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Sustainable forest management through floristic study (Case study: Darkesh forest, Northern Khorasan Province, Iran)

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Abstract: Floristic study of plants in each site is one the most important role in keeping natural resources of each country. Plant species were collected from field sites that representing major habitats of study area. Surveys were managed during active growth periods in 2013 and 2014. A total of 140 medicinal plant species were documented. These species were scattered in 39 families and 116 genera. Families of Lamiaceae with 26 species, Asteraceae with 21 species and Rosaceae with 13 species were the most dominant families of medicinal plants in the study area. Hemicryphtophytes with 40%, therophytes with 18.4%, geophytes with 14.25%, phanerophytes with 13.57% and chamaephytes with 6.42%. The phyto-geographically of the medicinal plant showed that these species belonging to the regions of Irano-Turanian, Euro-Siberian and Mediterranean. The results of the present study showed that medicinal plants and wild fruit as Non Timber Forest Products (NTFPs) documented in this study, play an important role in the rural community welfare and sustainable forest management.

Keywords: Floristic studies, forest management, sustainable forestry, Darkesh, Iran

Floristik çalışmalar ile sürdürülebilir orman yönetimi (İran Kuzey Horasan bölgesi Darkeş ormanı örneği)

Özet: Bitkilere yönelik gerçekleştirilen floristik çalışmalar, her bir ülkenin doğal kaynaklarını korumada en önemli rollerden faktörlerden biridir. Araştırma bölgesinde önemli yetişme alanlarını temsil eden konumlardan, bitki türleri toplanmıştır. Bu kapsamdaki bitki toplama çalışmaları, 2013 ve 2014 yıllarında bitkilerin aktif büyüme dönemlerinde gerçekleştirilmiştir. Toplamda 140 adet tıbbi bitki türü belgelenmiştir. Bu türler, 39 aileye ve 116 cinse ayrılmıştır. 26 türe sahip Lamiaceae (Ballıbabagiller), 21 tür ile Asteraceae (Papatyagiller) ve 13 tür ile Rosaceae (Gülgiller) aileleri, araştırma bölgesinde en fazla rastlanan tıbbi bitki aileleri olmuştur. Hemikriptofitler %40, terofitler %18,4, geofitler %14,25, fanerofitler %13,75 ve kamefitler %6,42 oranındadır. Tıbbi bitkilerin fitocoğrafya özelliği, bu türlerin İran-Turan, Avrupa-Sibirya ve Akdeniz bölgelerine ait olduğunu göstermiştir. Mevcut araştırmanın sonuçları, bu araştırmada belgelenen Kereste Dışı Orman Ürünleri olarak tıbbi bitkilerin ve yabani meyvelerin, kırsal toplumun refahında ve sürdürülebilir orman yönetiminde önemli rol oynadığını göstermiştir.

Anahtar kelimeler: Floristik çalışmalar, orman yönetimi, sürdürülebilir ormancılık, Darkesh, İran

1. INTRODUCTION

In Iran, the land is farmed for a few years, after which the soil becomes eroded and exhausted, the farmer move on to fresh forest land, and this is a most destructive cycle. Increased demand for agriculture commodities supplies incentives to convert forests to farm fields. The transition to agriculture from natural forest often can not hold on to the soil, and cultivate wheat and barley in steep area can actually increase soil erosion. Erosion due to wheat and barley production for example, Iran loss over 50 million

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tons of top soil every year(Amiri, 2010). This removal of surface soil by erosion results in soil organic matter (SOM) loss in the range of 1.23 to 84 million tons/yr, soil nitrogen loss from 0.45 to 5.7 million tons/yr and that of phosphorus from 1.23 to 12.3 million tons/yr (Amiri, 2010).

Available reports indicate that over 90% of agricultural land in Iran is severely affected by soil erosion. This lead to reduced soil fertility and degraded land. At present rate of soil erosion in Iran is about 48.5 tons/ha, which has increased by 10 tons/ha compared to the last decade (UNDP, 1993). A recent United Nation study shows, Iran with 94% of agricultural land degraded was the worst country affected from degradation among South Asian Countries. Soil erosion and agricultural land degradation emerge to be a significant threat to the economic of Iran. Iran is losing at least us $ 10 billion annually as a result of losses from land degradation. There is a well established connection between NTFPs and the reduction of soil erosion. Some research studies revealed that Agroforestry (NTFPs) have the potential to reduce erosion and runoff and can be used as a bio-fencing plant in erosion-prone areas (Nair, 1984; Young, 1991; Nepstad and Schwarzman, 1992; Sunderlin et al., 2005; Zheng et al., 2008).

Iran is known as one of the most interesting place for studying plant diversity, as 22% of its 8000 plant species are endemic (Asri et al., 2000). Determination flora of a region are fundamental for achieving other applied researches in biology. Different ecological and climatical conditions create unique habitats which make it remarkable for floristic studies in Khorasan Province of Iran. Also, recognizing floristic list of the study area is beneficial for protecting the natural resources and sustainable use of medicinal plants (Jankju et al., 2011; Aydani et al., 2004).

The main goal was to do a survey the flora, especially accurate recognition of medicinal plant species and review the chorotype and life form them. These objectives were choosing with a view toward informing potential conservation for plant species in North Khorasan, Iran. Result of this study can be used for the forest management and conservation.

2. MATERIALS AND METHOD

Darkesh forest region is placed in the North of Khorasan Province of Iran. Its elevation ranges from 900 m to more than 2030 m a.s.l. and consists of about 22,500 hectares (Figure / Şekil 1). The land-use consists of: forest (45%), rangelands (35%), arable lands (12%), settlement areas (5%) and other (3%). The inhabitants are approximately 1,200 people having a demographic decline in the last decades. The farms in the area are about 0.5 ha and the main crops grown are wheat and barley. The climate of the region is in the range of cold-humid climate according to Amberger coefficient.

Figure 1. Study area and location on Iran map
Şekil 1. Çalışma alanı ve İran haritası üzerindeki konumu

2.1 Floristic Analysis

Plant species were collected from field sites that representing major habitats of study area. Surveys were managed during active growth periods in 2013 and 2014. The following plants were collected and identified with the help of standard flora (Akhani, 2005; Assadi et al., 1988; Davis, 1965 and 1988; Komarov et al., 1963 and 1974; Rechinger, 1987; Townsend et al., 1985; Tutin et al., 1964 and 1980) and preserved in the form of Herbarium for correct identification of plants.

2.2 Concepts of agroforestry

Agroforestry is a system of land-use which utilizes both agriculture and multi-purpose tree planting. Unsustainable agricultural practices outside of forest in Iran are a major cause of deforestation. To solve this problem, we scheme to perform agroforestry practices. Some examples are given below of species having the potential for commercial exploitation.

2.3 Wild fruits

In the case of wild fruits, species identified by the Jihad Keshavarzi organization of Iran as having potential for commercial exploitation include: *Berberis vulgaris* L., *Vitis vinifers* L., *Punica granatum* L., *Phoenix dactylifera* L., *Ziziphus spina-christi* (L.) Desf., *Cydonia oblonga* Mill., *Malus orientalis* Uglitzk., *Ficus carica* L., *Prunus crasifera* Ehrh., *Diospyrus lotus* L., *Pistacia vera* L., *Morus alba* L., *Crataegus punctata* Jacq., *Pyrus communis* L.

2.4 Medicinal plants

Rural people in Iran expect to see financial returns in about 1 year. In view of the lack of interest in the tree-planting among rural people (tree-planting is too lengthy a venture), medicinal plants could be a viable alternative to encourage them and to generate greater interest among the rural communities. Financial returns more quickly than tree-planting within 1 year and prod will help to solve the problem of the lack of interest in tree-planting. Examples of medicinal plants that are in demand as having immediate potential from commercial exploitation include: *Medicago sativa* L. *(Alfalfa), Crocus sativus* L. *(Saffron), Zataria multiflora (Avishan-E-Shirazi, Satar), Scutellaria pinnatifida (Skullcap), Trachyspermum capticum (Carum), Cuminum cyminum* (*Cumin), Foeniculum vulgare (Fennel), Achillea millefolium (Yarrow), Heracleum maximum* Bartr *(Cow parsnip), Pimpinella anisum (Anise), Ocimum basilicum (Basil), Coriandrum sativum* (*Coriander), Anthemis Eecutita (Chamomile), Carum carvi (caraway).*

3. RESULTS

In the study, 140 medicinal species which belong to 116 genera and 36 families were identified. The families of Lamiaceae (26 species) Asteraceae (21 species) and Rosaceae (13 species) had the highest number of species.

According to Raunkiaer life form the most important groups are hemicryptophytes. Hemicryptophytes are included 40%, therophytes 18.4%, geophytes 14.25%, phaerophytes 13.57% and chamaphytes 6.42% (Figure / Şekil 2). Phyto-geographically, Irano-Turanian, Euro-Siberian and Mediterranean elements with several endemic species are dominant in the flora of the area. The results of this study are summarized in Table / Tablo 1.

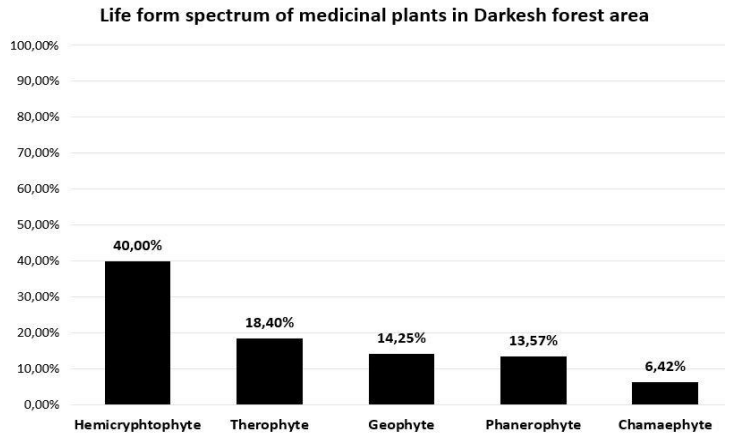

Figure 2. Life form spectrum of medicinal plants in Darkesh forest area
Şekil 2. Darkesh ormanında bulunan tıbbi bitkilerin yaşam süresine ve formlarına göre dağılımı

Table 1. Plants list of family, species, life form and Chorotype of Darkesh forest region
Tablo 1. Darkesh ormanındaki bitkilerin aile, tür, yaşam biçimi ve Chorotype listesi

Species	Life form	Chorotype
Pteridophytes		
Adiantaceae		
Adiantum capillus-veneris L.	*G*	*SCO*
Aspleniaceae		
Asplenium ruta-muraria L.	*G*	*COS*
Asplenium trichomanes L.	G	PL
Ceterach officinarum DC.	G	ES-M-IT
Equisetaceae		
Equisetum fluviatile L.	G	PL
Equisetum telmateia Ehrh.	G	PL
Gymnosperms		
Cupressaceae		
Juniperus communis L.	Ph	PL
Juniperus excelsa M.B.	Ph	IT
Juniperus sabina L.	Ph	ES-M-IT
Angiosperms (I. Dicotyledons)		
Apiaceae		
Anthriscus sylvestris L.	Th	PL
Bifora testiculata L.	Th	IT-M
Bupleurum rotundifolium L.	Th	IT-M
Conitum maculatum L.	He	PL
Daucus carota L.	He	PL
Falcaria vulgaris Bcnth.	He	ES-IT-M
Laser trilobum L.	He	IT
Asclepiadaceae		
Vincetozicum punilum Decne.	He	IT-ES
Asteraceae		
Achillea biebersteinii Afan.	He	IT
Anthemis triumfettii L.	He	ES-IT
Arctium lappa L.	He	IT
Artemisia annua L.	Th	M-IT
Carthanus lanatus L.	Th	II-ES
Chardinia orintalis L.	Th	IT
Cichorium intybus L.	He	PL
Eupatorium cannabinum L.	He	ES-M
Helichrysum graveolens L.	He	IT
Inula britanica L.	He	ES-IT-M
Inula salicina L.	G	ES-IT-M
Inula thapsoides L.	G	ES
Inula vulgaris L.	He	ES
Onopordon acanihium L.	He	ES-IT-M
Pulicaria dysentrica L.	He	ES-IT-M

Table / Tablo 1 continued (Devam ediyor)

Species	Life form	Chorotype
Scariola viminea L.	He	IT-M
Sonchus oleraceus L.	He	IT-M
Steptorrhamphus persicus L.	Th	PL
Tanacetum budjnurdense L.	He	IT
Tanacetum parthenium L.	He	PL
Tussilago farfara L.	G	ES-IT-M
Berberidacea		
Berberis integereima L.	Ph	IT
Boraginaceae		
Lithospermum officinale L.	He	ES-IT-M
Onosma dichroathum Boiss.	He	IT
Solenanthus stamineus Wettst.	He	IT-M
Brassicaceae		
Alliaria petiolata	He	ES-M-IT
Alyssum szowitsianum Fischa.	Th	IT
Capsella bursa-pastoris L.	Th	COS
Cardaria draba L.	He	IT-M
Descurainia sophia L.	Th	ES-IT-M
Isatis leuconeura Boiss & Buhs.	He	ES-IT-M
Capparidaceae		
Capparis spinosa L.	Ph	IT-M-SS
Caryophyllaceae		
Dianthus orientalis Adams subsp. Stenocalyx Rech. F.	Ch	IT
Saponaria bodeana Boiss.	He	ES
Convolvulaceae		
Convolvulus arvensis L.	G	SCO
Dipsaceae		
Scabiosa columbaria L.	He	ES-M
Euphorbiaceae		
Euphorbia chamaesyce L.	Th	M-IT
Fabaceae		
Coronilla varia L.	G	ES-IT
Glycyrrhiza glabra L.	G	IT-M-ES
Lathyrus aphaca L.	Th	ES-IT-M
Lathyrus sativus L.	Th	M-ES-IT
Lotus corniculatus L.	He	PL
Medicago sativa L.	He	IT-M-ES
Melilotus officinalis L.	He	IT-ES-M
Trifolium pratens L.	He	ES-IT-M
Vicia sativa L.	Th	M-ES-IT
Fumariaceae		
Fumaria asepala Boiss.	Th	IT-M
Geraniaceae		
Biebersteinia multifida DC.	G	IT
Erodium deserti EIG.	Th	IT
Geranium robertianum L.	Th	PL
Geranium rotundifolium L.	Th	ES-IT-M
Hypericaceae		
Hypericum helianthemoides Boiss.	He	IT
Hypericum scabrum L.	He	IT
Lamiaceae		
Ajuga comata Stapf	He	IT-ES
Clinopodium umbrosum(M.B) C.koch.	He	ES
Dracocephalum kotschyi Boiss.	Ch	IT
Eremostachys laboisiformis Knorring.	He	IT
Hymenocrater calycinus Benth.	Ch	IT
Lamium album L.	He	PL
Lycopus europaeus L.	He	ES-M-IT
Maribium astracanicum Jacq.	He	IT
Maribium vulgare L.	He	PL
Mentha aquatica L.	He	ES
Mentha longifolia L.	He	ES-IT-M-SS
Nepeta sintenisii Bornm.	He	IT
Origanum vulgar L. subsp. Viride. (Boiss)	He	PL
Perovskia abrotanoides Karel.	Ch	IT

Table / Tablo 1 continued (Devam ediyor)

Species	Life form	Chorotype
Prunella vulgaris L.	He	PL
Salvia sclarea L.	He	IT-M
Salvia virgata Jacq.	He	IT-M
Satureja mutica Fisch.	He	ES
Scutellaria pinnatifida.A. Hamilt subsp. *alpina*	Ch	IT
Stachys byzantina C.koch.	He	ES
Teucrium chamaedrys L.	He	ES-M-IT
Teucrium polium L.	Ch	IT-M
Thymus transcaspicus Klovkov.	He	IT
Ziziphora capitata L.	Th	IT
Ziziphora clinopodioides Lam.	He	IT
Ziziphora persica Bunge.	Th	IT
Malvaceae		
Althaea hirsute L.	Th	M-IT
Malva neglecta Wallr.	He	COS
Malva sylvestris L.	He	IT
Moraceae		
Ficus earica L.	Ph	IT-M
Onagracea		
Epilobium hirsutum L.	G	PL
Plantaginaceae		
Plantago lanceolata L.	He	ES-IT-M
Plantago major L.	He	SCO
Plumbaginaceae		
Plumbago europaea L.	He	M-IT-ES
Primulaceae		
Anagalis arvensis L.subsp. arvensis var coerulea.	Th	PL
Punicaceae		
Punica granatum L.	Ph	IT-ES
Ranunculaceae		
Adonis flammea Jacg.subsp.*flammea*	Th	IT
Ranunculus arvensis L.	Th	ES-IT-M
Thalietrum minus L.	He	PL
Resedacea		
Reseda luteola L.	He	ES-IT-M
Rhamnaceae		
Paliurus spina-christi Miller var.*spina-christi*	Ph	M-ES-IT
Rhamnus cathartica L.	Ph	ES-IT-M
Rosaceae		
Agrimonia eupatoria L.	He	ES-IT-M
Cerasus avium L.	Ph	ES-M
Crataegus pentagyna Waldst & Kit. exWilld.	Ph	ES
Geum kokanicum Ragel.	He	IT
Geum urbanum L.	He	ES
Malus orientalis Ugl.	Ph	ES
Mespilus germanica L.	Ph	ES
Prunus divaricata Ledeb. subsp. *divaricata*	Ph	ES
Pyrus boissieriana Buhse.	Ph	ES
Rosa caninia L.	Ph	ES-IT-M
Rubus caesius L.	Ch	ES-IT-M
Sanguisorba minor Scop.	He	ES-IT-M
Sorbus torminalis L.	Ph	ES
Rubiaceae		
Galium odoratum L.Scop.	He	ES
Galium verum L.	He	PL
Salicaceae		
Salix aegyptiaca L.	Ph	ES-IT
Solanaceae		
Solanum dulcamara L.	Ch	ES-IT-M
Solanum nigrum L.	Th	COS
Urtieaceae		
Parietaria officinalis L.	He	ES-M
Urtica dioica L.	He	SCO

Table / Tablo 1 continued (Devam ediyor)

Species	Life form	Chorotype
Vitaceae		
Vitis vinifera L.	Ph	IT
Zygophyllaceae		
Peganum harmala L.	He	IT-M-SS
Angiosperms (II. Monocotyledons)		
Araceae		
Arum maculatum L.	G	ES
Liliaceae		
Allium paradoxum G.Don.	G	ES
Allium sativum L.	G	IT
Allium vavillovii M.pop & Vved.	G	IT
Cochicum robustum Stefanov.	G	IT
Polygonatum orientale L.	G	ES

SS: Sahara-Sindian , M: Mediterranean, IT: Irano-Turanian, ES: European-Siberian, COS: Cosmopolitan, PL: Polyregional , G: Geophyte, Ph: Phanerophyte, Ch: Chamophyte, Th: Therophyte, He: Hemicryptophyte.

4. DISCUSSION

Local people' high dependency on forests can be reduced through the forest cooperative societies. To achieve this, the set up of forest cooperative societies (FCS) in Iran to manage the forest helps to the welfare of local people, sustainable forest management and regulation of wild harvesting of medicinal plant and the gathering of other Non-Timber Forest product (NTFPs). Over 130,000 cooperative societies with 23 million members encouraged the enforcement of harvesting regulation of NTFPs and forest management, all of which have helped reduce soil erosion. The percentage of hemicryptophyte species (40%) is high due to cold climate of the region. For this reason, they have high resistance to cold temperature conditions. High percentage of therophytes with 18.4% shows a period of growth accomplishment from seed to seed during a short time, humidity conditions (April to June). Thus there was a close relationship between climate and plant life forms. More than half of the species in this area are Irano-Turanian, therefore, the study area belongs to Irano-Turanian area. In addition to the climate, intense grazing pressure can be an effective factor for the relative abundance and geographic distribution of different life forms (Heithschimidt and Stuth, 1991).

5. CONCLUSION

This study raises awareness of the non-wood forest resources in Iran. Creating alternative income sources and subsidizing people requirements, helping to modify traditional forest management practices. A floristic survey of the Darkesh Forest has displayed that some of the species including *Tanacetum budjnurdense, Saponaria bodeana, Dracocephalum kotschyi, Dianthus orientalis, Vincetoxicum pumilum*, are among the threatened species in the study area and requires attention to keep their extinction. Thus, immediate action from the government is necessary for the preservation of this medicinal and vulnerable species.

The medicinal and wild fruits, as documented in the present study with the help of local people welfare, can help to protect forest area. Forest cooperative societies based on local people for improving forest management is need.

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