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Economic sustainability assessment in semi-steppe rangelands

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Abstract

This study was conducted to determine indices and components of economic sustainability assessment in the pastoral units of Sahand summer rangelands. The method was based on descriptive-analytical survey (experts and researchers) with questionnaires. Analysis of variance showed that the mean values of economic components are significantly different from each other and the efficiency component has the highest mean value (0.57). The analysis of rangeland pastoral units with the technique for order-preference by similarity to ideal solution (TOPSIS) indicated that from an economic sustainability standpoint, Garehgol ($C_i = 0.519$) and Badir Khan ($C_i = 0.129$), pastoral units ranked first and last, respectively. This study provides a clear understanding of existing resources and opportunities for policy makers that is crucial to approach economic sustainable development. Accordingly, this study can help better define sustainable development goals and monitor the progress of achieving them.

Keywords: Economic sustainability; economic components; TOPSIS model; semi-steppe rangelands.

1. Introduction

In recent decades, the concept of sustainable development has been proposed as the framework to determine and understand economic and social development and natural resource management around the world. Sustainable development as the turning point for the new paradigm, has been introduced to the human societies after 5 decades of theoretical and practical development challenges. It links the economic, social, and ecological systems to turn development into a humane, supreme, multi-aspectual, comprehensive, balanced and sustainable concept. Sustainable development is a broad concept and includes all the social, economic and cultural aspects of human

39 life among others. In other words, it can be claimed that the most significant attraction of
40 sustainable development is its broad-ranging scope (Jennifer, 2012, Dempsey et al., 2011, Yarihesar
41 et al., 2013).

42 The intention of sustainable development is to lead the human society to a fine, environment-
43 friendly and sustainable world by inducing economic and social development and environmental
44 responsibility (Kates et al., 2005, Khosrobeigi et al., 2011). In this meaning, sustainability is based
45 on maintaining capital resources (such as human, social, natural and economic) and in fact,
46 sustainable development is nothing but maintaining these resources (Pourtaheri et al., 2011).
47 Sustainable development comes to life only when ecological, economic and social layers overlap
48 with one another. This means that each ecological, economic, and social system or subsystem
49 should reach a desired level of sustainability to be eligible for judgment about sustainability (Ciegis
50 et al., 2009).

51 Sustainability as the descriptive aspect of development is the state where desirability and features
52 do not decrease with time (Kuhlman & Farrington, 2010; Finkbeiner et al., 2010; Al-Hallaj. et al.,
53 2012). Sustainability, in its wide definition, is regarded as the ability of a society, ecosystem or any
54 other current system to continue performance indefinitely without getting weak by the inevitable
55 erosion of the resources which the system depends on or tolerates extra load (Goodland, 2003).

56 Economic sustainability has been defined as a generating income and stability for society members
57 without the erosion of capital and resources. In other words, economy is stable when it does not
58 disturb the sustainability of natural, social, and human societies (Spangenberg, 2005; Pires et al.,
59 2017). It can also be said that economic sustainability is an ethical foundation which aims at justice
60 in the domain of human-nature relationships and in the view of long-term and inherently uncertain
61 future. This includes three specific relationships: (i) justice between humans of different

62 generations, (ii) justice between different humans of the same generation, in particular the present
63 generation, and (iii) justice between humans and nature (Baumgärtner and Quaas, 2010).

64 Multi-criteria models as subset foundations of sustainability assessment are official approaches to
65 create information and evaluate decision making about numerous subjects and contradictory goals.
66 Multi-criteria models can give the utilizers a better understanding of integrated assessment results,
67 such as evaluation of policy-making goals and using their results in a system, and methods of
68 employing recommended policies for sustainable development purposes (Bell et al., 2003). Multi-
69 criteria decision-making models are used in the integrated assessment of sustainability due to their
70 ability to make analyzing subjective and objective information possible in a unique framework
71 (Pancy and Batary, 2008). Since in planning and management models, altering the view from one
72 dimensional to multi-dimensional has happened from a single-attribute to a multi-attribute scheme,
73 multi-criteria models with the intention of causing overlap between various aspects and indices and
74 weighting indices have gained great importance from experts' points of view. One of these new
75 sustainability assessment techniques is the multi-criteria assessment method (Khosrobeigi et al.,
76 2011). It seems that multi-criteria methods are suitable tools to rank or select one or some
77 substitutes in an existing set of indices according to their multi-dimensional nature and especially
78 contradictory criteria (Anabestani et al., 2011). Due to the fact that sustainable development in
79 natural resources and especially in rangeland pastoral units has multiple aspects and the
80 conventional models to explain these multi-aspectual issues are ineffective, multi criteria models
81 can be used to facilitate the multiple alternatives entry with diverse criteria and goals (waas et al.,
82 2014). In multi criteria methods, there is a large set of tools to help planners and policy-makers
83 solve decision making problems by considering often contradictory points of view (de Miranda
84 Mota et al., 2009).

85 The technique for order-preference by similarity to ideal solution (TOPSIS) is one of the multi-
86 criteria methods which is used to assess and rank regions, cities, villages or any other study units
87 and it was suggested by Hwang and Yoon in 1981. This model is among the best multi-criteria and
88 multi-attribute models and is therefore used extensively in related studies. In this method,
89 alternatives are assessed by n indices. The basis for this technique is that the selected alternative
90 must have the least distance from the positive ideal solution (best performance) and the highest
91 distance from the negative ideal solution (worst performance) (Momeni, 2013). Its advantages are
92 using quantitative and qualitative criteria simultaneously to assess and rank the units under study,
93 decision making, distinguishing and giving importance to all the indices based on positive and
94 negative indices (Kalantari, 2012). Pourtaheri et al. (2011) conducted a study on assessment and
95 ranking of social sustainability in rural regions of Khodabandeh, Iran by using the TOPSIS model
96 and concluded that it has successfully determined the realities of sample village societies.
97 Khosrobeigi et al. (2011) conducted a similar study on Komeijan rural regions, Iran and reported
98 that the TOPSIS model, as a worthy and efficient technique among multi-criteria models, has
99 successfully determined and ranked the level of sustainability in the rural areas in the regions under
100 study. In other words, their findings from field studies and visual observations are highly consistent
101 with the realities of rural residences. Accordingly, Hedayati-Moghadam et al. (2014), in a study on
102 rural areas of Isfahan, Iran, reported that sustainability levels are not uniform and in each aspect of
103 sustainability, there is a difference between different areas and the TOPSIS model has been able to
104 distinguish them.

105 Rangelands are among the most important natural and economic resources of the country and has
106 been under the focus of agriculture and natural resource planners in recent decades due to the
107 improper utilization and ever growing destruction of them. Nonetheless, agricultural development
108 strategies, especially in renewable resources, have always experienced highs and lows in the

109 endogenous development of Iran. In other words, repeated fundamental changes have been made to
110 the strategies for management of natural renewable resources. On the other hand, the country's
111 nomadic society, with a population of 180000 households and 22551072 livestock which comprises
112 28.96 % of the country's entire livestock (Eskandari et al., 2008), are the major rangeland utilizers
113 of the country. They have been able to continue their activities by utilizing the peripheral areas and
114 rangelands and by producing the minimum cost for generations. Noting the importance of animal
115 husbandry in household economy of nomads, it can be stated that the biological model of these
116 utilizers is based on feeding the livestock from rangelands and its necessities. It should be noted that
117 the rangeland share of nomad household income has been reported to be 70% of their net income
118 which indicates the extent of economic and livelihood reliance of nomadic utilizers on rangelands
119 (Khakipour et al., 2012). The final strategy regarding the rangelands is transferring them by
120 providing property ownership documents whose theoretical basis includes a sense of belonging and
121 personal owning. Consequently, transfers have started in the form of pastoral units and rangeland
122 owner plans; a large number of rangelands have been processed and their plans have been prepared
123 and given to the beneficiary livestock holders (Hosseinia et al., 2013; Eftekhari et al., 2012).
124 Planning with the intention of empowering the economic system of pastoral unit utilizers is
125 essential to reach sustainable development; because, a healthy economy in rangeland pastoral units
126 can revive itself by expanding the side activities based on the existing products and a step towards a
127 sustainable economy on the road for development. However, a prerequisite for economic system
128 sustainability of rangeland pastoral units is having a clear understanding of the area under study and
129 being familiar with its capabilities in this aspect. This is plausible if an appropriate and
130 comprehensive framework is provided in order to assess sustainability (Khosrobeigi et al., 2011). In
131 recent years, sustainable development has been under focus in written studies on the country's
132 development more than before. However, a specific and defined framework of the methods and

133 models for sustainability assessment has not been proposed, especially for rural and nomadic areas.
134 Therefore, a new attitude must be made towards the concept of sustainability assessment in rural
135 and nomadic areas (pastoral units) and its indices must be rated. Changing the paradigm from
136 traditional (classic) to modern (substitute) has changed planning, management and methodology.
137 These changes are perceivable by using the methods capable of assessment, measurement,
138 interpretation and explanation. Therefore, discussing sustainable development without considering
139 proper assessment, measurement, interpretation and explanation methods is worthless.

140 So far there has been no study on sustainability assessment for rangeland pastoral units and there is
141 no information on whether rangeland pastoral units are socially, economically and environmentally
142 sustainable or not. Development decisions should be based on human and physical resources at
143 hand, internal, and external conditions of the area and residents' needs. Therefore, understanding
144 the status quo and the society's current place from a sustainability standpoint by using proper
145 assessment models is crucial because reaching economic, social, and environmental sustainable
146 development requires a clear understanding of existing resources and opportunities for utilizing
147 them. Investigating sustainability levels for rangeland pastoral units can provide this understanding
148 of the status quo and the society's current place from a sustainability standpoint by determining the
149 advantages, disadvantages, opportunities, and external threats corresponding to the development of
150 these areas. In other words, sustainability assessment for rating purposes helps us better define
151 sustainable development goals and evaluate progress in reaching them (Anabestani et al., 2011,
152 Gobattoni et al., 2015). Additionally, obtaining sustainable development in any level or with any
153 goal requires efficient planning according to the principles and a careful execution of it.
154 Formulating development strategies, success in planning and executive plans, evaluating and
155 recognizing the capabilities, shortcomings and determining the development level of local
156 residences according to a set of superior indices are essential for various economic, social, and

157 environmental plans (Waas et al., 2014, Ciegis et al., 2015). Due to the large span of the aspects of
158 sustainable development, sustainability assessment and its components in all its aspects do not fit
159 within the scope of this study. Therefore, the current study was performed in order to assess the
160 economic sustainability and analyze its components among the utilizers of Sahand rangeland
161 pastoral units.

162

163 **2. Materials and methods**

164 The regions under study were Sahand rangeland pastoral units in Maragheh Fig. 1. This mountain
165 range is located in the north of Maragheh and its peak is called Jaam. Sahand and Jaam are the two
166 stuck-together peaks of this rangeland. Sahand Mountain, with 129000 hectare summer rangelands,
167 in addition to its lush nature, is home to various herbal species such as cool season grasses,
168 *Agropyron trichophorum*, *Festuca ovina* and *Bromus tomentolus* with *Cousinia commutate*,
169 *Euphorbia* spp., *Cirsium arvence*, *Artemisia aucheri* and scattered *Thymus* spp, and *Astragalus* spp.
170 shrubs. And its hillsides have appropriate rangelands and pastures for the livestock owned by the
171 nomads and livestock holders of the area (Mofidi et al., 2012). The livestock holders and nomads of
172 Eastern and Western Azarbayejan Provinces migrate towards Sahand hillsides every year for their
173 yaylak and also feeding their livestock. Yaylak is a summer highland pasture for feeding the
174 livestock.

175

176 ***2.1 Statistical Population and units of analysis***

177 Sahand hillside has approximately 129000 hectare of summer rangelands which each year, 750
178 nomadic households with a livestock population of 105000 in the form of 124 pastoral units from
179 different cities of the country's north east such as Mahabaad, Mian-do-aab, Malekan, Bonaab,
180 Oskoo, Mianeh, and Azarshahr migrate for yaylak. Thus, the statistical population of the study

181 includes all the utilizers and summer pastoral units of Sahand. Additionally, the reference group for
182 validation of sustainability assessment indices includes the professors and graduates of rangeland
183 sciences and geography and rural planning from all over the country with at least master's degree,
184 experts of natural resources agencies especially the rangeland division and local experts among
185 utilizers in Sahand summer rangelands. Due to the large span of the study's statistical population
186 and noting the limitations facing enumeration, the sample population and this selection procedure
187 are of special importance. The sample population in this study includes 3 groups: The reference
188 group for validation and attribute weighting, pastoral units, and utilizers' households. The first
189 group was selected by the use of convenience sampling, which is a type of non-probability
190 sampling technique. It included 45 individuals including 20 experts from university professors and
191 graduates with at least master's degree in rangeland sciences, geography and rural planning fields,
192 15 executive experts of natural resources agencies, and 10 local experts chosen from summer
193 rangeland utilizers. In convenience sampling, basically generalizing the results to the population
194 under study is not the case, sampling is performed from the available expert population to increase
195 accuracy and validity. The number of sample households according to Cochran's q test was
196 estimated to be 205 households (utilizers). In order to fill the questionnaires of households and
197 rangeland pastoral units, 45 rangeland pastoral units were classified by random sampling according
198 to the number of utilizers, pastoral unit area, number of livestock, and availability probability.
199 Finally, the rangeland pastoral units questionnaires were selected for all the 45 units and the
200 household questionnaires were randomly filled by the 205 households.

201 The study method, considering the nature of the work, is based on descriptive-analytical surveys
202 (experts and researchers). As the first step, a reference group formed of experts, researchers,
203 executive experts was formed and local elites were created and unstructured interviews were
204 conducted about economic sustainability and its assessment indices in rangeland pastoral units.

205 Next, noting the results of said interviews and also the literature review of the aspects and goals of
206 sustainable development and indices, a set of indices related to economic sustainability of pastoral
207 units, which are more useful and are most relevant to pastoral units of the area, were determined. In
208 the end, in order to obtain more operational and limited indices and also make the indices
209 operational according to the subject and area of the study, final indices were assessed by the
210 reference group for validation and attribute weighting and as the last step, mode, median, mean
211 value, standard deviation, and coefficient of variation were calculated for each attribute. Next,
212 according to the scores given by experts and local elites, the indices having mode, median, and
213 mean value scores greater than 3, standard deviation smaller than 1, and coefficient of variation
214 smaller than 0.3 were selected. Afterwards, Kruskal-Wallis H test was used to determine how close
215 the opinions of natural resources agencies experts, faculty members and expert researchers, and
216 local elites are to one another regarding the appropriateness and inappropriateness of each attribute.
217 Finally, a number of indices which had an appropriate validity level were selected and introduced in
218 order to assess the economic sustainability of rangeland pastoral unit utilizers. The results of this
219 chapter were published in Issue 3 of Village and Development in Fall 2015 (Mofidi et al., 2015).

220

221 *2.2 Importance coefficient of sustainability assessment indices*

222 When different indices are used for assessing sustainability level, it cannot be claimed that all the
223 indices have the same value and importance. Therefore, in order to control the differences between
224 the indices, proper weights need to be assigned to them. In this study, due to the wide span and
225 large number of sustainability assessment indices, surveying was used for calculating the relative
226 weight of indices and Analytic Hierarchy Process (AHP), and pairwise comparisons were used to
227 calculate the relative weights of the components. Accordingly, the importance of components and

228 aspects of sustainability was determined by 20 university experts and related specialists and was
229 calculated in Expert Choice software.

230

231 ***2.3 Estimating the selected indices in rangeland pastoral units***

232 In order to estimate selected indices among utilizers and rangeland pastoral units, questionnaires
233 were used. For this purpose, 2 questionnaire types were devised for household data and general and
234 ecological data regarding rangeland pastoral units. For validity analysis, the questionnaires along
235 with goals, assumptions, and study questions were given to a number of experts in the field of
236 sustainability assessment and they were asked to present their corrective comments regarding
237 questionnaire questions. As a result, the found issues in the questionnaires were corrected.
238 Afterwards, in order to study the questionnaires' reliability, Cronbach's alpha was used. In this
239 study, it was calculated to be 78% for various sections of the questionnaires which is within the
240 desired limits (Cronbach, 1951). In the end, the questionnaires were filled by going to the areas
241 under study and the intended indices were estimated by conventional methods.

242

243 ***2.4. Analysis methodology of economic sustainability assessment data***

244 ***2.4.1 TOPSIS (Technique for order-Preference by Similarity to ideal Solution)***

245 TOPSIS is a compensative multi-criteria, multi-attribute technique for prioritizing the alternatives
246 by similarity to the ideal solution which has very low sensitivity to the weighting technique. In this
247 method, the selected alternative must have the shortest distance from the ideal and longest distance
248 from the nadir. In short, in the TOPSIS method a $n*m$ matrix is assessed where there are m
249 alternatives and n criteria. It is assumed that each attribute or criterion in the decision-making
250 matrix has either increasing or decreasing desirability. Among the most important advantages of
251 this method is the fact that objective and subjective indices and criteria can be used simultaneously

252 (Rajabi and Mousavizadeh, 2015). Nonetheless, it is required that all the values assigned to the
 253 indices be quantitative or converted to quantitative if they are qualitative for mathematical
 254 calculations. In order to utilize this method, the following steps need to be taken (Hwang and Yoon,
 255 1981).

256 The TOPSIS method is expressed in a succession of six steps as follows:

257 Step 1: Calculate the normalized decision matrix. The normalized value r_{ij} is calculated as follows:

$$258 \quad r_{ij} = x_{ij} \sqrt{\sum_{i=1}^m x_{ij}^2} \quad i = 1, 2, \dots, m \text{ and } j = 1, 2, \dots, n.$$

259 Step 2: Calculate the weighted normalized decision matrix. The weighted normalized value v_{ij} is
 260 calculated as follows:

$$261 \quad v_{ij} = r_{ij} \times w_j \quad i = 1, 2, \dots, m \text{ and } j = 1, 2, \dots, n. \quad (1)$$

262 where w_j is the weight of the j^{th} criterion or attribute and $\sum_{j=1}^n w_j = 1$.

263 Step 3: Determine the ideal (A^*) and negative ideal (A^-) solutions.

$$264 \quad A^* = \{(\max_i v_{ij} | j \in C_b), (\min_i v_{ij} | j \in C_c)\} = \{v_j^* | j = 1, 2, \dots, m\} \quad (2)$$

$$265 \quad A^- = \{(\min_i v_{ij} | j \in C_b), (\max_i v_{ij} | j \in C_c)\} = \{v_j^- | j = 1, 2, \dots, m\} \quad (3)$$

266 Step 4: Calculate the separation measures using the m-dimensional Euclidean distance. The
 267 separation measures of each alternative from the positive ideal solution and the negative ideal
 268 solution, respectively, are as follows:

269

$$270 \quad S_i^* = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^*)^2}, \quad j = 1, 2, \dots, m \quad (4)$$

271
$$S_i^- = \sqrt{\sum_{j=1}^m (v_{ij} - v_j^-)^2}, j = 1, 2, \dots, m \quad (5)$$

272 Step 5: Calculate the relative closeness to the ideal solution. The relative closeness of the alternative
 273 A_i with respect to A^* is defined as follows:

274
$$RC_i^* = \frac{S_i^-}{S_i^* + S_i^-}, i = 1, 2, \dots, m \quad (6)$$

275 Step 6: Rank the preference order.

276

277 **2.5 Statistical tests**

278 Analysis of variance and Duncan tests were used to compare economic sustainability components.
 279 Economic sustainability is an aggregation of various components which includes eight economic
 280 components including activity and employment, utilization, productivity, economic welfare,
 281 efficiency, economic justice, economic stability and governmental services (Table 1). Correlation
 282 tests were used to determine the relation between economic components and economic
 283 sustainability of summer rangelands. Furthermore, the factor analysis model was used in order to
 284 choose the important indices in assessing economic sustainability of pastoral units and determining
 285 the main components of sustainability.

286

287 **3. Results**

288 **3.1 Importance coefficient of components and indices of economic sustainability assessment**

289 In Table 2, significance coefficients of components and indices of economic sustainability
 290 assessment for summer pastoral units are shown. It can be seen that economic welfare has a high
 291 significance among the components and has the highest weight. Moreover, the lowest weight
 292 corresponds to economic stability component. Among the indices, the highest and lowest

293 significance values correspond to job satisfaction level in the unit and medicine and veterinary cost
294 ratio, respectively. It should be noted that indices corresponding to the activity and employment
295 component had a high significance.

296

297 ***3.2 Descriptive findings***

298 The results showed that in the households, about 50.17% were female and 49.83% were male. The
299 majority of utilizers were middle-aged; 39.5% were 50-60 and 38.5% were 60-70 years old. 59.5%
300 of utilizers were illiterate, 30.7% were able to read and write, 6.3% had elementary school
301 education and the rest (3.4%) had early high school education. Also, 31.7% of utilizers had 40-50
302 years of experience, 21.9% had 30-40 years of experience and 5.85% had 20-30 years of
303 experience.

304

305 ***3.3 Economic components of sustainability***

306 Table 3 shows the results of the analysis of variance test for the mean value of economic indices.
307 The results show that economic indices are significantly different from one another and efficiency
308 component with 0.57 has the highest mean value among the components and governmental support
309 component has the lowest mean value (0) due to lack of service in the economic section. In order to
310 categorize the economic sustainability components, the Duncan test was used. The results of this
311 test is shown in Fig. 2. This figure indicates that economic components are categorized into 5
312 different groups. (a,b,c,d,bc)

313 The results of sustainability assessment of rangeland pastoral units (Table 4) show that, from an
314 economic sustainability standpoint, Garehgol pastoral unit ranks first and has the highest
315 sustainability ($C_i=0.519$) and Badirkhan pastoral unit ranks last ($C_i=0.129$)

316

317 ***3.4 Correlation analysis of economic indices and economic sustainability of pastoral units***

318 Table 4, column Ci, shows the results of sustainability assessment of rangeland pastoral units. Table
319 5 shows the correlation of the economic components with economic sustainability of pastoral units.
320 In our hypothesis each of the components had only its effect on the final economic sustainability
321 independently, therefore we tried to find which components can effect directly and indirectly on the
322 economic sustainability. As shown in the table the utilization component has the least correlation
323 with economic sustainability. Efficiency and economic justice sustainability have no significant
324 correlation with economic sustainability.

325 Table 6 shows the important components in economic sustainability of rangeland pastoral units. In
326 this section, 9 important components were extracted which determine 85.05% variance of economic
327 sustainability. 7 important indices which were related to the costs and incomes of rangeland pastoral
328 unit utilizers were put in the productivity component and indicated 29.29% variance of economic
329 sustainability. 5 indices were put in the economic efficiency component. 2 indices related to
330 utilization method were put in the utilization system component. In each of the activity and
331 employment components like job safety, beekeeping, economic stability, utilization, and
332 governmental support, one attribute was placed. Additionally, 10 indices were removed due to not
333 having a correlation value above 0.7 with the important components of determining economic
334 sustainability (Table 7). Table 7 shows the correlation between economic sustainability assessment
335 indices (activity and employment, utilization, productivity, economic welfare, efficiency, economic
336 justice and economic stability) and their components.

337

338 **4. Discussion**

339 In recent years, the concept of strategic planning with a sustainability approach in the local level has
340 garnered much attention. In strategic planning for rangeland pastoral units, determining the current

341 state of the pastoral units under study is the starting point. Rangeland pastoral units are currently
342 faced with multiple issues and different options for their future. Therefore, this study was
343 systematically conducted on Sahand summer rangelands in order to evaluate the state of rangeland
344 pastoral units from the sustainability standpoint and determine the indices of sustainability and
345 appropriate sustainability assessment models. Reviewing the results indicates that from the
346 standpoint of correlation of economic indices with economic sustainability of rangeland pastoral
347 units, utilization, productivity and economic stability components had the highest correlation with
348 economic sustainability and the indices related to these components can be used for economic
349 sustainability assessment of Sahand summer rangeland pastoral units. On the other hand, economic
350 justice and efficiency components had the least correlation with the economic aspect of
351 sustainability and the indices related to these components have lower importance in economic
352 sustainability assessment of pastoral units.

353 Furthermore, productivity, economic efficiency and utilization system factors correspond to the
354 highest variations in economic sustainability. In this aspect of sustainable development, the values
355 of existing livestock in each household, income share from dairy and wool sales for each household,
356 life expenses, family's income, net income and productivity of production factors had the highest
357 correlation with the important factors of economic sustainability determination and can be used as
358 the most important indices of economic sustainability of rangeland pastoral units (Table 7). In this
359 regard, Ghadiri Masoum et al. (2010), Shayan et al. (2011), Yarihesar et al., (2012) used the
360 aforementioned indices for economic sustainability assessment.

361 The extracted points from unstructured interviews, field observations, and estimation results of
362 economic sustainability assessment in summer rangelands indicate that the weak economic power
363 of utilizers, low annual income level of nomadic households, lack of economic activities diversity
364 and mere dependence on husbandry, low education level, low productivity, low governmental

365 support, household size and low level of new technology usage are the main factors of economic
366 poverty of utilizers. The results also show that the low cost of grazing in rangelands, dependence on
367 traditional husbandry and not being familiar with economic aspects of husbandry (keeping sick
368 livestock and male livestock which are not capable of producing, assuming that they have more
369 livestock than their peers and that it can lead to income increase), result in the existence of surplus
370 livestock in summer rangelands. Additionally, these components lead to excessive usage of
371 rangeland resources. Sharifinia and Mahdavi, (2011) reported that the economic poverty factor and
372 the need for supplying life necessities causes over keeping of livestock in the limited space of
373 rangelands. It should be noted that in addition to said issues, the young and active generation of
374 utilizers are not interested in husbandry as a job due to the hard nature of the work and feeling of
375 deprivation; thus it is predicted that in the future, the problems will multiply.

376 The TOPSIS model results indicate that Garehgol pastoral unit (S_{28}) has the highest economic
377 sustainability. Field study results in the pastoral units of the area under study show that the used
378 indices and the techniques successfully determine and prioritize the pastoral units' sustainability
379 level. In other words, the findings of field studies and visual observations are highly consistent with
380 the realities of pastoral units of Sahand summer rangelands. It should be noted that Garehgol
381 pastoral unit (S_{28}) with an area of 300 acres is located in one of the best meadows of Sahand
382 summer rangelands where there is no limitation on forage production and water resources.
383 Furthermore, the utilizers of this pastoral unit benefit from high experience and local knowledge
384 regarding husbandry and are in an ideal state from social, level of cooperation and also social
385 solidarity standpoints. In this unit, the economic product diversity coefficient is high and the
386 utilizers do beekeeping activities in addition to husbandry.

387

388 **5. Conclusion**

389 The country's nomadic society has its own economic, social, and lifestyle characteristics and has
390 always been regarded as a productive, independent and powerful society with ethnic and tribal
391 indices based on familial connections. With time, various political, social, economic and natural
392 factors have made alterations to the lives of the members of this society especially in the last 50
393 years and have transformed the conventions of them to those of other lifestyles; in a way that this
394 society is currently going through a historical evolution, from traditional husbandry life to other
395 types of living. Considering the goals and policies and government planning for the country's
396 development, especially from social justice and regional balance standpoints, giving attention to the
397 nomadic society of the country and taking necessary steps towards the sustainable development of
398 this dynamic and changing society is among the requirements of comprehensive development
399 planning for the country.

400 In defining sustainability of economic activities, maintaining social desirability with time and
401 stabilizing production opportunities and economic growth for a sustainable future have been noted.
402 Economic system sustainability on the other hand, is defined as strengthening economic
403 foundations and obtaining economic justice from the standpoint of stable living availability in
404 ongoing affairs is in harmony with the environment by utilizing human resources. If sustainable
405 development is the final goal, there are tools and methods which are required to measure the move
406 towards sustainability in various scales. In other words, planning without analysis and assessment is
407 futile. Economic sustainability assessment reaches its goals when this procedure is carried out in a
408 systematic and comprehensive framework by providing purposeful tools and indices. Analyzing the
409 introduced economic components in this study shows that the indices which were selected show the
410 direction of income and households' market baskets and also their level of satisfaction regarding
411 their incomes and activities. In this study, in addition to introducing and analyzing the indices and
412 components of economic sustainability assessment in summer rangelands, a systematic and

413 scientific approach was taken to determine and validate the indices and components of economic
414 sustainability assessment and to analyze it in the rangelands which can be used for the experts and
415 researchers working in this field. Therefore, it is recommended that the natural resources experts
416 and planners, particularly those specialized in rangelands, use the accepted indices and components
417 used in the current study which experts and local elites agree on and work towards devising the
418 national sustainability assessment model and creating a data bank for rangelands. Development
419 decisions should be based on the current human and physical resources. This study provides a clear
420 understanding of existing resources and opportunities for policy makers that is crucial to approach
421 economic sustainable development. Accordingly, this study can help better define sustainable
422 development goals and monitor the progress of achieving them.

423

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531 **Table1.** Sustainability assessment indices for rangeland pastoral units (ref: Mofidi *et al.*, 2015)

Sustainability components	Sustainability assessment indices for rangeland pastoral units	Sustainability components	Sustainability assessment indices for rangeland pastoral units
Activity and employment	Job satisfaction level in the unit	Productivity	Coefficient of diversity for economic products Productivity of all the production components
	Job safety level		
	Degree of continuity and expansion of husbandry activities among the young generation		
Utilization	Value of existing livestock in each household	Economic welfare	Level of life expenses Family's income level
	Income share from dairy sales for each household	efficiency	Efficiency ratio (expenses/revenue) Family's continuity of income degree
	Income share from beekeeping for each household	Economic justice	Sponsorship load in the unit Eligibility chance for load
	Income share from rented livestock for each household		Income satisfaction level Net income
	Income share from wool sale for each household	Economic stability	Percentage of families having insurance support
	Livestock casualties ratio		Percentage of having livestock and rangeland insurance
	Livestock manual feeding expenses		
	Medicine and veterinary expenses ratio		
	Number of utilizers	Governmental services	Ratio of households having oil rations Ratio of households having gas rations
	Level of interest in common use		
Level of interest in utilization with tools			

532

533 **Table 2.** Significance coefficients of components and indices of economic sustainability assessment
 534 for summer pastoral units obtained by surveying and analytic hierarchy process.

Sustainability components	weight	Sustainability assessment indices for rangeland pastoral units	weight
Activity and employment	0.0282	Job satisfaction level in the unit	0.0567
		Job safety level	0.0547
		Degree of continuity and expansion of husbandry activities among the young generation	0.0566
Utilization	0.113	Value of existing livestock in each household	0.0056
		Income share from dairy sales for each household	0.0051
		Income share from beekeeping for each household	0.0052
		Income share from rented livestock for each household	0.0051
		Income share from wool sale for each household	0.0051
		Livestock manual feeding expenses	0.0052
		Livestock shepherd costs	0.0051
		Fines related to breach of grazing license for each household	0.0050
		Livestock casualties ratio	0.0052
		Medicine and Veterinary expenses ratio	0.0041
		Utilizers' sustenance cost	0.0056
Productivity	0.051	Level of interest in shared use	0.0053
		Level of interest in utilization with tools	0.0055
Economic welfare	0.136	Coefficient of diversity for economic products	0.0156
		Productivity of all the production components	0.0148
efficiency	0.074	life expenses level	0.0398
		Family's income level	0.0412
efficiency	0.074	Efficiency ratio (expenses/revenue)	0.0211
		Family's continuity of income degree	0.0220

Economic justice	0.080	Sponsorship load in the unit	0.0250
		Eligibility chance for load	0.0227
Economic stability	0.0235	Income satisfaction level	0.0347
		Net income	0.0351
		Percentage of families having insurance support	0.0322
		Percentage of having livestock and rangeland insurance	0.0320
Governmental services	0.029	Ratio of households having oil rations	0.0086
		Ratio of households having gas rations	0.0087

535

536 **Table 3.** Analysis of variance test for economic components of sustainability of pastoral units of
 537 Sahand summer rangelands

Source of change	Sum of squares	df	Mean Square	F value	Sig.
Between Groups	10.55	7	1.50	106.29**	0.000
Within Groups	4.99	352	0.014		
Total	15.55	359			

538 **Significant difference at one percent level.

539 **Table 4.** Assessment and comparison of pastoral units' sustainability with the TOPSIS multi-
 540 criteria method

		Economic				Economic	
Pastoral units		sustainability		Pastoral units		sustainability	
		Ci	Rank			Ci	Rank
S ₁	Esparan shomali	0.226	5	S ₂₄	Shah blaghi	0.288	4
S ₂	Afshar	0.208	13	S ₂₅	Shakor	0.154	36
S ₃	Aghblagh	0.197	15	S ₂₆	Ali zaman	0.183	19
S ₄	Aghche beiglo	0.168	25	S ₂₇	Gejel	0.148	39
S ₅	Aghavierdi goli	0.159	29	S ₂₈	Garehgoi	0.519	1
S ₆	Ay olan	0.197	14	S ₂₉	Garenaz	0.209	11
S ₇	Badir khan	0.129	45	S ₃₀	Gatargie	0.159	30
S ₈	Pari blaghi	0.141	41	S ₃₁	Gopi blaghi	0.165	27
S ₉	Pesyan	0.192	17	S ₃₂	Kalaklo	0.211	10
S ₁₀	Pehenlo	0.157	31	S ₃₃	Goy arkhaj	0.169	24
S ₁₁	Torab	0.149	38	S ₃₄	Goran bloghi	0.139	42
S ₁₂	Torpakhlo	0.240	8	S ₃₅	Goy dare	0.154	35
S ₁₃	Chapa	0.192	18	S ₃₆	Girve gasem khan	0.193	16
S ₁₄	Chpish darasi	0.143	40	S ₃₇	Lashkar meydani	0.209	12
S ₁₅	Chorog	0.336	3	S ₃₈	Ojaglo	0.468	2
S ₁₆	Haji hatam	0.156	33	S ₃₉	Masjedlo	0.149	37
S ₁₇	Haji khodayar	0.129	43	S ₄₀	Molamirali	0.169	23
S ₁₈	Haji rashid	0.182	20	S ₄₁	Nadir goli	0.168	26
S ₁₉	Haji ali darasi	0.261	6	S ₄₂	Nane gori	0.129	44
S ₂₀	Haji mohamad	0.178	22	S ₄₃	Yavar	0.156	32
S ₂₁	Hamze khan	0.162	28	S ₄₄	Yeli	0.179	21
S ₂₂	Hanife	0.154	34	S ₄₅	Yaharlo	0.229	9

S ₂₃	Sarmsaglo	0.259	7	-	-	-	-
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542 **Table 5.** correlation of economic components with economic sustainability of summer rangeland
 543 pastoral units

Sustainability component	economic sustainability	
	Correlation coefficient	Sig
Activity and employment	0.465**	0.001
Utilization	0.745	0.001
Productivity	0.625**	0.000
Economic welfare	0.343**	0.021
Efficiency	0.145	0.341
Economic justice	0.181	0.235
Economic stability	0.563**	0.000

544 **Significant difference at one percent level.

545 **Table 6.** Important components of determining economic sustainability of rangeland pastoral units

Factor	Factor's name	Eigen value	Eigen value variance	cumulative variance
1	Productivity	7.90	29.29	29.29
2	Economic efficiency	3.90	14.44	43.74
3	Utilization system	2.38	8.84	52.58
4	Activity and employment	1.94	7.19	59.78
5	Job safety	1.78	6.60	66.39
6	Beekeeping	1.48	5.50	71.89
7	Economic stability	1.32	4.89	76.78
8	Utilization	1.16	4.32	81.11
9	Governmental aids	1.06	4.93	85.05

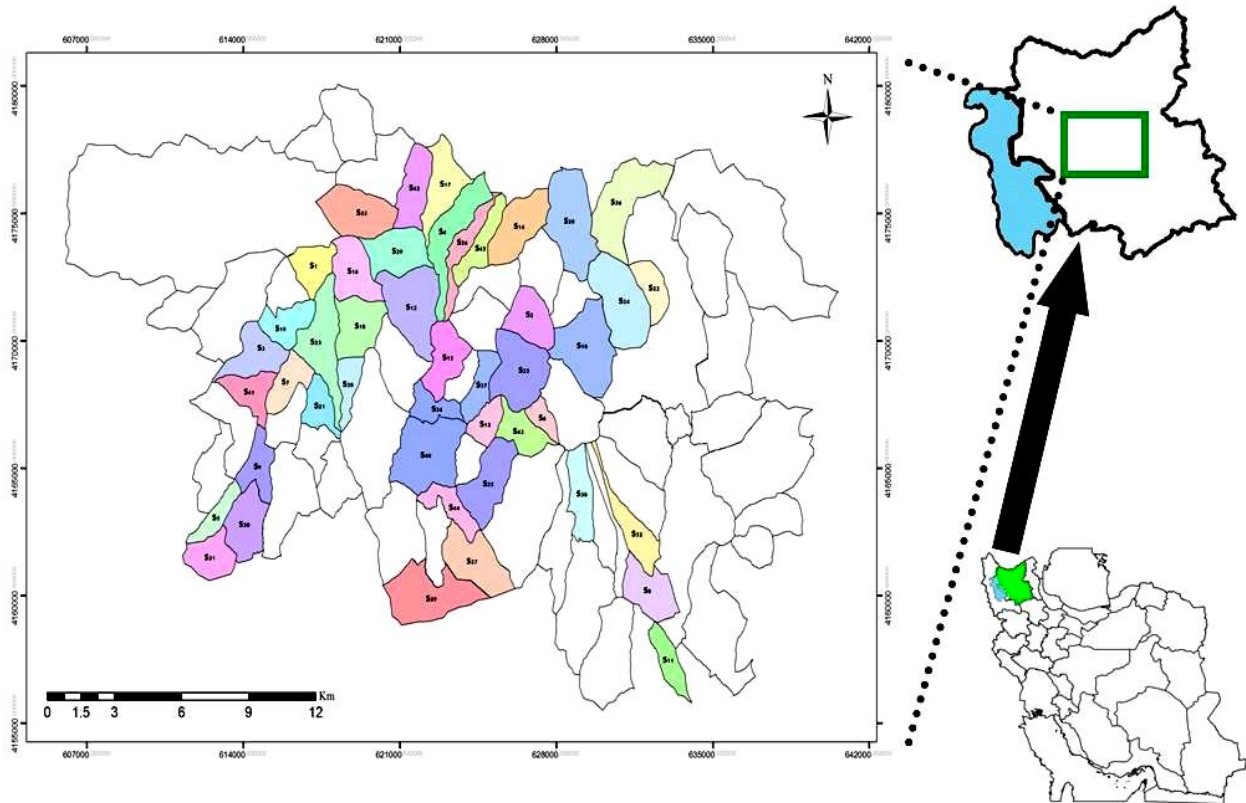
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547 **Table 7.** Correlation of economic sustainability assessment indices with determining components of
 548 economic sustainability

Factor	Factor's name	Attribute	Coefficient
		Value of existing livestock in each household	0.979
		Income share from dairy sales for each household	0.953
		Income share from wool sale for each household	0.840
1	Productivity	Life expenses	0.742
		Family's income	0.959
		Net income	0.884
		Productivity of production factors	0.744
		Income share from rented livestock for each household	0.954
		Livestock manual feeding expenses	-0.965
2	Economic efficiency	Fines related to breach of grazing license for each household	0.871
		Medicine and Veterinary expenses ratio	0.814
		Diversity coefficient of economic products	0.971
3	Utilization system	Interest level for common use	0.948
		Interest level for utilization with tools	-0.919
4	Activity and employment	Degree of continuity and expansion of husbandry activities among the young generation	0.789
5	Job safety	Job safety level (continuity)	.0887
6	Beekeeping	Income share from bee keeping for each household	0.865
7	Economic stability	Cost-income ratio	0.800
8	Utilization	Number of utilizers	0.844
9	Governmental aids	Eligibility for loan	0.853

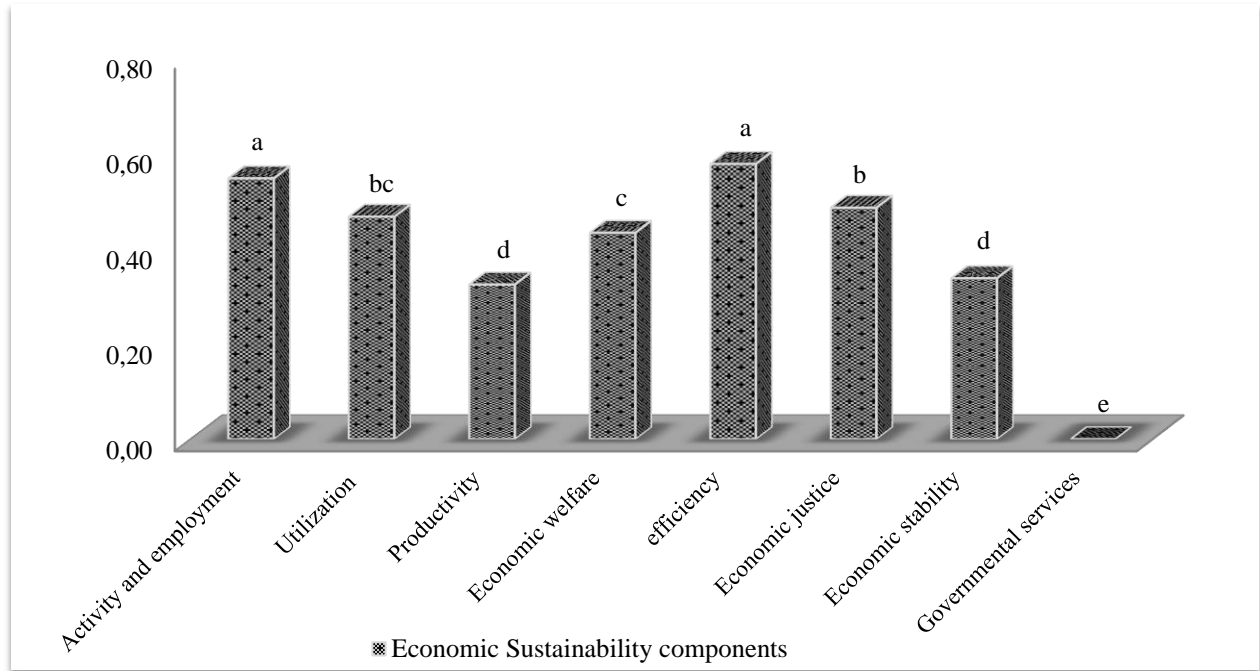
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551 **Figure 1.** The domain and units of analysis of Sahand summer rangeland pastoral units

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556 **Figure 2.** total mean and Duncan test results for economic sustainability components of the pastoral
557 units of Sahand summer rangelands