

Prioritizing of effective factors on development of medicinal plants cultivation using the analytic network process

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Abstract: For the overall development of medicinal plants cultivation in Iran, there is a need to identify various effective factors on medicinal plant cultivation. A proper method for identifying the most effective factor on the development of the medicinal plants cultivation is essential. This research conducted in order to prioritizing of the effective criteria for the development of medicinal plant cultivation in North Khorasan province in Iran using Analytical Network Process (ANP) method. The multi-criteria decision making (MCDM) is suggested to be a viable method for factor selection and the analytic network process (ANP) has been used as a tool for MCDM. For this purpose a list of effective factors offered to expert group. Then pair wise comparison questionnaires were distributed between relevant researchers and local producer experts of province to get their opinions about the priority of criteria and sub-criteria. The questionnaires were analyzed using Super Decision software. We illustrated the use of the ANP by ranking main effective factors such as economic, educational-extension services, cultural-social and supportive policies on development of medicinal plants. The main objective of the present study was to develop ANP as a decision making tool for prioritizing factors affecting the development of medicinal plants cultivation. Results showed that the ANP methodology was perfectly suited to tackling the complex interrelations involved in selection factor in this case. Also the results of the process revealed that among the factors, supporting the cultivation of medicinal plants, build the infrastructure for marketing support, having educated farmer and easy access to production input have most impact on the development of medicinal plant cultivation.

Keywords: Development, medicinal plants, multi-criteria decision methods, North Khorasan province, Iran

Analitik ağ süreci ile tıbbi bitki yetiştiriciliğinin gelişimi üzerine etkili olan faktörlerin önceliklerinin belirlenmesi

Özet: İran'da tıbbi bitki yetiştiriciliğinin gelişmesi için, bu konuda etkili faktörlerin belirlenmesine ihtiyaç bulunmaktadır. Tıbbi bitki yetiştiriciliğinin gelişmesinde en etkili faktörün belirlenmesi için uygun bir yöntem bulunması gerekmektedir. Bu çalışma, Analitik Ağ Süreci (ANP) yöntemi kullanılarak İran Kuzey Horasan bölgesinde tıbbi bitki yetiştiriciliğinin gelişiminde etkin kriterlerin belirlenmesi amacıyla yapılmıştır. Çok kriterli karar verme (ÇKKV) faktör seçimi için uygun bir yöntem olup, analitik ağ süreci (ANP) ise bu çalışmada araç olarak kullanılmıştır. Bu amaçla, tıbbi bitki yetiştiriciliğinin gelişimi üzerinde etkili olan faktörlerin olduğu bir liste uzman grubuna sunulmuştur. Daha sonra bu konuda etkili olan kriter ve alt kriterlerin önceliğinin belirlenmesi için ilgili araştırmacılar ve bölgenin yerel üretici uzmanlara hazırlanan anketler yapılmıştır. Yapılan anketler Super Decision yazılımı kullanılarak analiz edilmiştir. ANP kullanılarak tıbbi bitki yetiştiriciliğinin gelişimi üzerinde etkili ana faktörlerin örneğin ekonomik, eğitim-yayım hizmetleri, sosyal-kültürel ve destekleyici politikaların sıralaması gösterilmeye çalışılmıştır. Bu çalışmanın ana amacı, tıbbi bitkileri yetiştiriciliğinin gelişimini etkileyen faktörlerin önceliklerinin belirlenmesi için bir karar verme aracı olarak ANP geliştirilmesidir. Sonuçlar, ANP metodunun tıbbi bitkileri yetiştiriciliğinin gelişimini etkileyen faktörlerin önceliklerinin belirlenmesi için uygun bir metod olduğunu göstermiştir. Yapılan bu araştırma sonucunda tıbbi bitki ekiminin desteklenmesi, pazarlama desteği için altyapı oluşturulması, üreticilerin eğitilmesi gibi hususların tıbbi bitki yetiştiriciliğinin gelişimi üzerinde en fazla etkiye sahip olan faktörler olduğu ortaya çıkmıştır.

Anahtar kelimeler: Gelişme, tıbbi bitkiler, çok kriterli karar verme teknikleri, Kuzey Horasan ili, İran

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1. INTRODUCTION

Today, there is an increasing interest in the development of traditional medicine in the countries as an evidence of the growth. Iran is one of the countries in Asia, which has the richest arrays of medicinal plants richness. Approximately 1700 plant species are known to have medicinal characteristics in Iran (Ghahreman and Attar, 2000). Over the centuries, the use of medicinal plants has become an important part of life for treating diseases and proving the economic status. Karki (2002) estimated that 95% of medicinal and aromatic plants in developing countries are harvested and collected in natural wild. Realizing the over harvesting of some medicinal plant species in the past and the renewal interest at present (medicinal plants for health care and improving the economic status) need to analysis of the various factors associated with the medicinal plants, especially development of medicinal plants cultivation. Canter et al. (2005) reported that cultivation is an option that could reduce pressure on wild populations of medicinal plant and the opportunity of cultivation offers to optimize yield, achieve a uniform, high quality product and control in every stage of the production process (Amujoyegbe et al., 2012).

North Khorasan Province reflects an extraordinary plant diversity of Iran. It has a rich variety of plant species which have medicinal characteristics. These plants play an important role in the lives of the people, including providing health care, generating income and employment. Approximately 2.5 million people in Iran still rely on medicinal plants for livelihood. Total number of medicinal plants used in traditional medicine of Iran has been reported to be up to 1100 species. Total number of medicinal and aromatic plants cultivated in Iran including the 54 species belonging to 28 plant families. Since only 54 species were cultivated in Iran, it appears that more than 95% of plants used gathered from the wild (Ghahreman and Attar, 2000; Omidbeigy, 2001). Thus many medicinal plants face to extinction. The extinction of these plants has serious implications for people's health and livelihood. Therefore, it is important to conserve medicinal plants. The main way to conserve medicinal plants is cultivation on a large scale. Because of above reasons and preserve of biodiversity (1700 endemic species), the study of effective factors on the development of medicinal plants cultivation has become increasingly urgent. This paper provides framework information for the development of medicinal plants cultivation and describes the main factors that should be performed to cultivation of medicinal plants. The main objective of the present study was to develop ANP as a decision making tool for prioritizing factors based on four criteria including economic, promotional-educational services, supportive policies and social-cultural factors affecting the development of medicinal plants cultivation.

2. MATERIALS AND METHODS

North Khorasan Province in the Northeast of Iran is located between 55° 53' to 58° 20' Eastern longitude and 36° 37' to 38° 17' Northern latitude. It is a mountain state with an altitude ranging from 378 to 2823 m above sea level. Main bioclimatic region is Irano Turanian that is distinguished by hot and dry summers, wet and cold winters. The region is also influenced by cold and dry wind from North and wet mild climate from the West. Thus the flora of study area is affected by climatic fluctuations. Unique ecological and climatic conditions of this region make it a singular habitat (543 species belonged to 68 families) for study.

2.1 ANP Method

Analytic network process (ANP) was firstly brought out by Saaty in 1996. ANP not only can solve the AHP problem, but also can deal with interdependent relationship within a multi-criteria decision making model. With factors influenced each other, and dependent on each other in the network layer, important degree can use direct comparison or indirect comparison. While AHP has been very popular, ANP is less prominent in the literature (Othman et al., 2011). There are some studies that use ANP. Chung et al. (2005) applied ANP to constitute product mix planning in semi-conductor fabricator. Dagdeviren and Yuksel (2007) developed an ANP-based personnel selection system and weighted personnel selection factors. Greda (2009) used the ANP to select the most efficient option of quality management system in the food industry. Yang et al. (2009) developed a manufacturing evaluation system model with ANP approach for wafer fabricating industry. Valmohammadi

(2010) used the ANP to identify specific resources and capabilities of an Iranian dairy products firm and to develop an evaluation framework of business strategy. Ayag (2011) proposed ANP-based approach to evaluate a set of simulation software alternatives. Hsu and Kuo (2011) applied the ANP method for selecting the optimal full-service advertising agency. Agrawal and Vijayvargy (2011) presented a comprehensive method for the evaluation and selection of supplier's offers in food industry. Complication of decision making as well as multiple factors impact on the development of medicinal plants cultivation generate complex interrelationship. Consequently, prioritizing effective factor requires decision processes suitable to multi criteria analysis. The ANP as a new MCDM method allows one to include all the factors and criteria, tangible and intangible, which have bearing on making optimum decision.

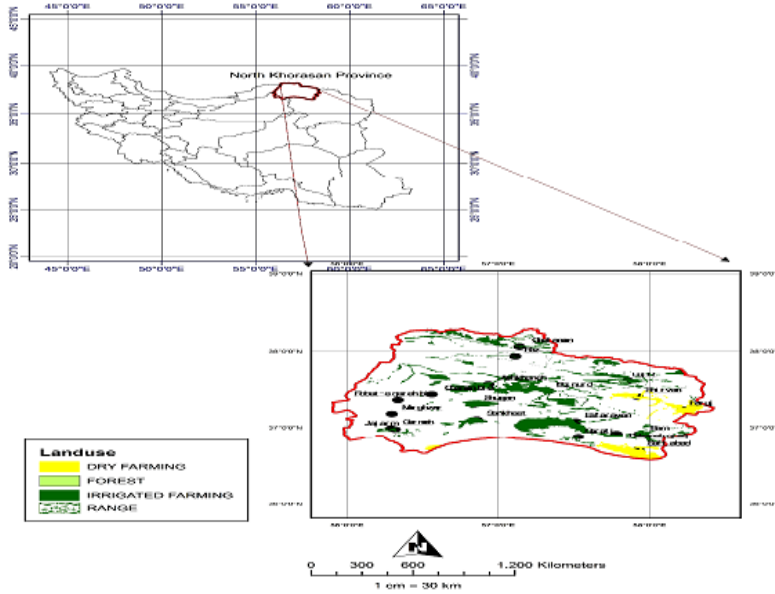


Figure 1. Study area and position on Iran map
Şekil 1. Çalışma alanının konumu

ANP approach comprises four steps (Saaty, 1996; Chung et al., 2005; Yuksel and Dagdeviren, 2007).

Step 1: Model construction and problem structuring: The problem should be stated clearly and decomposed into a rational system like a network.

Step 2: Pairwise comparisons and priority vectors: in ANP, like AHP, pairs of decision elements at each cluster are compared with respect to their importance towards their control criteria. In addition interdependencies among criteria of a cluster must also be examined pairwise; the influence of each element on other elements can be represented by an eigenvector. The relative importance values are determined by Saaty's scale (Table 1).

Step 3: Super matrix formation: The super matrix concept is similar to the Markov chain process. To obtain global priorities in a system with interdependent influences, the local priority vectors are entered in the appropriate columns of a matrix. As a result, a super matrix is actually a partitioned matrix, where each matrix segment represents a relationship between two clusters in a system.

Step 4: Synthesis of the criteria and alternative's priorities and selection of the best alternatives: The priority weights of the criteria and alternatives can be found in the normalized super matrix. The structural hierarchy and a network processes are pictured in Figure 2.

Table 1. The Sasty rating scale
Tablo 1. Sasty derecelendirme ölçeği

| Intensity of importance | Definition | Explanation |
|-------------------------|---------------------------|--|
| 1 | Equal importance | Two factors contribute equally to the objective |
| 3 | Somewhat more important | Experience and judgement slightly favour one over the other |
| 5 | Much more important | Experience and judgement strongly favour one over the other |
| 7 | Very much more important | Experience and judgement very strongly favour one over the other. It's importance is demonstrated in practice. |
| 9 | Absolutely more important | The evidence favouring one over the other is of the highest possible validity |
| 2, 4, 6, 8 | Intermediate values | When compromise is needed |

To draw a decision tree, it is needed to identify the factors that are involved in achieving the goals of the study. For this purpose the designer and analyst team, determined 19 factors in the development and cultivation of medicinal plants and presented it in the form of a questionnaire to expert group. These factors considered as factors affecting the cultivation of medicinal plants which were grouped in the form of the four criteria of economic factors, promotional-educational services, social-cultural factors and supportive policies based on medicinal plant knowledge of local producer experts and literature review. The hierarchical tree was developed considering the purpose of the study and criteria and sub criteria (Figure 3).

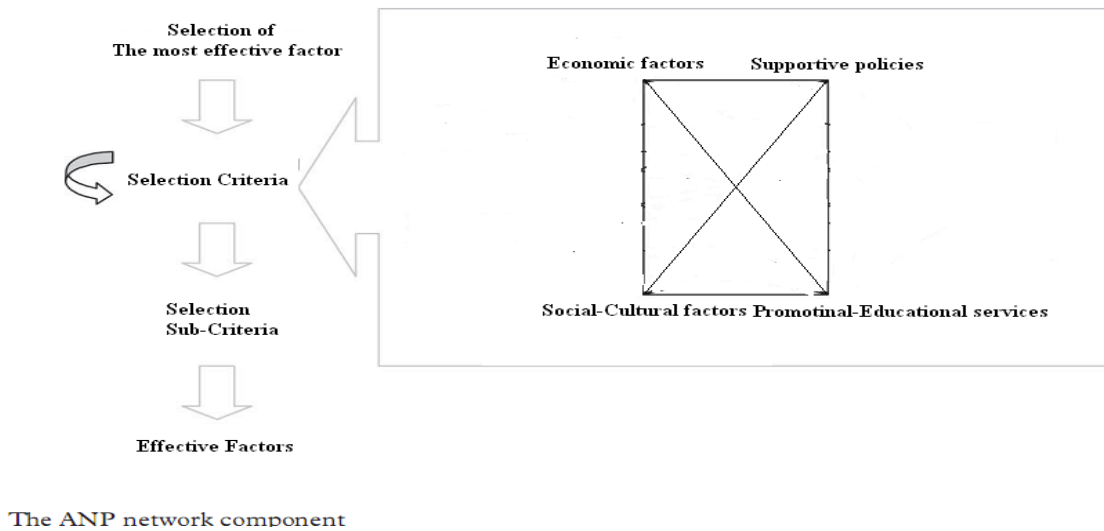


Figure 2. Structural network process
Şekil 2. Yapısal ağ süreci

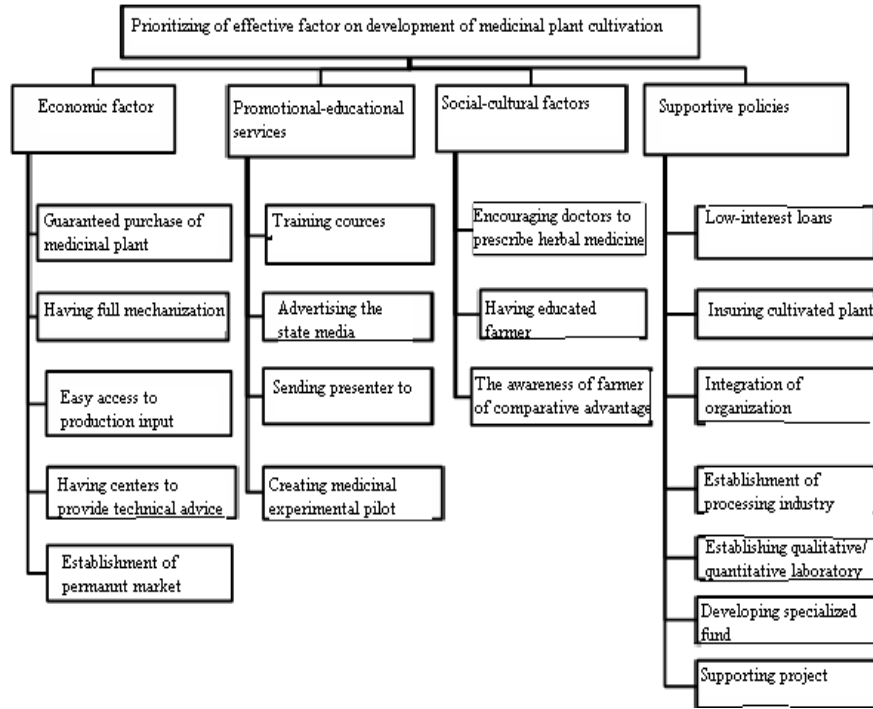


Figure 3. Hierarchy structure tree of factors affecting the cultivation of medicinal plants in North Khorasan
 Şekil 3. Kuzey Horasan’da tıbbi bitkilerin ekimi etkileyen faktörlerin hiyerarşi yapısı

3. RESULTS AND DISCUSSION

In Iran, medicinal plants were collected from the wild vegetation by local villagers. It is a major cause of natural habitat loss and leads to the destruction and degradation of natural habitat (IUCN, 2007). Most of evidence indicated that the natural habitat loss of medicinal plants has decreased to fewer than 17 million ha (Ghahreman and Attar, 2000). In the face of the threats posed by increasing demand, increasing human population and destruction of plant habitat/ecosystems of the arid zone, the need existed to identify the effective factor on medicinal plants, especially selection of the most effective factor. Beside a long history in use and production of medicinal plants, but report of the Iran medicinal plants cultivation is not suitable (Figure 4).

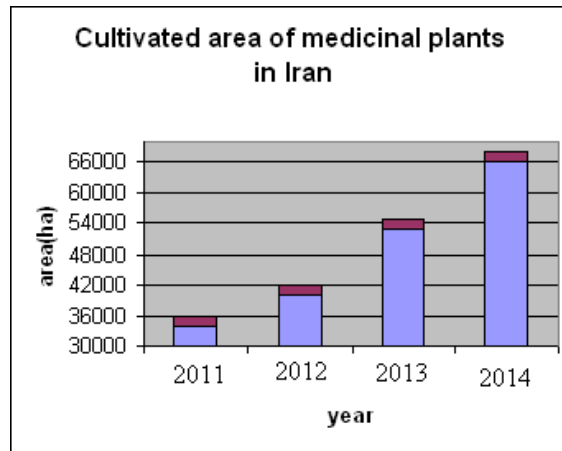


Figure 4. Cultivated area of medicinal plants in Iran over past four years
 Şekil 4. İran’da son dört yıl içinde tıbbi bitki ekili alan miktarları

We find that cultivation of medicinal plants has not yet taken place in North Khorasan, Iran. Some of difficulties include: poor supporting project and institutional infrastructure, insufficient awareness of farmer and long growth period (3-4 years in arid zone) and high risk of failure. In this paper illustrate that some of the factors such supporting the cultivation of medicinal plants, build the infrastructure for marketing support, having educated farmer and easy access to production input can overcome many of the constraints and provide conditions necessary for medicinal plant cultivation development. Results of ANP method indicate that educated farmer with relative weight of 0.080 have the first priority to develop medicinal plant cultivation. After then supporting project and having center to provide technical advice are being important, respectively (Table 2). The result is in agreement with (Canter et al., 2005; Alam, 2009; WHO, 2005) who reported on the specific measure to promote cultivation include training farmer, developing cultivation technology and supply planting material to farmer.

In response to over exploitation of the medicinal plants due to population growth, many plants are facing the threats of extinction (Prasad, 2009). Iran has 1700 medicinal plants species, Kempanna (1974) has earlier documented about 2700 collections of medicinal plants in India and Schmelzer and Gurib-Fakim (2008) recorded 2500 species of plants in Africa which have been found to have medicinal application.

As the demand for medicinal plants has increased and over harvesting of these plants has serious implications for people's health and livelihoods, effective way to conserve medicinal species is cultivation on a large scale. This paper is concerned with effective factor to promote the cultivation of medicinal plants in the North Khorasan, Iran. The most important factors that influenced on the development of medicinal plant cultivation are having educated farmer and supporting project. Government policies include the awareness of farmer of comparative advantage, having educated farmer, supporting project, establishing a permanent market and developing specialized fund, promotes the cultivation of medicinal plants (Alam and Belt, 2009). The government responsible for the promotion of medicinal plant cultivation should insure cultivated plant and development center to provide technical advice that is in agreement with the findings of (Alam and Belt, 2009). The medicinal plant sector can be improved if the agricultural support agencies would come forward easy access to production input and if having educated farmer would help the plant growers by improving their basic knowledge about cultivation practices (Parajapati, et al., 2002).

Table 2. Rank the sub-criteria according to ANP
Table 2. ANP'ye göre alt kriterlerin sıralaması

| Name | Weight |
|--|--------|
| 1. Having educated farmer | 0.080 |
| 2. Supporting project | 0.078 |
| 3. Having center to provide technical | 0.075 |
| 4. Easy access to production input | 0.071 |
| 5. Establishment of permanent market | 0.068 |
| 6. Creating medicinal experimental pilot | 0.057 |
| 7. Low-interest loans | 0.052 |
| 8. The awareness of comparative advantage | 0.050 |
| 9. Training course | 0.049 |
| 10. Establishment of qualitative/quantitative laboratory | 0.044 |
| 11. Advice Integration of organization | 0.042 |
| 12. Advertising the state media | 0.041 |
| 13. Encouraging doctors to prescribe herbal medicine | 0.039 |
| 14. Sending presenter to the area | 0.030 |
| 15. Establishment of processing industry | 0.027 |
| Inconsistency ratio | 0.086 |

4. CONCLUSION

Due to wild harvesting of medicinal plants, during the last few decades the natural resources have considerably decreased in Iran. Therefore, the natural resources are not able to supply of medicinal plants and development program in cultivation could conserve natural resources in Iran. The successful establishment of medicinal plant sector may help in increasing rural employment, boost commerce and contribute to the health of peoples in North Khorasan, Iran. There are many parameters attached to medicinal plant sector and the success of medicinal plant mainly depends on the guaranteed purchase of medicinal plants, establishment of permanent or seasonal market, developing specialized fund and supporting, creating an experimental pilot for visit farmer, supporting project and applied research. Awareness and interest of the farmer, supportive government policies, assured markets, having center to provide technical advice and having educated farmer are some of the key factors for successful plant cultivation development (Alam and Belt, 2004; canter et al., 2005; Alan, 2009; WHO, 2005). In summary, we state that medicinal plant cultivation is a conservation and sustainable option. In this case, the need for economic factors include easy access to production input and having center to provide technical advice are extremely urgent in North Khorasan, Iran. Major factors preventing the development of the medicinal plant cultivation in Iran are the lack of information on the economic benefits and low information the medicinal plant cultivation. It is therefore necessary to establish processing industry in order to assure farmers of the sale and having educated farmer by agriculture seminars greatly enhance the growth of medicinal plant cultivation. Plants are extremely important in the lives of people throughout the world and approximately 2.5 million people in Iran still rely on medicinal plants for livelihood. Now, natural habitat loss to fewer than 17 million ha and the current situation of vegetation is vital for Iran. It feels that protection of vegetation is vital need and the development of medicinal plants cultivation can be helpful to preserve of biodiversity (1810 endemic species) in Iran. This research produced valuable information about the relative importance of the factors that were evaluated and could be a useful precedent for future studies about the development of medicinal plants cultivation.

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