

# Investigation on Physiographic Condition of Wild Pistachio Habitats in Zagros Forests, Iran using GIS

**Sohrab Moradi**

Agriculture Sciences Faculty of Payame  
Noor University, Iran  
Email: moradi\_4@pnu.ac.ir

**Majid Pato**

Chief at Department of Natural Resources  
at Mahabad City and Ph.D Student at  
Guilan University, Iran

**Taha Majidi**

Forest Expert at Zanjan Agricultural &  
Natural Resources Research Center and  
Ph.D Student at Guilan University, Iran

**Abstract** – The first step in protecting and preserving forest ecosystems is identification of genetic reservoirs. Wild pistachio (*Pistachio mutica* F & M) forests are widely distributed throughout most parts of Zagros Mountain Ranges of Iran. These plants have edible fruits with extractable juice usable in pharmaceuticals, gums, paints, pesticides, pastes, perfumes and mineral oil industries. The habitats of this species in Salas babajani region, approximately with total area of 24000 ha can be observed in four open forest types including *Quercus spp – pistacia spp*, *pistacia spp- Acer monpessulanum*, *pistacia spp – Amygdalus spp* and *pistacia spp*. In this research, regarding the distribution area, elevation, slope and aspect characteristics of wild pistachio, different maps were provided using GIS, then were overlaid the map of distribution area of wild pistachio with maps of elevation, slope and aspect. The results obtained from statistic analysis, showed that 93.26% of habitats of wild pistachio have been located in 20-60% slope range, 85.7% are mostly distributed between 1000 and 2000 m.a.s.l and 43.9% have been located in the southwestern and northeastern aspects. The results obtained from one way variance analysis and Dunnet's T3 test; indicate significant difference between the distribution area of wild pistachio in different aspects and also different slope classes but no significant difference between the distribution areas of wild pistachio in different elevation classes.

**Keywords** – Aspect, Elevation, GIS, Salasbabajani Region, Slope, Wild Pistachio.

## I. INTRODUCTION

Salasbabajani region, with approximate area of 1670 km<sup>2</sup>, has been located in the west side of Kermanshah province between 43° 30' 05" of eastern longitude and 35° 07' 30" of northern latitude. The plant coverage of this region is mostly in park land form. Actually most part of the area has been covered with dense oak and wild pistachio forests.

Wild pistachio is the most economically important tree species in many rural areas in the west of Iran [5]. Wild pistachio is one of xerophyte species in Irano – Toranian and also Zagros region. The habitats of this species in Salas babajani region which is located in the Zagros mountaineer region of western Iran, approximately with total area of 24000 ha can be observed in four open forest types including *Quercus spp–pistacia spp*, *pistacia spp- Acer monpessulanum*, *pistacia spp–Amygdalus spp* and *pistacia spp*. There are many sources treating the physiographic condition of the Wild pistachio habitats among which some are represented here: Fattahi (1995) has reported the distribution area of Wild pistachio species, located in Kohgilouye & Boyerahmad, in

elevation range of 400-2500 m.a.s.l. He has also noted that the suitable distribution range of this species in Zagros is between 1500-2500 m.a.s.l. He has added that according to light demanding of this species, their frequency in southern slopes is in higher rate compared to northern slopes [4].

Negahdar Saber et al (2009) in investigating the physiographic condition of distribution area of Wild pistachio in Fars province have introduced the most suitable distribution range of this species as 1000-2000 m.a.s.l, slope class as 15-30% and northern & eastern aspects [8]. Bahrani et al (2010) in investigating the distribution of wild pistachio, in Ghalajeh forests located in Kermanshah province, under the effect of topographic factors, have come to the conclusion that the Wild pistachio trees are the dominant species in elevation range of 1500-2200 m.a.s.l. Also, Slope aspect had a prominent effect on plant growth and their distribution. There was higher plant density in the north facing slopes than others [7].

Internationally, there have been reported various conditions for physiographic condition of Wild pistachio habitats. Picchioni et al (1990) showed that the Wild pistachio species located in elevation range of 600-3000 m.a.s.l grows in different slopes and aspects [3]. Zohary (1995) has reported the habitats of Wild pistachio species having elevation range of 300-1800 m.a.s.l in Turkey, 600-1800 m.a.s.l in Iraq, 900-3000 m.a.s.l in Iran, 850-2500 m.a.s.l in Pakistan and 50-1200 m.a.s.l in Palestine [1].

## II. DATA & METHODS

The topographic maps of the area with scale of 1:50000 were purchased from geographic organization of army forces. The map of forests habitats of Salasbabajani region was provided by the head office of natural resources and watershed management of Kermanshah province. Via available reports & resources, field forest cruising and also personal experience, was drawn the distribution range of Wild pistachio on topographic maps. Then, the borders of polygons together with topographic curves inside the ranges were digitalized and recorded in GIS using Arc GIS software.

The map of elevation classes in four conventional classes (400-1000, 1000-1500, 1500-2000 & 2000-2540 m.a.s.l), the map of slope classes in four classes (0-10, 10-20, 20-40 & 40-60%) and also the map of geographic aspects (northern, southern, eastern & western) were prepared using the digitalized topographic map of wild pistachio distribution area.

Via overlaying each of these maps separately with the map of Wild pistachio distribution areas, were obtained the values of slope, elevation and geographic aspects of Wild pistachio distribution areas they were then surveyed

using Arc GIS software. Dunnet's T3 test in the level of %5 was applied to evaluate the differences between the areas of each class and compare them.

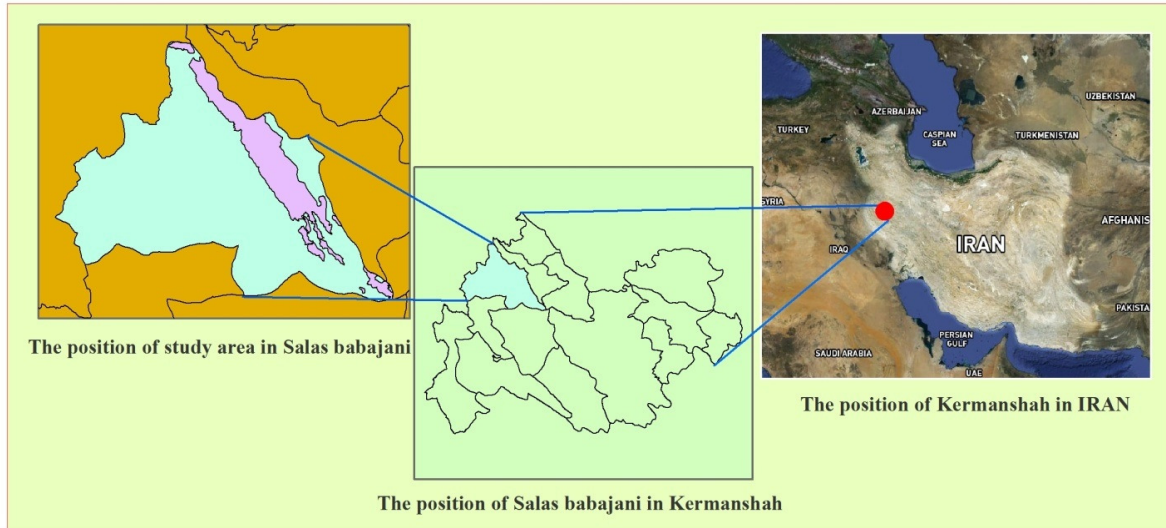


Fig.1. The position of study area in IRAN

### III. RESULTS

#### *Investigating the geographic aspects of Wild pistachio habitats*

In this research, four main aspect classes and one flat (with no aspect) class were determined based on which the areas occupied by wild pistachio habitats of Salasbabajani region, were to some extent close together in value in different geographic aspects. Hence, %33.49 of the total area belongs to the west and % 24.55, %22.94 & %18.93 belong to east, south and north aspects respectively.

It is worth mentioning that due to the region being mountaineer and hence having few flat lands, also little interest of wild pistachio to grow in flat regions, only % 0.08 of the total area of wild pistachio distribution area has been dedicated to flat regions. Figure 2 has depicted the map of Wild pistachio distribution in different classes of main geographic aspects.

To determine the distribution areas of Wild pistachio in various aspects (not only four main aspects), measures were taken to prepare a distribution map concerning various aspects with eight classes and one flat class. In this research, were determined four classes of main aspects, four classes of secondary aspects and one flat class based on which the Wild pistachio habitats of Salas babajani region have occupied different percentage of the whole distribution area. %22.55, % 21.34 & %17.16 are dedicated to aspects of southwest, northeast and west respectively. The classes of south, east, northwest, southeast, north and flat class are in fourth to ninth rank with values of %12.53, % 11.07, %6.50, %4.39, %3.88 & %0.06 respectively. Figure 3 shows the map of distribution area in different classes of geographic aspects (both main & secondary) in Salas babajani region.

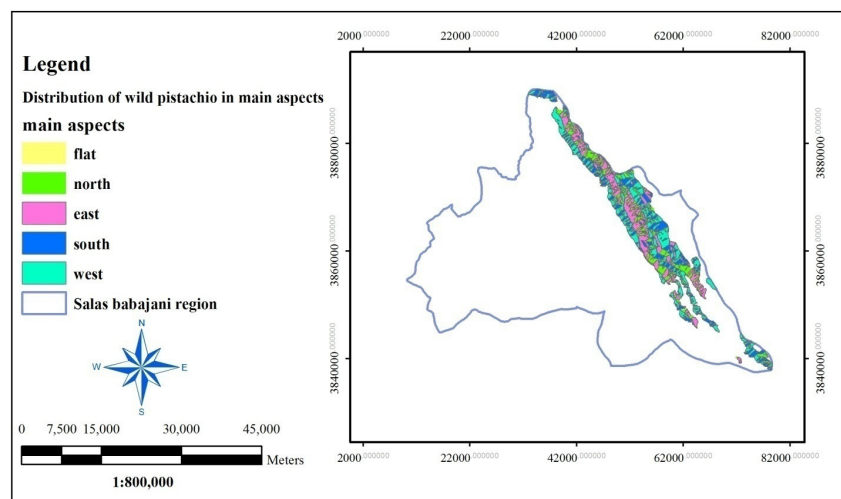


Fig.2. Distribution of wild pistachio in main aspect in Salas babajani region

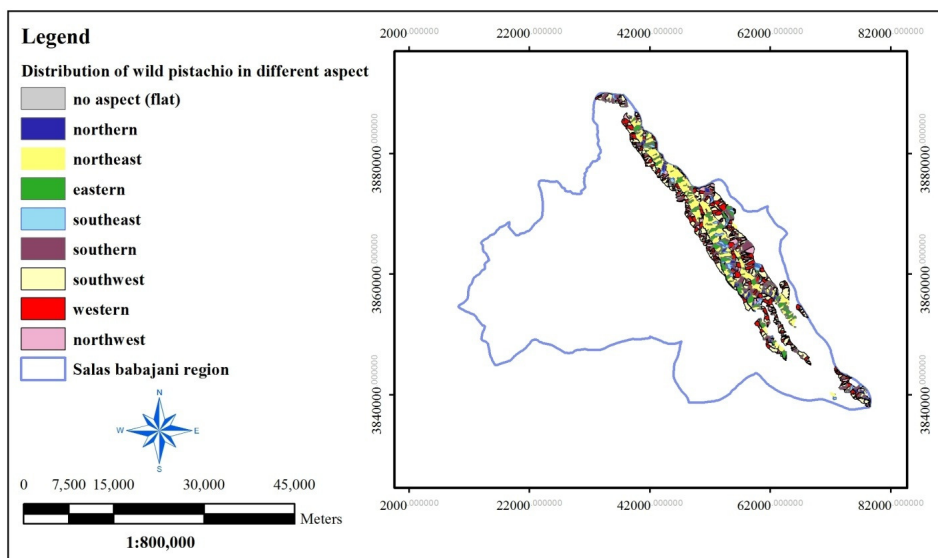


Fig.3. Distribution of wild pistachio in main and secondary aspect in Salas babajani region

The distribution area of Wild pistachio, were analyzed statistically in different classes of geographic aspects whose results have been depicted in tables 1 & 2.

Table 1: test of homogeneity variances of area of distribution region in different geographic aspects

Levene statistic	df 1	df 2	Sig.
17.700	4	810	0.000

The results obtained from table 1 show that in the test of comparison between variances of area of Wild pistachio distribution areas in five classes of geographic aspects, there is significant difference statistically and hence the hypothesis of variance homogeneity is not acceptable. In other word, the hypothesis of  $H_0$  which involves the equality of variances is rejected, because:  
Sig. = P-value = 0.000 < 0.05 =  $\alpha$

Table 2: Analysis Of Variance (ANOVA) of area of distribution region of Wild pistachio in different aspects

Source of variations	df	Sum of squares	Mean square	F statistic	Sig.
Geographic aspects	4	163122	40780	6.233	0.000
Observations	810	5299369	6542		
Total	814	5462491			

The table 2 shows that there is significant difference between the areas of distribution region in different classes of geographic aspects (P-value < 0.05). The results of Dunnet's T3 test in investigating the distribution area in different classes of geographic aspects show that the average of area of distribution region of Wild pistachio in flat class differs significantly from those of other geographic aspects. Also, the average of area of Wild pistachio distribution region in northern and southern aspects differs significantly from those of western aspects, whereas these differences are not so significant between north & east, north & south, south & east and east & west. Investigation of confidence interval of each class confirms these results.

#### Investigating the elevation of Wild pistachio habitats

In this research, were recognized four elevation classes based on which maximum density of Wild pistachio habitats is located in elevation class of 1000-1500 m.a.s.l. which has occupied %61.04 of the whole distribution area. Meanwhile, the minimum density has been dedicated to the elevation class of 2000-2540 m.a.s.l. occupying % 0.22 of the whole distribution area. Elevation classes of 1500-2000 & 400-1000 m.a.s.l. involving %24.26 & %13.87 of the whole area respectively, have occupied middle values of the whole distribution area.

On the whole, in the lands with elevation class of 400-1000 m.a.s.l., due to agricultural activities and also being easily available for both men and domestic animals, there has occurred the ruin of forests and regeneration of trees has been restricted as well. In elevation over 2000 m.a.s.l., due to the harsh condition of habitats, there grows less Wild pistachio trees. Figure 4 shows the distribution map of Wild pistachio in various elevations.

The distribution of Wild pistachio in different elevation was analyzed statistically the results of which have been shown in tables 3&4.

Table 3: Test of homogeneity variances of area of distribution region in different elevation classes

Levene statistic	df 1	df 2	Sig.
11.743	3	43	0.000

The results obtained from table 3 shows that in the test of comparison between the variances of area of Wild pistachio distribution regions in four elevation classes, there is significant difference statistically and hence the hypothesis of variance homogeneity is not acceptable. In other word, the hypothesis of  $H_0$  which involves the equality of variances is rejected, because:  
Sig. = P-value = 0.000 < 0.05 =  $\alpha$

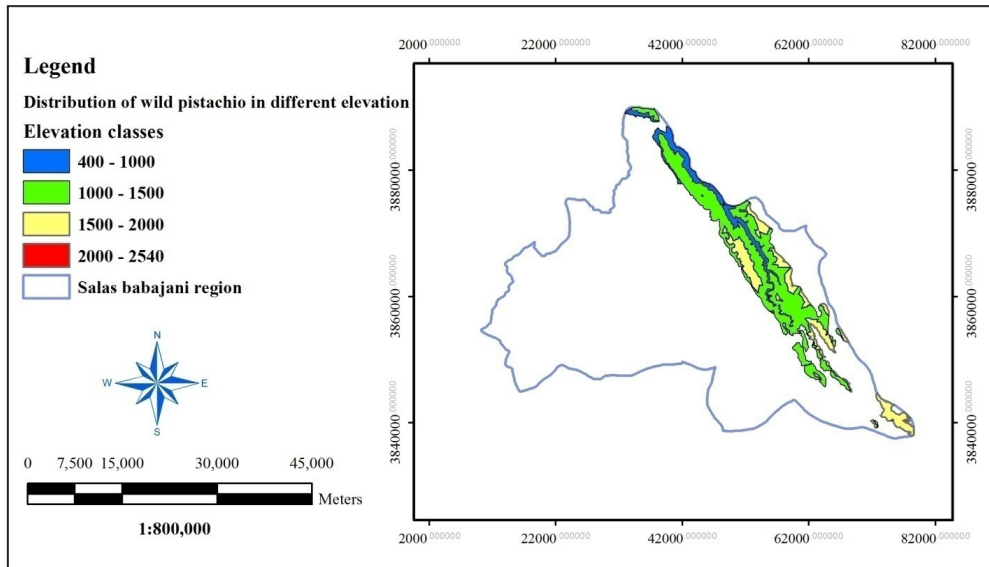


Fig.4. Distribution of wild pistachio in different elevation in Salas babajani region

Table 4: Analysis Of Variance (ANOVA) of area of distribution region of Wild pistachio in different elevation

Source of variations	df	Sum of squares	Mean square	F statistic	Sig.
Elevation classes	3	27480450	9160150	1.953	0.135
Observations	43	201714078	4691025		
Total	46	229194528			

The table 4 shows that there is no significant difference between areas of distribution regions in different elevation classes ( $p$ -values  $> 0.05$ ). The reason of no significant difference may be due to the high dispersal of the values.

#### Investigating the slopes of Wild pistachio habitats

In this research, four slope classes were determined based on which the areas occupied by Wild pistachio habitats of Salasbabajani region, have been more located in slope classes of 20-40% and 40-60%. Meanwhile slope classes of 0-10% and 10-20% have occupied the least areas (%0.86 & %5.88 respectively).while the slope class

of 20-40% has occupied the most area (%56.72) and the slope class of 40-60% is in the second place (%36.54). On the whole, in the lands with slopes less than %10, due to being easily available, either the local residents have changed these lands to agricultural land use or they have been treeless due to animal grazing and cutting trees for fuel supplying. In slopes over %60, due to the unsuitable condition of soil, also regeneration being hard, there grows less Wild pistachio trees. Figure 5 shows the distribution map of Wild pistachio in various slope classes.

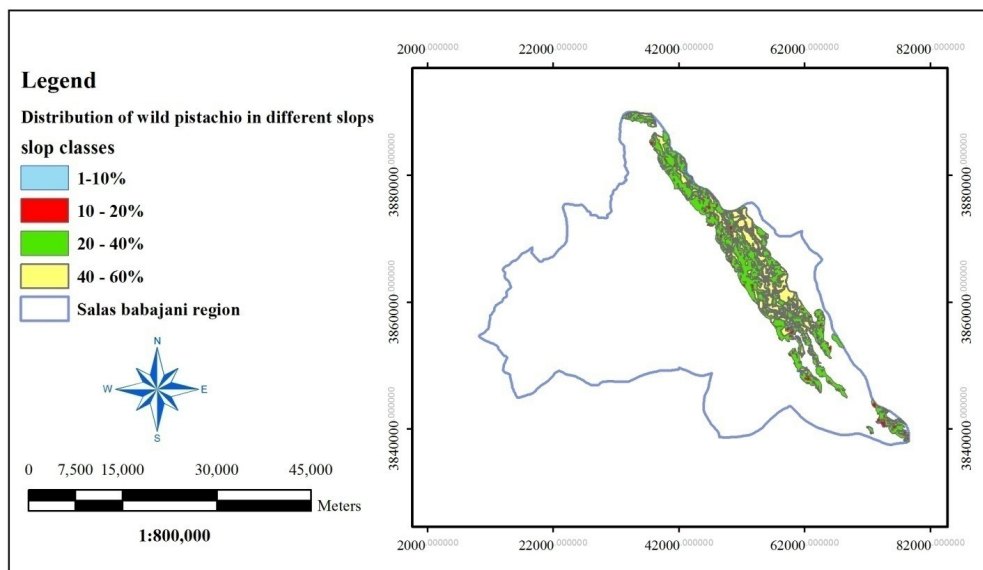


Fig.5. Distribution of wild pistachio in different slopes in Salas babajani region

The distribution of Wild pistachio in different slope classes were analyzed statistically the results of which have been shown in tables 5&6.

Table 5: Test of homogeneity variances of area of distribution region in different slop classes

Levene statistic	df 1	df 2	Sig.
10.153	3	479	0.000

The results obtained from table 5 shows that in the test of comparison between variances of area of Wild pistachio distribution region in four slope classes, there is significant difference statistically and hence the hypothesis of variance homogeneity is not acceptable. In other word, the hypothesis of  $H_0$  which involves the equality of variances is rejected, because:

$$\text{Sig.} = P\text{-value} = 0.000 < 0.05 = \alpha$$

Table 6: Analysis Of Variance (ANOVA) of area of distribution region of Wild pistachio in different slops

Source of variations	df	Sum of squares	Mean square	F statistic	Sig.
slop classes	3	413489	137829	4.320	0.005
Observations	479	15280750	31901		
Total	482	15694239			

Table 6 shows that there is a significant difference between areas of distribution regions of Wild pistachio in different slope classes ( $p\text{-value} < 0.05$ ). The high difference between squares of errors between groups (the sum of squares of difference of each group with total mean) with squares of errors inside group (the sum of squares of difference of each group value with group mean) also show the role of slop classes in changing group mean.

The results of Dunnet's T3 test in investigating the area of distribution region of Wild pistachio in different slopes, show that the average of area of distribution region of Wild pistachio are equal in slope classes of 0-10% & 10-20% and there is no significant difference between them while the difference is significant in case of slope classes of 20-40% & 40-60%. The results of this test showed that the averages of areas of distribution region of Wild pistachio are equal in slope classes of 20-40% & 40-60% and there is no significant difference between them. While the difference is significant in case of slope classes of 0-10% & 10-20%. Investigation of confidence interval of each class confirms these results.

#### IV. DISCUSSION AND CONCLUSION

The results obtained from investigating the physiographic condition of Wild pistachio distribution regions in Salasbabajani shows that %93.26 of the habitats of this species has been located in slope range of 20-60 %. In slopes above 60%, the soil is hardly suitable enough for trees to grow. Besides, these slope classes have been intermingled with high altitude factor in which geographic aspects can have a multiple effect and hence the forests in these slope classes are mostly in types of mountaineer open forests. Accordingly Wild pistachio species is not so expectable in these regions. In slopes below 20%, on the other hand, the land use changes like farming, ranching, easy availability of Wild pistachio trees for local residents and hence ruin of regeneration, easy treading of different kinds of rural domestic animals to regions with low slopes, also cutting trees for supplying fuel are all different factors in decreasing forest areas, most specially Wild pistachio species. The results of investigating Wild pistachio distribution regions in the present study can confirm the

results obtained by Negahdar Saber et al (2009) & Davarpanah (2009) in study of maximum distribution of Wild pistachio in above 20% slopes. The results obtained from statistic analysis and performing Dunnet's T3 test confirms the difference of Wild pistachio distribution in different slopes.

Generally speaking, 85.7% of Wild pistachio habitats in the area of study have been located in elevation range of 1000-2000 m.a.s.l. The most suitable elevation range (1500-2000 m.a.s.l) for growing Wild pistachio trees has been located in Zagros forests (Fattahi, 1995). In data analysis, as the general conformation of habitats with elevation classes has been represented in form of distribution regions map in different elevation classes, the most suitable elevation range for Wild pistachio species in Salasbabajani region has been introduces as 1000-2000 m.a.s.l. on the whole, in the lands with elevation range of 400-1000 m.a.s.l, due to agricultural activities and being easily available for both men and domestic animal, there has occurred the ruin of forests and consequently their regeneration. In elevation above 2000 m.a.s.l, due to the hard condition of habitats, there is low possibility of growing Wild pistachio trees. Although, considering the raw data, the maximum distribution areas have been located in elevation range of 1000-2000 m.a.s.l, but performing the test of variance analysis does not show the significant difference among areas of distribution regions in different elevation. The reason may due to the high dispersal of the values.

Having a glance at statistic analysis of Wild pistachio distribution regions in different geographic aspects, it will be demonstrated that the Wild pistachio habitats have been developed in southwestern & southeastern aspects occupying 43.89% of the whole distribution regions. The least distribution rate is dedicated to north aspect occupying 3.89% of the whole distribution regions. The results of performing variance analysis, also Dunnet's test confirm the significant difference among distribution regions in different geographic aspects. The obtained results are in high accordance with the results obtained from the research done by Davarpanah in 2009 [2]. Tahmasbi & Fatahi (2001) have announced that the most developed distribution region of Wild pistachio species in Ilam province is in south aspect [6]. Fattahi

(1995) believes that it is the light demanding characteristic of Wild pistachio that has caused the more distribution in south compared to north aspect [4].

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### AUTHOR'S PROFILE



#### **Sohrab Moradi**

was born in Salas Babajani - Iran. Instructor in Forestry and forest management in Payamenoor University and Ph.D student at University of Guilan, Iran.



#### **Majid Pato**

was born in Boukan City – Iran. Chief at Department of Natural Resources at Mahabad City – Iran and Ph.D student at Guilan University, Iran.



#### **Taha Majidi**

was born in Boukan City – Iran. Forest Expert at Zanjan Agricultural & Natural Resources Research Center and Ph.D student at Guilan University, Iran.