BIODIVERSITAS
Volume 20, Number 7, July 2019
Pages: 2043-2047

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d200734

Rangeland conversion to dryland and its effects on species diversity and richness

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Manuscript received: 1 May 2019. Revision accepted: 29 June 2019.

Abstract. *Hasanpori R, Sepehry A, Barani H. 2019. Rangeland conversion to dryland and its effects on species diversity and richness. Biodiversitas 20: 2043-2047.* Species diversity and richness status in ecosystem is important in confront to environmental threats and is guidance in plant management. Due to increasing land use changes and destruction of rangelands in western Iran, this research was conducted to study the effects of land use change from rangeland to dryland on species diversity and richness of vegetation cover in three land uses of rangeland, dryland and abandoned dryland. Vegetation cover data were collected from established plots in each land use. Species diversity and richness were calculated in each land use by Simpson and Shannon indices and Menhinick and Margalef ones, respectively. Results showed that these indices are significantly different at 95% level in three land uses. The highest species diversity and richness indices were in rangeland and the least were in dryland. So, we found that four above measured indices, are illustrative and accurate enough to demonstrate differences between several land-use diversity and richness. Simplification on a dynamic and diverse ecosystem, and land conversion to dryland reduced plant species numbers in the new ecosystem, and simplify species composition, so simple dryland ecosystem would be fragile against environmental threats. Therefore to reduce unfavorable effects of land use changing, paying more attention to species diversity conservation must be a base to management decisions.

Keywords: Iran**,** land use change, vegetation cover

INTRODUCTION

Rangelands with different functions have effective roles in the production cycle, environmental pollutants refinement, soil conservation, etc. Iran is one of the most diverse countries in plant species. Approximately there are more than 7000 plant species in this country. Iran wide rangelands with about 85 million hectares area have a key role in the economy of their 916000 inhabitant families. Population growth in this area, and subsequent economic and social problems affects these ecosystems and species diversity and richness. They are threatened continuously especially by land use changes and conversion of rangelands to drylands and finally to abandoned lands.

Nowadays farming became a serious threat to reduce species diversity all over the world (Mclaughlin and Minear 1995). Different plant species have various responses to environmental gradients (Austin et al. 1994). Environmental gradients relate to changes in ecosystem features. Also, these changes occur due to natural and unnatural agents (Grebner et al. 2013). Human factors as one of the most important unnatural agents affected vegetation cover directly and caused species changes and gave negative results on the kinds of species and their distribution (Enright et al. 2005). More land occupancy for agricultural actions results in the continual conversion of some rangeland ecosystems to farmlands (Assareh 2001). Land use changing from rangeland to dryland converts a stable and diverse ecosystem to a simple and low diverse community (Altierti 1999). These changes disturb ecosystem functions (Mclaughlin and Minear 1995). Vegetation cover changing and reduction in species diversity and richness will occur after land use changing (Johansson et al. 2008). By elimination of disturbance agent in the ecosystem, reclamation and return to natural status will start, and some of the plant species will appear gradually (Takehiro et al. 2011).

Natural communities are currently facing extensive land use modifications, which have the potential to greatly alter species composition and structure. Farming decreases the available habitat for a large number of species and usually allow the persistence of only those species with adaptations for survival within modified ecosystems (Villalobos and Vamosi 2016).

Plant diversity conservation is one of the ecosystem management programs (Yuguang et al. 2001). It is one of the important and rapid indices in vegetation cover studies and environmental researches, to determine ecosystems status. Comparison of different communities diversity has multiple functions in management role and situation evaluation (Goodman 1975; May 1975). By species diversity measurement, plant species dispersion in environment can be determined, and by emphasis on ecosystem dynamic, management suggestions can be presented (Vogt et al. 1997; Van der Maarel 2005).

By assessing growing destruction in Iran rangelands and more land conversion to drylands, this research was conducted to better understand how diversity and richness change with land use, to evaluate land use changing from rangelands to drylands effects, and to compare species

diversity and richness between rangeland, dryland, and abandoned dryland in Iran.

MATERIALS AND METHODS

Study site

Selected rangelands were in western Iran (The UTM coordinate is 39S, 283184-293104 E and 3697244-3703819 N) (Figure 1) and is part of the larger rangelands named Kian which is located 40 km east from Khorramabad, Lorestan Province, Iran. There are three land uses in this area namely rangeland, dryland and abandoned dryland and they were selected nearby each other with similar topographic, climatic and other conditions. So, the comparison was possible between them. In these land uses, slope is 15°, annual rainfall is 493 mm, altitude is 2220 m asl., and aspect of this site is northern (Figure 1.C).

Data collection

In the boundaries of each two land uses (rangeland-dryland and rangeland-abandoned dryland) three points were selected randomly. On these three points, three 50m transects were established. On each transect, 10 plots with equal distance were put up, as 5 plots were in one land use and 5 plots were in another land use. Minimal area method was used to plot size determination (Cain 1938). Measured minimal area in rangeland was 8 m^2 and in dryland and abandoned dryland was 16 m^2, but to appropriate analysis between land uses, the maximum of minimal area amount (16 m^2) was determined to plot size. Vegetation cover data from each plot were recorded on Jun 2017. Plant species were recognized and vegetation cover percentage in plots were calculated to determine species diversity and richness.

Species diversity and richness

Species diversity in three land uses vegetation cover was measured by Simpson and Shannon indices (Hammer 2018). Species richness in three land uses of rangeland, dryland and abandoned dryland, were measured by Menhinick and Margalef indices (Hammer 2018).

Data analysis

The calculations of diversity and richness indices were performed from data on vegetation cover percentages in the sampling plots. These data were recorded in EXCEL. Then PAST software (version 3.2) was used to conduct measurement with Simpson and Shannon diversity indices, and Menhinick and Margalef richness ones. Obtained data were analyzed by SPSS (version 20) and one-way ANOVA was performed. Mean comparison between diversity and richness indices in studied land uses were done by Duncan's test at 95% level. For each index in three land uses, one graph was drawn.

RESULTS AND DISCUSSION

Identified species in each land use

Observed plant species in this research were 71 species, in each land uses of rangeland, dryland, and abandoned dryland species number were 56, 33, and 41 species respectively. Results showed that some species were unique in one land use such as in rangeland 17 species, in dryland 13 species and in abandoned dryland 1 species with uniqueness were observed (Table 1). Dominant plant type in rangeland was *Astragalus microcephalus-Bromus tectorum,* in dryland was *Triticum aestivum-Heteranthelium piliferum*, and in abandoned dryland was *Bromus tectorum-Heteranthelium piliferum*. Selected dryland was once rangeland but now is land for wheat cultivation.

Figure 1. Study area in Kian rangelands in Khorramabad, Lorestan Province, Iran

Table 1. Identified species in rangeland, dryland and abandoned dryland

Plant species	Habitat	Family	R	D	AD
Achillea wilhelmsii	C	Compositae	+	+	+
Adonis aestivalis	L	Ranunculaceae	+	-	+
Aegilops triuncialis	L	Gramineae	+	+	+
Agropyron trichophorum	R	Gramineae	+	-	+
Alcea angulata	F, S	Malvaceae	-	+	-
Alyssum marginatum	S	Cruciferae	+	+	+
Amaranthus blitoides	S	Amaranthaceae	-	+	-
Anthemis haussknechtii	B, R	Compositae	+	+	+
Astragalus adscendens	B, H	Papilionaceae	+	-	+
Astragalus effuses	B	Papilionaceae	+	-	+
Astragalus compactus	L	Papilionaceae	+	-	-
Astragalus curviflorus	B	Papilionaceae	+	-	+
Astragalus microcephalus	W	Papilionaceae	+	-	+
Astragalus microphysa	B	Papilionaceae	+	-	-
Avena fatua	L	Gramineae	-	+	-
Bromus danthonia	T	Gramineae	+	+	+
Bromus rubens	L	Gramineae	+	+	+
Bromus tectorum	L	Gramineae	+	+	+
Bromus tomentellus	B	Gramineae	+	-	-
Callipeltis cucularia	L	Rubiaceae	+	-	-
Carthamus oxyacantha	M	Compositae	+	+	+
Centaurea virgata	L	Compositae	+	+	+
Cerasus microcarpa	B	Rosaceae	+	-	-
Clypeola aspera	T	Cruciferae	+	-	-
Cousinia lucida	DC	Compositae	+	-	+
Crepis sancta	B	Compositae	+	-	-
Cymbolaena griffithi	W	Compositae	+	-	+
Daphne mucronata	R	Thymelaeaceae	+	-	+
Echinops ritrodes	B	Compositae	+	+	+
Eragrostis barrelieri	D	Gramineae	+	-	-
Eremopoa persica	R	Gramineae	+	-	-
Ergocarpon cryptanthum	T	Umbelliferae	+	-	+
Eryngium thyrsoideum	B	Umbelliferae	+	-	+
Erysimum elymaiticum	M	Cruciferae	+	-	-
Euphorbia szovitsii	F, M	Euphorbiaceae	+	+	+
Festuca ovina	L	Gramineae	+	-	-
Galium aparine	L	Rubiaceae	+	+	+
Gundelia tournefortii	L	Compositae	+	+	+
Hedypnois rhagadioloides	S	Compositae	+	-	+
Heteranthelium piliferum	H	Gramineae	+	+	+
Heterocaryum szovitsianum	F, M	Boraginaceae	+	-	+
Hordeum bulbosum	L	Gramineae	+	-	+
Hordeum glaucum	S	Gramineae	-	+	-
Hordeum vulgare	L	Gramineae	-	+	-
Hypecoum pendulum	L	Papaveraceae	-	+	-
Lolium rigidum	G	Gramineae	+	-	-
Marrubium cuneatum	B, S	Labiatae	+	-	+
Noaea mucronata	A, S	Chenopodiaceae	+	-	+
Onopordon heteracanthum	M	Compositae	-	-	+
Papaver argemone	L	Papaveraceae	-	+	-
Phalaris minor	R	Gramineae	+	-	-
Phlomis olivieri	B	Labiatae	+	-	+
Picnomon acarna	C	Compositae	+	+	+
Poa bulbosa	L	Gramineae	+	-	+
Polygonum arenastrum	B	Polygonaceae	-	+	-
Portulaca oleracea	L	Portulacaceae	-	+	-
Scariola orientalis	B	Compositae	+	+	+
Silene conoidea	L	Caryophyllaceae	-	+	-
Solanum nigrum	L	Solanaceae	-	+	-
Sonchus asper	L	Compositae	+	+	+
Stachys inflate	B	Labiatae	+	-	+
Stipa holosericea	T, R	Gramineae	+	-	-
Taeniatherum crinitum	S	Gramineae	+	+	+
Tanacetum polycephalum	S	Compositae	+	-	-
Thymus kotschyanus	B	Labiatae	+	-	-
Thlaspi perfoliatum	L	Cruciferae	+	-	+
Torilis leptophylla	L	Umbelliferae	+	+	+
Tragopogon collinus	DC	Compositae	-	+	-
Triticum aestivum	L	Gramineae	-	+	-
Xanthium spinosum	B	Compositae	-	+	-
Ziziphora tenuior	L	Labiatae	+	-	+

Note: R: rangeland, D: dryland, AD: abandoned dryland

Comparison of species diversity and richness of vegetation cover in rangeland, dryland and abandoned dryland

Analysis of variance of species diversity indices (Simpson and Shannon) and richness indices (Menhinick and Margalef) of vegetation cover in rangeland, dryland and abandoned dryland showed that these land uses were significantly different in four above indices (P>0.05).

Mean comparison of observed taxa (species) in three land uses at 95% level showed that species number in rangeland, dryland and abandoned dryland plots were 21.93, 9.87, 13.87 respectively (Figure 1).

Mean comparison of species diversity indices in three land uses showed that the average of Simpson and Shannon diversity indices in rangeland were 0.80 and 2.31, in dryland were 0.20 and 0.57, and in abandoned dryland were 0.79 and 1.97 respectively. The mean comparison of these indices between rangeland, dryland, and abandoned dryland showed significant difference at 95% level (Figures 2-3).

Furthermore, mean comparison of species richness indices in three land uses showed that average of Menhinick and Margalef richness indices in rangeland were 2.42 and 4.73, in dryland were 1.02 and 1.95, and in abandoned dryland were 1.79 and 3.14 respectively. Mean comparison of these indices between rangeland, dryland, and abandoned dryland showed significant difference at 95% level (Figures 4-5).

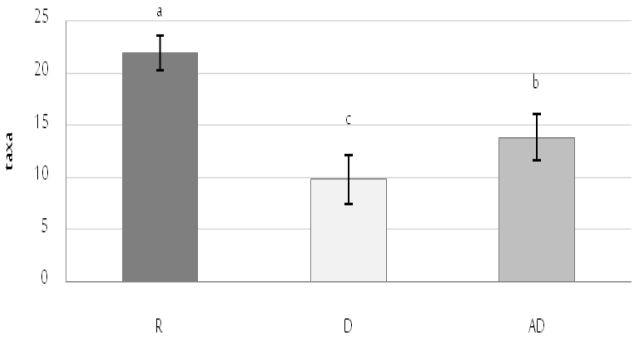

Figure 1. Average of species number in three land uses

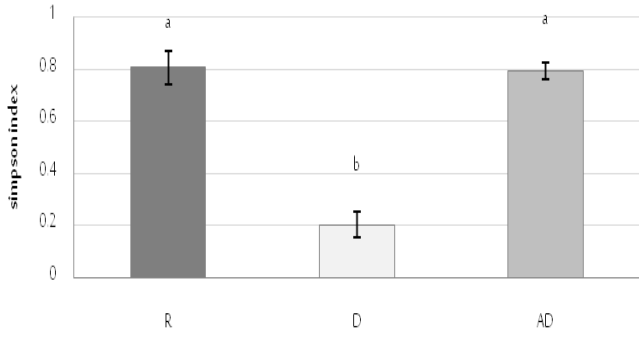

Figure 2. Average of Simpson diversity index in three land uses

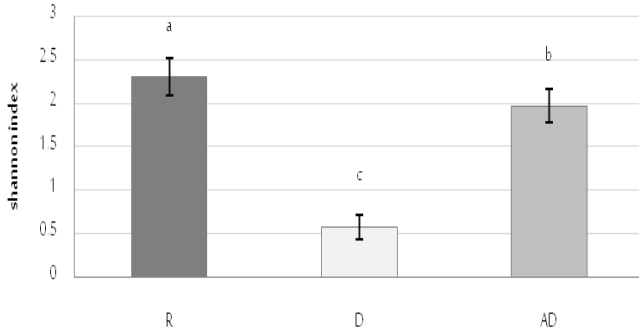

Figure 3. Average of Shannon diversity index in three land uses

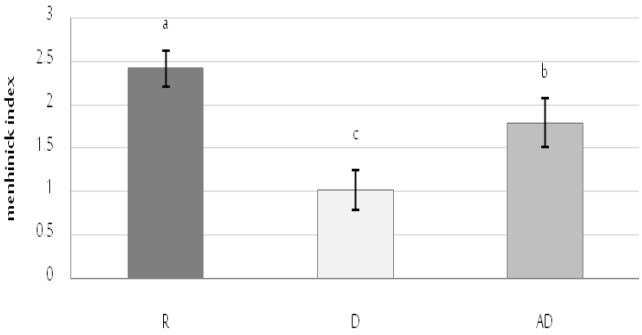

Figure 4. Average of Menhinick richness index in three land uses

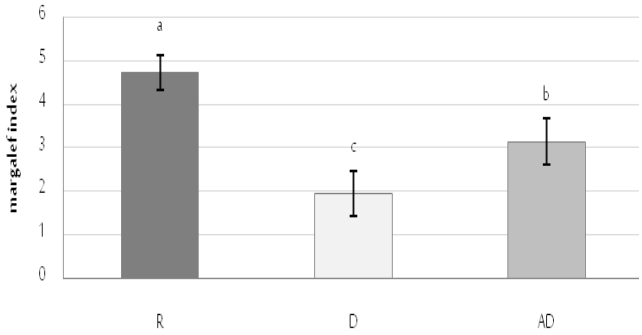

Figure 5. Average of Margalef richness index in three land uses

Discussion

Land use changing can transform vegetation cover and soil that can threaten biodiversity. Results of this research revealed that vegetation cover change was due to rangeland destruction and dryland extension, whilst the intensity of these changes depends on the type of land utilization. These changes were accompanied by disappearance of some rangeland species in dryland, and appearance of some annually opportunistic species in dryland and abandoned dryland. Ecologically, by destruction and change in natural ecosystems, some species ecological niches were changed and those species were eliminated gradually.

More species diversity of a community means more species sustainability. So that, communities with more species diversity have more diverse composition, and certainly, are more stable against environmental threats and changes. Also, no intense fluctuation in community composition is requisite for survival and stability of that community. Results of this research revealed that generally the amounts on Simpson and Shannon diversity indices and Menhinick and Margalef richness indices were the most in rangeland, and were the least in dryland, and the amounts in abandoned dryland were surely between the two land uses. This issue showed that land use change from rangeland to dryland, besides intense decrease in species diversity and richness, can simplify this dynamic and diverse ecosystem and produce an unsustainable community, which is in accordance with Palmer and Maurer (1997). We can mention that the research of Rahmani et al. (2016) in Kurdistan also gave similar results. Decrease in Margalef species richness index and Shannon species diversity one in dryland and abandoned dryland in comparison with rangeland were proved by Eghdami et al. (2012). Rahimidehcheraghi (2013) measured factors mentioned in this paper, and the results showed that in rangeland and dryland, there was significantly decrease in the amount of above indices after rangeland destruction.

Diverse plant species appearance after abandoning the dryland during the time increases species diversity and richness and facilitates progress to more stable ecosystem. Eloun et al. (2007) showed that species diversity and richness in farmlands are less than rangelands. Some species of native pristine rangeland were disappeared and other new species which were not in nearby rangeland appeared. Rahmani et al. (2016) believe that such conditions are due to the incompatibility of disappeared species with new conditions and destruction of rangeland habitat.

Conservation of species diversity is the most important aim of natural resources management, especially in recent decades in which vegetation cover is under destruction due to human manipulation and incorrect management. These findings can be a good guide to understand unfavorable effects of land use change in rangelands and simplification of ecosystems especially in developing countries, in which threat of conversion to farmlands is very common because of habitat economic conditions. So for stability and conservation of biological resources, land management

must be considered to prevent land use change in rangelands and simplification of ecosystems.

REFERENCES

Altierti MA. 1999. The Ecological Role of Biodiversity in Agroecosystem. Agric Ecosyst Environ 74: 19-31.

Assareh MH, 2001. Iran biodiversity flora. Research Institute of Forests and Rangelands. Tehran.

Austin MP, Nicholls AO, Doherty MD, Meyers JA. 1994. Determining species response functions to an environmental gradient by means of a β-function. J Veg Sci 5 (2): 215-228.

Cain SA. 1938. The species-area curve. Am Midl Natural 19: 573-581.

Eghdami H, Tarkesh M, Basiri M, Iravani M, Mohajeri A, 2012. Changes in indices of species diversity and richness of good, degraded rangelands and abandoned drylands in Fereydan, Isfahan. J Rangel 2: 100-109.

Eloun H, Ghorbani J, Shokri M, Jafarian Z, 2007. Vegetation composition in two rangelands and adjacent cultivated lands in a Part of Tangab Dam sub-basin in Firozabad at Fars Province. J Rangel 4: 370-385.

Enright NJ, Miller BP, Akhter R, 2005. Desert vegetation and vegetation-environment relationships in Kithara National Park, Sindh. J Arid Environ 61: 397-418.

Goodman D. 1975. The theory of diversity-stability relations in ecology. Q Rev Biol 50: 237-266.

Grebner DL, Bettinger P, Siry JP, 2013. Introduction to forestry and natural resources. Academic Press, New York.

Hammer O, 2018. PAleontological STatistics (PAST), Version 3.20, Reference manual.

Johansson LJ, Hall K, Prentice HC, Ihse M, Reitalu T, Sykes MT, Kindstromc M, 2008. Semi-natural grassland continuity, long-term land-use change and plant species richness in an agricultural landscape on Oland, Sweden. Landsc Urban Plan 84 (3-4): 200-211.

May RM. 1975. Patterns of species abundance and diversity. In: Cody ML, Diamond ML (eds). Ecology and evolution of communities. Harvard University Press, Cambridge.

Mclaughlin A, Minear P. 1995. The Impact of Agricultural Practices on Biodiversity. Agric Ecosyst Environ 55:210-212.

Palmer MW, Maurer TA. 1997. Does diversity beget diversity? A case study of crops and weeds. J Veg Sci 8: 235-240.

Rahimidehcheraghi M, Erfanzadeh R, Joneidi Jafari H, 2013. Effect of land use change on plant species diversity, richness and evenness (Case study: A part of Kamyaran rangelands). The second national conference of planning, protecting and Conserving Environment. Hamedan, 15 August 2013.

Rahmani H, Asri Y, Ramezani M, Khorasani N, Maroofi H, 2016. Effects of rangeland land use changing into dryland from herbal species diversity viewpoint (Case study: Rangelands in Dehgolan city, Kurdistan). J Environ Sci Technol 18(2): 433-444.

Takehiro S, Satoru O, Tomoo O, Unddarmaa J, Toshiya O, Kazuhiko T, 2011. Indicator species and functional groups as predictors of proximity to ecological thresholds in Mongolian rangelands. Plant Ecol 212: 327-342.

Van der Maarel E, 2005. Vegetation ecology. Blackwell Publishing, New York.

Villalobos S, Vamosi JC, 2016. Increasing land use drives changes in plant phylogenetic diversity and prevalence of specialists. Peer J 4:e1740.

Vogt KA, Gordon JG, Wargo JP, Vogt DL, Asbjornsen H, Palmiotto PA, Clarck HJ, Ohara JL, Keeton WS, Weynand TP, Witten E. 1997. Ecosystems Balancing Science with Management. Springer-Verlag, New York.

Yuguang B, Abouguendia Z, Redmann RE, 2001. Relationship between plant species diversity and grassland condition. J Range Manag 54: 177-183.