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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 (Ci= 0.519) and Badir Khan (Ci= 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

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

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

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

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

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

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

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

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

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

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

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

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

2. Materials and methods

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

2.1 Statistical Population and units of analysis

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

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

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

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

2.2 Importance coefficient of sustainability assessment indices

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

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

2.3 Estimating the selected indices in rangeland pastoral units

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

2.4. Analysis methodology of economic sustainability assessment data

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

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

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

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

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

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

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

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

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

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

$$A^* = \{(\max_i v_{ij} \mid j \in C_b), (\min_i v_{ij} \mid j \in C_c)\} = \{v_j^* \mid j = 1,2,...,m\} \qquad (2)$$

$$A^- = \{(\min_i v_{ij} \mid j \in C_b), (\max_i v_{ij} \mid j \in C_c)\} = \{v_j^- \mid j = 1,2,...,m\} \qquad (3)$$

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

$$S_i^* = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^*)^2}, \; j = 1,2,...,m \qquad (4)$$

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

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

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

Step 6: Rank the preference order.

2.5 Statistical tests

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

3. Results

3.1 Importance coefficient of components and indices of economic sustainability assessment

In Table 2, significance coefficients of components and indices of economic sustainability assessment for summer pastoral units are shown. It can be seen that economic welfare has a high significance among the components and has the highest weight. Moreover, the lowest weight 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 (Ci=0.519) and Badirkhan pastoral unit ranks last (Ci=0.129)
316

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

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

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

4. Discussion

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

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

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

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

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

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

5. Conclusion

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

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

scientific approach was taken to determine and validate the indices and components of economic sustainability assessment and to analyze it in the rangelands which can be used for the experts and researchers working in this field. Therefore, it is recommended that the natural resources experts and planners, particularly those specialized in rangelands, use the accepted indices and components used in the current study which experts and local elites agree on and work towards devising the national sustainability assessment model and creating a data bank for rangelands. Development decisions should be based on the current human and physical resources. 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.

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530

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

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
		Level of interest in shared use	0.0053
		Level of interest in utilization with tools	0.0055
Productivity	0.051	Coefficient of diversity for economic products	0.0156
		Productivity of all the production components	0.0148
Economic welfare	0.136	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

	Pastoral units	Economic sustainability			Pastoral units	Economic 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}	Garehgol	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	-	-	-	-

541

Table 5. correlation of economic components with economic sustainability of summer rangeland 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

**Significant difference at one percent level.

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

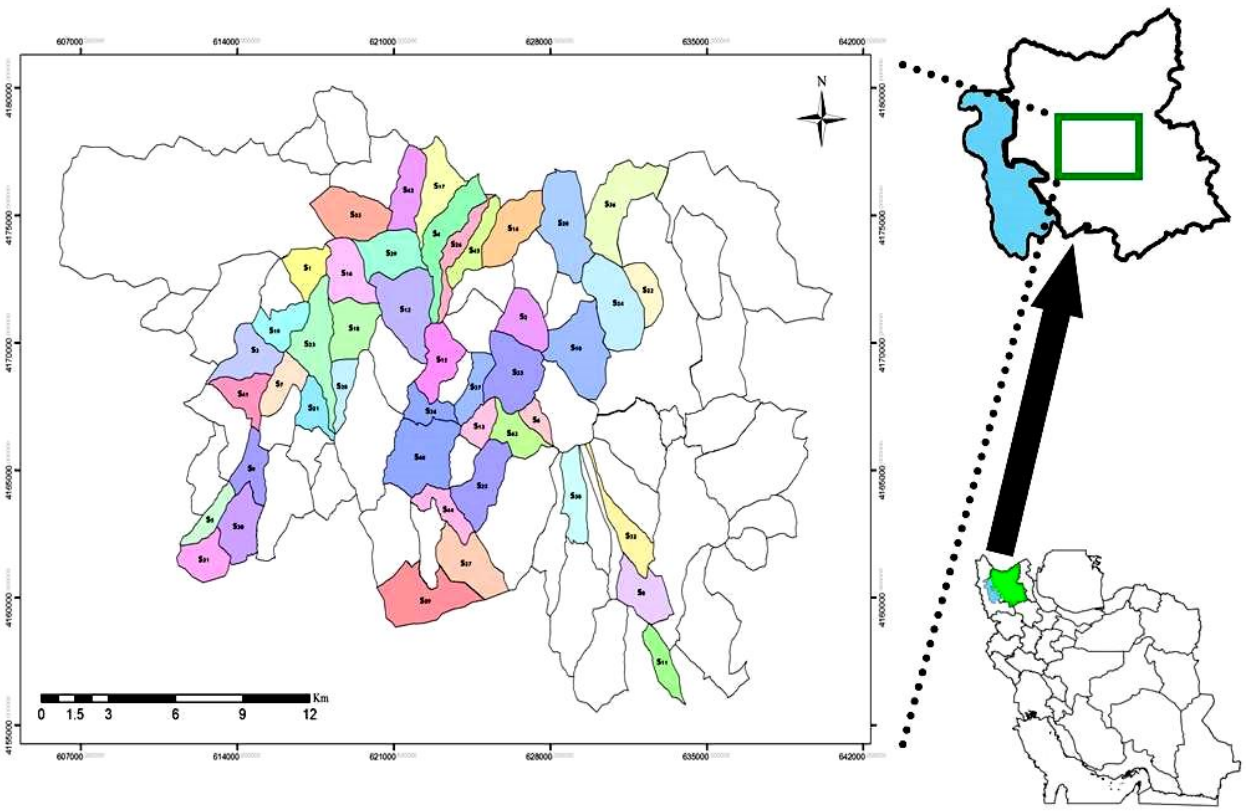
Factor	**Factor's name**	Eigen value	Eigen value variance	cumulative variance
1	Productivity	7.90	29.29	29.29
2	Economic efficiency	3.90	14.44	43.74
3	Utilization system	2.38	8.84	52.58
4	Activity and employment	1.94	7.19	59.78
5	Job safety	1.78	6.60	66.39
6	Beekeeping	1.48	5.50	71.89
7	Economic stability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

546

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

Factor	Factor's name	Attribute	Coefficient
1	Productivity	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
		Life expenses	0.742
		Family's income	0.959
		Net income	0.884
		Productivity of production factors	0.744
2	Economic efficiency	Income share from rented livestock for each household	0.954
		Livestock manual feeding expenses	-0.965
		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

550



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

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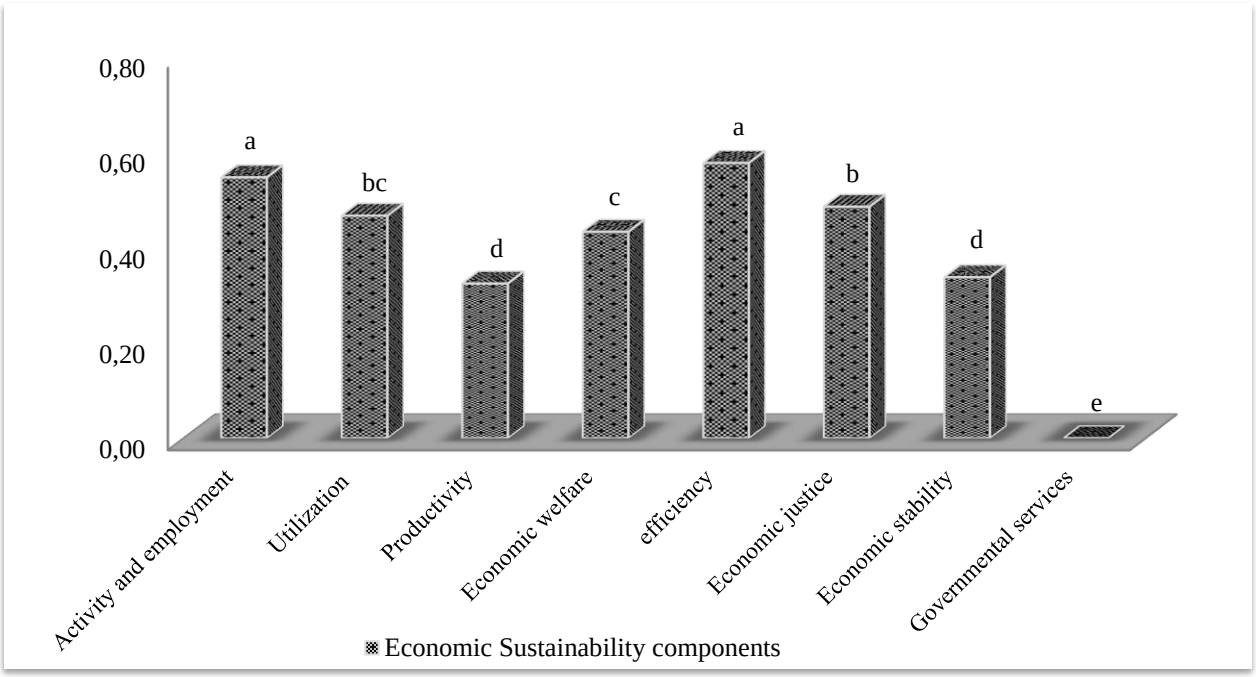

Figure 2. total mean and Duncan test results for economic sustainability components of the pastoral units of Sahand summer rangelands