The consequence of agroforestry in genetic diversity of Oak forests of west of Iran

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INTRODUCTION

Oak mortality of Zagros forests has been increasingly reported, especially in the last five years, and is turning into a disaster for Iran's plant diversity (Ebrahimi Rostaghi, 2010). There have been a number of hypothesis addressing the Persian Oak decline, of which genetic erosion according to the similar condition in the Oak forests in Europe and the United States (Brown and Davis, 1991) bacterial and/or fungal diseases due to the physiological weakness (and also probably due to the inappropriate management such as increasing of agroforestry) as well as changes in precipitation due to global climate change (Hosseini, 2011, Tahmasbipour and Beyranvand, 2012, Mirabolfathi, 2013).
Genetic studies uncover the facts of evolution of a species and provide important information for the planning of revival and improvement of forest as well as conservation of genetic diversity (White et al. 2007; Grivet et al. 2008). The wrong forest management methods, the commercial forest management, different plant diseases and so forth usually lead to the genetic diversity decline in a specific tree species (Harlan, 1975). The genetic diversity among the populations of a plant species is considered as the best factor to guarantee the preservation of the species and to find the elite inter- species (Harlan, 1975). The Persian Oak forests are ecologically important to guarantee the biodiversity as well as natural water reservoir of Zagros region in Iran.

OBJECTIVES

There has been presented many hypothesis for the Persian Oak decline such as genetic extinction. The agroforestry managements is one the prevalent systems in these natural forests.
The objective of this paper was to investigate the impact of agroforestry on the natural Oak forests of Ilam province especially with regard to the intra-species genetic diversity as on the possible causes of Oak decline.

The current paper is a part of the results of the comprehensive project entitled "Rehabilitation management based on community participation and recognition of stable (elite) oak stands in Ilam Province (Role of dust storms in Oak Zagros forests dieback)", number IRA/SGP/OP5/Y3/STAR/CC/13/09 (185), granted by SGP GEF/ UNDP and cofounded by the Total organization of Natural Resources and Watershed of Ilam Province.

METHODS AND MATERIALS

❑ Site of study

The studied sites were located on the Zagros region in Ilam province, west of Iran, bordering Iraq (Figure 1).

P1: 22-years highly conserved area (as the contorl site)
P2: Under limited cultivation
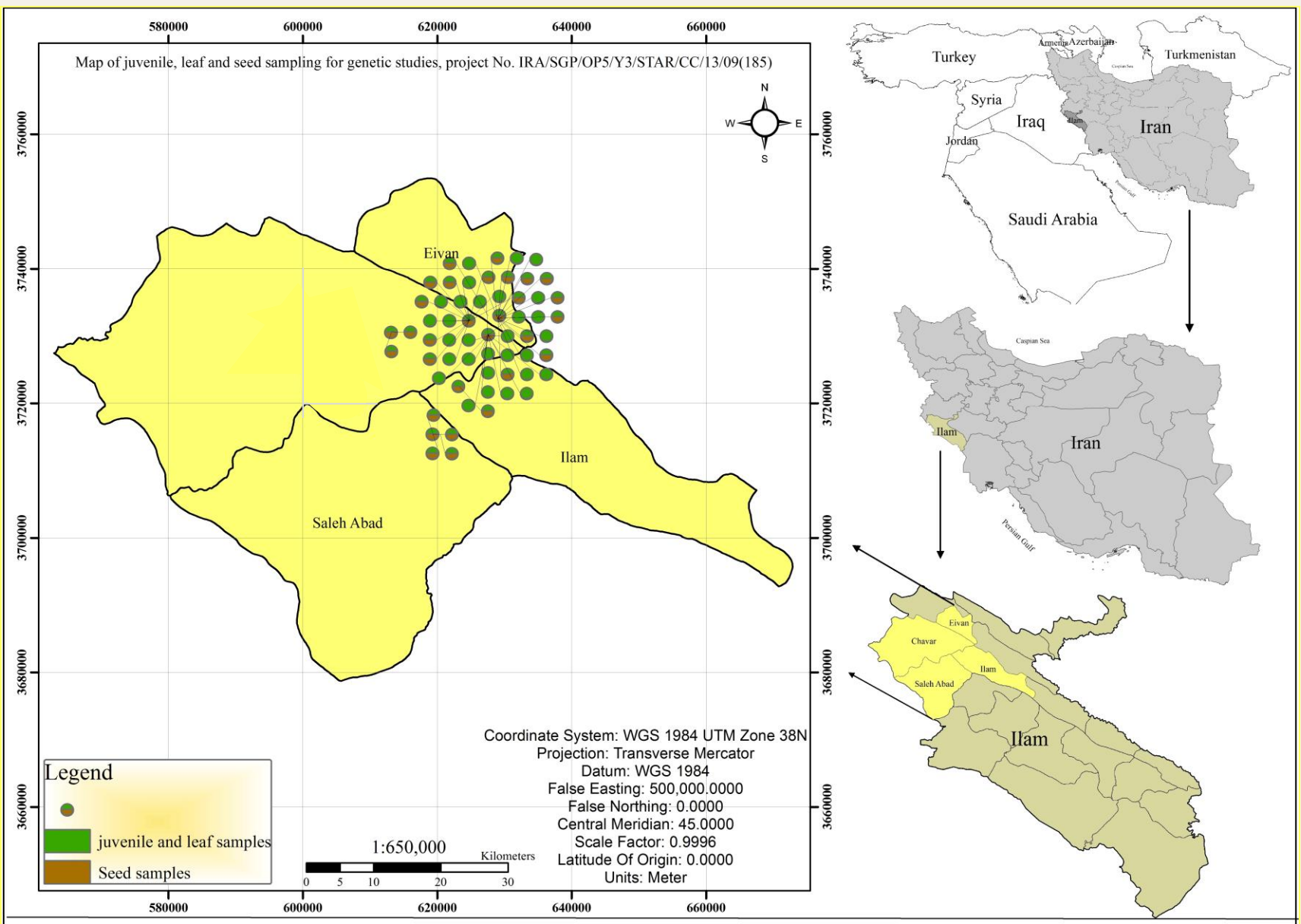**P3: Area with the totally agroforestry**

Fig.1:Three studied sites

❑ Social study

In this project we investigate the social issues and parameters of three villages near to considered sites include: Gale jar 1- Gale jar 2- Golzar (Figure 2).

Fig. 2: A view of local people in three investigated villages

❑ Molecular study

In each studied site, leave samples were taken from 15 stands, as well as 25 individual stands selected surrounding whole sites as another control which consider genetic diversity (Figure 3). Therefore, in total 70 individual stands were selected randomly in an area covers about 50000 ha for molecular investigation.

Fig. 3: leaves sampling for molecular studies

❑ Microsatellite PCR amplification

To evaluate outcrossing and genetic variation 12 primer pairs have been selected based on previous research (Steinkellner et al. 1997) on oak family (Table 1).

Table 1. The sequence of SSR primers used to the genetic variation assay

Primer Name	Forward primer	Reverse primer
ssrQPZAG15	CGATTTGATAATGACACTATGG	CATCGACTCATTGTTAAGCAC
ssrQPZAG9	GCAATTACAGGCTAGGCTGG	GTCTGGACCTAGCCCTCATG
ssrQPZAG36	GATCAAAATTTGGAATATTAAGAGAG	ACTGTGGTGGTGAGTCTAACATGTAG
ssrQPZAG119	GATCAGTGATAGTGCCTCTC	GATCAACAAGCCCAAGCCAC
ssrQPZAG1-5	GCTTGAGAGTTGAGATTTGT	GCAACACCCTTTAACTACCA
EE743812	TCTTTGCTTCTTTGCTTTCT	ACCTTTGCTCCATACACTTCT
EE743809	CTCCGAGTCTGAAATGCAA	ACTGGATCATGAAAAGGGT
EE743802	AAAAGCAACAACTCTTTCT	GATCAATTTGCCACAGACG
EE743785-1	CCAGAACTACAACTACAACCC	CCAAAAACCTCGTGTCACTC
EE743785-2	TTATTGGCTGTTTCCCTAAT	GCCTTTCTTGACGTTTGCT
EE743661	TAGAGAGAAATGGCTGTAGGA	GCCAATTGGGAGAACTAGAGA
EE743657	CGCAACTCAGGAGCTAGAC	ATGGGATGCATAATCTCTAAG

RESULTS

❖ SOCIAL STUDY

The results indicated that about fifty-three percent of population was Female and forty-seven percent was male, which the most of them were diploma (35.3 percent), while 30.5 percent were illiterate (Figure 4 and 5). In contrast, the lowest percentage was belonged to the under-diploma people and student (8.4 and 10.2 respectively). However, about 15.6 percent of people had the university educations. Overall, 69.5 percent of people had a kind of education while 30.5 percent was illiterate.
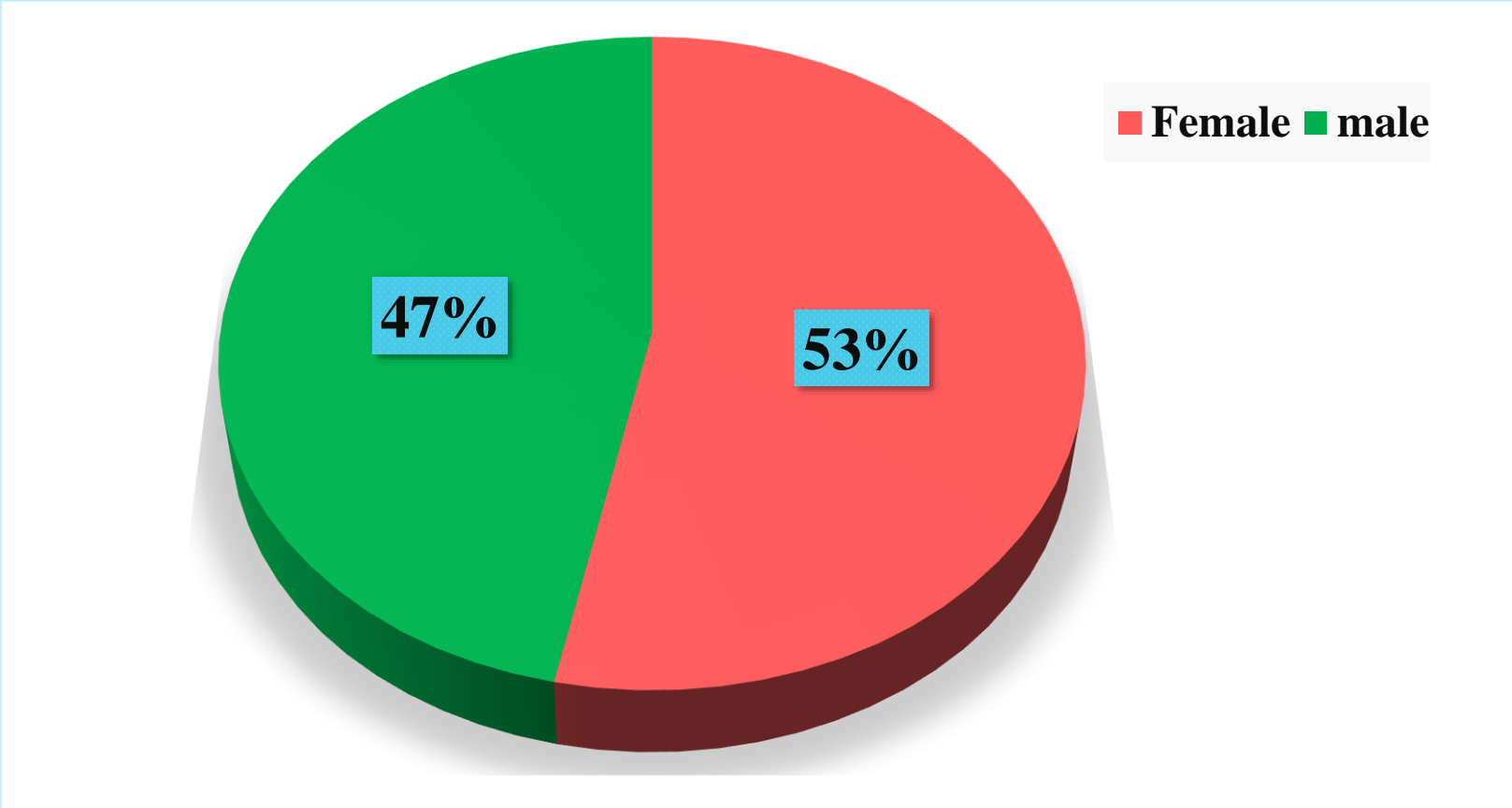

Fig. 4: Percentage of the population living in the three studied villages
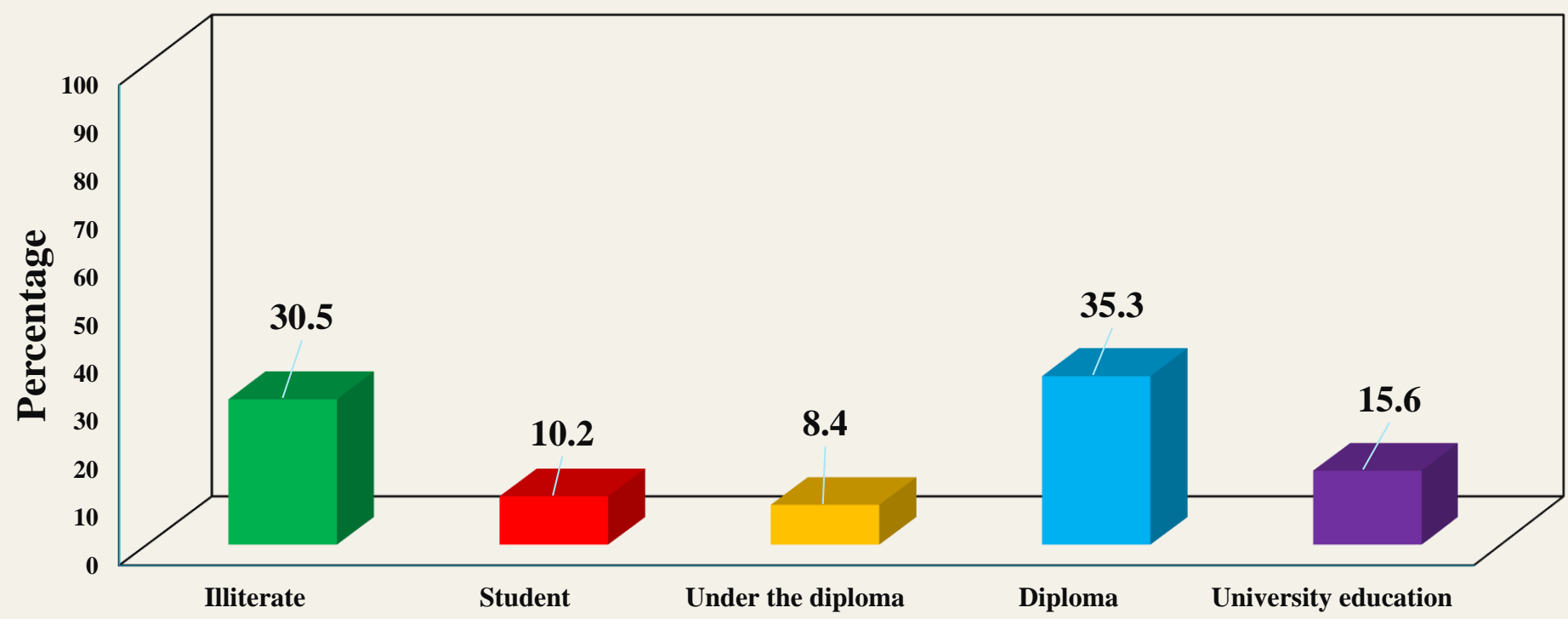

Fig. 5: Percentage of the population living in the three villages terms of education

❖ Genetic diversity

The genetic diversity such as the percentage of polymorphic loci as well as the Shannon diversity index within and among the populations showed that first population had the highest number of polymorphic loci (27) and the highest percentage of polymorphic loci (87.10) whereas the third population had the lowest number of polymorphic loci (24) and the lowest percentage of polymorphic loci (77.42). The highest value of the Shannon diversity Index was reported to be in the first population (0.36±0.22). Overall, there were 31 polymorphic loci in the whole studied population for which, the Shannon diversity Index was calculated to be 0.38±0.19 (Table 2). According to table 3, the amount of observed cross-pollination revealed that all stands a cross-pollinated and the formation of the seeds on the stands was originated from the pollen of other individual stands.

Tables 2. Parameters diversity estimated for the 70 stands of *Quercus persica* L.

Population	The number of observed alleles	The number of efficient alleles	Genetic diversity coefficient	Shannon diversity index	number of polymorphic loci	percentage of polymorphic loci
First population	1.87±0.34	1.35±0.31	0.23±0.16	0.36±0.22	27	87.10
Second population	1.83±0.37	1.35±0.32	0.22±0.17	0.35±0.23	26	83.87
Third population	1.77±0.43	1.36±0.36	0.22±0.19	0.34±0.26	24	77.42
Total	2±0	1.37±0.29	0.24±0.15	0.38±0.19	31	100

Table 3. Parameters diversity estimated for collected seeds of *Quercus persica* L.

Seed code	The number of observed alleles	The number of efficient alleles	Genetic diversity coefficient	Shannon diversity index	Percentage of polymorphic loci
Seeds from eastern-oriented crowns	2±0	1.39±0.26	0.26±13	0.41±0.166	100
Seeds from western -oriented crowns	2±0	1.43±0.28	0.28±0.14	0.44±0.17	100

❖ Cluster analysis

According to cluster analysis using simple similarity overlying coefficient, Jaccard and Nei and the three algorithms UPGMA, the closest neighbor (SLINK) and the farthest one (CLINIK), 70 individual sampled stands randomly were classified in four different populations (Figure 6), the Cophentic coefficient for the first, second and third populations were r=0.81, r=0.73 and r=0.89, respectively.
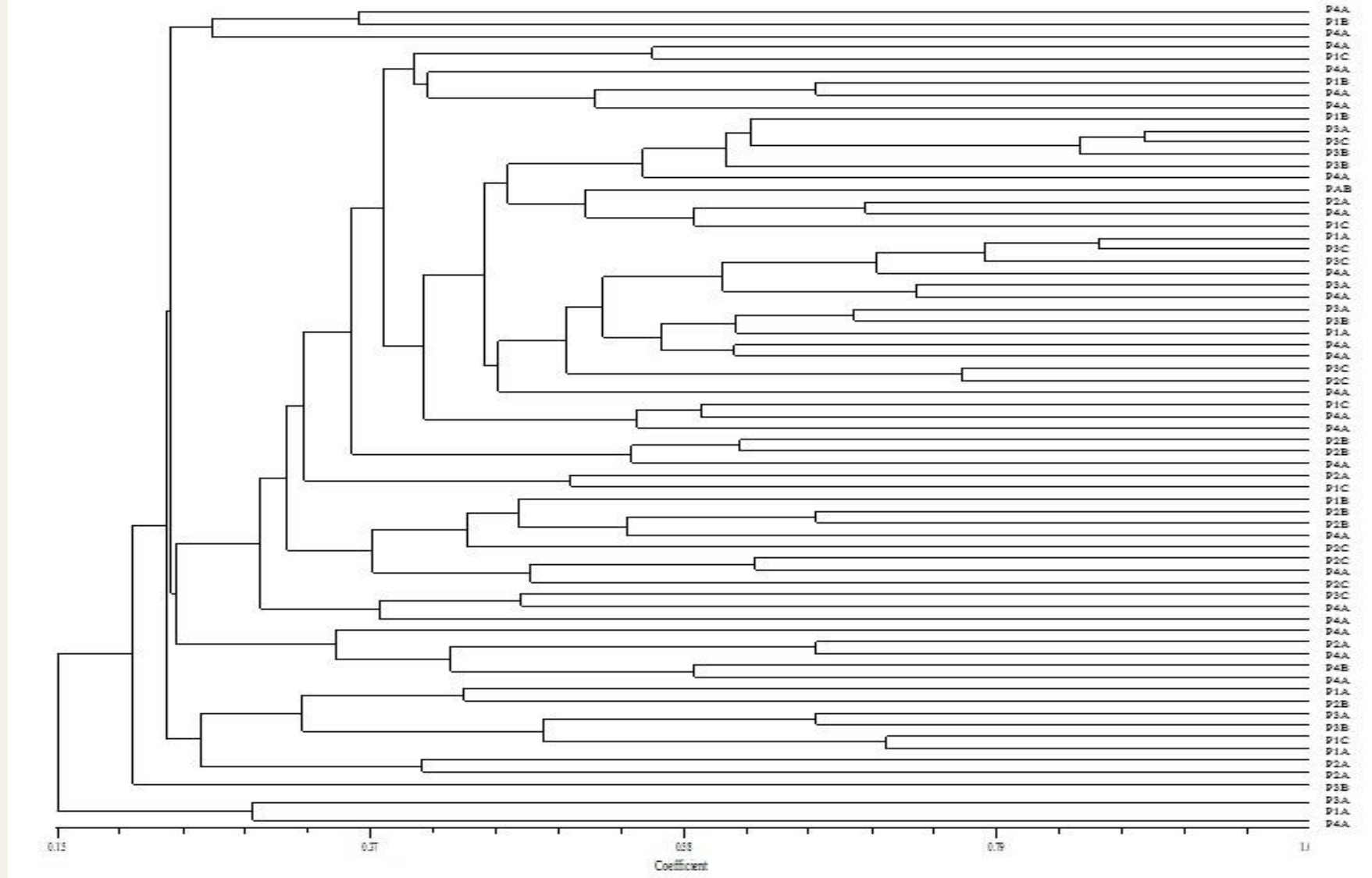

Fig. 6: The Cluster analysis of the 70 stands

Having applied the simple similarity coefficient (SM and UPGMA algorithm), the dendrogram determined the difference among and within groups to be 30 and 70 percent, respectively. As it has been mentioned before the four classification were done completely randomly (Figure 7)
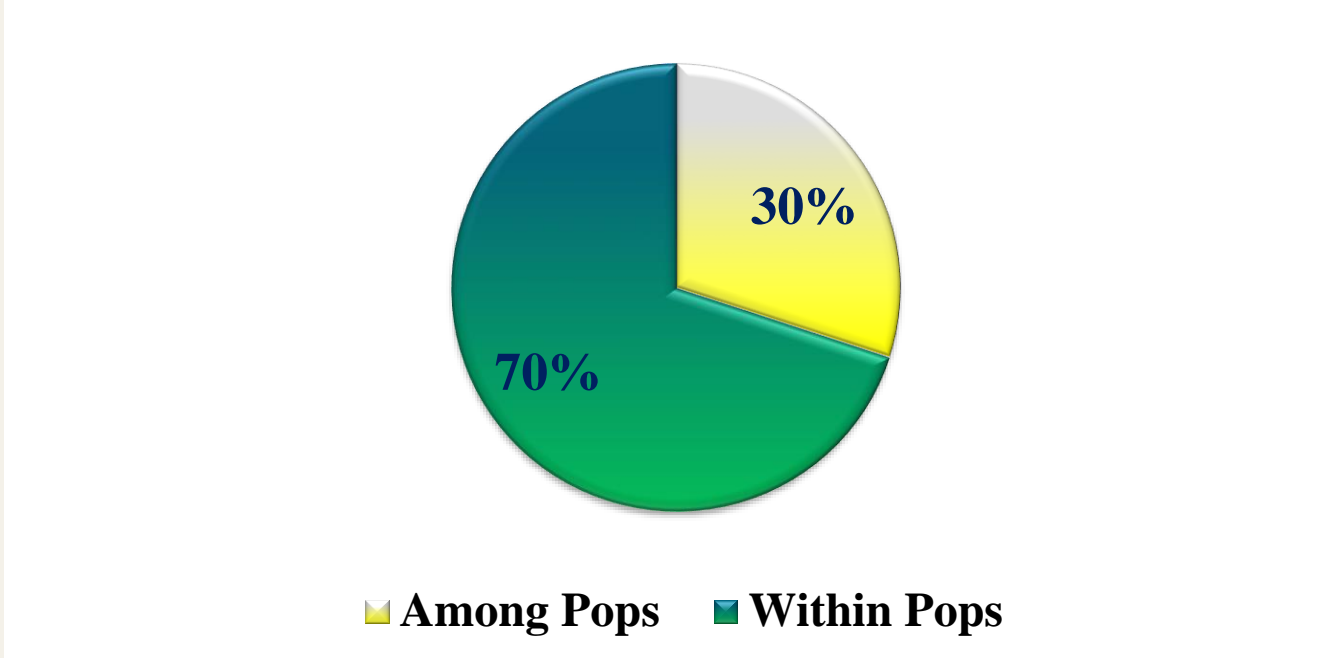

Fig. 7: The percentage of molecular variance among and within studied population

CONCLUSION & DISCUSSION

The Researches have been proved that in order to achieve a sustainable rehabilitation management, the all intra-species should be considered. (Porth and El-Kassaby, 2014).
This research proved that inappropriate management causes lack of people cooperation in management of forest restoration. According to our result, the forest has destroyed due to the fire and fall of trees by people in order to increase the land and on the other hand, natural disasters like flood as well. Therefore, seedling establishment and natural regeneration will face difficulties.
Solutions:
A) the implementation forest ecosystem management base on communication with people. B) establishing an ecosystem-friendly economic solution for the people. C) the creation supplementary programs such as Ecotourism, handicrafts development and establishing pilot factories to create jobs. D) create ecosystem-compatible gardens for trees such as *Prunus dulcis, Pistacia atlantica* and other medicinal plants in completely destroyed areas of Zagros forest and transferring them to the people without monopoly of sale. Finally, government should collaborate in the sale of products.

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