Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2014/03/jls.htm
2014 Vol. 4 (S3), pp. 1748-1754/ Ommani and Noorivandi
Research Article

THE INFLUENCE OF AGRICULTURE ON BIODIVERSITY OF SOIL ORGANISMS (WHEAT FARMS OF AHWAZ TOWNSHIP)

***Ahmad Reza Ommani and Azadeh N. Noorivandi**
Department of Agricultural Management, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran
**Author for Correspondence*

ABSTRACT
The purpose of research was identifying the influence of agriculture on biodiversity of soil organisms by analyzing behavior of wheat farmers in Ahwaz Township, Khuzestan province, Iran. The method of research was a descriptive-correlative. The sample size was wheat farmers in Ahwaz township (n=165). A five-point Likert-type scale was used as the instrument to gather data in order to measure the behavior of farmers. Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Questionnaire reliability was estimated by calculating Cronbach's alpha and it was appropriate for this study (Cranach's alpha 0.83). Based on the results the main threats respectively include: 1-The rate of pesticide use, 2-The rate of chemical fertilizers use, 3-Burning of crop residues, 4-Soil erosion and 5-The rate of heavy machinery use. At this research were categorized farmers in five groups. Majority of farmers (56%) had high and very high threats behavior. Also the results showed, the correlation (r= -0.612) between level of threat behavior on soil biodiversity and participation rate in extension activities at the level of 0.01 was significant. In addition, the correlation (r=-0.178) between level of threat behavior on soil biodiversity and educational level at the level of 0.05 was significant. The correlation between level of threat behavior on soil biodiversity and sustainability knowledge (r= -0.602) and sustainability attitude (r= -0.532) at the level of 0.01 was significant. Liner regression was used to predict changes in level of threat behavior on soil biodiversity by different variables. Educational level, participation rate in extension activities, sustainability knowledge and sustainability attitude may well explain for 56.7% changes (R^2 = 0.567) in level of threat behavior on soil biodiversity.

Keywords: *Biodiversity***,** *Soil organisms, Wheat farmers, Ahwaz Township*

INTRODUCTION
Biodiversity is under serious threat as a result of human activities. The main dangers worldwide are population growth and resource consumption, climate change and global warming, habitat conversion and urbanisation, invasive alien species, over-exploitation of natural resources and environmental degradation.

The links between human impacts and biodiversity loss are illustrated by the figure 1 (Convention on Biological Diversity, 2006).

Each animal, plant, and microbe species requires a slightly different habitat. Thus, a wide variety of habitats are required to support the tremendous biodiversity on earth. At the microbial level, diversity is beneficial for several reasons. Many different organisms are required in the multi-step process of decomposition and nutrient cycling.

A complex set of soil organisms can compete with disease-causing organisms, and prevent a problem-causing species from becoming dominant.

Many types of organisms are involved in creating and maintaining the soil structure that is important to water dynamics in soil. Many antibiotics and other drugs and compounds used by humans come from soil organisms. Most soil organisms cannot grow outside of soil, so it is necessary to preserve healthy and diverse soil ecosystems if we want to preserve beneficial microorganisms.

Estimated numbers of soil species include 30,000 bacteria; 1,500,000 fungi; 60,000 algae; 10,000 protozoa; 500,000 nematodes; and 3,000 earthworms (Pankhurst, 1997).

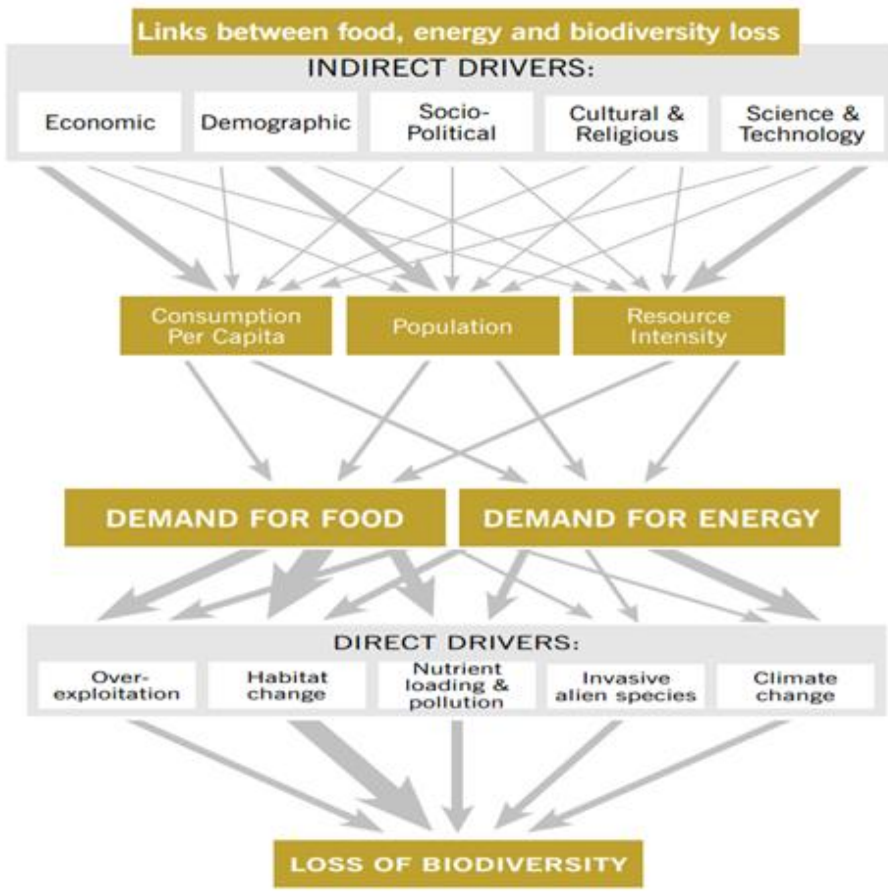

Figure 1: Links between food, energy and biodiversity loss (Convention on Biological Diversity, 2006)

The main driving forces that influence biodiversity soil organisms in agricultural soils are (Breure, 2004):
Intensification of Land-use: The introduction of agriculture and its expansion have changed the diversity of habitats, and thus the number of species occurring in the environment at the landscape scale. The increasing intensity of land use on the other hand has destroyed habitat and thus has substantially decreased biodiversity. E.g. a consequence of agricultural practices is the loss of trees and surface litter and consequently of the groups of macrofauna dependant on trees and surface litter (e.g. termites, ants, soil-dwelling insect larvae). Increased use of heavy machines in agriculture leads to soil compaction, and thus to degradation of habitat for soil organisms. Due to the destruction of biological stabilized structure the soil pores created by ploughing are unstable and sensitive to compaction (Gardi, 2008).
Influences of Crops: Systems that increase belowground inputs of C and N through inclusion of legumes or fibrous rooted crops in rotations may increase microbial populations and activities in comparison to application of commercial fertilizers. The chemical composition of crop residues may have a significant effect on the structure of decomposer communities. E.g., the application of animal manure leads generally to increased abundance and activity of a specific part of the soil biota.
Influences of Plants: Plants have an impact on soil microbial communities through C flow and competition for nutrients. It has been shown that there are distinct differences in bacterial community structure between the bulk, non-rhizosphere and rhizosphere soil. Numbers of bacteria in the rhizosphere are greater than numbers in non-rhizosphere soil. Bacterial activities are stimulated in this area because of the nutrients provided by roots. The variability in chemical composition of root exudates may also influences the composition of soil microbial communities.

Table 1: Summery of the main pressures, sources and driving forces on soil biodiversity

Pressure	*Source*	*Driving force*
Climate change	The increase in the greenhouse gas emissions in the atmosphere is recognized as the main cause of the climate change: • CO_2 originates when organic materials are oxidized, mainly by burning fossil energy carriers, but also by natural process such as soil and ocean respiration. • N_2O release to the atmosphere originates from agriculture (N over-fertilization), industrial processes and vehicle engines. • CH_4 originates from rice paddies, wetlands, animal breeding and waste site disposals.	Energy consumption Land use intensity Agricultural intensity
Ecosystem/habitat disruption	Land use change and the overexploitation of biodiversity can determine the disruption of ecosystems and habitats. Among the land use change processes the conversion of agricultural land into urbanize areas (soil sealing), and the conversion of natural or seminatural habitats into agricultural land use are the most prominent threat to soil biodiversity.	Land use change Land use intensity
Soil erosion	Soil erosion is a natural process, but is usually exacerbated by the human activities. The overexploitation of pasture or agricultural lands, can promote severe erosion.	Land use intensity Energy consumption (via climate change)
Soil compaction	The use of heavy load machinery in agriculture and the reduction in soil organic carbon content can determine soil compaction.	Agricultural intensity
Chemical pollution	Long range air pollutants Pesticides used in agriculture Persistent organic pollutants Heavy metals Trace elements from industrial processes and vehicle emissions	Agricultural intensity Dissipative use of chemicals
Soil organic matter decline	Decline in soil organic matter is the result of a series of causes, among them: • decoupling of animal husbandry and agricultural activities and consequent reduction of manuring practices • intensification of agricultural practices (frequency and depth of tillage, continuous cropping, narrow crop rotations, etc.) • climate change	Agricultural intensity Energy consumption (via climate change)
Human exploitation	Intensive agriculture Intensive animal husbandry and grazing Forest farming	Land use change Land use intensity Agriculture and animal husbandry intensity
GMO pollution	Accidental, deliberate or residual release of GMOs, with the subsequent establishment of modified organisms or of modified DNA in natural populations.	GMO production, trade and release
Invasive species	Accidental or deliberate introduction of foreign species as a results of globalization (global trade, tourism). The impact of invasive species may be exacerbated by climate change.	Globalization
Habitat phragmentation	The land use change processes and the construction of linear transport infrastructure, generally led to a reduction of natural and seminatural biotope size. This pressure for soil organisms, is not as dramatic as it is for other, above ground, organisms. However it is important to consider that some assets of land use. Even if, for soil organisms, the reduction in size of biotopes is not	Land use change Mobility infrastructures

Also, crop rotation is a key component, which influences the composition of the soil microbial community. The fact that crop rotation can change aggressiveness of pathogens approves changes in soil biodiversity and function because of management.

Influence of Fertilizers and pH: Application of fertilizers and the soil pH both influence the structure of the soil biota. Low pH favors fungi over bacteria, and high nitrogen concentrations result in increased bacterial concentrations. pH influences on soil fauna are also clear. E.g. a low pH in the soil leads to a decrease in abundance of earthworms.

Influence of Tillage Crop Residues: Periodic tillage reverts soil to an earlier stage of ecosystem succession. Physical disturbance caused by tillage is a crucial factor in determining soil species diversity in the agro-ecosystem. Tillage causes the loss of stratified soil microhabitat, which results in a decreased abundance of species that inhabit such agro-ecosystems. Tillage aerates the soil and therewith causes rapid mineralization of organic matter and an often substantial loss of nutrients. Activity and diversity of soil microbial communities are influenced by distribution of crop residues. Soil tillage can indirectly impact physical processes in soils through changes in the diversity and activity of soil communities. Reduced tillage with surface placement of residues creates relatively stable environments, which results in more diverse decomposer communities and slower nutrient turnover. No-till system favors fungi over bacteria, as decomposition of plant residues occurs on top of the soil.
Pesticides Application: Pesticides have both targeted and non-targeted effects that may cause a shift in the composition of the soil biota. When organisms are suppressed others can proliferate in the vacant ecological niches. The effect of pesticides strongly depends on soil physical and chemical properties, which affect their availability. Pesticides application to the soil can affect the microarthropods communities influencing the individual's performance and modifying ecological interactions between species. When one or more ecosystem components are impacted by pesticides, this will affect the microarthropods communities with respect to number and composition (Gardi *et al.*, 2008).
Influence of pollution on soil biodiversity and functioning. Pollutants in general influence the organisms living in the soil. In Table 1 the main pressures on soil biodiversity, and the related driving forces, are listed (Gardi *et al.*, 2008).

MATERIALS AND METHODS

The purpose of research was identifying the influence of agriculture on biodiversity of soil organisms by analyzing behavior of wheat farmers in Ahwaz Township, Khuzestan province, Iran. The method of research was a descriptive-correlative. The sample size was wheat farmers in Ahwaz township (n=165). A five-point Likert-type scale was used as the instrument to gather data in order to measure the behavior of farmers. Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Questionnaire reliability was estimated by calculating Cronbach's alpha and it was appropriate for this study (Cranach's alpha 0.83).

RESULTS AND DISCUSSION

Table 1: Demographic profile of farmers (n=165)

Variables	F	P	CP
Gender			
Male	148	89.70	89.70
Female	17	10.30	100.00
Age			
23-30	24	14.55	14.55
30-40	41	24.85	39.39
40-50	48	29.09	68.48
50<	24	14.55	14.55
Educational level (year)			
5>	35	21.21	21.21
6-8	49	29.70	50.91
8-12	69	41.82	92.73
12<	12	7.27	100.00
Familiarity with soil biodiversity			
Very Low	89	53.94	53.94
Low	46	27.88	81.82
Moderate	23	13.94	95.76
High	6	3.64	99.39
Very High	1	0.61	100.00

F: Frequency, P: Percentage, CP: Cumulative Percentage

Demographic Profile

Table 1 shows the demographic profile and the descriptive statistics for some characteristics of wheat farmers. The results of the demographic information and the descriptive statistics of the participant indicated that 90% of participants were men. The minimum age of participants was 23 years. 81% of farmers had low and very low familiarity to soil biodiversity.

Identifying the Main Threats on Soil Biodiversity

For assessment the effect of farmers behavior on soil biodiversity, was used multiple studies such as Breure (2004); Pankhurst (1997); Ehrnsberger and Butz-Strazny (1993). The results in Table 2 showed the situation different items of main threats on soil biodiversity. Based on the number of items (n = 5), minimum and maximum acquisition score (min = 1, max = 5), range scores between 5 and 25 was vary. This range was divided into 5 categories. People who had 5 to 9 score were located in group that had very low threats on soil biodiversity, who had score 9 to 13 were located in the low threats on soil biodiversity group, farmers who 13 to 17 were in the unsure group, who had a score of 17 to 21were in the high threats on soil biodiversity group, and those who had score 21 to 25 were located in the very high threats on soil biodiversity group. Based on results in Table 2 main threats respectively include: 1-The rate of pesticide use, 2-The rate of chemical fertilizers use, 3-Burning of crop residues, 4-Soil erosion and 5-The rate of heavy machinery use.

Table 3 categorizes farmers in five groups. Majority of farmers (56%) had high and very high threats behavior. Based on the mean (m=3.624), the situation of farmers behavior about conservation of soil biodiversity was very inappropriate.

Table 2 Situation different items of main threats on soil biodiversity

Items	**1**		**2**		**3**		**4**		**5**		**Mean**	**sd**	**CV**	**Rank**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**				
The rate of pesticide use	11	6.67	13	7.88	35	21.21	61	36.97	45	27.27	3.703	1.054	0.285	2
The rate of chemical fertilizers use	8	4.85	16	9.70	38	23.03	46	27.88	57	34.55	3.776	1.069	0.283	1
The rate of heavy machinery use	19	11.52	25	15.15	43	26.06	34	20.61	44	26.67	3.358	1.219	0.363	5
Burning of crop residues	12	7.27	9	5.45	54	32.73	47	28.48	43	26.06	3.606	1.051	0.291	3
Soil erosion	18	10.91	10	6.06	39	23.64	40	24.24	58	35.15	3.667	1.200	0.327	4

(1 = Very Low, 5 =Very High),

Table 3: Frequency of farmers based on threats behavior levels

Level of threat	**Frequency**	**Percent**	**Cumulative Percent**
Very low	12	7.27	7.27
Low	11	6.67	13.94
Moderate	49	29.70	43.64
High	48	29.09	72.73
Very high	45	27.27	100.00
Total	165	100	

Mean=3.624

Correlation Study

Spearman correlation coefficients to test hypotheses was used, the results of this test are as follows (Table 4):

The results of table 4 showed, the correlation (r= -0.612) between level of threat behavior on soil biodiversity and participation rate in extension activities at the level of 0.01 was significant. Therefore, the null hypothesis is rejected. It means that with 99% of confidence, we can conclude that farmers with high rate of participation in extension activities had low threat behavior.

Also the results of table 4 showed, the correlation (r=-0.178) between level of threat behavior on soil biodiversity and educational level at the level of 0.05 was significant. Therefore, the null hypothesis is rejected. It means that with 95% of confidence, we can conclude that farmers with high educational level had low threat behavior.

In addition the results of table 4 showed, the correlation between level of threat behavior on soil biodiversity and sustainability knowledge (r= -0.602) and sustainability attitude (r= -0.532) at the level of 0.01 was significant. Therefore, the null hypothesis is rejected. It means that with 99% of confidence, we can conclude that farmers with high rate of knowledge and attitude to sustainability had low threat behavior.

Table 4: Relationship between level of threat behavior on soil biodiversity and independent variables

Independent variable	Dependent variable	r	p
Educational level	Level of threat behavior on soil biodiversity	-0.178	0.043
participation rate in extension activities		-0.612	0.000
Age		0.089	0.133
Experience		0.076	0.219
Farm size		0.108	0.108
Crop yield		0.111	0.098
Sustainability knowledge		-0.602	0.000
Sustainability attitude		-0.532	0.000
Social participation		-0.103	0.112

Table 4: Multivariate regression analysis

Independent variable	B	Beta	T	Sig
Educational level	-0.487	0.531	2.023	0.000
Participation rate in extension activities	-0.568	0.218	3.009	0.000
Sustainability knowledge	-1.376	0.287	3.870	0.000
Sustainability attitude	-0.342	0.209	2.348	0.000
Constant	1.067	----	3.445	0.000

R^2=0.565, F=4.59, Sig= 0.000

Regression Analysis

Table 5 shows the result for regression analysis by stepwise method. Liner regression was used to predict changes in level of threat behavior on soil biodiversity by different variables. Educational level, participation rate in extension activities, sustainability knowledge and sustainability attitude may well explain for 56.7% changes (R^2 = 0.567) in level of threat behavior on soil biodiversity.

$Y=1.067-0.487x_1-0.568x_2-1.376x_3-0.342x4$

Conclusion

Based on the results the main threats respectively include: 1-The rate of pesticide use, 2-The rate of chemical fertilizers use, 3-Burning of crop residues, 4-Soil erosion and 5-The rate of heavy machinery use. At this research were categorized farmers in five groups. Majority of farmers (56%) had high and very high threats behavior. Based on the mean (m=3.624), the situation of farmers behavior about conservation of soil biodiversity was very inappropriate. Also the results showed, the correlation (r= -0.612) between level of threat behavior on soil biodiversity and participation rate in extension activities at the level of 0.01 was significant. Therefore, the null hypothesis is rejected. It means that with 99% of confidence, we can conclude that farmers with high rate of participation in extension activities had low threat behavior. In addition, the correlation (r=-0.178) between level of threat behavior on soil biodiversity and educational level at the level of 0.05 was significant. Therefore, the null hypothesis is rejected. It means that with 95% of confidence, we can conclude that farmers with high educational level had low threat behavior.

The correlation between level of threat behavior on soil biodiversity and sustainability knowledge (r= -0.602) and sustainability attitude (r= -0.532) at the level of 0.01 was significant. Therefore, the null hypothesis is rejected. It means that with 99% of confidence, we can conclude that farmers with high rate of knowledge and attitude to sustainability had low threat behavior.

Liner regression was used to predict changes in level of threat behaviour on soil biodiversity by different variables. Educational level, participation rate in extension activities, sustainability knowledge and sustainability attitude may well explain for 56.7% changes (R^2 = 0.567) in level of threat behaviour on soil biodiversity.

REFERENCES

Breure AM (2004). Soil Biodiversity: Measurements, Indicators, Threats and Soil Functions. International Conference Soil and Compost Eco-Biology, September 15th – 17th 2004, León – Spain.

Convention on Biological Diversity (2006). Global Biodiversity Outlook 2. Montreal, Quebec, Canada H2Y 1N9, CBD.

Gardi C, Menta C, Montanarella L and Cenci R (2008). Main threats on soil biodiversity: The case of agricultural activities impacts on soil microarthropods. In: *Threats to Soil Quality in Europe*, edited by Gergely Tóth, Luca Montanarella and Ezio Rusco, European Commission Joint Research Centre Institute for Environment and Sustainability, Joint Research Centre, TP 280, 21027 Ispra (VA) Italy.

Pankhurst CE (1997). Biodiversity of soil organisms as an indicator of soil health. In: Biological Indicators of Soil Health, CAB International.