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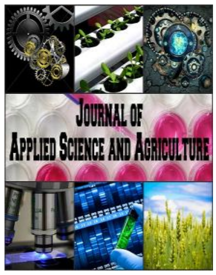

Bioassessment of Macrobenthos Communities in Rice Farms of Chaloos and Nowshahr (Mazandaran Province-Iran)

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ABSTRACT

Nowadays, in the study of determination of water quality the investigation of the presence of macrobenthos invertebrates are used as complementary indicators of chemical methods to identify pollution. In this study, in order to investigate the biodiversity of macrobenthos invertebrate in rice field in two cities Chaloos and Nowshahr, five stations were specified and the sampling were conducted three times throughout a cultivating season. Aquatic macro-invertebrates were identified up to the level of species. According to the result 10 order, 19 family and 26 species in Nowshahr and 10 order, 18 family and 29 species were collected in Chalous city. In Chaloos, The most amount of Margalef richness index was calculated 3.05 and the least amount was 0/34, Jaccard qualitative similarity index was between 0/58 and 0/76 and Shanon diversity index was between 1.8 and 2.4. In Chaloos Hilsenhoff biotic index varied from 4.34 to 6.87. In Nowshahr, The most amount of Margalef richness index was calculated 3.04 and the least amount was 1.31, Jaccard qualitative similarity index was between 0.19 and 0.90 and Shanon diversity index was between 0.66 and 3.25. In Nowshahr, Hilsenhoff biotic index varied from 5.47 to 6.64. Based on Hilsenhoff biotic index, water in the farms of Chaloos had a higher quality compared of water in Nowshahr rice farms.

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INTRODUCTION

Rice is the production of wet tropic and relatively hot or moderate areas and usually describe as a semi-aquatic adopting appropriately with anaerobic situation of soil. Kinds of rice are adapting appropriately to the aerobic situation and dry soil and can grow in dry farm like other grain. This kind of rice recognized as an upload rice or wild rice and against this kind of rice is the rice of flooding region. Regarding geographical latitude, this kind of rice is planted from 49 degree of north to 45 degree of south and altitude of sea level does not have any effect on the rice plant. Nearly 50 percent of world rice is planted on the wet fields, 2.5 percent of whole rice of world is gained from fields without watering and 75 percent of the whole rice of the world is gained from the fields with watering (Boumann and Toung, 2002). Most of the rice is planted through water in a way that rice which is planted through water dedicated 53 percent of world rice to itself and nearly 75 percent of rice production (Gravois and Helms, 1992). In comparing with other agricultural production, level of water consumption in the rice plant is high. Per hectare of field in the temperature degree of 40 in the summer needs 2000 cubic water. Although everywhere that has high level of raining, the level of water consumption will be decreased. One of the reasons of rice grow in the water is that the root did not need free Oxygen and soil ventilation. The level that a plant need water depends on plant species, grow stage, plant structure, length of growth period and earth topography in a way that daily water consumption on rice agriculture regarding different stages of growth, in preparing stage is 45 ML and in planting out (seedling) stage is 30 ML in a day and this water need in the stage of seed growth is 8ML (Gulati and Narayanan, 2002).

Environmental and economic dependence of people on water is undeniable and a change in the environment will have an effect on the quality of water (Karr, 1998). On the basis of international index, Iran is among the droughty country. Also according to the index of evaluating water resource in the world, individually water in Iran is 1700 cubic predicating it will be faced with crisis of draughty in

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1405. Unfortunately water was treated as an unlimited resource and in the recent years, several factors were severely threaded south basin of Khazar. Among these factors, effects of human activity are one of the most important factors threading aquatic ecosystem and river. Human activity cause directly (including building barriers, bridges, dam, destroying plant and drying rivers, urban and industrial sewage, playground) and indirectly (including agricultural activity, fishery, mining, industry production and urban development) a change and crisis in the population structure of rivers and at least pollution of river ecosystem.

Large benthic invertebrate are nutritional chain delivering stored energy of plants to the animals. Large benthic invertebrate are the energy resource for larger animals such as fishes that provide energy for Amphibious, birds, aquatic snake and even humane and benthic invertebrate are the best options for pollution problems because they are mostly sedentary in the water (Hynes, 1970). Lots of factors play an important role in macrobenthos distribution including soluble solution, flow rate, temperature and soluble oxygen of water are the most important factors in controlling life of aquatic animals (Hynes, 1970). This animal has relatively long term life and has low diversity in the rivers and in these rivers resistant species are more prevalent. Regarding aquatic Coleoptera, Legros did a research on Iran Fine and printed a paper regarding his study and in his book refer to some existed species in Iran. Using studied aquatic insect of US and reported 13 orders of aquatic insects. Soluk (1985) review life cycle of Chironomidae and Schmid study population Dynamism of Chironomidae Larva. Also Epler (1996) study Fone of aquatic Coleoptera in Florida including 11 families.

This research aims to determine biological diversity of large aquatic invertebrate in Noshahr and Challoos rice fields that are one of the most important nutritional resources of this region. It is good to use large benthic invertebrate that are animal of sedimentary of aquatic ecosystem and are 500 micron and their response to the biological and environmental changes are useful in evaluating pollution effect industrial agriculture on surface water. Presence and absence of these animals and their diversity are the reagent of pollution or lack of pollution. Severe organic pollution with a decrease in the concentration of soluble Oxygen usually limits diversity of large invertebrate to the resistance animal to pollution.

MATERIAL AND METHODS

Tools for sampling:

1) D-frame sampling: 20*20 CM (b) long glove, (c) long boot, (d) 3 Liter Flask, (e) description tray, (f) basin, (g) film bottle, (H) Sterio Microscope, (i) cooler, (j) Microscope, (K) label, (L) narrow needle, (M) camera, (N) seive, (O) thermometer, (q) 70 percent Alcohol, (U) Glycerin,

Challoos placed on the 39,6,63 north latitude and 59,26,51 west attitude with the 15953 KM2 space and Noshahr on the 40.51 north latitude and 56,19 east attitude with the space of 17175 KM2. In the beginning of test, we obtained list of rice field of 2 provinces from management of agricultural jihad. On the purpose of implementing the project, we choose 5 stations in each province and we did sampling 3 times in one year agricultural season. We have done sampling from the embankment and middle of the fields through D frame sampling with the dimension of 20*20 cm. we place tools of sampling against different direction of water flow and lead to the lace with dirt of basement. Finally basement floor was mixed slowly in order to lead the animal to the lace. Content of lace while washing will be transferred to the plastic basin and content of basin will be poured in the plastic container and will be fixed with the 4 percent Formalin. Material and animal of container will be transferred in to laboratory sieve with 20 micron lace and will be placed under moderate flow of water so the organic material and Formalin will be washed and then content of sieve transferred to the flat tray with the light background color and under the light separate from material and after separation, animals recognized through laboratory loop and Microscope and valid recognition key to the lowest rank. After recognizing, they transferred to the penicillin glass including 4 percent Formalin. On the purpose of drawing table of data calculation and diagram, we used Excel software. In this review, on the purpose of categorizing and evaluating water quality of stations, we used the most common indexes.

- *Diversity index:*

On the purpose of calculating diversity index of species, we used Shannon Weiner diversity index that is prevalent and also show species population and richness of a species as a numerical quantity. We use this index as a measure of sewage system and pollution resources effect on the species diversity. We calculate this index through following equity:

$$\sum_{i}^{n} pi \text{ Log } Pi = H'$$

In this equity, H is the Shannon function that it's unit is Bits/individual. N is the number of species and Pi is the abundance ratio of each species in a sample and calculate through the following equitation:

$$\frac{ni}{N}$$

Ni is the total number of people in a species and N is the total number of people in all species. (Shannon and Weaver, 1949)

Numerical value of this index is between 0-3. If value of Shannon index is H'<1, the region is severely polluted and if $1< H' <3$, the region is moderately polluted and if H' >3, the region is not polluted.

Table 1: The introduced Shannon sample through Welch 1990.

Result	Shannon index
The region with severe pollution	$H'<1$
The region with moderate pollution	$1< H' <3$
The region with out pollution	$H' >3$

- *Similarity species index:*

Similarity of species index is done through Jaccard qualification method that H' is the calculated Shannon value in each sampling station and H' max is the highest value in each repetition of sampling (Jaccard, 1908).the more this number is near to 1, the more the environment is more ideal.

$$\frac{H'}{H'MAX} = \frac{H'}{\text{Ln } S} = J$$

- *Tacconi richness index:*

On the purpose of evaluating Tacconi richness index, we used different prifiles the one of the most valuable profiles are Margalef Richness index explaining through the following equitation:

$$\frac{S-1}{\text{Ln}(N)} = R$$

In this equitation, R is Tacconi richness index, S is the reagent of species number, N is the total number of people. The more the R value is high, the higher will be the number of species in an ecosystem and this shows that stress and Turmoil is low in the environment because in inappropriate environmental condition, the sensitive species will be killed and resistant species will be replaced in this situation we will be faced with a decrease in population distribution but a decrease in a richness of species will be followed by increasing ability of species.

- *Hilsenhoff biological index:*

Hilsenhoff method scored each family through recognizing aquatic invertebrate and determining their tolerance to the pollution of river water (regarding pollution load of organic material). Hilsenhoff biological method through multiplying number of species to the value of special tolerance and divided by the total number of people. Range of tolerance value to non-tolerance is 0 to tolerance is 10. The high value of Hilsenhoff biological method shows organic pollution of water while it's low value is the index of pure water. Zero number shows non-tolerance of family to the organic pollution and shows cleanness sign of water and score 10 is the high tolerance of family to the pollution. Through the following equitation and table of qualification class, qualification class of water is determined is determined in 7 category (best to very bad).

$$HFBI = \sum \frac{X_i \ t_i}{n}$$

Xi: the number of people in each group
Ti: tolerance coefficient of family
N: total number of samples
HFBI: Hilsenhoff biological index

Table 2: Water quality classification scores based on HFBI.

Degree of pollution	Water Quality	Amount Of HFBI
No organic pollution	Higher	0.00-3.75
Low organic contamination	Very good	3.76-4.25
Possibility of some organic pollutants	Good	4.26-5.00
Significant organic pollution	goodish	5.01-5.75
Significant contamination	Relatively weak	5.76-6.50
High organic pollution	Weak	6.51-7.25
Severe organic pollution	Very weak	7.26-10.00

Goal of this project:

1. Determining index of diversity, similarity, richness of species
2. Determining water qualification class through Hilsenhoff biological method.
3. Utilizing biological indexes in order to consider effect of different pollution entering to the rice field

RESULTS AND DISCUSSION

On the purpose of following project goal and recognizing benthic invertebrate as an index for determining level of water pollution in the field of challoos and noshahr, numbers of these organisms were collected and recognized.

Biological indexes:

Regarding the obtained results in the challoos province, stations 1 and 5 have the highest Taxon with 15 or 12. Totally the highest number of Taxon is 15 and the lowest number is 6. Also the highest population of the sample in station 5 is 349 and the lowest number in the station 3 is 34.

Taxon richness index doing through Margalef method shows that in the station 1 which has the highest number of species, environmental condition is more ideal than other stations. The lowest richness value of Taxon related to the station 2 with the level of 1.34 that this decrease in richness of species shows an increase in the species ability that are more resistance to the inappropriate environmental condition because in the inappropriate environmental condition, sensitive species disappeared in the inappropriate environmental condition and resistant species were replaced.

Regarding qualification similarity of Jaccard, abundance of species in stations 1 to 4 have more stability than station 5 and so there are less stress in the environmental condition.

Table 3: biological indexes of Chaloos fields.

stations	*S*	*N*	*Margalef richness*	*Similarity index*	*Shanon index*
1	15	98	3.05	0.63	2.48
2	6	41	1.34	0.72	1.86
3	6	34	1.41	0.76	1.97
4	9	164	1.56	0.72	2.30
5	12	349	1.87	0.58	2.10

Hilsenhoff biological index in Challoos province:

Totally values of these indexes are in the range of 4.34 and 6.87 and on the basis of Hilsenhoff index, level of organic pollution and water quality in different stations are in 3 qualification degree good, rather weak, weak so station 2 and 3 have good qualification level with low organic pollution possibility and station 4 has rather weak qualification level with significant pollution and stations 1 and 5 have weak qualification level with significant organic pollution.

Table 4: Hilsenhoff biological index in challoos province.

5	4	3	2	1	station
6.56	6.15	4.47	4.34	6.87	HBI value
Weak	Rather weak	Good	good	weak	Qualification category

Regarding the obtained results in Noshahr, stations 2 and 5 have the highest Taxon with the number of 12 and 14. Totally, the highest number of Taxon is 14 and the lowest number is 6. Also, the highest population of samples in the station 5 is 422 and the lowest population of samples in the station 3 is 37.

Taxon richness index which has done through Margalef method shows that environmental condition in station 2 with the richness of 3.04 is more ideal than other station. The lowest Taxon richness value relates to station 4 with the level of 1.31 that this decrease in richness of species shows an increase in the ability of species that are more resistant to the inappropriate environmental condition because sensitive species will be disappeared in the inappropriate environmental condition and more resistance species will be replaced. Regarding Jacard qualification similarity index, in the stations of 2 and 5 abundance of species is more stable than station1 and so there is low stress in the environmental condition and environment is more stable and environmental condition is more ideal. Diversity index is calculated through Shannon, the level range between 0.66 to 3.09 and shows that the environment is without pollution in the second and fifth stations and the pollution is moderate in the third and fourth station and high in the first station.

Table 5: Biological index of Noshahr fields.

Stations	*S*	*N*	*Margalef richness*	*Similarity index*	*Shanon index*
1	11	422	1.65	0.19	0.66
2	12	37	3.04	0.90	3.25
3	8	45	1.83	0.73	2.21
4	6	45	1.31	0.75	1.96
5	14	172	2.52	0.81	3.09

Hilsenhoff biological index in Noshahr province:

Totally values index is in the range of 5.47 and 6.64 and on the basis of Hilsenhoffindex, level of organic pollution and water qualification is rather good, rather weak and weak. So fourth and fifth stations have the qualification degree of rather good with rather significant organic pollution, the first and second stations have rather weak qualitative degree with significant pollution and third stations have weak qualitative degree with high organic pollution. In 1996, a book namely an introduction to aquatic insect of north America was printed involving 11 order of insect relating to aquatic habitat (Meritt and Cummins,1996). Also Barbour and *et al* (1996) considered Biologic indexes of Florida River through macrobenthos. Also Overton (2001) and Bouchard and *et al* (2004) printed respectively standard method of Biologic evaluation of California macrobenthos and guideline of macrobenthos in North West of America. Sandin (2003) examined macrobenthos in Sweden river. Wilson (2008) examines the effect of different method of management on the diversity of macrobenthos in California rice field.

Table 6: Hilsenhoff biological index in Noshahr province.

5	4	3	2	1	station
5.52	5.47	6.64	5.48	6.08	HBI value
Rather good	Rather good	Weak	Rather weak	Rather weak	Qualification category

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