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Fuzzy Analytic Hierarchy Process (FAHP) applied to evaluating the forest management approaches

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Abstract: The study mainly aims at looking into the disparities in beneficiary's socio-economic status between the areas without implementation of forestry plans and the areas where forestry plans had initially been available even though they have recently been terminated as well. Babol Roud forestry plan is located in Lafoor forest area in the Babol County, the Mazandaran Province, Northeast Iran. This research was divided into three steps: first of all, by making use of Cochran's formula, we identified the number of participants. Later on, the Delphi method was employed in order to determine criteria and subcriteria through the questionnaires. From then on, Fuzzy Analytic Hierarchy Process (FAHP) was used to quantify the criteria that were weighted by experts' viewpoints through the planned questionnaires. By adopting the Fuzzy Forests method, we found out that the economic, environmental, social and managerial criteria are most prominent. Forestry project staff's income was in the highest relative weight (0.23) based on participant's viewpoint. Most of the participants in the study did not give their consent to the forestry plan suspension due to the inevitably forthcoming economic and environmental problems ahead. Instead, they strongly underlined the need to go into immediate action such as revising the former plans as well as constant stream of close attention to the plan execution details of the ongoing process. Eventually, developing a new policy and using alternative forest management strategies that would meet the needs of all various stakeholders have been recommended.

Keywords: criteria; Delphi method; forestry plan; questionnaires

Throughout the history of forest management development, the forestry plan has been thought of as a key component to obtain forest management objects (Kangas et al. 2006; Linser et al. 2018). The first serious discussion and analyses of forestry plans emerged during the 1960s with the nationalization of forests and rangelands in Iran (Sotoudeh Foumani et al. 2017). In the light of this event and regarding the fact that forest ecosystems require preferential treatment the forestry plan has been used to manage and harvest forests in some specific parts of Hyrcanian industrial forests in the north of Iran (Goméz et al. 2006). Consequently, they recently were recklessly abandoned by related state authorities where there is no longer production function in such ecosystems.

The instructions of forestry plan involve silvicultural, forest harvesting and forest protection activities (Stirn 2006). The forestry plan is strongly influenced by both forestry project staff and beneficiaries in the forest area (Parrotta et al. 2016). While the primary aim of the forestry project staff

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appears to derive much benefit from wood industrial utilization, the resources meanwhile are favourable for the beneficiaries (forest dwellers and local communities) who were traditionally using forest resources in order to meet their living needs (Chukwuone et al. 2020).

Despite the undeniable numerous gains, forestry plans, in recent years, have brought many concerns to many conservationists who put forward oppositions on the ground that these plans have served the least interests of forest ecosystem and should not be allowed carrying out any longer (Mostafa et al. 2020). This group argues that industrial utilization of Hyrcanian forests has hopelessly been inadequate and often inaccurate in many areas in order to meet the sustainable management goal. Whilst all this was going on, environmentalist groups set out to hoping that they can preserve the area's outstanding natural beauty and also cater for the ecosystem services. Hence, they firmly believe in a complete cessation of forest exploitation intended for forest restoration with leaving a chance of compensating the past damage (Shirzadi Laskookalayeh et al. 2021). On the contrary, the forestry plan advocates believe that the benefits of the plans far outweigh the drawbacks. These benefits are manifold. First of all, it is an indisputable fact that the responsible forest utilization simply needs to be so imperative that planners should consider it to meet today's and tomorrow's needs of all groups. Additionally, it could enhance its quantitative and qualitative status over time including the stand diversity maintenance and its sustainability. Equally importantly, the implementation of the instructions not only prevents the forestlands from land use change, but also can deter them from severe depletion. The interest of the group partially collides with that of another one. Those contradictory views and disagreements on the overall effect of forest plans have grown in importance in recent years, which ultimately resulted in bringing thoroughly to a halt both executing the forestry plans and forest utilization for the period from 2015 to just now. As a consequence, currently, the ceased forest plan has been considered as a new approach of Iran's forest management. It matters a great deal to be taken into forest experts' hands and should be discussed as a matter of great urgency. In the study we tried to draw on one Fuzzy Analytic Hierarchy Process (FAHP) which has recently been a kind of immensely popular method in doing forest management studies. Some other methods that have recently been carried out in forest management studies include Least Cost Path (LCP) algorithm in a Geographic Information Systems (GIS) environment (Liang et al. 2018; Peng et al. 2018), Fuzzy AHP (Li et al. 2009; Salehnasab et al. 2016; Dos Santos et al. 2020), Delphi method (Filyushkina et al. 2018), SWOT analysis (Mostafa et al. 2020).

The Fuzzy AHP method is based on the fuzzy set theory which was advanced by Zadeh (1965). The assumption made in a Fuzzy AHP process is that all the involved criteria are independent of each other. Careful attention, the relationship among criteria is usually complex in practice and there might be interdependencies.

In order to control the quality, relevant element and method are needed (Tu, Hu 2015), as a fuzzy model can be applied to various subjects (Shaverdi et al. 2014). FAHP is considered as an appropriate referable model for decision makers (Chiu et al. 2014). This method could be applicable as a control tool for the quality aims and valuable for multicriteria decision-making problems (Wang et al. 2007).

The Fuzzy Analytic Hierarchy Process is making use of various fascinating subjects of knowledge with acceptable results. For example, in order to estimate the optimum stock level in forest (Etemad et al. 2019), determination of forest fire risks (Güngöroğlu 2017), evaluating the biodiversity conservation (Mendoza, Prabhu 2001), identifying the dynamic sustainable management index in agriculture (Lin 2020). To date, a considerable body of research has applied Fuzzy Analytic Hierarchy Process (FAHP) to investigate forest management approaches (Stirn 2006; Kangas 2008; Li et al. 2020) among the other ones which were common in forest management studies such as variable retention systems of forest management (Nocentini et al.2017; Ezquerro et al. 2019), close-to-nature silviculture (Schütz et la. 2016), systemic silviculture (Corona, Scotti 2011) and ecosystem management (Grumbine 1994).

Following the new approach in Hyracanian forest management, different debates have been raised among forest researchers, experts and managers regarding the ecological, technical and social-ecological effects of the current forest administration. Although all of the range of items seem to be critical in order of importance in sustainable forestry, considerable controversy has grown in terms of forest management policy between forest ecosystem conservationist who deeply hold utilization stop-

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page beliefs and the idea opposing fans in society. However, there has been paid little attention to the consequence of ceasing the forest utilization for its dependent society and no alternative approach has already been put forward on their behalf.

Regarding the socio-economic effects of ceasing the forest utilization in Iran, in this regard there have not been any noticeable investigations so far, and we hope to reach our more sufficient results via more research implications on the new managerial approach in the following several years.

The Lafoor forest area in Babol County in the north of Iran is one of the few areas that have, at the same time, both regions with and without forestry plan, so it has been selected for this research. Therefore, current research is one of the first attempts to highlight the impact of both attitudes on local communities and other forest product and service users. In the first place, the study was initiated with an investigation of the adoption of FAHP technique which could be applied to looking closely at socio-economic issues. Accordingly, the immediate aim is to look into the differences in beneficiary's socio-economic status between the areas with the total lack of forestry plans and the areas where forestry plans had generally been available, even though they have recently been terminated as well.

MATERIAL AND METHODS

Study area. The study was performed in the Lafoor forest area with an estimated area of 8 477 ha in northeastern Iran (from 36°14'11'' to 36°22'21''N and from 52°41'34'' to 50°50'45''E) (Figure 1). From 1996 to 2015, 4 934 ha of the forest were managed as Babol Roud forestry plan as well as 3 543 ha where there is a lack of forestry plans. The forest stand is dominated by *Querceto-Carpinetum betuli* (up to 40%), and *Parrottia-Carpinetum* (up to 30%) in the managed area and *Parrotia persica* (up to 50%), *Gleditsia caspica* (up to 20%) in the unmanaged area. Other major species include: hornbeam (*Carpinus betulus* L.), oak (*Quercus castaneifolia* C.A.M), *Parrotia persica* (DC) C.A.M, *Gleditsia caspica* Desf., *Diospyros lotus* L., beech (*Fagus orientalis* Lipsky), maple (*Acer* spp.), alder (*Alnus glutinsa* L. Gaertn). Most forest tree stands are natural. The elevation ranges from 100 m a.s.l. to 910 m a.s.l. and annual average precipitation and temperature are 829 mm and 17 °C, respectively. There are seven villages with a population of 3 500 inhabitants in the study area and at its edge.

Methodology. The research was divided into three steps. Step 1: to determine the participant number using Cochran's formula. Step 2: the Delphi method was employed to determine criteria and subcriteria through the questionnaires. Step 3: FAHP was used to quantify the criteria weighted by an expert via the questionnaires that had already been prepared in step 2.

Managerial criteria: Managerial criteria include manners, policies, functions of manager and forest management's decision makers that are designed and move forward based on the out-of-forest environment (macro laws and policies).

Social criteria: Livelihood status and function of the population who live in the reference forest area impact on the forest management method.

Economic criteria: Forest economic criteria are needed to be given serious consideration to achieve the sustainable development objects as it could lead to forest resource conservation as well as ensuring the beneficiaries' livelihood.

Cochran's formula

Cochran's formula was used to determine the number of participants. Cochran's equation could be written as follows [Equation (1)]:

$$n_0 = \frac{z^2 \times p \times q}{e^2} \quad (1)$$

where:

n_0 – sample size;

z – selected critical value of desired confidence level;

p – estimated proportion of an attribute which is presented in the population;

q – $1 - p$.

Therefore, participants were chosen based on the central tendency of the geometric mean index [Equation (2)].

$$n_0 = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \quad (2)$$

where:

n, N – respective sample population sizes.

A special mention is that in main statistical methods, which have already been used in the Delphi method, the three most common central tendency measures are mean, median, and mode as well as the dispersion measures that involve

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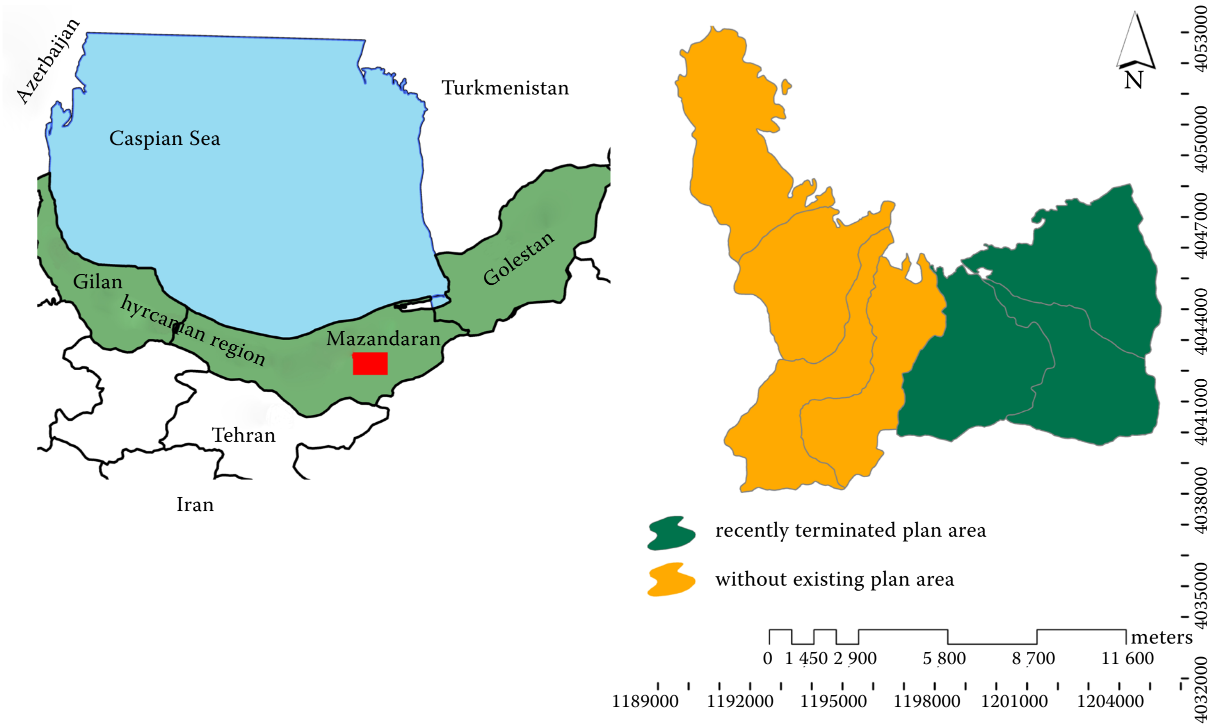

Figure 1. Map of the study area

standard deviation and interquartile range (Hasson et al. 2000), applying median and mode though more common, the mean is utilizable. The next step in the process was combination and analysis of expert's opinions which were performed using SPSS (Version 26.0.0.1, 2018).

Delphi method

An approach of expert deduction techniques is often linked with an extensive range of benefits such as capability to effort with a great degree of uncertainty and far too little data (Martini et al. 2012).

They are always pertinent to subjects when generalization is required whilst still being able to understand the systems growing complexity (Keeney et al. 2011; Waldron et al. 2016).

The Delphi method is a multi-decision structured group relationship approach that acquires a group expert viewpoint on the determined question(s) or problem(s), and subsequently makes an agreement through faceless deliberations attainable in the case (Filyushkina et al. 2018). In the current research, the Delphi technique was applied to determine important and effective socio- economic criteria that are significant in a forest management approach. To start, the participants were asked to individually and anonymously complete the questionnaires. Then, all answers were analyzed within a panel and improved. We kept sending the questionnaires in four stages until the constant level in responses was obtained.

Fuzzy-AHP method

The FAHP was developed from the combination of Analytic Hierarchy Process (AHP) and fuzzy (Tiryaki, Ahlatcioglu 2009). Most of the multi-criteria decision-making challenges are efficiently solved via FAHP (Lin 2020). After designing the questionnaires based on the Delphi method, the FAHP structure was organized (Figure 2) and conducted in three steps.

Step 1: Sending the questionnaires. Samples consisted of at least 32 participants (experts) rooted in Cochran's formula. Therefore, participants were divided into two groups that included agreement and disagreement ones depending on their notion with regard to forestry plan performance. All 42 individuals who were chosen for the investigation were asked by sending emails. The questions were answered on behalf of 36 participants. The finest answers were 32 ones in terms of the consistency ratio of criteria and drew on the information in the related analysis.

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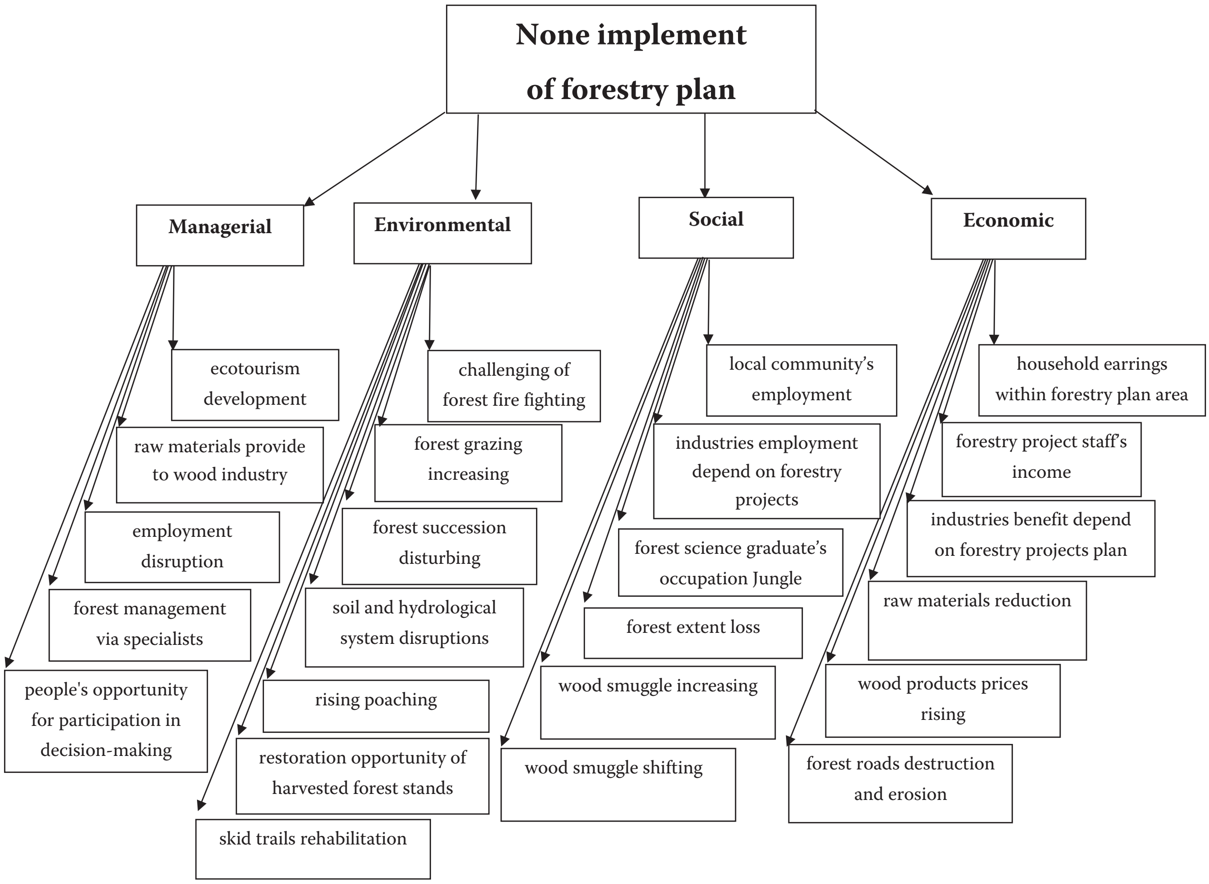

Figure 2. Applied criteria and sub criteria in Fuzzy Analytic Hierarchy Process (FAHP)

Step 2: Assessing the questionnaire reliability. The questionnaire reliability was put a figure on using the pre-testing method. The scores of pairwise comparisons were collected and applied to form pairwise comparison matrices for each decision maker (Saaty 1980) [Equation (3)]:

$$R \times W = \lambda_{max} \times W \quad (3)$$

where:

W – eigenvector, the weight vector, of matrix R;

λ_{max} – largest eigenvalue of R.

The consistency property of the matrix is then checked to ensure the consistency of judgments in the pairwise comparison. The consistency index (CI) and consistency ratio (CR) are defined as follows (Saaty 1980) [Equations (4, 5)]:

$$CI = \frac{\lambda_{max} - 1}{n - 1} \quad (4)$$

where:

CI – consistency index,

n – number of criteria used.

$$CR = \frac{CI}{RI} \quad (5)$$

where:

CR – consistency ratio;

RI – random index.

If the CR is less than or just equal to 0.1, the inconsistency was admissible. If not, subjective judgment is revised.

Step 3: Calculating the weights of criteria and subcriteria. FAHP was used to calculate the weight of integrated answers through the questionnaires. The triangular fuzzy number and the operational laws of triangular fuzzy numbers are defined as the next process. Therefore, we applied Chang's extent analysis method as one of the FAHP approaches which can be explained as follows (Chang 1996):

The membership function $\tilde{M}(x): R \rightarrow [0,1]$ of the triangular fuzzy number $\tilde{M} = (l,m,u)$ is defined on R is equal to [Equation (6)].

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$$\tilde{M}(x):\begin{cases}\dfrac{x}{m-l}-\dfrac{l}{m-l'} & x\in[l,m]' \\ \dfrac{x}{m-u}-\dfrac{u}{m-u'} & x\in[m,u]' \\ 0' \text{ etc.} \end{cases} \quad (6)$$

where:

m – the most possible value of the fuzzy number $\tilde{M}$;

l, u – lower and upper bounds, respectively ($l \leq m \leq u$).

Considering Zadeh's extension principle, two triangular fuzzy numbers are given as $\tilde{M}_1 = (l_1, m_1, u_1)$ and $\tilde{M}_2 = (l_2, m_2, u_2)$, ($l_1$ and $l_2 \geq 0$).

The extended addition is defined as [Equation (7)].

$$\tilde{M}_1 \otimes \tilde{M}_2 = (l_1 + l_2 m_1 + m_2 u_1 + u_2) \quad (7)$$

where:

$\otimes$ – the extended multiplication of two fuzzy numbers.

The extended multiplication is defined as [Equation (8)]:

$$\tilde{M}_1 \otimes \tilde{M}_2 \approx (l_1 \times l_2, m_1 \times m_2, u_1 \times u_2) \quad (8)$$

The triangular fuzzy number inverse $\tilde{M}_1 = (l_1, m_1, u_1)$ is defined as [Equation (9)]:

$$\tilde{M}_1^{-1} \approx \left(\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1}\right) \quad (9)$$

Chang's fuzzy AHP method

Chang's fuzzy AHP method is:

Let $X = \{O_1, O_2, ..., O_n\}$ be an object set, and $U = \{g_1, g_2, ..., g_n\}$ be a goal set. With regard to Chang's extent analysis method, each object is considered one by one, and for each object, the analysis is carried out for each of the possible goals as follows [Equation (10)]:

$$\tilde{M}_{gi}^1, \tilde{M}_{gi}^2, \ldots, \tilde{M}_{gi}^m, \quad i = 1, 2, \ldots, m \quad (10)$$

where:

$\tilde{M}_{gi}^j, (1,2,\ldots,m)$ – triangular fuzzy numbers.

The membership function of the triangular fuzzy number is denoted by fuzzy number which is denoted by $\tilde{M}(x)$. The steps of Chang's extent analysis can be given as follows:

Step 1. The value of the fuzzy synthetic extent with respect to the ith object is defined as [Equation (11)]:

$$S_i \approx \sum_{j=1}^{m} \tilde{M}_{gi}^j \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} \tilde{M}_{gi}^j\right]^{-1} \quad (11)$$

where:

S_i – fuzzy synthesis value.

In order to reach $\sum_{j=1}^{m} \tilde{M}_{gi}^j$ carry out the fuzzy addition operation of m extent analysis values for a particular matrix [Equation (12)]:

$$\sum_{j=1}^{m} \tilde{M}_{gi}^j = \left(\sum_{i=1}^{m} l_i, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_i,\right) \quad (12)$$

and to reach $\left[\sum_{i=1}^{n}\sum_{i=1}^{m} \tilde{M}_{gi}^j\right]^{-1}$, spot the fuzzy addition operation of $\tilde{M}_{gi}^j \,(j = 1,2,\ldots,m)$ values so that [Equation (13)]:

$$\sum_{j=1}^{n}\sum_{j=1}^{m} \tilde{M}_{gi}^j = \left(\sum_{i=1}^{n} l_i, \sum_{j=1}^{n} m_j, \sum_{j=1}^{n} u_i,\right) \quad (13)$$

The inverse of the vector in Equation (11) is computed as follows [Equation (14)]:

$$\left[\sum_{i=1}^{n}\sum_{i=1}^{m} \tilde{M}_{gi}^j\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \quad (14)$$

Step 2. The possibility degree $\tilde{M}_2 = (l_2, m_2, u_2) \geq \tilde{M}_1 = (l_1, m_1, u_1)$ was defined as [Equation (15)]:

$$V(\tilde{M}_1 \geq \tilde{M}_2) = \sup\left[\min\left(\tilde{M}_1(x), \tilde{M}_2(Y)\right)\right] \quad (15)$$

where:

V – degree of possibility of $\tilde{M}_1 \geq \tilde{M}_2$;

And it could be equivalently expressed as [Equation (16)]:

$$V(\widetilde{M}_1 \geq \widetilde{M}_2) = hgt \times (\widetilde{M}_1 \cap \widetilde{M}_2) = \widetilde{M}_2(d) = \begin{cases} 1, & \text{if } m_2 \geq m_1, \\ 0, & \text{if } m_2 \geq m_1, \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & \end{cases} \text{etc.} \quad (16)$$

where:

hgt – height of fuzzy set;

d – abscissa value.

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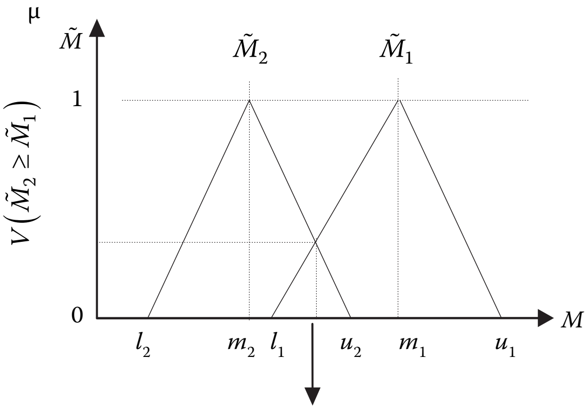

Figure 3. The intersection between $\tilde{M}_1$ and $\tilde{M}_2$

$\tilde{M}_1$; $\tilde{M}_2$ – fuzzy numbers; m – the most possible value of the fuzzy number; l, u – lower and upper bounds; V – degree of possibility of $\tilde{M}_1 \geq \tilde{M}_2$; M – triangular fuzzy numbers of pairwise comparison matrices; μ – member degree

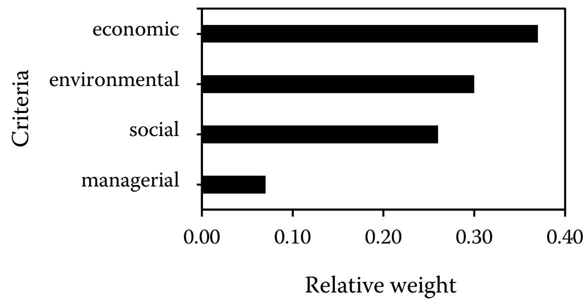

Figure 4. Prioritized criteria driven by fuzzy analytic hierarchy process (FAHP)

$V(\tilde{M}_1 \geq \tilde{M}_2)$ is illustrated in Figure 3, for the case $m_2 < l_1 < u_2 < m_1$, where d is the abscissa value corresponding to the highest crossover point D between $\tilde{M}_1$ and $\tilde{M}_2$. To compare $\tilde{M}_1$ and $\tilde{M}_2$, both the values $V(\tilde{M}_1 \geq \tilde{M}_2)$ and $V(\tilde{M}_2 \geq \tilde{M}_1)$ are needed (Figure 3).

Step 3. The possibility degree for convex fuzzy numbers to be greater than k convex fuzzy numbers $\tilde{M}_i$ (i = 1,2,...k) can be defined by [Equation (17)]:

$$V(\tilde{M} \geq \tilde{M}_1, \tilde{M}_2, \ldots, \tilde{M}_k) = \min V(\tilde{M} \geq \tilde{M}_i), \quad i = 1,2,\ldots,k \tag{17}$$

Step 4. Eventually, $W = (\min V\ (S_1 \geq S_k),\ \min V\ (S_2 \geq S_k),\ \ldots,\ V\ (S_n \geq S_k)^T$ is the weight vector for k=1, 2, ... (T – time complexity).

RESULTS

In the current research, our main objective was to look into the differences in beneficiary's socio-economic status between the areas where forestry plans are missing and the areas where forestry plans had primarily been available, even though they have recently been terminated as well. The weights for the criteria were calculated considering the fuzzy evaluation matrices, as shown in Equations 6–17. The pairwise comparison matrices for criteria are given in Tables 1 and 2 and in Figure 4 the local relative weight was calculated. According to the calculations, upper and lower relative weights (0.37, 0.07) were determined for economic and managerial criteria, respectively.

Economic subcriteria. The results of a detailed assessment of economic subcriteria by the current forest management approach are presented in Table 1 and Figure 5. The forestry project staff's income was at the highest level of the relative weight (0.23) on the basis of participant's viewpoint while the benefit of industries depending on the forestry projects took the back seat.

Social subcriteria. Figure 6 shows the social subcriteria hierarchy according to the participant's opinion and FAHP method. Resulting from the study, employing the industries, which are deeply dependent on the forestry projects, has shown the maximum rate of relative weight, whereas the least amount, among all social subcriteria, went to wood smuggling transformation. However, an increase in wood smuggling held a pivotal position in the social issue which appears to be a direct result of the newly adopted forest system management (Table 1).

Table 1. Geometric mean weights and pairwise comparison matrix of criteria

Criteria	Economic			Social			Environmental			Managerial		
Economic	1	1	1	3	5	7	1	3	5	1	3	5
Social	0.14	0.2	0.33	1	1	1	0.2	0.33	1	3	5	7
Environmental	0.2	0.33	1	1	3	5	1	1	1	1	3	5
Managerial	0.2	0.33	1	1	0.14	0.2	0.2	0.33	1	1	1	1

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Table 2. Relative weights and criteria and sub-criteria

Criteria	Criteria's relative weight	Sub-criteria	Sub-criteria's relative weight
Economic	0.37	household earrings within forestry plan	0.12
		forestry project staff's income	0.23
		industries benefit depend on forestry projects	0.21
		raw materials reduction	0.15
		wood products prices rising	0.20
		forest roads destruction and erosion	0.10
Social	0.26	local communities' employment	0.19
		industries employment depend on forestry projects	0.20
		forest science graduate's occupation	0.16
		forest extent loss	0.14
		wood smuggle increasing	0.19
		wood smuggle shifting	0.12
Environmental	0.30	challenging of forest fire fighting	0.25
		forest grazing increasing	0.15
		forest succession disturbing	0.09
		soil and hydrological system disruptions	0.11
		rising poaching	0.20
		restoration opportunity of harvested forest stands	0.11
		skid trails rehabilitation	0.09
Managerial	0.07	ecotourism development	0.03
		raw materials provide to wood industry	0.42
		employment disruption	0.33
		forest management via specialists	0.11
		people's opportunity for participation in decision-making	0.11

Environmental subcriteria. The forest fire fighting was ahead among all environmental subcriteria that is followed by an increase in poaching and forest grazing, respectively, which seem to be critically important components addressing the environmental subcriteria issue. Figure 7 and Table 1 show the environmental subcriteria in detail.

Managerial subcriteria. A detailed comparison of the managerial subcriteria indicates that the newly adopted forest management system creates the most disturbance in the raw wood material provision for wood industry. Figure 8 proves that the raw wood material provision is the first largest criteria weight among all which is fol-

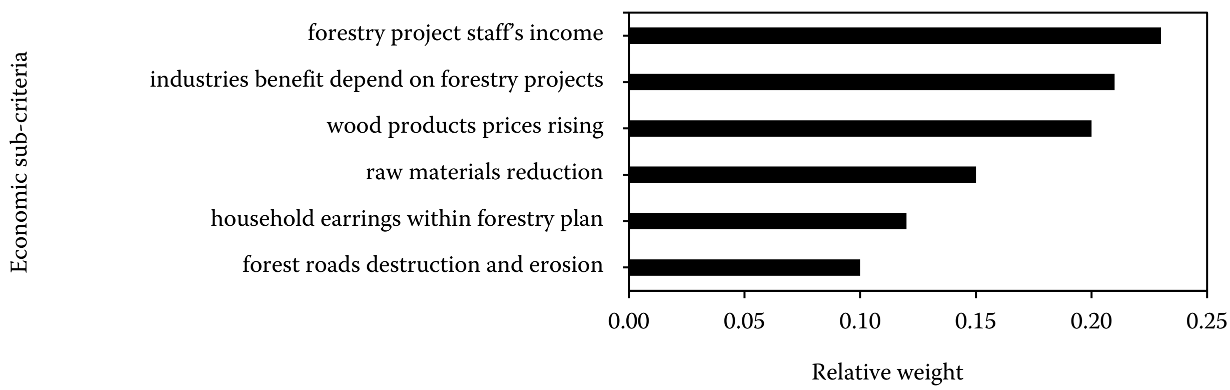

Figure 5. Prioritized economic sub-criteria based on Fuzzy Analytic Hierarchy Process (FAHP)

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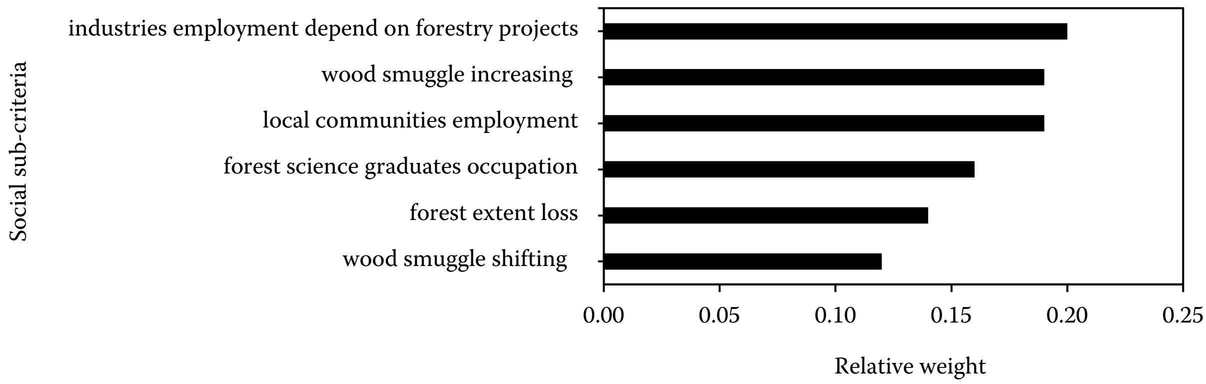

Figure 6. Prioritized social sub-criteria based upon Fuzzy Analytic Hierarchy Process (FAHP)

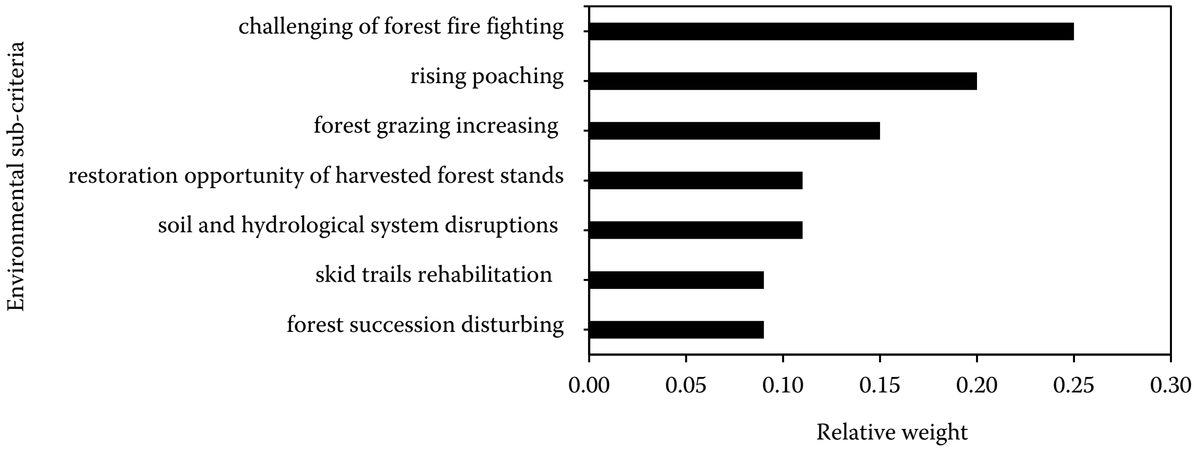

Figure 7. Prioritized environmental sub-criteria arises from Fuzzy Analytic Hierarchy Process (FAHP)

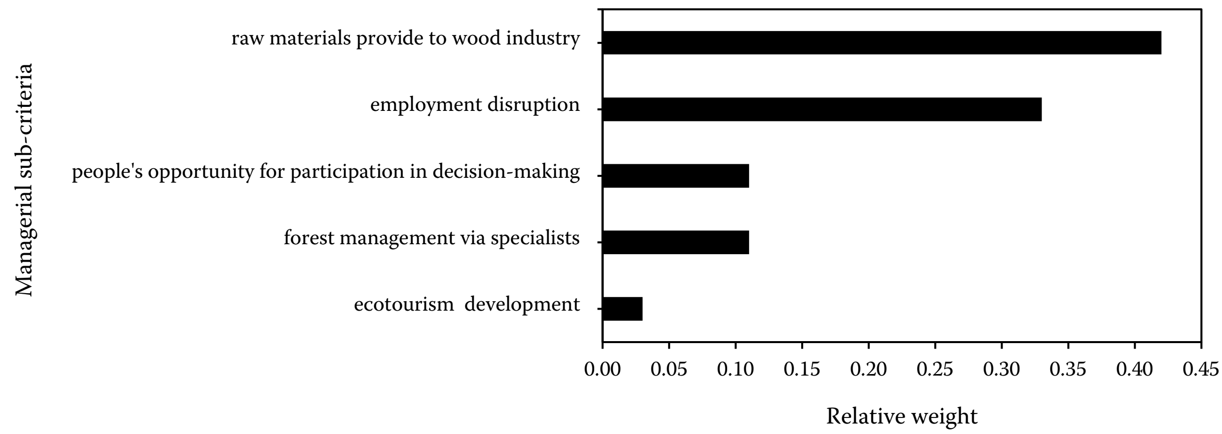

Figure 8. Prioritized managerial sub-criteria results from Fuzzy Analytic Hierarchy Process (FAHP)

lowed by the employment disruption that holds the second largest managerial subcriteria weight (Figure 8, Table 1).

Subcriteria comparison. The results of the survey on the subcriteria comparison reveal that the wood product prices containing a particular amount (0.85) of relative weight, the industries benefit depending on forestry projects, the raw materials giving the relative weight of (0.77) and (0.75), respectively, are the most noteworthy criteria which were affected

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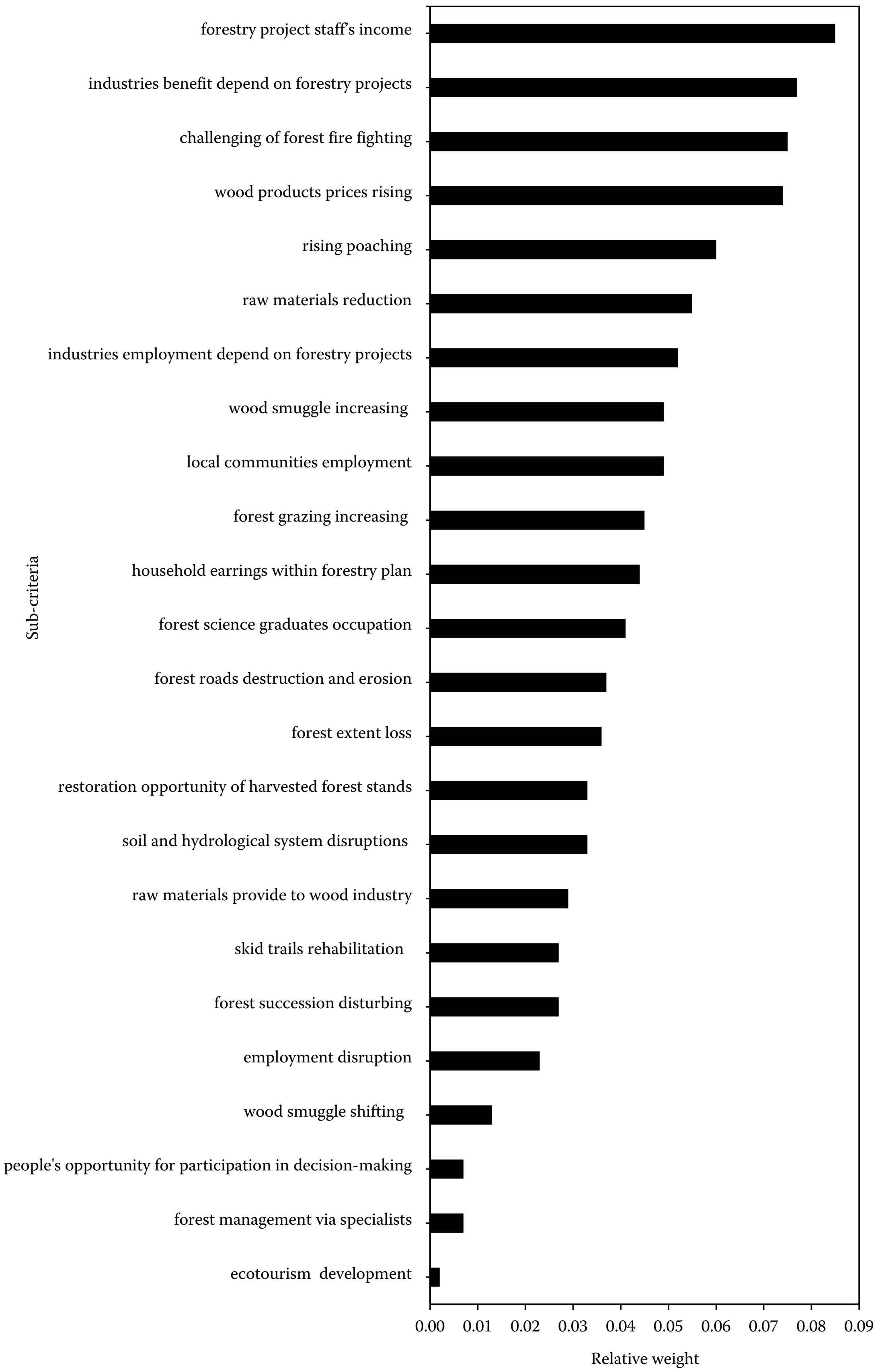

Figure 9. Ultimate prioritized sub-criteria rooted in Fuzzy Analytic Hierarchy Process (FAHP)

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by a temporary halt to the forestry plan idea (Figure 9). Figures of consistency ratios, fitted in all criteria, demonstrate an amount of less than 0.1, pointing out an acceptable and structurally sound pairwise comparison level to be viewed including in the economic, social, environmental and managerial subcriteria 0.093, 0.055, 0.09 and 0.028, respectively.

DISCUSSION

The investigation was made based on the multicriteria decision making theory to compute differences in beneficiary's socio-economic status between the areas that are abandoned without the active forestry plans and the areas where the plans had generally been available even though they have recently been terminated. It also aims to provide some typical examples of sustainable forest management criteria that have been hit during the matter and their dependencies on forestry plan performance in order to communicate the value of forestry plans. The present study highlights the need for a desired forestry plan which appears to be as an indicator of sustainable forest management. It affects numerous issues covering the business social, environmental, economic benefits, to name but a few in the forest area. A direct implication of the study which was highly significant revealed that the forestry project staff's income has suffered major changes among all economic criteria, because most people lean heavily on forestry projects for their livelihood. These results are in agreement with those obtained by Shirzadi Laskookalayeh et al. (2021) that indicated the economic values are crucial factors in forest logging prohibition. To place greater emphasis, owing to the recent lack of appropriate plan which appears to be issued in unfortunate livelihood consequences of those who are in need of handling the situation, the outcome must be seriously considered. Additionally, with such high levels of dependence, a total lack of plans can result in a sharp reduction of the forest role in people's livelihood which can give a substantial rise to their mass migration to the cities contributing to fading out their crucial role in forest conservation (Friedman 2009). To address the local challenges of climate change, we need massive public and private investment in science-driven nature-based solutions which can be found in desirable forestry plans specifically in Iran's delicate forest ecosystems. Likewise, Gong et al. (2020) emphasized that creating needed policies for ecological environmental sustainability should be in line with economic development. It covers many key objectives ranging over a variety of topics, from forest conservation which is a considerable achievement to all global, national, regional and local policy priorities. In the research firefighting and forest physical protection were introduced as exhaustive parts of environmental concerns. This finding seems to be consistent with some other researchers such as Haidari and Karamdoost Maryan's (2017), who believe that the most important opportunity and strength points associated with forest logging could be the steady increase in marked sustainability and more employment in forestry and wood industry sectors at the national levels. It is due to the disruption of conducting the forestry plans whereupon the regular forest monitoring and physical conservation which range over a variety of weighty matters from keeping miscellaneous people away from trespassing on forest, deforestation, forest smuggling and forest fire control to current affairs have been plagued. The bare fact is that forest stock and people's national properties are now seriously threatened by the apparent lack of closely guarded forest plans. Accordingly, owning to the heavy dependence of local communities on forests particularly in Iran, forest plan enforcement is the authority's duty to be enforced with regard to taking local interest in their welfare benefits (Kotwalm et al. 2008). Equally importantly, the expert's opinion indicates that the household earnings within the forestry plan as well as the forestry project staff's income are subcriteria of crucial importance among all economic ones; this result was supported by the Geng et al. (2021) idea indicating that the worker households' welfare stands on the forest logging ban in Northeast China. The raw material provision for wood industries is a matter of concern for managers who are constantly struggling against the prolonged closed plans bringing them into conflict with the supporter of the recent idea as it has been the most conclusive proof according to respondents' opinions. The evidence which could be studied further notes that quite apart from the investigating of the technical aspects, we need to take great care of the socio-economic fundamentals. This serious side should be hugely acknowledged in order to make any structural adjustment in forest management, endeavouring

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to give instructions broadly based on the institutional development, jointly managed principles as well as meeting the community-oriented affairs.

Taking the FAHP test indicates that economic and environmental criteria have been the important factors in dynamically living forestry projects. The recent numerical investigation has let us see that the determination of the indicator coefficient paves technically the way in natural resource management for a further consideration in providing an appropriate scale for a decision making process, nevertheless, there has been a huge hesitation in the monitoring and evaluation system of criteria and indicators in Iran. Yet, regrettably, there has not been any executive support for such detailed surveys. The main aim of the inquiry was not only to underline the need for the determination of the indicator coefficient in natural resource management but also it emphasizes to put their efficient usage into action in order to move in the vicinity of sustainable forest management goals (Sunderlin et al. 2005). The forest management structure in Iran comes across as a very delicate matter in which formulating and then giving the criteria performance as well as continuously conducting practical research would bring about a dramatic improvement toward its preceding place.

CONCLUSION

The whole forestry plans which have recently had ground to a halt, regardless of proposing the appropriate alternative scenario, could threaten, in long run, the most needed forest management principles such as the forest stock maintenance and the national ownership.

The study let us have a look in the way that the economic issues in the forest area could be strongly dependent on the forestry plan performance implications and logging ban in which differently impact on the households of local communities based on their livelihood strategies.

Furthermore, it could be the decrease in the importance of the forest resources in the households' livelihood leading onto the creation of an unfavourable impression and subsequently less importance of protective measures on their behalf. Hence, the importance of carefully handling all the aspects of such approach has to be perceived by authorities in order to bridge the gap between all beneficiary groups. In this research we had to face up to the fact of some limitations such as non-cooperation of some experts in completing the needed questionnaires, lack of sufficient expertise on behalf of individual statistical samples on forestry plans and its impact on their lives as well as an apparent scarcity in the database system that would be able to show us the impact of forestry projects on the beneficiaries' economic condition. Regarding the research findings, we came up with the idea that continuing bringing forestry plans to a stop, which is based on the forest logging ban, might not be the mere existence of a solution to guarantee to make the forest current situation in a more protective way and keeping the forest resources from excessive logging. As a consequence, making some revisions to the forestry plans may be more suitable alternations to make them more proper in many ways and modifying the projects based on the economic, social and environmental criteria could give a further sustainability which is about the climate, biodiversity, social considerations and the economy. In this light, we should (once more) become aware of the active forestry fact when we need to protect forests and exploit them sustainably at the same time.

The points could also be obtainable through the enacting strict laws in delicate areas, increasing protection guard, using new technologies to prevent forest lands from encroachment and wood smuggling as well as creating a platform to encourage the private sector investments and public participation in forest management.

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