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### **ECOLOGICAL FISH FOR THE CLEANING OF WATER RESERVOIRS**

Fish from specific species are blessed with the ability of cleaning water pools from microorganisms, plants and snails, which are their natural food. The fish are “ecological cleaners” and have no influence in the water composition and, at the end of their growing procedure, can be sold at reasonable good price.



Israel is a sun soaked country, with high temperatures most of the year. Under these conditions, all opened water reservoirs are blessed with sunlight and a large number of natural population – algae, microorganisms and water plants which their quantity depends on the type of water or soil in every place. Due to lack of water from wells and rain, water reservoirs are built to irrigate inland fields and citric plantations during drought periods.

The supply of water for the agricultural irrigation is more and more pumped from water provided by the filtration systems which, together with rains, ultimately reach the water reservoirs to provide all the irrigation needs for fields and plantations. The pumped waters are very rich in organic materials and favors the major growth of algae, microorganisms and plants in the water reservoirs. These quite often difficult the flow – rough filtering - from the reservoir to the pumping facilities , and the further water

pumping for irrigation, due to blockage of the delicate filters close to the pumping unit. This situation requires a solution, which can be reached by two ways: use of chemical materials to destroy the natural population of the water or, the use of fish to clean the water – of which the above mentioned natural population is their natural source of nutrition .

## **USE OF CHEMICAL MATERIALS**

### **Advantages**

A solution to the formation of algae and superfluous microorganisms.

The materials can be easily obtained and most of the times the distribution is made by irrigation planes.

### **Disadvantages**

The solution works for a short time, and the operation has to be repeated many times. The distribution by planes increases the cost of the treatment. The chemical materials do not provide a solution for snails and algae. The annual cost to keep the reservoirs clean is high. Sometimes, the materials do not solve the problem and there is no possibility to pump from the reservoir.

It may influence the composition of the water and thus affect the contents of fruits and vegetables irrigated by these waters.

## **USE OF FISH**

### **Advantages**

The recommended fish to populate the waters eat algae, microorganisms, plants and snails.

All the types of fish recommended are easy to obtain in the right size. The fish remain at the reservoir all the time, filtering the water 24 hours a day.

The price of embryos per hectare is much lower than the price of chemical materials per hectare.

The fish are “ecological cleaners” and do not influence the water composition or the contents of the fruits and vegetables. It is also possible, afterwards, to sell the fish to the industry at a reasonable price to cover their purchased cost.

### **Disadvantages**

It is not possible to populate fish in waters that have been treated only with secondary treatments with high nitrogen levels. In low oxygen levels, oxygen should be added to prevent death. The fish can suffer from sicknesses and die from them. In a few cases, chemical materials have to be added to help the fish cleaning the water. The months of Autumn and Winter bring with them the hazard of pelycans' predation. The marketing of fish for food can be done only from fish that were treated tertiary, and a water quality control by the Ministry of Health is compulsory. The company “Mekorot”, the greatest water supplier in Israel, chose the second option. Already, since 1984, the company started to use vegetarian fish to clean the national water transportation system in all the water reservoirs in Israel. Good results were achieved. The quantity of fish needed to populate waters per hectare is small, and due to this factor, fish do not suffer from sicknesses and lack of oxygen. The company maintains

this policy throughout the years up to now, and fill the reservoirs with fish every year. In previous times, when the private reservoirs in Israel were filled with flood waters only, fish for food grew in low density with small additional food or no additional food at, which kept the waters clean. Pumped water located in the reservoirs which received only first and second treatments, have high levels of nitrogen (ammonia and nitrates), and do not allow in most cases fish population (table 1)

**TABLE 1 | COMPARISON OF NITROGEN LEVEL AMONG THE DECONTAMINATED FACILITIES**

TREATMENT LEVEL	AMMONIA	NITRATE
Primary - Secondary	PPM 25-30	PPM 10
Tertiary	PPM 3-5	PPM 2

**Pumped waters are very rich in organic materials, and cause a big development of algae, microorganisms and flora, which difficult the water flow from the reservoirs to the pumping facilities.**

Today, most of the pumped waters reach the reservoirs from the decontaminated facilities after the third treatment, and it is not far away the day when all the pumped water will reach the reservoir only after the third treatment, which has low nitrogen levels, and will allow to populate the waters with fish to filter the water pumped from the reservoirs before water is pumped for irrigation and marketing of edible fish.

### GILBOA WATER SOCIETY

The society reservoirs were used in the past to grow intensively fish and to irrigate field crops and plantations of the society. With the rise of a limited quota for irrigation, about 10 years ago, the fish culture was closed and the water was pumped for irrigation only. Without the fish in the reservoirs, "natural populations" grew and blocked the filters hardly. Spraying with chemical materials from the air, which costed a lot, were efficient only for a short time, and it was difficult to keep the irrigation schedule on time for irrigation of crops and plantations. Thereafter, reservoirs were filled with fish, whose only purpose was to filter the water. Due to the low density of fish per hectare, without nutrition and lack of oxygen no fish sicknesses were observed. The yearly fish crop reached 60-135 kg/hectare.

**TABLE 2 – RESULTS FROM FISH GROWTH IN THE HAROD WATER IRRIGATION RESERVOIR – 2013 (28 HECTARES), HIGHER CROP OF ALMOST 140 KG/FISH PER HECTARE WITHOUT ADDITIONAL NUTRITION**

TYPE OF FISH	POPULATION (DATE)	PLACENTA (DATE)	FISH/HECTARE	SIZE OF POPULATION (gr)	SIZE OF DISMANTLING (gr)	CROP/HECTARE (kg/net)
CARP	15/4/13	20/10/13	200	780	1,200	114
NAMSIF	15/4/13	20/10/13	290	810	2,930	590
TILAPIA	15/4/13	20/10/13	2850	1	100	290
MULLET	15/4/13	20/10/13	1640	10	256	400
<b>TOTAL</b>			<b>4980</b>			<b>1394</b>

**Table 2** shows the results of growth in the west side of the Gilboa Society water reservoir in 2013 (28 hectares). In order to populate fish in the reservoir, it must be checked that the nitrogen levels are not higher than allowed. The fish yield depends on the fertility of the reservoir and the quantity of days there is water in the reservoir. Production of 1 kg of fish with this system needs 10 kg of natural food. Cumulative experience shows that fish which grew with only natural resources, reached between 600 to

1000 kg of fish/hectare ,that is to say that the natural food, ate by the fish is between 6000 to 10000 kg of natural food per hectare. This quantity will not interfere in the filter system that transfers the water for irrigation of plantations and fields. The fish prevented the use of chemical materials, the costs are lower by far and most important – healthier.

<b>TABLE 3 – FISH GROWTH RESULTS IN THE IRRIGATION RESERVOIRS IN EMEK IZRAEL</b>						
TYPE OF FISH	POPULATION (DATE)	PLACENTA (DATE)	FISH/HECTARE	SIZE OF POPULATION (gr)	SIZE OF DISMANTLING (gr)	CROP/HECTARE (kg/net)
<b>BEIT SHEARIM 2015 (9 HECTARES)</b>						
NAMSIF	15/5/15	8/10/15	170	900	4,500	600
TOTAL NET FISH CROP 5400 KG = 54000 KG OF “NATURAL POPULATION”						
<b>FIELD CROPS EMEK HAMAARAVI 2015 (4 HECTARES)</b>						
NAMSIF	15/5/15	10/9/15	400	250	1,100	1000
TOTAL NET FISH 4000 KG = 40000 KG OF “NATURAL POPULATION”						

Table 3 shows results of fish for cleaning in 2 water reservoirs in Emek Izrael in 2015.

#### **POPULATION PROCEDURE**

The population is done by filling the water with different types of fish, each type eating the sort of food that suits it (picture 1)





FISH	FOOD	No. OF FISH/HECTARE
NAMSIF	Algae and microorganisms	200
GRASS CARP	Flora	50
BLACK CARP	snails	50
MULLET	dirt and organic materials	100
<b>Total population per hectare</b>		<b>400 fish</b>

Namsif inbreeding of Silver carp that eats algae and Big Head Carp that eats microorganisms - This hybrid mixture eats algae and microorganisms at the same time and performs a very good “cleaning work”.

Black carp – eats snails and prevents formations on the filter nets in the reservoir. As long as the fish are bigger they filter the water better. It is recommended to populate the water with embryos of 20-25 gm

and more, which can be obtained as from the autumn season of each year. It is not recommended to populate the waters with less than 20 gm embryos since their efficiency and survival is low.

Please see Appendix 1, translation of the below letter from the Ministry of Health to Ms. Dina Zilberg, authorizing the raise of fish.



## Appendix 1

Dr. Dina Zilberg

The Institute for Desert Studies

Ben Gurion University

## GROWTH OF FISH IN FILTERED WATER

The Ministry of Health do no discard the possibility to grow fish using tertiary reclaimed water, when scientific proof will be provided confirming that this procedure is as good, in terms of quality and security, compared to the growth of fish using water of drinking quality.

Sincerely yours,

Dr. Yoni Ynon

Director of the Veterinary Department

c.c. Engineer Eli Gordon – Director of the National Food Service

Dr. Edie Tal – Principal Doctor for Food from the Fauna

Dr. Rina Versano – Manager of the Hazards Management Division

### **CONCLUSION**

The company “Mekorot” is assisted by fish to clean their water reservoirs for more than 30 years, and prove, with another additional particular factors, **THAT FISH ARE THE BEST CHOICE AND DO NOT HARM THE WATERS.**

**OFER BERZAK, FOUND AND DIRECTOR OF GALIDI**

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