

9

Technology and Livelihood Education

• AGRICULTURAL ARTS  
• AQUACULTURE NC II

• Learner's Material

Government Property  
NOT FOR SALE

9

# Technology and Livelihood Education

## AGRICULTURAL ARTS



**AQUACULTURE NC II**

### Learner's Material

Department of Education  
Republic of the Philippines

**Department of Education  
Republic of the Philippines**

**Aquaculture-Grade 9  
Learner's Material  
First Edition, 2013  
ISBN: \_\_\_\_\_**

**Republic Act 8293, section 176** states that: No copyright shall subsist in any work of the Government of the Philippines. However, prior approval of the government agency or office wherein the work is created shall be necessary for exploitation of such work for profit. Such agency or office may, among other things, impose as a condition the payment of royalties.

Borrowed materials (i.e. pictures, photos, brand names, trademarks, etc.) included in this book are owned by their respective copyright holders. Every effort has been exerted to locate and seek permission to use these materials from their respective copyright owners. The publisher and authors do not represent nor claim ownership over them.

Published by the Department of Education  
Secretary: Br. Armin A. Luistro FSC  
Undersecretary: Yolanda S. Quijano, Ph.D.  
Assistant Secretary: Elena R. Ruiz, Ph.D.

**Development Team of the Learner's Material**

**Consultant:** Andres Z. Taguiam, Ph.D.

**Authors:** Blair D. Castillon, Ph.D, Editha P. Durante,  
Ma. Corazon D. Maguate, Rosa F. Vasquez  
Ruby Jane S. Busing

**Reviewers:** Leo I. Moral Jr.  
Dr. Jose Abucay

**Illustrator:** Adonis A. Erni

**Subject Specialists:** Albert B. Erni and Emmanuel S. Valdez

**Layout Artists and Encoders:** Jocelyn M. Gamo, and Joel G. Castillo

**Printed in the Philippines by \_\_\_\_\_**

**Department of Education-Instructional Materials Council Secretariat(DepEd - IMCS)**

Office Address: 2<sup>nd</sup> Floor Dorm G, Philsports Complex, Meralco  
Avenue, Pasig City, Philippines 1600

Telefax: (02) 634-1054, 634-1072

E-mail Address: [imcsetd@yahoo.com](mailto:imcsetd@yahoo.com)

## TABLE OF CONTENTS

Introduction .....	6
General Objectives .....	6
What is this Learning Material About .....	7
How Do You Use the Module.....	8
Pre-assessment .....	9
Learning Goals/ Targets .....	10
Module I Personal Entrepreneurial Competencies (PECs).....	11
Learning Objectives .....	12
Pre-Assessment .....	12
Self-Assessment .....	15
What to Know .....	16
What to Process .....	18
What to Reflect and Understand.....	20
What to Transfer .....	22
Sample Action Plan.....	22
Post-Assessment .....	23
Module II Environment and Market .....	25
Learning Objectives .....	26
Pre-Assessment .....	27
What to Know .....	28
What to Process .....	33
What to Reflect and Understand .....	34
What to Transfer .....	36
Post-Assessment .....	37
Quarter I- Module III Preparation and Maintenance of Aquaculture Facilities	38
Introduction.....	38
Learning Objectives .....	39
Pre-Assessment .....	40

Definition of Terms .....	41
What to Know .....	42
What to Process .....	50
What to Reflect and Understand .....	50
What to Transfer .....	51
Summative Assessment .....	51
Quarter II- Module IV Lesson I Monitor Water Parameters	53
Introduction .....	53
Objectives .....	54
Pre-Assessment .....	54
Definition of Terms .....	55
What to Know .....	56
What to Process .....	74
What to Reflect and Understand .....	75
What to Transfer .....	75
Summative Test .....	76
Quarter III- Module V Monitor and Collect Mortalities	79
Learning Objectives .....	80
Diagnostic/Pre-Assessment .....	80
Definition of Terms .....	81
What to Know .....	82
What to Process .....	83
What to Reflect and Understand .....	84
What to Transfer .....	84
Post-Assessment .....	84
Lesson II Determine the causes of Mortality	85
Objectives.....	85
Diagnostic/Pre-Assessment.....	85
What to Know .....	86
What to Process .....	106

What to Reflect and Understand .....	107
What to Transfer .....	107
Post-Assessment .....	108
Quarter IV: Prepare and Secure Aquaculture Facilities	109
Lesson I: Pond Preparation	109
Objectives.....	109
Pre-Assessment .....	110
Definition of Terms .....	111
What to Know .....	112
What to Process .....	127
What to Reflect and Understand .....	127
What to Transfer .....	128
Lesson II: Secure Pond Facilities	129
Objectives.....	129
Pre-Assessment .....	129
Definition of Terms .....	130
What to Know.....	130
What to Reflect and Understand .....	133
What to Transfer .....	133
Summative Test .....	134
Glossary of Terms.....	137

# TECHNOLOGY AND LIVELIHOOD EDUCATION AGRICULTURE AND FISHERY

Specialization  
**(Aquaculture)**  
Grade 9



## Introduction

This learning materials will equip you with the knowledge, skills and attitudes pertaining to Aquaculture. It covers one core competency that a Grade 9 Technology and Livelihood education (TLE) student ought to learn.

It is composed of six modules.

Module 1: Personal Entrepreneurial Competencies

Module 2: Environment and Market

Module 3: Conduct Pre-Operational Aquaculture Activities

Module 4: Changing the Water of Aquaculture Facility

Module 5: Monitor and Analyze Mortalities

Module 6: Prepare and Secure Aquaculture Facilities

As you go through the process of learning the six modules gaining the knowledge and skills in Aquaculture, you will have the readiness to participate in any fishery program of the government and promote economic progress of your community and the country.



## General Objectives:

At the end of the module, you are expected to

- ❖ Demonstrate an understanding of the underlying theories in aquaculture.
- ❖ Demonstrate an understanding of one's Personal Entrepreneurial Competencies and Skill(PECs) in Aquaculture.

- ❖ Demonstrate an understanding of environment and market in Aquaculture in one's town/municipality.
- ❖ Demonstrate an understanding on the preparation of tools, equipment and aquaculture facilities for operation.
- ❖ Select appropriate method of water exchange in aquaculture facility.
- ❖ Determine and analyze mortality.
- ❖ Prepare and secure Aquaculture facilities.



## **What Is This Learning Material About?**

Aquaculture

K to 12 – Technology and Livelihood Education

This learning material has 6 Modules. Each Module has the following parts.

- Learning Objectives
- Content Standards
- Performance Standards
- Pre-Assessment
- Reading Resources/ Instructional Activities
  - ◆ What to KNOW?
  - ◆ What to PROCESS?
  - ◆ What to REFLECT or UNDERSTAND?
  - ◆ What to TRANSFER?
- Post Assessment



## How Do You Use The Module?

**To get the most from every module, you need to do the following:**

1. Begin by reading and understanding the Learning Objective/s, Content and Performance Standards. These will tell you what you should know and be able to do at the end of each module.
2. Find out what you already know by taking the Pretest. If you get 80% to 100% of the items correctly, you may proceed to the next Module. This means that you need not go through the Module because you already know what it is about. If you failed to get 80% to 100% correctly, go through the Module and review especially those items which you failed to answer correctly..
3. Do the required Learning Activities. They begin with one or more Information Sheets. An Information Sheet contains important notes or basic information that you need to know. After reading the Information Sheet, test yourself on how much you learned by means of the Self-check. Do not hesitate to go back to the Information Sheet when you do not get all test items correctly. This will ensure your mastery of basic information.
4. Demonstrate what you learned by doing what the Activity / Operation /Job Sheet directs you to do.
5. You must be able to apply what you have learned in another activity or in real life situation.
6. Accomplish the Scoring Rubrics for you to know how well you performed.

Each lesson also provides you with references and definitions of key terms for your guide. They can be of great help. Use them fully.



## Pre-Assessment

**Directions:** Provide information on what you already know in the first column (**K**), and what you want to know in the second column (**W**). You will record what you have learned in the third column (**L**) as the lesson progress. In the fourth column (**S**) So What is used to list ways in which the new knowledge will be useful to you in relation to Personal Entrepreneurial Competencies (PECs), Environment and Marketing (E&M), Conduct Pre-Operation Aquaculture Activities(CPOA), Changing Water of Aquaculture facility(CWAF), Determine and Analyze Mortality(DAM), Prepare and Secure Aquaculture Facilities(PSAF).

	K (Know)	W (Want)	L (Learned)	S (So What)
PECs				
E &M				
CPOA				
CWAF				
DAM				
PSAF				





## Module 1. Personal Entrepreneurial Competencies (PECs)



Have you ever thought of running your own business? Entrepreneurship has brought great success to some, but it's not a career path for all. Do you think you can handle the stress and hard work that go with running a small business enterprise? The key to succeed in a small business enterprise is your entrepreneurial ability to produce the desired results. Before embarking on your first business, it's worth spending some time evaluating your own preparedness for entrepreneurship. Try to examine your own personality and compare it with the Personal Entrepreneurial Competencies (PECs) of a successful entrepreneur. Ask yourself if you are ready to enter into the world of business. If your answer is yes, take this reminder: ***“Successful entrepreneurs continuously develop and improve their PECs”.***

Content Standard	Performance Standard
The learner demonstrates understanding of Personal Entrepreneurial Competencies (PECs).	The learner prepares an activity plan that addresses his/her development areas based on his/her PECs and improves further his/her areas of strength.



## Learning Objectives:

1. Assess ones' Personal Entrepreneurial Competencies (PECs): characteristics, attributes, lifestyles, skills and traits.
2. Assess practitioner's characteristics, attributes, lifestyle, skills, and traits.
3. Compare one's PECs with that of a practitioner /entrepreneur.
4. Align one's PECs with that of a practitioner/ entrepreneur.

**Hello there! Are you ready to assess yourself to become a successful entrepreneur in the future? As honesty as you could, please answer the pre-assessment below.**



## Pre- Assessment

### A. Matching Type

**Directions:** Column A lists the characteristics of a successful entrepreneur. Draw a line from the items in Column A that connects with the correct definition of terms listed in Column B.

Column A	Column B
1.Hardworking 2.Self-confident 3.Profit-Oriented 4.Goal-Oriented 5.Persistent 6.Responds to feedback 7.Willing to listen 8.Committed 9.Reliable and has integrity 10.Risk-taker	a. Ability to set realistic targets. b. Interest in money generation. c. Belief in oneself to succeed. d. Working diligently and industriously. e. Being able to listen to the advice of others. f. Obtaining useful feedback and advice from others. g. Being patient and strives to achieve the goal. h. Ability to take measured or calculated risks. i. Being honest, fair and trustworthy. j. A major priority in the entrepreneur's life.



**Are you done? This time you will do another set of pre-assessment which could give you a better understanding of what this module is all about. Are you ready? So, let's begin!**

## **B. Multiple Choice.**

**Directions:** Read and study the situation that describes the entrepreneurial characteristics or attributes. Answer the question by writing the letter of your choice in your assignment notebook or in the answer sheet provided.

***Mrs. Gina Magno opens her own processed fish product business. She knows that her personal entrepreneurial characteristics are insufficient to ensure a successful operation of the business that she has in mind. Your answers to the questions below will help in developing her PECs.***

1. What PECs must she possess if there are customers who complain about the quality of her product?
  - a. Hardworking
  - b. Patient
  - c. Versatile
  - d. All of the above
  
2. Which of the following is NOT considered a characteristic of an entrepreneur?
  - a. Copes with failure
  - b. Dependent
  - c. Opportunity seeker
  - d. Persistent

3. If she wants to ensure a profitable business operation, what characteristic must she maintain?
  - a. Committed
  - b. Futuristic
  - c. Goal oriented
  - d. Opportunity seeker
  
4. Mrs. Magno follows the advice of a friend to be flexible especially if she intends to open a retail business. What PECs does Mrs. Magno demonstrate?
  - a. Open to feedback
  - b. Persistent
  - c. Reliable and has integrity
  - d. Confident
  
5. She tells Mary, her best friend that she has a strong will and does not give up in find a solution to a business problem. What PECs has been does Mrs. Magno demonstrate?
  - a. Hard work
  - b. Persistence
  - c. Risk- taking
  - d. Confident

This time evaluate your own personal entrepreneurial characteristics to determine whether you too, can become an entrepreneur. If you are ready, you may begin!



### C. Self- Assessment

**Directions:** Below is a list of Personal Entrepreneurial Competencies (PECs) of a successful entrepreneur. Put a check mark on the 2nd column that indicates your strong PECs. The check mark on the 3<sup>rd</sup> column are those PECs that need to be developed.

Personal Entrepreneurial Competencies of an Entrepreneur	My Personal Entrepreneurial Competencies	
	Strength	Need to be Developed
Hardworking		
Self-confident		
Builds for the future		
Profit-oriented		
Goal-oriented		
Persistent		
Copes with failure		
Responds to feedback		
Demonstrates initiative		
Willing to listen		
Sets own standards		
Copes with uncertainty		
Committed		
Builds on strengths		
Reliable and has integrity		
Risk-taker		



Did you enjoy examining yourself? You can become a successful entrepreneur someday. Please don't feel bad when you discover that you still have PECS to be developed. Continue your exploration to find answers to these underdeveloped PECS



## What to KNOW?

### Lesson1. Important Entrepreneurial Traits

The following are the fundamental characteristics of an entrepreneur:

1. **Hard working:** If you are determined to run your own business, you must concentrate on your work either as a producer or a seller. The success of your business depends on how much time and effort you will spend on it.
2. **Self- Confidence:** You must have a strong faith in your ability despite the problems that you may encounter along the way.
3. **Future-Oriented:** Once you enter in a line of business, you must understand that you are in a non-stop contract. It may take several years to build up a business to a reasonable standard. The goal of most successful business people is to build a secure job with a stable income based on their own ability.
4. **Profit-Oriented:** When you enter into the world of business, obviously, you are looking for income because you know that this will be your bread and butter not only for you but also for your family. Therefore, you must see to it that the business can generate income. Another plan of action is to expand your own business through the use of your generated income.
5. **Goal-Oriented:** An entrepreneur is forward looking. You must have an advanced preparation for your business. You must set a long-term goal for the activities that are needed, an extensive preparation for the production process and procedures that you need to go through to acquire, human and non-human resources. Everything in your business **will have to be** set clearly, organized, and well-planned depending on the goal you want to achieve.

6. **Persistence:** Differences in opinion and judgment. Your opponent can be a part of the rejection on what you intend to do for your endeavor. As an entrepreneur, you must be firm, strong-willed, and stick or follow what you believe is the best.
7. **Copes with Failure:** “Learn from your mistakes”. As an entrepreneur, you must learn how to deal with the frustrations and failures. Instead, turn these into productive learning experiences.
8. **Responds to Feedback or Open to Feedback:** You must be concerned to know how well you are doing and keep track of your performance. You must obtain useful feedback and advice from others.
9. **Takes the Initiative:** A successful entrepreneur takes the initiative. You must put yourself in a position where you, personally, are responsible for the failure or success of your business.
10. **Shows Willingness to Listen:** Take time to listen to the advice, suggestions, and recommendations of fellow entrepreneurs. It will help your business grow.
11. **Set your Own Standards:** This involves developing and using logical, step-by-step plans to reach the goal; offering evaluation alternatives, monitoring progress, and switching to successful strategies. To be a successful entrepreneur, you must take into consideration that sales and production depend on your own standards.
12. **Copes with Uncertainty:** Pursue your vision to be a successful entrepreneur. You should know how to handle unusual events that may happen in the business. These include problems in; managing the workers, the delivery of goods and services, and the demand and production. You must be patient in dealing with these uncertainties.
13. **Shows Commitment:** You should know that in your business, personal needs, attachment to your friends, families, and relatives are set aside. You must separate the money for your business from the amount that you need to spend for personal obligations and lifestyles.

14. **Builds on Strengths:** Successful business people base their work on strengths. Use your manual skills, and knowledge in creating products or services. Use also your knowledge in trade and industry, and the ability to make and use a wide network of contacts to build your business.
15. **Reliable and has Integrity:** An entrepreneur must build a good reputation, and possess the courage to do the right thing. Do what you say, walk your talk, be loyal, and be fair in dealing with the subordinates and costumers.
16. **Risk-Taker:** Risk sometimes cannot be anticipated. When misfortunes happen, consider these as challenges. Work them out and set good alternatives. Risks may result to loss of your business or even bankruptcy.



### What to PROCESS:



#### Activity1: Aligning one's PECs

**Directions:** Choose from the list below the characteristics and traits that best describe your own personal entrepreneurial characteristics. Find ways on how to align them according to the personal characteristics of an entrepreneur which were discussed earlier. Write your answers in the activity sheet provided.

Creative	Resourceful	Persistent	Organized	Independent
Confident	Risk taker	Observant	Competent	Trustworthy
Optimistic	Passionate	Flexible	Sensitive	Committed
Dynamic	Knowledgeable	Hardworking	Decision-maker	Reliable
Efficient	Persevering	Decisive	Strong-minded	Courteous

Example: My PECs

My PECs	My Simple Definition	Things to do to align with PECs of a successful entrepreneur.
1. Creative		
2. Organized		
3. Competent		
4. Observant		

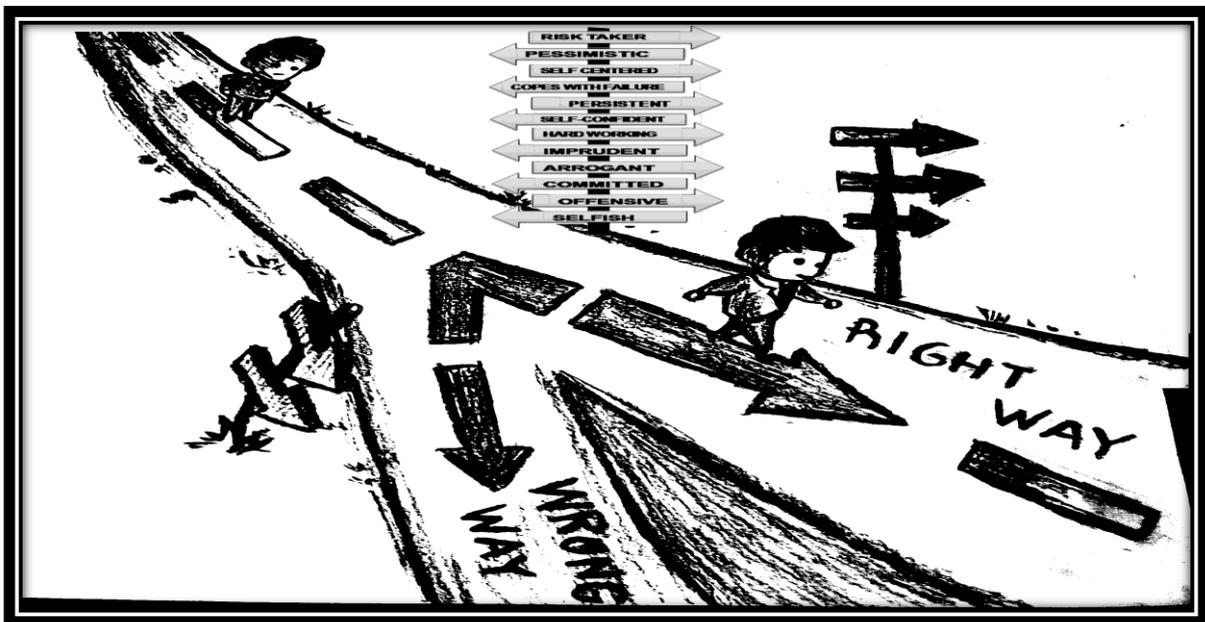


Try to design a concept map that indicates your traits, characteristics and skills that you need to possess in order to become a successful entrepreneur.



**Activity 2. My PECs that need to be further improved**

**Directions:** At the center of the street are arrows where positive and negative characteristics and traits are written. Pick out the positive PECs that you are already strong at, and write them down below the blank arrows on the left side. PECs written on the arrows at the right side are the negative characteristics that need to be further improved.





## What to REFLECT and UNDERSTAND?



### Lesson 1 Strengthening your Identified PECs

Here are your guides on how to strengthen your own PECs.

1. React positively to criticisms and be open to feedback.
2. Always demonstrate positive attitude to achieve a desired goal.
3. Always project strong and well-balanced behavior.
4. Always exercise the assertive style in your work environment.
5. Avoid being too passive and too aggressive.
6. Don't let anyone worsen your business life.
7. Prioritize your business goal rather than your personal goal in order to become a successful entrepreneur.
8. Acquire specific skills for creating and maintaining a conducive work environment.
9. Be responsible in everything you do in your business.
10. Always observe business ethics in putting up a business.



Hello! I'm here once again check whether you have achieved a certain point when you could honestly tell that you are already successful in strengthening your own PECs.

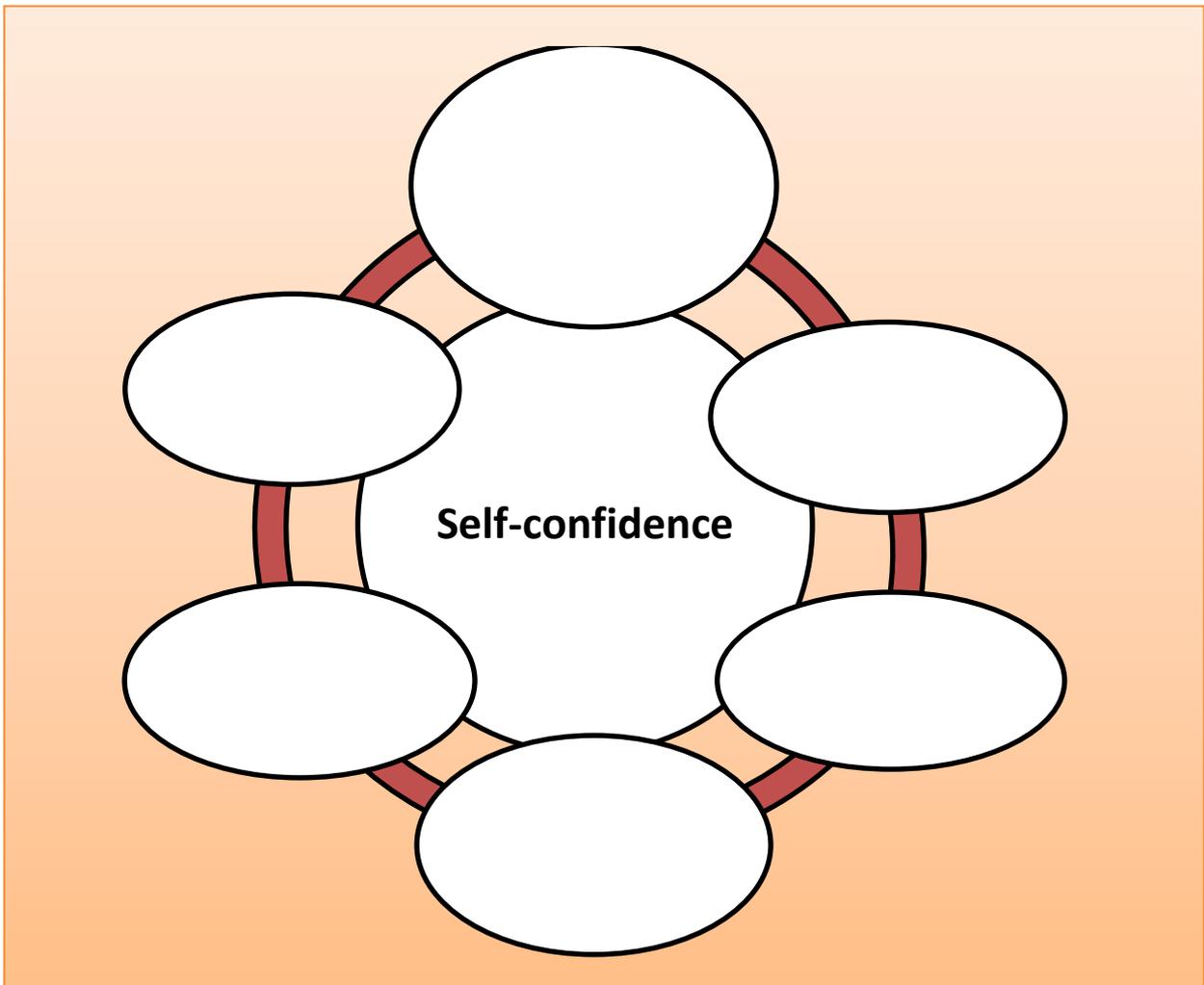
Let' s see!



## Activity 1 My techniques to strengthen PECs

**Directions:** From the given chart below, write at least six techniques on how you could strengthen your own PECs. Write the PECs that you feel you still need to focus on to strengthen them.

Example: Self-confidence





## What to TRANSFER:



## Preparation of an Action Plan

### Culminating Activity

**Directions:** Examine yourself once again. Make a list of PECs that you need to strengthen. Then, prepare an action plan to develop them further. You may opt to follow the suggested format below. You may improve or change it as long as it suits your own plan of action.

### Sample Action Plan

<b>Specific Purpose Statement:</b> ( <i>Your vision of your future</i> )						
Ex. Developing self-confidence in retail business.						
<b>Focus Area</b>	<b>Current Situation</b>	<b>Goal</b>	<b>Measures of Success</b>	<b>Actions Required</b>	<b>Time Frame</b>	<b>Reward/ Recognition</b>
My PECs	I need to develop my undefined characteristics need for my retail business. such as: _____ _____ _____ _____	To exercise my own PECs during selling and producing products/ services -To become successful in my chosen business.	Achieve 100% completion of development of my own PECs through selling and production of products, and proper manner in dealing with people.	-Selling finished products derived from culminating activities in my chosen career. -Participate in skills competition sponsored by the NGO, and GOs	-During the culminating activities -After learning the principles, theories, and process in the chosen business	-Earns expected income -Outstanding performance in selling and promoting products and services



Answer the post assessment below to determine whether there is a significant increase in your understanding of PECs.

Good Luck!



## Post-Assessment

### A. Matching Type

**Directions:** Column A lists the characteristics of a successful entrepreneur.

Draw a line from the items in Column A that connects with the correct definition of terms listed in Column B.

Column A	Column B
<ol style="list-style-type: none"> <li>1. Hardworking</li> <li>2. Self-confident</li> <li>3. Profit-oriented</li> <li>4. Goal-oriented</li> <li>5. Persistent</li> <li>6. Responds or open to feedback</li> <li>7. Willing to listen</li> <li>8. Committed</li> <li>9. Reliable and has integrity</li> <li>10. Risk-taker</li> </ol>	<ol style="list-style-type: none"> <li>a. Ability to set realistic targets.</li> <li>b. Interest in money generation.</li> <li>c. Belief in oneself to succeed.</li> <li>d. Working diligently and industriously.</li> <li>e. Being able to listen to the advice of others.</li> <li>f. Obtaining useful feedback and advice from others.</li> <li>g. Being patient and strives to achieve the goal.</li> <li>h. Ability to take measured or calculated risks.</li> <li>i. Being honest, fair and trustworthy.</li> <li>j. A major priority in the entrepreneur's life.</li> </ol>

## B. Multiple Choice.

**Directions:** Read and study the situation that describes entrepreneurial characteristics. Then answer the question by writing the letter of your choice in your assignment notebook or in the provided

***Mrs. Gina Magno opens her own processed fish products business. She knows that her personal entrepreneurial characteristics are insufficient to ensure a successful operation of the business she has in mind. Your answers to the questions below will help in developing her PECs.***

1. What PECs must she possess if there are customers who complain about the quality of her product?
  - a. Hardworking
  - b. Patient
  - c. Versatile
  - d. All of the above
2. Which of the following is NOT considered as a characteristic of an entrepreneur?
  - a. Copes with failure
  - b. Dependent
  - c. Opportunity seeker
  - d. Persistent
3. If she wants to ensure a profitable business operation, what characteristic will she maintain?
  - a. Committed
  - b. Futuristic
  - c. Goal oriented
  - d. Opportunity seeker
4. Mrs. Magno follows the advice of a friend to be flexible especially if she intends to open a retail business. What PECs does Mrs. Magno demonstrate?
  - a. Open to feedback
  - b. Persistent
  - c. Reliable and has integrity
  - d. Self- confident
5. She tells Mary, her best friend that she has a strong will and does not give up in finding a solution to a business problem. What PECs does Mrs. Magno demonstrate?
  - a. Hard work
  - b. Persistence
  - c. Risk- taking
  - d. Self-confidence



## Module 2. Environment and Market (E & M)



One of your greatest dreams in life is to become a successful entrepreneur. As a person, you are capable of developing your character and personality, and how to respond to some business challenges and opportunities. You can make things happen by identifying the opportunities around you. You may ask yourself these questions: What do people need? What products and services are available in the market today? Can they be improved? How are they made or delivered? Can things be done better? cheaper? faster? cleaner? Can a product which is used for specific purpose be also used for some other purposes?

You slowly find answers to these questions as you decide to do the first step in launching an aquaculture business enterprise. Be cautious however, that you should develop a habit of identifying opportunities around you. Only then, you will find the activity both exciting and easy.

<b><i>Content Standard</i></b>	<b><i>Performance Standard</i></b>
The learner demonstrates an understanding of environment and market in Aquaculture in one's town/municipality.	The learner independently creates a business vicinity map reflective of potential Aquaculture market within the locality.



### **Learning Objectives:**

1. Identify the players/ competitors within the town
2. Identify the different products/services available in the market
3. Identify the profile of potential customers
4. Identify the customer's needs and wants through consumer analysis
5. Conduct consumer/market analysis
6. Explore ways of generating business idea from ones' own characteristics/attributes
7. Generate business ideas using product innovation from irritants, trends and emerging needs
8. Generate business ideas using Serendipity Walk

**Hello there! Are you ready to assess yourself if you are ready to generate potential business ideas? Let's try by answering the succeeding pre- assessment.**





## Pre-assessment

1. Which of the following is not an example of peoples' basic need?
  - a. Clothing
  - b. Food
  - c. Recreation
  - d. Shelter
2. Which of the following should be considered first by a prospective entrepreneur in choosing the right location for his/her store?
  - a. Access to the target customers
  - b. The attractiveness of the store layout
  - c. The prevailing prices of goods in the area
  - d. Types of merchandise
3. Lawrence plans to put a **"Catfish Production"** in their locality. Which of the following will help him determine a successful plan for setting up of his business?
  - a. Checking for similar business to avoid competition
  - b. Conducting a SWOT analysis
  - c. Getting feedback on the quality of service
  - d. Conducting a Survey of consumer associations
4. Eleazar studies the population in his immediate community. What is his reason for doing this:
  - a. determine whom to sell his product or service
  - b. identify his would be "suki"
  - c. Predict his biggest buyers
  - d. select his favorite costumers
5. What does an entrepreneur do to the products when he improves and alters them to make them more appealing to target consumers?
  - a. alteration
  - b. improvisation
  - c. innovation
  - d. invention



## What to KNOW:



## Lesson 1. Needs and Wants of People

Everyone has his or her own needs and wants. However, people have different concepts of needs and wants. Needs in business are important things that every individual cannot do without in a society. These include:

1. Basic commodities for consumption
2. Clothing and other personal belongings
3. Shelter, sanitation, and health
4. Education and relaxation

Basic needs are essential to every individual so he/she may be able to live with dignity and pride in the community of people. These needs can obviously help you generate business ideas.

Wants are desires, luxury and extravagance that signify wealth and an expensive way of living. Wants or desires are considered above all the basic necessities of life. Some examples are the eagerness or the passion of every individual which are not basic needs like; fashion accessories, shoes, clothes, travelling around the world, eating in exclusive restaurants; watching movies, concerts, plays, having luxurious cars, wearing expensive jewelries, perfumes, living in impressive homes, and others.

Needs and wants of people are the basic indicators of the kind of business that you may engage into because it can serve as the measure of your success. Some other good points that you might consider in business undertakings are the kind of people, their needs, wants, lifestyle, culture and tradition, and their social orientation.



## Lesson 2. Generating ideas for business

Here are some ways by which you may generate possible ideas for business:

1. **Examine the existing goods and services.** Are you satisfied with the product? What do other people who use the product say about it? How can it be improved? There are many ways of improving a product from the way it is made to the way it is packed and sold. You can also improve the materials used in crafting the product. In addition, you may introduce new ways of using it, to make it more useful and adaptable to the customers' many needs. When you are improving the product or enhancing it, you are doing an *innovation*. You can also do an *invention* by introducing an entirely new product to replace the old one.

Business ideas may also be generated by examining what goods and services are sold outside the community. Very often, these products can still be enhanced or improved.

2. **Examine the present and future needs.** Observe and examine what the customers, institution, and communities are missing in terms of goods and services. Sometimes, these needs are already obvious and felt at the moment. Other needs are not that obvious because they can only be felt in the future, in the event of certain developments in the community. For example, a town will have its electrification facility in the next six months. Only by that time will the entrepreneur could think of electrically- powered or generated business such as production of aquarium fishes with aerator, seafood restaurant selling live fish, crustacean and others.

3. **Examine how the needs are being satisfied.** Needs for the products and services are referred to as market demands. To satisfy these needs is to supply the products and services that meet the demands of the market. The term market refers to whoever will use or buy the products or services, and these may be people or institutions such as other businesses, establishments, organizations, or government agencies.

There is a very good business opportunity when there is absolutely no supply to a pressing market demand.

Businesses or industries in the locality also have needs for goods and services. Their needs for raw materials, maintenance, and other services such as selling and distribution are good sources of ideas for business.

4. **Examine the available resources around you.** Observe what materials or skills are available in abundance in your area. A business can be started out of available raw materials by selling them in raw form and by processing and manufacturing them into finished products. For example, in a copra-producing town, there will be many coconut husks and shells available as “waste” products. These can be collected and made into coco rags/doormat and charcoal bricks and sold profitably outside the community.

A group of people in your neighborhood may have some special skills that can be harnessed for business. For example, women in the Mountain Province possess loom weaving skills that have been passed on from one generation to the next generation. Some communities there, set up weaving businesses to produce blankets, as well as decorative and various souvenir items for sale to tourists and lowland communities.

Business ideas can come from your own skills. The work and experience you may have in agriculture and fishery arts, industrial arts, home economics, and ICT classes will provide you with business opportunities which will give you extra

income, should you decide to engage in income-generating activities. With your skills, you may also tinker around with different things in your spare time. Many products were invented this way.

5. **Read magazines, news articles, and other publications on new products and techniques or advances in technology.** You can pick up new business ideas from Newsweek, Reader's Digest, Business Magazines, Go Negosyo, KAB materials, and Small- industry Journal. The Internet serves as a library where you may browse and surf on possible businesses. It will also guide you on how to sell the right product in the right place, at the right price, and at the right time.

Listing of possible businesses to set up in an area may also be available from banks or local non-government organizations.



### **Lesson 3. Selecting the Right Idea**

Once you have embarked on identifying the business opportunities, you will eventually see that there are many possibilities that are available for you. It is very unlikely that you will have enough resources to pursue all of them at once. Which one will you choose?

You have to select the most promising one from among hundreds and one ideas. It will be good to do this in stages. In the first stage, you screen your ideas to narrow them down to about five choices. In the next stage, trim down the five choices to two options. In the final stage, choose between the two and decide which business idea is worth pursuing.

In screening your ideas, examine each one in terms of the following factors:

1. How much capital is needed to put up the business?
2. How big is the demand for the product? Do many people need this product and will continue to need it for a long time?
3. How is the demand met? Who are processing the products to meet the demand (competition or demand)? How much of the demand is now being met (supply)?
4. Do you have the background and experience needed to run this particular business?
5. Will the business be legal, not going against any existing or foreseeable government regulation?
6. Is the business in line with your interest and expertise?

Your answers to these questions will be helpful in screening which ones from among your many ideas are worth examining further and worth pursuing.



## **Lesson 4. Environmental Scanning**

There is a need to conduct environmental scanning to identify the needs and wants of people, the niche for your business mission, and to give attention to trends and issues. This may also serve as an evaluation of the type of the entrepreneurial activity appropriate in the community.

*Environmental scanning is defined as a process of gathering, analyzing, and dispensing information for tactical or strategic purposes. The environmental scanning process entails obtaining both factual and subjective information on the business environments in which a company is operating.*

Environment in the community can be viewed according to its technological, political, economic, and social aspects. For example, in the past, people in the community used conventional way of growing fish but the transmission of development in terms of technology was interrupted because people were not satisfied with what they have today. They still look for the changes in their life that corresponds to their environment.

As a future entrepreneur, you must be well-versed in this kind of advancement and progress of your environment particularly in technology so as to ensure the success of your future business. Always think of something new, something novel, authentic, reinvent the existing ones, and create your new version of goods/products, and services. For instance, your own fish farm uses conventional methods of growing aquatic product, while in the other fish farms organic fish adapting organic method are raised. This kind of changes being made will affect the existing principles in business and industries that can be easily adapted to the changes in producing the products/services to meet the needs and wants of people in the community.



### **What to PROCESS:**

In generating business idea, you should first identify what type of business you want to put up. You should analyze and scan the potential environment, study the marketing practices and strategies of your competitors, analyze the **Strengths, Weaknesses, Opportunities**, and the **Threats** in your environment to ensure that the products/goods and services you are planning to offer will be patronized within the easy reach of your target markets/consumers.

**Bear in mind these simple rules for successful SWOT analysis.**

- *Be realistic in identifying the strengths and weaknesses of your business when conducting **SWOT** analysis.*
- *SWOT analysis should distinguish between where your business is today, and where it could be in the future.*
- *SWOT should always be specific. Avoid any grey areas.*
- *Always apply SWOT in relation to your competitor, that is, better than or worse than your competitor.*
- *Keep your SWOT short and simple. Avoid complexity and over analysis*
- *SWOT is subjective.*



**What to REFLECT and UNDERSTAND:**

People keep on searching for new things, new trends, and new issues. For these reasons, an entrepreneur must hurriedly respond to these needs and wants of people.

As generations come and go, another set of new trends will come or will exist. In order to adapt to the rapid changes in the business environment, the existing industries need to improve their products and services. But how can you generate business ideas with those strong competitors? There are three main sets of decisions that you need to make - *what to produce, how to produce, and how to share or sell the product to the market.*



### Activity 1 Mini survey

**Directions:** Conduct a mini survey in your immediate community. Gather pertinent data on population across age brackets as suggested in the matrix below. Opposite each age group, indicate their probable needs and wants.

Aquaculture Product	Price Range	Market Supply			Demand		
		Low	moderate	High	Low	moderate	High
Example:							
Tilapia							
Milkfish							
Catfish							
Mudfish							
Oyster							
Bluecrab							
Mudcrab							
Prawn							
Shimp							

**Directions:** After filling out the chart above, try to list down all the probable Business opportunities which you may wish to venture in. Remember to consider the ideas and suggestions discussed in Lesson 3. Use the suggested matrix below to indicate your choice. Write your answers in your notebook.

Example: Selling tropical Fish

Positive Factors		Negative Factors	
Strengths	Opportunities	Weaknesses	Threats



### What to TRANSFER:

Now that you have all the information, are you ready to test your ability to generate your own business idea? If your answer is yes, start studying the sample vicinity map of a community with a population of two thousand people. A concrete fish farm adapting organic method will be constructed adjacent to Daang Hari St, close to Old Molino St., its main road. This fish farm targets the homeowners who are fond of eating seafoods.



In this activity, you need to answer the questions that may lead to the generation of a probable business. Your answers to these questions will serve as the bases in formulating your own business ideas.

1. Who do you think are your target consumers/markets?
2. Where is the most ideal location to situate your business?
3. Which products or services would appeal to your target consumers/markets?
4. Can you say that you have seized the most feasible business opportunity?



## **Post-Assessment**

1. Which of the following is not an example of people's basic needs?
  - a. Clothing
  - b. Food
  - c. Recreation
  - d. Shelter
2. Which of the following should be considered first by a prospective entrepreneur in choosing the right location for his/her store?
  - a. Access to the target customers
  - b. The attractiveness of the store layout
  - c. The prevailing prices of goods in the area
  - d. Types of merchandise

3. Lawrence plans to put a “**Catfish Production**” in their locality. Which of the following will help him determine a successful plan for setting up of his business?
  - a. Checking for similar business to avoid competition
  - b. Conducting a SWOT analysis
  - c. Getting feedback on the quality of service
  - d. Conducting a Survey of consumer associations
4. Eleazar studies the population in his immediate community. What is his reason for doing this?
  - a. determine whom to sell his product or service
  - b. identify his would be “suki”
  - c. Predict his biggest buyer
  - d. select his favorite costumers
5. What does an entrepreneur do to the products when he improves and alters them to make them more appealing to target consumers?
  - a. Alteration
  - b. Improvisation
  - c. Innovation
  - d. invention



## Quarter 1

### Lesson I. Preparation and Maintenance of Aquaculture Facilities

#### Introduction:

He lessons deals on the preparation and maintenance of aquaculture facilities. This includes determining good quality of equipment, tools, and materials and ways of maintaining them; procedures in preparing aquaculture facilities and ways of monitoring them; and ways of reporting defective tools, equipment and facilities.

### Module 3. Conduct Pre-Operational Aquaculture Activities

Content Standard	Performance Standard
The learner demonstrates understanding and skill on the preparation of tools, equipment and aquaculture facilities for operation.	The learner independently prepares appropriate tools, equipment and aquaculture facilities based on standards.

#### Learning Objectives:

1. Identify aquaculture tools ,equipment and facilities
2. Explain the basic concepts in the preparation and maintenance of aquaculture tools, equipments and facilities..
3. Differentiate aquaculture tools, equipment ,and facilities.
4. Discuss the proper ways of preparation and maintaining tools, equipment and aquaculture facilities.
5. Enumerate and explain the procedure in conducting pond preparation before stocking.
6. Distinguish defective tools, equipment and facilities.

Fish culture, as an aspect of aquaculture, is one of the answers to the pressing needs of increasing food production. As a subsidiary of aquaculture, it deals with the cultivation of fishes in ponds and in other aquaculture facilities such as cages, fish pens, tanks, raceways and rice paddies. Since many freshwater and brackish water areas are utilized for fish production, it is the concern of this lesson to study the basic concepts in the preparation and maintenance of aquaculture tools, equipment and facilities, checking, cleaning, and repairing defective tool, equipment, and facilities, and the different procedures in conducting pond preparation before stocking.

Before going through the lesson, answer the pre-test to enable you to find out what you already know and what you still need to know in this modules. Answer this in your notebook.



## Pre-Assessment

Write the letter of the word or group of words that best completes the thought of each of the statements below.

- Harvesting tools, net cages and frames should be \_\_\_\_\_ after use.
  - bleached
  - checked
  - cleaned
  - stored
- In maintaining tools, materials, and equipment in aquaculture operation, the factor that is most included is \_\_\_\_\_.
  - Farm tools, equipment and materials are checked and cleaned after us
  - Farm tools, equipment and materials must be branded
  - Harvesting tools and equipment are checked for damage and repair.
  - Aquaculture facilities are inspected and repairs are done.
- \_\_\_\_\_ is a great factor in determining the quality of equipment, tools, and facilities.
  - appearance
  - brand
  - durability
  - low-cost
- \_\_\_\_\_ is used for scooping fish out of the water.
  - basin
  - bucket
  - scoop net
  - weighing scale
- It is necessary to \_\_\_\_\_ the tools, equipment, and facilities before using them in operation.
  - check
  - dispose
  - keep
  - store

B. Identify whether each item is **a.** tool; **b.** equipment; **c.** facility. Write the letter of your answer in your quiz notebook.

1. bucket
2. water pump
3. thermometer
4. scoop net
5. nets
6. screens
7. pond
8. weighing scale
9. basin
10. Gate



### Definition of Terms:

- Conical** - shaped like a cone
- Dike** - an embankment or enclosure of the pond to hold back the water and prevent flooding.
- Equipment** - the tools, clothing or any item needed for a particular activity or purpose.
- Facility** - something designed or created to provide a service or fulfill a need.
- Faulty** - containing flaws, which cause malfunctioning.
- Leak** - an unintentional hole or crack that permits something such as liquid, gas or light to escape or enter

- Maintenance-** continuing repair work; work that is to be done regularly to keep a piece of equipment in good condition.
- Seepage** - slow discharge or escape of liquid.
- Tool** - any object designed to do a specific kind of work such as cutting or chopping by applying manual force or by means of motor.



### **What to KNOW:**

#### **Maintenance of Tools, Equipment and Facilities**

When you are purchasing new tools and equipment, consider the price and quality. Quality tools and equipment need safekeeping and maintenance. Maintaining farm tools and equipment on a regular basis assures that they will be ready for farm work. Following the proper ways of monitoring the maintenance of tools, equipment and facilities in aquaculture will ensure efficiency, effectivity and serviceability.

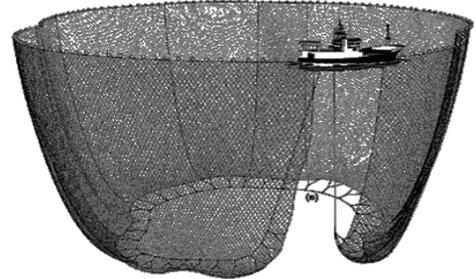
1. Clean the tools and equipment used and check them for any damage.
2. Ensure that the tools and equipment are properly guarded.
3. Use the appropriate tools for the job.
4. Read the manual before using new tools and equipment.
5. Check harvesting tools, net cages, cast net and frames for damage and repair them.
6. Follow instructions on safety procedures in using tools, equipment, and aquaculture facilities.
7. Check farm equipment and facilities according to their use.
8. Store tools safely to prevent damage and unauthorized use.



## Checking Harvesting Tools, Net Fish Cages and Frames

### Kinds of Harvesting Tools

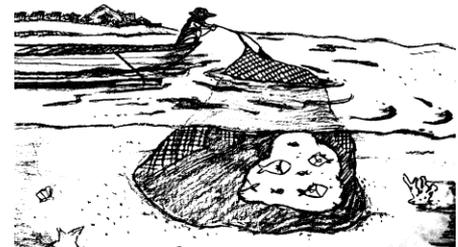
1. **Seine** – nets that consist of a bust or bag with very long wings or towing warps. The capture of fish is done by surrounding a certain area of water with school of fish and towing the gear over this area with both ends to a fixed point on the shore or on a vessel.



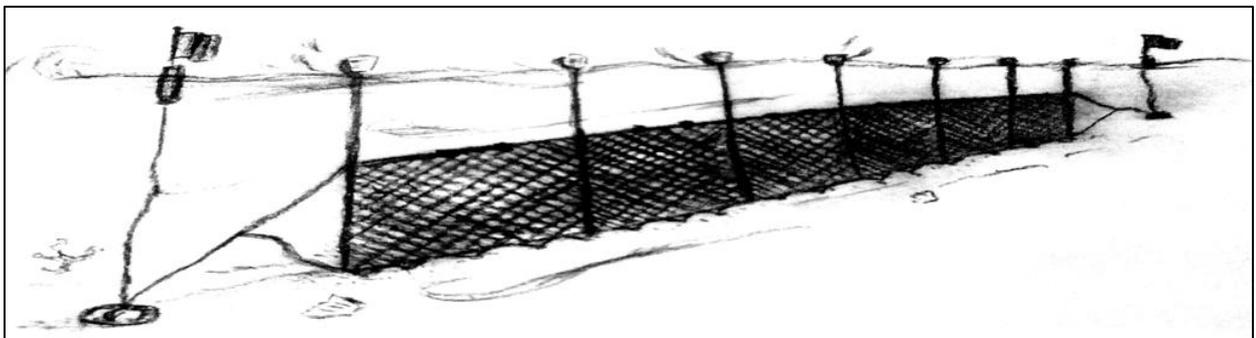
2. **Cover net** - This is a modification of cover pot .It has a rigidly formed mouth which is conical in shape. This gear is made of a net, provided with a small opening on the top and catches fish by covering.



3. **Cast net** - This is a typical type of falling gear which covers the school of fish when thrown above it. It is constructed from nets which are shaped triangularly and operated on the shallow water area.



4. **Gill net** - This is a walled curtain- like net set vertically in the water. It has meshes that allow the head of the fish to pass through but not the body.



Cover net, cast net and gill net are not commonly used in aquaculture but for catching fish in natural water bodies.

5. **Scoop net**- This is a framed bag of various shapes. Capture is done by dipping the net and scooping the fish with hand or by mechanical power. It is also used for scooping the fish out of the water for sampling purposes particularly during harvesting.



### **Kinds of Harvesting Containers:**

- a. Pail
- b. Buckets
- c. Styrofoam boxes
- d. Basin

### **Pointers to consider in maintaining harvesting tools, net cages, and frames in good working condition.**

- Before harvesting, seine meshes should be inspected for any damage. Torn meshes should be patched or mended.
- Harvesting containers should be checked for any damage. Replace any damaged containers.
- Net cages and frames should be in good condition during fish culture operation. Mend or patch torn meshes. Frames should be replaced if destroyed.

### **Aquaculture facilities**

1. **Fishpond**- Is a man- made enclosure surrounded by dikes and provided with gate and compartments where fish and other aquatic resources are cultivated from fry to marketable size.



2. **Hapa**- Is an unframed net tied to posts and principally used for nursing fry and holding breeder. It looks like an inverted mosquito net.



Source: Prepare Nursery Pond LM, TESDA PCF

3. **Fish cage**- Is a framed net that is either fixed or mobile. It is set in water, surrounded with a bamboo raft, and provided with an anchor at the bottom. It is used for the culture of fish from fry to marketable size.



Source: Agri Fishery LM for Grade 7 & 8

4. **Fish pen** - Is an enclosure of net or bamboo slats with sturdy posts staked at the bottom of the water and used for the culture of fish from fry to marketable size.



Source Agri Fishery LM for grade 7 & 8

5. **Fishtank** - Is a structure made of brick tile or concrete used for the purpose of culturing fish from fry, to marketable size. It can also be used as a breeding tank, or as a conditioning tank for breeders.



Source: Cavite State University and Agri Fishery LM for grade 7 & 8

6. **Raceway** – Is an enclosure of concrete soil or added materials generally in the shape of the canal through which constant water flows. Fish are raised in the raceway at high density and their waste products are carried out by the water passing through the areas.



Figure 6 :Raceways

Source:Agri Fishery LM for grade 7 and 8

## Ways of Identifying Defective Tools, Equipment and Facilities

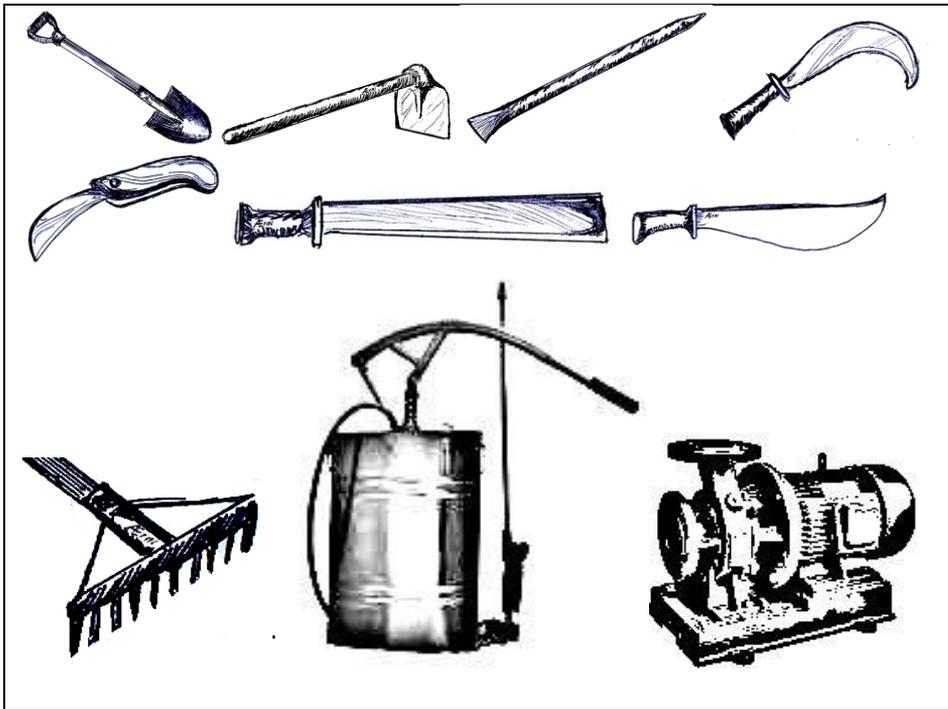
Before beginning a work on the farm, be sure you are authorized to inspect the tools and equipment. If a procedure is potentially hazardous to others in the area, warn fellow workers accordingly. Use warning signs or barriers as necessary.

Notify your farm manager or supervisor if you notice any unsafe condition such as the following:

- defective tools or equipment.
- improperly guarded machines
- oil, gas and other leaks.

Inform other fellow workers if you have seen any unsafe work practice.

However, be careful not to distract a person who is working with power tools.



**Commonly Used Farm Tools and Equipment.**

### Points to Consider:

- Follow "lock out" and "tag out" procedures that have been developed to prevent accidents.  
Any equipment that is found to be faulty needs to be identified so that other users are not put at risk, Be sure to tag the tool as faulty or broken. Write on the tag the fault, the date it was detected and your name, attach the tag to the tool/equipment.
- Smaller equipment should also be tagged and placed in an accessible location if found faulty.
- Replace workshop tools that are broken or worn out.
- Tag and set aside tools that have been identified as faulty. The tool can be used again after its repair.



### Let us Remember:

- Tools and equipment should be checked and cleaned regularly.
- The safety procedures when carrying out the tasks should be thoroughly understood and observed.
- Paying closer attention in doing the task is very important and should be observed.

Fish Farming Activities can be undertaken in three types of water. These are the following:

1. **Mariculture.** This is also called marine culture. It uses the open sea water for its culture medium. The suggested farming activities are seaweeds farming, oyster and mussel culture, cage culture of marine water fishes, pearl culture and other sea farming activities.

2. **Brackish water culture.** This refer to the combination of salt and fresh water as a culture medium. Milkfish or bangus cultivation is predominant over the cultivation of other species of fish in this water. Lately, seabass(apahap) and grouper(lapu-lapu) cultivation has caught the attention of fish farmers because of the higher price these fishes command, in both the domestic and foreign market.
3. **Freshwater culture.** The latest trend undertaken in fresh water culturels the utilization of our fresh water lakes, swamps, marshes and even our dams and raceways for fish production . Laguna lake, the largest lake in the Philippines is the most famous for its fishpen industry. Tilapia is the most popular fish cultured in freshwater.

## **Identifying and Repairing Defective Aquaculture Facilities**

### **A .Fishpond**

Before stocking, fishpond should be prepared. Leaks and seepages should be checked and repaired. Water control structures should be screened properly in order to prevent the entry fish of predators. Wind and wave breakers should be installed to protect the dike from erosion. Pond bottom soil should be prepared properly

### **B. Fish Pen and Fish Cage:**

For daily and routine work, check loose twine and torn meshes of the nets and repair immediately by mending or patching. Remove by brushing fouling organisms such as fresh water algae, sponges, and debris that set on the nylon net as soon as they are detected. Plenty of accumulated fouling organisms obstruct good water circulation. Changing the whole cage is also becoming common

Check the net screen everyday for wear and tear as there might be possible damages that may lead to the escape of fish stock. Dive and inspect the condition of nettings and other materials submerged underwater.

## C. Fish Tank

Fish tank for fish culture must be ready for operation. Check accessories such as water pump, and supply pumps aeration system, electricity and other life support system for the fish. They should always be in good condition when needed in production cycle.



### Process

#### Activity I:

Research on different samples of tools, equipment and facilities for aquaculture operation and bring it to the class.



### What to PROCESS:

#### Let's think!

1. Why is there a need to familiarize yourselves with the different tools, equipment, and facilities for aquaculture operation? Explain.
2. How are the different facilities for aquaculture operation prepared?
3. How do you prepare aquaculture facilities before stocking?
4. How do you check aquaculture facilities?



### What to REFLECT and UNDERSTAND:

Write your opinion and reflection after discussing the first part of the lesson. Can you now decide whether or not, you will be engaging in aquaculture to augment family income?

**Ex. As a student of grade 9 specializing in aquaculture and after and have acquired the knowledge and skills in the preparation of tools, equipment and facilities in aquaculture operation, I have decided to apply them in the fish production industry. \_\_\_\_\_**



## What to Transfer:

### Activity I

Visit a nearby fish farm. Jot down the different tools, equipment and facilities they used in aquaculture on operation. Draw on a short bond paper your ideal facilities with the scale of 1 mm:1 m. Follow the specific dimension and scale.

### Activity II

Make a narrative report of what you have observed during the farm visit. Indicate how the fishpond operators/caretakers check their tools, equipment, and facilities, and how inspection and repairs are done.

## Summative Assessment

**A. Multiple Choice:** Read and understand the questions below then select the correct answer.

1. Harvesting tools, net cages and frames should be \_\_\_\_\_ after use.
  - a. checked
  - b. cleaned
  - c. bleached
  - d. Stored
2. In maintaining tools, materials and equipment, in aquaculture operation the factor that is not included is \_\_\_\_\_.
  - a. Farm tools, equipment and materials are checked and cleaned after use.
  - b. Farm tools, equipment and materials must be branded
  - c. Harvesting tools and equipment are checked for damage and repair.
  - d. Aquaculture facilities are inspected and perform repairs are done
3. \_\_\_\_\_ is a great factor in determining the quality of equipment, tools and facilities.
  - a. appearance
  - b. branded
  - c. durability
  - d. Low-cost





## Quarter 2

### Introduction

#### I. Monitor Water Parameter

This lesson covers monitoring and maintaining good water quality for aquaculture. Water quality for aquaculture embraces all the physical, chemical, and biological factors that influence production of aquatic organisms. It surely affects the survival and growth as well as reproduction of fishes. All management practices are intended to improve the water quality conditions of a culture facility for maximum production. Although the design, location and management operation of a fish farm are very crucial attributes in selecting aquaculture system, whether it is a fishpond or any fish container, water quality is also of primary consideration.

Water quality management is one of the most important factors to have a healthy fish population, so, it must be given special attention. Dissolved oxygen (DO), pH, ammonia, temperature, and turbidity, and suspended solids are just but few examples of water quality variables that directly influence fish growth.

#### Module 4. Changing the Water of Aquaculture Facility

<b>Content Standard</b>	<b>Performance Standard</b>
The learner demonstrates understanding and skill in monitoring water parameters and changing water in the aquaculture facilities.	The learner monitors water parameters and change water in the fishpond/ tank in accordance to the standards.

## Learning Objectives:

1. Identify the tools and equipment used to monitor water quality.
2. Explain the importance of observing/ monitoring water quality .
3. Perform the monitoring of water parameter by following the water perimeter standards.

## Pre-Assessment

- A. Answer this pre-test to determine what you know and what you should know. Write your answer on your test notebook.

### Multiple Choice:

**Directions.** Choose the correct answer from the given choices. Write the letter of your answer in your test notebook.

1. Which of the following does not belong to the group?
  - a. pH
  - b. salinity
  - c. lime
  - d. temperature
2. What water quality parameter is affected if the pond needs to be limed?
  - a. dissolved oxygen
  - b. pH of the pond
  - c. temperature
  - d. turbidity
3. What is the most ideal pH of the pond water for the fish growth?
  - a. 5-9
  - b. 6.5-9
  - c. 7-9.5
  - d. 4-5.5
4. Which if the following will result if there is a heavy application of manure in the pond?
  - a. increase of ammonia level
  - b. increase of the fertility of the soil
  - c. increase of hydrogen sulfide level
  - d. all of the above

5. Which of the following factors in a pond operation will ensure a healthy fish population?
- a. proper stocking management
  - b. water quality management
  - c. feeding management
  - d. all of the above
6. Which of the following is a sign of oxygen depletion in the pond?
- a. Fish are in group swimming.
  - b. Fish are staying at the surface of the water.
  - c. Fish eat actively.
  - d. all of the above
7. How is a pH reading below 7 considered?
- a. Neutral
  - b. Acidic
  - c. Alkaline
  - d. None of the above
8. Which of the following is not an effect of ammonia to fish?
- a. good growth
  - b. excessive production of slime
  - c. poor growth
  - d. distended operculum
9. Which of the following instruments is used to measure the salt concentration in the water?
- a. Secchi disc
  - b. Thermometer
  - c. Refractometer
  - d. Spectrophotometer
10. Which of the following instruments is used to indicate the presence of natural food in the pond?
- a. Thermometer
  - b. Spectrophotometer
  - c. Secchi disc
  - d. Refractometer



## Definition of Terms:

**Water Quality Parameters** - the sources and losses profile in the environment, which affect fish and other aquatic organisms

**Water Transparency** - the condition of water with the presence of silting and no-silting suspended particles

**Suspended inorganic material** – the colloidal clay and coarse suspensions of soil particles

**Suspended organic material** - the colloidal or suspended remains of organisms of various stages of decomposition



## What to KNOW:

Water quality management is one of the most important factors to have a healthy fish population so it must be given special attention. To mention some, dissolved oxygen (DO), pH, ammonia, temperature and turbidity/suspended solids are just but few example of water quality variables that directly influence fish population.

## WATER QUALITY PARAMETERS

Physico-chemical parameter

1. Temperature
2. Dissolved oxygen
3. pH
4. Inorganic nitrogen
  - a. ammonia
  - b. nitrite
  - c. nitrate

5. Gases (hydrogen sulfide, methane, etc.)

6. Turbidity (clay, plankton)

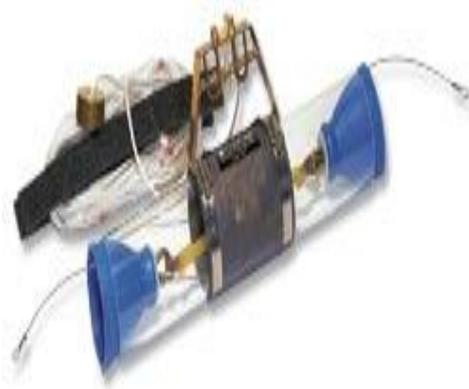
7. Salinity

### Water Monitoring Tools and Instruments

#### Refractometer



Refractometer



Water Sampler



Plankton Net



meter

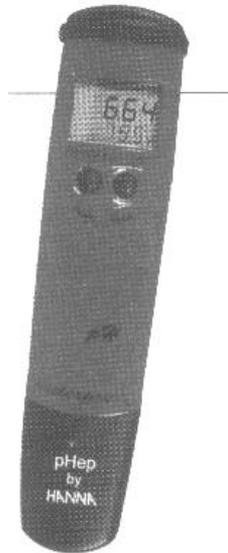
Dissolved Oxygen



**Figure I: Water Monitoring Tools and Instruments**



**Secchi disc**



**pH meter**  
**Thermometer**



**Figure 2: Water Monitoring Tools and Instrument**

Sources: Water Sampling Equipment Aquaculture & Fish Farming Products -  
© LaMotte Company.htm, STVEP CBLM, TESDA PCF

### **1. Dissolved Oxygen ( DO)**

Oxygen is a gas that fish, like all animals and human beings need in order to breathe. Through the process called respiration, fish and human beings take in oxygen and give off carbon dioxide. Fish will not grow well when the dissolved oxygen level is low. Fish will die when the dissolved oxygen level depleted. Hence, DO is one of the most important water quality parameters.

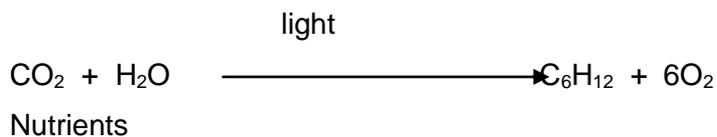
In water quality, this is the most important chemical variable. Regardless of species and culture systems, all fishes require oxygen for survival and growth. Insufficient supply of this would mean poor growth, and disease outbreak which can lead to mortality. The level of dissolved oxygen in water is measured using D.O. meter or with laboratory analysis using filtration process.

## Principal Sources of Dissolved Oxygen

### 1. Atmospheric Oxygen

The diffusion of oxygen into natural waters is slow, except under conditions of strong turbulence, so diffusion is aided by mechanical disturbance of the water surface such as by paddling, air bubbling, and using a pump to agitate the water.

### 2. Phytoplankton photosynthesis



## Dissolved Oxygen losses are caused by the following:

1. Respiration of fish
2. Negative diffusion
3. Respiration of benthos and other aquatic organisms
4. Respiration of plankton
5. Chemical oxidation
6. Phytoplankton die-offs
7. Sudden destratification of pond or lake water.

## Effects of Different Levels of Dissolved Oxygen to Fish

DO Concentration (mg/L) (ppm)	Effect
< 0.3	Fish would die if exposed to short periods
0.4-1.0	Lethal to fish if exposure is prolonged
1.1-5.0	Fish survive, but slow in growth
> 5.0	Desirable range

## **Indicators of Low Dissolved Oxygen Concentrations in the Ponds**

The following are the cardinal rules in identifying low DO in ponds:

- a. Behavior of the fish. Fish gasps air at the water surface
- b. Odor of the water. Water smells pungent
- c. Color of the water. Brownish to grayish color of water

## ***Suggested Water Management Practices***

A proper water management prevents the incidence of DO depletion. Besides the above mentioned physical symptoms of DO deficiency, there are some pointers that a fish farmer should observe:

- a. Prevent the growth of unnecessary aquatic vegetation, such as water lily, kangkong, and others over the pond surface. These plants tend to cover the pond from sunlight thereby reducing the rate of photosynthetic activities of phytoplankton to produce oxygen.
- b. Use herbicides with care. Herbicides may cause the sudden death of plant life in the pond, resulting to DO depletion.
- c. Always follow recommended rate of stocking. Overstocking leads to high oxygen consumption and possibly oxygen deficiency especially at night.
- d. Avoid overfeeding the fish. The unconsumed feeds pollute the pond water as they sink to the bottom and decay. The decaying organic matter consumes oxygen.
- e. Follow the recommended fertilizer rates. Applying more than what is required may result in algae blooming and algae die off. Decomposing organic matter consumes oxygen..

## 2. Hydrogen Ion Concentration (pH)

This is the measure of hydrogen ions ( $H^+$ ) in the water and is measured on a scale of 1 to 14. If the pH is between 0 to 6.9, the water is considered to be acid. If the pH is at 7, the water is neutral. If the pH is between 7.1 to 14 the water is basic. The indication that pH is not within the ideal range for fish culture is when there is no growth of plankton. The remedial procedure is to apply lime.

**Table I. Effects of Different Levels of pH to Fish**

<b><i>pH Range</i></b>	<b>Effect</b>
< 0-4	Acid death point. Fish die because of acidity.
4.1-5	No reproduction will occur.
5.1- 6.4	There will be slow growth because of low fish food production.
6.5 – 9	Desirable range, fish thrive well and grow fast.
11	Alkaline death point. Fish die because of alkalinity.

### ***Scientific Method of pH Determination***

In measuring pH scientifically there are several ways like. These are the use of litmus paper or colorimetric, a pH comparator, portable pH meter, and the Hach Kit or its equivalent.

## Procedure in Determining the pH of the Water

The manufacturer's instructions should be consulted in the use of a pH meter. Before making pH measurement, carefully calibrate the meter with a pH 7 buffer solution. However, this procedure does not guarantee that the meter will read other pH values correctly. A second buffer solution, pH 5 if samples are expected to be acidic or pH 9 if samples are expected to be basic, should be used to determine if the pH meter will read a second pH correctly after it has been calibrated at pH 7.

- a. Collect water samples from the surface, middle and bottom layers of a pond.
- b. If water samples have been collected, stored in bottles and placed in iced box, the *in situ* pH should be calculated by formula below:
- c. Determine the pH of water samples. Make 3 readings per sample and report average.

$$\text{In situ pH} = \text{Measured pH} + [0.0114 \times (\text{Measuring temperature} - \text{in situ temperature})]$$

- d. The temperature coefficient, 0.0114, is useful for general purposes. The formula is used when samples were stored in low temperature and allowed to warm to room temperature for determination in the laboratory.
- e. Present summary of data in a table.
- f. Discuss similarities and differences in the pH values of the three layers of pond water.

## Practical Methods of pH Measurement

In the absence of equipment, there are two ways how to determine the pH of the water:

- a. Taste the water. If it has a sour taste it is *acidic*, while if it is bitter, it is *basic*.
- b. Source of the water. Water from swamps, bogs or stagnant areas usually is acidic.

### 3. Ammonia (NH<sub>3</sub>)

Ammonia is usually present in the water as an intermediate product of natural breakdown of protein into simple nitrogenous compounds. Usually, it is present in effluents from sewage works and intensive livestock rearing units and in industrial effluents as well. The waste of the fish can also be a source of ammonia. There are two types of ammonia; the NH<sub>3</sub> being the more toxic, and has a great effect on the pH level and the NH<sub>4</sub> which is less toxic.

For aquaculture, it is highly toxic. As a rule of thumb, the higher the pH and the temperature, the higher the percentage of the total ammonia that is in toxic form. For freshwater species, the safe level of un-ionized ammonia is between 0.02 and 0.5 mg/L (Stickney, 1979), although different species of fish have certain tolerance limits.

#### ***Sources of Ammonia in the Water***

- a. Decomposition of organic matter, particularly after fertilizing the pond with organic manure or inorganic ammonia based fertilizers. The decomposition of waste feed in intensive fish farming will also produce ammonia.
- b. Excretion of aquatic organisms. Particularly fish and shellfish in intensive aquaculture systems, and also during fish transportation.
- c. Denitrification. Ammonia is oxidized to nitrite and less harmful nitrate in oxygenated waters (a process known as nitrification). In deoxygenated waters nitrate is converted to nitrite and ammonia (denitrification).
- d. Death of phytoplankton blooms. High levels of ammonia in pond systems are commonly associated with the death of phytoplankton blooms.

## ***Effects of Ammonia on Fish***

Here are some signs of ammonia toxicity in fish:

- poor growth
- spongy appearance of gill filaments
- excessive production of slime
- distended operculum

## ***Scientific Method of Measuring Ammonia***

Ammonia can be measured by the use of Hach Kit, Tetra test kit, and an ammonia electrode or spectrophotometer.

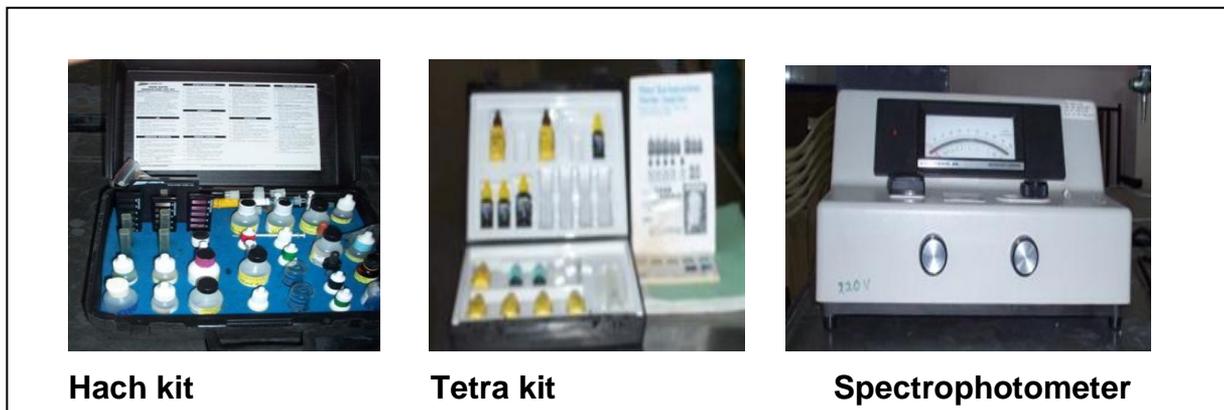


Figure 3: Equipment and Tools used in measuring Ammonia  
Source: STVE CBLM

## **Suggested Water Management**

*There are several ways to avoid ammonia toxicity in pond*

- Avoid excessive application of manure because this is the most common source of high ammonia levels in ponds.
- Supplemental feeds should be given only when necessary. Unconsumed feeds will just settle and decompose at the bottom of the pond, hence ammonia level increases.

Here are some techniques that could be done to reduce the effects of ammonia in fish population.

- Improved overall dissolved oxygen concentration by aeration and water change. It will also tend to decrease the pH (hence reduce toxicity), and may blow off some of the gaseous unionized ammonia from the water.
- Good pond management. Healthy phytoplankton population will remove ammonia from the water. Care should be taken when using fresh manure which is high in ammonia. (These can be left to dry for a few days if required to allow ammonia gas to escape).
- Stocking, feeding control, and improved water flows in more intensive systems.
- Chemical treatment. Salt has been shown to reduce the toxicity of nitrite ( $\text{NO}_2$ ) ammonia to Clarias (catfish) ponds in Thailand, 299-300 kgs/rai (1 rai =  $1600\text{m}^2$ ).
- Biological filtration. This maybe used to treat water to convert ammonia to nitrite to less harmful nitrate (nitrification), however, excessibly high content of nitrate may also be harmful.

#### **4. Hydrogen Sulfide ( $\text{H}_2\text{S}$ )**

Hydrogen sulfide is a poisonous gas which evolves from the pond bottom as a result of decaying organic matter, such as dead algae. Its presence is easily detected by its smell which is similar to that of a rotten hard-boiled egg. For excellent fish condition, 0.002 mg/L of water is the maximum acceptable level for hydrogen sulfide.  $\text{H}_2\text{S}$  production happens only under anaerobic decomposition when oxygen is present and sulfur is in  $\text{SO}_4$  form.

### ***Effects of Hydrogen Sulfide on Fish***

Here are some of the effects of hydrogen sulfide on fish:

- mass mortality
- small patches or hemorrhage in the gill region

### ***Methods of Measurement***

For scientific way of measuring hydrogen sulfide one may use chemical kit e.g. Hach Kit

Besides the scientific way, there are practical ways on how to determine hydrogen sulfide toxicity.

- emission of a very unpleasant odor which is similar to that of a rotten hard-boiled egg
- presence of dead fish like gobies, which has a very low hydrogen sulfide tolerance.

### ***Suggested Water Management***

Draining and drying of the pond from 1 to 2 weeks until the pond bottom cracks is a practical way of eliminating hydrogen sulfide. If just in case draining is not possible, water agitation with the use of boats or the likes is also applicable. On the other hand, adding of fresh water into the pond can also eliminate hydrogen sulfide. Organic fertilizer can only be applied when the smell disappeared to restore the productivity of the water.

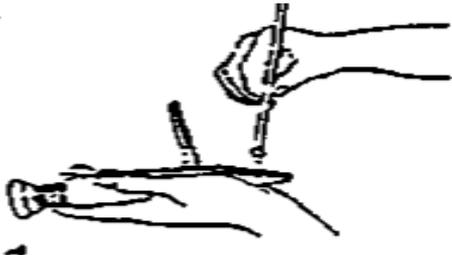
**5. Salinity** - It is simply defined as the concentration of mineral salts in water.

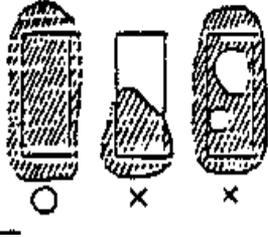
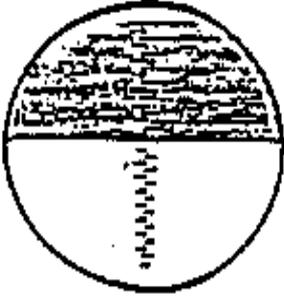
Aquatic environment used for aquaculture varies based on its salinity ranges. Salinity is expressed in part per thousand (ppt, 0/00 or “per mille”). One ppt is 1/10 of 1%.

**There are several methods on how to measure salinity, such as:**

- a) Titration – This is one of the methods used following the general procedure for titration, which is laborious.
- b) Water density determination with the use of hydrometer taken at the appropriate temperature (20<sup>0</sup>C). The water density can be rapidly converted to salinity by using tables developed for that purpose.  
Drawback: Hydrometer is too fragile and often breaks even when great care is observed.
- c) Refractometer- This is the simplest and most rapid means of measuring salinity. A typical refractometer looks like a pocket telescope and requires only a drop of water in order to provide the user with an accurate measurement appropriate for aquaculture.
- d) Conductivity meter can also be used to measure salinity with a high degree of accuracy and precision.

**Procedures on how to use a refractometer**

1. Place one or two drops of sample on the prism	
2. Close the prism with special care.	

<p>3. Distribute evenly the sample over the surface of the prism</p>	
<p>4. Draw the device near the source of light and look through the field vision.</p>	
<p>5. The line between the dark and the light fields can be observed in the field vision. Read the corresponding number on the scale. This number expresses the percentage of salt in the sample.</p>	

NOTE: Refractometry is generally accurate to within  $\pm 0.5$  ppt. Others are much less than 0.1 ppt

## 6. Temperature

Temperature is a very important water quality parameter because it influences a wide array of biological, physical, and chemical processes within freshwater habitat. It also affects the distribution of organisms as it affects the solubility of dissolved oxygen.

All fish species have their own upper and lower tolerance limit for temperature. Once the temperature goes beyond these limits, the condition becomes stressful to the fish thus decreasing their resistance to diseases. The influences of temperature to tilapia are as follows:

<i>Common Name</i>	<i>Scientific Name</i>	<i>Water Temperature (°C)</i>
Tilapia	<i>Oreochromis niloticus</i>	25 - 35
Gourami	<i>Osphronemus goramy</i>	24 - 28
Tawes	<i>Puntius javanicus</i>	25 - 33
Common carp	<i>Cyprinus carpio</i>	20 - 25
Grass carp	<i>Ctenopharyngodon idellus</i>	25 - 30
Eel	<i>Anguilla japonica</i>	20 – 28
Silver carp	<i>Hypophthalmichthys molitrix</i>	25 – 30
Rohu	<i>Labeo rohita</i>	25 – 30
Mrigal	<i>Cirrhinus mrigal</i>	25 – 30
Catla	<i>Catla catla</i>	25 – 30

However, for culture purposes, the ideal water temperature must be between 25°C–30°C (Boyd, 1990).

### ***Effects of Temperature on Fish***

If the temperature is beyond the optimum tolerance limit of the fish, the following are the effects:

- very poor food conversion ratio
- abnormal metabolism as shown by its high or low growth rate

### ***Indicators that the water temperature is stressful:***

- restlessness of the fish
- poor appetite of the fish

### ***Methods of Temperature Determination***

An ordinary thermometer can be used to measure water temperature. In some cases, a DO meter with temperature sensor can also be used to monitor the water temperature.

In a practical way, one can just merely touch the water in order to know its temperature, but this requires expertise.

### ***Suggested Water Management***

Temperature usually varies depending on the atmospheric condition. Therefore, it is but wise to maintain the desirable water depth for aquaculture purposes to provide the fish population a suitable water temperature. This could be done by changing water regularly.

### **Procedure in Measuring Water Temperature in Pond**

1. Measure the depth of each pond.
2. Determine the water temperature at surface, middle and bottom layers of the pond. Construct a graph to depict the temperature profile of each pond.
3. Compare the temperature readings from the different layers of each pond
4. Determine difference between air temperature and compare with surface temperature. Tabulate results.

## **7. Turbidity**

Any suspended solids in the water contribute to the turbidity of the water. These suspended solids usually include soil particles, and organic matter, examples are fecal materials, unconsumed feeds and phytoplankton. Turbidity can either be desirable or undesirable in fish culture. If turbidity is due to plankton, it is advantageous. On the contrary, if it is caused by solid particles, it is disadvantageous, mainly because it restricts light penetration that eventually prevents any photosynthetic activity.

- It is a term for the suspended dirt and other particles in the water.
- Two sources of water turbidity are clay particles and plankton.

- Turbidity can be a problem, especially in shallow ponds, if the dirt and particles prevent sunlight from reaching the planktons. The phytoplankton can not produce oxygen.
- A cultured pond can be turbid if there are bottom feeders such as common carp stirring up the bottom mud.
- Turbidity can also originate from a water source that has a lot of silt in it.

### **Types of Turbidity**

- a. Clay Mineral turbidity - high amount of silt/ clay particles
- b. Plankton turbidity - high content of micro-organisms ( plants and animals )
- c. Humic turbidity - humic substances due to excess organic matter.

### **Clay turbidity**

- Clay turbidity is one of the problems for fertilization management in freshwater ponds. It contribute to the palatability of fish.
- This is a common problem in newly constructed ponds.
- It originates mainly from a number of sources:
  - Turbid water source
  - Rainwater run-off from pond dikes that contains clay particles in dikes not covered with vegetation
  - Erosion of pond edges caused by water movement or fish grazing.
  - Re-suspension of bottom mud by water and fish movement.

### ***Effects of Turbid water on Fish***

The following are the effects of turbid water:

- Clogs the gills of the fish
- Makes fertilization ineffective
- Decreases dissolved oxygen which Irritates the gill filaments
- As the soil/clay particles settle to the pond bottom the fish eggs will be buried or smoothen, thus suffocating the eggs.
- Destroys benthic communities due to sedimentation.

## **Plankton Productivity**

Plankton productivity can be gauged using a Secchi disc. It is a wooden device used to measure visibility of water. It is made of wood, painted black and white, and suspended by a calibrated rope. The average of the depth at which the disc disappears and reappears is the Secchi disc visibility depth.

Some considerations when taking Secchi disc visibility are as follows:

1. clearness of the day
2. position of the sun
3. roughness of the water
4. sight of the observer

### **Formula:**

$$SDVD = (\text{Depth 1} - \text{Depth 2}) / 2$$

Where:        Depth 1= depth at which disc just disappeared  
                  Depth 2= depth at which disc just appeared.

### ***Methods of Turbidity Determination***

A Secchi disc is a standard way to measure visibility on water. The disc measures 20 cm in diameter and is painted black and white in opposing quadrants to make it very visible when it is lowered in waters. A simple disc can be made from a round can lid. The disc is attached to a wooden stick or rope marked off in centimeters.

Visibility readings are taken while standing with the sun at the back of the observer. Readings are taken usually at 9 AM and 3 PM. To measure visibility of water, slowly lower the disk in water and record the depth at which the disk disappears (first reading). Lower the disc a little further, then slowly raise it and read the depth as it reappears (second reading). Compute the secchi disc visibility (SDV) by getting the average of the first and second readings.

Example: Depth at which the disk disappears = 40.00 cm ( $D_1$ )

Depth at which the disk reappears = 35.00 cm ( $D_2$ )

$$\text{SDV} = \frac{40 \text{ cm} + 35 \text{ cm}}{2} = 37.5 \text{ cm}$$

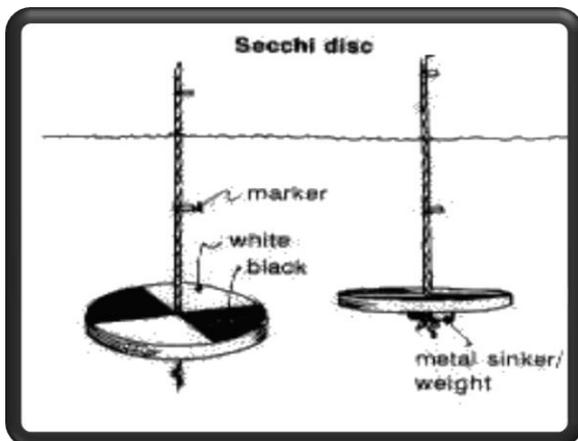


Figure 4: Secchi disc lowered in the water  
Source: STVEP CBLM



Figure 5: Measuring water turbidity using the arm  
Source: STVEP CBLM

If Secchi disc is not available, a fish farmer can use his arm and hand to measure water visibility. The fish farmer's arm serves as meter stick and the upturned or cupped palm serves as the disk. The depth at which the cupped or upturned palm disappears is taken as the visibility reading. Ideal visibility reading is within the range of 10-30 cm. Readings lower than 10 cm would indicate heavy phytoplankton bloom which means application of fertilizer is not necessary. However using the hand to measure the water visibility is done only to have a quick reading. Using Secchi disc is still the best.

## **Suggested Water Management**

The use of chopped hay placed on the pond surface is suggested. Once the hay settles into the bottom, it carries with it the silt particles thereby making the water clear. Stop fertilization regime for sometime until the ideal transparency be obtained. If clay turbidity uses hay of plankton turbidity, drain water and change with clear water.

### **METHODS OF CHANGING WATER is suggested**

1. Check water parameters. Any deficiency is a factor of changing water.
2. Remove soil seal. If the gate is soil sealed, remove the soil by using digging blade or shovel.
3. Detached flush boards from top to bottom. In some instances especially during rainy season, surface water needs to be removed. To do this, detach only 2 to 3 flush boards enough to drain surface water.
4. Flood in tidal water in pond. Watch the incoming water brought by high tide and be sure to control the water.
5. Close and soil seal the gate.



### **What to PROCESS:**

#### **Student's Activity**

Instructions:

1. Prepare and calibrate every instrument. Be sure to follow the procedure.
2. Perform the correct way of taking the readings of every parameter.
3. Determine the atmospheric conditions to be considered in every parameter.  
(clearness of the day, weather condition)
4. Be sure you record every parameter reading.

Guide Questions:

1. Why do you need to calibrate the instrument before using it?
2. Is the location on the pond a factor in the reading? If yes, what parameters are affected?
3. Which parameter registered differently? What was the reason?
4. If the reading is not ideal, what do you think is the reason?



**What to REFLECT and UNDERSTAND:**

Research/Gather information from the internet or other fish farmers about taking/monitoring the parameters of the pond water and how it is affected by atmospheric conditions ( weather condition, clearness of the day, time of the day).

Guide Questions

1. Why is water quality management important in aquaculture operation?
2. What are the other factors that could affect water quality in aquaculture facilities?



**What to TRANSFER:**

JOB SHEET # 2-1

Title	Monitoring and Maintaining Water Parameters
Purpose	To apply knowledge and demonstrate skills in monitoring and maintaining water parameters
Equipment, tools and materials	DO meter, thermometer, pH meter, secchi disc and refractometer
Precautions	Be sure to calibrate the instrument before using. Wear appropriate personal protective outfit.

## Instructions:

Select/Identify a fishpond in the community where you can perform the job aside from the pond in the school.

1. Read the respective manual for each water quality instrument.
2. Calibrate the instrument.
3. Go to the pond and monitor water quality parameters.
4. Make your own reading of every parameter. Record them.
5. Compare your readings with the readings of the worker.
6. If the reading is not ideal, what remedy can you do to obtain the optimum readings?
7. Monitor again the water quality after 4 hours to know if it is maintained.
8. Write a narrative report about the job you performed.

## Summative test

**Directions:** Choose the correct answer from the given choices. Write the letter of your answer on your test notebook.

1. Which of the following is a simple instrument used in predicting dissolved oxygen in the pond?
  - a. dissolved oxygen meter
  - b. pH meter
  - c. refractometer
  - d. thermometer
2. What do you call the device that tells whether the pond water is acidic, alkaline or neutral.
  - a. pH meter
  - b. salinometer
  - c. secchi disc
  - d. thermometer
3. Which of the following water parameters is not included in monitoring the water environment for growing fish?
  - a. temperature
  - b. salinity
  - c. water supply
  - d. dissolved oxygen

4. pH scale ranges from 0-14. If the water pH ranges below 7, what is the reaction?
- a. acidic
  - b. basic
  - c. neutral
  - d. none of the above
5. Which of the following refers to a circular metal or wooden device painted alternately black and white attached to a graduated pole or rope that is used to measure the transparency of water.
- a. pH meter
  - b. Refractometer
  - c. salinometer
  - d. Secchi disc
6. What signs will the fish show if dissolved oxygen reaches low levels?
- a. eating actively
  - b. gasping for air at the surface
  - c. swimming alone
  - d. all of the above
7. Which of the following factors may cause turbidity in the pond water?
- a. rising waste
  - b. soil erosion
  - c. planktons
  - d. all of the above
8. Which is a management technique in preventing problems with dissolved oxygen depletion?
- a. acclimatization
  - b. avoid overstocking
  - c. feeding
  - d. fertilization
9. How is water temperature measured?
- a. by using DO meter
  - b. by using pH meter
  - c. by using refractometer
  - d. by using thermometer
10. Which is the ideal range of pH for the growth of fish is?
- a. 4
  - b. 4-5
  - c. 6
  - d. 6.5-9
11. Which of the following pond management will lead to dissolved oxygen deficiency in ponds?
- a. proper feeding
  - b. heavy manuring
  - c. pond freshening
  - d. none of these

12. Which of the following is a result of low oxygen in the pond?
- a. Fishes grow fast.
  - b. Fishes have uniform size.
  - c. outbreak of disease
  - d. all of the above
13. Which of the following is not a pointer to prevent oxygen depletion in the pond?
- a. Avoid over feeding
  - b. Follow recommended rate of stocking
  - c. Plant aquatic vegetation over the pond surface
  - d. Use herbicides with care
14. Which is a poisonous gas which evolves from the pond bottom as a result of decaying organic matter?
- a. ammonia
  - b. dissolved oxygen
  - c. hydrogen sulfide
  - d. all of the above
15. Which of the following factors in pond operation will ensure a healthy fish population?
- a. feeding management
  - b. proper stocking management
  - c. water management
  - d. all of these
16. Which of the following is a sign of oxygen depletion in the pond?
- a. Fishes eat actively
  - b. Fishes stay at the water surface
  - c. Fishes swim in group
  - d. all of the above
17. What does a pH reading below 7 tell about the water?
- a. acidic
  - b. alkaline
  - c. neutral
  - d. None of the above
18. Which of the following is not an effect of ammonia to fish?
- a. distended operculum
  - b. excessive production of slime
  - c. good growth
  - d. poor growth

19. Which of the following instruments is used to measure the percent of salt content in the water?

- a. thermometer
- b. refractometer
- c. secchi disc
- d. spectrophotometer

20. Which is the best remedy for any water parameter problem that occurs in the pond?

- a. Aerate the water
- b. Apply lime
- c. Change the water
- c. Feed the stocks



### Quarter 3

### Module 5: Monitor and Collect Mortalities

This module deals on how to determine and analyze mortality, and its causes in fresh, in brackish and in marine water aquaculture. It also discusses the precautionary measures in reducing mortality and the steps to disinfect, check and prevent predators.

Content Standard	Performance Standard
The learner demonstrates understanding in determining and analyzing mortality, the steps in using disinfectants and preventing predators.	The learner independently determines and analyzes mortality, and observes the use of disinfectant and prevent predator.

## Learning Objectives:

1. Determine and analyze mortality
2. Determine the causes of mortality.
3. Observe the precautionary measures in reducing mortality
4. Follow the steps in using disinfectants.
5. Check and prevent predators



## Lesson I. Determine and compute mortality in aquaculture facilities

### LO.1. Determine Mortality in aquaculture facilities (Fresh water, Brackish water and marine water facilities).

#### Pre- Assessment:

Before going through the lesson, answer this pre-test to enable you to find out what you already know and what you still need to know. Answer this in your test notebook.

#### Modified True or false:

Write **true** if the statement is correct and **if false**, change the underlined word/s to make the statement correct.

1. The term fish mortality, commonly used in British English, is a synonym for fish life.
2. Natural mortality is the removal of fish from the stock due to causes not associated with fishing.
3. Fishing mortality is the removal of fish from the stock due to environmental factor.
4. The natural environment of fish is land, When fish is removed from their environment, they are subjected to stress.
5. Any departure from the normal condition of an organism means that the organism is suffering from stress.



## Definition of Terms:

- Algal bloom** - growth of algae covering the water or excessive growth of algae on or near the surface of water.
- Cannibalism** - an act of being cannibalistic. An animal that eats the flesh of other animals of the same species.
- Competition** - The struggle between organisms of the same or different species for limited resources such as food, space and light.
- Depletion** - to use up or reduce something such as supplies, resources, or energy.
- Disease** - any deviation from the normal state of the body of fish.
- Drought** - A long period of extremely dry weather when there is not for enough rain for the successful growing of crops or the replenishment of water supply.
- Mortality** - the number of deaths that occurs at a specific time, in a specific group or from specific causes.
- Predation** - preying of one specie on another. The relationship between two groups of animals in which one specie hunts, kills, and eats the other.
- Severe** - extremely bad or dangerous.
- Starvation** - lack of food; the state of not having enough food, or loosing strength or dying because of lack of food.
- Stress** - Strain felt by species, mental, emotional or physical strain caused by example: anxiety or over crowding.
- Suffocation** - condition due to lack of air.
- Toxic** - involving something poisonous, containing a poison.



## What to KNOW:

**Fish mortality** is a term widely used in fishery science that denotes the loss of fish from a stock through death. The term is also commonly used in British English as a synonym for fish kill. Fish die as a result of a variety of natural and unnatural causes.

Fish mortality can be divided into two types:

- ❖ **Natural mortality:** the removal of fish from the stock due to causes not associated with fishing. Such causes can include starvation, body injury, stress, suffocation, disease parasites, competition, cannibalism, old age, predation, pollution, toxic algae, severe weather, or any other natural factor that causes the death of fish.
- ❖ **Fishing mortality:** the removal of fish from the stock due to fishing activities using any fishing gear.

## What is Fish Kill?

Fish kill usually happens in major production area and seldom in the ocean. The Fishes drown for lack of oxygen/oxygen depletion, diseases and parasites, toxin, algal bloom and red tide, biological decay, old age, water temperature, underwater explosion, drought, and overstocking.

The natural environment of fish is water. When fish is removed from water, they are subjected to stress. Fishpond caretaker should handle fish sensitively to avoid stress. Fish that have undergone stress are more likely to have disease.

Any departure from the normal condition of an organism means that the organism is suffering from a particular kind of diseases. Thus could lead to fish mortality.

To calculate mortality rate on the aquaculture facilities, you need to follow the formula:

$$MR = \frac{Nom}{SD} \times 100$$

Where ;

- MR = Mortality rate  
Nom = Number of collected mortality  
SD = Stocking Density



## What to PROCESS:

### Activity 1.

Consider that there are available fish stock in your school fishpond. Inspect the condition of your stock and determine if mortality occurs by observing the following.

- (a) Fish floating at the surface of the water
- (b) Migratory birds on the vicinity
- (c) Water Temperature
- (d) Water salinity
- (e) Transparency of water

Compute the mortality rate of your fish stock following the formula. Upon discovering that your classmates gather 25 pcs. of died catfish and 30 pcs. of tilapia after 3 days of stocking, can you determine the mortality rate? Show your solution with stocking of 2000 for 10 square meters.



## What to REFLECT and UNDERSTAND:

Visit a nearby fishpond. Observe the fishfarm operations.

Interview the fishpond operator to obtain the following information:

- A. Type of water used
- B. Density of stocking
- C. Presence of fish parasites and diseases
- D. Nutritional status of the pond
- E. General condition of the pond.

Discuss your findings in class.



## What to TRANSFER:

Now that you have acquired the knowledge, and information about determining and analyzing mortality, answer this question: Why do fish kills happen?”. Write your answer in your test notebook

### Post- Assessment

#### Modified True or false:

Write **true** if the statement is correct and **if false** change the underlined word/s to make the statement correct.

1. The term fish mortality commonly used in British English is a synonym for fish life.
2. Natural mortality is the removal of fish from the stock due to causes not associated with fishing.
3. Fishing mortality is the removal of fish from the stock due to environmental factor.
4. The natural environment of fish is land. When fish is removed from their environment, they are subjected to stress.
5. Any departure from the normal condition of an organism means that the organism is suffering from stress.

## Lesson 2: Determine the causes of Mortality

### Learning Objectives:

1. Enumerate the common causes of mortality
2. Identify the causes of mortality
3. Observe precautionary measures

### Pre- Assessment

Choose the letter of your best answer and write it in your test notebook.

1. Any change in the normal state of the body of the fish is called\_\_\_\_\_.  
A. fish disease  
B. nuisance to the fish  
C. physical injury to the fish  
D. stress o the fish
2. If lack of oxygen occurs in pond, the best thing to do to avoid mortality is\_\_\_\_\_.  
A. aerate the water  
B. drain the fishpond  
C. harvest the fish  
D. plant aquatic vegetation
3. Stress factors to the fish can be avoided by \_\_\_\_\_.  
A. adopting polyculture practice  
B. avoiding stress during pond preparation  
C. disinfecting pond using insecticide in a high dosage.  
D. maintaining good water quality
4. The best move for a fishfarmer to do to prevent and control fish diseases is\_\_\_\_\_.  
A. avoid giving supplemental feed to the stock .  
B. monitor fish health  
C. prepare the feeding tray during night.  
D. screen water control structure
5. Wild fish, pests and other animals in the pond can be controlled by\_\_\_\_\_.  
A. harvesting the fish  
B. maintaining good water quality  
C. planting aquatic vegetation  
D. providing protective nets and fences and scaring the birds



## What to KNOW:

### Lesson 1.2 Causes of Fish Mortality

#### Common Causes of Fish Mortality

- ❖ Oxygen Depletion
- ❖ Diseases and Parasites
- ❖ Toxin
- ❖ Algal Bloom and Redtide ( commonly occur in marine water )
- ❖ Biological Decay
- ❖ Spawning Fatalities
- ❖ Water Temperature
- ❖ Underwater Explosion( Marine water area)
- ❖ Drought and Overstocking

#### Lack of Dissolve oxygen/Oxygen Depletion

One common cause of fish mortality in the pond is lack of dissolved oxygen. In recent years, most fishpond operators had been affected by this phenomena. Insufficiency of dissolved oxygen is usually fatal to the fish especially during three to six o'clock in the morning when the amount of oxygen supply is at its lowest level. Oxygen enters the water through diffusion. The amount of oxygen that can be dissolved in water depends on the atmospheric pressure, water temperature and water salinity. Low oxygen level is the most common cause of fish kills. Oxygen level normally fluctuates even over the course of a day and is affected by weather, water temperature, (as mentioned above) the amount of sunlight, and the amount of living and dead plant and animal matters in the water. In fishpond the main source of dissolved oxygen are the phytoplanktons. This is why dissolved oxygen is decreasing during night time because phytoplanktons do not release oxygen at night.

Oxygen depletion problem can be remedied by employing the following solutions.

- **Water flowing.** Adding and draining water in the pond will allow the water to move away from the infected compartment. The current that will be produced by the movement of the water will also help dissolve oxygen from the air.
- **Agitation.** If the water from the pond compartment cannot possibly to be flowed, stirring the pond water with a motorized banca would solve the problem .Paddling with a small banca can only be used if the pond is very small, for example, less than a hectare.
- **Aeration.** Mechanically or electrically operated device that will aerate the water in the pond have been introduced. This has been proven beneficial to the prawn industry which commonly employs intensive method of farming.

### **Diseases and Parasites**

Fish are constantly exposed to a wide variety of diseases and parasites that occur in surface/bottom waters. Fish are subject to infection by disease-causing viruses, bacteria, and fungi. Fish are also parasitized by tapeworms, trematodes (grubs), nematodes (roundworms), leeches, and lice. Most of these organisms normally occur at low levels in farm ponds and in limited numbers on the fish. Some parasitized fish in a pond are not unusual. However, large numbers of infected fish are causes for concern since slow growth, sterility, stunted populations, and massive fish kills may result from extensive diseases and parasite infestations.

Fortunately, fish diseases and parasites seldom reach epidemic levels and sudden large fish kills in farm ponds are rarely caused by diseases or parasites. Fish suffering from diseases or parasites usually die slowly, a few fish each day. Only in severe cases, when fish are in poor condition, starving, crowded, injured, mixed with wild fish, or stressed by rough handling, low oxygen levels, high temperature, or chemical toxins, do diseases and parasites become a serious problem.

## Causes of Fish Diseases

A fish farmer should be aware of the following factors which commonly cause fish diseases:

- 1. Density of Stocking.** Heavily stock- ponds are prone to fish diseases and the degree of contamination and communicability is high. Care must be taken not to subject the fish to such condition. Overcrowding will lessen their resistance and will increase their susceptibility to the attack of various infectious organisms such as bacteria, protozoa, fungi and viruses.
- 2. Poor farming Conditions.** The practice of fish farming is said to be poor when water is not changed. What is important is the basic water quality requirement of the area provided. Stagnant water tends to weaken the resistance of fish. Insufficient food does not provide the nutrients that will be converted to gain in fish weight. Neglected ponds do not provide a conducive environment for growth. Instead, they encourage infectious organisms to thrive in the water and attack the fishes. Frequent changing of fresh, clean, and well-oxygenated water is desired to reduce the occurrence of fish diseases.
- 3. Quality of Fish Stock/Genetic Disorders** These are diseases presumed to be genetic in origin. Heredity plays a vital role in the success or failure of fish farming activities. When the parents of the fish stock to be grown in the pond are inferior in quality and already suffering from diseases, their characteristics may be transferred or passed on to their offsprings by heredity. To overcome this problem, stocking materials should be secured from reliable sources such as the Bureau of Fisheries and Aquatic Resources(BFAR) or other private institutions of proven reputation.
- 4. Co-existing Organisms/Presence of parasites.** Acting as causative agents of diseases, the major known agents to cause fish diseases are virus, bacteria, fungi, protozoans, and trematodes.Parasitic organisms are also common causes of mortality and loss in the fishponds.

Zero water c=exchange is designed to prevent the entry of disease causing/carrying organism. The wastes produced are by heterotrophic bacteria by balancing the Nitrogen-Carbon ratio. The waste colonized by bacteria (termed bioflac) can also serve as food for the fish-shrimps. This technology is also designed to minimized ammonia as the bacteria will utilize them.

### **Common Fish Parasites**

- Anchor worms
- Chitodonella
- Costia
- Dactylogerous
- Digenetis trematodes
- Fish Lice
- Gyrodactylous
- Ichthyophthirius multifillis
- Monogenetis Trematodes
- Nematodes
- Parasitic copepods
- Protozoans
- Scyphidis
- Spistylin
- Tetrahymena pyriformis

Ponds not properly prepared before stocking may harbor numerous kinds of parasitic organisms which will eventually attack and weaken the fish. This will cause secondary fish infection. Ponds, therefore, should be prepared properly before stocking.

5. **Nutritional Disorder/Nutritional Diseases.** This is caused by feeding error, Examples are hepatoma and lipoid hepatic degeneration. Like animals and human beings, fish also suffer from diseases caused by nutritional deficiency. Properly formulated feeds could greatly solve the nutrient deficiency problem in fish. The identified nutrients lacking in their diet should be incorporated at once in dilutions to prevent nutritional diseases. Natural food are still the best food as they contain all the necessary nutrients needed by the fish. Production of natural food should also be recommended.
6. **Stress** which weakens their resistance. Difference in water salinity, pond pH and temperature as well as long travel of the stocking materials expose the fish to considerable degree of stress. Care should be taken to acclimatize the fish to its new environment before releasing them to the pond.

**Stress can be divided into:**

- a. *Chemical Stress.* It can be attributed to low oxygen levels, high carbon dioxide, hydrogen sulfide, ammonia and nitrite level, sub-lethal level of insecticides, and heavy metals.
  - b. *Environmental stress.* This includes extremes in temperature, excessive saturation of water with gases, and excessive sunlight.
  - c. *Biological Stress.* This includes infestation of external or internal parasites or lack of balance diet.
7. **Wounds and minor injuries.** Injured fishes such as those with ruptured skins, removed scales, and minor injuries or wound are prone to secondary infection because the damaged parts serve as entry points of harmful organisms. The fishpond caretaker must be knowledgeable enough to detect the various signs of injury and symptoms of a disease before it worsens into epidemic proportions.

## Some early warning symptoms of fish suffering from disease or parasite infections:

- Discoloration, open sores, reddening of the skin, bleeding, black or white spots on the skin
- Abnormal shape, swollen areas, abnormal lumps, or popeyes
- Abnormal distribution of the fish such as crowding at the surface, inlet, or pond edges
- Abnormal activity such as flashing, twisting, whirling, convulsions, loss of buoyancy
- Listlessness, weakness, sluggishness, lack of activity
- Loss of appetite or refusal to feed

### Fish Diseases and Treatment

The aim of applying treatment is to remove, suppress, or neutralize the disease-causing circumstances and the restoration of the normal state of the diseased fish.

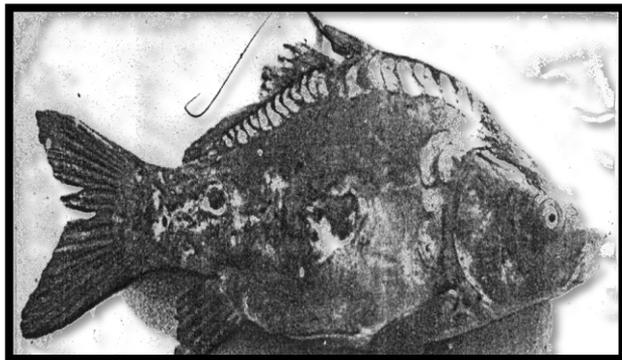
The following are types of fish diseases, symptoms, and treatment applied.

#### A. Bacterial Diseases

##### ❖ Infectious Abdominal Dropsy

##### Symptoms:

- a. Swelling of the belly
- b. Fish starts jumping
- c. Bloody areas on the body
- d. Fins are partially destroyed



Picture taken from CBLM of Tech. Voc.  
Aquaculture Module II

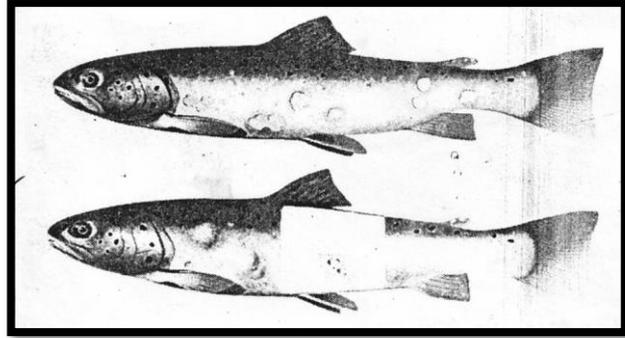
##### Treatment:

- Antibiotics mixed in water or in food, treatment against the bacteria.

## ❖ Furunculosis

### Symptoms:

- a. Bloody boils of various sizes on the body of the fish
- b. Small lumps under the skin



Picture taken from CBLM of Tech. Voc.  
Aquaculture Module II

### Treatment:

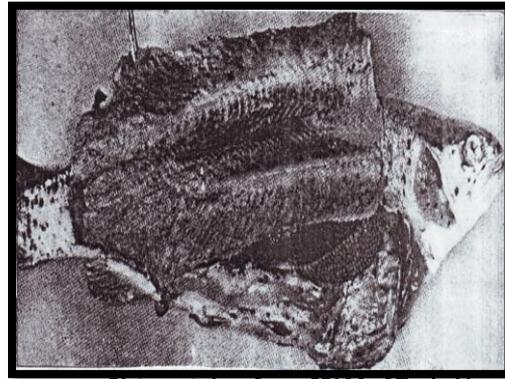
- Furunculosis can be treated with antibiotics mixed with the food.

## B. Viral Diseases

### ❖ Viral hemorrhagic septicemia

#### Symptoms:

- a. exophthalmus (swelling of the eyes)
- b. Pale gills
- c. Anus protrudes
- d. Sores on the skin



Picture taken from CBLM of Tech. Voc.  
Aquaculture Module II

### Treatment:

- At present, there is no effective treatment yet to this disease. It is probably possible to obtain certain measures of immunity.

### ❖ Infectious pancreatic necrosis

#### Symptoms:

- a. Fish swims rapidly and disorderly
- b. Fish skin turns dark
- c. Liver and spleen are pale
- d. Gall bladder shows severe necrosis



Picture taken from CBLM of Tech. Voc.  
Aquaculture Module II

### Treatment:

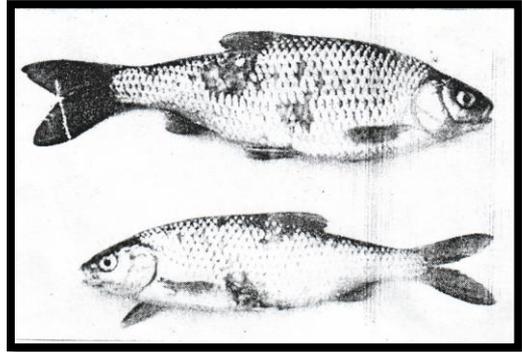
- There is no known method of treating this highly contagious disease effectively. Prophylaxis has been tried in an effort to avoid the spread of pathogenic germs.

## C. Fungal Disease

### ❖ Saprolegnia infection

#### Symptoms

- Light Brown patches on skin, fins, eyes mouth or gills.



Picture taken from CBLM of Tech. Voc.  
Aquaculture Module II

#### Treatment:

- Potassium permanganate bath 1g. per 100 liters of water for 60-90 minutes
- Salt bath 25 g. per liter of water for 10 minutes.

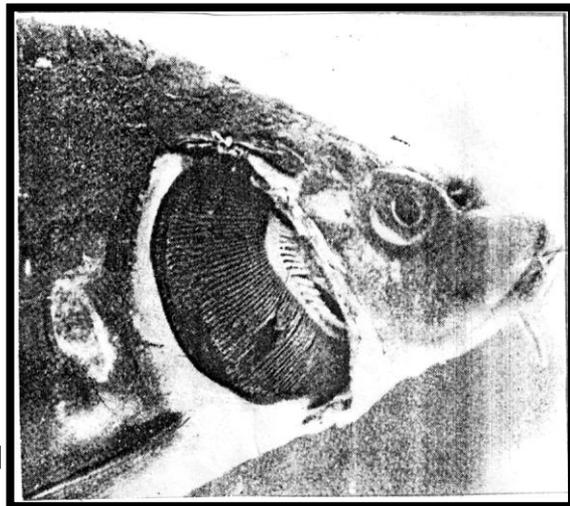
### ❖ Gill rot

#### Symptoms:

- a. Fish have pale gills

#### Treatment:

- A copper sulfate bath 1 g in 10 water for 10 to 30 minutes will parasite.



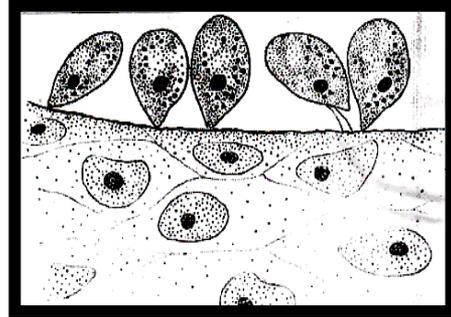
Picture taken from CBLM of Tech. Voc.  
Aquaculture Module II

### C. Disease caused by protozoans (parasites)

#### ❖ Costiasis

##### **Symptoms:**

- The skin of the affected fish is covered with a light gray blue film.
- Parts affected show red patches.
- Gills partially destroyed, turn brown.
- Fish are weak and lose their appetite.



Costia necatrix attached to the epidermis of catfish

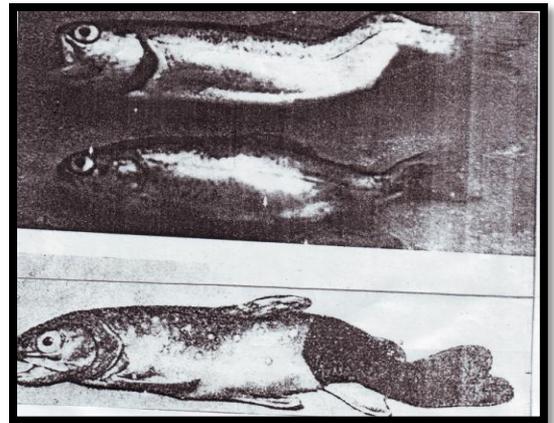
##### **Treatment:**

- Formalin bath is suggested 40 ml/100 liters of water to 15 minutes. Salt baths 10 gm/liters of water for 20 minutes.

#### ❖ Whirling disease

##### **Symptoms:**

- Fish whirl round and round then fall to the bottom.
- Fish develop black tails.
- Malformation such as deformation of the spine, shortening of the jaws and gill cover, bumps, and small cavities appear in the heads.



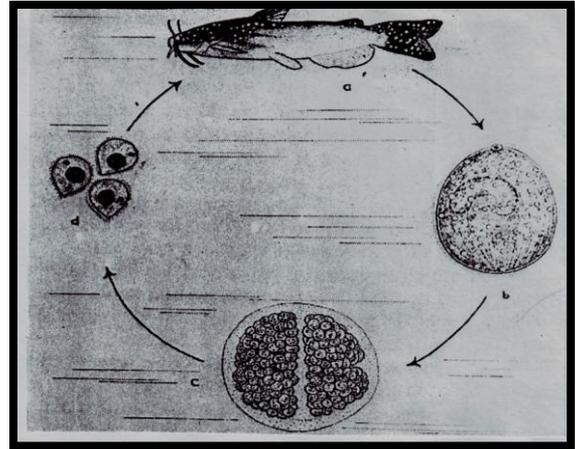
##### **Treatment:**

- Step must be taken to avoid infection, for contaminated fish cannot be cured. Once infected, it is difficult to get rid of the disease.

## ❖ Ichthyophthiriasis

### **Symptoms:**

- a. Small White spots are noticeable on the skin.
  - b. Fish rub themselves against the bottom to get rid of the parasite.
- Life cycle of Ichthyophthiriasis multifilis.



Parasite attached on the skin of a catfish.

### **Treatment:**

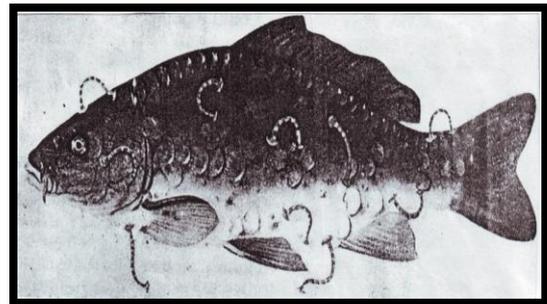
- Salt baths 30 gm per liter of water.
- Fish should be rinsed immediately with clean water.

## E. Disease caused by worms

### ❖ Fish leeches

### **Symptoms:**

- Bloody spots are found outside the body of the fish



*Carp with fish leeches*

### **Treatment:**

- Lysol solution 1 ml of Lysol for 5 liters of water for 5-15 seconds.

### ❖ Ligulosi

### **Symptoms:**

- Intestine of infected fish becomes partially destroyed.

### **Treatment:**

- In fish culture, it is possible to prevent the disease by eliminating waterfowls.

*Life cycle of Ligula intestinalis*

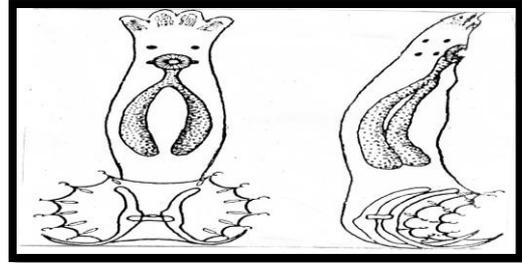
❖ **Gill Flukes**

**Symptoms:**

- The gills swell and turn gray at the edges.

**Treatment:**

- Salt baths: 25 g/liters of water for 10 minutes;  
Formalin Bath: 1 ml/liter of water for 15 minutes



Ventral and lateral view of gill fluke

**F. Diseases caused by crustaceans:**

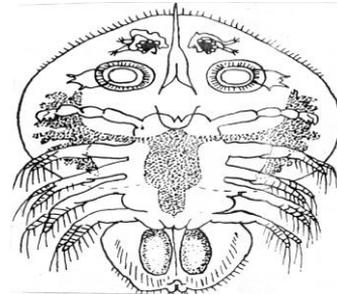
❖ **Argulus**

**Symptoms:**

- a. Red blotches on appear skin,
- b. Fish show sign of nervousness.

**Treatment:**

- 1 gram in 1 liter of potassium permanganate for 40 seconds



Fish louse

**G. Environmental Diseases**

❖ **Too alkaline and too acidic water .**

**Symptoms :**

- a. Fish secretes a lot of mucous.
- b. Gills turn brownish.

**Treatment:**

- Broadcast 200 grams of calcium carbonate ( $\text{CaCO}_3$ ) per hectare if the pond water is acidic.
- Application of acidic fertilizer 50 kg/hectare if water is highly alkaline.

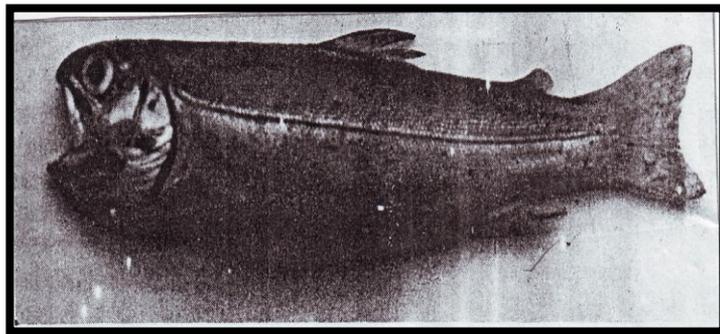
❖ **Temperature variation**

Monitor and maintain the optimum desirable temperature of water.

❖ **Lack of oxygen**

**Symptoms:**

- a. Fish dying from suffocation have wide-open mouth.
- b. Raised gill cover and widely separated gill



Brown trout dead from asphyxiation.

**H. Nutritional Diseases**

❖ **Lipoid hepatic degeneration**

**Symptom:**

Yellow-brown color of the liver.



***Preventive measures:***

- a. Food distributed must be in good condition
- b. Food should be rich in vitamins.
- c. Food should not be too fatty or too salty.

❖ **Enteritis**

**Symptoms:**

- a. Fish show red, congested, and severely inflamed intestines.

***Preventive measures:***

- a. Food distributed must be in good condition.
- b. Food should be rich in vitamins.
- c. Food should not be too fatty or too salty.

❖ **Hepatoma**

**Symptom:**

- a. External hard tumor behind the pectoral fin

**There are few practical methods for treating diseased or parasitized fish in natural pond, lake, or stream waters. Sick fish can be effectively treated in hatcheries and aquariums under controlled conditions. However, in natural waters, it is almost impossible to eradicate a disease or parasite without draining, drying, and disinfecting the pond bottom soil and destroying all the fish. Therefore, pond owners should make every attempt to prevent fish diseases and parasites from becoming a problem by:**

- **stocking only healthy fish from disease-free commercial hatchery stocks.**
- **excluding all wild fish from the pond.**
- **preventing the transfer of fish from other ponds, lakes, or streams.**
- **following the stocking recommendations to avoid overcrowding.**
- **preventing fertilizer, animal waste, or pesticide runoff into ponds**
- **avoiding overfeeding of pond fish.**

## **Toxin**

Agricultural runoff, sewage, surface runoff, chemical spills, and hazardous waste spills can all potentially lead to water toxicity and fish kill. Some algae species also produce toxins. These include *Aphanizomenon*, *Anabaena* and *Microcystis*. Natural instances of toxic condition can occur, especially in poorly buffered water. Aluminium compound can cause complete fish kills.

Human-induced fish kills are unusual, but occasionally a spilled substance causes direct toxicity or a shift of the water temperature or pH that can lead to fish kill. It is often difficult or impossible to determine whether a potential toxin is the direct cause of fish kill but with the help of the expert and proper sampling of the affected stock, fish farmers have an idea of what really causes fish kill.

Cyanide is a particular toxic compound that has been used to poach fish. In cyanide poisoning, the gills turn distinctive cherry red. Chlorine introduced as alkaline hypochlorite solution is also extremely toxic leaving pale mucilaginous gills and an overproduction of mucilage across the whole body. Lime produces similar symptoms but is also often associated with milk eyes.

## **Algal blooms and red tides**

An algal bloom is the appearance of a large amount of algae floating on the surface of a body of water. Algal blooms are the natural occurrence in nutrient-rich lakes and rivers, though sometimes, increased nutrient levels leading to algae blooms are due to fertilizer or animal waste runoff, the waste of the fish, and uneaten feeds. A few species of algae produce toxin, but most fish kills due to algae bloom, are a result of decreased oxygen levels. When algae die, decomposition uses oxygen in the water that would be available to fish. When people manage algae blooms in the fishpond, it is recommended that treatments be staggered, to avoid too much algae dying at once, which may result in a large drop in oxygen content. One of the more bizarre and recently discovered diseases produces huge fish kills in shallow marine water. It is

caused by the ambush predator *dinoflagellate, Pfiesteria piscicida*. When large numbers of fish are in confined situation such as shallow bays, the excretion from the fish encourages this dinoflagellate, which is not normally toxic, to produce free-swimming *zoospores*. If the fish remain in the area, continuing to provide nourishment, then the zoospores start secreting a *neurotoxin*. This toxin results in the fish developing bleeding lesions and their skins flake off in the water. The dinoflagellates then eat the blood and flakes of tissue while the affected fish die.

Red tide is the name commonly given to an algal bloom of *Karenia brevis*, a microscopic marine dinoflagellate which is common in Gulf of Mexico waters and in Philippine seas. In high concentrations. It discolors the water which often appears reddish-brown in color. It produces a toxin which paralyses the central nervous system of fish so they cannot breathe. Humans can also become seriously ill from eating oysters and other shellfish contaminated with the red tide toxin. The term "red tide" is also commonly used to describe harmful algal blooms .

### **Biological decay**

Just as an algae bloom can lead to oxygen depletion, introduction of a large amount of decaying biological material in pond leads to oxygen depletion as microorganisms use available oxygen in the process of breaking down organic matter.

### **Spawning Fatalities**

Some species of fish exhibit mass simultaneous mortality as part of their natural life cycle. Fish kill due to spawning fatalities can occur when fish are exhausted from spawning activities such as courtship, nest building, and the release of eggs or milt(sperm). Fish generally weaken after spawning and are less resilient than usual to smaller changes in the environment The best example is the Atlantic salmon where many of the females routinely die immediately after spawning.

## **Water temperature**

A fish kill can occur with rapid fluctuations in temperature or sustained high temperatures. Generally, cooler water has the potential to hold more oxygen, so a period of sustained high temperatures can lead to decreased dissolved oxygen in a body of water. A short period of hot weather can increase temperatures in the surface layer of water as the warmer water tends to stay near the surface and be further heated by the air. In this case, the top warmer layer may have more oxygen than the lower cooler layers because it has constant access to atmospheric oxygen. If a heavy wind or cold rain then occurs, it probably would help overturn water where accumulated toxin at the bottom would resurface. If the volume of low oxygen water is much greater than the volume in the warm surface layer, this mixing can reduce oxygen levels throughout the water column and lead to fish kill.

## **Underwater explosions**

Underwater explosions can lead to fish kill and fish with swim bladders are more susceptible. Sometimes underwater explosions are used on purpose to induce fish kills, a generally illegal practice known as blast fishing. Underwater explosions may be accidental or planned such as for construction, seismic testing, mining or blast testing of structures under water. In many places, an assessment of potential effects of underwater explosions on marine life must be completed and preventive measures taken before blasting.

## **Droughts and overstocking**

Droughts and overstocking can also result in inland fish kills.

A drought can lead to lower water volumes so that even if the water contains a high level of dissolved oxygen, the reduced volume may not be enough for the fish population. Droughts often occur in conjunction with high temperatures so that the oxygen carrying capacity of the water may also be reduced. Low river flows also reduce the available dilution for permitted discharges of treated sewage or industrial

waste. The reduced dilution increases the organic demand for oxygen thereby reducing the oxygen concentration available to fish.

Overstocking of fish (or an unusually large spawn) can also result in inland fish kills. Fish kill due to insufficient oxygen is really a matter of too much demand and too little supply for whatever reason(s). Recommended stocking densities are available from many sources of bodies of water ranging from a home aquarium or backyard pond to commercial aquaculture facilities.

### **Fish Enemies and their Effects to Fish Mortality:**

Aside from various form of fish diseases in ponds that may directly affect fish production, fish enemies and predators also contribute to failure in fish farming. The foremost fish enemies and predators are the following:

Harmful insects, Examples of harmful insects are *water beetles, water bugs, dragonflies, and larvae of other insects*.

1. Voracious fish. Fish predators such as *dalag, bid-bid, apahap*, and many other harmful fishes should be prevented from entering the pond. Great loss and damages in the stock may be attributed to these predators.
2. Harmful amphibians. The eggs of frogs and other harmful amphibians must be destroyed at once when discovered inside the pond. The larvae will not only compete for food and space but also for dissolved oxygen in the water. Amphibians also endanger the newly-stocked fish from direct feeding by the adult animals.
3. Harmful birds. The *king fisher, tagak* and other numerous other predatory birds are considered harmful. They cause losses in the fish farm because they feed on fish.
4. Reptiles. *Water snakes and lizards* also do harm in considerable proportion to the fish farming industry Extra care should be employed to protect the fish stock from these predatory reptiles. Lately, turtles have become pest. Careful pond

preparation could eliminate the problem brought about by water snakes as clear surroundings will inhibit the entry of lizards into the pond.

5. Mammals. The best means of controlling the entry of mammals such as dogs inside the fishpond area is by fencing this area or setting some sort of trap for other predatory mammals.

### ***Treatment Methods and Disease Prevention:***

#### **A. Immersion**

**Bath.** Immersion is a static chemical treatment for a period greater than 5 minutes.

**Dip.** A dip is a short bath less than 5 minutes. The chemical concentration used are much higher.

**Flush.** One dose of chemical is added to the flowing water. The chemical is diluted by water flow.

**B. Systemic Treatment.** The drug to be used is added to the fish feeds.

This method is used in treating bacterial and fungal diseases.

**C. Combination of Immersion and systemic method.**

This method is not often used but useful in fry and small aquarium fishes.

**D. Swabbing.** This method applies high concentration of chemicals to individual fish without exposing the gills to chemicals.

**E. Injection.** This is used for giving anti bacterial agent, hormones and vaccines

## Disease Prevention and Control Measures:

Basic Approaches to the prevention and control of diseases:

1. Stock healthy fish.

Use disease- free fish.

Do not mix new fish introduced to the farm, with the original stock.

2. Monitor fish health.

Check daily the feeding activity and general behavior.

3. Control wild fish, pests ,and other animal in culture pond.

*They should be:*

Screened out

Poisoned during pond preparation

Scared away especially the birds.

Nest and trees near the pond should be removed.

4. Sanitation and hygiene

Avoid the build up of feces, detritus, uneaten food and dead fish.

Every production cycle, drain and disinfect the pond.

5. Population regulation and stock age grouping

Avoid overstocking at all times. It will result to competition among the fish, stress, spread of parasites and oxygen deficiency.

6. Immunization

7. Use disease-resistant strain of fish.

8. Avoid of stress.

Do not overstock.

Maintain water flow.

Maintain good water quality.

Identify climatic changes.

Provide a fresh, well balanced diet in sufficient quantities.

9. Control Pollution.
10. Prevent by chemical prophylaxis. Treatment of fish should be based on accurate diagnosis of the disease.
11. Water source. Check the water. pH, pollution level, salinity, suspended solids, dissolved oxygen, temperature, and others.
12. Use probiotics/bioremediation

**Prevention and control measures.**

1. Bacteria

Apply disinfectant regularly.

Maintain optimal growth condition.

Eliminate causes/sources of stress.

2. Virus

Disinfect all equipment and facilities.

Re-stock with fry, fingerlings from virus -free broodstock.

Install adequate filtration, sanitizing system

Report any viral outbreak.

3. Fungal Disease

Avoid or minimize physical injuries associated with handling particularly during stocking, transporting, and re-stocking.

Handle eggs with care.

Keep the fish in the best possible condition and shield them from stress.

4. Parasites and Fish Pests

Have clean source of water supply.

Provide pathogen-free food.

Maintain hygienic practices.

Eliminate vectors, intermediate host(snail)and the definite host(small mammals and Birds).

Control wild fish.

Quarantine fish before stocking.

Avoid overcrowding and other causes of stress.



### **Let us remember:**

Fish disease is one of the main causes of fish mortality. Accurate diagnosis, treatment, and control measures must be practiced to avoid the problem.



### **What to PROCESS:**



#### **Activity I:**

#### **Let's Think!**

1. Suppose you have stocked 150 pieces of catfish in the dug-out pond in your school. What will you do to assure one hundred percent (100 %) survival rate?
2. Aside from various forms of fish diseases in pond that may directly affect fish production, what other factors could contribute to failure of fish farming?



#### **Let's Do**

#### **Activity # 2**

Make an interview with an experienced fish producer in the locality. Ask how he determines mortality in the pond. Answer the following questions and discuss the results of the interview in class:

1. What are the most common causes of mortality in the pond?
2. Why is it necessary to determine and analyze mortality?
3. How does mortality affect your production?

### Activity # 3

After the farm visit, write in a clean sheet of bond paper a summary of your observation on the different causes of fish mortality and the possible remedies to reduce such problem



#### What to REFLECT and UNDERSTAND:

Visit a farm in your locality and observe the pond condition. Make a report about the description of the pond water you had visited. Make a checklist of the common fish predators and competitors. Is the condition of the pond water suited for the cultivation? Why or why not? If you were the owner of the pond, what will you do to reduce mortality?



#### What to TRANSFER:



##### Activity 1:

Assuming that you are the fish pond care taker, and the pond owner expects you to cultivate 200 pieces of fish in a 70 sq meter pond with only 2% mortality rate what will you do in order to meet or fulfill the expectation? Make a plan of the activities you will undertake.



##### Activity 2:

Make a portfolio of the following:

- A. Picture of different fish diseases with prevention and control.
- B. Fish Predators and Competitors.



##### Activity 3:

Among the methods listed above, what do you think is the easiest common, easy, and most effective method of controlling fish diseases? Why?





## QUARTER 4

### Introduction

This module deals with the identification of tools, materials, and equipment used in the preparation of ponds; explanation and performance of procedures used in the preparation of ponds; identifying the types of preventive structures for aquaculture facilities; explaining the preventive methods in securing aquaculture facilities, and demonstrating knowledge and skills in installing preventive structures.

### Module 6. PREPARE AND SECURE AQUACULTURE FACILITIES

Content Standard	Performance Standard
The learner demonstrates understanding and skill on monitoring water parameters and changing water in the aquaculture facilities.	The learner independently monitors water parameters and changes water in the fishpond/ tank in accordance with standards.



### LESSON I: Pond Preparation

#### Objectives

1. Identify the tools, materials and equipment used in pond preparation.
2. Explain the procedures in pond preparation.
3. Perform the procedures in pond preparation

## Pre-Assessment

To assess yourself, answer this pre-test to determine what you know and what you should know. Write your answer on your test notebook.

Multiple Choice:

**Directions:** Choose the correct answer from the given choices. Write the letter of your answer in your test notebook.

1. Which of the following steps is done first in pond preparation?
  - a. Pond drying
  - b. Pond liming
  - c. Pond draining
  - d. Pond fertilization
2. Which material is used to neutralize the acidity of the soil?
  - a. Fertilizer
  - b. lime
  - c. Tobacco dust
  - d. none of these
3. How are carnivorous fishes considered?
  - a. Competitors
  - b. Predators
  - c. Nuisance
  - d. Pest
4. Why is it necessary to apply fertilizer in the pond?
  - a. To produce natural food
  - b. To neutralize the pH value
  - c. a and b
  - d. none of these
5. Which is the most economical way of eliminating pest and predators in the pond?
  - a. Leveling
  - b. Fertilization
  - c. Sun drying
  - d. Liming
6. Which of the following means making the pond bottom gradually slope from its farthest end down towards the drainage?
  - a. Leveling
  - b. Draining
  - c. Drying
  - d. Fertilizing

7. Why do you repair gates and screens during pond preparation?
- a. To make the pond beautiful                      c. To prevent the escape of stocks  
b. To make the screen durable                      d. none of these
8. Which of the following is not a task in pond preparation?
- a. Draining    c. Harvesting fish  
b. Drying    d. Repairing dikes
9. Which is the first step in pond preparation?
- a. Draining    c. Leveling  
b. Drying    d. Repairing dikes
10. Which method of eradicating pest and predators is the most safest, and most practical?
- a. Chemical method                                      c. Organic method  
b. Mechanical method                                      d. All of the above



### Definition of Terms:

- Aeration** - adding oxygen to water by spraying or bubbling air through the water
- Aquaculture** - fishery operations involving all forms of raising and culturing fish and other fishery species in brackish and marine water areas; the rearing of aquatic organisms under controlled or semi-controlled conditions
- Fertilization** - management technique applied in fish culture to enhance primary productivity.
- Fertilizer** - anything added to water to make it more productive.

- Fish Cage** - an enclosure which is either stationary or floating made up of nets or screens fastened together and installed in the water with opening at the surface or covered and held in a place by wooden/ bamboo posts or various types of anchors and floats.
- Fishpen** - an artificial enclosure constructed within a body of shallow water for culturing fish and fishery/aquatic resources made up of poles closely arranged in an enclosure with wooden materials, screen or nylon netting to prevent escape of fish.
- Fishpond** - a land-based facility enclosed with earthen or stone material to impound water for growing fish.
- Fish Tank** - any large concrete, fiber glass or steel container of liquids for culturing fish and other aquatic plants and other animals.
- Lime** - a white substance used to neutralize the acidity of the soil.
- Sanitation** - the study and maintenance of public health and hygiene especially the water supply and sewage system



### **What to KNOW:**

Proper pond preparation is the key to a successful grow-out operation. Being equipped with the proper know-how to prepare grow-out facilities such as ponds, pens, cages, and tanks is an important skill for a grow-out operator.

Pond preparation is necessary because it affects water quality during the culture period/ production process. Typically for old ponds, the initial step is drying to oxidize organic matter produced during the previous operations.

Pond preparation is conducted in accordance with organizational standard procedure.

## Procedures in pond preparation

1. **Total draining** - For proper pond preparation, pond water is drained after harvest to eliminate old stocks, predators and unwanted species. Total draining of fishpond is important.



Figure 1. Draining the pond using the water pump

Source: STVEP CBLM Aquaculture

2. **Pesticide application**- Fish production in ponds is commonly affected by some pests and predators. To ensure that all predators and unwanted species are eliminated, it is recommended to poison the pond. Poison or pesticides are applied by spraying it all over the pond bottom. It is advised not to spray poison in a totally drained pond, because it is difficult to wash the pond when the poison sticks to the soil. However most pesticides are none or less degradable so minimizing their use is highly recommended. It is better to use organic pesticides such as tobacco dust and rotten ones if available.

## Methods of eliminating and controlling pest and predators:

### 1. Mechanical removal

- ❖ Drain and dry the fish pond, ideally until the pond bottom cracks.
- ❖ Pick up fishes, snails and other predators.
- ❖ Burrowing predators may not be completely eliminated

### 2. Chemical method

- ❖ Organic pesticides although bulky or with insufficient supply are recommended because they are biodegradable.
- ❖ Inorganic or chemical pesticides are more effective but they may persist in the environment.



Figure 2: Spraying pesticide in a drained pond  
Source: STVEP CBLM Aquaculture

3. **Pond Washing** – after poisoning all the old stocks and unwanted species, pond washing is done by letting filtered water come in and out of the pond. The effects of poison will be easily removed by pond washing, however, it may affect the receiving water.
4. **Leveling the pond bottom** – The bottom of the pond is leveled to remove excess mud and dirt. It also facilitates harvesting especially during seining.

5. **Sun drying of pond bottom** – In old ponds, it is better to expose the pond bottom to sunlight to allow the soil to crack. The toxic gases evaporates and eliminates faster in a sun-dried pond bottom.



Figure 3. Drying the pond bottom until it cracks

Source: Solana Freshwater Fishery School

6. **Screening of water inlet and outlet** – Before filling the pond with water, fine mesh screen is installed in water inlet to avoid entrance of unwanted species and in water outlet to prevent the escape of fish after stocking.
7. **Filling in water** – Pond is ready to be filled with water to the required depth, after all the inlets and outlets are installed with screen.
8. **Application of lime** – if the pond becomes acidic, application of lime is recommended.

### **What is liming?**

Liming is a preventive measure or remedial process to increase alkalinity of the ponds, consequently improve aquatic organism survival, optimize growth, and ensure desirable water quality. It helps maintain optimum alkalinity level and improves the buffering capacity of water. Further, response to fertilization is best, when pH values of pond soil are brought within the range of 7.5–9.5.

Lime is commonly applied on pond bottom. To attain maximum effectiveness, lime should be raked and incorporated in the soil.

An indicator that water needs liming is when it does not turn green after fertilization. In freshwater ponds lime serves as pond sterilant, since it may kill

some of the pathogenic organisms. The amount of lime to be applied depends on how acidic the soil is and its texture. Hence, the best way to determine exact liming rate is through soil analysis. For brackishwater ponds, for instance, common application rate of lime is 1-2 tons/ha calcium carbonate (agricultural lime) or 200- 300 kg/ha calcium oxide.

5. **Fertilization** – Growth of natural food in the pond is produced through basal fertilization. Organic fertilizer is applied by broadcast method all over the pond bottom. Combination of chicken manure and inorganic fertilizer is also applied by hanging or platform method. When the natural food is already present in the pond, the pond preparation is completed and is now ready for stocking.

### **General rules for using fertilizers**

1. Water and soil must have neutral reaction or be slightly alkaline. If acidic, fertilizers will not react.
2. Bottom mud must be of good quality, rich in colloids, not too thick, and constituted principally, by fine detritus of submerged plants and algae. Bad mud resulting from emergent plants is too rich in cellulose and decomposes badly.
3. Aquatic plants in the pond must be very minimal as they compete with phytoplankton for nutrients utilization. Floating and submerged plants must not interfere with the penetration of light and heat

### **Important points to remember in fertilization**

1. For freshwater tilapia ponds, water with enough phytoplankton is indicated in the Secchi disc visibility depth of 30 cm and below. Overbloom of phytoplankton may be determined once the pond water has a visibility depth of 10 cm and below.
2. Ponds receiving full fish feeding develop enough abundance of phytoplankton.
3. Nutrients from wasted feeds become source of nutrients for phytoplankton production.

4. These nutrients can accumulate and later cause an over bloom of phytoplankton that may deteriorate water quality. In such case, refrain from fertilizing the pond except during the initial production of phytoplankton.

### Three methods on how to apply fertilizer

#### Method A. Dissolved fertilizer

- ❖ Put fertilizer particles in a pail and dissolve with water.
- ❖ Apply dissolved fertilizer evenly on pond surface.

#### Method B. Platform method

- ❖ Construct a platform made of galvanized iron sheet with area of 1 m x 1 m. The platform must have posts to stand in the water.
- ❖ Set the platform 10-15 cm below water surface.
- ❖ Put fertilizer particles on the platform and allow the fertilizer to dissolve slowly.
- ❖ The platform must be at a location of the pond where the wave action as influenced by the wind can help in the distribution of the dissolved fertilizer. It can also be positioned near water inlet so that added water will distribute the fertilizer.

#### Method C. Sack method

- ❖ Place fertilizer in a sack and suspend in water. The sacks with fertilizer must be tied to bamboos set in different locations of the pond.
- ❖ The sack will be saturated with water and fertilizer particles will be dissolved slowly

### Suggested fertilization rates

Fertilizer	Source	Application rate
Organic fertilizer	Chicken manure	5-10 t/ha
Inorganic/Chemical	Ammonium phosphate (16-20-0)	120 kg/ha
	Urea (46-0-0) + ammonium phosphate (16-20-0)	25 kg/ha + 50 kg/ha
Inorganic fertilizer	Any source	4 kg/ha/day

**NOTE:**

*Initial fertilization is done for production of natural food at lower water depth. Second fertilization is done after two weeks when water depth is increased to 1 meter. Fertilization is done every after two weeks, however, fertilization should be stopped when observed that algae is blooming.*

**SANITATION OF TANKS AND OTHER FACILITIES**

(A portion obtained from paper entitled Sanitation Practices for Aquaculture Facilities Dr. Ruth Francis-Floyd)

Sanitation is one of the cornerstones of fish health management in modern aquaculture. A number of infectious diseases, particularly external fungal infections, may be directly attributed to accumulation of organic material in the culture unit. Ponds may be sanitized between groups of fish by draining, drying, and in some instances by using of chemical sterilant such as hydrated lime. For smaller systems such as tanks and aquaria, debris should routinely be removed from the system by siphon hose. Equipment should be disinfected between culture units, and chemical disinfectant (i.e., sodium hypochlorite) should be used to disinfect fish-holding units between groups of fish. Ultraviolet light and ozone may be incorporated into recirculating culture systems to minimize the number of infectious particles in the solution. Professional advice should be sought before investing in this equipment.

Sanitation practices should include disinfection between groups of fish, cleanliness while fish are growing, and prevention of disease transmission by equipment, personnel, or water.

## **Sanitation Practices for Indoor Tank Facilities**

Fish housed in tanks or aquaria are increasingly subject to disease as intensity of rearing increases. Increased organic load, associated with high feeding and stocking rates, creates an environment where opportunist bacteria, fungi and parasites can flourish. To minimize this, water exchange should be adequate for the stocking densities and feeding rates. Particulate matter (feces, uneaten food, and others.) should be removed regularly. Dead fish should be removed promptly as they are important means of transmitting infectious disease to other fish in the system, as well as fouling the water as they decompose. Many facilities design a rotational system so that each housing unit is thoroughly cleaned once a week. Cleaning includes removal of debris by siphoning, manual removal of algae from tank walls, and removal of excess particulate matter from the biofilter or sponge filter.

It is important that siphon hoses, brushes, and other equipment used to clean tanks be chemically disinfected between uses. An easy way to disinfect cleaning equipment is to have 30-gallon garbage cans located strategically throughout the building where it can be dipped or placed between uses. Chemicals used should be minimally toxic to fish yet effective in the removal of infectious particles, oils, and other organic debris that are likely to accumulate on equipment. Commercial disinfectants should be used according to label instructions. Equipment should always be rinsed in fresh water following disinfection and before use in a tank containing live fish.

Footbaths and areas for employees to wash hands with a disinfecting soap should be placed at the entrances to buildings and between rooms within buildings. Washing hand and feet not only directly decreases the potential for spread of infectious disease, but also encourages employees to think about cleanliness.

There will be times when tanks or entire buildings must be thoroughly sanitized. Sodium hypochlorite (chlorine) is often used as a disinfectant in hatchery buildings. The granular form (i.e. HTH) should be used for disinfection of tanks that are not in use but are near tanks housing live fish. Granular chlorine does not volatilize as readily as

liquid bleach. In a poorly ventilated room, fumes from liquid bleach can cause fish kills in adjacent tanks. Concentrations of 10 mg/l for 24 hours are effective for disinfections of tanks or submersed equipment. If equipment is to be disinfected by submersion in a chlorine solution, concentrations of 200 mg/l can be used for 30 to 60 minutes, or 100 mg/l for several hours. Chlorine can then be neutralized by adding sodium thiosulfate to the solution (5.6 grams of sodium thiosulfate will neutralize the chlorine present in one gallon of a 200 mg/l solution).

If a building is to be thoroughly cleaned and disinfected while no fish are present, formalin or chlorine bleach may be used in high pressure sprays. Employees must wear protective clothing, eye protection, and respirators, and professional advice should be sought on methods, concentration, and exposure time. This extreme practice is necessary only in rare instances.

### **Ozonation**

Ozone (O<sub>3</sub>) Ultraviolet light has been used for disinfection of large marine systems (i.e., public aquaria) for years. Ozone acts as a free radical and non specifically oxidizes organic material. Ozonation plays an important role in maintenance of water clarity in large display aquaria and can help decrease the number of infectious particles in solution. Excess ozonation is hazardous to humans as well as to fish. Ozone gas is colorless and odorless. Malfunctioning ozone generators may release ozone gas, which can be a serious health hazard to humans in the vicinity. The safety recommendations made by the manufacturer should be observed. Ozone gas that remains in solution and comes in contact with live fish is also toxic. It damages epithelial surfaces (i.e., skin and gills) and will kill the fish. Before the installation of an ozone generator, professional advice should be sought to determine if it is appropriate for the system in question, and to determine the type of equipment necessary.

## CALCULATION FOR CHLORINE CONCENTRATION

How much chlorine is needed for the initial dose of 5 parts per million (5 mg/L)?

Firstly, work out the volume of water in your tank in kilolitres. –

For a cylindrical tank,

Volume of water (in kilolitres) =  $D \times D \times H \times 0.785$ , where

D = diameter of the tank (in meters), and

H = depth of water in the tank (in meters)

(To check your calculation, compare this volume with the maximum capacity of your tank).

For every kilolitre (1,000 liters) of water in your tank, add either 40 ml of liquid pool chlorine (sodium hypochlorite - 12.5% available chlorine)

;or

125 ml of plain (unscented) household-grade bleach (4% available chlorine);

Or

8 grams of granular pool chlorine (calcium hypochlorite - 65% available chlorine).

Given:

How much initial dose is needed for a tank with a diameter of 5 m and height of 3 m?

❖ liquid pool chlorine (sodium hypochlorite - 12.5% available chlorine) = \_\_\_\_\_

❖ plain (unscented) household-grade bleach (4% available chlorine) = \_\_\_\_\_

❖ granular pool chlorine (calcium hypochlorite - 65% available chlorine) = \_\_\_\_\_

## FISH CAGES

Different terms have been used for fish culture in an artificially enclosed area of a natural water body. The term '**Enclosure**' is the general term applied to a culturing unit in such types of culture.

**'Cage'** refers to the type of culturing units consisting of a framed net open at the top and floating on the surface, or when completely enclosed, the cage is kept below the water surface by adjustable buoyancy or suspending from the surface. Meanwhile 'Pen' refers to that type of culturing unit where one part of the natural water body is enclosed by a fence-like wall resting on the bottom.

### **What is a fish cage?**

A fish cage is a structure with materials which allow water to freely flow through while confining the fishes. It has rigid frames in order to retain its shape if lifted up from the water. It is used in spawning fishes and rearing during their early life stages. Further, it is the ideal place to culture fish until they reach marketable sizes.

### **Fish cage culture**

Fish cage culture is an aquaculture method of confining aquatic animals in small floating cages in ponds that cannot be drained in, reservoirs and lakes, and even at seas (at coastal areas). It is employed primarily in freshwater situations, but also found applications in coastal regions.

### **Advantages:**

1. The applicability of cage culture is extremely varied. Rivers, backwaters, reservoirs, lakes, strip-mine lakes, irrigation canals and others, are all suitable for culture without any alteration in their state or function.
2. The production in small units (cages) as well as their quick and simple harvest render the method capable both for flexible adaptation to the actual market demands and for continuous supply.
3. Cages are a convenient means of wintering, thus, they save the vast investments for separate wintering ponds.
4. Due to the high stocking density of enclosures, the direct observation of fish and immediate intervention, if necessary, are possible.
5. Harvest is simple and quick, and the technological steps can be mechanized.

6. Investment necessary to produce a unit of fish meat is 30-40 percent of that invested in a conventional fish pond system.
7. Production of carnivorous fish, in monoculture, is also feasible.
8. By producing seed for stocking natural waters in cages, building nursery ponds can be avoided.
9. An indirect advantage is that by utilizing existing natural waters, land areas for fish ponds can be used for other rural activities.
10. Cage culture can be well associated with sport fishing.
11. The in situ construction of cages is quick and simple, so both the location and dimension of cages are easy to change.
12. It facilitates feeding
13. Intensifies fish production

### **Disadvantages**

1. Since in cage culture natural feed is partly or completely ruled out of the fish diet, complete feed of higher protein content is required which significantly increases the feeding expenses in the net cost of the fish meat produced.
2. Due to high stocking density fish are more susceptible to bacterial and parasitic infection and are more sensitive to the decrease of DO (dissolved oxygen) content of water. This latter may result to lack of appetite and mortality in serious cases.
3. From the viewpoint of environmental protection, the rules of applied technology should be kept in mind.
4. When choosing the site, the foreseeable environmental stresses (pollution, oxygen depletion) should be considered. For instance, crowding can have negative impact on water quality within the cages.

## Three major factors prior to cage culturing

Before construction cage culture to a natural water body, there are three major factors which should be considered:

### Water quality

- ❖ First of all temperature, dissolved oxygen, pH, and ammonia content have to meet the requirement of the species of fish desired to be cultured.
- ❖ In addition to these parameters the total mineral content, different forms of N and P, free CO<sub>2</sub>, fenol, oil, and tar content should be measured.
- ❖ The water should not contain poisonous materials for fish. The expected change in the water quality parameters during the growing season has to be taken into account.

### Water depth

- ❖ There should be a minimum of 1 m of clear water below the bottom of the cage in order to keep it away from the mud and sediment. Generally deeper water areas have to be used for siting of the cages.
- ❖ When the water depth is considered, the expected minimum water level should be taken as a decisive value.

### Water current

- ❖ Although cage culture can be carried out successfully even in still water, water current (10-20 cm/sec) has a good effect on the oxygen supply of fish, ensuring permanent water exchange between the water body inside and outside of the cage.
- ❖ The water current helps to remove the solid wastes from the cage quickly. However a high water velocity is disadvantageous for cage fish culture for the following reasons:
  - A large part of the food can be washed away
  - The fish is forced to swim causing energy waste

- The regular shape of the cage is deformed (the useful water volume is decreased by the current)
- ❖ According to some authors, water velocity in cage fish culture should not exceed 40 cm/sec.
- ❖ The prevailing wind has to be taken into account during site selection as well. It may have a good effect on the water exchange by generating surface water current, however, if it is too strong the cages should be placed in a sheltered water area or have to be protected by breakwaters.

## **Types of cages**

### **Floating cages**

- ❖ used for freshwater
- ❖ generally relatively small
- ❖ covered with fine mesh netting
- ❖ “Hapa” nets can be easily lifted

### **Fixed cages**

- ❖ used for cage culture at sea
- ❖ Nets are anchored to the sea bottom
- ❖ fish pen

## **Types of Nets for Cage Fabrication**

- ❖ B-NET (1/4” mesh)
- ❖ DD-NET (3/8” mesh)
- ❖ CC-NET (1/2” mesh)

## **Netting**

The netting has three major functions as follows: keeping the fish stock together, protecting the stocks against harmful external influences, and allowing free water exchange between the inside and outside water.

The most commonly used netting material is flexible nylon since it is relatively inexpensive and it can be treated with chemicals against anti-fouling. Rigid netting material (e.g., rigid plastic, galvanized, or plastic coated steel) are also used in some cases

The mesh size should be large as possible, taking into account the fish size. The larger the mesh size the better the oxygen supply of the stocks and the fouling problems are less as well. The fouling of the net should be avoided by regular cleaning or by replacing it. Heavy fouling reduces the water exchange through the net wall and thus causes oxygen depletion inside the cage, increases the net drag requiring large and more expensive mooring, and increases labor requirement in cleaning and replacing the net.

### **Frame**

The frame can be made of galvanized steel, aluminum, timber, and different plastic materials. The frame should be mechanically strong, resistant against corrosion, and easily repairable or replaceable. For fixing the different frame elements together, special joints have to be used. The applied rubber and hemp hose ensure flexible connection between the adjoining cages. Although the feeder is not a real part of the frame structure, one has to provide for the mounting and easy operation of a feeder in the design.



## What to PROCESS:

### Activity #1

Visit fish farmers in your community. Observe and evaluate how they prepare their pond.

1. Why is there a need for you to observe different methods in pond preparation?
2. How do the fish farmers prepare their pond prior to stocking?
3. If you were given a chance to venture on fish farm industry, would you adopt the procedures you learned? Why?
4. Do you think the methods/ procedures of pond preparation really play an important role that leads to a successful fishpond operation ? Why?



## What to REFLECT and UNDERSAND:

### Activity #1

Research/ Gather information about the different organic chemicals used to control/ eliminate predators and pest during pond preparation. Report your work in the class. Test the effectiveness of those chemicals through experimentation by using different amounts with different volumes of water in containers containing different predators and pests.



## What to TRANSFER:

Demonstrate skill in pond preparation

### JOB SHEET # 4-1

Title	Active Participation in Preparing a Fishpond
Purpose	To apply knowledge and demonstrate skills in pond preparation
Equipment, tools, and materials	Water pump, sprayer, harrow, digging blades, shovels, lime, fertilizer
Precautions	Observe safety procedures in the workplace. Wear appropriate protective outfit.

#### Procedures:

1. Conduct a fish farm visit. The teacher will assist you arrange on this matter. Make sure that the schedule of visit will be during the pond preparation.
2. Make an active participation during the process, in order to have hands-on experience.
3. Be sure to perform the proper procedures in pond preparation.
4. Ask the farm operator the details about the number of kilos of lime and fertilizer applied in the area. Record the data in your notebook.
5. Find out how much the operator spends for the said materials.
6. Be sure to observe safety measures while in the workplace.

- a. How did you find the activity?
- b. Did you demonstrate interest and skills in performing the activity?
- c. Do you think, you can apply your learned technology in a business venture? How?
- d. Did you perform the activity with the proper use of tools. Did you observe safety measures in the area?

## LESSON 2: SECURE POND FACILITIES

### Objectives:

1. Identify the types of preventive structure for aquaculture facilities.
2. Explain the preventive methods in securing aquaculture facilities.
3. Demonstrate knowledge and skill in installing preventive structures.

### Pre-Assessment

Answer this pre-test to determine what you know and what you should know.  
Write your answer on your test notebook.

True or False: Write T if the statement is correct and F if the statement is incorrect.

1. Installing nets in the water entrance of a pond is necessary to prevent the washing out of dikes.
2. Tools and equipment must perfect in good condition.
3. To minimize the entrance of predators and loss of stocks, install plastic sheets in the pond.
4. Bamboo fence, traps and installing plastic sheets are the preventive measures in securing aquaculture facilities.
5. Regularly check the gate.
6. Burrowing aquatic animals like crabs are eliminated by installing slabs.
7. Patch the leaks or seepages of dikes with sand.
8. Install structure to prevent the entry of predators during inclement weather condition.
9. Weather and climate are factors of securing pond facilities.
10. Store the tools and equipment properly.



## Definition of Terms:

- Pond Facilities** - include gates, screens, pipes and drainage system which are inspected and secured regularly.
- Upkeeping** - the act of keeping the pond in good condition



## What to KNOW:

This lesson deals on how to secure pond facilities. This includes the different methods in upkeeping pond facilities, the preventive methods in securing pond facilities, and the procedures in installing preventive structure. The need to secure the pond facilities is important to prevent the trespassers or even poachers to come into the vicinity. Likewise, preventive structures must be installed along the water entrance to prevent the entry of predators or any unwanted specie, and most probably the loss of stocks during inclement weather condition.

### Methods in Keeping Up Facilities

1. Maintain cleanliness on top and slope of the dikes.
2. Check dikes regularly and patch up the leakage s and seepages.
3. Regularly check the gates, screens and slabs regularly.
4. Clean the pond. Remove the debris, plastic, and unwanted materials.
5. Remove oysters and other shells that are attached to the gate.
6. Clean the supply canals and culvert water pipes of debris, and other materials that may pollute the water.
7. Maintain and check the water entrance.
8. Store the tools and equipment properly.

## **Preventive Measures to Secure the Aquaculture Facilities**

1. Planting creeping grasses on the top and slope of the dike for protection against soil erosion.
2. Construction of beam and placing bamboo pegs to the dike to protect the dike from wave action.
3. Placing of plastic sheets over the dike slope to prevent washing out of the dikes.
4. Installing of screens inside and outside the gate to prevent the entrance of predators and loss of stocks.
5. Not allowing trees and bushes to grow on the dikes as the roots loosen the dike soil.
6. Totally replacing weak wooden gates including the screens to prevent predators from entering the pond system.
7. Installing fences made of nylon nets, wire screens or bamboo slats on the dikes to prevent the fish from escaping.
8. Preventing trespassers to enter the aquaculture facilities.

## **Procedure in Installing Preventive Measures**

1. Put fence made of nylon net.

### *Materials needed:*

1. Net - as fence
2. Bamboo pole – for braces
3. Rope or nylon – for tying purposes
4. Bamboo pegs – for clipping the nets
5. Digging blade or shovel – for excavating soil
6. String – for marking purposes

### *Procedure:*

1. Clear the area and remove the debris or any unwanted materials found in the place.

2. Put bamboo poles on both ends of the dikes and attach string which serves as markers of the path.
3. Install bamboo poles at a distance of 1 meter apart from the starting point of marker up to the end of the dike.
4. Arrange the nets by inserting the lower ends of nets at the bottom and clip it with bamboo pegs to make them strong, firm, and properly placed.
5. Put soil until the desired depth is reached.

## 2. Check and repair the leaks and seepage of dikes

### ***Materials needed:***

1. Digging blade – for excavating mud blocks
2. Shovel – for carrying soil/ mud blocks

### ***Procedure:***

1. Check the dikes for leaks.
2. Clean and clear the area.
3. Repair the leaks completely.

### ***For the large damage***

1. Clear the path.
2. Dig the area and fill up with a new mud.
3. Pile the mud and compact it hardly.
4. Allow the pile to harden, then place another set of pile until it leveled with the crown or top width.

## 3. Fix/repair the gate

1. All gates whether concrete, semi-concrete, or wooden are checked periodically for their efficiency in letting in and out of water.
2. Weak wooden gates are totally repaired including the coarse and fine screens before the beginning of the culture period to prevent or minimize predators and pests, from entering the pond system.

## Storing Tools and Equipment

At the end of each working day, the tools must be stored properly. First, clean the tools and equipment you used and check them from any damage. If you notice any damage, tag the tool as faulty. Then store the tools and equipment. Always ensure safe storage to prevent unnecessary accidents.



### What to REFLECT AND UNDERSTAND:

Research through the internet other improved techniques/ ways to secure aquaculture facilities. Gather information from a fishpond owner about the other innovations that could be used as preventive measures to secure the pond.

Record the gathered data and take note of the procedures.



### What to TRANSFER:

#### JOB SHEET 4-2

Title	Securing the Pond Facility by putting Fence Along the Dikes.
Purpose	To apply knowledge and demonstrate skills in securing the pond
Equipment, tools and materials	Digging blades, shovels, nets, ropes bamboo pegs
Precautions	Wear appropriate personal protective outfit Observe safety measures in the workplace.

### **Procedures:**

1. Prepare the needed materials for the task.
2. Measure the length, the width and the area to be fenced.
3. Follow the procedure you have learned.
4. Perform the job properly.
5. Wear the appropriate outfit for the job.
6. Be sure to observe safety measures while in the workplace.

## SUMMATIVE ASSESSMENT

A. Directions: Choose the correct answer from the given choices. Write the letter of your answer on your test notebook.

1. Which of the following steps is done first in pond preparation?
  - a. Pond drying
  - b. Pond liming
  - c. Pond draining
  - d. Pond fertilization
2. Which material is used to neutralize the acidity of the soil?
  - a. Fertilizer
  - b. Lime
  - c. Tobacco dust
  - d. none of these
3. How are carnivorous fishes considered?
  - a. Competitors
  - b. Predators
  - c. Nuisance
  - d. Pest
4. Why is it necessary to apply fertilizer in the pond?
  - a. To produce natural food
  - b. To neutralize the pH value
  - c. a and b
  - d. none of these
5. Which is the most economical way of eliminating pest and predators in the pond?
  - a. Leveling
  - b. Fertilization
  - c. Sun drying
  - d. Liming
6. Which of the following means making the pond bottom gradually slope from its farthest end down towards the drainage?
  - a. Cultivating
  - b. Draining
  - c. Drying
  - d. Fertilization
7. Why do you repair gates and screens during pond preparation?
  - a. To make the pond beautiful
  - b. To make the screen durable
  - c. To prevent the escape of stocks
  - d. none of these
8. Which of the following is not a task in pond preparation?
  - a. Draining
  - b. Drying
  - c. Harvesting fish
  - d. Repairing dikes

9. Which is the first step in pond preparation?
- a. Draining
  - b. Drying
  - c. Leveling
  - d. Repairing dikes
10. Which method of eradicating pest and predators is the safest and most practical?
- a. Chemical method
  - b. Mechanical method
  - c. Organic method
  - d. All of the above
11. Which is the act of keeping the pond in good condition?
- a. design
  - b. construction
  - c. upkeeping
  - d. all of the above
12. Which does not belong to the group?
- a. drainage
  - b. gates
  - c. tank
  - d. screen
13. Which of the following includes gates, screens, pipes and drainage system which are inspected and secured during cultivation period.
- a. Aquaculture facilities
  - b. Fish cage
  - c. Fishpond
  - d. Pond Facilities
14. What should be maintained and checked to prevent the entrance of predators and competitors?
- a. dikes
  - b. gates
  - c. nets
  - d. screens
15. Which of the following is not a way of checking and maintaining the pond dikes?
- a. Install net in pond dikes
  - b. Plant trees on top of the dike
  - c. repair leaks or seepage
  - d. All of these
16. What should be planted on top of the dikes to prevent soil erosion?
- a. Creeping grass
  - a. kangkong
  - c. mangrove
  - d. vegetables
17. Which of the following are stones, concrete block, or concrete slabs hand placed compactly on the dike slopes in order to prevent the scouring action of the water?
- a. Concrete slope
  - b. External support
  - c. riprap
  - d. All of these

18. Which is not a preventive measure to secure the aquaculture facilities?
- a. Check and repair dikes
  - b. Fix and repair the gates
  - c. installing fence
  - d. Allow trespassers
19. What should be constructed around the aquaculture facilities to prevent unauthorized person in the area?
- a. Install fence
  - b. Plant trees on the dikes
  - c. Put warning sign.
  - d. All of these
20. What is the common material used for barriers in fish pen/cage to prevent floating materials and water hyacinths to be trapped by the framework?
- a. bamboos
  - b. lumber
  - c. nets
  - d. None of these

B. True or False: Write T if the statement is correct and F if the statement is incorrect.

1. Installing nets in the water entrance of a pond is necessary to prevent the washing out of dikes.
2. Tools and equipment should be kept in good condition.
3. To minimize the entrance of predators and loss of stocks, install plastic sheets in the pond.
4. Bamboo fence, traps and installing of plastic sheets are the preventive measures in securing aquaculture facilities.
5. Regularly check the gate.
6. Burrowing aquatic animals like crabs are eliminated through installing slabs.
7. Patch the leaks or seepages of dikes with sand.
8. Install structure to prevent the entry of predators during inclement weather condition.
9. Weather and climate are factors of securing pond facilities.
10. Store the tools and equipment properly.

## Glossary of Terms

- Aeration** - adding oxygen to water by spraying or bubbling air through the water
- Algal bloom** - growth of algae covering the water, or excessive growth of algae on or near surface of water.
- Aquaculture** - fishery operations involving all forms of raising and culturing fish and other fishery species in fresh, brackish and marine water areas; the rearing of aquatic organisms under controlled or semi-controlled conditions
- Cannibalism** - an act of being cannibalistic; an animal that eats the flesh of other animals of the same species.
- Competition** - The struggle between organisms of the same or different species for limited resources such as food or light.
- Conical** - shaped like a cone
- Depletion** - to use up or reduce something such as supplies, resources, or energy.
- Dike** - an embankment or enclosure of the pond to hold back the water and prevent flooding.
- Disease** - any deviation from the normal state of the body of fish.
- Drought** - A long period of extremely dry weather when there is not enough rain for the successful growing of crops or the replenishment of water supply.
- Equipment** - the tools, clothing, or any items needed for a particular activity or purpose.
- Facilities** - something designed or created to provide a service or fulfil a need.
- Faulty** - containing flaws which cause malfunctioning.
- Fertilization** - management technique applied in fish culture to enhance primary productivity

<b>Fertilizer</b>	- anything added to water to make it more productive
<b>Fish Cage</b>	- an enclosure which is either stationary or floating made up of nets or screens fastened together and installed in the water with opening at the surface or covered and held in a place by wooden bamboo posts or various types of anchors and floats
<b>Fishpen</b>	- an artificial enclosure constructed within a body of water for culturing fish and fishery/aquatic resources made up of poles closely arranged in an enclosure with wooden materials, screen or nylon netting to prevent escape of fish
<b>Fishpond</b>	- a land-based facility enclosed with earthen or stone material to impound water for growing fish.
<b>Leak</b>	- an unintentional hole or crack that permits something such as liquid, gas, or light to escape or enter
<b>Lime</b>	- a white substance used to neutralize the acidity of the soil.
<b>Maintenance</b>	- continuing repair work; work that is to be done regularly to keep a piece of equipment in good condition or working order.
<b>Mortality</b>	- the number of deaths that occurs at a specific time, in a specific group or from specific causes.
<b>Predation</b>	- preying of one specie on another. The relationship between two groups of animals in which one specie hunts, kills and eats the other.
<b>Predator</b>	- destructive organism that kills other organism in order to survive.
<b>Seepage</b>	- slow discharge or escape of liquid.
<b>Severe</b>	- extremely bad or dangerous.
<b>Starvation</b>	- lack of food; the state of not having enough food, or loosing strength, or dying because of lack of food.

- Stress** - Strain felt by somebody, mental ,emotional or physical strain caused by example: anxiety or over working.
- Suffocation** - condition of caused by lack of air.
- Suspended inorganic material** – the colloidal clay and coarse suspensions of soil particles.
- Suspended organic material** - the colloidal or suspended remains of organisms of various stages of decay.
- Tool** - an object designed to do a specific kind of work such as cutting or chopping by applying manual force or by means of motor.
- Toxic** - involving something poisonous; containing a poison.
- Water Quality Parameters** - the sources and losses profile in the environment, which affect fish and other aquatic organisms.
- Water Transparency** - the condition of water with the presence of silting and no-silting suspended particles

## REFERENCES

### A. BOOKS

- Boyd, C.E., Water Quality of Warm Water Fishponds. Alabama Experimental Station, Auburn University, Alabama, Auburn. 1982
- Calmorin, Laurentina P., Introduction to Fishery Technology, Mandaluyong City, National Bookstore. Manila, Philippines, 1953.
- Huet, Marcel, Textbook of Fish Culture; Breeding and Cultivation of Fish. 1979
- Villaluz, D.K., Fish Farming in the Philippines. Bookman Inc. Manila, Philippines 1953.

### B. HANDBOOKS

- Cagauan, A.G. Steps in Preparing Ponds for Freshwater and Brackishwater Fish/Shrimp Grow-out Operations. Department of Aquaculture, College of Fisheries and Freshwater Aquaculture Center, CLSU. Munoz, Nueva Ecija. 2004.
- Saturno, J. O., Pond Liming. College of Fisheries, CLSU, Science City of Munoz, Nueva Ecija, Philippines. 2005.
- Region 02 Technoguide for Tilapia. 1999 Revised Edition.
- Aquaculture NC II Learners' Guide, TESDA-PCF (in CD)
- Modules NC II Competency Based Learning Materials for Aquaculture (CBLM)

### C. SOURCES OF PICTURES

- Cavite State University, Main Campus, Indang, Cavite
- Department of Agriculture, Trece Martires City
- Aquaculture NC II Learners' Guide, TESDA-PCF (in CD)
- Modules NC II Competency Based Learning Materials for Aquaculture (CBLM)

#### **D. OTHERS**

1. [e.n.wikipedia.org./wiki/aquaculture](http://en.wikipedia.org/wiki/aquaculture)
2. pdf-eliminating unwanted fish and harmful insects from the fishpond
3. [www.auburn.edu/.../GT.4%Eliminating%.20](http://www.auburn.edu/.../GT.4%Eliminating%.20)
4. [e.n wikipedia org./wiki/fish-kill](http://en.wikipedia.org/wiki/fish-kill)