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Sustainable management of Kiyan forest reserve-Iran: An analysis of hierarchal process

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Abstract
Management of natural ecosystems, like forests, has several objectives such as wood production, sustainability of ecological systems, preserving aestheti,c and cultural or psychological satisfaction. This management is especially essential in dry regions with sensitive biodiversity, like Iran. The aim of this research is to elaborate a management scheme for developing a sustainable tourism plan for the Kiyan Forest Reserve, using an Analytical Hierarchy Process. At this point, four management alternatives were evaluated from socioeconomic, management (monitoring by governmental or private sector), environment and recreational perspectives. Each part was given a weight based on the opinions of specialists and local experts and tourist (by means of Questionnaire) using the "Expert Choice 11" Software. The results showed that the importance of these criteria is descending in the following order: socioeconomic, management (monitoring), environment, and finally promotion of the regional conservation and biological actions. Also, contribution of each part to the management plan was 47.8% for the environment and 46.2% for the promoting plan of the regional management. In this study, environment criterion is selected as the most important criterion and upgrading region protection is introduced as the best plan. Consideration towards the application of Analytical Hierarchy Process in tourism sustainable development and based on the former findings concludes that protection level in this area must be upgraded to national natural zone.

Keywords
AHP, ecotourism, Kiyan forest reserve, management plan, sustainable development.

1. Introduction
History shows that the welfare of rural and civilized societies is affected by the availability of forests and natural resources. Based on experts' idea, a way for calculation of people's welfare level is equal to forest resources divided by population size (Mossadegh, 2004). Recreation is a forest's capacity, and growing rate of ecotourism industry improves socioeconomic condition of local societies; hence, the use of forests based on principles of sustainable development is important (Amirnejad et al., 2006). Monavari et al. (2010) declared that strategic factors affecting internal and external environment of nature-based tourism are complicated, and emphasized using application methods such as combination of SWOT and AHP. Piran et al. (2013) applied AHP for selecting a suitable site for a local forest park. Jokar Sarhangi and Jabari (2015) concluded that AHP can create a framework for group participation in decision making. However, ecosystem-based management needs extensive information that encompasses a wide range of knowledge (Garcia et al., 2003). On the other hand, Iran can be considered as one of the top countries in the world regarding natural features, biodiversity, various

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ecosystems, climate variability, having four full seasons and unparalleled natural attractions, which points out its high potential of sustainable tourism development. Protected areas managed by the Department of Environment, parks and forests under the management of the Forest, Range and Watershed Organization with other unique natural attractions are some of Iran's capacities for sustainable tourism development (Rezvani, 2001). Also, Iran is located in an arid region of the world, and protection of its natural resources is essential. Ozhan et al. (2008) have stated that AHP is a new method for integrated watershed management. In this method, opinions and thoughts of experts are applied to reduce the errors and improve the decision making process (Ghodsipour, 2010b). Although this method has been applied in some studies like planning of road network in mountain forests (Mohammadi Samani et al., 2010), risk zoning of forests and rangelands wildfire (Mahdavi et al., 2012), there is no comprehensive study on developing sustainable tourism management using this method. Suitable management for ecotourism development is essential to conserve and preserve the biological richness of the area as well as economical progress of the local people (Piran et al., 2013). During recent years, it has been tried to organize the Kiyan Reserve Forest to expand the ecotourism industry. Therefore, this research tries to elaborate a management scheme for developing sustainable tourism plan of this area using AHP method. This plan has three aspects of green spaces development, construction of service centers and forest parks, which is required for sustainable ecotourism.

2. Study area

The study area (Kiyan Forest Reserve), known as Kiyan Spring is in south of Kiyan city, at a 14 km distance from southwest of Nahavand city (Central Zagros) located in Hamadan Province, Iran. This area has the latitude 34º 8' 21" to 34º 9' 40" North and the longitude 48º 12' 55" to 48º 14' 9" east, and its height ranging from 1615 to 2080 meters above sea level (Fig. 1). Population size of Kiyan city is about 9000 people, and annual local and international tourist is about 11000 and 100 people, respectively (Kiyani, 2013).

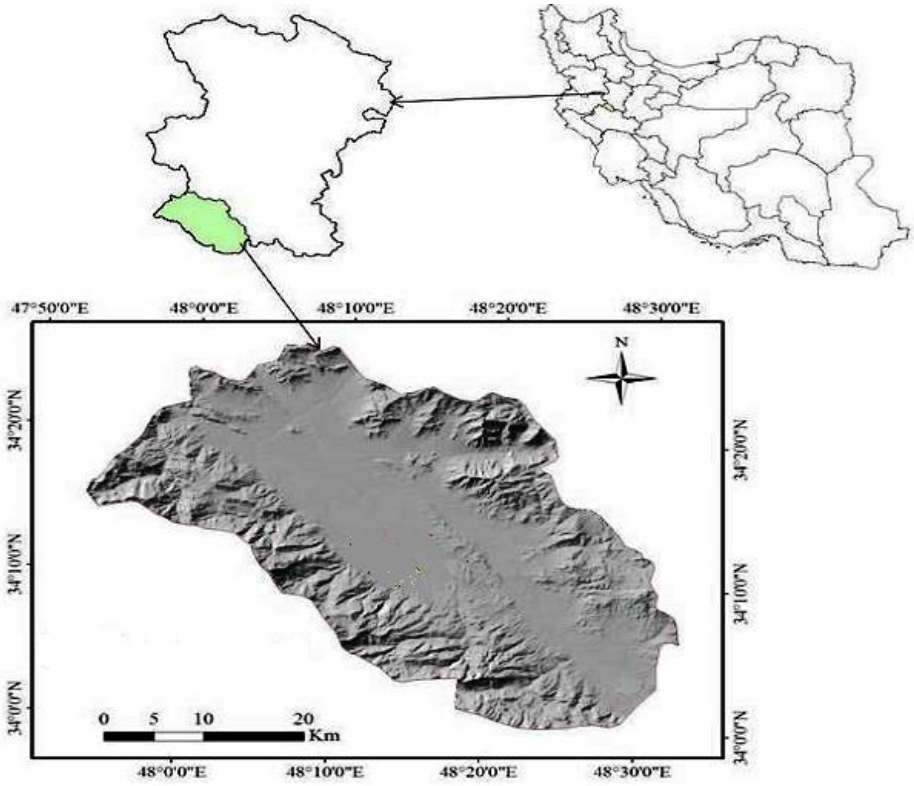

Fig.1. Location of study area in Nahavand Province and Iran

Fig. 2. A view of Kiyan spring waterfall in autumn and the tourists in spring

Kiyan Forest Reserve is the only natural forest in the Hamadan province, and it is the remaining part of Zagros forests in the west of Iran, also provides a microclimate in this region. The sequence of ecosystem succession is in climax level and undoubtedly the study area reached this level after a long period, about millenniums of time. Moreover, floristic composition and high species richness (about 405 plant species) are among main reasons for choosing this area of the country as genetic reserves (Safi Khani et al., 2007). These region grows some trees with over 300 years of age like Oak (*Quercus* sp.), Walnut (Juglans regia), Fraxinus sp., Plantanus orientalis, Ficus carica and so on. Kiyan area comprises 5 main vegetation types of hydrophytes, petrophytes, stream plants, forest and pasture. Based on plant sociology, 19 plant associations were identified in the study area (Safi Khani, 2001). Besides karst limestone, a mixture of volcanic - limestone rocks is present in the area (Safi Khani, 2001). However, this reserve has protected species like oak, walnut and hawthorn, which represents a natural forest area of 100 hectares; however, around this area there is about 400 hectares of planted and semi destructed forests (Barzeh Kar, 2005). Grassland vegetation cover like endemic species of *Fritillaria* sp. and other species such as Agropyron intermedium, *Euphorbia* sp., Astragalus, *Festuca* sp., *Stipa* sp., in this area varies from 20 to 80%. Furthermore, there exists a number of animal species in the study area as wild goat (Capra aegagrus), Brown bear (Ursus Arctus), Fox, wolf, Lepus europaeus, Hystrix indica (the biggest rodent of Iran) and endemic species of Sciurus anomalus.

Kiyan area is located on an alluvial fan, with a deep soil and high percentage of gravel (Khezeli, 2000). In Nahavand city because of calcareous formations, rain penetrates to groundwater, dissolving the limestone and usually appears on surface as notable springs. Discharge of Kiyan spring is about 2.5 m^3/s, which obtain drinking and farming needs of villagers; the excess water flows into the Gamasyab River. Maximum and minimum temperature of the study area in the summer and winter is 40 and -25°C, respectively.

3. Materials and Methods

In order to conduct the present study survey - analytical, as its research method, is applied. And, it tries to provide solutions for better management of natural areas. Basic information of this research is based on integrated- executive studies of the study area. Complementary data and information in different stages were gathered from analyzing the available data and field survey, communication with native people, the completed questionnaires by experts and native engineers and use of their various opinions. Then, based on previous studies and experiences of authors (Kiyani, 2011, 2013; Kiyani and Khalil Nezhad, 2009; Kiyani and Kiyani, 2010), main criteria was extracted as questionnaires which filled in by experts of the study area. After gathering their ideas, the primary data was analyzed using Expert Choice 11 software for extracting the matrix of pairwise comparison. Use of experts knowledge combined with data lead to more accurate results in pairwise comparison method. Therefore, this method was used

for weighting of factors, assessment, and control of compatibility of any decision. Moreover, the same pattern was used for decision making on acceptance or rejection (Asgharpour, 2008). Considering various studies, incompatibility rate should be less than 0.1; otherwise, weighting will be corrected in order to solve the problem (Ghodsipour, 2010a). Table 1 was applied for pairwise comparison process.

Table 1. Scale of preferences in the pairwise comparison process using expert's opinions (Ghodsipour, 2010a)

Definition	Value
Absolute importance	9
Demonstrated importance	7
Essential or strong importance	5
Weak importance of one over another	3
Equal importance	1
Intermediate values between the two adjacent judgments	2, 4, 6, 8

Next, in order to choose the best plan, four main criteria comprising socioeconomic, environmental, management and recreational capability with following sub criteria were considered:

- Socioeconomic Criteria
  Raised income of the native people
  Public participation in sustainable tourism plan
  Economical justification of reserve development
- Management criteria
  Management Transfer (to governmental or nongovernmental section)
  Welfare services (such as Hotels, Restaurants, Tele Cabin…)
  Tourists' Safety
- Environmental criteria
  The Effect of reserve development on sustainable conservation
  The Effect of tourist's number on vegetation cover destruction
  The Effect of watershed management structures on water and soil conservation
- Recreational capability criteria
  Geographical characteristics (situation, area and geological features)
  Exclusive landscapes
  Infrastructure installations (road, parking, electric power…)

Finally, some alternatives to solve the problems in the study area were selected as following projects:

Project 1: public participation as a basic strategy to develop tourism management plan
Project 2: creating jobs and income for local people, according to the needs of visitors
Project 3: management and conservation of study area by nongovernmental section
Project 4: promotion of the study area's protection level to national natural zone.

Using pairwise comparisons, the relative importance of one criterion over another can be expressed. Next, according to ideas of local experts and university professors, alternatives were evaluated through the pairwise comparison matrix using the Expert Choice software. In AHP method, a decision maker should have made a comparison for each pair of criteria, in qualitative and qualitative forms in a scale from 1 to 9 according to Table 1. In other words, the AHP method is a qualitative- quantitative method with more scientific values than qualitative or quantitative methods (Nikmardan, 2007). The weight of any alternative is the quota of that alternative in relevant criteria. Thus, the final weight of any alternative was calculated by the sum of multiplication of each criterion weight in weight of each alternative. Criteria weights were determined by calculating the weight of each plan in all criteria. It is worth noting that contribution of each criterion in the best plan was identified. Moreover, paired comparisons of criteria were done and paired preference of these criteria was determined by the decision maker and the paired comparison matrix was formed, finally the net (absolute) weight of plans was calculated. After getting the hierarchical structure and weighting of criteria, inconsistency coefficient was calculated for all the criteria and alternatives, and in some

cases, the coefficients were adjusted by the software. The Number of experts who fill the questionnaires was up to 10 people.

4. Results and Discussion

In 2004 the International Ecotourism Society estimated that about 40% of travel incentive is tourism, ecotourism and visiting of natural attractions (Ecotourism rule of Islamic Republic of Iran, 2005). As mentioned earlier, Kiyan Forest Reserve has a unique nature and is the only forest in the Hamadan province (Safi Khani et al., 2007); however, during recent decades, it has been threatened by the large number of visitors and inadequate protection strategies. Therefore, the assessment of ecological ability under the normal development rules is necessary for using this landscape as a tourism attraction. As a rule, paying less attention to native people demands has caused to wasting a lot of time and money (Makhdoum, 2008). Although Kiyani and Khalil Nezhad (2009) and Kiyani and Kiyani (2010) explained that the study area has a great tourism potential, because of livestock grazing and overuse rather than region ecological carrying capacity, this ability is reducing. Furthermore, using ecological model of tourism in Iran and multi-criteria evaluation method, Kiyani (2011) showed the concentrated and extensive tourism capability of Kiyan area is 2 and 1, respectively. Based on the study purpose, which was the application of AHP in tourism management, pairwise comparison matrix is presented in Table 2.

Modeling in AHP method starts from zero or goal level and extends to lower levels of the hierarchy like criteria, sub-criteria and alternatives. The goal level (general plan) is the selection of the best alternative for sustainable tourism management of Kiyan forest reserve. In the next level, four criteria of socioeconomic, management, environmental and recreational capability is considered. Figure 3 shows the hierarchical tree in Expert Choice software and the weight of alternatives. In Figure 4 the relative weight of each sub-criterion with regard to the main criteria is presented.

Table 2. Pairwise comparison matrix

Criteria	Socioeconomic	Management	Environment	Recreation
Socioeconomic	1	5	4	3
Management	0.2	1	3	4
Environmental	0.25	0.33	1	2
Recreation	0.33	0.25	0.5	1

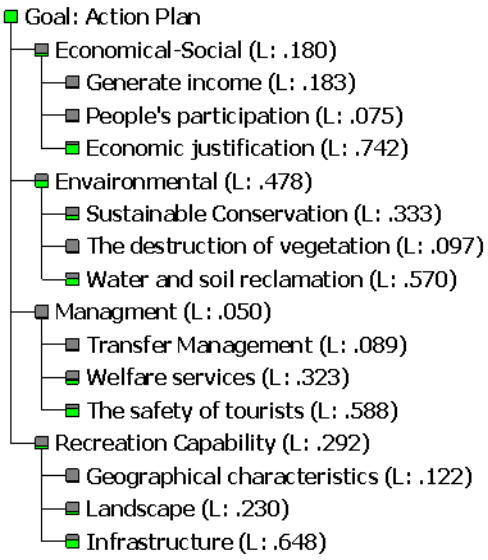

Fig. 3. Prioritized operations relative to strategic plan

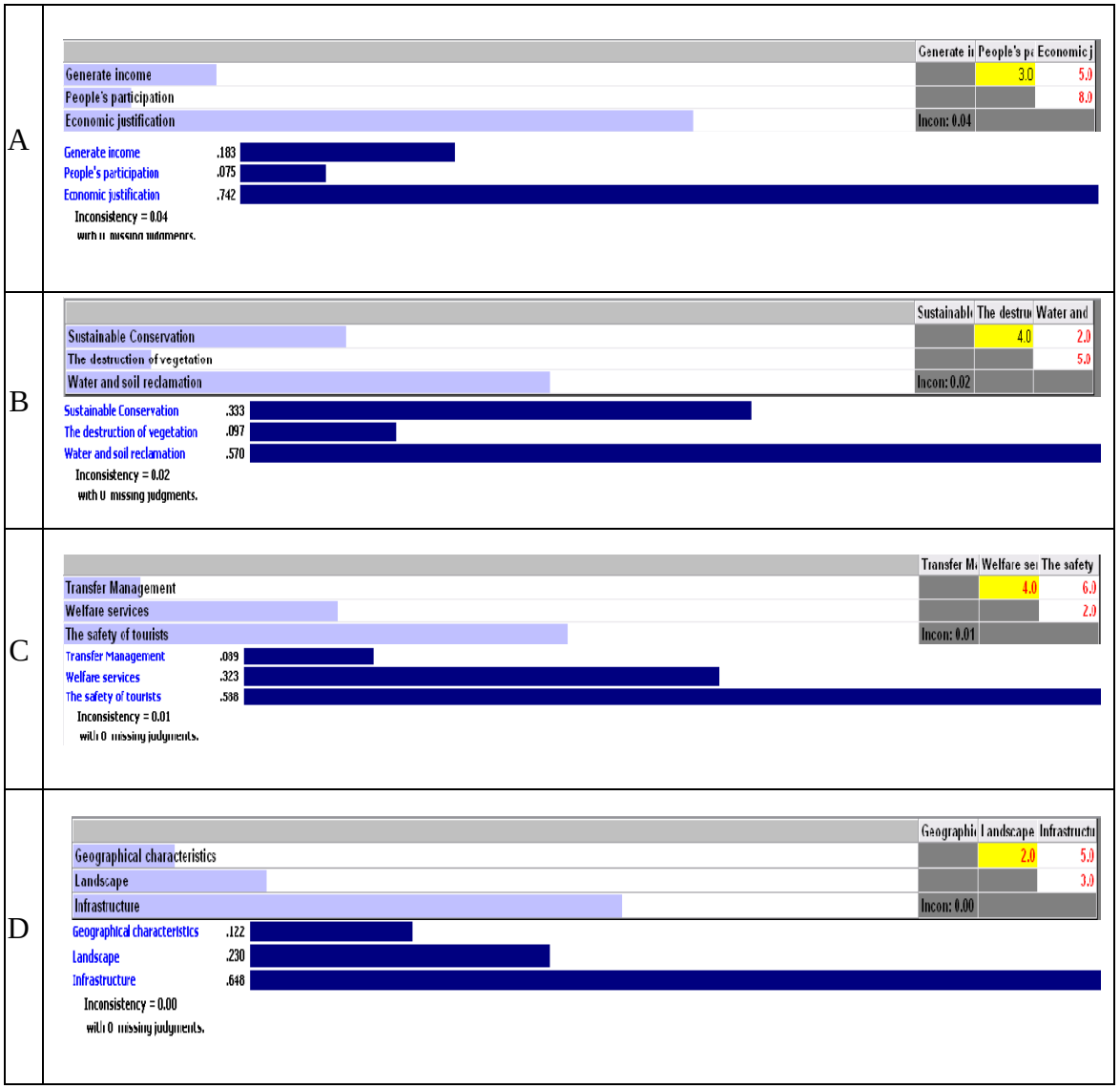

Fig. 4. Pairwise comparison matrix of criteria (Socioeconomic (a), Environmental (b), Management (c) and Recreational capability (d))

After calculating the weight of each plan rather to all criteria, criteria weights were identified. In other words, contribution of each criterion in choosing the best plan is determined. The most important criterion was environmental criterion with the relative weight of 47.8% (Fig. 3), and the best plan was the upgrade of area protection level with the relative weight of 46.2% (Fig. 5).

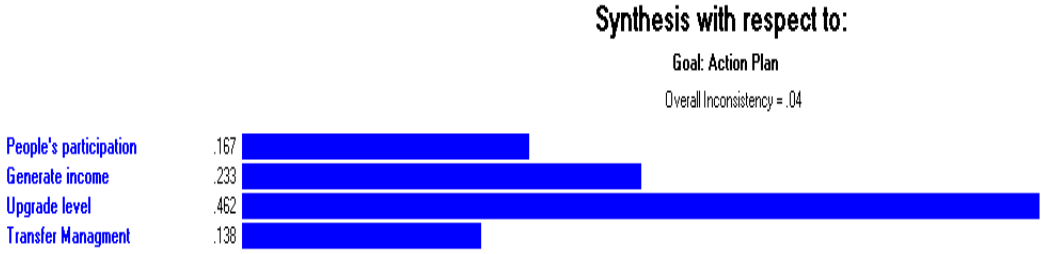

Fig. 5. Priorities of the criteria with respect to the goal

Finally, sensitivity analysis of the alternatives was performed in order to rank the changes of criteria weights. Sensitivity analysis was calculated based on performance, dynamics, gradient and two-dimensional methods (Fig. 6). In this analysis, the increase or decrease of criteria weights (left bar graphs), shows its effect on the alternatives ranking (bar graphs on the right). As Figure 6 shows, the highest sensitivity is related to environmental criterion, and alternative (plan) of upgrading the management level of the area.

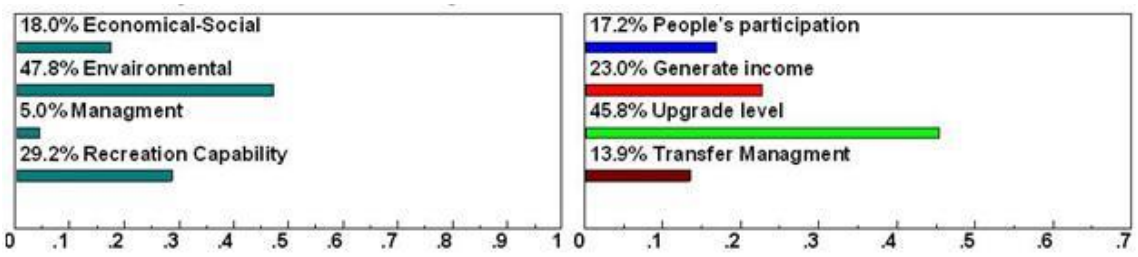

Fig. 6. Dynamic Sensitivity Analysis (Consistency Ratio: 0.03)

	Pairwise	Pairwise	Pairwise
Alternative	Economical-Social Generate income (L: .183)	Economical-Social People's participation (L: .075)	Economical-Social Economic justification (L: .742)
People's	.425	1.000	.124
Generate income	1.000	.136	1.000
Upgrade level	.153	.401	.096
Transfer	.252	.307	.334

	Pairwise	Pairwise
Alternative	Envaironmental Sustainable Conservation (L: .333)	Envaironmental The destruction of vegetation (L: .097)
People's	.435	.224
Generate income	.183	1.000
Upgrade level	1.000	.149
Transfer	.225	.342

Fig. 7. A sample Pairwise comparison matrix of the criteria in comparison to projects

Fig. 8. Priorities of principle criteria

This study showed that AHP can be one of the most comprehensive designed systems for multi-criteria decision making. Ozhan et al. (2008) stated that AHP is an effective tool in integrated watershed management and decision making with capacity for planning and weighting of criteria quantitatively. The main benefit of AHP method is its ability in group decision-making; therefore, it combines decisions of all the members together as the ideal decision with viewpoints of all stakeholders. Result of this study focused on this topic that by classification of stakeholders purposes, AHP method can lead to better and stronger decisions made by the beneficiaries. Moreover, based on the results of this study, AHP can be a helpful tool for land use planning, which is consistent with the findings of Kiyani (2013).

5. Conclusions

Rapid population growth and urbanization, coupled with uncontrolled exploiting of environment and natural resources are factors that affect recreational resources. Kiyan is the only natural forest of Hamadan province and remaining of Zagros forest reserves in the west of Iran due to its specific floristic composition and diversity of species. Because of natural forest, spring and mountainous feature, this region is considered as an important habitat with high ecological capability. Therefore, it is essential to conserve the present condition and try to rehabilitate the habitat and reduce the damages. In this study, environmental criterion was selected as the most important criterion, and upgrading region's protection was introduced as the best plan (first priority). As the main conclusion, AHP method is a powerful tool in planning of sustainable tourism development.

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