J. Appl. Environ. Biol. Sci., 5(8S)290-294, 2015

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Study the Effects of Wastewaters Output of the Pisciculture Ponds in Nurali Region on Changes in Dissolved Oxygen of Gorgor River

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Received: March 8, 2015
Accepted: May 10, 2015

ABSTRACT

Due to population growth and the increasing need of people to food and passion for fish and other aquatics as well as limited natural resources of fish, Production and Pisciculture has been highly regarded. The objective of this study is the analysis the effects of wastewaters output of 1500 pisciculture ponds with an area of 2,000 hectares in regions, including Cham Kenar, Noor Ali, Behdid and Darkhazineh, which in total have 23 Large drains of discharging wastewater, on characteristics and quality of Gorgor river water located between the city of Shooshtar and Ghir dam (at 55 km from the North of Ahvaz). the qualitative and quantitative data of studied stations were extracted and examined after identifying all major pollutant sources. Lower dissolved oxygen curve represents the water pollution due to the wastewaters of pisciculture ponds into the Gorgor River and the gradual rise of dissolved oxygen in the river downstream suggests the river self-refinement and show that the reduction of pollution load. In general, the effects of pisciculture ponds wastewaters on the quality of the river were quite evident at different intervals, and the minimum critical time (tc), the critical shortage of oxygen (Dc) and its place at the downstream of the discharge point (X) were obtained as 2.64 day, 5.2 mg/L and 45.619 km, respectively. However, given the river self-refinement capacity in the last station at the downstream, a relatively acceptable quality will be resulted. Finally, the Gorgor River water quality improvement depends on proper management of wastewater due to various applications and reduced pollution load.

KEYWORDS: Gorgor River, Pisciculture ponds wastewater, dissolved oxygen changes

INTRODUCTION

Rivers are of particular importance as one of the most important sources of water supply and transmission in the sectors of industry, agricultural and urban uses [1]. Maintaining the quality of water resources aiming at drinking water supply, improving the activities and recreational uses as well as creating an appropriate ecosystem for fish and wildlife require the high quality of rivers' water. For this reason, acquiring knowledge on qualitative changes trend of rivers' water associated with identification of pollution factors is very important [2].

Aquaculture is an important tool for promoting economic growth in urban and rural areas through job creation and income. Nevertheless, production methods should be taken into consideration to reduce the negative impacts of production process in aquaculture [3]. Numerous scientific studies have been conducted concerning the impact of fish farm ponds on rivers and their eco-environmental impacts on aquatic ecosystems in the world [4 & 5]. Characterizing the rate of the physicochemical parameters of the effluent of fish farm ponds entering into water resources and determining aquaculture based on the these parameters provide basic information in order to make the regulations of environmental protection. Based on this information, fish growers are required to develop sewage treatment systems of the effluent of farms and improve environmental conditions in the water resources [6]. The lack of certain standards for pisciculture centers' output wastewater has led to a rise in the density of pisciculture ponds far from any criteria and regulations, especially in path of the rivers that part of their water is currently used to supply drinking water. Considering that achieving a certain amount of production in aquatic environments requires the use of needed food in pisciculture ponds, the unused food associated with fish feces and waste and used toxins and drugs, including animal manure, phosphate fertilizer and ammonium and nitrogen fertilizer may cause severely reduction in water quality. The Gorgor River is one of the fresh water resources of Shooshtar City that 1500 pisciculture ponds have been already established in its area; the wastewater from the activity of them, causing the pollution of the river's water. Among previous conducted studies in this regard is the examination of the effluent of fish farm ponds of rainbow trout on physicochemical parameters of the water of Rijab River (Kermanshah) conducted by Husseini et al. In the mentioned research, measuring the parameters of required biological oxygen and chemical oxygen at different stations are shown that the effluent of fish farm ponds pollutes the water of Rijab River and change the physicochemical parameters of water so that the river is unable to self-refinement [7]. In research titled "Effect of Aquaculture Farms Wastewater on Physicochemical Parameters of Kabkian River which was

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conducted by Sobhan Ardakani et al, According to this study and the WHO recommendation on concentrations of pollutants for drinking and agricultural water, self-refinement of Kabkian River is possible. However, increasing number of aquaculture farms and lack of monitoring of pollution sources could result in serious problems, especially eutrophication. [8]. Nhan et al. in one research evaluated the relation between economic performance and environmental impacts of consumptive nutrients for producing fish in several fish ponds in Vietnam and concluded that by increasing nitrogen as a nutrient, even if an adequate amount of freshwater is entered into the pools, fish production and economic productivity are increased, but only part of this element is used by fish and much of it is accumulated at the bottom of ponds or entered into discharging effluent. Thus, production increase is directly related with the concentration reduction of dissolved oxygen in water [9]. Finally, determining seven sampling stations and measuring parameters DO and BOD5, Tayebi and Sobhan Ardakani attempted in relation to the effect of reproduction and farming workshops of salmon fish on the water quality of Gamasiab River. The results showed that the water quality of this river is classified in the waters with moderate contamination and Gamasiab River, in the current situation, has the capacity to self-refinement pollutants, but respecting the development of aquaculture as well as the lack of monitoring of pollutants entering the river, in the not too distant future, it will be faced with serious problems [10].

MATERIALS AND METHODS

The study area

Gorgor River, located between the city of Shooshtar and Ghir dam (at 55 km distance of north of Ahvaz), is the eastern branch of Karun River that separated by Mizan dam from its western branch, i.e. Shatit River, and passing through the Shooshtar and traveling a distance about 78 km in a tortuous path, re- joins to the Shatit and Dez branches at Ghir dam location at 60 km far from the south of Shooshtar and forms the great River of Karun. In terms of geographic location, the Gorgor River is located between east longitudes 48 ° 48′ and 49 ° 20′ and north latitudes 31 ° 31′ and 32 ° 40′. The absolute maximum and minimum temperatures in this region are respectively as 52.5 °C (August) and - 4 °C (February) [11]. Meanwhile supplying the drinking water of cities, including Shooshtar, Haftgol, part of Ramhormoz and its villages, the river is considered as one of the large pisciculture centers in the Province [12], so that about 1,500 pisciculture ponds around the river with an area of approximately 1,500 hectares provide their use water from this river. The water from the river is also used for other uses such as Shooshtar slaughterhouse and Seyed Hassan Water Treatment. Hence, the river has a great importance for many organizations and agencies such as Fisheries, Ministry of Energy, Agriculture Jihad, Water and Sewer Organization and the people living in the area [13]. The study area includes the river path in the distance between Mizan dam in Shooshtar and Ghir dam.

Figure 1. Location of Gorgor River in the region

Sampling and analysis

After selecting the best location of stations for sampling, including Mizan dam station (river upstream) and outlet stations of ponds wastewater, the parameters of DO, BOD5 and temperature were measured. According to

the obtained parameters, the curve of oxygen reduction was calculated and plotted in order to examine and compare with the standard value.

Laboratorial results obtained from the stations are as follows:

Table 1. Parameters of the obtained results from stations

Parameter	River upstream	Ponds output
BOD_5 (mg/L)	3.5	62
T(°C)	23	25
Do (mg/L)	8.6	2

RESULTS AND DISCUSSION

Usually, the most important point in the curve of the oxygen reduction is the point with minimum concentration, since it represents the maximum impact on oxygen rate due to wastewater discharge. To determine the critical oxygen rate in water flow and the place that such an event occurs, the following relations can be used:

$$tc = \frac{1}{k2-k1} \ln\left[\frac{k2}{k1}\left(1-D0\ \frac{k2-k1}{k1\times Lo}\right)\right] \quad (1$$

$$Dc = \frac{k1}{k2} \times Lo \times e(-k1 \times tc) \quad (2$$

$$X = 0.2m/s \times 86400\ s/d \times Dc \quad (3$$

Where, tc: critical time (day); Dc: critical shortage of oxygen (mg/L); k1: reaction rate constant; k2: aeration rate constant; Lo: final BOD rate (mg/L); X: the place of critical shortage of oxygen in the downstream discharge point (km).

Table 2. The amount of oxygen shortage and oxygen concentration in the downstream

Distance at downstream (km)	Oxygen shortage D (mg/L)	Oxygen concentration C (mg/L)
0	1.43	7.07
5	2.4	6.1
10	3.21	5.29
15	3.84	4.66
20	4.33	4.17
25	4.69	3.81
30	4.94	3.56
35	5.11	3.39
40	5.20	3.3
45	5.23	3.27
50	5.21	3.29
55	5.15	3.35
60	5.05	3.45
65	4.93	3.57
70	4.79	3.71
75	4.63	3.87
80	4.47	4.03

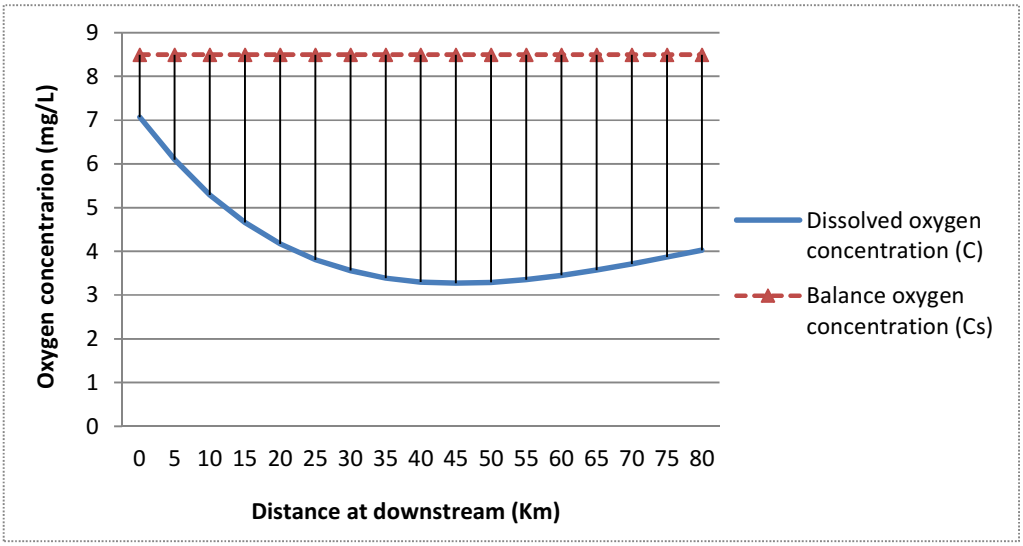

Figure 2. Oxygen reduction curve

Table 3. The results of calculations to determine the critical values of dissolved oxygen

D_c critical shortage of oxygen (mg/L)	X the place of critical shortage of oxygen in the downstream discharge point (km)	tc critical time (day)
5.23	45.619	**2.64**

According to results shown in the Table and Figure 2, the decrease of dissolved oxygen curve from 7.07 mg/L to 3.45 mg/L indicates the water pollution resulted from the entrance of wastewater of fish farm ponds to Gorgor River, because when the wastewater is discharged into a river, the organic materials are broken into ammonium, nitrate, sulfate, carbon dioxide and son on by bacteria. In this process, dissolved oxygen in the water is used for oxidation and, thus, oxygen depletion occurs and as shown in Table 3, the lowest amount of shortage of dissolved oxygen is 5.23 mg/L occurred at the distance of 45.619 km from the downstream discharge point and critical time 2.64 day, that this position is the gathering place of the most of fish farm ponds that enter their wastewater directly in Gorgor River and therefore, decreasing dissolved oxygen water considerably. Afterwards, respecting the gradual increase in the amount of dissolved oxygen from 3.45 mg/L to 4.03 mg/L in downstream, it indicates the reduction of water pollution load that the cause of this gradual increase of dissolved oxygen is that the natural cycle would be restabilized in a process known as "self-refinement" where oxygen capacity recompleted by wind-conditioning. In addition, the stable oxidation byproducts are used by plants and algae in order to produce carbohydrate and oxygen. This cycle is known as "photosynthesis" forming the basis of the life of ecosystem. The highest amount of dissolved oxygen at the beginning point of discharge is obtained 7.07 mg/L, which is related with the upstream and there is still no water pollution in it.

CONCLUSION

Generally, the impact of the wastewater of fish farm ponds on the quality of Gorgor River was clearly visible at various intervals. However, in respect to the power of the self-refinement of river, a relatively acceptable quality is obtained in the final station of downstream, but this important point should be noted that rivers have limited capacity and decomposition of organic materials. If the dissolved oxygen of river is lower than 4 mg/L, it means that the organic load into in the river is above the natural ability to absorb organic materials of river. regarding the above point and results shown in Table and Figure 2, the amount of dissolved oxygen is lower than 4 mg/L at interval between 25 and 75 km downstream, which it indicted that further development of fish farm pond around Gorgor River, especially in these areas should be avoided. Finally, the Gorgor River water quality improvement depends on accurate and proper management of wastewater due to various applications and reduced pollution load. Further studies on the Gorgor River's water quality and monitoring the selection of appropriate areas to construct and establish pisciculture ponds, design of wastewater treatment systems for pisciculture ponds to reduce the pollution load of wastewater entering the river and the use of ponds wastewater for irrigation of rainfed lands are of suggestions that need further research.

Acknowledgements

The authors are willing to appreciate the Water and Wastewater Office Laboratory of Imam Khomeini Agroindustrial Company, Shooshtar for performing the tests related to this research.

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