Water Quality for Aquaculture and Impact of Aquaculture to Environments

Proposal:

In the framework of the FAO Turkey Partnership Programme (FTPP) FAO provides assistance to the countries of the sub-region namely Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan and Uzbekistan.

The development goal of the regional programme is to increase the Central Asian fisheries and aquaculture sector performance in terms of its capacity to generate food, employment and income, and in terms of its economical viability, environmental compatibility and social acceptability.

In the direction of the project, the regional workshop to assess the fisheries and aquaculture sector education, training and research needs in Central Asia was held in Tashkent, Uzbekistan in 12-14 January 2010. Between the countries mentioned above, the representation of Uzbekistan declared that one of their priorities was research, training and education about water quality and to monitor the impact of aquaculture on the ecosystem.

This proposal aims to explain what kind of and how water quality studies could be carried out inland water bodies in Uzbekistan.

General Context

The total area of inland water bodies in Uzbekistan (except Aral Sea) is more than 800,000 ha. The water bodies in the Aral Sea basin could be grouped as follows;

1. Natural water bodies (rivers and streams, lakes);
2. Primary, artificial freshwater bodies (irrigation channels, reservoirs and ponds);
3. Secondary, artificial brackish water bodies (drainage canals, lakes for residual water storage)

Generally; the water bodies that are mentioned above as number 1 and 2 can be suitable for aquaculture applications. That’s why water quality monitoring should be done for those waters to determine the annual values of water quality parameters such as temperature, dissolved oxygen, pH and ammonia. If they can be monitored and recorded regularly, annual changes can give an idea about environmental status of waters to either possible investors or fish farmers in the Central Asia.
Importance of Water Quality Parameters and Monitoring Activities

1. **Monitoring Temperature:**

Temperature affects all chemical and biological processes. The metabolic rate of fish doubles for every rise of 10°C. Therefore, temperature has a direct effect on important factors such as growth, oxygen demand, food requirements and food conversion efficiency. The higher the temperature, the greater the requirement for oxygen and food and the faster the growth rate. Temperature partly determines the concentration of oxygen in water. The solubility of oxygen decreases with increasing temperature, and so concentrations are usually lower in summer. Temperature also has a crucial role in stimulating fish gonad maturation and spawning activity.

2. **Monitoring Dissolved Oxygen**

Dissolved oxygen (DO) is the most critical and limiting factor in intensive aquaculture. Oxygen enters water through photosynthesis by aquatic plants, principally phytoplankton, and by diffusion at the air-water interface. Diffusion occurs when waters are below saturation, and the greater the deficit between the oxygen concentration in the water and the saturation concentration, the greater the rate of diffusion. In ponds, diffusion is promoted by wind and wave action and by artificial aeration. Oxygen is lost from water through respiration by fish, plankton and other organisms, and by aerobic decay of organic matter. There are distinct diurnal fluctuations of oxygen, with concentrations lowest just after dawn, increasing during daylight hours. This is because of the photosynthetic production of oxygen, (there is also usually more wind during the day) to a maximum in late afternoon, before decreasing again during the night.

3. **Monitoring Ammonia**

Ammonia is the major waste product of protein or nitrogenous metabolism in fish and other aquatic organisms. The major source of nitrogen compounds in fishpond culture is the protein contained in the feed. Therefore, the rate of ammonia production of fish is proportional to the feeding rate. It is excreted primarily across the gills, and in urine and faeces. Ammonia is also produced during the aerobic decomposition of organic matter by bacteria. In water, the total ammonia-nitrogen (TAN) occurs in two forms, unionised ammonia (NH₃) which is toxic to fish, and the ammonium ion (NH₄⁺) which is relatively non-toxic, except at extremely high concentrations. Ammonia can change from one form to the other creating a
balance between the two forms. Water pH and temperature influence the proportion of total ammonia occurring as the toxic \( \text{NH}_3 \) form.

Consequently, water samples are taken for TAN levels in the afternoon when pH and temperature are at the daily maxima. Ammonia levels then decrease during the night.

4. Monitoring of pH

The pH is the measure of the hydrogen ion concentration in soil or water. An ion is an electrically charged atom. Water exists as a balance between hydrogen ions (H\(^+\)) and hydroxyl ions (OH\(^-\)) and has the formula H\(_2\)O. The pH scale ranges from 0-14 with 7 neutral. When there are more hydrogen ions (H\(^+\)) present the pH will be lower than 7 and the water acidic. The water is basic (alkaline) when there are more hydroxyl ions (OH\(^-\)). Carbon dioxide has an acidic reaction in water. The pH in ponds rises during the day because phytoplankton and other aquatic plants remove carbon dioxide from the water during the process of photosynthesis. The pH decreases at night because of respiration and production of carbon dioxide by all organisms.

5. Measurement physic-chemical parameters of pesticides and herbicides (in relation to cotton culture)

Material – Method

1. Possible water bodies for aquaculture or existing fish farms on the water bodies will be determined (Places should be selected by the local experts).
2. One or two multiparameter(s) (measures water temperature, dissolved oxygen, ammonia and pH) will be purchased.
3. 2 institutions are interested in water quality will received the multiparameter(s).
4. They will monitor the water quality using the multiparameter from determined water bodies.
5. Monitoring or sampling will be weekly or monthly (depending on the budget)
6. Duration of the study is 24 months (The seasonal changes of water quality will be recorded)

Expected outputs

1. Fish farmers can be receive the information about seasonal changes of water quality parameters of their places.
2. Possible investors can have the idea about the water quality of water bodies; to enable them to decide whether aquaculture is possible in these bodies.
NOTE: The study can be limited according to type of water bodies (if it’s carried out between fish farms, we can also determine the aquaculture impacts of fish farms to environment)

3. Research institutes will have the chance to find out water quality of the waters, in the country and prepare some research papers.

4. Water quality reports will give the idea to all about fish species can be produced in water bodies (High temperature-low DO sign to carp culture or tropic species; low temperature-high DO sign to trout culture etc).

5. Research paper on general prospectus in water bodies use for aquaculture in Uzbekistan.