvest [L: .333 G: .049]	I Technical and exploitation [ forests revitalization [L: .333 G: .049]	I Governmental laws executive politics [L: .500 G: .119]
<input checked="" type="checkbox"/> benefits	.327	medium	medium	high
<input checked="" type="checkbox"/> opportunities	.302	high	medium	medium
<input checked="" type="checkbox"/> costs	.127	very low	very low	high
<input checked="" type="checkbox"/> risks	.244	low	medium	low

very high 1 (.900)	high 2 (.700)	medium 3 (.500)	low 4 (.300)	very low 5 (.100)
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Distributive mode		RATINGS		
Alternative	Total	I Technical and exploitation [ forests revitalization [L: .333 G: .049]	I Governmental laws executive politics [L: .500 G: .119]	I Governmental laws executive politics [L: .500 G: .119]
<input checked="" type="checkbox"/> benefits	.327	medium	high	very high
<input checked="" type="checkbox"/> opportunities	.302	medium	medium	high
<input checked="" type="checkbox"/> costs	.127	very low	high	high
<input checked="" type="checkbox"/> risks	.244	medium	low	high

In table 2, the alternatives are ranked with respect to benefits, opportunities, costs and risks.

Table2. The alternatives ranking with respect to BOCR

Governmental management	Total priority	Ranking
Benefit	0.0438	4
Costs	0.0687	4
Opportunities	0.0742	3
Risks	0.0597	4
Collective management	Total priority	Ranking
Benefit	0.01411	1
Costs	0.01501	1
Opportunities	0.01222	1
Risks	0.01546	1
Management by cooperatives elected representatives	Total priority	Ranking
Benefit	0.0570	3
Costs	0.0964	3
Opportunities	0.0719	4
Risks	0.0914	3
Hybrid management	Total priority	Ranking
Benefit	0.0914	2
Costs	0.01223	2
Opportunities	0.01017	2
Risks	0.01065	2

To achieve stability and compatibility of the analysis, we apply sensitivity analysis. The results are shown in table 3.

Table3. Sensitivity analysis of BOCR sub criteria (Basic ranking: A-B-C-D)

BOCR sub criteria		Base weight	Changed weight	Number of Alternative's changes	Total changes	New priority of the alternatives
B	Improving local economic power	0.513	-	0	-	No change
	Natural resources extension	0.318	0.883	1	1	B-A-C-D
	Drawing public participation	0.168	-	0	-	No change
					1	

Continued of Table 3

BOCR sub criteria		Base weight	Change d weight	Number of Alternative's changes	Total changes	New priority of the alternatives
C	Lack of cooperation and co-working with other section...	0.461	-	0	-	No change
	Difficulty of coordinate performance of cooperatives	0.286	-	0	-	No change
	Delay or error in executing respective plans	0.254	-	0	-	No change
					0	
O	Improving social status	0.407	0.477	1	1	A-B-D-C
	Drawing initial and infrastructural investment	0.295	-	0	-	No change
	Supporting backing organization...	0.163	0.08	1	2	A-B-D-C
			0.844	1		A-C-B-D
	Attaining suitable mechanization level at...	0.134	0.044	1	2	A-B-D-C
			0.764	1		A-C-B-D
				5		
R	Not employing competent and appropriate manpower	0.37	-	0	-	No change
	Extension of natural resources destruction	0.204	0.472	1	2	A-C-B-D
			0.741	1		A-C-D-B
	Conflict between national benefits...	0.172	-	0	-	No change
	Local social tensions	0.137	-	0	-	No change
	Not exploiting other existing talents and potentials	0.117	-	0	-	No change
				2		

Description of the alternatives: A: Collective management under supervision of all members, B: Hybrid management model including people and civil institution, C: Management by cooperative's elected representative, D: Governmental management.

## 6. Discussion and Conclusion

Table 1 shows overall factors' effects on BOCR merits. Effects of overall factors on benefits are more than other merits. Among overall factors effective on merits, "Social and cultural" factor has more importance because this factor has more weight and it's more effective on benefits. In this factor two sub-indexes are the same in importance and effectiveness. After that, in comparison with other factors, "governmental laws" and its sub-index have more importance. After "Social and cultural" factor, this factor is more effective on merits.

With respect to benefits, "deprivation elimination" sub-criteria (weight of 0.3) have more effects on benefits. In facts, in comparison with other sub-criteria, change of this one leads to more change in benefits. After this sub-criteria, the most effective sub-criteria orders in this form: "forest protection" sub-criteria (weight of 0.123), "forest poetry elimination" sub-criteria (weight of 0.118) and "improving local people's income level" sub-criteria (weight of 0.115). With respect to costs, the most important effective sub-criteria are "lack of cooperation and co-working with other section and organizations" (weight of 0.461). The second one, with weight of 0.254, is "delay or error in executing respective plans" sub-criteria. "Difference in specialty between manager and members" sub-criteria with weight of 0.168 has third place of importance. With respect to opportunities, we can see this order in sub-criteria's effectiveness: 1. "executing civil projects" sub-criteria (weight of 0.204). 2. "Supporting backing organization such as trade unions" sub-criteria (weight of 0.163). 3. "Attaining suitable mechanization level at forest revitalization, maintenance and exploitation" sub-criteria (weight of 0.134) and the last one "road construction" sub-criteria (weight of 0.121). The most effective sub-criteria in Risks are "not employing competent and appropriate manpower" sub-criteria (weight of 0.37). After that, "extension of natural resources destruction" sub-criteria (weight of 0.204) have more effect on risks. The third one is "removing forester's jobs" sub-criteria with weight of 0.129 and "specialty and skill" sub-criteria (weight of 0.101) are the last one. Regarding the experts' opinion, compared with each other, "collective management item under the supervision of all the members" proves to be the most fruitful item with respect to benefits. Items "hybrid management model including people and civil institution", "management by cooperatives' elected representatives" and "governmental management" are less fruitful as reported in table 2 respectively. As table 2 shows, In terms of items' effect with respect to opportunities indexes, the experts believed that "collective management under the supervision of all the members" alternative has higher priority in comparison with other alternatives. Then, item "hybrid management model including people and civil institution", "governmental management" and "management by cooperatives' elected representatives" follow the preferred item. According to experts' comments, priority of items in terms of costs indexes are as follows: "collective management under the supervision of all the members", "hybrid management model including people and civil institution", "management by cooperatives' elected representatives" and "governmental management" are reported in table 2.

As shown in table 2, In terms of risks index, the priority is as follows: "collective management under the supervision of all the members", "hybrid management model including people and civil institution", "management by cooperatives' elected representatives" and "governmental management".

To achieve stability and compatibility of the analysis, we apply sensitivity analysis. In all cases is possible sensitivity analysis for sub-indexes and indexes. Change of more sensitive index leads to change in priorities of alternatives. Basic ranking which have obtained from current research is A-B-C-D. With respect to sensitivity analysis of Benefits, weight change of "natural resources extension" index (from 0.318 to 0.883) leads to change of priorities in this form: B-A-C-D. It means that with weight increase of this index, first priority becomes instilled the second one. So in comparison to other indexes, this one has more sensitiveness. With respect to costs, by increasing or decreasing of the weight, we will find that the ratios of our priorities don't change meaning cost's index aren't sensitive and don't change the priorities. We can find the most sensitive indexes in opportunities. "Supporting backing organizations such as trade

unions” index leads to twice change in the priorities. In the first change, with weight decrease of this index (from 0.16 to 0.08) the priorities changes to A-B-D-C and in the second time, with weight increase (from 0.163 to 0.844) the priorities change in this form: A-C-B-D. Weight change of “attaining suitable mechanization level at forest revitalization, maintenance and exploitation” index also results in twice changes in the priorities. At first, with weight decrease (from 0.134 to 0.044) the priorities changes to: A-B-D-C and with weight increase of this index (from 0.134 to 0.764) the priorities would have this form: A-C-B-D. So opportunities' indexes are more sensitive having more effect on the priorities. The changes of these indexes give rise to five changes in the priorities. With respect to Risks, with weight increase ”extension of natural resources destruction” index (from 0.204 to 0.472) the priorities would be A-C-B-D and more increase its weight (from 0.204 to 0.741) our priorities changes in this form: A-C-D-B. Accordingly opportunities and risks merits have more sensitive, and ranking of the alternatives is more sensitive with regard to these merits and their sub criteria changes. These results are reported in table 3.

Finally, according to the final report of Super Decision Software as shown in table 4, after overall analysis and assessing weights, the item of “collective management under the supervision of all the members” has the first priority. “Hybrid management model including people and civil institution”, “management by cooperatives' elected representatives” and “governmental management” follow the first item. Collective management under the supervision of all the members secures the first priority with respect to benefits, opportunities, costs and risks. In this term, cooperatives are managed by their members who are mostly local people. This model of management yields the highest profit and results in the lowest cost. To be added, this item enjoys the most desirable and probable indices (opportunities) and the least undesirable and probable indices (risks). Villagers' confidence in members of the cooperative who are mostly indigenous is an effective factor in the success of this model of management. This managerial structure can be generalized to other similar institutions and can be used as a pattern for attaining a desirable management in deferent structures.

Table 4. Final outcome

Alternatives	Total	Normal	Ideal	Ranking
Governmental management	0.0597	0.1448	0.3860	4
Collective management	0.1546	0.3752	1.0000	1
Management by cooperatives elected representatives	0.0914	0.2217	0.5910	3
Hybrid management	0.1065	0.2583	0.6886	2

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