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Representative Group Decision-Making in Forest Management: A Compromise Approach

Esther Ortiz-Urbina [1,*], Luis Diaz-Balteiro [1], Marta Pardos [2] and Jacinto González-Pachón [3]

[1] ETS Ingeniería de Montes, Forestal y del Medio Natural, Universidad Politécnica de Madrid, Ciudad Universitaria, s/n, 28040 Madrid, Spain; luis.diaz.balteiro@upm.es
[2] Department of Forest Dynamics and Management, INIA CIFOR, Ctra. La Coruña Km 7.5, 28010 Madrid, Spain; pardos@inia.csic.es
[3] Department of Artificial Intelligence, Campus de Montegancedo, Computer Science School, Universidad Politécnica de Madrid, Boadilla del Monte, 28660 Madrid, Spain; jgpachon@fi.upm.es
* Correspondence: e.ortizdeurbina@upm.es; Tel.: +34-910-671-631

Abstract: The correct aggregation of stakeholders' preferences is a vital aspect of solving problems associated with natural resources. In fact, there is no one solution that permits the incorporation of those preferences into techniques that, in turn, address multiple objectives in the management of those resources. In this context, this work aims to assign, analyse, and compare the weights of importance to groups of stakeholders (representativity) starting from different approaches and methodologies: pairwise comparison matrices (using a subjective approach) and the voting power notion (when an objective approach is deployed). For the latter, a variant of the extended goal programming model is employed. The results show different weight values and, therefore, scenarios, in which the social groups defined acquire diverse importance. It is also observed that there are scenarios determined by different values of the control parameter, in which the results of the two above-mentioned approaches are similar. Finally, it is demonstrated how the affiliation of stakeholders to other social groups (different identities) affects the results obtained.

Keywords: participatory multicriteria decision making; goal programming; voting power

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1. Introduction

Nowadays, forestry problems have become increasingly complex due to the multitude of criteria intervening in the decision-making process and due to the way in which different social groups or stakeholders perceive the importance of these criteria [1]. This is why it has become necessary to integrate and evaluate multiple criteria with the consideration of the different points of view of the stakeholders involved in the decision making in order to obtain more realistic results [2].

There is a progressively more frequent simultaneous employment of multicriteria decision techniques (MCDMs) to include several criteria in forest management [3] and of group decision techniques (GDMs) to attempt to reach a consensus that would be the most satisfactory alternative for all the stakeholders implicated in the decision-making process [4]. In sum, the hybridisation of multicriteria techniques with group decision ones to tackle forest management problems constitutes a useful solution, into which diverse techniques have been integrated [5–7]. Even recently, it has been seen that the joint use of this group of techniques has increased throughout the time in different land and fishery issues [8].

In decision making, different social groups or stakeholders participate in forest management to evaluate their preferences [9], making it necessary to integrate their different points of view [10]. Most existing studies in the literature give stakeholders the same importance weights [11], ignoring all current possibilities or trying to make this process easier.

Some authors have reviewed multiple attribute GDM methods and classified these GDM approaches [12]. In relation to the methodologies employed in this study, one of them (pairwise comparison with AHP) can be classified as an "explicit multiple attribute evaluation" in the group of "content-oriented approaches" because the preference for choosing among the alternatives appears clearly in an explicit multi-attribute evaluation [11].

These preferences are considered subjective preferences of the stakeholders, as they are related to the greater or lesser importance of one alternative over another [13] and are associated with the idea of preferential weights. The latter are usually obtained by using participation methods, as they are highly effective when choosing between different alternatives, which can present themselves in forest management problems [9].

At the moment of integrating the stakeholders' preferential weights into the decision-making problem, the possibility of directly employing individual preferences or the preferences of each group of stakeholders with a representative weight for each one arises, which is equivalent to the weights of importance for each group of stakeholders in the collective. The representative weights, unlike the preferential ones, underline the importance of each social group involved in the problem, valuing the influence of their opinions in the collective decision. The representative weight of each social group defines the degree of importance (expressed numerically on a scale of 0–1) of the representative person of any social group within a hypothetical committee. These representative weights express the opinion that reflects the common knowledge of the social group that they represent [14]. For these reasons, it is of interest to calculate the weight of the representation in each group of stakeholders within a collective decision problem. There are various methods in the literature that can be used to obtain the representation weight. These start from multicriteria techniques, such as the Analytic Hierarchy Process (AHP), which permits the assignment of the degree of importance of each social group by means of pairwise comparison matrices (PCMs), to the voting power (VP) notion, which uses the cardinality of each group to calculate the degree of importance. In this article, we take into account the diversity of techniques by defining two groups of approaches according to the nature of the information available: the subjective approach and the objective approach. The subjective approach is understood to be the result obtained from the valuation of the stakeholders involved in the decision making, in this case, by means of a system in which the recipients make their perceptions known. In contrast, the objective approach proceeds from the use of the cardinality of the stakeholder groups implicated in the decision making.

Each social group participating in a collective multicriteria decision-making problem presents different preferences regarding the criteria and the alternatives that are present. To give an example related to forest management, depending on the social group, the interests will be aimed more towards achieving economic, conservation, or recreational objectives, among others. It is therefore vital to integrate the influence and importance that each social group has in decision making, and to find out whether all members have the same representativity independently of the social group to which they belong or independently of the number of stakeholders forming each group, or, on the contrary, if the group formed by a larger number of members is the one with greater representativity. Comparing the representative weights obtained through the PCM (subjectively) with those obtained through VP (objectively), the intention of the stakeholders with regard to the representativity of each social group can be discovered.

It should be noted that the cardinality on which the VP is based is conditioned by the number of stakeholders in each social group involved, so the formation of groups is a determining factor. This is why it is crucial to determine which of the groups formed for the case study of this work is assimilated to the greatest extent in the results obtained with the PCMs. With the latter, it can be analysed whether the grouping of the stakeholders is important in forest management and if the representative weights vary in terms of the group formed.

As a general scheme and guide, Figure 1 details the characteristics of the methodologies used in this work. First, the approaches employed are differentiated. On the one hand,

preferential information is obtained from a survey, the basis of a subjective approach, in which the different stakeholder groups participating in the decision-making process intervene. That preferential information is structured in the form of pairwise comparison matrices (PCMs). On the other hand, empirical information based on the cardinality of each stakeholder group, the basis of an objective approach, is also used.

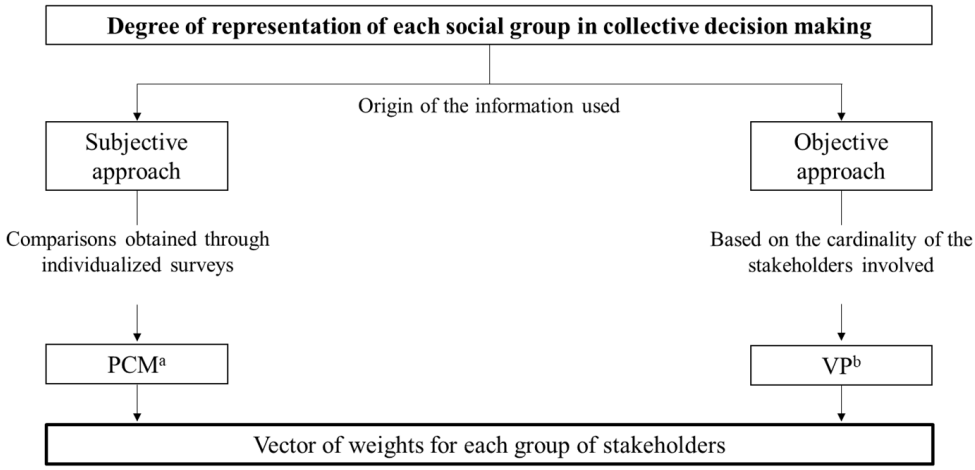

Figure 1. Characteristics of the methodologies employed. Acronyms: [a]—PCMs: pairwise comparison matrices, [b]—VP: voting power.

This work aimed to calculate, analyse, and compare the weights representing different social groups involved in a collective decision problem by means of the two approaches described above. To calculate the weights, a methodology is proposed for each type of approach. For the subjective approach, it is suggested to use the PCMs from which the individual perceptions of the stakeholders are obtained through the AHP model [15] from subjective prioritizations. This method is the most habitually employed in group decision-making problems in the forestry sphere [7]. Second, it is suggested to use the VP notions proposed in [16], in which the cardinality of the group, not the opinions of the stakeholders, intervenes. Thus, an objective approach is adopted in which the balance between the principle of majority and minority is converted into the criterion of the model selection. With these methodologies, we compare group versus individual trade-offs in collective decision-making situations, which is a real problem when stakeholder preferences are involved. The results can be beneficial in the current vision of forest management for the analysis of different ecosystem services linked to a case study, regardless of their nature, and for the selection of the best management alternatives in accordance with those ecosystem services and the integration of the stakeholders' preferences.

As the main hypothesis, it is expected that, through surveys, the best representation values are obtained in the (or those) group(s) in which most of the surveys' recipients are placed. As a result, these weights approximate those obtained by the VP point of view following the rule "1 person, 1 vote", which is explained below.

2. Materials and Methods

As previously indicated, this work proposes two approaches to quantify the representative weight of each social group implicated in a collective decision problem. In order to compare the results obtained, a proximity matrix was calculated using IBM SPSS Statistics software so that it would be able to determine which were the nearest results due to the Euclidean distance calculated. These approaches are specified in two methodologies to calculate the representativity weights detailed below.

2.1. Pairwise Comparison Matrices (PCMs)

Although pairwise comparison was proposed a long time ago [17], nowadays, it is frequently employed in multicriteria decision methods [18]. This method consists of making a total ordering of n alternatives and comparing them two by two by means of the scale popularized by Saaty [19] in order to quantify the relative importance of each alternative. On this scale, each stakeholder has the option to express the intensity or importance that they give to one alternative with respect to another using a scale of nine points (Table 1); that is, if they consider that two alternatives are of equal importance in the comparison, they can give them a value of 1, whereas 9 would be the value they give if they consider the first alternative as being much more important than the second.

Table 1. A summary of Saaty's fundamental scale [19].

Value of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favour one activity over another
5	Strong importance	Experience and judgment strongly favour one activity over another
7	Demonstrated importance	An activity is favoured very strongly over another, and its dominance is demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation

Pairwise comparison matrices include the stakeholders' perception in decision making in the form of a matrix, $M = (m_{ij})_{i,j=1\ldots n}$, called the pairwise comparison matrix (PCM). In preference aggregation issues, this method has already been used in forestry under diverse variants [2]. Each stakeholder's opinion of the importance of alternative i compared to that of j is gathered in the value m_{ij}, whereas from matrix M, the system of weights of importance of the alternatives n, represented by the vector $(w_1, \ldots w_n)$ can be obtained, considering the weight system as the final objective, a PCM close to the following dimension matrix dimension: $n \times n$.

The coefficient m_{ij} estimates the quotient $w_{ij} = {}^{w_i}/_{w_j}$, in which w_i is the importance assigned to the alternative i, and w_j is the importance assigned to the alternative j. By definition, the matrix defined by the quotients above, $w = (w_{ij})_{ij}$, verifies the following properties:

1. Reciprocity: $w_{ij} x w_{ji} = 1 \ \forall i, j$
2. Consistency: $w_{ij} x w_{jk} = w_{ik} \ \forall i, j, k$

Once all the PCMs are obtained, the individual weights of importance are calculated using the eigenvalue method and its associated eigenvector [15]. A more detailed description of AHP and its application can be found in [20]. We analysed the consistency of each pairwise comparison matrix using the consistency ratio (CR) defined by Saaty [21]. Following [22], we accepted a matrix as being consistent if CR < 0.2. To obtain the weights of importance in the group, we used the geometric mean as an aggregation operator [23,24].

2.2. Voting Power (VP)

This approach consists of assigning the weights of importance (in this case, representative weights) using the cardinality of each group [16]. It is said that the VP approach employs objective information because it uses the number of stakeholders involved in the decision-making process [25] and not their individual preferences, as in the previous approach. Taking this view into account, an extended goal programming (EGP) model was formulated, which combines the following 3 rules: "1 person, 1 vote", with all the stakeholders acquiring the same importance of opinion; "1 social group, 1 vote", in which all the social groups are of the same importance regardless of the number of stakeholders forming the group; and "the minimization of the maximum deviation or discrepancy be-

tween the two above rules", in which the interests of the groups and of the stakeholders are confronted. The following describes the terminology that is used in this methodology:

$j = 1, 2, \ldots m$: number of social groups, m being the total number of groups participating.

$n_1, n_2, \ldots n_m$: number of stakeholders in each social group.

w_j: final collective weight of the group.

α_j, η_j: variables of positive deviation, representing the quantification of the over-achievement with respect to the targets.

β_j, ρ_j: variables of negative deviation, representing the quantification of the nonachievement with respect to the targets.

D: maximum deviation.

λ_1 and λ_2: control parameters.

By means of these control parameters, a balance is sought between the representation based on the group cardinality and that based on the group itself equitatively, not on its cardinality. Taking into account the degree of representativity that it is prepared to give to a collective, different results are obtained in terms of the value assigned to λ_1 and to λ_2. Following the rules proposed in [16], when $\lambda_1 = 0$ and $\lambda_2 = 1$, the best result is obtained from the perspective of the individuals (1 person, 1 vote); when $\lambda_1 = \lambda_2 = 0$, the best option is given from the groups' point of view (1 social group, 1 vote); and when $\lambda_1 = 1$ and $\lambda_2 = 0$, the deviation between the interests of the stakeholders and of the social groups is minimized. The intermediate values that can be assigned to these parameters give an intermediate result related to the rules previously indicated. Ultimately, these parameters are associated with the representativity rules that balance two desirable principles but that may enter into conflict. Next, the extended goal programming model [16] was formulated:

Achievement function:

$$MIN\,\Omega = \lambda_1 D + \lambda_2 \sum_{j=1}^{m} \frac{\alpha_j + \beta_j}{n_j / \sum_{j=1}^{m} n_j} + (1 - \lambda_1 - \lambda_2) \sum_{j=1}^{m} \frac{\eta_j + \rho_j}{1/m} \tag{1}$$

Goals:

$$W_j + \alpha_j - \beta_j = \frac{n_j}{\sum_{j=1}^{m} n_j} \quad j \in \{1, 2, \ldots m\} \tag{2}$$

$$W_j + \eta_j - \rho_j = \frac{1}{m} \quad j \in \{1, 2, \ldots m\} \tag{3}$$

$$W_j - D \leq \left| \frac{n_j}{\sum_{j=1}^{m} n_j} - \frac{1}{m} \right| \; j \in \{1, 2, \ldots m\} \tag{4}$$

Constraints:

$$\sum_{j=1}^{m} W_j = 1 \tag{5}$$

$$\lambda_1 + \lambda_2 \in [0, 1] \tag{6}$$

$$\alpha_j \geq 0,\ \beta_j \geq 0,\ \eta_j \geq 0,\ \rho_j \geq 0,\ W_j \geq 0\, j \in \{1, 2, \ldots m\}\ D \geq 0 \tag{7}$$

In sum, (3) includes the achievement function of the extended goal programming (EGP) model, in which the number of social groups (j = 1, 2, … m) and the number of stakeholders in each social group (n_1, n_2, … , n_m) are known. In this model, the 3 rules previously described are combined, integrating them as objectives: "1 person, 1 vote" (4), with all the individuals acquiring the same importance of opinion; "1 social group, 1 vote" (5), in which all the social groups have the same importance regardless of the number of stakeholders forming each group; and the third rule (6), which is associated with the minimisation of the maximum deviation (D) or discrepancy between the two previous rules in which the interests of the groups and of the individuals are confronted.

3. Case Study

The above methodologies are applied to Valsaín's public forest. The forest is located on the north-facing slopes of the Sierra de Guadarrama (Spain), and it is owned and managed by the Spanish National Parks Agency. This forest covers an area of 10,668 ha. According to the most recent forest inventory, more than 80% is occupied by pure *Pinus sylvestris* forest [26]. The first management plans were adopted in 1889, and since then, it has been one of the most productive pine forests in Spain. However, in addition to the classic objective of timber production, since the 1980s, the concept of multifunctionality has been progressively introduced [27], and, today, different ecosystem services show great prominence [28]. Moreover, since 2013, the upper parts have been included in the "Sierra de Guadarrama" National Park. As Madrid, with 5 million inhabitants, is less than 60 min away by car, tourism has gained importance as one of the most important sectors in the whole area [29].

3.1. Survey

The data used in this research were obtained through a survey carried out with the support of the ARANGE project (http://arange-project.eu/) (accessed on 28 February 2022). This project focuses on the impacts of climate change and management, embracing diverse ecosystem services in European mountain ranges in seven different case studies [30]. Different management alternatives were defined in each case study area, and a selected set of indicators provided the values associated with each ecosystem service throughout the horizon planning (100 years) [31].

This questionnaire, composed of nine sections, was sent by post to different stakeholders using Monkey Survey software (Survey Monkey Advanced Plan, San Mateo, CA, United States). The selected typology of the stakeholders resembled the most customary ones in the literature [7]. A total of 34 questionnaires were received, and the stakeholders were classified into the following 10 social groups: public authorities and technicians, hunters, ecologists and NGOs, forestry work firms, cattle farmers, industries, mycologists, small forest firms, professionals and university professors, and landowners. However, as six questionnaires were excluded due to the consistency ratio (CR), the valid responses received (28) were scarce; thus, we decided to reduce the number of groups to four, as shown in Table 2.

The survey sent out was presented in a pairwise comparison format and was divided into several sections. One of them asked about the importance that should be given to the stakeholders' preferences in the management of forest systems; i.e., how much more important is one social group than another? From these results, the PCMs that were analysed in this work were obtained. In another section, the recipients were asked to answer questions on the preferences of the stakeholders involved in management, but, this time, questions directly linked to the social group to which the recipient belongs were eliminated. As such, the survey recipients themselves are those that take up a position, following their own criterion, in the social group that they think that they belong to, and, thus, the second large group of stakeholders in this case study was created.

3.2. Group Formation

The number of stakeholders in each social group is a determining factor in the VP point of view. There are many ways to group together the stakeholders implicated in a study, for example, the methods followed by Mendoza and Prabhu [32], Nordström [10], or Buchy and Hoverman [33]. In this case study, two large groups were set up in accordance with the perception with which each group was created. The first group formed following an objective criterion: the job or the personal or professional activity performed by each stakeholder. However, group 2 was created following the subjective perception of each stakeholder, taking into account the attitude that each one adopted in the survey made on their social group. Table 2 shows the two groups formed.

Table 2. Stakeholders' distribution and grouping.

	Group 1				Group 2			
	Land	**Asso**	**Firm**	**Ecol**	**Land**	**Asso**	**Firm**	**Ecol**
Public authority/technicians	5				4	1		
Hunters		2			1	1		
Ecologists/NGOs				3				3
Forestry work firms			1				1	
Cattle farmers	1		1		2			
Industry	2		1			1	2	
Mycologists	1	1				2		
Small forest firms			1				1	
Professional/university professor	3	5			1	6		
Landowner	1				2			
Total stakeholders	13	8	4	3	10	11	4	3

4. Results

In order to respond to the issues proposed above, first, the representative weights obtained using the subjective approach were calculated (Table 3) by means of the pairwise comparison matrices (see Appendix A). Second, the representative weights were calculated following the objective approach (Table 4).

Table 3. Results obtained using pairwise comparison matrices.

	Land [1]	**Asso** [2]	**Firm** [3]	**Ecol** [4]
PCM [5]	0.409	0.211	0.207	0.173

[1] landowner, [2] associations, [3] firms, [4] ecologists, [5] pairwise comparison matrix.

Table 4. Results obtained through voting power.

		Group 1				Group 2			
VP [1]		**Land**	**Asso**	**Firm**	**Ecol**	**Land**	**Asso**	**Firm**	**Ecol**
n [2]		13	8	4	3	10	11	4	3
λ_1 [3]	λ_2 [4]								
0	1	0.464	0.286	0.143	0.107	0.357	0.393	0.143	0.107
1	0	0.388	0.209	0.204	0.199	0.242	0.279	0.242	0.237
0	0	0.25	0.255	0.25	0.245	0.25	0.255	0.25	0.245
0.6	0.2	0.464	0.286	0.143	0.107	0.357	0.393	0.143	0.107

[1] voting power, [2] number of stakeholders in each group, [3,4] control parameters.

Table 4 shows the representative weights calculated by the VP notion, in which values of 0–1 are assigned to the control parameters as a function of the rules established. In the case of wishing to give more importance to the individuals, and to therefore follow the rule "1 person, 1 vote", the values employed are 0 and 1; when it is desired to give all the social groups the same importance, the value of the parameters is 0, exerting the second rule "1 social group, 1 vote"; and when the third rule is used, i.e., to minimise the maximum deviation between the two previous rules, these values are 1 and 0.

With the surveys made through PCMs, the order of greater to lesser importance is as follows: landowners, associations, firms, and ecologists, the same order as the one obtained with VP. Additionally, attention is drawn to the high importance provided to the landowner group in the survey. This group obtained a representation of 40.9%, a very high percentage compared to the rest, practically representing the majority of the social groups.

In addition to the representative weights obtained as a function of the value given to each control parameter, Table 4 shows the representative weights estimated for the two groups set up in this case study. The aim of forming them was to find out whether the restructuration of these groups of stakeholders, by which new identities are created in changing the number of members in each group and, thus, their cardinality, permits one to obtain a closer coincidence between the objective and the subjective approaches. As such, it is determined whether the formation of different groups is a determining factor in the calculation of representative weights.

As previously noted, a proximity matrix was calculated (Table 5) in order to compare the results obtained by the two approaches defined in Tables 3 and 4. Table 5 shows that the nearest representative weights are those calculated with group 1, which minimise the maximum deviation between the first and the second rules.

Table 5. Proximity matrix (Euclidean distance).

	PCM	**VP1** [1]	**VP1**	**VP1**	**VP1**	**VP2** [2]	**VP2**	**VP2**	**VP2**		
		0–1	1–0	0–0	0.6–0.2	0–1	1–0	0–0	0.6–0.2	λ_1 [3]	λ_2 [4]
PCM	0.000	0.131	0.034	0.185	0.131	0.210	0.195	0.185	0.210		
VP1		0.000	0.155	0.278	0.000	0.151	0.276	0.278	0.151	0	1
VP1			0.000	0.159	0.155	0.217	0.171	0.159	0.217	1	0
VP1				0.000	0.278	0.247	0.028	0.000	0.247	0	0
VP1					0.000	0.151	0.276	0.278	0.151	0.6	0.2
VP2						0.000	0.230	0.247	0.000	0	1
VP2							0.000	0.028	0.230	1	0
VP2								0.000	0.247	0	0
VP2									0.000	0.6	0.2

PCM = pairwise comparison matrix, VP = voting power, [1] group 1, [2] group 2, [3,4] control parameters.

The results obtained in this work give the nearest representative weights as being among those procured with the objective approach (VP), and those with the subjective approach (PCM) are those calculated with the stakeholders that were grouped following an objective criterion according to their job or the personal or professional activity performed by each person (group 1). In this group, the nearest representative weights (Table 5) to those obtained with the survey are those that minimise the deviation between the interests of the stakeholders and those of the social groups, since they seek an intermediate result between the rules "1 person, 1 vote" (in which there is no collective representativity) and "1 group, 1 vote" (in which all the social groups acquire the same representativity).

5. Discussion

Through the two approaches employed (PCM and VP), it can generally be observed that the values of the representative weights obtained for each social group are different. The stakeholders seek a balance between representativity, based on the cardinality of the group, and the representation equally based on the group itself and not on its cardinality. At the same time, it is confirmed that the formation of the groups is a determining factor.

The stakeholders consider that the landowner group should have a higher representativity in the decision-making problem. It could be supposed that the high representativity would be obvious if most of the stakeholders belonged to this social group, as was assumed in the principal hypothesis of this work, but in this case, it is not so, since the stakeholders take up their positions in the group of their choice (group 2, see Table 2), and it can be seen that those placing themselves in the landowner group are not in the majority.

With respect to group 2 (formed following the subjective perception of the stakeholders), it should be noted that the number of stakeholders in the landowner and the associations groups is very similar. Thus, they are, to a great extent, far removed from the results obtained by the PCM, since, with the latter, the landowner group's representativity is 40.9%, which is double that of the associations group's representativity of 21.1%. Therefore, the linking of the stakeholders to different social groups affects the final results, and, in this case, the most appropriate option would be the formation of objective groups.

Other authors also followed this objective approach [10,32], with them themselves defining the social groups in their work, carefully selecting the stakeholders so that all the groups involved would be well represented.

As mentioned above, the representative weights obtained using the subjective approach were calculated by means of a survey. This is a highly adequate option, as pairwise comparison systems obtained from surveys lead to pairwise comparison matrices, which are an appropriate method due to their simplicity [2]. However, surveys can be more effective than methods requiring interaction between stakeholders, as they prevent any confrontations that can occur in the latter [34]. Following this idea, it is concluded that the preferences obtained by the questionnaires with pairwise comparisons with AHP are especially useful given that the stakeholders do not have any opportunity to interact with each other and arrive at a consensus [35].

The availability of participation tools could be of great interest when solving problems associated with forest management [36]. In this work, the weights obtained in different ways could be applicable in a forest management exercise that includes the objectives considered. However, these approaches may only be suitable in situations in which a considerable number of stakeholders are handled [37]. It should be remembered that the incorporation of different stakeholders' preferences is one of the open problems in forest management [38].

To date, there are no works that analyse the possibility of forming different groups to obtain weights that represent each social group implicated in a decision-making issue in the field of forestry. Other studies analyse stakeholders' preferences using three different methodologies, namely, approval voting, the Borda count, and the cumulative rule [39], but the possibility of grouping the stakeholders in more than one way was not considered. In our case, a representative from each social group was assigned to participate in the decision-making process so that all the social groups would have the same representation (which corresponds to the rule "1 group, 1 vote").

For future research, it is proposed to carry out a new survey of the same stakeholders participating in this case study. It would therefore be possible to analyse and compare the representative weights at two different times, and to observe if there were any changes or if the stakeholders maintained their preferences. In addition, the formation of the group set up with a subjective approach could be examined to see whether it had been maintained and to see if those stakeholders reaffirm their position in the social group to which they belong.

6. Conclusions

With these results, it was concluded that a stakeholder group that is set up in terms of an objective criterion or following a subjective perception has an impact on the representative weights since each social group acquires a different representativity. This demonstrates the importance of correctly grouping stakeholders.

The most similar representative weights were obtained when stakeholders were grouped by means of the objective approach using pairwise comparison matrices and the voting power methodology and when the voting power minimising the deviation between the interest of individuals and groups was obtained. That is, the most similar representative weights were obtained when we attempted to reach an intermediate result between the representativity based on the cardinality of the group and the representation based on the landowner group in equal terms.

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Appendix A

Table A1. The 28 pairwise comparison matrices obtained from the respective interviews.

	LAND	ECOL	FIRM	ASSO	LAND	ECOL	FIRM	ASSO	LAND	ECOL	FIRM	ASSO
LAND	1	1/3	1/3	1/3	1	7	3	3	1	7	5	5
ECOL	3	1	3	3	1/7	1	1/7	1/9	1/7	1	1/3	1/3
FIRM	3	1/3	1	3	1/3	7	1	1/3	1/5	3	1	3
ASSO	3	1/3	1/3	1	1/3	9	3	1	1/5	3	1/3	1
LAND	1	5	3	3	1	3	5	3	1	3	3	5
ECOL	1/5	1	1/3	1	1/3	1	3	1/3	1/3	1	3	5
FIRM	1/3	3	1	3	1/5	1/3	1	1/3	1/3	1/3	1	3
ASSO	1/3	1	1/3	1	1/3	3	3	1	1/5	1/5	1/3	1
LAND	1	1	3	3	1	5	7	5	1	1/7	1/3	1/5
ECOL	1	1	3	5	1/5	1	1/3	1	7	1	5	5
FIRM	1/3	1/3	1	3	1/7	3	1	3	3	1/5	1	1
ASSO	1/3	1/5	1/3	1	1/5	1	1/3	1	5	1/5	1	1
LAND	1	5	9	7	1	3	3	3	1	1/3	1/3	1/3
ECOL	1/5	1	1/3	1/3	1/3	1	3	3	3	1	1/3	1/3
FIRM	1/9	3	1	1/3	1/3	1/3	1	1/3	3	3	1	3
ASSO	1/7	3	3	1	1/3	1/3	3	1	3	3	1/3	1
LAND	1	3	1	5	1	5	5	5	1	3	1	3
ECOL	1/3	1	1/3	3	1/5	1	1	1	1/3	1	1/3	1
FIRM	1	3	1	7	1/5	1	1	1/3	1	3	1	1
ASSO	1/5	1/3	1/7	1	1/5	1	3	1	1/3	1	1	1
LAND	1	1	3	5	1	5	3	5	1	3	1/3	1/7
ECOL	1	1	3	5	1/5	1	1/5	1/3	1/3	1	1/5	1/7
FIRM	1/3	1/3	1	3	1/3	5	1	3	3	5	1	1/5
ASSO	1/5	1/5	1/3	1	1/5	3	1/3	1	7	7	5	1
LAND	1	7	5	3	1	1/3	3	1/5	1	7	1	1/5
ECOL	1/7	1	1/5	1/7	3	1	3	1/3	1/7	1	1/5	1/9
FIRM	1/5	5	1	1/5	1/3	1/3	1	1/3	1	5	1	1
ASSO	1/3	7	5	1	5	3	3	1	5	9	1	1
LAND	1	7	7	7	1	1/9	9	3	1	5	1	3
ECOL	1/7	1	1/3	1/3	9	1	9	9	1/5	1	1/5	1/5
FIRM	1/7	3	1	1	1/9	1/9	1	1/3	1	5	1	5
ASSO	1/7	3	1	1	1/3	1/9	3	1	1/3	5	1/5	1
LAND	1	1/3	1	1/3	1	3	3	5	1	9	7	7
ECOL	3	1	7	3	1/3	1	3	1	1/9	1	1/5	1/7
FIRM	1	1/7	1	1/3	1/3	1/3	1	1	1/7	5	1	1
ASSO	3	1/3	3	1	1/5	1	1	1	1/7	7	1	1
LAND	1	3	3	1								
ECOL	1/3	1	1	1/3								
FIRM	1/3	1	1	1								
ASSO	1	3	1	1								

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