Identifying Optimal Utilization System of Rangeland Using by Analytical Hierarchy Process (Case of Guilan and Ardebil, Iran)

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Abstract

Decisions are important issues in today’s world, and considering that a lot of decisions are based on several criteria, multi-criteria decision methods hold a special position. In this study, using Analytical Hierarchy Process (AHP), preferred methods of exploiting the system of Guilan and Ardebil’s rangelands were chosen according to economic, social, and ecological measures, and their importance and priority were evaluated. The preference and priority of standards and strategies were assessed by making hierarchy and paired comparisons between criteria and sub-criteria and using the Super Decision software and the Guilan and Ardebil rangeland experts. Then, by combining the results the final priorities of obtaining recommendations were determined. Data analysis of Ardebil showed that private exploit systems by a final weight of 0.543, governmental exploit systems by a final weight of 0.234, and traditional exploit systems by a final weight of 0.230 were the first, second, and last preference, respectively. The Data analysis of Guilan indicated that the private exploit systems by a final weight of 0.4516, governmental exploit systems by a final weight of 0.3173, and traditional exploit systems by a final weight of 0.2224 were the first, second, and last preference, respectively.

Keywords: private exploit systems, governmental exploit systems, traditional exploit systems, rangeland management

Introduction

The total area of rangelands in Iran is estimated to be about 90 million acres, comprising about 14 million acres of moderate to poor rangeland, and 16 million acres of poor to very poor rangeland (Sandgol, 2005). One global rangeland property is forage production for wild and domestic animals. Rangelands are also important in rough ground water aquifer recharge, to prevent erosion, and in wildlife habitats and recreation, but in Iran the use of the rangelands also has economic importance. The available rangelands of Iran produce about 100 million tons annually of dry forage, and this is enough for 100 days feed for 50 million livestock units (Farahnak and Movahedi, 1997).

Generally, operational efficiency and sustainability of rangelands in every region are affected by factors such as climate, soil topography, and economic and cultural conditions, which affect production. If soil, climatic conditions, development and plant production were more appropriate, the quality and quantity of rangeland production would be greater and better (Tavakoli, 2004; Mahdavi et al., 2005). On the other hand, several studies have shown that conditions and rangeland production in areas with similar ecological conditions have had significant differences and this is caused by types and styles of human intervention brought about by socioeconomic and technical factors. For example, with two areas of similar climate and with the same
slope, direction and altitude in western Azerbaijan, grazing management, in its time and intensity, had different effects on the two rangelands (Ahmadi, 2004). That study concluded that in an allocated area of rangelands, management of a thirty year plan, which motivated and provided a sense of ownership of the rangelands in centralized management, and observed grazing time and the amount of animals grazing on the rangelands, with the modification of livestock in times of drought, improved rangeland conditions.

In a study by Moradian (1998), an evaluation of status and trends of 53 rangelands with different managements in Fars Province showed that the majority of these rangelands have poor condition and negative trends. This researcher suggested that to prevent deterioration rangelands should provide forage additives for livestock breeders to prevent pre-term grazing and destruction of plants for fuel and emphasized regeneration by implementing systems. Khatoun Abadi et al., (2002) stated that educational, economical, planning and communities in the participation rate of livestock breeders have a major role in preserving and restoring the rangelands. Piper and Beck (1990) suggested that rangeland conditions are the most important factor and their assessment is necessary in rangeland management. In rangelands that are divided into different parts attention should be paid to the number of cattle, different levels of components and the amount of their production (Umberger, 2001) and to ecological characteristics of the area such as sun or shade and topography. Hunt and Hapkinson (1996), as well as to human factors and beneficent approaches to flock guidance (Nathan 2004, Lynam and Smith 2003). Hantsinger and Hapkinson (1996) believed that in the operation and the management of rangelands ecological characteristics and social issues of the rangelands should be noted. Lee and Smith (2003) expressed that humanitarian issues are as important as ecological issues in the operation and management of rangelands. Nathan (2004) believed that the use and management of rangelands include management of ecological and social dimensions and combination of these two guarantees conservation and sustainable use of resources. Appropriate grazing systems are the strongest livestock and rangeland management tool.

Several factors such as topography, climate, soil and the type of vegetation affect selection of an appropriate grazing system for each rangeland. Thus, each type of grazing system should be coordinated to suit the appropriate rangeland condition. Layne Coppock and Birkenfeld (1999) in their study concluded that less complicated grazing systems were more effective in increasing animal production. Van Pollen and Lasi (1981) concluded that the density of livestock in arid and semi-arid rangelands was more important than the grazing system. Umberger (2001) believed that the type of livestock, growth stage and body weight determines quantity and quality of forage for livestock and that this issue should be considered in strategic management of time and place grazing. In a study by Campbell et al., (2000), an evaluation of four methods of bovine flock management concluded that herders should refuse to use traditional methods of rangelands maintenance and instead use a flexible method. Arzani et al. (2007) expressed that the rangeland economic problem is one of the challenges of rangeland management and demonstrated that existing conditions are far from ideal. The destruction of management structures, shrinking of rangelands and poor sales of products and economic pressure has led to poor and competitive management of rangelands and destruction of natural resources (Farvar, 2005). Selective decisions and the top prioritization options between various options have a significant role in organizational goals. Of all the various decision making systems the Analytical Hierarchy Process (AHP) is the most important. This method was first introduced by Thomas L. Saaty in 1980. Today, AHP has been widely used in management decisions in the industrial, agricultural and service sectors. The basis of AHP is a paired comparison of options and possibilities for different scenarios. Flexibility and compatibility can be used to solve simple problems and complications, these being the benefits of AHP in making multi objective decisions (Saadi et al., 2009). This method formulates issues hierarchically and considers various issues as qualitative and quantitative. This method involves different options in deciding and analyzing the sensitivity of criteria and sub-criteria. Its basis is a paired comparison
that facilitates judgments and calculations. Systematic group participation was used for the selection of strategies. This method also indicates the amount of compatibility and incompatibility of decisions, and it has a strong theoretical basis based on axioms (Ghodsipour, 2011). The purpose of this study is an adjustment comparison of operating systems in Gilan and Ardebil’s rangelands and the selection of priorities of each of the operating systems in the rangelands of these two provinces by the Analytical Hierarchy Process method.

**Materials and Methods**

**Site of Study**

**Guilan province**

The study area of this study was the rangelands of Guilan Province (14711 square kilometers). This province is located at 36° 34’ to 38° 27’ north latitude and 48° 53’ to 50° 34’ east longitude. Based on quality, the rangelands of Guilan province were divided into three parts: good (grade A), moderate (grade B), and poor (grade C). In addition, other functions of rangelands include fodder production, beekeeping (because of existing plants such as thyme, Astragalus, Sainfoin and types of flowers), the growth of beneficial herbs (borage, thyme, chamomile, spearmint, etc.), recreation, and sightseeing.

**Ardebil province**

Ardebil Province, measuring 17,880 square kilometers, is found in the northwest of the plateau of Iran (1.1% of the total area). This province is located at 37° 45’ to 39° 42’ north latitude and 47° 30’ to 48° 5’ east longitude.

**Statistical Population and Research Tool**

The statistical population of this study included 10 experts of forest organization and rangelands of the provinces of Guilan and Ardebil, selected from among 30 experts by purposive sampling. Thomas L. Saati’s Inventory in nine degrees was a research tool; its basis is paired comparisons between criteria and sub-criteria.

**Methods**

The method used in this study was the Analytical Hierarchy Process model. First, the criteria and important sub-criteria were determined. The aim of the research was to select the most preferred operating system for the Ardebil Province rangelands. Social, economic and ecological indexes were the main criteria. The first important sub-criterion was determined by the focused group method between rangeland specialists, because this study had various criteria with varied levels of importance (Khosravi and Abedsaaidi, 2011). Five main sub-criteria of each criterion were specified in Table 1. In the next step, paired comparisons between the criteria and sub criteria and options were performed using Thomas L. Saati’s 9-degrees questionnaire, and then data were analyzed by the Super Decision Software. After paired comparisons, the criteria, the sub criteria, and the options were weighed and, by determining and combining the relative weights, the final weight of options was obtained (Moreno et al., 2005). In this research, numeric paired comparison was performed, and the paired comparison of inconsistency sets of judgments was calculated by software. The inconsistency rate of comparisons should not be than 0.1 (Ghodsipour, 2011).

**Table 1 Important sub-criteria of research criteria**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Sub-criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Organized the work of grazing; Decision system for number of livestock and composition of flock; Decision system for nomad; Amount of interest among farmers’ descendants in rangeland activity; Use change effects.</td>
</tr>
<tr>
<td>Economic</td>
<td>Rangeland forage produced; Dependence on regional income on other rangeland production inputs; Total livestock units kept on rangelands; Ratio of rangeland area to households; Living benefit costs.</td>
</tr>
<tr>
<td>Ecological</td>
<td>Condition of rangelands; Capacity of rangelands; Competence of rangelands; Matching time between entry and exit of livestock and vegetation phenology; Identification of the destructive effects of livestock in the region.</td>
</tr>
</tbody>
</table>
Analytic Hierarchy Process

Creating hierarchy

The first step in creating a hierarchy is to determine its surface. There are four target levels of criteria, sub criteria, and options in this study. Relating the problem to the hierarchy is the most important part of the analytical hierarchy process (Saaty, 1990). In other words, the Analytical Hierarchy Process simplifies a complex issue through its decomposition to minor elements, which provides a relationship between the main problem and the lowest level of the hierarchy (Ngai, 2003). Four steps should be considered in the construction of a hierarchy. Step one: modeling, step two: preferred judgment (paired comparisons), step three: calculation of relative weights, and step four: integration of relative weights (obtaining final weight) (Sarvar, 2005). Hierarchy levels in this study include four levels. The first level is the comparison of operating systems in the Ardebil Province rangelands. The second level is determining the main economic, social and ecological criteria. The third level is matching the sub-criteria of each criterion with five sub-criteria. The fourth level is determining the private, public, and traditional operating systems of rangelands.

Determining the important factors of criteria and the sub-criteria

The method of paired comparisons is used to determine the important factors of criteria and the sub-criteria. In this method, criteria are compared together, and the importance of each is determined by each of the other criteria. The standard method by Thomas L. Saati can be used. In this method, the paired comparison will assign a number from one to nine. Table 2 indicates the importance of each number. After weighting, weights should be normalized for this purpose. There are a variety of ways for weighting. In this study, each weight was divided into the total weight of the same column (Ghodsipour, 2011).

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**Goal:**
Adjustment comparison of optimal system operation of Guilan and Ardebil’s rangeland by Analytical Hierarchy Process Model (AHP)

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**Figure 1** Empirical model of research
Table 2 Saaty Scale (Bowen, 1990)

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Verbal scale</th>
<th>Numerical values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two elements contribute equally</td>
<td>Equal importance of both elements</td>
<td>1</td>
</tr>
<tr>
<td>Experience and judgment favour one element over another</td>
<td>Moderate importance of one element over another</td>
<td>2</td>
</tr>
<tr>
<td>An element is Strongly favored</td>
<td>Strong importance of one element over another</td>
<td>3</td>
</tr>
<tr>
<td>An element is very strongly dominant</td>
<td>Very strong importance of one element over another</td>
<td>4</td>
</tr>
<tr>
<td>An element is favored by at least an order of magnitude</td>
<td>Extreme importance of one element over another</td>
<td>5</td>
</tr>
<tr>
<td>Used to compromise between two judgments</td>
<td>Intermediate values</td>
<td>6</td>
</tr>
</tbody>
</table>

**Determining the importance of a factor’s options**

After determining the coefficients of the importance of criteria and sub-criteria, the important factor options should be specified. At this stage each preferred option evaluated was associated with each sub-criterion. Processing options obtain weight than each of the criteria like determining importance of factor criteria than a goal. In both cases, judgments are expressed according to paired comparison criteria or options, and the coefficient is obtained by normalizing the rows of this matrix. There is a major difference in of this comparison that compare different options perform than sub criteria or criteria (if you do not sub criteria) whereas comparison criteria together performs than aim of this study. So rather than asking the question of how important is preferring criterion “I”, than criteria “j” in achieving the goal, the question that should be asked is how much preference is there to option “I”, in relationship with sub criteria “x” on option “j” in the comparison of options (Hemaida and Kalb, 2001).

**Determining final rating options**

At this stage, the final weight of each of the options is determined by the relative importance of combining coefficients based on a hierarchical combination of satire that leads to priority setting according to all judgments at all hierarchical levels (Moreno et al., 2006).

**Inconsistency reviews in judgments**

One of the advantages of the analytic hierarchy process is control of decision incompatibility. On the other hand, in the analytical hierarchy process the decision incompatibility can be calculated and judged as well than bad or acceptable to reject it. Incompatibility rates indicate how much the priorities determined by the software can be trusted. It is recommended that the decision maker appeal the judgments when decision incompatibility is more than 0.1 (Alam Tabriz and Bagherzadeh, 2009).

**Results and Discussion**

Results of the analysis of data obtained through questionnaires completed by 10 rangeland experts of Ardebil Province are as follows:

The comparison and determination of the precedence of major criteria in the economical, social, and ecological indices based on this research’s aim showed that the social index with a relative weight of 0.494 had the highest priority in the province of Ardebil. Rates of incompatibility in judgment are 0.089, which is less than 0.1 and can therefore be trusted (Dyer, 1990).

Therefore, the special vector of the original criteria’s priority would be W1. According to the obtained special vector, the economic index has the highest priority, followed by the ecological index, and the social index has the lowest priority.

\[
W_1 = \begin{pmatrix}
0.494 \\
0.316 \\
0.190
\end{pmatrix}
\]

Results of the analysis of data obtained from questionnaires completed by 10 rangeland experts of Guilan Province are as follows:
The comparison and determination of the precedence of major criteria in the economical, social, and ecological indices based on the aim of this research showed that the economical index with a relative weight of 0.492 has the highest priority in the province of Guilan. Table 3 expresses the main criteria for setting priorities. The special precedence vector of the main criteria is W1. The inconsistency rate of performing comparisons is 0.056; since it is smaller than 0.1 it can therefore be trusted to make comparisons (Hil et al., 2010).

\[
W_1 = \begin{pmatrix}
0.194002 \\
0.492868 \\
0.313130
\end{pmatrix}
\]

After the paired comparison of the main criteria (according to the study’s goal) was calculated, the important factor each sub-criteria was related to them. Five sub-criteria were identified for each of the three indexes. To prioritize the sub-criteria, the opinions of 10 experts were used, and a special vector was calculated by the geometric mean technique and normalization of obtained values. Calculations performed for each of the sub criteria are provided in Tables 4-6.

### Table 3 The main criteria for determining the priority

<table>
<thead>
<tr>
<th>Eigenvector</th>
<th>Ecological</th>
<th>Economic</th>
<th>Social</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.194</td>
<td>0.671</td>
<td>0.318</td>
<td>1</td>
<td>Social</td>
</tr>
<tr>
<td>0.492</td>
<td>1.113</td>
<td>1</td>
<td>3.143</td>
<td>Economic</td>
</tr>
<tr>
<td>0.313</td>
<td>1</td>
<td>0.897</td>
<td>1</td>
<td>Ecological</td>
</tr>
</tbody>
</table>

### Table 4 Determination of main criteria

<table>
<thead>
<tr>
<th>Eigenvector</th>
<th>Ecological</th>
<th>Economic</th>
<th>Social</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.194</td>
<td>0.671</td>
<td>0.318</td>
<td>1</td>
<td>Social</td>
</tr>
<tr>
<td>0.492</td>
<td>1.113</td>
<td>1</td>
<td>3.143</td>
<td>Economic</td>
</tr>
<tr>
<td>0.313</td>
<td>1</td>
<td>0.897</td>
<td>1</td>
<td>Ecological</td>
</tr>
</tbody>
</table>

### Ardebil Province

The special priority vector identified sub-criteria would be W2. According to an obtained special vector, the highest priority is related to the social index. The ecological index is next in priority, and the economic index has the lowest priority.

\[
W_2 = \begin{pmatrix}
0.234 & 0.343 & 0.204 \\
0.208 & 0.209 & 0.225 \\
0.228 & 0.160 & 0.253 \\
0.130 & 0.080 & 0.180 \\
0.200 & 0.207 & 0.138
\end{pmatrix}
\]

### Table 5 Determination of social sub-criteria

<table>
<thead>
<tr>
<th>Eigen vector</th>
<th>C15</th>
<th>C14</th>
<th>C13</th>
<th>C12</th>
<th>C11</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.234</td>
<td>0.987</td>
<td>2.202</td>
<td>1.133</td>
<td>0.983</td>
<td>1</td>
<td>C11</td>
</tr>
<tr>
<td>0.208</td>
<td>0.548</td>
<td>1.104</td>
<td>2.202</td>
<td>1</td>
<td>1.018</td>
<td>C12</td>
</tr>
<tr>
<td>0.228</td>
<td>1.935</td>
<td>2.744</td>
<td>1</td>
<td>0.454</td>
<td>0.882</td>
<td>C13</td>
</tr>
<tr>
<td>0.130</td>
<td>0.873</td>
<td>1</td>
<td>0.364</td>
<td>0.906</td>
<td>0.454</td>
<td>C14</td>
</tr>
<tr>
<td>0.200</td>
<td>1</td>
<td>1.145</td>
<td>0.517</td>
<td>1.824</td>
<td>1.013</td>
<td>C15</td>
</tr>
</tbody>
</table>

C11: organized the work of grazing, C12: decision system about number of livestock and the composition of in flock, C13: decision system about nomad, C14: the amount of interest descendants of farmers to activity rangeland, C15: use change effects.

### Table 6 Determination of economic sub-criteria

<table>
<thead>
<tr>
<th>Eigen vector</th>
<th>C25</th>
<th>C24</th>
<th>C23</th>
<th>C22</th>
<th>C21</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.343</td>
<td>1.244</td>
<td>3.483</td>
<td>2.074</td>
<td>2.817</td>
<td>1</td>
<td>C21</td>
</tr>
<tr>
<td>0.209</td>
<td>0.611</td>
<td>2.780</td>
<td>3.483</td>
<td>1</td>
<td>0.355</td>
<td>C22</td>
</tr>
<tr>
<td>0.160</td>
<td>1.108</td>
<td>3.619</td>
<td>1</td>
<td>0.287</td>
<td>0.482</td>
<td>C23</td>
</tr>
<tr>
<td>0.080</td>
<td>0.605</td>
<td>1</td>
<td>0.276</td>
<td>0.360</td>
<td>0.287</td>
<td>C24</td>
</tr>
<tr>
<td>0.207</td>
<td>1</td>
<td>1.653</td>
<td>0.902</td>
<td>1.636</td>
<td>0.817</td>
<td>C25</td>
</tr>
</tbody>
</table>

C21: rangeland forage produced, C22: The dependence on regional income people to other rangeland production inputs, C23: The total livestock units kept in rangelands, C24: Ratio rangeland area to households, C25: Living benefit costs.
Identifying utilization system of rangeland using AHP

Table 7 Determination of ecological sub-criteria

<table>
<thead>
<tr>
<th>Eigen vector</th>
<th>C35</th>
<th>C34</th>
<th>C33</th>
<th>C32</th>
<th>C31</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.204</td>
<td>1.430</td>
<td>0.753</td>
<td>2.074</td>
<td>1.375</td>
<td>1</td>
<td>C31</td>
</tr>
<tr>
<td>0.225</td>
<td>2.013</td>
<td>1.796</td>
<td>3.483</td>
<td>1</td>
<td>0.737</td>
<td>C32</td>
</tr>
<tr>
<td>0.253</td>
<td>1.529</td>
<td>1.502</td>
<td>1</td>
<td>1.329</td>
<td>1.185</td>
<td>C33</td>
</tr>
<tr>
<td>0.180</td>
<td>1.326</td>
<td>1</td>
<td>0.276</td>
<td>0.557</td>
<td>1.329</td>
<td>C34</td>
</tr>
<tr>
<td>0.138</td>
<td>1</td>
<td>0.754</td>
<td>0.902</td>
<td>0.497</td>
<td>0.699</td>
<td>C35</td>
</tr>
</tbody>
</table>

C31: Condition rangelands, C32: Capacity of rangelands, C33: Competence rangelands, C34: Matching time between entry and exit livestock and vegetation penalty, C35: Identify the destructive effects livestock in the region.

Guilan Province

\[
W_2 = \begin{bmatrix}
0.3603 & 0.4408 & 0.3127 \\
0.1916 & 0.1407 & 0.2274 \\
0.1216 & 0.1376 & 0.1309 \\
0.0797 & 0.0998 & 0.1922 \\
0.2468 & 0.1811 & 0.1369
\end{bmatrix}
\]

In determining the priority of options, options must be evaluated as paired according to each criterion separately. In this study, fifteen paired comparison matrices will be calculated, because there are fifteen criteria. A super matrix of the priority of options was calculated based on a special vector from each matrix. Due to the performing comparisons volume, only the special vector of priority of options based on each sub-criterion as super matrix \( w_3 \) are shown in the Table 11.

Table 8 Priority determination of social sub-criteria

<table>
<thead>
<tr>
<th>Eigen vector</th>
<th>C15</th>
<th>C14</th>
<th>C13</th>
<th>C12</th>
<th>C11</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.360</td>
<td>0.826</td>
<td>4.047</td>
<td>2.884</td>
<td>3.810</td>
<td>1</td>
<td>C11</td>
</tr>
<tr>
<td>0.191</td>
<td>0.505</td>
<td>2.906</td>
<td>4.047</td>
<td>1</td>
<td>0.262</td>
<td>C12</td>
</tr>
<tr>
<td>0.121</td>
<td>1.466</td>
<td>1.282</td>
<td>1</td>
<td>0.247</td>
<td>0.346</td>
<td>C13</td>
</tr>
<tr>
<td>0.079</td>
<td>0.294</td>
<td>1</td>
<td>0.780</td>
<td>0.344</td>
<td>0.247</td>
<td>C14</td>
</tr>
<tr>
<td>0.246</td>
<td>1</td>
<td>3.396</td>
<td>0.681</td>
<td>1.976</td>
<td>1.210</td>
<td>C15</td>
</tr>
</tbody>
</table>

C11: Organized the work of grazing, C12: Decision system about number of livestock and the composition of in flock, C13: Decision system about nomad, C14: The amount of interest descendants of farmers to activity rangeland, C15: Use change effects.

Table 9 Priority determination of economic sub-criteria

<table>
<thead>
<tr>
<th>Eigen vector</th>
<th>C25</th>
<th>C24</th>
<th>C23</th>
<th>C22</th>
<th>C21</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.440</td>
<td>2.055</td>
<td>3.218</td>
<td>3.597</td>
<td>4.534</td>
<td>1</td>
<td>C21</td>
</tr>
<tr>
<td>0.140</td>
<td>0.805</td>
<td>0.624</td>
<td>3.218</td>
<td>1</td>
<td>0.220</td>
<td>C22</td>
</tr>
<tr>
<td>0.137</td>
<td>1.198</td>
<td>3.090</td>
<td>1</td>
<td>0.310</td>
<td>0.278</td>
<td>C23</td>
</tr>
<tr>
<td>0.099</td>
<td>0.398</td>
<td>1</td>
<td>0.323</td>
<td>1.600</td>
<td>0.310</td>
<td>C24</td>
</tr>
<tr>
<td>0.181</td>
<td>1</td>
<td>2.508</td>
<td>0.834</td>
<td>1.241</td>
<td>0.486</td>
<td>C25</td>
</tr>
</tbody>
</table>

C21: Rangeland forage produced, C22: The dependence on regional income people to other rangeland production inputs, C23: The total livestock units kept in rangelands, C24: Ratio rangeland area to households, C25: Living benefit costs.

Table 10 Priority determination of ecological sub-criteria

<table>
<thead>
<tr>
<th>Eigen vector</th>
<th>C35</th>
<th>C34</th>
<th>C33</th>
<th>C32</th>
<th>C31</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.312</td>
<td>1.391</td>
<td>1.819</td>
<td>3.321</td>
<td>1.453</td>
<td>1</td>
<td>C31</td>
</tr>
<tr>
<td>0.227</td>
<td>1.223</td>
<td>1.620</td>
<td>1.819</td>
<td>1</td>
<td>0.688</td>
<td>C32</td>
</tr>
<tr>
<td>0.130</td>
<td>1.531</td>
<td>0.618</td>
<td>1</td>
<td>0.549</td>
<td>0.301</td>
<td>C33</td>
</tr>
<tr>
<td>0.192</td>
<td>1.953</td>
<td>1</td>
<td>1.616</td>
<td>0.617</td>
<td>0.549</td>
<td>C34</td>
</tr>
<tr>
<td>0.136</td>
<td>1</td>
<td>0.511</td>
<td>0.652</td>
<td>0.817</td>
<td>0.718</td>
<td>C35</td>
</tr>
</tbody>
</table>

C31: Condition rangelands, C32: Capacity of rangelands, C33: Competence rangelands, C34: Matching time between entry and exit livestock and vegetation penalty, C35: Identify the destructive effects livestock in the region.
According to the performed calculations in Ardebil Province, option A of the private system, with a final weight of 0.534 has the highest priority. The next priority is the option of three traditional systems with a final weight of 0.234. A government system with a final weight of 0.230 has the lowest priority.

According to the performed calculations in Guilan Province, option A of the private system with a final weight of 0.451 has the highest priority. The next priority is option B—the government system with a final weight of 0.317. A traditional system with a final weight of 0.222 has the lowest priority.

Therefore, the structure of the super matrix of preference of options according to the main criteria is as follows:

\[
W_2^*W_1 = \begin{pmatrix}
0.234 & 0.343 & 0.204 \\
0.208 & 0.209 & 0.225 \\
0.228 & 0.160 & 0.253 \\
0.130 & 0.080 & 0.180 \\
0.200 & 0.207 & 0.138 \\
\end{pmatrix} \begin{pmatrix}
0.494 \\
0.316 \\
0.190 \\
\end{pmatrix}
\]

\[
W_2^*W_1 = \begin{pmatrix}
0.3603 & 0.4408 & 0.3127 \\
0.1916 & 0.1407 & 0.2274 \\
0.1216 & 0.1376 & 0.1309 \\
0.0797 & 0.0998 & 0.1922 \\
0.2468 & 0.1811 & 0.1369 \\
\end{pmatrix} \begin{pmatrix}
0.194002 \\
0.492868 \\
0.313130 \\
\end{pmatrix}
\]

Table 11 Determination of options according to sub-criteria (Ardebil province).

<table>
<thead>
<tr>
<th>C35</th>
<th>C34</th>
<th>C33</th>
<th>C32</th>
<th>C31</th>
<th>C25</th>
<th>C24</th>
<th>C23</th>
<th>C22</th>
<th>C21</th>
<th>C15</th>
<th>C14</th>
<th>C13</th>
<th>C12</th>
<th>C11</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.472</td>
<td>0.402</td>
<td>0.535</td>
<td>0.485</td>
<td>0.403</td>
<td>0.449</td>
<td>0.432</td>
<td>0.461</td>
<td>0.568</td>
<td>0.573</td>
<td>0.584</td>
<td>0.458</td>
<td>0.641</td>
<td>0.544</td>
<td>0.617</td>
</tr>
<tr>
<td>0.317</td>
<td>0.345</td>
<td>0.271</td>
<td>0.301</td>
<td>0.395</td>
<td>0.232</td>
<td>0.297</td>
<td>0.295</td>
<td>0.158</td>
<td>0.224</td>
<td>0.222</td>
<td>0.213</td>
<td>0.129</td>
<td>0.230</td>
<td>0.919</td>
</tr>
<tr>
<td>0.212</td>
<td>0.253</td>
<td>0.194</td>
<td>0.214</td>
<td>0.202</td>
<td>0.320</td>
<td>0.272</td>
<td>0.245</td>
<td>0.274</td>
<td>0.204</td>
<td>0.194</td>
<td>0.329</td>
<td>0.257</td>
<td>0.226</td>
<td>0.185</td>
</tr>
</tbody>
</table>


results. Also Ahmadi (2004) suggests that this issue arises from the type and style of human intervention that is affected by economic, social, and technical factors. Hantsingr and Hapkinsvn (1996) believe that ecological characteristics and social issues of rangelands should be noted in the exploitation and management of rangelands. Lee and Smith (2003) expressed that humanitarian issues are more important than ecological issues in the exploitation and management of rangelands.

Nathan (2004) believes that the use and management of rangelands include the management of both ecological and social dimensions and combining these two dimensions ensures the conservation and sustainable use of resources. And that confirms the results of this research. Questionnaire number two examined the sub-criteria of each criterion. Among the social criteria of both provinces, organized grazing of livestock is an important sub-criterion. Because of overgrazing and untimely use by livestock, severe damage has occurred to rangeland. These issues are effective on the status and trends of rangeland. Grazing management is important, and our results are consistent with study of Moradian (1998). This researcher suggested that forage should be provided to ranchers in order to prevent the deterioration of rangelands by preventing early grazing, and plant cutting in the rangeland should decrease with the fuel supply. Amberger (2001) also believes that the livestock growth stage and body weight determine the quality and quantity of forage needed by livestock and that grazing time and place should be considered in management strategies.

In review of the sub-criteria of the economic criteria, rangeland forage produced has first priority in both provinces. Our results were similar to the results of Farhnak and Movahedi (1997). They expressed that in Iran, the use of rangelands is of utmost economic importance, and the rangelands
produce about 100 million tons of dry forage grazing annually. This amount is sufficient for a 100-day feed of 50 million livestock units. Rangeland qualification is an important sub-criterion of ecological criteria in Ardebil Province where rangeland sustainability is the most emphasized qualification of rangeland.

Rangelands use should not provide a limitation for future generations. In Guilan Province, rangeland condition has a higher priority. Piper and Beck (1990) in their study expressed that rangeland condition is the most important index, the evaluation of which is necessary for rangeland management. Analysis of the third questionnaire indicated the comparison of three exploitation systems of rangelands with the sub-criteria of research. The private exploitative system has a higher final weight than the preferred exploitation system in both provinces. These conclusions are consistent with the research of Ahmadi (2004) about rangeland grants in the 30-year rangeland plan that motivation and sense of ownership of the rangeland will improve rangeland conditions. Campbell et al. (2000) concluded in their studies that ranchers should abandon traditional methods of maintaining rangeland and use flexible methods instead.

### References


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