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An ecological capability evaluation model for recreation, conservation and protection functions of Iran's Zagros forests: Javanrood region

Rahim Maleknia[1]*, Afshin Amiraslany[2] and J. Mirarab Razi[3]

[1]Department of Forest Engineering, Lorestan University, Khoramabad, Iran.
[2]Department of Range and Watershed Engineering, Lorestan University, Khoramabad, Iran.
3Department of Forestry Science, University of Tehran, Iran.

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Nowadays, in different parts of the world forest ecosystems are increasingly viewed as resources that could be managed for a wide range of ecological, economical, and social uses. The forest based recreation can be considered as an economic and social function that can provide recreation opportunities and income for entrepreneurs. Zagros forests in the west of Iran play an important role for soil and water conservation and can be used for forest based recreation. This study develops a model to evaluate ecological capability of Iran's Zagros forest. Results showed that 23861 and 43589 ha of Javanrood region have capability for intensive and extensive recreation respectively. The model suggests that 7869 ha of region can be assigned for conservation and protection. Also, the results revealed that current land use pattern is not based on ecological capability and some potential protection and conservation area are used for understory farming and urban development.

Key word: Ecological capability, forest based recreation, conservation, protection, Zagros forests.

INTRODUCTION

In the recent years, timber production, as the main goal of forest management has changed to the other important forest functions. Forest based recreation, soil and water sources protection and habitats and species conservation are some of these new important functions (Pukkala, 2004). Sustainable forest management recognizes a forest's potential to maintain a range of values and needs, rights of all users, and to find the best balance of uses based on the relative benefits and impacts of management alternatives. Based on this idea, the multiple use forest management (MUFM) aims to integrate biodiversity into the forest management. Various forest values such as wood production, water production, soil erosion prevention, carbon sequestration, and recreation are some important potential of forest ecosystems (Baskent and Keles, 2005).

In different parts of the world forest ecosystems are increasingly viewed as resources that could be managed for a wide range of ecological, economical, and social uses (Seely et al., 2004; Pukkala, 2004). One of the most important functions for forest is recreational use. The forest based recreation can be considered as an economic and social function that can provide recreation opportunities and income for entrepreneurs. Many nations promote nature-based tourism in order to promote the dual goals of nature conservation and income generation (Hearne and Sarinas, 2002). Tourism directed towards natural forests can be viewed as another element within the array of non-timber forest benefits, complemented by other forest services, such as watershed protection, carbon storage and erosion control, and by the exploitation of various non-timber

*Corresponding author. E-mail: Maleknia.r@lu.ac.ir. Tel: 0098-9126806297.

forest products (NTFPs). As an important principle, non-consumptive use of the forest is a potentially well-suited element for conservation (Wunder, 1999). It is very important to consider soil susceptibility to erosion and protection of soil and water resources in forest based recreation. Therefore, the land capability assessment of forest lands for recreation should be done along with considering protection and conservation functions. It can fulfill multi-objective forest goals and play an important role in sustainability of forest management.

Zagros forests with area of around 6 million ha consist almost 40% of Iran's forests (Sagheb-Talebi et al., 2004). These forests are located in the west mountainous area of country and provide a home and livelihood for approximately 10% of Iran's population (Salehi et al., 2008). Characterized by a semi-Mediterranean climate, Zagros forests are one of the most important and sensitive ecosystems in Iran. Zagros forests play an important role in the soil and water conservations. About 40% of water supplies in the country come from this region. Also, more than 90% of these forests are coppice form, due to a long-term pressure of people's uses. Forest have been used for collection various non-wood products, as a source for firewood and construction materials and farming on understory (Babaie-kafaky, et al., 2009; Maleknia, 2005). More than 1.7 million ha of the Zagros forests has been destroyed since 1962 (Fattahi, 1994). Increasing population, low level of development, and high dependence of local communities on forest for their primary livelihood needs are resulted in degradation of forests (Ghazanfari et al., 2004; Jazirehi and Ebrahimi, 2003). Therefore, forest based recreation planning can be used as a tool to provide local people with economic benefits. However, it is necessary to define the conservative and protective plan for these forests because of important role of them in soil and water conservation and protection. The main goal of this study is to develop a model to evaluate ecological capability of Iran's Zagros forest and to illustrate forest based recreation, conservation and protection plans.

MATERIALS AND METHODS

Study area

This study is conducted in Javanrood region located in Zagros forests in the west of Iran (Figure 1). Javanrood covers more than 76000 ha and has 97 villages with population of about 20000. Most of people are indigenous farmers. Many people of this region have been migrated to cities during last decade. The main forest type is *Quercus persica*. Forest lands are used for livestock grazing and understory farming. The annual rainfall is about 700 mm. The moderate climate, forest lands and permanent springs and rivers make Javanrood one of most attractive places for tourists in the west of Iran.

Model

The advisory process of forest experts was used to select the best criteria for the model. First, an initial model was developed based on past studies, experiences, and experts' advises (Makhdom, 2006; Adl et al., 2007; Maleknia et al., 2011). Then, the model provided to experts who were familiar with study area conditions and forest functions. Later, the most important criteria were selected based on their opinions. In the final step, some additional criteria were added to model. Final model was used in geographic information system (GIS) and information layers were integrated and suitable regions for every function were determined. This process was done using structured query language (SQL). This language allows user to manage the maps easily and separate different parts with special properties. After the above process, the land capability map was overlaid with current land use map and final ecotourism, conservation and protection capability prepared.

For this goal, physical zoning of functions was used to recognize primary potentials of outdoor recreation activities in the intensive and extensive forms, conservation and protection land. For physical zoning of outdoor recreation, unit topographic map, map of crown cover percentage, soil texture, and water resources map and erosion susceptibility map were used. Erosion susceptibility map was prepared based on erosion potential method (EPM) and using canopy cover, geology, slop, soil and land use maps. This criterion is shown by Z in Table 1. A buffer zone of 100 m width around rivers, are used as a protective zone.

In physical zoning for ecotourism function the "and" logic and for conservation and protection function the "or" logic is used. It means that lands assigned for ecotourism must have all criteria in the models and no limitation but having only one criterion make land assigned for conservation and protection function.

RESULTS

Table 1 shows the criteria and their ranges for different forest functions. Were S is slope, CC is canopy cover, ES is susceptibility to erosion, RB is river buffer zone, LU is current land use and D is drainage. Using these criteria a linear, multi unknown quantity model to evaluate and recognize the potentials and capabilities of the land for functions were made. In general, a generic model of site/land suitability can be described as:

$S = f(x1, x2\ldots xn))$

Where S = suitability measure; x1, x2…, xn are the factors affecting the suitability of the site/land.

The developed model for current study was shown below:

In. Recreation= slope (1) + canopy cover (1) + erosion susceptibility (1) + current land use (forest) + drainage (1)

Ex. Recreation = slope (1, 2) + canopy cover (1, 2) + erosion susceptibility (1, 2) + current land use (forest) + drainage (1, 2)

Conservation and protection= slope (1, 2, 3), + canopy cover (1, 2, 3) + erosion susceptibility (1, 2, 3) + current land use (forest or non forest) + drainage (1, 2, 3)

Figure 2 shows the land capability for different functions. Result shows that 23861 ha of area have capability for

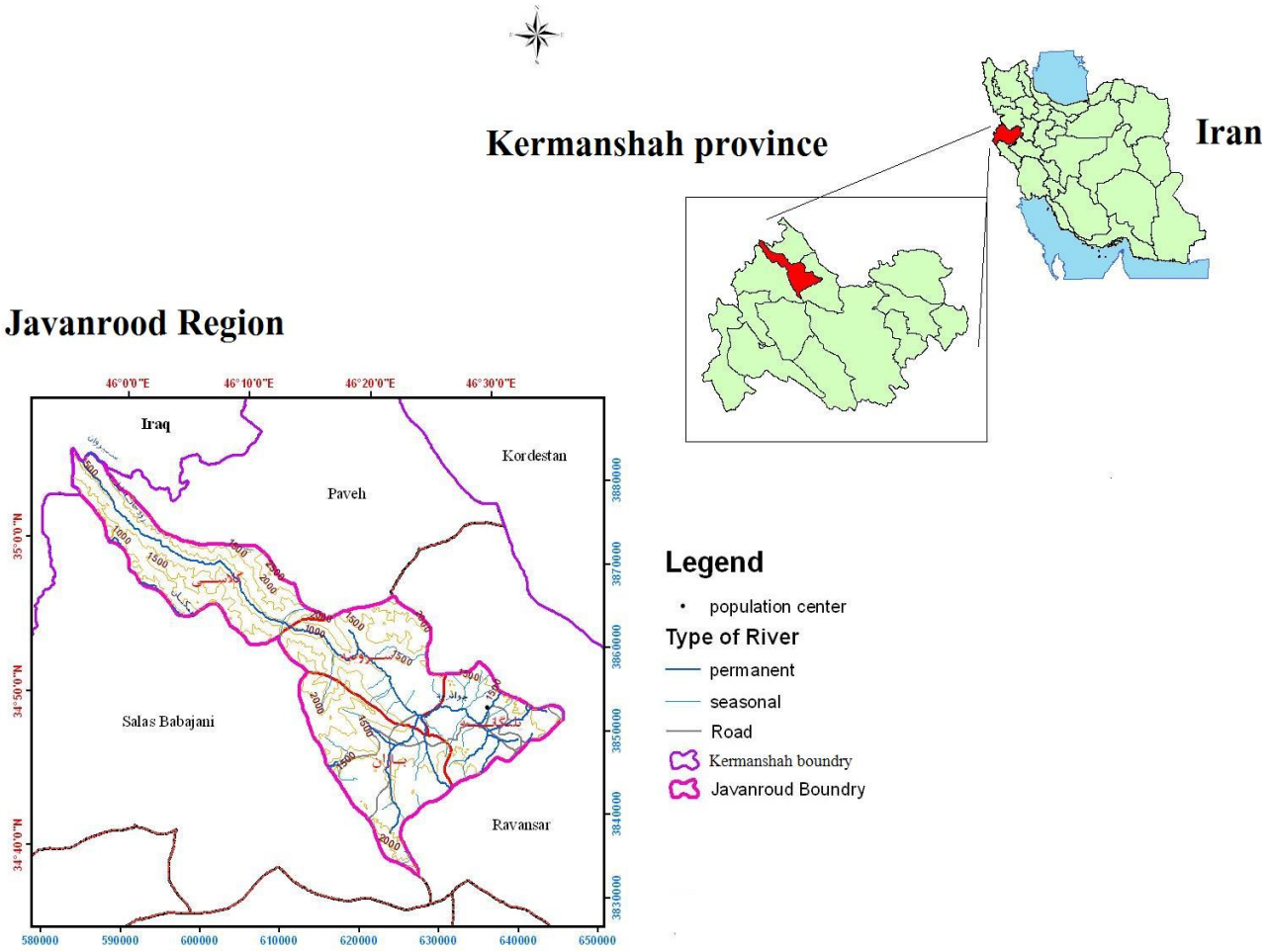

Figure 1. Study area.

Table 1. Criteria of ecological capability valuation model.

Criteria classes	Slope degree (%)	Canopy cover	Erosion susceptibility (ES)	River buffer zone (RB)	Land use (Lu)	Drainage (D)
1	0-15	(%)	(Z)	(m)	Forest	Complete
2	15-50	<25	0-0/4	0-100	Forest	Poor to intermediate
3	>50	50-25	0/4-0/7	>100		Very poor

intensive recreation and 43589 ha have potential for extensive recreation. Also, 7869 ha of region assigned as conservative and protective based on the model result. In Figure 3, the current land use is shown. Comparison of current land uses and land capability map shows that 713 ha of area with capability of conservation and protection are used for understory farming. Finally, 7316 ha of area with capability for extensive recreation are used for understory farming while 61400 ha of area with capability for intensive recreation are used for farming and settlement uses (Figure 4).

DISCUSSION

Forest may be a unique place for tourists because of their flora and fauna, ecology and biodiversity characteristics. The recreational forests can be developed for suitable ecotourism purpose. For a sustainable forest based recreation, it is important to evaluate ecological capability. This study was carried to evaluate the land capability of Javanrood region for intensive and extensive recreation, conservation, and protection functions. Zagros forest of Iran, are degraded forest and needs to be

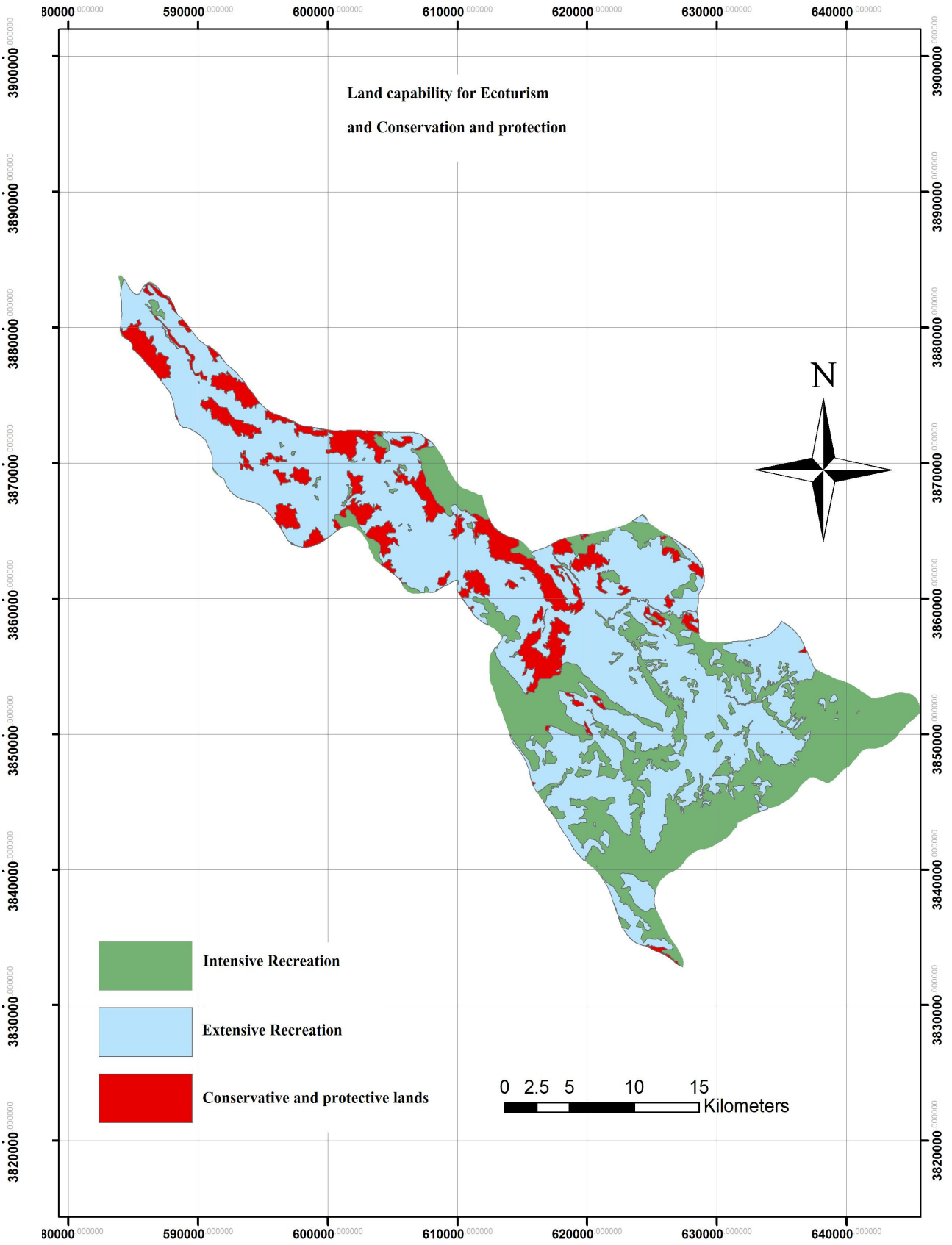

Figure 2. Land capability for ecotourism, conservation, and protection.

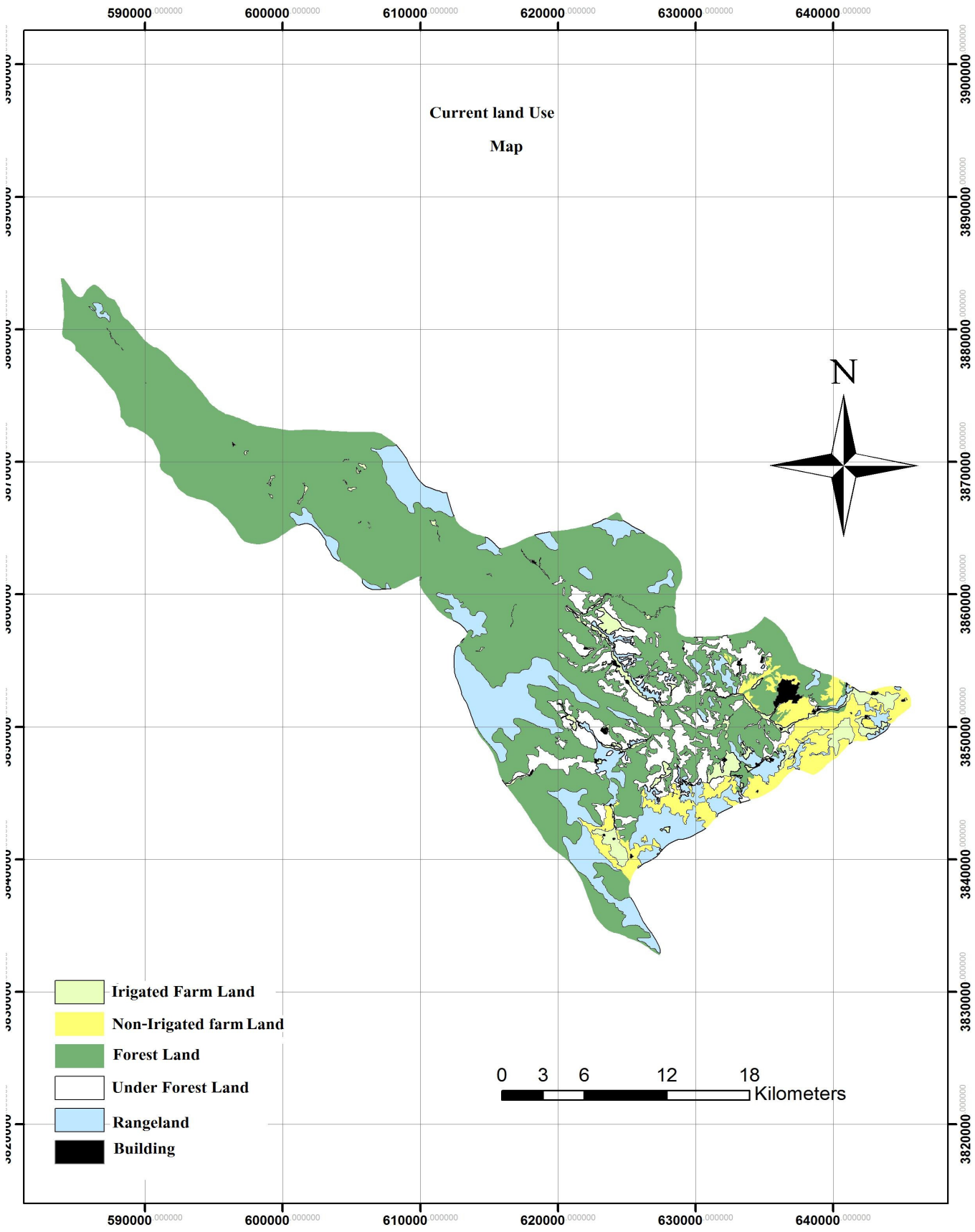

Figure 3. Current land use map.

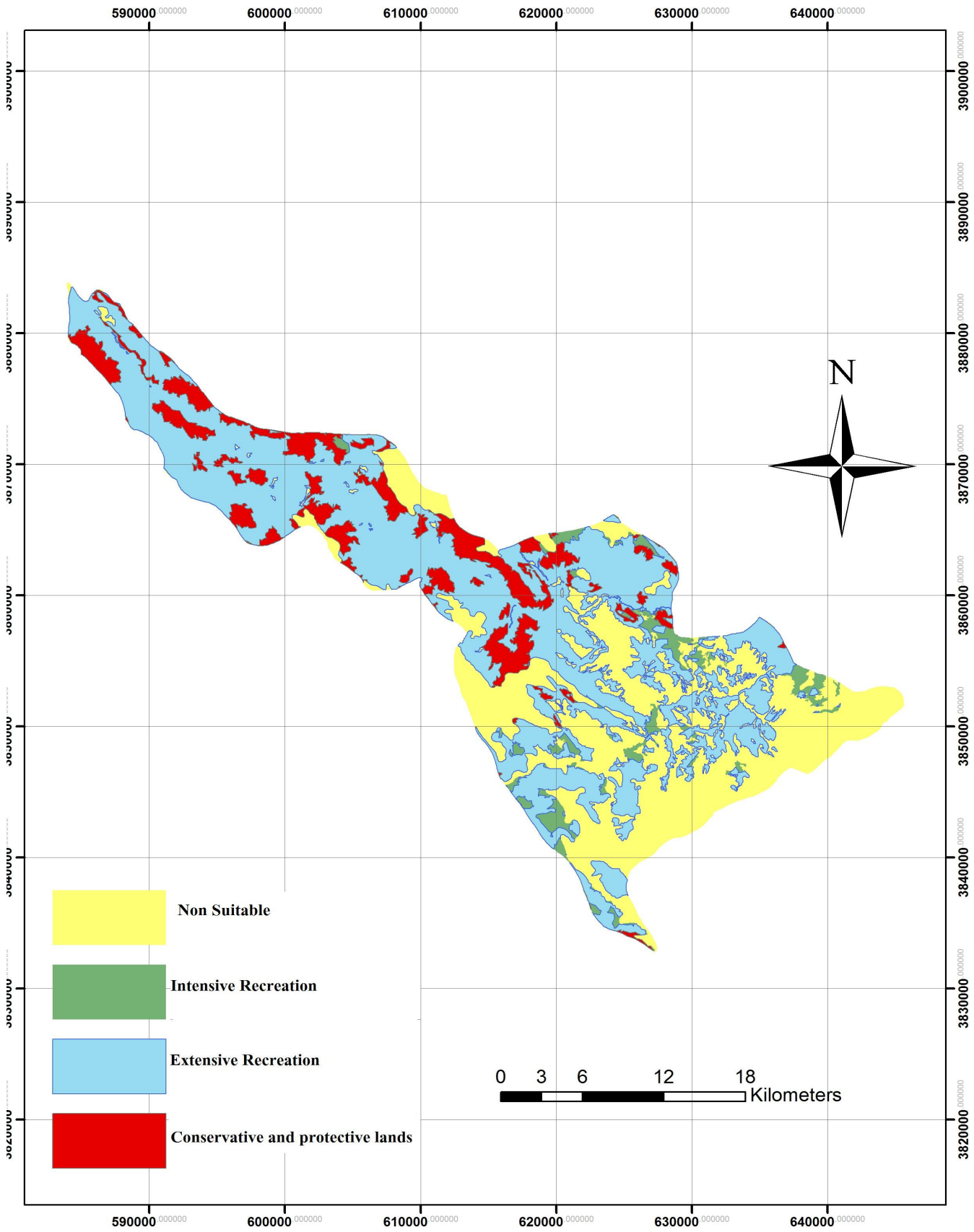

Figure 4. Final land use map.

managed in sustainable manner to include ecological, social and economical aspects of this ecosystem. Recreation forests can be described as areas designated for not only picnicking and outdoor activities but also conservation of local flora and fauna as well as areas with environmental education purposes (Bhuiyan et al., 2011). The forest based recreation planning in region can help to protect and conserve forests more effectively.

Current land use of region is not based on land capability. Also, some parts of the region with capability for protection, and/or conservation and/or ecotourism are used for understory farming and settlement uses. This can result in erosion and more degradation of forested area. On the other hand, recreation can make direct income for local entrepreneur and it is considered as a vehicle for poverty alleviation (Sunderline et al., 2005). The direct income and indirect income from recreation activities can prohibit migration. As mentioned before, many of people have been migrated from this rural area to cities. Recreation can stop this trend by creating more income and employment opportunities. This can make people more involved in the forest conservation and protection plans in turn.

In the current model, we tried to use all important criteria for land allocation. Although, this is a useful model but it should be included social and economical criteria for final planning. In some studies in Zagros forests (Rashidi et al., 2011; Mahmoudi et al., 2012) different criteria were used. For example they used depth of soil, slope aspects and soil texture. But we tried to simplify the model and combine soil properties, slope aspects and soil depth in susceptibility to erosion layer. Results showed that current land use pattern is not based on land capability. Results from other studies in Zagros forest (Babaie-kafaky et al., 2009; Rashidi et al., 2011) support our findings and indicates importance of land capability evaluation in the sustainable forest planning. Using the final map, the preferences of suitable land use for each area has been shown ecologically. However, in three cases, land uses could not be executed together, thus; the best land use could be identified if some further economical studies undertake.

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