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Assessment of Successfulness of Tree Plantations Based on Multiple Criteria in North of Iran

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ABSTRACT The present study was conducted to determine the most appropriate tree species planted in the same ecological condition considering different variables at Darabkola forest, Mazandran Province. For this purpose, the success of planted species (maple, walnut, oak, pine, ash and elm) was assessed according to nine criteria (soil nitrogen, soil phosphorus, soil potassium, leaf nitrogen, leaf phosphorus, leaf potassium, growth of diameter at breast, diameter at breast, H/D: height/diameter at breast height ratio). Analytical Hierarchy Process (AHP) was used to assess forest stands based on multiple criteria. Results showed that the maximum local priority of average annual growth, and leaf and soil nitrogen were observed in pine stands, while the highest levels of phosphorus, potassium, and DBH were recorded for maple plantation. The calculated overall priority showed that based on concerning criteria, pine stand had higher growth and nutritional potential compare to the other stands, while other stands ranked as maple> elm> walnut> oak> ash. In conclusion, our findings from AHP suggested that the growth rate and nutrition of pine and maple stands had more appropriate condition and efficiency than other stands and therefore found suitable for planting in the study area.

Key words: *Darabkola, Analytical Hierarchy Process, Overall priority, Soil chemistry, Tree nutrition*

1 INTRODUCTION

Principles of proper planning and management in natural resources are based on recognition of capacities and assessment of ecological potential. Clear cutting and then planting with native and exotic tree species is the common management practice to reconstruction of degraded Hyrcanian Forest ecosystems in the north of Iran. Maple, walnut, oak, pine, ash are the common tree species have been used to the different areas with variety of ecological characteristics. Those tree species have been planted alone or mixed with each other during the last five decades; but there have been no documents for finding the most appropriate tree species which is planted in the same ecological area (Mohammadnejad Kiasari *et al*., 2010). The structure and function of forest ecosystem

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in relation to their sustainability do not only depended on dynamic status of organic components but are also influenced by various nutrient variables and the applied management procedures (Lodhiyal and Lodhiyal, 2003). The nutrient availability is the most influencing factor in distribution of plant species (Paschke *et al*., 2000; Baer *et al*., 2004). Therefore, production is limited due to the lack of nutrients. The functioning of man-made forest in relation to the production and nutrient cycling influenced by the species characteristics, site and spacing on which they are planted (Lodhiyal and Lodhiyal, 2003). In forest ecosystem each tree has specific nutritional needs and litter fall rate and certain amount of elements returns to the soil surface. Through examining the nutrient cycling in each species, appropriate information will be obtained about the amount of each element required for species growth and returned to the environment. It helps managers to introduce a suitable species for each region aiming for sustainable forestry. Correct choice of plant species has particular importance in the success of plantation.

The Analytical Hierarchy Process (AHP), developed by Saaty (1980) is a mathematical method for analysing complex decisions with multiple criteria. This process is one of the most famous techniques in multi-criteria decision making (Ananda and Herath, 2003). An AHP model typically consists of an overall goal, a set of criteria to specify the overall goal. Beyond the decomposition principle, the AHP is based on pair wise comparisons of elements in a decision hierarchy that are made on a scale of relative importance where a decision maker has the option to express preferences between two elements on a ratio scale from equally important (i.e. equivalent to a numeric value of one) to absolute preference (i.e. equivalent to a numeric value of nine) of one element over another (Saaty, 2001). When applying AHP, a hierarchical decision schema is constructed by decomposing the decision problem into its decision elements. The preferences for attributes are compared in a pair wise manner and numerical techniques are used to derive quantitative values from these comparisons (Kurttila *et al*., 2000). The decision maker has the option of expressing his or her intensity of preference on a nine point scale. If two attributes are of equal importance, a value of 1 is given in the comparison, while number 9 indicates the absolute importance of one criterion over the other (Saaty, 1980). The AHP method has been applied in numerous areas including forest management (Kuusipalo and Kangas, 1994; Wolfslehner *et al*., 2005; Ananda, 2007).

The present study aimed to evaluate the plantated species elm (*Zelkova carpinifolia*), oak (*Quercus castanifolaia*), maple (*Acer insign*), ash (*Fraxinus excelsior*), walnut (*Joglans regia*) and pine (*Pinus brutia*) in Darabkola Forest, north of Iran and to select and prioritize the appropriate species in this area.

2 MATERIALS AND METHODS

2.1 Site characteristics

This research was conducted in plantations of Darabkola Forest, the Educational and Experimental Forest Station of Sari Agricultural Sciences and Natural Resources University located in a part of Hyrcanian Forest in Mazandaran Province in the north of Iran, between 36˚ 33´ N and 36˚ 28´ N latitudes and 51˚ 20´ E and 51˚ 31´ E longitudes (Figure 1). The elevation is 300 m above sea level. The minimum and maximum of temperature was recorded in December (7.5˚C) and June (21.1˚C), respectively. Mean annual precipitation is 983.8 mm.

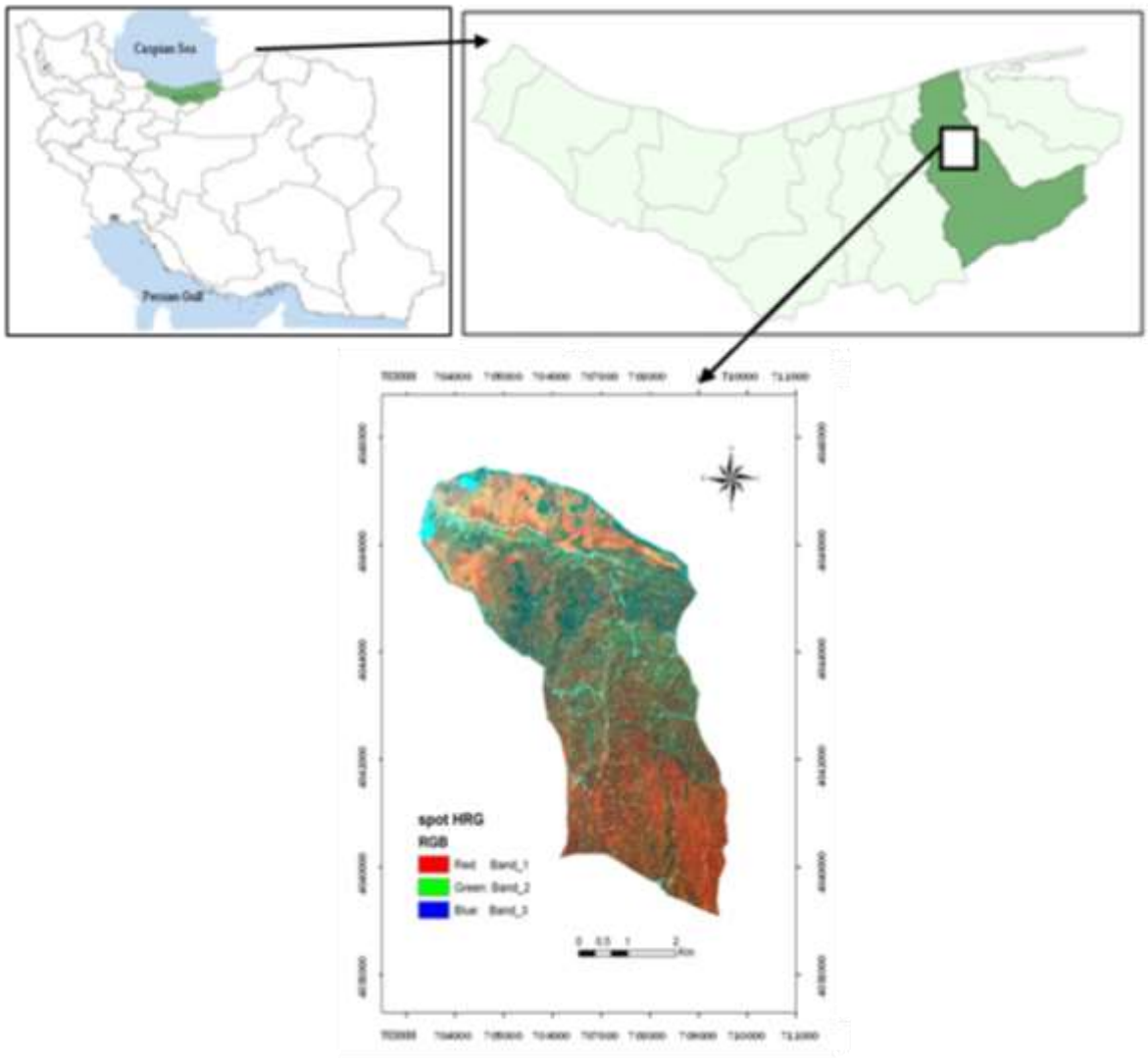

Figure 1 Geographical location of the study Area

2.2 Data collection

Within each stand, diameter (d) at breast height (DBH) all of trees were measured (using Caliper) in every species and height (h) trees were measured with using of Suunto. Average width of annual ring were measured using the increment borer.

From each stand, six soil samples were taken in the depth of 0-15 cm by a soil auger. The samples were air dried ground and passed through 2 mm stainless steel sieve. Total nitrogen (N) was extracted with perchloric-concentrated sulphuric acid and determined by the Kjeldahl method and the available phosphorus (P) was determined with spectrophotometer using the Olsen method (Chapman and Pratt, 1962). The available potassium (K) (by ammonium acetate extraction at pH 9) was determined with atomic absorption spectrophotometer (Bower *et al*., 1952).

Foliage samples were collected in mid-summer (August 2009) from the upper one-third

of the tree (Jalilvand, 2001). Six representative trees of each species were sampled in each stand. The samples were dried at 70 ˚C for at least 48 h and ground in a Willey mill to pass through a 2 mm meshes sieve prior to chemical analysis at the laboratory. The powdered leave material of each species was analyzed for macro-lements such as total N, P and K. Total N was analyzed after digesting the sample in concentrated H_2SO_4 using a catalyst mixture (potassium sulphate and cupric sulphite in a ratio of 9:1) with a quick digestion unit. The total N was estimated using the Micro-Kjeldhal method (Jackson and Barak, 2005). Phosphorous was measured after digesting the samples in triple acid mixture (HNO_3, H_2SO_4 and $HClO_4$ in a ratio 10:1:3). Potassium was determined using an atomic absorption spectrophotometer after wet digestion of a 1 g sample with triple acid mixture (10 ml of HNO_3, 4 ml of $HClO_4$, and 1 ml of HCl) (Issac and Johnson, 1975).

2.3 Hierarchical framework

Hierarchical decision model has a goal, and involves criteria that are evaluated for their importance to the goal, and alternatives that are evaluated for how they are preferred with respect to each criterion. The goal, criteria, and alternatives are all considered as elements in the decision problem, or nodes in the model. An abstract view of such a hierarchy is shown in Fig. 2 The first level of this diagram shows the goal (selection of the best species for plantation in a locale), while growth, soil and leaf nutrient characteristics are presented at the second level and criteria and alternatives (average annual growth, diameter at breast height, form quotient, soil and mature leaf nitrogen, phosphorus and potassium) are shown at the last level. The lines connecting the goal to each criterion mean that the criteria must be pairwise compared for their importance with respect to the goal. Similarly, the lines connecting each criterion to the alternatives mean the alternatives are pairwise compared as to which is more preferred for that criterion (Ananda and Herath, 2003; Kooch and Najafi, 2010; Kooch *et al*., 2012).

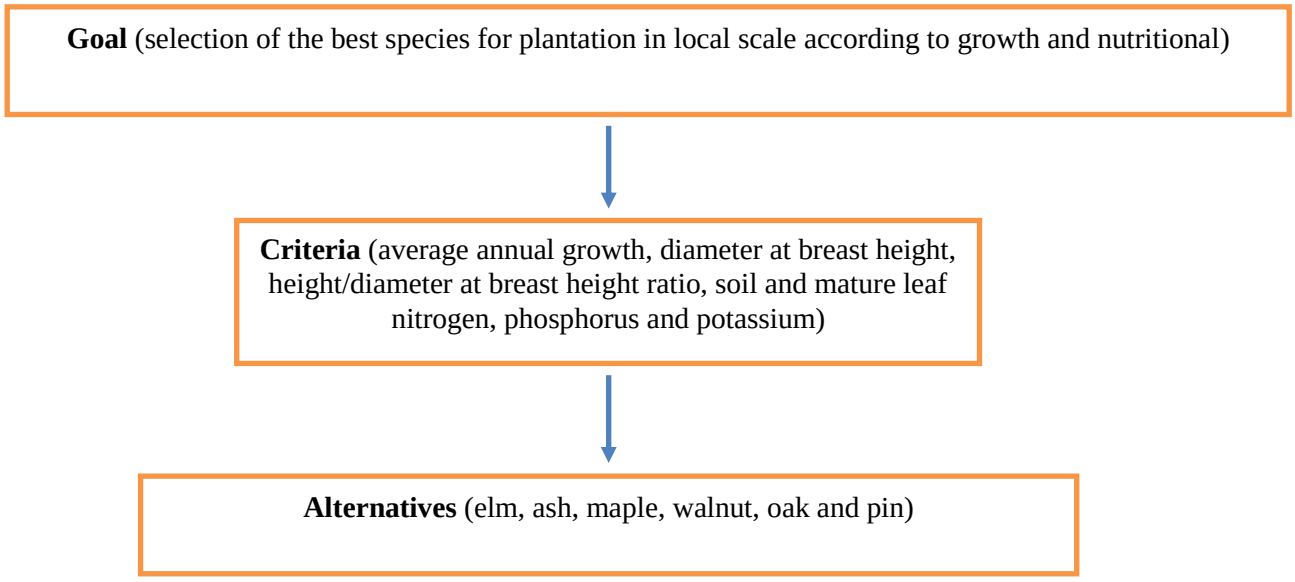

Figure 2 A schematic diagram of the AHP process in the present study

After determinations of hierarchical framework on basis of goal, criteria and alternatives, they are compared with each other and their importance values will be found. AHP application is based on the determination of structure and framework for problems, priorities determination by paired comparisons and determination of reasonable consistency for measurements. Following the design of schematic diagram for AHP, the next step was element assessment with paired matrix. Then, for calculating values of criteria and alternatives importance, geometric mean of paired matrix cells was calculated by the following equation:

$$a_{12} = (a_{12}1 \times a_{12}2 \times ... \times a_{12}N)^{\frac{1}{N}} \quad (1)$$

In the next step, the results were normalized and finally the weight of criteria and alternatives were calculated. The inconsistency ratio measure were used for identifying possible errors in judgments as well as actual inconsistencies in the judgments themselves. In general, the inconsistency ratio of less than 0.1 was considered reasonably consistent (Saaty, 1980). In this research, Expert Choice software was used for determining a selection of the best species on basis of growth and nutritional values for plantation in Darabkola Forest using AHP method.

3 RESULTS

The planted species (maple, walnut, oak, pine, ash and elm) were assessed according to nine nutritional criteria (average annual growth, diameter at breast height, form quotient, soil and mature leaf nitrogen, phosphorus and potassium). Due to determine the contribution of each criterion and selection the best species, the weight of each criterion was determined. For this purpose, the matrixes of paired comparison were prepared and the criteria weights were calculated by arithmetic mean (Figure 2). Overall priorities were obtained for every alternatives paying attention to calculated local priorities.

Table 1 Average of used parameters for the evaluation of study species

Variables	Species					
	Maple	**Oake**	**Elm**	**Walnut**	**Ash**	**Pin**
Ns (%)	0.27	0.27	0.36	0.39	0.37	0.30
Ps (%)	68.4	19.8	63.3	83.4	58	14
Ks (%)	17.6	15.3	17.66	22.4	17.5	13.7
Nm (%)	1.98	2.11	2.22	2.64	2.22	2.09
Pm (%)	0.45	0.16	0.52	0.41	0.35	0.17
Km (%)	2.3	0.17	2.13	2.24	2.25	1.3
RW (cm)	3.94	4.31	3.94	4.65	3.14	4.87
H/D (m/cm)	85.3	86.5	160	94	121	89
D (cm)	20.18	21.7	9.86	19.65	9.95	14.1

NS: soil nitrogen, PS: soil phosphorus, KS: soil potassium, NM: leaf nitrogen, PM: leaf phosphorus, KM: leaf potassium, RW: growth of diameter at breast, D: diameter at breast, H/D: height/diameter at breast height ratio

The results of study showed that the maximum weight of total soil nitrogen, leaf nitrogen and growth of average diameter characteristics were in pine stand. The highest weight based on parameters including soil phosphorus and potassium, leaf phosphorus and potassium and also diameter at breast was obtained in maple stand. Whereas, the ash stand showed the lowest values for total nitrogen and potassium of soil, leaf nitrogen, mean growth and diameter at breast characteristics. The lowest weight of soil phosphorus, leaf potassium and form quotient characteristics were observed in oak stand (Figures 3 to 12). According to investigated characteristics of plantation stands, the average of relative weights showed that the ecological power of maple stand (0.228) is higher than other stands, while pine, elm, walnut, and ash stands form the next level (Figure 13).

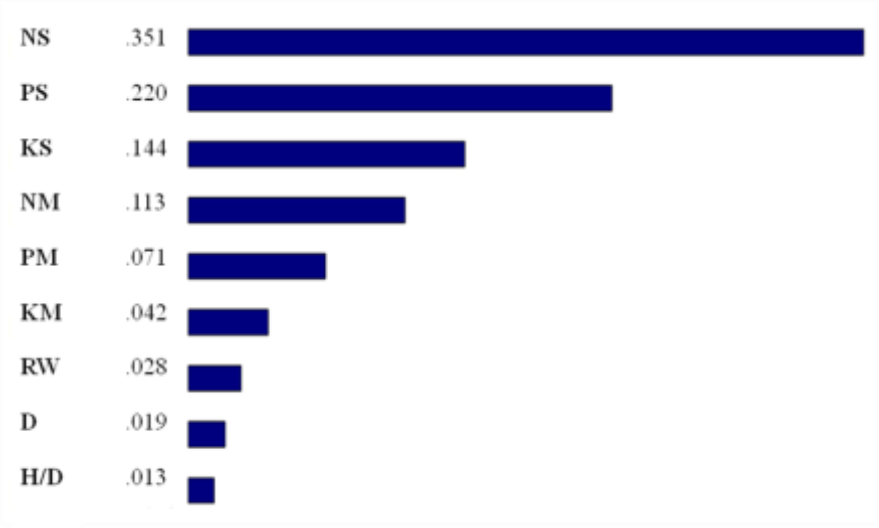

Figure 3 Weight criteria based on the arithmetic average (inconsistency ratio: 0.04)

Figure 4 Local priorities of species on the basis of soil nitrogen (inconsistency ratio: 0.04)

Figure 5 Local priorities of species on basis of soil phosphorus (inconsistency ratio: 0.04)

Figure 6 Local priorities of species on the basis of soil potassium (inconsistency ratio: 0.04)

Figure 7 Local priorities of species on the basis of leaf nitrogen (inconsistency ratio: 0.04)

Figure 8 Local priorities of species on the basis of leaf phosphorus (inconsistency ratio: 0.03)

Figure 9 Local priorities of species on the basis of leaf potassium (inconsistency ratio: 0.04)

Figure 10 Local priorities of species on the basis of diameter at breast (inconsistency ratio: 0.03)

Figure 11 Local priorities of species on the basis of growth of diameter at breast (inconsistency ratio: 0.03)

Figure 12 Local priorities of species on the basis of H/D (inconsistency ratio: 0.04)

Figure 13 Final weights of study stands in relation to nine criteria (inconsistency ratio: 0.03)

4 DISCUSSION

Assessment of different forest stands in forest habitats is one of the important and valuable points for forest ecosystems management. Knowledge of the ecological conditions under which different tree species occur is an essential pre-requisite for forest management, particularly for choosing tree species adapted to natural site conditions (Pinto and Gegout, 2005).

High levels of nutrients in forest stands can be considered as their suitability conditions for habitat (Kooch and Najafi, 2010) and on the other hand tree species can differ in their influence on soil properties. In particular, differences between N_2-fixing and non-N_2-fixing species, between gymnosperms and angiosperms, and between native and exotic species are often highlighted (Vitousek *et al*., 1987; Binkley and Ryan, 1998; Binkley *et al*., 2000; Giardina *et al*., 2001, Rhoades *et al*., 2001; Kaye *et al*., 2002).

Inappropriate selection of species will lead to reduced growth and possible mortality. The cause will vary according to site, and may be assessed in terms of tree growth, health, level of water stress, or nutrient status (Specht and Turner, 2006).

In this study, in addition to nutritional properties, some of the tree parameters including the average DBH, form quotient and annual growth rate were considered. The assessment of various forest stands using the analytical hierarch process revealed that the highest criteria weights of soil and leaf nutrients, and growth characteristics occurred in maple and pine stands.

The average of relative forest stands weight based on investigated criteria showed that pine and maple stand have higher ecological capacity than other stands and elm, walnut, oak and ash stands the formed next level, respectively. Among the evaluated criteria in the stands soil nitrogen and form quotient have the highest and lowest contribution, respectively. Calculated final weight also indicated maple and pine forest stands have more suitable conditions than other stands. Several studies in plantations of northern parts of Iran (Fattahi, 1995; Majd Taheri and Jalili, 1997; Radmanesh and Jalilvand, 2009; Kooch and Najafi, 2010) demonstrated that native species especially maple is the successful species and also *Pinus brutia* adapted for the plantation.

Radmanesh and Jalilvand (2009) investigated some qualitative and quantitative characteristics of plantation stands in Darabkola. Their results showed that native species including maple and pine have a better quality and quantity situation than other stands. Also, Kooch *et al.* (2010) assessed species plantation (*Acer insign*, *Quercus castaneifolia*, *Pinus brutia*, *Carpinus betulus – Zelkova carpinifolia* and *Quercus castaneifolia*) in Darabkola forest with respect to nine criteria (soil pH, total nitrogen, extractable phosphorous, exchangeable solution K^-,

earthworm biomass, number of trees per hectare, mean of diameter at breast height, total height of trees, and canopy area of trees), and found the same results in their study of regarding maple plantation in this area. They showed that soil condition of this region had the main effect in increasing maple growth. These studies demonstrated the suitability of ecological conditions of the region for this species, so that showed higher ecological potency than other studied stands. In another study, Azadi Nejat (2008) in Chitgar forest park, Tehran (Iran) showed that pine with the final weight of 0.198 has the highest priority for planting, while maple and oak were next in priority with weights of 0.162 and 0.159, respectively, were next in priority. According to the evaluated criteria in present study plantation with pine species has the first ecological level in the Darabkola region and in terms of these characteristics maple forms the next level. *Pinus brutia* is a fast growth species that has economic and functional importance, etc. Most of the natural habitat of this species is in the east Mediterranean and covers a large part of Turkey (Arbez, 2000). Dastmalchi (1999) in a study on Guilan Forest concluded that *Pinus brutia* can be used as a vanguard species in plantation. Investigations indicated high ecological potency of this species at high altitudes, so that the best quality and quantity its growth characteristics are at high altitudes (over 600 m) (Atalay *et al*., 2001; Fisher *et al*., 2001). Due to increasingly destruction of Hyrcanian Forests, plantation with native species is an appropriate method for rehabilitation and reconstruction of destroyed forest areas. To select a species, in addition to growth quantity and quality the effects of species in ecosystem, restoration should also be noted. Evaluation of trees in terms of soil moderator of different habitats conditions and classification of tree species based on achieved results are necessary. It appears using analyzed hierarchical process gives a broad perspective in relation to the assessment of forest stands and can be considered an appropriate strategy.

5 CONCLUSION

The outhouse results showed that *Pinus brutia* and *Acer insign*, has better growth than other species in the region. The findings of this study revealed the importance of species function in relation to nutrients metabolism and biomass before plantation. Comparative studies of several species growing on the same soils allow a better understanding of differences between species under similar nutrient conditions. The obtained results can increase the extent of information in order to select appropriate species.

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7 REFERENCES

Ananda, J. Implementing participatory decision making in forest planning. Environ. Manage., 2007; 39: 534-544.

Ananda, J. and Herath, G. The use of Analytic Hierarchy Process to incorporate stakeholder preferences into regional forest planning. Forest Policy Econ., 2003; 5: 13-26.

Arbez, M. Distribution, ecology and variation in *Pinus brutia* Ten. FAO- Forest genetic resources information, 2000; 3: 21-23.

Atalay, I., Sezer, I. and Cukur, H. The ecological properties of Red Pine (*Pinus brutia Ten.*) forests and their rejoining in terms of seed transfer. Orman Bakaligi, Orman Agaclari, 2001; 108P.

Azadi Nejat, S. Applying Multi criteria decision making in assessment of afforestation in Chitgar forest park. M.Sc. thesis, Dept. of

Forestry. Tarbiat Modares University, 2008; 126P. (In Persian).

Baer, S.G., Blair, J.M., Collins, S. L. and Knapp, A.K. Plant community responses to resource availability and heterogeneity during restoration. Oecologia., 2004; 139: 617-629.

Binkley, D. and Ryan, M.G. Net primary production and nutrient cycling in replicated stands of Eucalyptus saligna and Albizia falcataria. Forest Ecol. Manag., 1998; 112: 79-85.

Binkley, D., Giardina, C. and Bashkin, M.A. Soil phosphorus pools and supply under the influence of Eucalyptus saligna and nitrogen-fixing Albizia falcataria. Forest Ecol. Manag., 2000; 128: 241-247.

Bower, C.A., Reitemeier, R.F, and Fireman, M. Exchangeable cation analysis of saline and alkali soils. Soil Sci., 1952; 73: 251-261.

Chapman, H.D. and Pratt, P.F. Methods of Analysis for Soils, Plants and Waters. (Book Review Paper), Soil Sci., 1962; 93(1): 68 P.

Dastmalchi, M. Compatibility survey of trees species in west Azerbaijan province. Iran. J. Forest and Poplar Res., 1999; 203: 168-175.

Fisher, J.T., Neumann, R.W. and Maxel. J.G. Performance of *Pinus brutia* Ten. Halepensis group pinus in southern New Mexica. Forest Ecol. Manag., 2001; 16: 403-410.

Giardina. C.P., Ryan, M.G., Hubbard, R.M. and Binkley, D. Tree species and soil textural controls on carbon and nitrogen mineralization rates. Soil Sci. Soc. Am. J., 2001; 65: 1272-1279.

Fattahi, M. Investigation of exotic needle leaves in Kurdistan, Institute of Forests and Rangeland Rresearches Publications, 1995; 141 P. (In Persian).

Jackson, M.L. and Barak, P. Soil Chemical Analysis: Advanced Course. UW-Madison Libraries Parallel Press, USA, 2005; 930 P.

Hagen-Thorn, A., Callesen, I., Armolaitis, K. and Nihlgard, B. The impact of European tree species on the chemistry of mineral topsoil in forest plantation on former agricultural land. For. Ecol. Manag., 2004; 195: 373-384.

Issac, R.A. and Johnson, W.C. Collaborative study of wet and dry ashing techniques for the elemental analysis of plant tissue by atomic absorption spectrophotometry. J. Assoc. Off. Ana. Chem., 1975; 58: 436-440.

Kaye, J.P., Binkley. D., Zou, X. and Parrotta, J.A. Non-labile 15nitrogen retention beneath three tree species in a tropical plantation. Soil Sci. Soc. Am. J., 2002; 66: 612-619.

Jalilvand, H. Development of dual nutrient diagnosis ratios for basswood, American beech, and White ash. J, Agri. Sci. Technol, 2001; 3(2): 121-130.

Kooch, Y., Hosseini, S.M., Mohammadi, J. and Hojjati, S.M. Determination of the Best Canopy Gap Area on the Basis of Soil Characteristics Using of Analytical Hierarchy Process (AHP). Folia For. Pol., 2012; 54 (1): 15 -24.

Kooch, Y. and Najafi, A. Application of Analytical Hierarchy Process (AHP) in Ecological Potential Assessment of Forest Stands in Darabkola Region. Iran. J. Natural Res., 2010; 63: 161-175.

Kurttila, M., Pesonen, M., Kangas, J. and Kajanus, M. Utilizing the analytical hierarchy process (AHP) in SWOT analysis — A hybrid method and its application to a forest-certification case. For. Policy Econ., 2000; 1: 41-52.

Kuusipalo, J. and Kangas, J. Managing biodiversity in a forestry environment. Biol. Conserv., 1994; 8: 450-460.

Lodhiyal, N. and Lodhiyal, L.S. Aspects of nutrient cycling and nutrient use pattern of Bhabar Shisham forests in central Himalaya, India. For. Ecol. Manag., 2003; 176: 237-252.

Majd Taheri, H. and Jalili, A. Comparition effects of forestation by *pinus eldarica* and *Robinia psudoacacia* on some physic-chemical properties of soil and under story Vegetation. Pajohesh Sazandegi, 1997; 32: 7-15. (In Persian)

Mohammadnejad Kiasari, Sh., Sagheb-Talebi, Kh., Rahmani, R., Adeli, E., Jafari, B. and Jafarzadeh, H. Quantitative and qualitative evaluation of plantations and natural forest at Darabkola, east of Mazandaran. Iran. J. Forest and Poplar Res., 2010; 18: 337-351.

Paschke, MW., McLendon, T. and Redente, E.F. Nitrogen availability and old-field succession in a shortgrass steppe. Ecosystems. 2000; 3: 144-158.

Pinto, P.E. and Gégout, J.C. Assessing the nutritional and climatic response of temperate tree species in the Vosges Mountains. Ann. For. Sci., 2005; 62: 761-770.

Radmanesh, H. and Jalilvand, H. Qualitative and quantitative survey of Darabkola forest stands. The First International Conference of Climate Change and Dendrochorology in Caspian Ecosystems., 2009; 8 P. (In Persian).

Rhoades, C., Oskarsson, H, Binkley, D. and Stottlemyer. B. Alder (*Alnus crispa*) effects on soils in ecosystems of the Agashashok River valley, northwest Alaska. Ecoscience., 2001; 8: 89-95.

Saaty, T.L. The analytic Hierarchy Process. Mc Graw - Hill, New York. 1980. 460p.

Saaty, T.L. Decision making with dependence and feedback: Analytic Network Process: the Organization and Prioritization of Complexity, RWS Publisher, Pittsburg., 2001; 370 P.

Specht, A. and Turner, J. Foliar nutrient concentrations in mixed-species plantations of subtropical cabinet timber species and their potential as a management tool. For. Ecol. Manag., 2006; 233: 324-337.

Vitousek, P.M. and Denslow, J.S. Differences in extractable phosphorus among soils of the La Selva Biological Station, Costa Rica, Biotropica., 1987; 19: 167-170.

Wolfslehner, B., Vacik, H. and Lexer, M.J. Application of the analytic network process in multi-criteria analysis of sustainable forest management. Forest Ecol. Manag., 2005; 207: 157-170.

ارزیابی موفقیت جنگل‌کاری‌های شمال ایران با استفاده از ارزیابی چند معیاره

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چکیده مطالعه حاضر به منظور تعیین مناسب‌ترین گونه درختی کاشته شده در شرایط اکولوژیکی مشابه با توجه به متغیرهای مختلف در جنگل‌های دارابکلا استان مازندران انجام شد. برای این منظور، موفقیت گونه‌های کاشته شده (افرا پلت، گردو، بلوط بلندمازو، کاج بروسیا، زبان گنجشک و آزاد) با توجه به نه معیار (نیتروژن خاک، فسفر خاک، پتاسیم خاک، نیتروژن برگ، فسفر برگ، پتاسیم برگ، قطر برابر سینه، رشد قطری و نسبت:ارتفاع/ قطر) مورد بررسی قرار گرفت. برای ارزیابی گونه‌ها بر اساس معیارهای چندگانه، فرآیند تحلیل سلسله مراتبی (AHP) بکار گرفته شد. نتایج نشان داد بالاترین میزان وزنی متوسط رویش سالانه، نیتروژن خاک و برگ، در توده کاج بروسیا و بالاترین مقادیر فسفر و پتاسیم خاک و برگ و قطر برابر سینه در توده دست کاشت افرا پلت وجود دارد. وزن نهایی بدست آمده نشان داد که توده کاج بروسیا با توجه به معیارهای مورد بررسی دارای توان بالاتری نسبت به سایر گونه‌ها می‌باشد. در حالی که توده‌های افرا پلت، آزاد، گردو، بلوط ون به ترتیب در رتبه‌های بعدی قرار می‌گیرند. با توجه به نتایج بدست آمده از نظر میزان رویش و تغذیه توده‌های کاج بروسیا و افرا پلت دارای شرایط و بهره‌وری مناسب‌تری نسبت به سایر گونه‌های مورد مطالعه هستند و برای کاشت در این منطقه مناسب می‌باشند.

کلمات کلیدی: دارابکلا، فرآیند تحلیل سلسله مراتبی، وزن نهایی، شیمی خاک، تغذیه درخت