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Full Length Research Paper

Investigating central Iran pedodiversity and its relation to soil evolution

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To determine the diversity of soil and its relation with soil evolution, Hassan Abad area from central part of Isfahan province was studied. Initial study involved stereoscopic interpretation of aerial photos and differentiation of landform patterns. This interpretation was done based on geomorphic viewpoint and Shannon index was used to determine pedodiversity and this was related to evolution of soils in each separated geomorphic unit. It was found that pi121 unit have lowest diversity index therefore the soils belonging to this unit are young and undeveloped. The pi123 unit have higher diversity index therefore soils belonging to this unit are elder and more developed. In this study it was found that with running this technique we are able to monitor soil evolution and investigate soil age with lowest facilities and cost. Bases used in this study can be used by soil scientist for land management activities also these can be used by biology scientist to help them to interpretation of the complexity the nature.

Key words: Pedodiversity, Geomorphic unit, Soil development, Shannon index.

INTRODUCTION

The diversity of soils and landforms has hardly received any attention although their spatial and temporal variation may produce important quantitative and qualitative changes in the landscape. It is only in the last few years that the term diversity has also caught the attention of scientists working on soils and other fields within the earth sciences which creates a forum and research projects on geodiversity. Measurements of diversity were introduced to pedology few years ago (3,4,5). The concept of pedodiversity is now widely accepted within the soil science community. Pedodiversity, as well as biodiversity, may be considered as a framework to analyze spatial patterns, being recognized as a novel pedometric tool (1,2). Pedodiversity is a measure of soil variation and also a function of soil formation and development or evolution. Pedodiversity is introduced to pedology to analyze soil spatial patterns, soil geography, and test the pedogenetic theories. Thus, pedodiversity is not only concerned with analysis of the pedotaxa number in a given area or region, but it should tackle also with the pedological structures, spatial pedotaxa and soilscapes structure.

Objectives of the study

The objective of this study was to determine the relation

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Table 1: Family and soil series classification of soils distinguished in study area

Physiography	Soil Survey staff (2010)		No. of Soil Series
	Soil Family	Sub groups	
Young gravely alluvial sloping landforms	Loamy -skeletal, Mixed, Thermic	Typic Torriorthents	1
Gravely undulating bajadas	Loamy-skeletal, Carbonatic, Thermic	Typic Haplocalcids	2
		Calcic Haplosalids	3
	Loamy-skeletal, Gypsic, Thermic	Typic Calcigypsids	4
		Gypsic Haplosalids	5
	Fine-loamy, Gypsic, Thermic	Gypsic Haplosalids	6
		Typic Haplogypsids	7
	Fine-loamy, Carbonatic, Thermic	Typic Calcigypsids	8
		Calcic Haplosalids	9

of soil evolution to pedodiversity indices in Hassan Abad area in central Iran.

MATERIAL AND METHODS

Study area

The Hassan Abad area with 7789 hectares is located on south east of Isfahan, 130 Km far. The region has hot and arid climate with 84 mm annual rainfall which falls in winter. The annual evaporation is extremely higher than the annual rainfall. Soil moisture and temperature regimes are Aridic, Thermic consequently.

Geomorphic stratification

Aerial photos were interpreted using the bases presented by Zinck (6). The delineation was imported to Ilwis and attributed with the legend defined on categorical bases of Zinck. The area comprises some little mountains, alluvial fans and differently evolved bajadas (younger ones near mountain and elder ones far from the mountain front). All of parent material of these landforms is brought from Cretaceous Limestone Mountains being placed in south of studied area.

Sampling

The sample points were designed to be on nods of a 1000 m grid in stratified land units. In some central places, where soil surface was more undulating, the nods were 500 m apart. One hundred and twenty profiles were excavated, described and all genetic layers sampled. Genetic and morphologic characteristics of soil layers were all identified and noted. The samples were air dried and sieved for physic- chemical analyses.

Pedodiversity computation

To run the pedodiversity study shanon entropy indices were used .shanon index equation defined as below

$$H' = -\sum_{i=1}^{n} p_i \times \ln p_i$$

where H′ is the entropy or diversity of the population, and pi is the proportion of individuals found in i^{th} unit. In calculations, the ni/N was used instead of pi, where ni is the number of individuals of the objects belonging to i^{th} unit, and N is the total number of individuals collected. Hmax (the richness when all objects in reference area are equiprobable) is used to measure the evenness (E). If the following condition is fulfilled

$$H' = H_{\max} = \ln S$$

$$E = H' / H_{\max} = H' / \ln S$$

Where S is the richness, the number of individuals in each category or map unit. As Saldana and Ibanez (2004) stated in the present study to calculate the diversity index the number of soil series in each geomorphic unit was considered . For example to calculate the diversity index in one geomorphic unit the amount of soil series in this series is considered to total profile in study area .

RESULTS AND DISCUSSION

The soils were classified in nine soil series in study area (Table 1) by traditional approach the aerial photo interpretation cause to determine five geomorphic unit (figure 1) in study area . The result of pedodiversity indices calculations in each these five unit are represented in (table 2). The investigation of soil

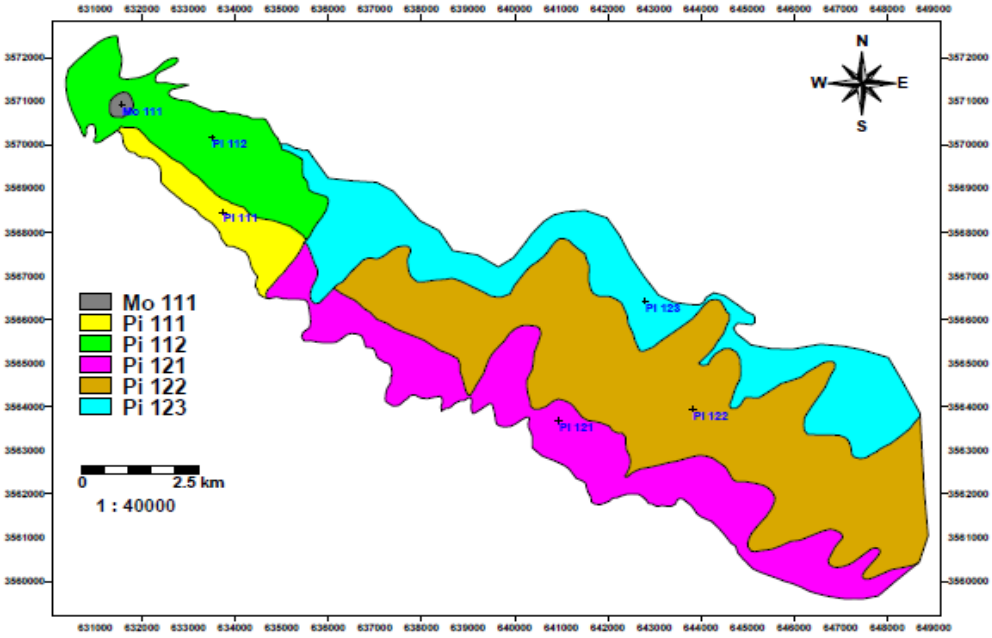

Figure 1 : Geomorphic unit in study area

Table 2: Pedodiversity calculation in each geomorphic unite of study area

land form code	soil taxonomy	freq	H`	S	Hmax	E
Mo 111	**********	0	0	0	0	0
Pi 111	Loamy-Skeletal, Carbonatic, Thermic- Typic Haplocalcids Loamy-Skeletal, Carbonatic, Thermic- Calcic Haplosalids	4	0.56	2	0.69	0.81
Pi 112	Fine-loamy, Gypsic, Thermic- Typic Calcigypsids Fine-Loamy, Carbonatic, Thermic- Typic Calcigypsids Loamy-Skeletal, Mixed, Thermic- Ttypic Haplocalcids Fine-Loamy, Carbonatic, Thermic- Calcic Haplosalids Loamy-Skeletal, Carbonatic, Thermic- Calcic Haplosalids Loamy-Skeletal, Carbonatic, Thermic- Typic Calcigypsids	20	1.41	6	1.79	0.78
Pi 121	Loamy-Skeletal, Carbonatic, Thermic- Typic Calcigypsids Loamy-Skeletal, Carbonatic, Thermic- Typic Haplocalcids Loamy-Skeletal, Gypsic, Thermic- Gypsic Haplosalids Loamy-Skeletal, Carbonatic, Thermic- Calcic Haplosalids Loamy-Skeletal, Mixed, Thermic- Typic Torriothent	18	1.37	5	1.6	0.85
Pi 122	Fine-loamy, Gypsic, Thermic- Typic Haplogypsids Loamy-Skeletal, Gypsic, Thermic- Typic Haplogypsids Loamy-Skeletal, Carbonatic, Thermic- Typic Calcigypsids Loamy-Skeletal, Gypsic, Thermic- Gypsic Haplosalid Loamy-Skeletal, Carbonatic, Thermic- Typic Haplocalcids Loamy-Skeletal, Carbonatic, Thermic- Calcic Haplosalids Fine-loamy, Gypsic, Thermic- Gypsic Haplosalids	54	1.48	7	1.94	.76
Pi 123	Fine-loamy, Gypsic, Thermic- Typic Haplogypsids Loamy-Skeletal, Carbonatic, Thermic- Typic Haplocalcids Loamy-Skeletal, Gypsic, Thermic- Gypsic Haplosalids Loamy-Skeletal, Carbonatic, Thermic- Typic Calcigypsids Fine-loamy, Gypsic, Thermic- Typic Calcigypsids Loamy-Skeletal, Carbonatic, Thermic- Calcic Hplosalids Fine-loamy, Gypsic, Thermic- Gypsic Haplosalids	24	1.72	7	1.94	.83

evolution showed that pi111 and pi121 geomorphic units have undeveloped soil because analysis of profile excavated in these units showed less profile evolution therefore soil existing in this units are young and

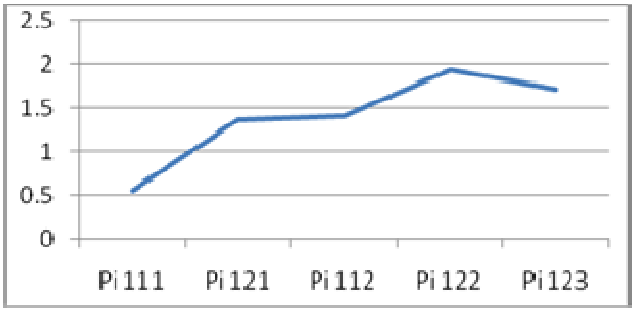

Figure 2: The relation between pedodiversity index and soil age and geomorphic unite evolution

undeveloped pi112 and pi122 geomorphic units have mid soil profile evolution and pi123 have maximum soil profile evolution Pedodivesity Calculation result showed that pi121 unit have lowest diversity index therefore the soils belonging to this unit are young and undeveloped.

The pi123 unit have higher diversity index there for soils belonging to this unit are elder and more developed. figure 2 show the relation between soil age and pedodiversity indices. Therefore calculating the pedodiversity index can showed the rate of soil evolution also can determine soil age and can interprete land evolution pathways.

In this study it was found that with running this technique we are able to monitor soil evolution and investigate soil age with lowest facilities and cost. Bases used in this study can be used by soil scientist for land management activities Also these results can be used by biology scientist to help them interprets important complexity problems of the nature . calculated pedodiversity indices for different geomorphic unit in study area revealed that this method can identify the evolution and development of soil on a landscape so this can be useful tools to management of study area land to identify zones with high potential for cropping different plant especially in pi 123 unit. Because this unit show high diversity index so we can conclude that this unit have more developed soil than other units , so we can estimate the connection between the diversity of soil and land use in spatial distribution using shanon entropy index.

CONCLUSION

Finally we conclude that pedodiversity may be one of the way to explore, quantify and compare the complexity of soil landscape in different area and environment and can be thought as way to preserve or even reconstruct the soil cover . Just as biologists argue that organisms need to be maintained, soil scientists can argue that preserving soil will maintain organisms as well as other unique soil materials equally crucial in insuring our future wellbeing. In areas which have been degraded it will become important to reconstruct the variation. A quantitative knowledge of natural pedodiversity will ease the task of the person who attempts to rebuild quasi-natural soil systems as in current study it was found that calculating pedodiversity indices for different geomorphic unite in study area can identify the units with low and high soil evolution and development so this technique can be useful for management lands for different purpose such as agriculture and soil reconstruction.

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