Annual Review & Research in Biology
3(4): 530-539, 2013

SCIENCEDOMAIN *international*
www.sciencedomain.org

A Study of Agrobiodiversity and the Impacts of Biophysical and Ecogeographical Factors on it in Ghalaje Protected Area / West of Iran

Reza Rostami[1*], Korous Khoshbakht[1], Abdolmajid Mahdavi Damghani[1] and Hadi Veisi[1]

[1]Department of Agroecology, Environmental Sciences Research Institute,Shahid Beheshti University, G.C., Tehran, Iran.

Authors' contributions

This work was carried out in collaboration between all authors. Authors RR and KK designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors AMD and HV managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

Case Study

Received 24th February 2013
Accepted 21st May 2013
Published 15th June 2013

ABSTRACT

It is considered that agrobiodiversity as a vital component for human food security is increasingly eroding and so making more attention to this section of biodiversity is necessary. This study was conducted in a protected area located in Kermanshah, Iran, in order to infer biodiversity characteristics and the effect of biophysical and ecological factors on it. Ten villages were selected randomly and the information was gathered through interviewing 25 to 30 percent of the household heads and visiting the area too. The mean Species richness for agricultural species of the villages was 2.31. Shannon-Weiner Index was in the range of 1.06 to 2.56 and it was associated with other biodiversity indices, calculated in this study. Comparing the biodiversity indices indicated that generally being in a protected area can be useful to protect agricultural biodiversity. Cultivated land area, annual precipitation and altitude were some factors having significant effects on Species richness of agricultural plants in this study.

**Corresponding author: Email: rezarostami19@gmail.com;*

Keywords: Species richness; food security; protected area; biodiversity indices; Shannon-Weiner index.

1. INTRODUCTION

Intensification of agriculture affects our environment increasingly [1]. Monotony of the societies will enhance the ecologic risks of the sociologics and nowhere else is at risk like agroecosystems [2]. Sanderson and et al. [3] estimated that 80-90 percent of habitable lands were impressed by human productivity actions. Another study mentioned that most ecosystem services are influenced by human activities [4,5]. Beside, diversity of life can be useful for the whole life and especially for human kind [6]. Agrobiodiversity as the result of integrating biodiversity and the field of genetic resources includes the whole agricultural plants, livestock, wild relatives and etc. [7]. Intensification of agriculture was known as the main element of widespread decreasing in biodiversity of agricultural systems [8]. Although the farmers have conserved the agrobiodiversity for years, the lack of steady plan to conservation of agrobiodiversity has caused neglecting this important component of biodiversity. Furthermore, the higher biodiversity can create a sustainable livelihood [9], it can also enhance the resistance and sustainability of the ecosystems against climatic and environmental turmoil [10,11]. The perfect biodiversity can decrease the intensity of the pests and diseases' attack [12], so decrease in chemical pesticide consumption can result in the lower negative effect on soil biodiversity, pollinators insects, water resources and workers in farms [13]. In spite of all benefits that can be earned from biodiversity, agrobiodiversity is eroding intensively and subsequently the environmental costs have increased along previous decades [1]. Conservation of agrobiodiversity in protected areas can be one of the effective approaches at in situ conservation of agricultural plants, as conservation of agroecosystems is the lone wise strategy to preserve the genetic recourses of agricultural plants [14]. Although the role of protected areas in conservation of crop genetic diversity is clear, but bodily it was neglected by researchers of biological sciences [15]. The villages and regional institutions can also be important in conservation through activities that improve their livelihoods [16]. The widespread researches to signalize the importance of the agrobiodiversity in protected areas as an important component to provide the food security for the current and future generations is necessary. Whereas the protected areas are planned and managed carefully and their role as an effective in situ approach for protecting the genetic resources is evident, and in the other hand the statue of these regions in conservation of agrobiodiversity is neglected, so this study was conducted to survey the conservative management role in a protected area and its efficacy on conservation of agricultural species.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Ghalaje protected area, this 42609 ha is located at south west of Kermanshah and Ilam province (Fig. 1) which is located between latitudes of 34º 05′ to 33º 49′ and longitudes of 46º 17′ to 46º 37′. The border of this area was not under protective actions and was selected as comparative region with the protected area. The altitude range is between 1160m to 2204m creating a variety of weather condition and hosting a rich biodiversity. This area has a semi-humid and cold weather conditions and its average annual precipitation is about 490mm. The average annual temperature is about 11ºC.

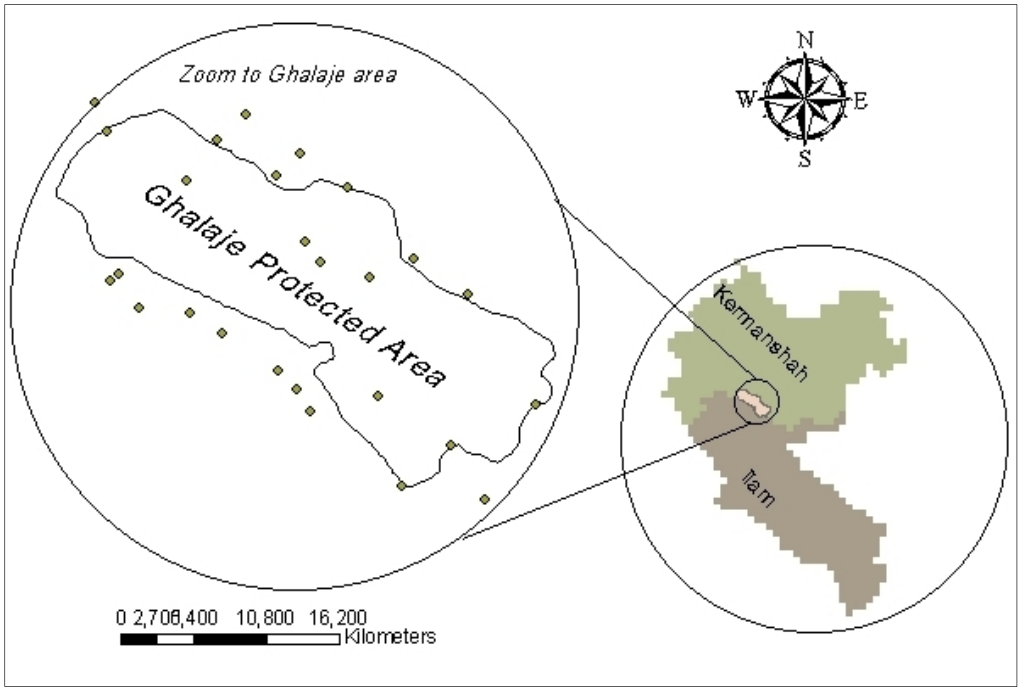

Fig. 1. Location of Ghalaje protected area and its villages

2. METHODOLOGY

Ten villages are selected from different points as they cover the whole area. Features of these villages are available in Table 1. During September 2010 a questionnaire was provided and ten selected villages were perused. 25-30% of the head of the households were randomly interviewed. Biodiversity indices including "Shannon-weiner Index" (1948), "Simpson dominance Index" (1949) and "Evenness Index" proposed by Camargo (1993) was conducted to horticultural and agronomic systems**.**

Table 1. Demographic and geographic characteristics of the selected villages

		Number of household	Cultivated land area (ha)	Longitude	Latitude	Altitude(m)
Protected area	Anjirak	25	100	46º 28'	33º 57'	1260
	Sayadian	120	1300	46º 25'	33º 60'	1204
	Sarabghanbar	25	200	46º 19'	34º 05'	1220
	Poshte	20	150	46º 29'	33º 52'	1340
	Daranbar	52	350	46º 32'	33º 50'	1303
Non protected area	Baigrezaei	25	250	46º 35'	33º 43'	870
	Mohamdrezavandi	30	250	46º 21'	33º 51'	980
	Alirezavandi	20	120	46º 23'	33º 35'	890
	Garmab	20	80	46º 33'	33º 38'	920
	Darbadam	45	300	46º 31'	33º 41'	1110

Analysis of the data was done using SPSS software (version 18), and excel software (version 2007) was used to make the graphs. Calculating biodiversity indices has been done with Ecological Methodology software (version 6). To find the geographic information and presenting the map of the area GIS software (version 9.3) was used.

3. RESULT AND DISCUSSION

3.1 Agronomic Systems

3.1.1 Species richness

Having a good weather condition including good edaphic condition, the amount of annual precipitation and perfect thermal statue, Ghalaje area has a high potential to produce agricultural production. The diversity of cultivated plants in this area is not only influenced by markets of agricultural products but also by social and religious beliefs. For example wheat is a sanctimonious plant, so natives are eager to cultivate this plant.

Independent T test to compare the Species richness for agronomic plants showed that there was a very significant difference between two areas (Sig. = 0.000). The mean of the Species richness for villages located in Ghalaje Protected Area and villages located outside of it were 4.92 and 3.93 respectively. Sayadian village had the high score of 6 and Daranbar, Poshte (all of them located in Ghalaje Protected Area), Bairezaei and Garmab villages (both of them located at outside part of Ghalaje Protected Area), had the minimum score of 3 (Fig. 2).

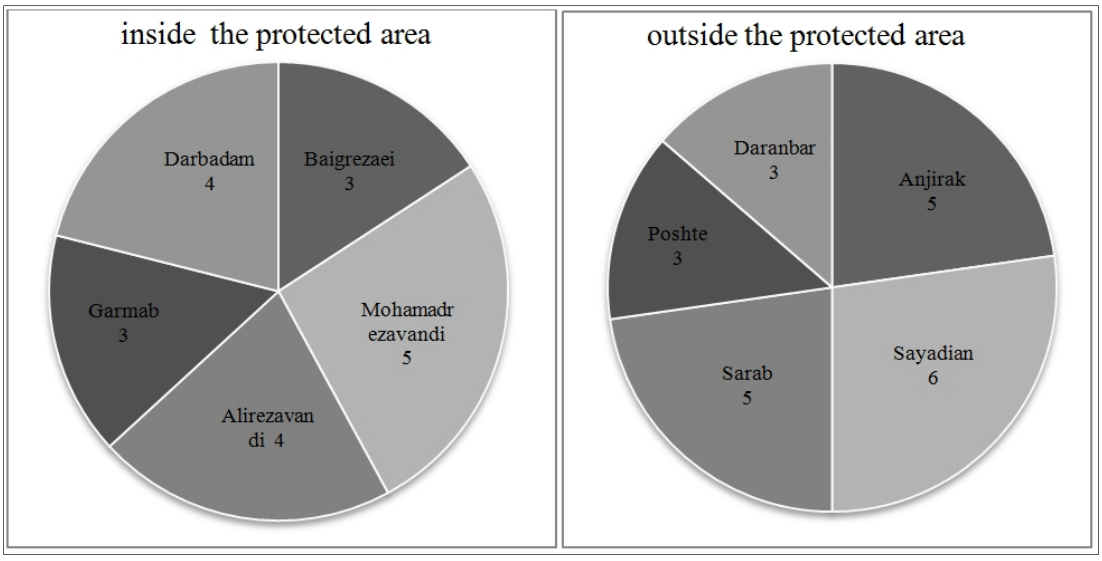

Fig. 2. Species richness for studied villages

The amount of Shannon-Weiner Index for Mohamadrezavandi village is 1.91 that is the highest amount though this village is located at the outside part of Ghalaje Protected Area (Fig. 3).

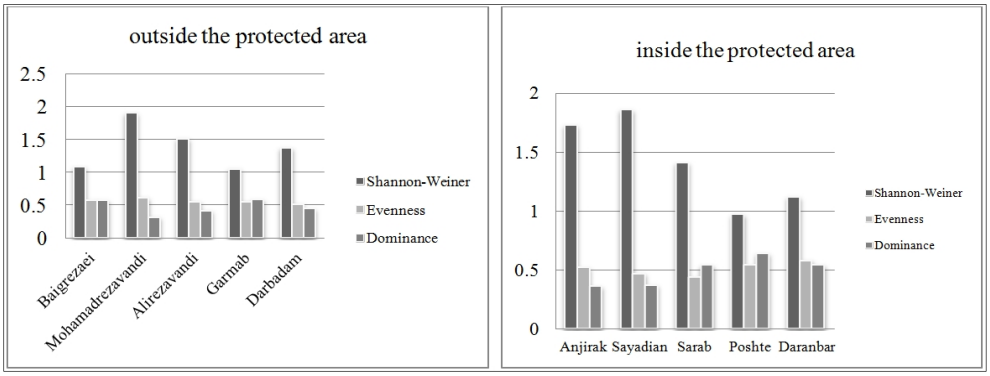

Fig. 3. Biodiversity indices in agronomic farms of studied villages

Chickpea (*Cicer orientinum* L.) that is cultivated rain-fed in spring and wheat (*Triticum aestivum* L.) that is cultivated in winter are current crops in this area. Both of them are the major economic crops for farmers. The estimation of this study is associated with Koocheki et al. [17] and approximately with Nassiri et al. [18] that estimated the range of Shannon-weiner index at .97 to 1.86. Shannon-Weiner Index in another part of Iran was 1.25 to 1.87 by Hashemi et al. [19]; however our study estimated Shannon-Weiner Index in the range of .96 to 1.91. Providing the water for irrigation can also improve the better condition to cultivate more crops and so having a high variety of crops can be considered as a factor to gain sustainability in providing a livelihood.

3.2 The Effect of Biophysics Factors on Agronomic Species Richness

The stepwise regression was conducted for biophysics factors including cultivated land area, accessibility to the water for irrigation, accessibility to the chemical inputs, mechanization, breeder's seed, depth and texture of the soil and etc. Three factors including cultivated land area, accessibility to the water and distance from the city were significant and entered to the regression equation (Table 2). As seen by increasing in cultivated land area and accessibility to the water, Species richness is increasing (Adjusted R^2 are .554 and .611 respectively). other study, it is indicated that land fragmentation is making agriculture inefficient in parts of Estran because cultivated lands were passed down within families, resulting in increasing tiny plots [20]. By increasing of distance from the city, Species richness is decreasing. The reason is that the villages that are far from the city have the low cultivated lands, because they are located in the impassable regions that have a mountainous statue. By approaching to the cities there are more plain lands perfect to farming.

Table 2. Statistical results of stepwise regression for biophysics factors

Step	Independent variable	Beta coefficient	B score	Adjusted R^2	F	Sig.
1	Cultivated land area(ha)	0.719	0.002	0.554	115.4	0.000
2	Accessibility to the water	0.243	0.431	0.611	73.2	0.000
3	Distance from the city	-0.193	-0.032	0.641	55.6	0.000

Y = 3.387 + 0.002X1 + 0.431X2 – 0.032X

Symons [21] and Visser [22] indicated that with receding from the city, intensity of the farming is decreased because of decreasing in incomes and the high cost of transportation.

Such a condition would lead to more dependency on self-agricultural products. This point can improve the diversity of agricultural plants in such areas.

3.3 The Effect of Ecogeographic Factors on Agronomic Species Richness

Three factors including annual precipitation, altitude and the mean of annual temperature were processed into stepwise regression equation. In the first step the annual precipitation (Sig. = 0.013), then the altitude and the mean of annual temperature were conducted with the amount of Adjusted R^2 of 0.55, 0.129 and 0.28 respectively (Table 3).

Table 3. Statistical results of Stepwise Regression for ecogeographic factors

Step	Independent variable	Beta coefficient	B score	Adjusted R^2	F	Sig.
1	Annual precipitation	0.23	0.010	0.055	6.37	0.013
2	altitude	0.527	0.004	0.129	7.84	0.001
3	Annual temperature	0.468	2.07	0.280	12.89	0.000

$$Y = -32.55 + 0.01X_1 + 0.004X_2 + 2.07X_3$$

As seen with increasing in the amount of annual precipitation and two another factors the amount of Species richness is increasing. Although the amount of B for the mean of annual temperature is high, but according to the score of Beta for the altitude of the villages, with a single variation in standard deviation of the altitude there is a variation of about 0.527 in standard deviation of the dependent variable (Species richness). This amount for altitude of the villages is higher than the amount of the two another variables and indicates the important effect of altitude on biodiversity in studied villages. This result is same to hashemi and et al. [19].

3.4 Horticultural Systems

3.4.1 Species richness

The mean species richness for horticultural plants in Ghalaje Protected Area and outside part of it were 4.4 and 2.46 respectively. Independent T test indicated that differences between the villages located in protected area and the outside of the protected area was significant (Sig. = 0.000). Sayadian village had the highest score of 6 and the minimum score was for Baigreaei and Garmab villages. Because of providing the water by the shafts in Sayadian village there is a high potential to cultivate the horticultural plants. The estimation of the Shannon-Weiner Index indicated that statue of horticulture in Ghalaje protected area is better than the outside part of it. The reason for that is the higher altitude and precipitation in Ghalaje Protected Area that causes the possibility to cultivate rain-fed products (Fig. 4). Hashemi et al. [19] estimated the range of 0.04 to 4.75 for Shannon-Weiner Inex in another protected area in southwest of Iran. These results indicate that Ghalaje Protected Ares have a weak condition of growing horticultural plants in spite of mountainous statue that is suitable for horticulture. The natives remarked that lack of sufficient water to irrigate is the main reason of horticulture being slender.

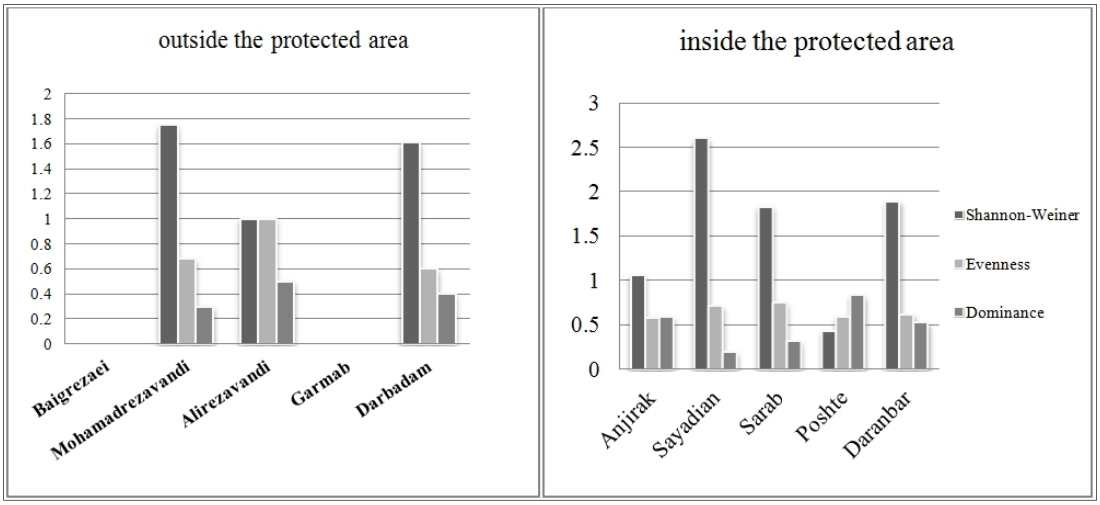

Fig. 4. Biodiversity indices in horticultural systems of studied villages

3.5 The Effect of Biophysics Factors on Horticultural Species Richness

The results indicated that variables including cultivated land area, distance from the city and accessibility to the water had a very significant effect on species richness of horticultural products, Sig. = 0.000 (Table 4). In this case, distance from the city had a negative effect on species richness thus the villages far from the city had lower species richness. Reardon et al [23] emphasized on transportation conveniences and accessibility to the markets as the developer factors to expand modern crops so expanding agricultural biodiversity. The reason for our results is related to the location of the far villages that located in more mountainous situations in which the lands for cultivating are less than villages with further extent of plain lands. Adjusted R^2 indicates that 70.3 percent of variation in independent variable (Species richness) is related to three aforementioned factors. These results are not associated with Hoogerbragge and fresco [24], Abebe [25], kaya et al. [26] that they believed by approaching the cities and markets the species diversity will be reduced.

Table 4. Statistical results of stepwise regression for biophysics factors

Step	Independent variable	Beta coefficient	B score	Adjusted R^2	f	Sig.
1	Cultivated land area	0.703	0.003	0.600	138.7	0.000
2	Distance from the city	-0.295	-0.82	0.677	67.2	0.000
3	Accessibility to water	0.172	0.515	0.703	73.4	0.000

$$Y = 2.423 + 0.003X_1 - 0.295X_2 + 0.172X_3$$

3.6 The Effect of Ecogeographic Factors on Horticultural Species Richness

Two factors of altitude and annual precipitation affected the horticultural species diversity significantly (Table 5). These two factors explain 38.1 percent of variation in Species richness (independent variable). Altitude has the highest effect on species richness, as a single variation in standard deviation of altitude creates 0.577 variations in standard deviation in Species richness. Rana et al. [27] and Bardesly et al. [28] indicates that

development of modern crops in mountainous areas is slow that is related to loss of suitable condition for this crops and high compatibility of native crops to mountainous condition. Modern agriculture tends to apply less diversity of plants in agroecosystems and reach the highest yield. So usually less diversity and genetic erosion will be resulted from approving modern crops.

Table 5. Statistical results of stepwise regression for ecogeographic factors

Step	Independent variable	Beta coefficient	B score	Adjusted R^2	f	Sig.
1	Altitude	0.577	0.008	0.270	35.11	0.000
2	Annual precipitation	0.345	0.025	0.381	29.34	0.000

$Y = -16, 85 + 0.008X_1 + 0.025X_2$

4. CONCLUSION

In this study biodiversity on plants in agricultural systems were analyzed. Quantifying the condition of the crop species in an area and presentation of them by biodiversity indices can be effective creating a general precise view on current conditions to plan the management plans by the experts. As seen in this study there are different factors influencing biodiversity of agricultural plants, including cultivated land area and accessibility to the water by excavating the shafts as two under controlling factors by farmers. Since conversion of land use in Ghalaje Protected Area like other protected areas is prohibited, along previous years there were no reducing in cultivated land area and this area have been effective to protect the agrobiodiversity. Inasmuch as extreme number of plants taking in agrobiodiversity, *in situ* conservation of these plant genetic resources is inevitable [29], so a protected area can be a perfect case to this purpose. Our results generally indicated that having conservative plans Ghalaje Protected Area has been able to contain more species diversity of agricultural plants. In this area consumption of subterranean water is so patterned that it has created the possibility to cultivate more species. Finally, agricultural practices in protected areas approaching conserving more crop diversity as one of the basic elements in the body of the sustainable agriculture concept, is recommended by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Jackson LE, Pascual U, Hodgkin T. Utilizing and Conserving Agrobiodiversity in Agricultural Landscapes. Agriculture, Ecosystems & Environment. 2007;121(3):196-210.
2. Bardsley D. Risk alleviation via in situ agrobiodiversity conservation: drawingfrom experiences in Switzerland, Turkey and Nepal. Agri Ecosys Environ. 2003;99:149-157.
3. Sanderson EW, Jaiteh M, Levy MA, Redford KH, Wannebo AV, Woolmer G. The human footprint and the last of the wild. Bioscienc. 2002;52:891–904.
4. Balvanera P, Pfisterer AB, Buchmann N, He JS, Nakashizuka T, Raffaelli D, Schmid B. Quantifying the Evidence for Biodiversity Effects on Ecosystem Functioning and Services. Ecology Letters. 2006;9:1146-1156.

5. Scherr SJ, McNeely JA. Biodiversity conservation and agricultural sustainability: towards a new paradigm of “ecological agriculture” landscapes. Phil. Trans. R. Soc. B. 2008;363:477–494.
6. Wilson EO, Ehrlich PR. Biodiversity studies: science and policy. 1991; 253: 758-762.
7. Hammer K, Arrowsmith N, Gladis T. Agrobiodiversity with emphasis on plant genetic resources. Naturwissenschaften. 2003.90:241-250.
8. Piha M, Tiainen J, Holopainen J, Vepsalainen V. Effects of land-use and landscape characteristics on avian diversity and abundance in a boreal agricultural landscape with organic and conventional farms.BiolCoserv. 2007;140:50-61.
9. Johns T, Smith IF, Eyzaguirre PB. Understanding the links between agriculture and health. IFPRI. 2006;focus 13, Brief 12 of 16.
10. Hughes A, Stachowicz J. Genetic diversity enhances the resistance of a seagrass ecosystem to disturbance, Proc. Natl. Acad. Sci. 2004;101:8998–9002.
11. Reusch T, Ehlers A, Worm B. Ecosystem recovery after climatic extremes enhanced by genotypic diversity, Proc. Natl. Acad. Sci. 2005;102:2826–2831.
12. Wolfe M. The current status and prospects of multiline cultivars and variety mixtures for disease resistance, Annu. Rev. Phytopathol. 1985;23:251–273.
13. Hajjar R, Jarvis DI, Gemmill-Herren B. The utility of crop genetic diversity in maintaining ecosystem services. Agr Eco Environ, 2008;123:261-270.
14. Altieri MA, Merrick LC. In-situ conservation of crop genetic resources through maintenance of traditional farming systems. Economic Botany, 1987;41(l):86-96.
15. Stolton S, Maxted N, Ford-Lloyd B, Kell SP, Dudley N. Food Stores: Using Protected Areas to Secure Crop Genetic Diversity. WWF Arguments for Protection Series.WWF, Gland, Switzerland. Translated by Khoshbakht, K., Veisi, H; 2006.
16. Bawa KS, Joseph G, Setty. Poverty, biodiversity and institutions in forest-agriculture ecotones in the Westem Ghats and Eastern Himalaya ranges of India. Agric. Ecosyst. Environ. 2007;121:287-295.
17. Koocheki A, Nasiri M, Asgharipoor MR, Khodashenas A. Biodiversity of agronomic and horticultural plants in Iran. 2005;208-2014.
18. Nassiri M, Koochaki A, Mazaheri D. Crop species diversity of Iran. Byaban. 2005;10(1):39-42.
19. Hashemi F, Khoshbakht K, Mahdavi AM, Veisi H. Evaluation of Plant Agrobiodiversity; a Case Study of Basht District - Gachsaran County. Shahid Beheshti University. Iran. 2009;56-61.
20. Bisaillon V, Gagnon G, Minville AP. Biodiversite agricole anthropique. Unpublished report. Estran, Quebec. 2006;10:11-13.
21. Symons L. Agricultural Geography, third ed. Bell and Hyman Limited, London. 1978;187–223.
22. Visser S. Technological change and the spatial structure of agriculture. Economic Geography. 1980;56:311–319.
23. Reardon T, Barrett CB, Kelly V, Savadogo KIn: Lee, D.R., Barrett, C.B. (Eds.), Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment. CABI Publishing, Wallingford, UK. 2001;1(1):13-17.
24. Hoogerbrugge ID, Fresco LO. Homegarden systems: agricultural characteristics and challenges. Gatekeeper Series No. 39. 1993;41-43.
25. Abebe T. Diversity in homegarden agroforestry systems of southern Ethiopia. PhD Dissertation, Wageningen University, Wageningen. 2005;10:31-35.
26. Kaya M, Kammesheidt L, Weidelt HJ. The forest garden system of Saparua island, Central Maluku, Indonesia, and its role in maintaining tree species diversity. Agroforest Syst. 2002;54:225–234.

27. Rana RB, Garforth C, Sthapit B, Jarvis D. Influence of socio-economic and cultural factors in rice varietal diversity management on-farm in Nepal. Agriculture and Human Values. 2007;24,461-472.
28. Bardsley D, Thomas I. Valuing local wheat landraces for agrobiodiversity conservation in Northeast Turkey. Agric Ecosystems Environ. 2006;106:407-412.
29. Maxted N, Ford-Lloyd RV, Jury SL, Ken SP, Scholton MA. Towards a definition of a crop wild releative. Biodiversity and conservation. 2005;14:I-B.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=239&id=9&aid=1479