

## **Fishery and Aquaculture**

### **Level-III**

**Based on July 2022, Version-1 Occupational standard**



**Module Title: - Maintaining Water Quality**

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## Introduction to the Module

This module covers the knowledge, skills and attitude required to collect, taste, preserve, pack and label water samples for water quality maintaining. It also covers taking treatment measure based on test result. In aquaculture water quality refers to all physical, chemical, and biological attributes of water that affect yields. The physical and chemical characteristics of water directly affect the fish physiology and consequently, its production performance. When water quality is suboptimal fish become stressed. This results in poor growth, ill health and mortality.

The major factors that affect water quality during fish production are the environment, water source and production system. Weather pattern and climatic factors, such as rainfall, ambient temperature, wind and cloud cover affect water temperature, phytoplankton growth and consequently the dissolved oxygen (DO) and pH level of surface water. Minerals in soil dissipate into the water and determine hardness, alkalinity, and pH of water.

## LG #13

## LO#1- Prepare for water quality maintaining

### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying tools, equipment and materials
- Personal protective equipment
- Physical and chemical nature of pure water
- Identifying water quality and environmental parameters
- Water quality maintaining techniques and schedules
- Collect data or record sheets

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify tools, equipment and materials
- Identify personal protective equipment
- Understand physical and chemical nature of pure water
- Identify water quality and environmental parameters
- Determine water quality maintaining techniques and schedules
- Collect data or record sheets

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## Information Sheet 1


### 1.1. Identifying tools, equipment and materials





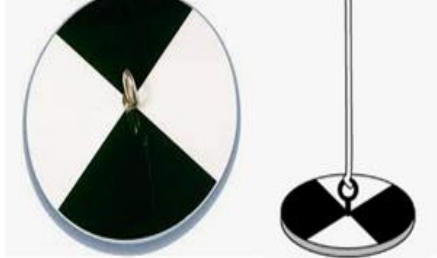
Required materials, tools and equipment for fish farming should be identified according to lists provided and/or supervisor instructions before any activity. The equipments can be grouped as Water Quality testing equipment, Water treatment equipment ,Measuring equipment, personnel protective equipments(PPE).


#### 1.1.1 Water quality testing equipment





Water-quality testing is one of the most important jobs in aquaculture. If the water quality of a culture structure, such as a pond or tank, is poor, stock can suffer from health problems such as damage and diseases. A range of tools and test kits are used to test water-quality parameters such as the level of dissolved oxygen, pH, alkalinity, water hardness, and ammonia levels and so on.

**Table 1.1. materials, tools and equipments of water quality testing**

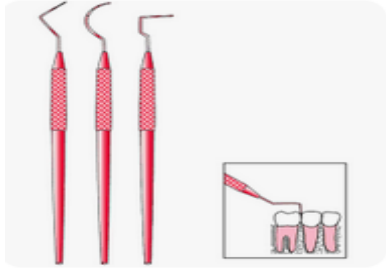



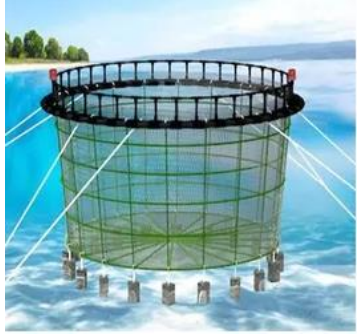
No.	Types of equipments	Description	Figure
1	Dissolved oxegen meter (Oxymeter)	Is used to measure the level of dissolved oxygen in water. It consists of a probe and a meter. The probe is lowered into water and gently moved from side to side, then a reading is taken from the meter.	


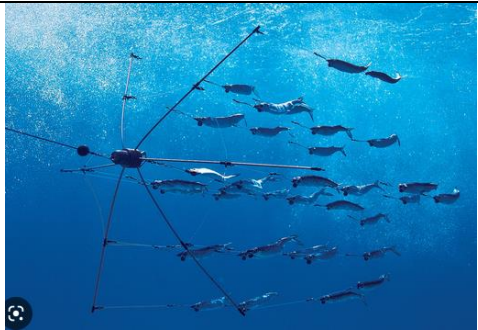
2	Thermometer	Is used to record the temperature of water. To use it, lower the thermometer into the water and wait a minute or two.	
3	Salinity meter	Is used to measure the salinity of water. A salinity meter has a probe that detects the salinity of a water sample, and a meter that displays the salinity of the water in parts per thousand.	
4	PHmeter	Is used to measure the pH in water. It consists of a probe and a meter. The probe is lowered into the water sample and the pH of the sample will be displayed on the meter.	
5	Amonia test kit	Is used to measure the level of ammonia in a water sample. It comes with two separate reagents that are added to the water sample.	
6	Secchi disk	Is a painted disk attached to a length of cord. It is used to measure the turbidity of water. The cord is often graduated so that the depth the disk has sunk to can be measured.	

7	Micropipettes	It is a common yet essential laboratory instrument used to accurately and precisely transfer volumes of liquid in the microliter range. Micropipettes are available in single-channel and multi-channel variants.	
8	Microscope	Microscopes are used to examine scrapes from the fish skin – the vet will look at the mucus and see if any harmful parasites are present, and then be able to treat the fish accordingly.	
9	Refractometer	It provides accurate salinity readings for Marine and Brackish Aquariums. It is equipped with Automatic Temperature Compensation (ATS) system.	
10	Spectrophotometer	It provide an objective basis for the determination of fish freshness.	

11	Chlorinometer	The HI97734 meter measures free and total chlorine (Cl <sub>2</sub> ) in water samples from 0.00 to 10.00 mg/L (ppm).	
12	Soil analysis kits	A soil test is a chemical analysis that estimates a soil's ability to supply nutrients. Results from a soil test allow you to monitor soil chemical conditions.	
13	Nitrate kit	Is used to measure the amount of nitrite in a water sample. The test kit often comes with two reagents and a sampling container.	
14	Test tube	A test tube is a clear glass or plastic container that is much longer than it is wide, commonly has a U-shaped bottom, and has an open top.	




15	Probe	A blunt-ended surgical instrument used for exploring a wound or part of the body.	
16	Sample kit	This kit contains the necessary supply for the collection and transport of biomedical samples (Blood, CSF, stool, urine, skin and respiratory samples).	
17	Water Sample bottle	Bottles are suitable for incubating diluted samples of sewage, sewage effluents, polluted waters, and industrial wastes to determine the amount of oxygen	
18	Plankton nets	A plankton net is equipment used for collecting samples of plankton in standing bodies of water. It consists of a towing line and nylon mesh net	
19	Cages	A cage or net pen is a system that confines the fish or shellfish in a mesh enclosure. By strict definition, a cage and a net pen differ based on their construction.	


20	Scoop nets	A hand net, also called a scoop net, is a fishing net or meshed basket held open on a rigid hoop, which may or may not be mounted to the end of a handle.	
21	Dredge	A fishing dredge, also known as a scallop dredge or oyster dredge, is a kind of dredge which is towed along the bottom of the sea by a fishing boat in order .	

### 1.1.2. Water treatment equipment

Water treatment involves changing the existing conditions of a body of water, such as that found in a pond, tank or dam. Water can be treated by being aerated, or by adding lime or fertilizer to it.


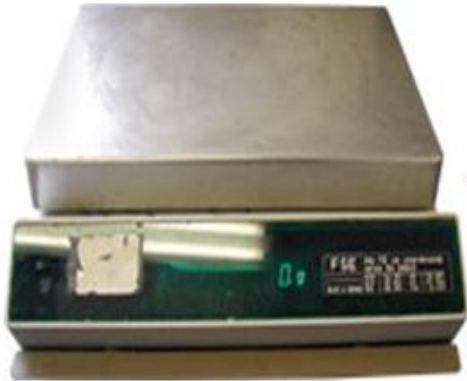
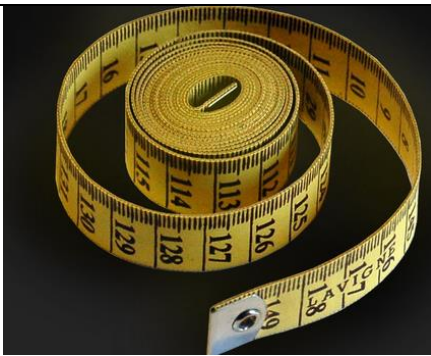
**Table 1.2. Materials tools and equipment for water treatments**

No.	Types of Equipments	Discription	Figure
1	Oxygen cylinder	Is used to maintain correct levels of oxygen in water. An oxygen cylinder consists of three main parts: Oxygen cylinders are usually painted black, with a white top. This distinguishes them from other types of gas cylinders.	

2	Water pump	centrifugal pump uses a rotating impeller that draws water into the centre of the pump and then throws it out the discharge pipe (other end of the pump). Centrifugal pumps are simple to construct, and easy to use and maintain. These pumps can handle most fluids and suit most pumping needs.	
3	Air blower /Oxygenator/ /Aerator /	An air blower is an aerator that provides pressurized air to water. It is the most common form of diffuser aeration used in aquaculture hatcheries. Hoses and pipes can be tapped into the main pipe to aerate tanks, ponds or raceways any where within the system.	
4	Paddle wheel	paddlewheel aerator is a surface aerator. It is best used to aerate a pond. This aerator consists of a motor, gearbox, paddles and a floating apparatus. Aeration occurs by splashing when the paddles lift water out of the pond.	

### 1.1.3. Measuring equipment




**Table: 1.3. materials ,tools and equipimnts used for masuring water quality**

No.	Types of equipments	Dscription	Figure
1	Mesuring board	A fish measuring board consists of a board on which a scale is marked in centimeters (cm) and millimetres (mm). It is used to measure the length of fish or crayfish.	
2	Sensetive electrical balance	Is measuring equipment used to weigh fish or feed. They are usually electronic and have a keypad, a digital display and a flat metal surface to hold the fish being weighed.	
3	Masuring tape	A measuring tape is a tape with increments or graduations used for measuring the length of various items.	





## 1.2. Personal protective equipment



The use of appropriate personal protective equipments as of the regulations and rules in the requirements. Using appropriate Personal Protective Equipment is important to reduce the possible hazard at work operation. Personal Protective Equipment (PPE) The equipment designed to protect handlers from injury. This equipment should be selected based on the procedures to be accomplished, referring to manuals or supervisors if in doubt of its appropriateness.

**Table 1.4. Personal protective equipments**

No.	Types of PPE	Discription	Figure
1	Respirators	A champion amongst contenders for industrial-level respiratory protection, the PD-101 is the premier choice for complete defense against environmental hazards.	
2	Sun glass /Goggle	Goggles, or safety glasses, are forms of protective eyewear that usually enclose or protect the area surrounding the eye in order to prevent particulates, Protect eye from dust, chaff, and chemicals.	
3	Sun hat /Sun protection/	Sun-protective clothing is one of the easiest and most important tools we can use to protect our skin from the harmful rays of the sun and allow us to enjoy the outdoors safely,"	

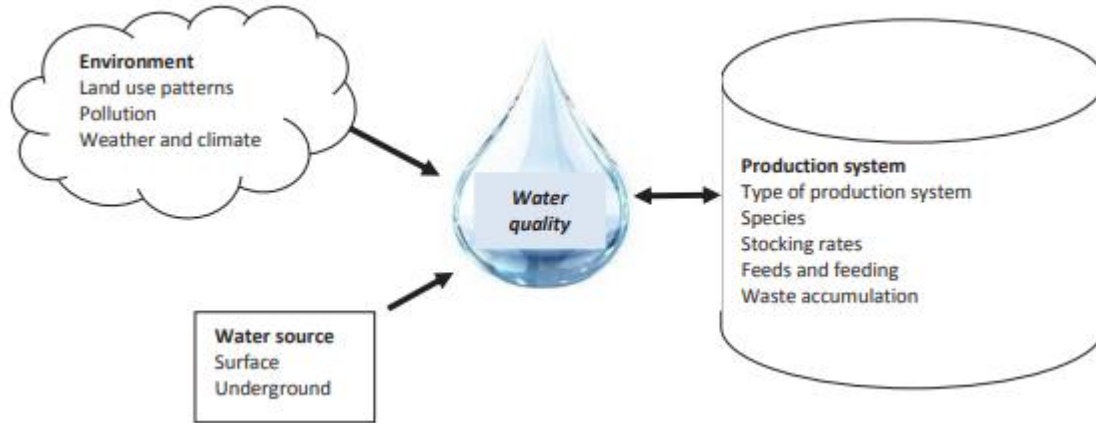


4	Rubber glove	Is used to protect from caustic or toxic substances, leather or canvas to protect from abrasion, disposable plastic to maintain bio-security]; used around sick fish	
5	Safety gown	gown is made of high-quality spunbonded material that offers comfortable and reliable protection. An essential addition to your medical supplies, personal protective equipment & safety gear.	
6	Life saver jacket	Life Jacket is a a personal flotation device also referred to as a PFD, life preserver, life belt, Mae West, life vest, life saver, cork jacket, buoyancy aid or flotation suit is a piece of equipment designed to assist a wearer to keep afloat in water. The wearer may be either conscious or unconscious.	
7	Over all	safety vests and suits and should be used for tasks that can cause body injuries from extreme temperatures, flames and sparks, toxic chemicals, insect bites and radiation.	

8	Safety boot	Is heavy leather or rubber for protection and disposable plastic for bio-security	
9	Wader	Fly fishing waders are one of the most intimidating purchases an angler can make. They're a critical safety element when fishing in lower temperatures and can make or break a day on the water. Even at the low end, they're an expensive accessory in a sport defined by expensive accessories.	

### 1.3. Physical and chemical nature of pure water

Water quality determines not only how well fish will grow in an aquaculture operation, but whether or not they survive. Fish influence water quality through processes like nitrogen metabolism and respiration. Knowledge of testing procedures and interpretation of results are important to the fish farmer. Some water quality factors are more likely to be involved with fish losses such as dissolved oxygen, temperature, and ammonia. Others, such as pH, alkalinity, hardness and clarity affect fish, but usually are not directly toxic. Each water quality factor interacts with and influences other parameters, sometimes in complex ways. What may be toxic and cause mortalities in one situation, can be harmless in another. The importance of each factor, the determination method and frequency of monitoring depends upon the type and rearing intensity of the production system used.



**Figurer : 1.1. Factors that influence water quality**

### **1.3.1. Physical nature of water quality**

Successful pond culture operations mainly depend on maintenance of a healthy aquatic environment and production of sufficient fish food organisms in ponds. Physical, chemical and biological factors play an important role in governing the production of fish food organisms and fish production in the pond. It helps in the survival and growth of the fish. Hence, fish farmers should take a lot of care to maintain hygienic conditions in the pond, so that they get more profits.

If the water quality is maintained with utmost care, the farmers need not spend much money for treatment of the diseases. If the water quality is maintained, the fishes also have a good taste. Water quality is influenced by physical, chemical and biological factors of the water.

#### **1.3.1.1. Physical factors**

##### **a. water depth**

Depth determines the temperature, circulation pattern of water and the extent of photosynthetic activity. In shallow ponds, sunlight penetrates up to the pond bottom and facilitates an increase in the productivity. A depth of 1-2 metres is considered optimal for biological productivity of a pond. If the depth is very less, water gets overheated and thus has an adverse effect on the survival of the fish.



In arid and semi-arid areas, water depth should be more than 2 metres. The excess water from pond can be removed through pumping or through the use of outlet in the embankment. If the water depth is reduced then from a nearby source it should be filling up.

#### **b. Water temperature**

- Temperature affects fish migration, reproduction and distribution.
- Fish pose well defined limits of temperature tolerance with the optimal being 20-32°C.
- Wide fluctuations of water temperatures affect the survival of fish.
- In very low or very high temperatures, the fishes are strained and spend more energy; ultimately growth of the fish is affected.
- If the water temperature changes to a remarkable level then supplying feed and fertilizer to the pond should immediately be stopped.
- Replenishment of water from a nearby source, harvesting the table size fish, is some of the corrective measures to be taken for it.

#### **c. Turbidity**

- Water turbidity is mainly due to suspended inorganic substances like clay, silt, phytoplankton, zooplankton and sand grains.
- Ponds with a clay bottom are likely to have high turbidity.
- Turbidity reduces sunlight penetration and photosynthesis and hence acts as a Limiting Factor.
- If the turbidity is due to more suspended particles, they absorb nutrients in their ionic form, making them unavailable for plankton production.
- High turbidity reduces the dissolved oxygen in the pond water.
- Turbidity is measured with the Secchi Disc.
- If the secchi disc disappears at 30-50 cm, the water is productive in nature. If it is not visible at a depth less than 25 cm it indicates the blooming of algae, if it is more than 50 cm, the plankton produced is less in the pond water.
- In less turbid waters, the aquatic weeds growth is more.

- In highly turbid waters, the sand grains accumulate in the gills of the fish and prawns, causing suffocation and excessive secretion of mucous and finally leads to fish death.
- High turbidity can be reduced by adding lime and alum.
- If the water is more turbid, it should be stored in sedimentation tanks and then used for fish culture tank.
- If the turbidity is more due to phytoplankton, water from the pond should be changed
- Fertilizers have no effect in high turbid waters; hence fertilization of the pond should be stopped.

#### **d. Light**

- Availability of light energy to a fish pond greatly influences its productivity and photosynthesis.
- In shallow ponds, light penetrates to the bottom and is responsible for lush growth of aquatic weeds.
- In high turbid waters, the light will not penetrate to the bottom. Due to this, the vegetation at the bottom will decay and produce harmful gasses, which affect the fish and prawn life.

#### **e. Water Colour**

- Water gets its colour due to phytoplankton, zooplankton, sand particles, organic particles and metallic ions in the pond water.
- Water used for fish culture should be clear, either colourless or light green or blue in colour.
- Water colour of golden or yellow brown indicates the abundant diatoms.
- Water becomes greenish in colour when phytoplankton is more, develops a brown colour due to zooplankton and mud colour due to more sand grains.
- Water with black, blackish green, dark brown, red, yellow colours are not good for culture. These colours are due to the presence of more phytoplankton, bad pond bottom and acids in the water.
- The red colour of water is due to the presence of high levels of iron and death of phytoplankton (phytoerythrin released).

### 1.3.2. Chemical nature of water quality

#### a) pH

- Water is slightly alkaline in condition, with the optimal range of 6.5 – 8.
- Less than 5 and more than 10 pH are lethal to fish.
- The pH of pond water undergoes a diurnal change; it is alkaline during the day time and slightly acidic just before day break.
- The fluctuations of pH are similar to dissolved oxygen. pH fluctuations are more in phytoplankton and weed infested waters and water with less hardness.
- The difference in pH from morning to evening should not be more than 0.5. When pH increases, ammonia and nitrites become toxic, when it is reverse H<sub>2</sub>S becomes more toxic.
- pH below 6.5 and above 8.5 is responsible for reduction of growth and resistance of parasitic infection increases in acidic waters.
- Whenever pH falls, lime should be added to the pond water.
- When pH is high, lime and urea should not be used to reduce pH. This is because NH<sub>3</sub> becomes toxic at high pH. It is always better to add new water to maintain an optimal pH. Alum or aluminium sulphate can be used to reduce the PH and turbidity.
- Alum removes phenolphthalein alkalinity; 1 ppm alum reduces 1 ppm phenolphthalein alkalinity.

#### b) Dissolved oxygen:

- Dissolved oxygen is one of the most important chemical parameters, which has a great influence on the survival and growth of fishes and prawns.
- The pond water gets oxygen mainly through interaction of atmospheric air on the surface water of the pond and by photosynthesis.
- It is produced only during day time and reaches a maximum at 3 PM, then gradually decreases up to early morning.
- During night period, it decreases and it reaches a minimum during the early hours of the day. It is due to nil production of dissolved oxygen at night and instead, consumption of oxygen by plankton, weeds, fishes and prawns will be there.

- During overcast days, the production of dissolved oxygen during the day is less and during the subsequent nights it decreases drastically.
- When water temperature rises, oxygen is released into atmosphere. When salinity increases it is dissolved in water.
- The optimum dissolved oxygen is 5-8 ppm. If less than 5 ppm the growth rate of the fish and prawns decreases and are prone to get diseases.
- Less than 1ppm of dissolved oxygen results in death and more than 15 ppm results in gas bubble disease in fishes and prawns.
- Whenever the animals are under stress due to less dissolved oxygen the food consumption temporarily decreases.
- When oxygen decreases, fishes come to the surface and engulf the air.
- Precautionary measures should take at nights, especially during the early hours to increase oxygen levels.
- If it is very less, the water surface should be disturbed by beating water with bamboo poles or by running boats or by using aerators.

#### c) Alkalinity:

- Alkalinity is caused by carbonates and bicarbonates or hydroxides of Ca, Mg, Na, K, NH<sub>4</sub> and Fe.
- Alkalinity is less in acidic soils and in ponds with more organic load.
- Alkalinity is more in clay soil ponds and is increased if water is not exchanged.
- The optimal level of total alkalinity is 40 – 150 ppm.
- Alkalinity has direct effect on the production of plankton.

#### d) Hardness:

- Hardness is caused by Ca and Mg.
- Water with less than 40 ppm is soft and more than 40 ppm is hard.
- The pond water with a hardness of 15 ppm or more is satisfactory for growth of fishes and do not require additional lime.
- If water has less than 11 ppm hardness, it requires liming for higher production.

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- If it is less than 5 ppm, the growth rate is affected and causes eventual death of the fish.

#### e) Carbon Dioxide:

- CO<sub>2</sub> is produced during respiration and consumed during photosynthesis.
- CO<sub>2</sub> is less during daytime and more at nights.
- The optimal level of CO<sub>2</sub> is 5 ppm.
- At high CO<sub>2</sub> levels, pH decreases and water becomes acidic.
- CO<sub>2</sub> is accumulated in the blood of the animals. Then, the animals become sluggish, loss of resistance occurs, they cannot utilize dissolved oxygen and they ultimately die.
- Whenever CO<sub>2</sub> increases lime should be added to the pond.
- 1 ppm of lime reduces 0.9 ppm of CO<sub>2</sub>.

#### f) Dissolved ammonia and its compounds

- NH<sub>3</sub> is found in excreta and is also released due to decomposition of organic matter and also increases with unfed feed due to high protein levels and death of phytoplankton.
- It is an important compound influencing the growth of phytoplankton in the aquatic ecosystem.
- The optimal limit of NH<sub>3</sub> is 0.3-1.3 ppm and less than 0.1 ppm is unproductive.
- Whenever NH<sub>3</sub> increases pH also increases, but dissolved oxygen decreases.
- CO<sub>2</sub> reduces the toxic effect of NH<sub>3</sub>.
- NH<sub>3</sub> accumulates in the blood and oxygen transport in the blood reduces. Gills become black, biochemical tissue is damaged and gaseous exchange is affected.
- NH<sub>3</sub> levels can be reduced with good management like no excess feed, optimal stocking and water exchange.
- Lime should not be added when NH<sub>3</sub> is high.
- Optimal level of nitrites is 3.5 ppm.

#### g) Hydrogen Sulphide:

- H<sub>2</sub>S is produced in anaerobic conditions by the action of micro organisms on sulphur compounds.
- H<sub>2</sub>S is toxic to fish and prawn and is responsible for respiratory problems.
- It should be less than 0.05 ppm in pond water.
- When H<sub>2</sub>S increases, lime should be added.



**Figure 1.2. physical and chemical nature of water**

<https://www.youtube.com/watch?v=dROWrN07VDo> /accessed date 05/04/2023

#### 1.4. Identifying water quality and environmental parameters

The quality of the water used for fish farming activities must meet specific parameters. There are three water quality parameters that help to measure the quality of water, which include physical parameters, chemical parameters, and biological parameters. The physical parameters include color, taste, odor, temperature, turbidity, solids, and electrical conductivity.

On the other hand, chemical parameters can include pH, acidity, alkalinity, chlorine, hardness, dissolved oxygen, and biological oxygen demand. The third type of parameter involves biological parameters, which include bacteria, algae, and viruses. Water quality parameters matter because of the different requirements that applications can have.

For instance, dissolved oxygen is among the most important parameters when measuring a river's water quality. The amount of dissolved oxygen in the water dictates how polluted the water sample is. Low amounts of dissolved oxygen indicate that the water is highly polluted and that organic contaminants are consuming the dissolved oxygen. This article offers a more in-depth explanation on the three types of water quality parameters.

### **1.4.1. Physical water quality parameters**

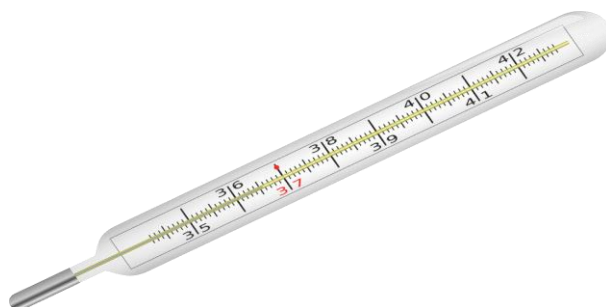
#### **A) Turbidity**

Turbidity refers to how cloudy water is. When you use Turbidity sensors, these devices are designed to measure the ability that light has to pass through water. High levels of turbidity can occur as a result of higher concentrations of silt, clay, and organic materials. The main issue with turbidity in water is that the water will look bad. Several additional problems that are caused by high turbidity include:

- Water treatment costs will be higher
- High levels of particulates can act as a shield for harmful microorganisms, which makes it more difficult to get rid of these contaminants
- Suspended materials may damage fish gills, reduce growth rates, and decrease resistance to diseases
- Various suspended particles can act as adsorption media for mercury, cadmium, lead, and other heavy metals
- Dissolved oxygen concentration will likely decrease

Turbidity starts to become visible in water when sensors provide you with readings of over five NTU. As for muddy water, it can have turbidity readings of more than 100 NTU.

#### **B) Temperature**



**Figure 1.3. Sensetive thermomoetre**



Some of the aspects of water quality that are influenced by the water's temperature include odors, chemical reactions, solubility, palatability, and viscosity. As such, biological oxygen demand, sedimentation, and chlorination all depend on the water's temperature. The ideal water temperatures range from 50-60 degrees Fahrenheit.

<https://www.youtube.com/watch?v=LKfWV45953I> /accessed date 05/04/2023

<https://www.youtube.com/watch?v=837ErTxJRuo> /accessed date 05/04/2023

### **C) Color**

It's possible for the color of the water to be altered by materials that decay from organic matter, the primary of which include vegetation. Such inorganic matter as rocks, soil, and stones may also affect the color of the water. Even though these changes to a water's color may create aesthetic issues with the water, they don't change how the water tastes. You can effectively measure color by comparing a water sample to color glass disks or standard color solutions.

When you're attempting to identify the color of water, it's important to understand the difference between the water's apparent color and its true color. Apparent color is made up of suspended material and dissolved solid colors. The true color of water can be identified after all suspended materials have been filtered out of the water. Keep in mind that color can be graded on a scale that ranges from 0-70 color units. Pure water contains no color units because it is essentially colorless.

### **D) Taste and odor**

It's possible for the taste of water to change and for odors to develop as a result of foreign matter being introduced to the water. This matter can include organic materials, dissolved gases, and inorganic compounds. Most of this matter is derived from agricultural, natural, and domestic sources.

### **E) Solids**

Solids can be in suspension or in solution when they get into the water. If you put a water sample through a glass fiber filter, suspended solids will remain at the top of this filter. On the other hand, any dissolved solids will pass through and remain in the water. When measuring the number of solids in water, it's common for total dissolved solids to be measured. You can identify how much



organic matter is present in the water by measuring for total dissolved solids. The three different water classifications for total dissolved solids include:

- Freshwater – Less than 1,500 mg/L TDS
- Brackish water – 1,500-5,000 mg/L TDS
- Saline water – More than 5,000 mg/L TDS
- Electrical Conductivity

Another core physical parameter that you should be aware of involves electrical conductivity, which measures how well a sample of water or similar solution can carry or conduct electrical currents. Conductivity levels will increase as the amount of ions in the water increases.

This is one of the main parameters when measuring water quality because of how easy it is to detect water contamination levels when measuring the conductivity of water. High conductivity means that the water contains a high amount of contaminants. On the other hand, potable water and ultra-pure water are practically unable to conduct an electrical current. The main units of measurement for electrical conductivity include micromhos/cm and milliSiemens/m, the latter of which is abbreviated into mS/m.

#### 1.4.2. Chemical water quality Parameter

Several parameters help to determine water quality

##### A) PH

When measuring the quality of water, pH is one of the first measurements that you should take. The pH of water is measured with a simple pH sensor or test kit, which will tell you how acidic or basic the water is. Acidic water will invariably be comprised of more hydrogen ions. On the other hand, basic water contains more hydroxyl ions.

It's possible for pH levels to range from 0-14. If you receive a reading of 7.0, this means that the water is neutral. Any readings below 7.0 are acidic, while any readings above 7.0 are alkaline. Pure water has a neutral pH. However, rainfall is somewhat more acidic and typically has a 5.6 pH. Water is considered to be safe to drink if it has a pH of 6.5-8.5. The many effects that changing pH levels can have on plants and animals include:

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- The majority of aquatic plants and animals are able to live in water with a specific pH, which means that slight changes could worsen quality of life
- Slightly acidic water can irritate fish gills, damage membranes, and reduce the number of hatched fish eggs
- Water with extremely high or extremely low pH is fatal to aquatic plants and animals
- Low pH can kill amphibians because their skin is sensitive to contaminants

#### **B) Nitrite (NO<sub>2</sub>)**

- It is a very unstable intermediate formed during conversion of NH<sub>2</sub> into nitrate.
- In aerobic condition nitrite is oxidized into nitrate whereas in anaerobic condition, nitrite is reduced to ammonia.
- If the concentration of nitrite is greater in drinking water, it brings serious health hazards to the consumers.
- Disease caused by high concentration of nitrite in infants is called Blue baby syndrome, which is characterized by blue coloration of skin
- Level of nitrite in drinking water should not exceed 3mg/ltr.

#### **C) Nitrate (NO<sub>3</sub>)**

- It is the most stable oxidized form of nitrogen. In water nitrate comes from organic matter decomposition and from atmospheric nitrogen fixation.
- Like nitrite Nitrate should not exceed 3mg/ltr in drinking water. It is because nitrate can be reduced into nitrite in the gut of infants and causes nitrite poisoning.
- Nitrate is very important in natural water systems like lakes and ponds because high concentration of nitrate facilitates heavy growth of aquatic plants causing eutrophication.

#### **D) Phosphate:**

- In water phosphate is present in the form of H<sub>2</sub>PO<sub>4</sub><sup>-</sup>, polyphosphate and as organic phosphate.
- Phosphate in water sources comes from agricultural wastes, sewage and from industrial effluent.

- Phosphate is not toxic to human beings but it is an important chemical in natural water systems like ponds because its high concentration facilitates eutrophication.

### **E) Acidity**

This refers to the measure of how much acids are in a specific solution. The water's acidity is the quantitative capacity that it has to neutralize a base at a certain pH level. Acidity is commonly caused by the presence of mineral acids, hydrolyzed salts, and carbon dioxide. When acids are introduced to water, they can influence many different processes, which include everything from biological activities and chemical reactions to corrosion. The acidity of water is measured with a pH sensor.

### **F) Alkalinity**

Alkalinity indicates the water's acid-neutralizing capacity. Likely the most common reason to measure the alkalinity of a sample of water is to identify how much soda and lime must be added to the water for water softening purposes. The water softening process is particularly beneficial for mitigating corrosion in boilers.

In the event that water is alkaline, this means that it has a pH that's at least higher than 7.0. The presence of bicarbonate ions, carbonate ions, and hydroxide ions increases the alkalinity of water. If you find that your water samples have high alkalinity or acidity, this indicates that the water is contaminated in some way.

### **G) Ammonia:**

The decomposition of organic matter like protein, amino acid increases the concentration of Ammonia in water. Besides, it also increases with the use of chloramine in the water disinfection process. Concentration of  $\text{NH}_3$  in ground water systems is usually 3mg/ltr. If its concentration is greater than 50mg/ltr, it gives characteristic taste and odor.

## H) Chlorine

While chlorine doesn't occur naturally in water, it's commonly added to wastewater for disinfection purposes. Even though base chlorine is a toxic gas, the aqueous solution is completely harmless to humans. If a small amount of chlorine is found in water, this indicates that the water is clean and essentially free from contaminants. You can measure chlorine residual with a spectrophotometer or color comparator test kit.

## I) Hardness:

- Hardness of water is merely due to salt of calcium and magnesium.
- Temporary hardness is due to carbonate and bicarbonate of calcium and magnesium while permanent hardness is due to chloride and sulfate of calcium and magnesium.
- Water is classified as 9 on the basis of concentration of calcium carbonate)
  - ✓ Soft water: <50mg/ltr
  - ✓ Moderately hard water: 50-150 mg/ltr
  - ✓ Hard water: 150-300 mg/ltr
  - ✓ Very hard water: >300 mg/dl
- Hard water is not suitable for industrial use. But hard water is usually beneficial for drinking purposes. However, hardness caused by  $MgSO_4$  gives some serious health effects. So, the concentration of  $Mg^{++}$  should not exceed 50 mg/ltr in drinking water.

## J) Dissolved oxygen

This is a critical water quality parameter that can help you determine how polluted rivers, lakes, and streams are. When water has a high concentration of dissolved oxygen, you can be confident that the water quality is high. Dissolved oxygen occurs because of the solubility of oxygen. The amount of DO that you can find in water depends on numerous factors, the primary of which include the water's salinity, pressure, and temperature. It's possible to measure dissolved oxygen levels with a colorimeter or with the electrometric method.

## K) Biological oxygen demand (BOD)

- Biological oxygen demand represents the amount of oxygen required by living organisms (microorganisms) for oxidation of biodegradable organic matter present in water under aerobic conditions.
- BOD is a direct measurement of quantity of oxygen needed for biodegradation of organic matter and indirect measurement of quantity of biodegradable organic matter in water.
- When biodegradable organic matter is added in water. Microorganism utilizes dissolved oxygen to oxidize organic matter. If the rate of consumption of oxygen during biodegradation is greater than solubilization of atmospheric Oxygen into water, level of dissolved oxygen gradually decreases.
- If organic matter content is very high, complete loss of dissolved oxygen occurs. This creates anaerobic environment in water. In this case aerobic aquatic organisms cannot survive.
- Furthermore, if dissolved oxygen is absent then organic matter starts to decompose anaerobically that creates taste and odor problems.
- High value of BOD is an indicator of water pollution.

### 1.4.3. Biological parameters of water

#### a) Bacteria

Bacteria are single-celled plants that can ingest food and reproduce at rapid rates if the water's pH, food supply, and temperature are ideal. Because bacteria can grow rapidly, it's almost impossible to count the number of bacteria in a sample of water. In most cases, bacteria will reproduce at a slow rate in colder water. There are many harmful waterborne diseases that can be caused by high amounts of bacteria in water, which include cholera, tularemia, and typhoid.

#### b) Algae

Algae are tiny, microscopic plants that consist of photosynthetic pigments. These plants are able to support themselves by effectively converting inorganic matter into organic matter, which is done with energy from the sun. While this process is ongoing, the algae consume carbon dioxide and release oxygen.

Algae are also essential in wastewater treatment processes that use stabilization ponds. The main issues caused by algae include strange odors and poor taste problems. Keep in mind that some species of algae can pose serious public health risks. For instance, it's possible for blue-green algae to kill cattle.



Figure 1.4. Algae in water

### c) Viruses

Viruses are tiny biological structures that can be harmful to a person's health. Only strong electronic microscopes are able to view viruses. All viruses require parasites to live. Because of how small viruses are, they are able to pass through the majority of filters. Certain waterborne viruses can cause hepatitis and similar health problems. Despite the difficulty in treating viruses, most water treatment facilities should be able to eliminate viruses during the disinfection process.

Understanding the three primary types of water quality parameters may prove useful when you want to treat water and remove the many contaminants that can be found in water. Whether your water has high turbidity, a low pH, or ample bacteria, there are an array of solutions that you can use to eradicate these issues for good.

<https://www.youtube.com/watch?v=94YcjbYBhc> 05/04/2023

### 1.5. Water quality maintaining techniques and schedules

The more important physical and chemical qualities of water influencing aquatic productivity are temperature, transparency, pH, dissolved oxygen, free carbon dioxide, and total alkalinity and dissolved nutrients like nitrogen, phosphorus, potassium, calcium, magnesium.

Maintaining water quality in a pond is not rocket science. You just need to follow the following tips to successfully maintain the water quality.

- A. Examine oxygen levels to avoid algae blooms
- B. Avoid overfeeding your fish to prevent waste accumulation
- C. Add a proper and healthy balance of aquatic plants
- D. Choose the right size of pond pump
- E. Keep your pond cool during summer
- F. Clean the debris before it starts to decay

#### 1.5.1. Quality of water Source

**Table 1.5. Water quality maintaining techniques from different source of water**

Water quality parameter	Under ground water		Surface water	
	Common Issue	Recomondation	Common Issue	Recomondation
Dissolvd oxygen	Low	Expose to air Oxygenation or aeration	Water drawn from wetlands usually low dissolved oxygen	Expose to air Oxygenation or aeration
Tempreture	Low	Satand in open reservoir, heat water		
Alkalinity/ Hardness	Generally medium to high	Verfy level	May be soft water	Add agricultural lime
PH	Often acidic	Expose to air	Swampy	Expose to air

		Oxygenation or aeration	water often acidic	Add agricultural lime
Amonia			Run of from animal establishment	Siting of farm channel
Turbidity			Run of from Eutrophic water	Prevent erosion bypass water channel, treatment for algae
Dissolved Gases	High	Degas water by exposure to air/ aeration		
Organic mater			Swampy area trash water	Screen major inlet, settlement pond prior to entry, clean inlet chanel
Wild fish			Various aquatic animals and plants	Screen and keep inlet chanel clener
Pollution	Rare	Site selection, check water profile at source	May occure	Site selection
Toxic metal	May occure	Avoid such site	May ocure	Avoid such site, if due to environmental accident, put inplace mitigation mesure



### 1.5.2. Maintain water temperature

Under favorable conditions, the optimum temperature range for many 'coldwater' and 'warm water' fishes is 14-18°C and 24-30°C, respectively. Metabolic activity is nearly doubled for every 10°C rise in temperature and hence fish growth is greatly dependent on water temperature. With the increase in temperature microbial activity is also increased and hence the release of nutrients by the decomposition of organic matter at the pond bottom is more with consequent increase in nutrient status of water. It is difficult to adjust water temperature in large water bodies. Operation of aerators during calm and warm afternoons helps to break thermal stratification of ponds by mixing warm surface water with cool subsurface water.

But if the water is controlled and under pond, changing former water by fresh one is one of best method to balance water temperature for fish pond.

### 1.5.3. Maintain water turbidity

Turbidity is the result of several factors including suspended soil particles, planktonic organisms and humic substances produced through decomposition of organic matter. Turbidity is measured by Secchi disk visibility. Optimum Secchi disk visibility of fishponds is considered to be 40-60 cm. If you do not have a Secchi disc, you can use your arm instead. Stick your arm vertically underwater. As long as your hand is not visible when your elbow is at the water surface, there is no need for fertilization. Turbidity resulting from plankton is generally desirable. However, heavy blooms limit heat and light penetration thus reducing the effective volume of the productive zone. Turbidity due to suspended soil particles can be controlled by lime/alum application of 25-50 kg/ha and other ways also. Such as exchanging water.

### 1.6. Table shows maintain water turbidity

Secchi disk transparency	Management/control
Less than 25 cm	Avoid fertilization: dissolved oxygen is likely to be less. Increase water inflow, likely lime application if necessary.
25-40 cm	Fertilization should not be frequent. Minimize quantity.
40-60 cm	Routine fertilization necessary.

More than 60 cm	If pond bottom muck is too high, removal/ bottom drying is better. If it is not possible then inorganic fertilization dose may be increased with higher frequency.
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#### 1.5.4. Maintain water PH level

The pH of pond water indirectly throws light on the availability of different nutrients. pH 7.5-8.5 is desirable for optimum production of fish. The decrease of water pH due to application of heavy dose of organic manure and feeding can be corrected by the application of lime at 50-200 kg/ha/week in presence of fish till desired pH obtained. Total amount of lime application in a month should not exceed 600 kg/ha. Generally PH of water can be corrected by adding appropriate lime in to fish pond.

**Table 1.7. Effect of pH on fish is generalized below:**

PH	Effect
4	Accid death point
4-6	Slow growth
6-9	Best for growth
9-11	Slow growth, lethal to fish over long period of time
11	Alkaline death point

#### 1.5.5. Maintaine water alkalinity and carbon dioxide (CO<sub>2</sub>)

Total alkalinity is a measure of carbonate, bicarbonate and hydroxyl concentration in water and expressed as CaCO<sub>3</sub> mg/l equivalent. Most suitable range for fish farming is 80- 200 mg/l.. Alkalinity can be improved or raised by the application of lime of any form. Total alkalinity decreases with intensive organic manuring and feeding, which can be improved by liming the pond with 50-200 kg/ha/week maximum for 3 doses in a month till the level of desirable alkalinity achievement, considering the pH of water.

Alkalinity is an index of potential carbon dioxide. Low alkalinity indicates that CO<sub>2</sub> is not available particularly in latter phases of the day. As a result photosynthesis stops due lack of CO<sub>2</sub>. So fishes will not get their food in the afternoon.

### 1.5.6. Maintain water dissolved oxygen

Fish cultured pond exhibit a wide fluctuation in the oxygen content from day to night. Dissolved oxygen is ranged from 2.0-12.0 mg/l throughout the day and night but for fish culture pond water the lower value should not fall below 3.5 mg/l sample. In case oxygen falls below the lower range, pond water may be aerated by a suitable aerator, or bottom pond water suctioned and sprinkled over surface water by diesel pump set. Little liming at 50kg/ha, a sprinkling of 10kg single S.S.P/ha can save from fish surfacing or mortality to some extent.

Generally dissolved oxygen in water managed by:

- Controlling of oxygen consumption rate in the production unit
- Aeration
- Oxygenation and Biological treatment

### 1.5.7. Maintain water dissolved Nitrogen

Among the various dissolved nutrients in water, nitrogen and phosphorus are the two nutrients and having major importance. Nitrogen and phosphorus in ponds are generally far below the concentration for the optimal growth of plankton. A concentration of 0.2-0.5 mg/L of dissolved nitrogen is considered optimal for productive ponds while below 0.1 mg/L indicative of poor productivity.

Under normal condition ponds seldom contain such high level of ammonia nitrogen. But high ammonia concentration is most common in ponds with very high feeding rates, high organic matter content and also in sewage-fed ponds. The only feasible mean of reducing ammonia concentration is water exchange. Nitrite nitrogen is an intermediate compound in the oxidation of ammonia to nitrate.

### 1.5.8. Maintaining dissolved Phosphorus

Phosphorus is the most important single element responsible for aquatic productivity. In natural freshwater ponds.

Dissolved phosphorus below 0.05 mg/L may be considered insufficient while 0.05-0.20 mg/L and above 0.20 mg/L may be indicative of medium to high and highly productive fish ponds. While N/P<sub>2</sub>O<sub>5</sub> ratio above 2.6 is strictly indicative of poor production 2.6-1.3 is not strictly optimal.

### 1.5.9. Principles of nutrient management in composite fish culture

Pond productivity depends on soil conditions such as soil pH, available nutrient status (nitrogen, phosphorus and potassium) and organic carbon and based on that fish prawn cultured ponds are classified into low, medium and high productivity.

**Table 1.8. The details about liming and fertilizer management in fish ponds .**

Parametre	Pond catagory		
	low	Medium	High
Available Nitrogen (mg/100 gm soil)	<25	25-50	>50
Available phosphorus (mg/100gm soil)	<3	3-6	>6
Organic carbon (%)	<0.5	0.5-1.5	>1.5
PH	<5.5	5.5-6.5	>6.5-7.5

### 1.5.10. Maintaining level of ammonia

Ammonia is the by product of protein metabolism by fish and bacterial decomposition of organic mater. level of ammonia managed by the followin ways:

- Limiting feeding rate
- Controlling water PH to prevent it from raising above 8
- Fertilization regime
- Increase water exchange through production unit

### 1.5.11. Liming

Liming is the first step of management of fish pond. Liming materials are not fertilizers, but they will improve the response to fertilization or manuring in acidic ponds. Lime corrects the pH, establishes a good buffering system, rapid decomposition of organic matter and reduces toxic effects of harmful compounds including disinfecting the environment to prevent fish disease, flocculate suspended soil particles.

<https://www.youtube.com/watch?v=fxjDJuwmUbQ> /accessed date 05/04/2023

### A) Lime Requirments

The most common index of lime requirements of a soil is its pH. But it determines only the active acidity or the hydrolysable H<sup>+</sup> ion concentration. But since the reserve or potential acidity of a soil depends upon its cation exchange capacity and buffering this factor also deserves consideration. The common and easy method is to follow a ready reckoner for determining the quantity of lime of a pond. According to the soil pH, lime is usually applied in ponds.

**Table 1.9. Rate of lime application in fish ponds**

Soil of PH	Soil condtion	Does of lime kg/ha		
		Sand soil	Medium	Clay soil
4.5-5.0	Highly acidic	1000	2000	3000
5.0-6.0	Moderately acidic	600	1200	1800
6.0-6.5	Slightly acid	500	1000	1500
6.5-7.5	Near Neutral	200	400	600

- liming is advised for better utilization of fertilizers and prophylactic measures.
- To determine whether a pond needs to be limed, the levels of total alkalinity in the pond water may be checked.
- When the total alkalinity of the water sample is less than 40 mg/L, the pond derives greater benefit from liming
- Pond water is also checked for total alkalinity and hardness with water quality test kits and thereafter adjusted to reach a total hardness and alkalinity of desired range and from this value the lime requirement of a pond can be calculated.

### B) Frequency of liming

Bulk quantity of about 30% of the total lime requirement of a drainable pond with sandy soils may be applied as first dose before filling water while the balance quantity may be applied in split doses at shorter intervals to achieve higher response of liming. On the other hand, ponds having heavy soils, application of about 50% of the total lime requirement of the pond may be beneficial before filling water and thereafter at split doses of longer intervals.

In case of non-drainable ponds with sandy soils, bulk application of 20% of the total lime requirement may be done before stocking seed and the balance in split doses at short intervals while for heavy soils, about 40% of the total lime requirement of the pond may be useful before stocking seed and thereafter in split wide intervals.

### **C. Method of application of liming materials:**

- The best and easiest time to lime a pond is before it is filled with water and should be distributed as evenly as possible over the entire surface.
- Newly constructed ponds should be limed prior to filling with water.
- During culture process, lime can be applied evenly over the entire surface of pond water by loading on a boat and then dissolved, separated uniformly into the pond.
- It is better to lime the pond before water filling for drainable ponds. But for non-drainable ponds phase-wise application is beneficial.
- To get better response of liming during rainy season, about 25% of the calculated dose, should be applied on the inner sides of the bund.
- To be most effective against diseases, powdered quick lime (calcium oxide) or after its hydrolysis (calcium hydroxide) may be used in ponds as both preventive as well as curative measures.

### **D) Timing of application:**

- The best time to lime a pond is before water filling for drainable ponds. But for non-drainable ponds phase-wise application is beneficial.
- Limestone can be added anytime during the production cycle.
- It is better to apply lime during approach of winter in order to provide effective sanitation in ponds.
- Limestone takes several weeks to complete its impact on the water quality, so application should be at least one month prior to stocking and fertilization in the pond.

### 1.5.12. Fertilization fish pond

Fish ponds are usually fertilized with animal manure at least ten to 15 days before stocking with fish. In drained ponds, the manure is applied to the pond floor just before refilling with water and mixed by ploughing or other ways. After the first application, the pond should be fertilized at regular intervals throughout the fish production cycle.

#### a) Types of fertilizer

Commonly available fertilizer for fish pond production are

1. Organic fertilizer/ animal manure and grasses
2. chemical fertilizer - phosphorous source and nitrogen source (urea and DAP)

**Table: 1.10. Comparison between organic and chemical fertilizers**

Organic fertilizers	Chemical fertilizer
Contain trace mineral and vitamins	Contain only what the label says plus filler
Use oxygen to decompose	Does not use oxygen when dissolving
Is highly variable in composition depending on feeds given and bedding used	Varies little in composition from what is indicated on the label
Can help reduce turbidity due to clay silt in the pond	Does not reduce turbidity
Can help reduce seepage in pond	Does not act on seepage
Some ingredients can be directly consumed by fish. Animal manure may contain unwanted substance such as antibiotics	It is not directly consumed by the fish

#### b) Controlling the amount of animal manure

The amount of animal manure to be applied to a particular pond varies greatly, depending on factors such as climate, water and soil quality, characteristics of the manure and kind of cultural system

(type of fish, rearing density, length of rearing period). As for inorganic fertilizers, it is impossible to recommend any treatment valid under all circumstances.

One should monitor your pond carefully during fertilization to avoid fish losses. This is The behaviour of the fish remains normal.

- The water quality remains acceptable
- Especially important if you are using animal manure.

**Table: 1.11. amount of animal manure to fish pond water**

Name of Animal manure	Application of manure (kg)/100m2
Poultry droppings	4.5
Ship or Goat dung	3
Pig dung	6
Cattle or Horse dung	5

### 5.1.13. Pond water quality maintenance schedule

While maintaining healthy water quality is important for all ponds, it becomes especially critical if the pond contains koi. To keep them healthy, they need plenty of room to swim around and oxygen-rich water. If their surroundings do not accommodate this, they could contract ulcers or become ill. If you have a koi pond, you should consider adhering to a pond maintenance schedule, or hiring a professional pond contractor. Once all the pond ecosystem parts are in place, what kind of maintenance is required? Here's a schedule to keep you on track.

1. **Check the skimmer basket.** You should do this every two or three days. After a storm or a windy day, this may need to be daily. – Time: 1-2 minutes in fall, we highly recommend using a net to prevent tons of leaves from getting in the water. Your pond netting can look surprisingly unobtrusive and save hours of work.
2. **Add bacteria.** This is as simple as dumping a little powder into the water. – Time: 1 minute every week or 5 minutes every two months to change the dose packet
3. **Feed the fish.** This isn't a chore – it's a highlight of the day. But if you're out of town for a few days, don't worry. The fish will be fine eating debris in the pond. Time: 2 minutes



4. **Check the water level.** With a pond, there will always be a small amount of water loss through evaporation and splash. You just need to keep an eye on it. Every pond is different, but monitor the water level maybe once a week. Again, this isn't really a chore – you just have to hang out by your pond. – Time: 5-10 minutes
5. **Trim plants.** You generally don't need to worry about this until the plants are mature. It also depends on the number of plants you have. – Time: 15 minutes a month
6. **Spring clean.** We highly encourage a cleaning and checkup to make sure your pond is working efficiently. It starts the new growing season off right and makes sure your pond looks great. This is a messy and time-consuming job that works best with proper equipment. If you're an enthusiastic DIYer, you can clean a pond yourself - here's how. But you might consider hiring a professional to save the trouble. – Time: 2 minutes for a quick phone call or up to a full day if doing it yourself (time will vary depending on the size of your pond)

## 1.6. Collect data or record sheets

Before we define what is data collection, it's essential to ask the question, what is data? The data is various kinds of information formatted in a particular way. Therefore, data collection is the process of gathering, measuring, and analyzing accurate data from a variety of relevant sources to find answers to research problems, answer questions, evaluate outcomes, and forecast trends and probabilities to evaluate possible outcomes is Known as Data Collection.

**Record** sheet means a sheet designed to accept and retain recorded data, to be placed in an analogue tachograph, and on which the marking devices of the analogue tachograph continuously inscribe the information to be recorded;

### 1.6.1. Recording data on pond water quality

Proper management consist of monitoring the fish pond regularly, keeping good records and planning a head for the operation of the farm. On the basis you can for example decide when to fertilize the pond, quality of water and you can plan the stocking , transfer and harvesting of the fish. Above all you can be well informed on how much you spend for or gain from fish farming. A simple record which can be completed separately for each pond is proposed, It makes it possible to keep track of the following:

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- Date and hour in which the water quality is checked; check the water, particularly in nursery ponds in the early morning and, if necessary, at sundown at intervals of seven to 15 days;
- water temperature
- Secchi disc transparency (SD in cm)
- dissolved oxygen content (DO in mg/l;)
- pH
- total alkalinity TA in mg/l  $\text{CaCO}_3$ , )
- plankton general observations on phytoplankton and/or measurement of zooplankton density
- under Remarks (column 9) note any additional information useful to judge water quality status such as water colour, weather, evolution of dissolved oxygen content, management measure taken, etc.

You may need several such forms to record the water quality parameters in a pond during one production cycle only. As for the previous records, use a small pocket notebook to note various data on the spot. Transfer these on to the record form later to maintain good records.

**Table: 1.12. sample of recording sheet for fish ponds water quality**

POND NO. 8		TYPE OF PRODUCTION: tilapia fingerlings					PERIOD FROM: 4/5 to 30/6/89	
Date	Hour	t°C	SD (cm)	DO (mg/l)	pH	TA (mg/l)	Plankton	Remarks
1	2	3	4	5	6	7	8	9
8/5	0645	24.2	46	—	—	—	phyto well developed	water greenish; clear weather
19/5	0630	22.8	73	—	—	43	poor phyto; zoo-0.9 ml/100 l	weather cloudy; some frog eggs; fertilize
26/5	0710	23.7	52	6.1	—	—	phyto developing again	overcast after rainy night; some filam. algae
—	1815	27.3	—	7.7	—	—	—	overcast day but no rain
5/6	0600	25.1	28	4.9	—	—	very rich phytoplankton	green water; warm, clear weather
—	1900	29.4	—	6.7	—	—	—	DO level falling
7/6	0610	25.8	27	4.4	—	—	very rich phytoplankton	DO deficient; cloudy; add fresh water
—	1840	30.2	—	6.1	6.8	—	—	add fresh water for night
8/6	0600	26.0	—	4.9	—	—	—	clear weather; check behaviour fish OK

Table: 1.13. Sample of recording sheet

**Aquarium Water Quality / Tank Cycling Tracker - use with API FRESHWATER M**

#	pH	Ammonia (NH <sub>3</sub> /NH <sub>4</sub> <sup>+</sup> )	Nitrite (NO <sub>2</sub> <sup>-</sup> )	Nitrate (NO <sub>3</sub> <sup>-</sup> )	
	7.6	0.25 ppm	0 ppm	0 ppm	<b>TESTING INSTRUCTIONS - when</b>
	7.0	0.50 ppm	0.25 ppm	20 ppm	<b>pH (6.0 - 7.6) - add 3 drops and inve</b>
	7.2	1.0 ppm	1.0 ppm	40 ppm	
					<b>HIGH RANGE pH (7.4 - 8.8) - add 5 d</b>
					<b>AMMONIA - add 8 drops of #1 and</b>
					Shake vigorously for 5 seconds, wait
					<b>NITRITE - 5 drops, shake for 5 secon</b>
					Wait 5 minutes to read
					<b>NITRATE - add 10 drops of #1 then i</b>



**Self-check- 1**

**Written test**

Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Multiple choices**

1. One of the following is a painted disk attached to a length of cord, used to measure the turbidity of water?
  - A. secci disk
  - B. Oxygen metre
  - C. Salinity meter
  - D. PH metere
2. One of the following equipments is used to maintain correct levels of oxygen in water.
  - A. Oxygen metre
  - B. Oxygen cylinder
  - C. Ph metre
  - D. Salinity metre

**Test II: Short Answer Questions**

1. List at least five types of personal protective equipment for maintain water qulity?
2. What are the chemical water quality parameter?
3. What are the two types of fertilizer?

## Operation Sheet -1

### 1.1. Pond maintenance schedule

#### A. Materials and Equipments

- PPE
- Fish pond/water
- Skimmer basket
- Bacteria/powder
- Fish feed
- Plant trimmer equipments

#### B. Steps of pond maintenance schedule

- I. Wear appropriate PPE
- II. Check the skimmer basket. You should do this every two or three days.
- III. Add bacteria. This is as simple as dumping a little powder into the water.
- IV. Feed the fish. This isn't a chore it's a highlight of the day.
- V. Check the water level.
- VI. Trim plants.
- VII. Spring clean.



LAP TEST-1	Performance Test
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Name.....

ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **8** hour. The project is expected from each student to do it.

**Task:** perform pond maintenance schedule.

## LG #14

## LO #2- Carry out sampling

### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Calibrating water quality measurement tools and equipments
- Sampling techniques and procedures
- Sample collection
- Preserving, packing and labeling water sample

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Calibrat water quality measurement tools and equipments
- Determine sample techniques and procedures
- Undersatand sample collection
- Understand preserving, packing and labeling water sample

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”



## Information Sheet -2

### 2.1. Calibrating water quality measurement tools and equipments

Calibration is the process of configuring an instrument to provide a result for a sample within an acceptable range. Eliminating or minimizing factors that cause inaccurate measurements is a fundamental aspect of instrumentation design.

#### 2.1.1. Calibration of Dissolved oxygen meter

The follow these steps to calibrate and use a dissolved oxygen meter:

- Turn the meter on and inspect the probe for damage.
- Place the probe in a holder that contains a sponge which has been moistened with distilled water.
- Allow time for the probe to "warm up" and for the air in the probe holder to become saturated with water vapor.
- Set the altitude on the meter.
- The probe will now be calibrated to 100% saturation.
- Set the salinity of the water sample that you want to measure on the meter.
- Put the probe into the water sample and gently move it from side to side.
- Wait until the reading on the meter becomes stable, and then record the result.

The methods of calibration can be very similar for different types of dissolved oxygen meters, but you should always check the user manual for the specific dissolved oxygen meter you are using for the correct way to calibrate it.

#### 2.1.2. Calibration of PH meter

A pH calibration is the process of adjusting your pH meter by measuring solutions of a known pH value. This is because the characteristics of your electrode will change over time and this needs to be compensated for. A calibration does this by matching your pH meter to the current characteristics of your pH sensor.

Follow these steps to calibrate a pH meter:

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- Turn the meter on.
- Connect the probe to the meter.
- Place the probe in buffer 7 solution and wait for the reading to stabilize.
- Press the "Cal" button to enter the calibrate mode.
- Press the "Con" button to set the meter to pH 7.
- This method can be repeated for a buffer 4 and/or a buffer 10 solution.
- Press the "Meas" button and Measure will appear on the display screen.
- Rinse the probe with distilled water.
- The pH meter is now calibrated and ready for use.

The methods of calibration are very similar for most pH meters. However, you should always check the user manual for the meter you are using to find out how to calibrate it.

How to use the pH meter:

- place the probe in the sample to be measured
- wait for a stable reading to appear on the meter
- Record that reading.

### 2.1.3. Calibration of Salinity meter

Most salinity meters don't require calibration. However, some salinity meters require the temperature of the water sample to be set on the meter before it can measure the salinity of the water sample.

How to use a salinity meter:

- insert the probe into the water sample so that the probe is completely submerged
- allow time for the reading on the meter to become stable
- Record the value of the reading on the meter once it stops changing.

### 2.1.4. Calibration of thermometer

Fill a large container with crushed ice, and then add clean cold tap water until container is full. Stir. Place the thermometer stem/probe into the ice water. Make sure the thermometer is not touching bottom or sides of the glass. Hold the thermometer by its top for 30 seconds or until the reading stays steady. The use of lower the thermometer into the water and wait a minute or two. Then take the thermometer out and read the temperature recorded on it.

### 2.1.5. Calibration of ammonia test kit

Ammonia test kits can contain chemicals that can be harmful to you, to stock, or to the environment.

Adopt the following guidelines when using an ammonia test kit:

- Always wear clean gloves when using the test kit.
- Always store used waste reagents in a suitable container for disposal later.
- Avoid contact with skin and eyes.
- Do not swallow reagents.
- Do not smell the reagents.

How to use the ammonia test kit:

- fill the container with the water sample
- add the first reagent to the water sample
- add the second reagent, then wait for the water to change color
- compare the color of the water sample to the color chart that comes with the test kit
- Find the color on the chart that matches the color of the water sample, and take a reading of the value on the chart. This is the amount of ammonia in the water sample.

### 2.1.6. Calibration of nitrite test kit

Nitrite test kits can contain chemicals that can be harmful to you, to stock, or to the environment. Adopt the following guidelines when using a nitrite test kit:

- Always wear clean gloves when using the test kit.
- Always store used waste reagents in a suitable container for disposal later.
- Avoid contact with skin and eyes.
- Do not swallow reagents.
- Do not smell the reagents.

How to use the nitrite test kit:

- fill the container with the water sample
- add the first reagent to the water sample
- add the second reagent and wait for the sample to change color
- compare the color of the water sample to the color chart that comes with the test kit
- Find the color on the chart that matches the color of the water sample, and take a reading of the value on the chart. This is the level of nitrite in the water sample.

### 2.1.7. Calibration of Secchi disk

- hold the cord or rod and slowly lower the disk into the water
- keep lowering the disk until it is just no longer visible
- note the depth of the disk by checking where the water level is on the cord or rod
- Record this depth.

## 2.2. Sampling techniques and procedures

Water sampling is the process of collectiong arepresentative portion of water as from the natural environment or from an industrial site for the purpose of anlysing it for constitute. The process of taking a portion of water analysis or other testing. Eg. Fish pond water and drinking water to check thatit complies or rivers water to check for pollutant or bathing water to check that it is safe.

### 2.2.1. Water sampling techniques

The most common sampling techniques to collect different aquatic samples.

#### A. Leachate or Soil Solution

In this paper, we consider leachate water as equivalent to the soil solution. On that basis, soil solution refers to the interstitial water with its dissolved solutes, suspended particulate constituents, and dissolved gases . Among environmental monitoring studies, subsurface P mobilization is one the most common, and it is sensitive to sample collection.

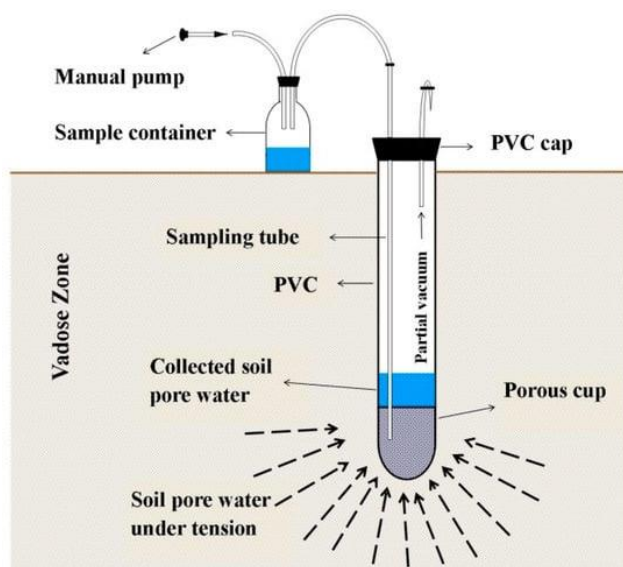
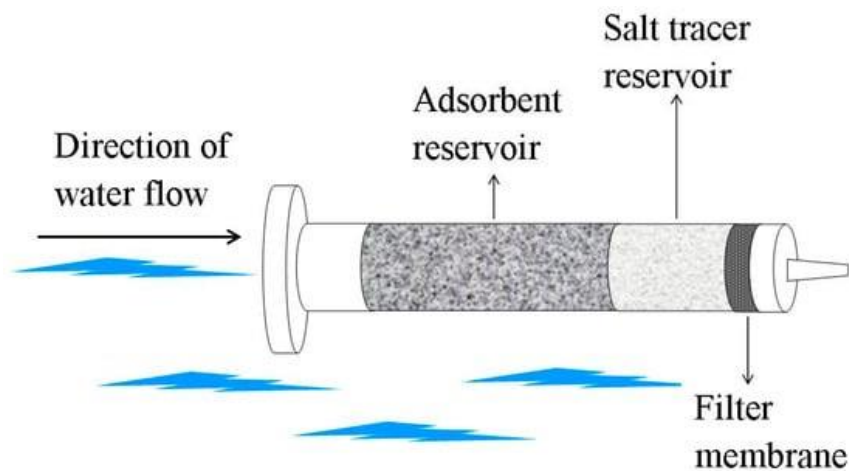


Figure 2.1. Components of suction cup lysimeter.

## B. Runoff

Surface runoff refers to overland flow, and it is typically sampled at the edge of a field. Surface runoff is perhaps among the most complicated freshwaters to sample when assessing the mass flux of nutrients. If runoff results from rainfall or irrigation, then rainfall or irrigation intensity plays an important role in selecting the time-interval or frequency of sampling and consequently in monitoring temporal changes of runoff nutrient fluxes.



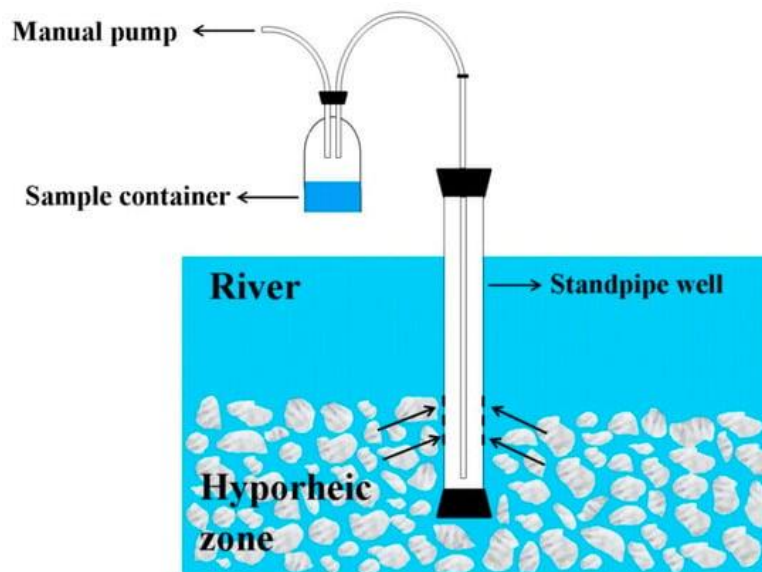
**Figure 2.2. Components of a SorbiCell passive sampler**

## C. Groundwater

Groundwater resources are widely used for municipal, agricultural, and industrial purposes. Several methods are available for groundwater sample collection and quality assessment. Wells are the simplest method to sample groundwater. The main complexities in well installation include site selection, drilling methods, and borehole construction, which, in turn, require experienced technicians, knowledge of local geological and hydrogeological conditions, and proper tools. It is important to thoroughly clean the equipment prior to drilling. Furthermore, some information about temporal changes in groundwater level is required before well installation.

## D. Rivers and Streams

A river is a very dynamic ecosystem in terms of biological activities, concentrations of dissolved and particulate constituents, and temporal and spatial variations in water flow and temperature. Sampling location and time schedule are the two main components in river monitoring studies and should be chosen in relation to the dimensions of the river (surface area and depth) and temporal changes in water flow/temperature, respectively.



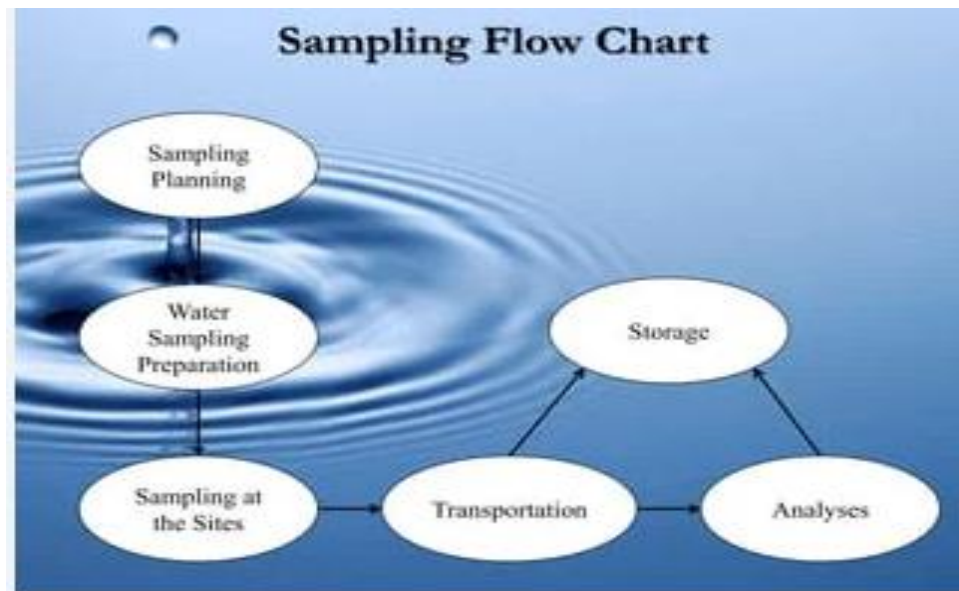
**Figure 2.3. Pump sampling of hyporheic zone (adapted from Biddulph)**

### **E. Lakes and Ponds**

Like rivers, lakes are very complex environments. Therefore, several parameters should be taken into consideration to collect representative samples. It is important to estimate the required frequency of sampling, as well as human and technical costs. It has also been shown that the depth and time of sampling influence the determination of total 'P' concentrations in lakes.

#### **2.2.2. Water sampling procedure**

1. if sampling a body of running water, point the mouth of the bag upstream and your hand downstream to avoid contamination.
2. if sampling from a water faucet, run the faucet for 1 minute before obtaining a sample.
3. Rinse the bag twice with the sample water prior to filling and closing.
4. fill bag as full as possible, half fulling the bottle leaves more room for oxygen which will promote degradation of your sample.
5. Collect data such as temperature and PH which affect the solubility of many ions.



**Figure: 2.4. Smpling flow chart**

### 2.2.3. Sampling tube

A sampling tube is usually constructed from some form of potable water tubing (i.e. Tygon) fitted to a one-way foot valve. As the tube is lowered into the water, the foot valve opens, allowing water to enter the tube. The tube is lowered at a consistent rate to the desired depth. Or a sampling tube is a special device was designed to sample the water column with minimal delay between sample depths as well as minimal water disturbance and stress to the fish.



**Figure: 2.5 Sampling tube**



### 2.3. Sample collection

Sample collection is one of the main complexities in environmental freshwater monitoring. While traditional grab sampling procedures offer spot concentrations, recent techniques using automatic, continuous sample collection may improve the sample representativeness and accuracy of measurements. Sampling procedures must be selected by taking into account human, technical, and financial resources .

When we establish a new farm there are fish health challenges on farm such as sudden fish kills, adapting new production system, equipment and management practice.

When collecting water sample;

Obtain a clean 0.5 litter sample bottle in the field one may use a new an opened mineral water bottle. Empty out the mineral water. Otherwise clean bottle can be obtained from laboratories.

- After that label the bottle with site information.
- Obtain sample from water column where there is no debris, mud, algae, in surface film. Be careful not to stir up sediments of accumulated debris from bottom of tanks.
- Prior to collecting sample , rinse the bottle three times with the water you shall take to the laboratory by filling bottle ¼ full close cap then pour out – not back in to same spot.
- Submerge bottle about 30 cm from water surface depend on depth of water column to draw water for sample.
- Water sample should be kept cool, preferably on ice and out of the sun and submitted to the laboratory as soon as possible. If possible reduce delay during shipping and avoid submitting sample at time.
- When they will reach the laboratory on holiday or weekend as the concentration of the variable may change over time in unpreserved water sample.

### 2.4. Preserving, packing and labeling water sample

Careful collection and handling of samples must be made to minimize errors. The objective is to provide the laboratory with a set of samples that closely represent the aquatic environment from which they are taken. To ensure consistency and efficiency, sample handling, preservation, storage, and transportation procedures must be properly and accurately documented and adhered to.

The stability of analytes depends on how well the samples are preserved. Preservation instructions must specify proper containers, pH, protection from light, absence of headspace, chemical addition, and

temperature control. The chemistry of all analytes must be considered, recognizing that certain reactions may still occur under recommended preservation conditions.

Holding time is the length of time a sample can be stored after collection and preservation, and before preparation and analysis, without significantly affecting the analytical results. Holding times vary with the analyte, preservation technique, and analytical methodology used. Maximum holding times are specified by the method used, and must be taken into account when sampling and analysis protocols are being developed.

Samples preserved by cooling should be refrigerated or sealed and placed in wet ice; blue ice, a synthetic glycol packaged in plastic bags and frozen, is acceptable for maintaining low temperatures. These placed in a common cooler, usually supplied by the laboratory is normally sufficient. Preservation methods are limited generally to pH control, chemical addition, refrigeration, and sometimes freezing. Always read the sampling instructions provided by the laboratory and ask them for additional information if unsure.

#### **2.4.1. Labeling water sample**

A Label samples: Fill out your sample labels with your name, the date, time, the site location (GPS, or address). Write Sample 1 on one label, and Sample 2 on the other. Attach one label to the side of each unopened sample bottle covering the label entirely with clear packing tape. Generally labeling is an important part in sampling programme.

The following information should be included in the label.

- Use water proof ink to record all the information.
- Date and time of sampling
- Sample field code
- Sampling point
- Nature of sample: Effluent / Surface water / Ground water / Others
- Type of sample (Grab/Composite/Integrated)
- Pre-treatment or preservation carried out on the sample
- Any special notes for the analyst
- Name and sign of sample collector.



**Figure: 2.6. Labeling water sample**

#### **2.4.2. packing of water sample**

Place the sample in a cooler/lunch box with gel ice packs (do not use dry ice). Make sure the sample is in contact with the sample container. Add extra padding to make sure that the sample does not roll around in the cooler and stays in contact with the ice pack. Transport sample to the laboratory for testing. Include your Sample ID, water source, location, and collection depth. Place sample bottle in a resealable plastic bag and seal it try to minimize the amount of air inside the bag. Place the sample in the cooler with ice packs.



**Figure: 2.7. packed water sample**

Self-Check – 2	Written test
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Short Answer Questions**

1. How to take water sampling collection water
2. List water sampling procedure?
3. What are labeling and packing of water sample?
4. How calibrate dissolved oxygen of pond water?
5. How calibrate thempreture of pond water?

## Operation Sheet -2

### 2.1. Procedure of measuring water turbidity

#### A. Materials and equipments

- PPE
- Secchi disk
- Meter/ tape measure
- Pond water

#### B. Steps of turbidity measurement

- I. Wear appropriate PPE
- II. Take secchi disc reading during the day at about mid day when there is no shadow
- III. That there is the least amount of shadow falling over the secchi disk hold the rope or board from which the secchi disk is suspended upright and release the secchi disk into the water.
- IV. Slowly lower the secchi disk into the water to the point where it starts becoming invisible and you can not clearly see it.
- V. Read from the measurement. Slowly release the secchi disk out of the water until it just starts to become visible
- VI. Measure this depth
- VII. Get the average of this two readings. Depth  $(a+b)/2$  this will give you the secchi disk depth
- VIII. Look at the reference color chart or table from your notebook

### 2.2. Techniques of measuring water quality through PH metre

#### A. Materials and tools

- PPE
- PH metre
- Litmus paper

#### B. procedure of measuring water quality by pH meter

- I. Wear appropriate PPE
- II. Turn the meter on.
- III. Connect the probe to the meter.

- IV. Place the probe in buffer 7 solution and wait for the reading to stabilize.
- V. Press the "Cal" button to enter the calibrate mode.
- VI. Press the "Con" button to set the meter to pH 7.
- VII. This method can be repeated for a buffer 4 and/or a buffer 10 solution.
- VIII. Press the "Meas" button and Measure will appear on the display screen.
- IX. Rinse the probe with distilled water.
- X. The pH meter is now calibrated and ready for use.
- XI. Measure the pH of the pond

### 2.3. Steps of collecting water sample

#### A. Materials and equipments

- Glove
- Eye goggle
- Plastic bottle

#### B. Steps of collectiong water sample

- I. Wear hand glove and eye protection
  - II. Rinse the bottle and cap three times with sample water
  - III. fill the bottle to within one to two inches from the top.
  - IV. Place the sample into a cooler with ice for immediate delivery or shipment to the laboratory.
- Sterile 125 or 150 mL plastic bottles must be used.

### 2.4. Techinques of packing water sample

#### A. Materials and Equipments

- PPES
- Water
- Sample bottle
- Plastic bag
- Sample ID

#### B. procedure

- I. Wear approptate PPE
- II. Prepare and organize your Sample ID, water source, location, and collection depth.
- III. Place sample bottle in a resealable plastic bag and seal it.

- IV. try to minimize the amount of air inside the bag.
- V. Place the sample in the cooler with ice packs..

## 2.5. Techniques of labeling water sample

### A. Materials and Equipments

- PPES
- Pen or marker
- Sample bottle
- Sampled water
- Packing tape

### B. Procedures labeling water sample

- I. Wear appropriate PPE
- II. Label samples:
- III. Fill out your sample labels with your name, the date, time, the site location (GPS, or address).
- IV. Write Sample 1 on one label, and Sample 2 on the other.
- V. Attach one label to the side of each unopened sample bottle covering the label entirely with clear packing tape (this will help keep it dry).

## 2.6. Steps of preserving water sample

### A. Materials and Equipments

- PPE
- plastic bottle
- Sample container
- Sampled water

### B. procedures

- I. Wear appropriate PPE
- II. Tightly seal the sample container immediately after collection. (The bottle can be of glass or plastic. Plastic is preferred because it is less likely to be broken).
- III. add them to the bottle prior to collecting the sample.
- IV. Putting samples in ice and keeping them there until they are submitted to the laboratory will preserve them well enough for most tests.



LAP TEST-2	Performance Test
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Name.....

ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **6** hour. The project is expected from each student to do it.

**Task 1:** Perform measuring water turbidity.

**Task 2:** Perform techniques of measuring water PH

**Task 3:** Perform collecting water sample

**Task 4:** Apply techniques of packing water sample

**Task 5:** Apply techniques of labeling water sample

**Task 6:** Perform preserving water sample

## LG #15

## LO # 3- Test and maintain water quality

### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Undertaking water quality test
- Detecting and interpreting results
- Recording results and physical characteristics of water
- Analyzing physicochemical water quality
- Basic treatment measures

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Undertake water quality test
- Detect and interpreting results
- Record results and physical characteristics of water
- Analyze physicochemical water quality
- Understand basic treatment measures

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

### Information Sheet-3

#### 3.1. Undertaking water quality test

Water quality is characterized on the basis of water parameters (physical, chemical, and microbiological). Water quality tests will give information about the condition of the waterway. By testing water over a period of time, the changes in the quality of the water can be seen. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates and phosphates. Testing can be done in the field with portable test kits or mobile laboratories. Water samples can also be collected and sent to a professional laboratory.

water can come from different sources depending on where we live in the world. Some sources of water listed as follow.

- Groundwater
- Surface water
- Rainwater
- Pond water
- Stream water
- Lake

Even though water may be clear, it does not necessarily mean that it is safe for us to use aquaculture. It is important for us to judge the safety of water by taking the following three qualities into consideration.

- Microbiological – bacteria, viruses, protozoa, and worms
- Chemical – minerals, metals and chemicals
- Physical – temperature, colour, smell, taste and turbidity

**Table: 3.1. The first step to check water quality can be done by very simple observations:**

Water Observations	Possible Contaminants
Foamy	Detergents
Black in colour	Manganese, bacterial growth
Brown, yellow or reddish in colour	Iron
Dark brown or yellow in colour	Tannins and pigment from leaves and bark
White deposits or scale	Hardness, dissolved metals
Earthy, fishy, muddy, peaty odour	Organic matter, algae, bacteria
Rotten egg odour	Hydrogen sulphide
Chlorine odour	Chlorine residual from water treatment process
Bitter or metallic taste	pH, zinc, copper

### 3.1.1. Portable testing kits

Analyses for many physical, chemical and microbiological contaminants can be carried out in the field or in a temporary laboratory using specifically designed products that are portable and relatively easy to use. A significant advantage of field analysis is that tests are carried out on fresh samples whose characteristics have not been contaminated or otherwise changed as a result of being stored and transported over long distances .

Portable water quality test kits should have the following characteristics

- Easy to use with simple instructions
- Small and easy to transport
- No restrictions on air transport
- Fast results
- Limited requirement for distilled or deionised water
- Dilution not necessary
- Does not require calibration
- Robust (limited effects from UV light, shock, humidity or temperature)
- Can test several parameters
- Easy to repair or replace
- Limited consumables or consumables are easy to obtain

### 3.1.2 Laboratory Testing

Water quality testing can also be carried out in a laboratory. This method requires facilities, trained technicians, equipment and other supporting materials. Laboratory testing can be useful if you are only taking a small number of samples and your project is located close to an urban area where a laboratory is present .

**Table: 3.2. advantage and limitation of laboratory testing**

Advantages	Limitations
Controlled environment	Relatively expensive
High level of precision and accuracy	Requires trained and skilled technicians
High level of quality assurance	Usually located in urban areas, may require samples to be transported over long distances
More consistent results	Some laboratories may have very limited options of test methods
More samples can be processed in a shorter time	



**Figure: 3.1. laboratory testing**

<https://www.youtube.com/watch?v=NQ7NvZCFLA0> /accessed date 05/04/2023

[https://www.youtube.com/watch?v=G0MFs70\\_Qrc](https://www.youtube.com/watch?v=G0MFs70_Qrc) /accsed date 05/04/2023

### 3.1.3. Types of water testing

There are a wide range of water quality tests used to help determine how safe. These different types of tests help determine if specific materials or contaminants have infected a body of water, and help inform how it needs to be further treated. Here are just a few types of water testing methods.

#### I) Bacteria Tests

There are a range of potential bacterial contaminants that can plague water. coli bacteria, which comes from fecal matter exposure and can result in serious health issues when consumed. Bacteria testing is essential in determining how safe water is to fish and drink or expose to your skin.

#### II) Mineral Tests

The list of mineral testing available could be a thesis paper, for how many there are. A few common and important mineral tests include chlorine and chloride, nitrate and nitrite, lead, copper, iron, zinc, potassium, and sodium.

This wide range of mineral testing is essential and relevant in determining water quality, as different regions or areas of terrain may have more of a build-up of certain types of minerals, which informs what kind of mineral treatments the water actually needs in order to be purified.

#### III) pH Testing

pH is a measure of the concentration of hydrogen ions in a solution.

The more of these hydrogen ions there are in a solution, the more acidic that water is. Acidity affects the taste of water.

### 3.1.4. Water testing procedure

Testing procedures and parameters may be grouped into physical, chemical, bacteriological and microscopic categories.

- Physical tests indicate properties detectable by the senses.
- Chemical tests determine the amounts of mineral and organic substances that affect water quality.
- Bacteriological tests show the presence of bacteria, characteristic of faecal pollution.

### 3.2. Detecting and interpreting results

water analysis from a testing laboratory is a necessary first step toward solving water quality problems. If you monitored water quality through periodic testing and have recently noticed differing results between tests for one or more indicators. To positively identify the source of contamination problems, as well as to determine the type of corrective action to take, a properly interpreted water analysis report is essential.

Besides providing a laboratory report of the analysis for given contaminants, most water testing laboratories provide little additional explanation of test results beyond the units used and possibly a footnote or similar comment in the event that a problem contaminant is identified.

Some contaminants have units that are specific to the test like those used for radon, hardness, conductance, and turbidity. Others, such as pH, are expressed as an index number and not in terms of concentration, and therefore have no units.

Even with modern techniques and expensive equipment, there are limits to which a water testing laboratory may determine the amount of a given contaminant in water. If the amount of a substance is so small it cannot be measured, the laboratory will usually indicate that the result is "below detection limit"

### 3.3. Recording results and physical characteristics of water

The physical and chemical properties of water quality to help environmental consultants make sure the water meets regulatory requirements, and it is safe for the environment.

Physical characteristics of water look at the temperature, color, taste, and odor of the water sample. Chemical properties of water involve parameters such as pH and dissolved oxygen. Monitoring these characteristics helps to determine if the water meets government regulations and is safe for the environment. Physical characteristics of water quality is essential to monitor the physical aspects of water quality to determine if the water is polluted or not.

Physical characteristics of water can be determine by:

- Color - pure water is colorless; colored water can indicate pollution. Colour can also show organic substances. The maximum acceptable level for the color of drinking water is 15 TCU (True color unit).
- Turbidity - pure water is clear and does not absorb light. If turbidity appears in the water, it may indicate water pollution.



- Taste and odor - pure water is always tasteless and odorless. If any type of taste and smell is present, it may indicate water pollution.
- Temperature - the temperature is not directly used to evaluate whether water is drinkable or not. However, in natural water systems like lakes and rivers, the temperature is a significant physical factor that determines water quality.
- Solids - If water is filtered to remove suspended solids, the remaining solid in the water indicates the total dissolved solids. If the dissolved solids in the water exceed 300 mg/l, it adversely affects living organisms as well as industrial products.

### 3.4. Analyzing physicochemical water quality

Analysis of water quality (e.g. dissolved oxygen, ammonia, nutrients etc) should also comprise part of regular monitoring to be undertaken by the worker.

Physicochemical parameters are important water quality parameters of river water i.e., pH, temperature, turbidity, conductivity, total dissolved solids, total suspended solids, total alkalinity, sulfate, nitrate, heavy metals, and phosphate.

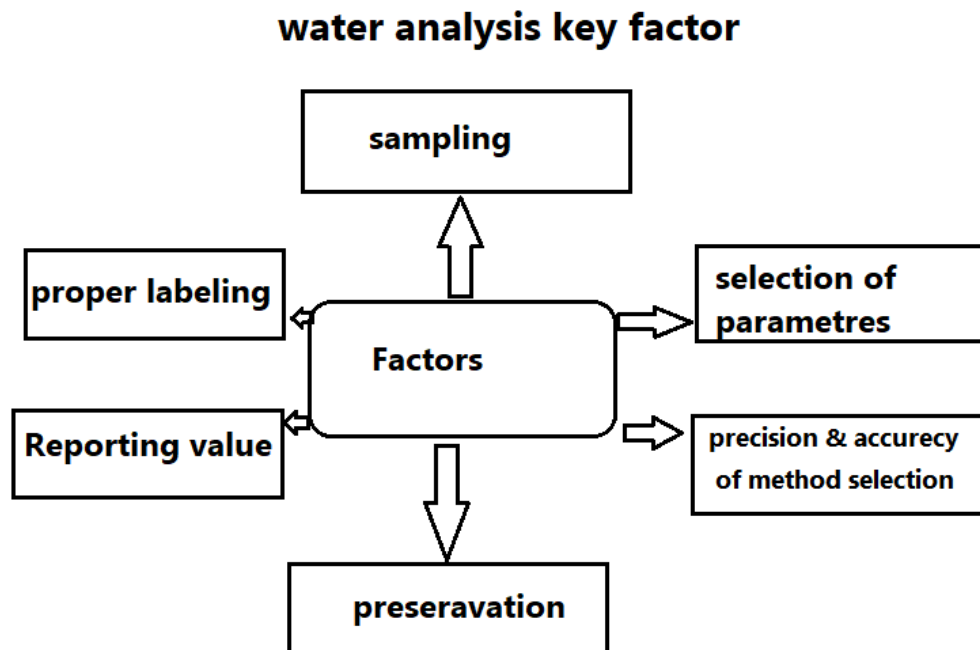


Diagram: 3.1. water analysis key factor

<https://www.youtube.com/watch?v=LU6Mwmi49eo> accesd date 05/04/2023

### 3.5. Basic treatment measures

Treatment may be added to water to improve quality in extreme case particularly during live transportation which the possibility for water exchange are minimal. This water treatment primer covers the major types of water treatment products, including what they are used for and best practice for water treatment.

#### 3.5.1. Oxigenation of water

Oxygen requirements vary between fish species, however, it is recommended your aquarium water has an 80-110% oxygen saturation and DO level of 6-8 mg/L. Supersaturation (anything >115%) in aquariums should be avoided, as it is one of the causes of gas bubble disease in fish

Control of temperature fish pond

You should try to keep it below 29 degrees Celsius. Above this point, the pond will be unable to retain oxygen in the water. As a result, fish and aquatic animals will start to die. The ideal temperature will be between 18 to 24 degrees Celsius.

#### 3.5.2. Biofiltration

Biofiltration is defined as a filtration process where the filter medium comprises porous materials. Eg sand, granulate active carbon (GAC) or a synthetic carrier materials, which is colonized by indigenous microbial communities and where the microorganism perform at least one of the essential treatment functions of the process.

Biofiltration is a pollution control technique using a bioreactor containing living materials to capture and biologically degrade pollutants. Common uses include processing waste water, capturing harmful chemicals or silt from surface runoff, and microbiotic oxidation of contaminants in air. Industrial biofiltration can be classified as the process of utilizing biological oxidation to remove volatile organic compounds, odors, and hydrocarbons.

Examples of biofiltration include:

- Bioswales, biostrips, biobags, bioscrubbers, Vermifilters and trickling filters
- Constructed wetlands and natural wetlands
- Slow sand filters
- Treatment ponds
- Green belts
- Green walls

- Riparian zones, riparian forests, bosques
- Bivalve bioaccumulation

### 3.5.3. Solid removal of water

Sedimentation processes are very effective in removing suspended solids in industrial wastewater. Clarifiers, either rectangular or circular, are most commonly used in the application of sedimentation in wastewater treatment facilities.

### 3.5.4. Alum

Alum is used to reduce turbidity from clay particles suspended in water. Alum is acid forming and can substantially reduce total alkalinity and PH. This makes alum unsuitable for use in ponds with low total alkalinity as it may lower pH to points where it is toxic to fish. Alum also reduces phosphorus in water.

Therefore, use of alum may necessitate

- Liming if pH drops to low
- Fertilization to increase levels of dissolved phosphorus



**Figure: 3.2. Alum**

[https://www.youtube.com/watch?v=imhlT7ts\\_IQ](https://www.youtube.com/watch?v=imhlT7ts_IQ) accessed date 05/04/2023

### 3.5.5. Ammonia Removers

Elevated ammonia is a problem that always should be addressed promptly. Failure to do so can result in fish death or damage to their health. Every new aquarium will go through a process sometimes referred to as the break-in cycle. During that time, biological colonies that convert harmful toxins, quickly begin

growing. However, until those colonies grow sufficiently to convert of all the ammonia in the tank, the fish are at risk.

During that time, it is critical that water tests be performed regularly to determine the level of ammonia in the tank. If the ammonia reaches dangerous levels, steps must be taken to quickly reduce it. Water changes will help, but if the ammonia is extremely high, an ammonia binder should be used to bring ammonia down. Ammonia binders are available in a liquid form, or in the form of filtration media. For rapid reduction of critically high ammonia, use a liquid binder. Filter media form is useful when levels are elevated.

#### 3.5.5.1. Zeolite

zeolite is an effective means of reduce levele of ammonia dissolved in water. It is recommended for use in transportation tanks when undertaking long distance live fish haulage. Zeiolte may be recharged severaltime by overnight immersion in a salt solution or oven drying. Zeoilte is not effective in salt water.



**Figure: 3.3. Zeolite**

#### 3.5.6. Aquarium salt

Freshwater aquariums often can benefit from the use of small quantities of salt. This is particularly true in a newly set up aquarium that will go through a period of elevated nitrite. Salt can help avoid the effects of nitrite poisoning. Generally speaking, salt aids in the healing of minor skin irritations and improves respiratory function in fish. However, salt also has a downside. Scaleless fish, such as many in the catfish family, do not tolerate salt well. Live plants are also fairly intolerant of salt. Before using salt in a freshwater tank, research best practices and dosing methods.

#### 3.5.6.1. Rock salt (Magadi)

Rock salt is used to manage water quality in livefish transport containers. Since it is a balanced salt, it helps to buffer the water. It also helps to control the build up of nitrite level in the transportation tank. Consequently fish stressed is reduced.



**Figure: 3.4. Rock salt**

#### 3.5.6.2. Salt

Salt is one of the easiest and cheapest forms of medication available for fresh water fish. Salt (sodium chloride NaCl) is safe for most species of fish. It can also be used in live fish transportation if one has no rock salt.



**Figure: 3.5. Salt**

### 3.5.7. Algae Treatments

Sooner or later algae occurs in most aquariums. A small amount of algae growth is not harmful and is desirable if there are algae eating fish in the tank. If the algae growth becomes excessive, it can be harmful to live plants, and possibly even the fish. Even if it is not harmful, it is unsightly and detracts from the beauty of the aquarium. Before treating your aquarium for algae, it's important to determine what the underlying cause is. This aquarium algae primer describes each source, how to treat according, and includes preventative measures to help avoid future algae overgrowth.

### 3.5.8. Biological Aids

A large part of maintaining a healthy aquarium environment is establishing and promoting stable colonies of beneficial bacteria. Several products are available that are designed to promote healthy biological colony growth. It is important to understand that these colonies do not instantly grow and reach stable levels. Even when using biological aids, it will take some time to reach a stable balance. During the time these colonies are growing and reaching stable proportions, testing the water regularly, and taking steps to address elevated ammonia or nitrite is important.

### 3.5.9. pH Modification

pH is an important parameter to consider when keeping an aquarium. Although most fish will do okay in a tank with a neutral pH, each species has a pH range that they thrive in. Many Tetras prefer a lower pH, while most cichlids favor a higher pH. Live plants also thrive in a certain pH range, which should be considered when keeping plants. Generally speaking, it is wise to use source water that is already in the pH range you desire, rather than trying to modify the pH on an ongoing basis.

However, there are times when it is necessary to alter the pH. Lowering the pH is best achieved by using filtered water that is low in mineral content. Blackwater treatments will lower pH and soften the water, but if the source water has a high buffering capacity, the pH will rise again. Using filtered water that is has a low buffering capacity will ensure the pH remains stable in the lower range you desire. Raising the pH requires the opposite strategy, increasing the buffering capacity of the water.

### 3.5.10. Phosphate Removers

Phosphates (PO<sub>4</sub>) are present in all aquariums, even well-maintained ones. Ideally, phosphate levels should be kept at 0.05 ppm, or below. When phosphates are elevated, water changes and tank maintenance will help reduce them. The use of phosphate reducing products such as specialized filter media, or phosphate control additives will help bring phosphate levels down and reduce algae growth.

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### 3.5.11. Tap water conditioners

Virtually everyone will use some type of treatment for the water they fill their aquarium with. If you use tap water, you must treat it before using it in an aquarium. This is even true if you age your tap water, as aging doesn't always eliminate all potentially toxic substances. In addition to chlorine and chloramine, heavy metals can be a problem as well. Water conditioners will neutralize all of those.

Most tap water conditioners also contain an agent to support the slime coat of your fish, which is important when fish are stressed. Even though you may not think so, every time you change the water, perform maintenance, or make any changes in the aquarium, it stresses the fish. Although it may be only mild stress, it can affect the health of your fish.

A number of water conditioners also include an agent to convert ammonia to the non-toxic ammonium. Some will also advertise that they neutralize nitrite and nitrate. However, none of them can do that instantly. The best they can do is promote the biologicals that are part of the nitrogen cycle. Given time, those biologicals will break down toxins, but it won't happen immediately.

### 3.5.12. Water clarifiers

Over time, aquarium water can become somewhat cloudy due to fine particles of algae, dirt, silt, fine sand, and other debris. These particles are too fine to be removed by the filter media and can cause the water to be hazy. Products sometimes referred to as flocculants, are designed to help remove those fine particulate matter from the water. Flocculants, or water clarifiers, cause the fine particles to clump together into aggregates that are large enough to be filtered out, or heavy enough that they fall to the bottom of the tank where they can be vacuumed out. Most water clarifiers are safe for all tanks, but read product descriptions carefully and follow dosing instructions closely to ensure the safety of your fish and live plants.

### 3.5.13. Water treatment methods

#### A. primary treatment

There are four methods of primary treatments: chlorination, ozone treatments, ultraviolet treatments and membrane filtration. Chlorination: Fresh or sea water can be chlorinated using either chlorine gas or hypochlorites. Chlorinated water minimizes slime development on working surfaces and helps control odour.



## **B. Secondary treatments**

Secondary treatments of water consists of sedimentation and filtration followed by chlorination. Sedimentation can be carried out by holding the raw water in ponds or tanks. The four basic types of filtration are cartridge filtration, rapid sand filtration, multimedia sand filtration, and up-flow filtration.

## **C. Complete treatment**

Complete treatment consists of flocculation, coagulation, sedimentation and filtration followed by disinfection. Flocculation and coagulation will assist in removing contaminants in the water, causing turbidity, colour odour and taste which cannot be removed by sedimentation alone. This can be achieved by the addition of lime to make the water slightly alkaline, followed by the addition of coagulants like Alum (aluminium sulphate), ferric sulphate or ferric chloride.

<https://www.youtube.com/watch?v=fLUalgT-1Co> /accssed date 05/04 2023

### **3.5.14. The processes involved in water treatment**

The following are the types of processes involved in water treatments.

#### **I- Physical water treatment process**

- Sedimentation
- Filtration
- Dissolved Air Floatation

#### **II. Chemical Water Treatment Process:**

- Pre-chlorination
- Aeration
- Disinfection

#### **III. Physio-Chemical (Conventional) Water Treatment Process:**

- Coagulation
- Flocculation

#### **IV. Biological Water Treatment Process:**

- Slow Sand Filtration



Self-Check – 3	Written test
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Multiple choices**

- One of the following is an effective means of reduce levele of ammonia dissolved in water.
  - Rock salt
  - Zeolite
  - Alum
  - Algae
- One of the following is used to reduce rerbidity from clay particlcs suspended in water, acid forming and can substancially reduce total alkalinity and PH.
  - Alum
  - Oxygenation
  - Zeolite
  - Rock salt

**Test II: Short Answer Questions**

- What are the three most important water treatment methods ?
- List the basic treatment measures of water?
- List the four methods of primary treatments?

### Operation Sheet -3

#### 3.1. The techniques of measuring of dissolved oxygen for water

##### A) materials and equipments

- PPES
- Oxygen metre
- Water body/ fish pond/

##### B) procedure of measuring dissolved oxygen

- I. Wear appropriate PPES
- II. Turn the meter on and inspect the probe for damage.
- III. Place the probe in a holder that contains a sponge which has been moistened with distilled water.
- IV. Allow time for the probe to "warm up" and for the air in the probe holder to become saturated with water vapor.
- V. Set the altitude on the meter.
- VI. The probe will now be calibrated to 100% saturation.
- VII. Set the salinity of the water sample that you want to measure on the meter.
- VIII. Put the probe into the water sample and gently move it from side to side.
- IX. Wait until the reading on the meter becomes stable, and then record the result.

#### 3.2. Techniques of nitrate testing

##### A. Materials and equipments

- PPE
- Sample bottle
- Test tube
- Acid reagent
- Spoon
- Nitrogen comparator

##### B. procedure of nitrate testing

- I. Fill the sample bottle with sample water. Use gloves if drawing the sample by hand.
- II. Rinse and fill one test tube to the 2.5 mL line with water from the sample bottle.
- III. Dilute to the 5 mL line with the Mixed Acid Reagent. Cap and mix. Wait 2 minutes.

- IV. Use the 0.1 g spoon to add one level measure (avoid any 50-60 times in one minute). Wait 10 minutes.
- V. Insert the test tube into the Nitrate Nitrogen Comparator. Match the sample color to a color standard. Record the result as mg/L(ppm) Nitrate Nitrogen (NO<sub>3</sub>-N). To convert to mg/Nitrate (NO<sub>3</sub>) multiply by
- VI. Place the reacted sample in a clearly marked container. Arrangements should be made with toxic
  - a. material handlers for safe disposal. Please wash your hands after this water test is completed.

### 3.3. pH Testing Procedure

#### A. Tools and equipment's

- PPE
- Test tube
- Sample water
- Dropper bottle
- Cap
- Comparater

#### B. Procedures water PH mesurment

- I. Rinse each test tube with the water sample. Gloves should be worn to avoid skin contact with the water.
- II. Fill the tube to the 5mL line with sample water.
- III. While holding a dropper bottle vertically, add 10 drops of Wide Range Indicator Solution.
- IV. Cap and invert several times to mix.
- V. Insert the tube into the Wide Range pH Comparator. Hold the comparator up to a light source. Match the sample color to a color standard.
- VI. Record the pH value.
- VII. Wash your hands

### 3.4. Thechinques of measuring of water tempreture

#### A) materials and Equipments

- Hand glove
- Tehrmometer

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- Pond water sample
- large container
- Ice

#### **B) procedure of measuring water temperature**

- I. Wear appropriate ppe like handglove
- II. Fill a large container with crushed ice, and then add clean cold water until container is full.
- III. Place the thermometer stem/probe into the ice water.
- IV. Make sure the thermometer is not touching bottom or sides of the glass
- V. Hold the thermometer by its top for 30 seconds or until the reading stays steady.
- VI. wait a minute or two.
- VII. take the thermometer out and read the temperature recorded on it.

<b>LAP TEST-3</b>	<b>Performance Test</b>
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Name.....

ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

**Task 1:** Perform the techniques of measuring dissolved oxygen of water.

**Task 2:** Perform techniques of nitrate testing.

**Task 3:** Apply pH Testing Procedure.

**Task 4:** Measure of water temperature of fish pond.

<b>LG #4</b>	<b>LO # 4 - Complete water quality maintaining activities</b>
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### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Recording and reporting water quality and environmental parameters
- Handling tools, equipment and materials
- Discarding damaged tools, equipment and waste materials
- Store leftover materials and chemicals

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Record and reporting water quality and environmental parameters
- Handle tools, equipment and materials
- Discard damaged tools, equipment and waste materials
- Store leftover materials and chemicals

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## Information Sheet-4

### 4.1. Recording and reporting water quality and environmental parameters

Reporting is an integral part of a monitoring, evaluation and reporting process that is tied to the monitoring program objectives. Reporting is all about communication. Sharing the results of monitoring and evaluation with an audience in a meaningful way. A single monitoring program may lead to one report. In other situations, monitoring may be used to generate several different types of reports, varying in complexity and format, but all relating to the same underlying data.

Answer two important questions to help define your reporting requirements:

- Who are the users that would benefit from receiving your water quality data or information products?
- What level of detail do these people need?

#### 4.1.1. Compliance reporting

Environmental regulators, such as environment protection authorities (EPAs), require many industries to comply with legislation that minimises the risk of water pollution.

Compliance reporting presents data and information as required by regulation. It can be done in various ways, such as the submission of raw data through to detailed discharge monitoring and receiving environment monitoring reports. Compliance reporting is designed to show that the regulated activity is performing as required. The regulator would typically specify the reporting content and format, which would relate back to the compliance monitoring plan objectives. Compliance reports in some jurisdictions are available to the general public. Contact your state or territory environmental regulator.

Problems or difficulties in completing work to required standards or timelines are reported to supervisor. Any problems or difficulties which will happen while we are accomplishing our farming activities have to be reported to supervisor or manager by the required standards or timelines. But before reporting we have to do our best to control the problems.

Some of the important parameters used to report problems or difficulties in working area are:-

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- The place, time and location of the farm
- The name and job title of person injured in the incident
- Name of witness
- A brief description of the incident
- An event which preceded the incident
- Possible measures/recommendations/ to reduce similar incidents
- Name of a person who investigated the incident

#### **4.2. Handling tools, equipment and materials**

Materials used for fish farming work have to be handled and transported safely. Any fishery has to do this task safely because any damage will create inconvenience on the next use of the equipment, and also it will cause injury to our fish.

Safety Tips When Handling Tools, equipments and materials

- Use Personal Protective Equipment.
- Dress Right.
- Educate Yourself.
- Regularly Inspect Your Tools.
- Keep Your Work Area Clean.
- Be Extra Cautious With Power Tools.
- Turn the Tools Off After Use.
- Use Proper Lighting.
- Ground All Tools
- Maintain a Firm Grip and Balance
- Stay Calm and Confident

#### **4.3. Discarding damaged tools, equipment and waste materials**

The advice of the supplier, local authority or a reputable waste disposal contractor may need to be sought on the safe disposal of unwanted substances. Provisions need to be made for the removal and disposal of food wastes, trash, and debris. Disposal facilities must be provided and operated in a manner that minimizes vermin infestation, odors, and disease hazards in farm that garbage and refuse in the food preparation area should be in a container that is rodent- and insect-proof, as well as leak-proof.



Waste materials include: waste water, chemicals, aquatic weeds, pond mud, and broken components, plant debris, plastic, metal and paper-based materials. All these wastes will be either disposed according to enterprise work procedures or recycled or re-used or returned to manufacturer. Waste produced during fish processing operations can be solid or liquid.

**Solid wastes:** include skin, viscera, fish heads and carcasses (fish bones). Solid waste can be recycled in fish meal plants or it can be treated as municipal waste.

**Liquid wastes:** include blood water and brine from drained storage tanks, and water discharges from washing and cleaning. This waste may need holding temporarily, and should be disposed of without damage to the environment. How liquid waste should be disposed from fish processing operations depends on the content levels in the waste of solid and organic matter, as well as nitrogen and phosphorus content, and oil and grease content. It also depends on an assessment of parameters such acidity levels, temperature, odor, and biochemical oxygen demand and chemical oxygen demand. The magnitude of waste management issues depends on how much waste volume there is, the nature of the pollutants it carries, the rate at which it is discharged and the capacity of the receiving environment to assimilate the pollutants. Many countries dispose of such liquid wastes through their municipal sewage systems or directly into a waterway. The receiving waterbody should be able to degrade the organic and inorganic waste components in a way that does not damage the aquatic ecosystem

#### 4.5. Store left over materials and chemicals

After finishing of a given operation important materials such as Polyethylene bag, Lime, Feed, Fertilizer, Stocking materials (fry, fingerlings, egg, larvae) e.tc should be either stored or disposed. Workers handling fish feeds must be vigilant about feed storage and rodent control and protect abraded skin and mucous membranes from contact with potentially contaminated feeds and soiled pond waters.

##### 4.5.1. Materials and tools storage

While these leftover items often get stored in your attic or shed, these places do not offer the most ideal environment for the long-term storage of these materials. Therefore, stored building items often deteriorate to the point where they cannot be used again once they come out of storage.

As these materials are often expensive, it pays to know exactly how to best store these items to maximize their longevity.

#### **4.5.2. Chemical storage**

Chemical storage areas in academic laboratory settings include central departmental stockrooms, storerooms, laboratory work areas, storage cabinets, refrigerators and freezers. There are established legal requirements as well as recommended practices for storing chemicals. These requirements and guidelines are summarized below in the following sections:

- General requirement
- Segregation of incompatible chemicals
- Specifications for chemical storerooms
- Chemical storage in laboratories (outside of chemical storerooms)
- Additional storage requirements and recommendations for specific hazard chemical classes

Self-Check – 4	Written test
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Multiple choices**

- One of the following is **not** solid wastes in fish pond.
  - Skin
  - Viscera and fish heads
  - carcasses (fish bones).
  - Blood water
- One of the following is **not** liquid wastes in fish pond.
  - Blood water
  - Brine from drained storage tanks
  - water discharges from washing and cleaning
  - Skin

**Test II: Short Answer Questions**

- What are the important parameters used to report problems or difficulties in working area?
- What is the importance of discarding damaged tools, equipment and waste materials?
- What do you understand compliance reporting?

## Reference Materials

### Books:

- Dodds, W.K.; Smith, V.H. Nitrogen, phosphorus, and eutrophication in streams. *Inland Waters* **2016**, 6, 155–164. [[Google Scholar](#)] [[CrossRef](#)].
- Eveborn, D.; Gustafsson, J.P.; Hesterberg, D.; Hillier, S. XANES Speciation of P in environmental samples: An assessment of filter media for on-site wastewater treatment. *Environ. Sci. Technol.* **2009**, 43, 6515–6521. [[Google Scholar](#)] [[CrossRef](#)]
- Hall, C.B, 2002. Ponds and Fish culture. Agrobios ( Jodhpur) India
- Litaor, M. Review of soil solution samplers. *Water Resour. Res.* **1988**, 24, 727–733. [[Google Scholar](#)] [[CrossRef](#)]
- Regenstein, J, M, Carrie E. regenstein. 1997. Introduction To fish, Technology. New Delhi. Chapman & Hall., New youk.
- Worsfold, P.; McKelvie, I.; Monbet, P. Determination of phosphorus in natural waters: A historical review. *Analytica Chimica Acta* **2016**, 918, 8–20. [[Google Scholar](#)] [[CrossRef](#)][[Green Version](#)]

### Web addresses

- <https://www.youtube.com/watch?v=dROWrN07VDo> /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=LKfWV45953I> /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=837ErTxJRuo> /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=94YcjbYBhc> /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=fxjDJuwmUbQ> /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=NQ7NvZCFLA0> /accessed date 05/04/2023
- [https://www.youtube.com/watch?v=G0MFs70\\_Qrc](https://www.youtube.com/watch?v=G0MFs70_Qrc) /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=LU6Mwmi49eo> /accessed date 05/04/2023
- [https://www.youtube.com/watch?v=imhlT7ts\\_IQ](https://www.youtube.com/watch?v=imhlT7ts_IQ) /accessed date 05/04/2023
- <https://www.youtube.com/watch?v=fLUalgT-1Co> /accessed date 05/04/2023

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**The experts who developed the learning guide**

No	Name	Qualification	Educational background	Institution	Phone number	E-mail
1	Gashaw Assefie	A	Animal Production	Agarfa ATVET College	0914068274	<a href="mailto:lakomelzajournalist@gmail.com">lakomelzajournalist@gmail.com</a>
2	Addise Desta	A	Animal production	Wolaitasodo ATVET College	0913270120	Addiserahel2701@gmail.com
3	Mezigebe Abate	A	Biotechninlogy	Woreta ATVET College	0937705931	Mezgebuabate16@gmail.com
4	Alemayehu Tolera	A	Animal production	Bako APTC	0994132626	Toleraalex@gmail.com
5	Elias Tekle	A	Animal production	Alage ATVET College	0913352348	Eliastekle39@gmail.com
6	Temesgen Tadesse	A	Human nutrition	Asosa ATVET College	09511593623	Temesgen9393@gmail.com