ANIMAL HAELTH CARE SERVICE

Level - III

Based on March 2018, Version 3

Occupational standards

Module Title: - Identifying and Controlling Pest, Predators and Disease of Fish

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LG #74	LO #1- Diagnosing predator, pest and disease infestations

Instruction sheet

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

- Implementing hazard identification and risk control procedures
- Providing appropriate PPE clothing and equipment
- Identifying pest, predators and diseases of fish.
- Monitoring Stock for a range of health problems.
- Diagnosing sick stock
- Investigating and reporting disease outbreaks and stock deaths.
- Collecting Samples
- Drawing conclusions from relevant information

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

- Identify hazards and assesse and control risk procedures
- Identify the pest, predators and diseases of fish
- Use and maintain of appropriate PPE
- Monitor stock for a range of health problems
- Diagnose sick stock
- Collect and submit sample properly
- Identify disease outbreak and death report procedures
- Draw conclusion from relevant information

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”

Information Sheet-1	Implementing Hazard identification and Risk Control Procedures

1.1. Hazard Identification

The broad and usually interlinked social and economic impacts of risks include loss of livelihood, loss of income, loss of market, loss of assets and loss of capacity to work productively. From this perspective, just about any hazard has the potential to translate into a risk that has social impact. For instance, a natural disaster that not only wipes out the crop but also destroys farm assets and erodes the topsoil or silts up the pond will result in loss or severe and prolonged disruption of livelihood for the farmer and unemployment for the workers.

Civil unrest, threats to peace and order and widespread poverty and social inequalities are by themselves social hazards. But these are not results of socially or environmentally irresponsible practices of aquaculture. A farm or a company deciding to locate in an area considered high-risk because of social unrest is expected to make a decision analysis on the basis of an already known hazard that could threaten the viability of its operations. Similarly, farms or enterprises located in an area where risks of a social nature or origin are imminent or suddenly occur would need to weigh management options, i.e. pull out and avoid the risk or stay and initiate risk management actions. This falls under project risk management. But it is relevant – project risk assessments include a social risk assessment, which could be a useful method to adopt for analysis of risks to aquaculture. It is instructive in that an evaluation of social risks to a project includes their impacts on project costs and viability.

Furthermore, aquaculture or any other economic sector has nothing to do with spawning the most serious hazard of all, bad government, although opportunistic behavior from the industry could support it. However, there are actions that farmers and industry can adopt to improve the sector's management and governance, including voluntary or self-management measures and co-management arrangements, forging alliances with each other as well as with other stakeholders such as the science and technology sector, and

organizing into well-run professionalized farmers' associations. Below is a list of social, economic and political hazards to any economic activity:

- civil unrest or civil strife,
- social tension,
- political instability,
- rampant poverty (a proxy to weak government),
- high unemployment (an indicator of horizontal inequality between groups),
- social exclusion (highly defined inequality in access to services and resources),
- tendency of government to solve social conflicts by military action, lack of independent judiciary (for dispute resolutions),
- insufficient regulatory system,
- excessive regulation,
- poor or weak governance, and
- economic crisis.

The essence of the definition of social risk – i.e. a challenge by society to a practice or the practices of an entity – precludes these aforementioned situations in risk analysis. This does not mean they should be ignored; their potential impacts can be very severe and they are abetted by improper practices in the sector. Small farmers, who are most vulnerable to these risks, need to be assisted to deal with them. Another category of hazards consists of those that tend to prevent farmers from adopting, or to make risk-averse ones reluctant to adopt, strategies (such as crop diversification or intensification) or practices (such as an effluent treatment system) that improve their livelihoods or management. Examples are ill-defined property rights, lack of protection of assets, seasonality or unreliability of labour, perception of loss of profitability and a number of those listed above. Economic hazards that are spawned in the market and industry, such as changes in consumer preferences and tastes, appearance of substitutes, development of competitive products and market volatility, invariably translate to social risks.

The siting of farms, farm management practices such as effluent treatment and discharge, and other aquaculture practices carry social and environmental impacts to the community. Environmental impacts invariably translate to social impacts. Conflicts

can arise because people's access to the shore is blocked by aquaculture installations, salination of crop lands, encroachment or decline in fish catch because of various aquaculture impacts that include fish kills on the wild fishery. The use of inputs such as feed, drugs and chemicals is a great source of social hazards, not so much to the farm as to the industry or the sector as a whole. A scare caused by a tainted product invariably gives the industry a bad press potentially resulting in consumer resistance or boycott, importing countries' burning of containers of the product and perhaps change in product or product-supplier preference, all of which lead to loss of market. Loss of market could jeopardize the viability of the sector and the welfare of workers and people dependent on it for a living. The ingestion or exposure of a farmer and/or farm workers to toxic substances from chemicals and drugs because of poor or lack of safety precautions can reach the media and become a serious local or national issue, with the potential of escalating into such challenges as lawsuits, community action against the farm or consumer resistance to the product.

The process of identifying hazards with social consequence includes posing the critical question "What challenges to the industry can be expected from society or certain stakeholders if something went wrong?" Answers to "What could go wrong?" which should be the first question, can be found or inferred from:

- codes of conduct
- principles of good aquaculture
- codes of practice
- good aquaculture practices
- international agreements
- certification schemes
- ethical and fair trade standards
- animal welfare and free range
- labour standards
- rules and regulations
- International Standards Organization (ISO) standards
- others

These instruments can be used to identify hazards, i.e. to assess what could go wrong. Beyond this, aquaculture needs to know what challenges can be expected from any sector of society if something goes wrong. For example, introduced species that become pests or that carry pathogens have in some cases caused the collapse of fisheries and aquaculture operations, resulting in massive losses in revenue and severe implications for farmers, fishers, post-harvest industries and human health. The risk analysis methodologies used for alien or introduced species are well established and the methodologies to evaluate their economic, environmental and social impacts have been developed. It is the likely challenges to aquaculture as a whole (or, for example, the ornamental fish industry, if it were the source of the alien) that their impact would incite that need to be identified, assessed and mitigated.

The hazards that could provoke challenges from industries in other countries are those with potential impacts from a country's policies (i.e. subsidies) or a sector's targets (i.e. species and production targets) and marketing practices (e.g. dumping). Subsidies, as well as protectionism, could cause harm to a similar industry and its workers in another country. Over-production and flooding the market thus depressing prices would hurt competitors in poorer areas or countries, and dumping can create a lot of economic backlash on an industry or commodity sector.

In summary, an action within the aquaculture sector that tarnishes its reputation for social responsibility has the potential to provoke challenges from society. Codes of conduct and practices, certification schemes (especially Eco labeling) and standards of food safety, chemical use and labour are useful guides to identifying hazards that could turn into social risks.

1.2. Risk Assessment and Control

Risk management is the process of bearing the risk you want to bear, and minimizing your exposure to the risk you do not want. This can be done in several ways: not doing things that carry a particular risk; hedging, which involves deliberately taking on a new risk that offsets an existing one, such as your exposure to an adverse change in an exchange rate, interest rate or commodity price; and diversification, which means not

putting all your eggs in one basket (having a portfolio in which you hold several different shares and assets helps to reduce risk; and buying insurance (in economic terms, anything used to reduce the downside of risk. In its most familiar form, insurance is provided through a policy purchased from an insurance company. A fuller definition would include, for example, a financial security (or anything else) used to hedge, as well as assistance available in the event of disaster. The latter could be provided by the government in various ways, including welfare payments to sick or poor people and legal protection from creditors in the event of bankruptcy.

Social risk arrangements: Arrangements to deal with vulnerability fall into three main categories: (i) informal, (ii) market based and iii) public arrangements on a large scale. In an ideal world with perfectly symmetrical information and complete and well-functioning markets, all risk management arrangements can be market based. In reality, all risk management arrangements will play important roles that could change over time.

- Informal – With no or incomplete market institutions and public provision of support, households and small farms respond to risk by protecting themselves through informal and personal arrangements. Credit from relatives and self-help group arrangements are examples.
- Market based – Where available and affordable, smallholders and households take advantage of the financial products offered by insurance companies and banks. Because formal market institutions have difficulty to lend or provide insurance to small farms without secured earnings and improved access to information, micro-credit and insurance are potentially interesting instruments for social risk management.
- Public – This category takes various forms. When informal or market-based risk management arrangements do not exist (there is no insurance), the government can provide or mandate social insurance programmes for risks such as unemployment, work injury, disability and sickness, and compensation schemes for catastrophes or unusually large damages to assets and crop. Additionally, governments have a whole array of instruments to help farms cope after a shock hits, such as social assistance, subsidies on basic goods and services and public works programmes. Through legislation, government is also able to introduce

prevention strategies such as zoning, safety standards, property rights and protection of rights to assets. Many government programmes (in health, education and infrastructure) also play an important role in social risk prevention.

SRM strategies Social Risk Management (SMR) consists of three strategies: prevention, mitigation and coping. Prevention strategies are those that reduce the probability of the risk occurring. Measures that could apply to aquaculture include:

- skills training or job function improvement to reduce the risk of un/underemployment or low wages that are probably man-made;
- optimizing macroeconomic policies to reduce the shocks of financial crisis, such as oil price surges or unpredictable market moves on currencies;
- for natural disasters and environmental degradation, deploying a networked pre-warning system or sustainable, renewable and environmentally friendly ecosystem management strategies and practices to minimize the impact of the consequences, such as flooding, earthquakes, drought, global warming and soil acidity or salinity;
- in human and animal health care, focus is on the preventing epidemics and the introduction of pathogens by awareness and educational programmes, responsible movement of live animals, quarantine, certification etc.; and
- for social security, establishing a farm mutual to compensate for loss of assets, disability or chronic illness. Mitigation strategies focus on reducing the impact of a future risk event. Common practices include: diversifying to a reasonable level that is commensurate to the resources and management skills of the farmer, to spread the risk as well as reduce shock from a crop wipeout; micro-financing to smallholders; and insurance. Coping strategies are designed to relieve the impact of the risk event once it has occurred. Usual measures are:
- issuing government relief and rehabilitation funds for very serious risks such as disasters or epidemics; and
- alternative and emergency employment such as work-for-food programmes.

The aquaculture sector is familiar with a number of social risks. Certification and eco-labeling schemes, developing alliances with various sectors and working with stakeholders to build or re-build trust and reputation in order to avoid or limit the damage or to engage on the issues to prevent future incidents are strategic responses that the sector could make.

Building relationships can help farms or a commodity sector gain freedom from stakeholder challenges to their management and business practices. Strong relationships with stakeholders that are maintained over time can be insurance: they buy time and patience from those with the power to challenge the farm or the sector when it causes a negative social impact. These relationships can be good sources of sensing emerging risks and opportunities. They can help to identify the issues, understand the dynamics behind them and track them as they evolve.

For the aquaculture sector, alliances with consumer groups, supermarket chains, researchers and technology developers, and civil society organizations with social agenda are examples. The sector should build relationships that are conducive to managing the risks and opportunities arising out of the issues in which both parties have common stakes, such as food quality and safety, eco-labeling and development of certification standards, as well as fair trade. Ultimately, it is a farm's commitment to its customers and to socially responsible farming that assures a lasting relationship.

Social Risk Communication: The aim of risk communication usually is to avoid or correct misperceptions of a risk. It goes without saying that the source of the message must be able to understand the sources and causes of anxieties and perceptions of stakeholders. In short, there has to be a common understanding between the communicator and the public about the elements of the risk. Communication is a tool for risk management. One important arm of "corporate social responsibility" (CSR) is a public affairs or public relations unit with the capabilities and expertise to manage strategic risks stemming from social (and environmental) issues. In the aquaculture sector, with the obvious absence of a CSR body for small, widespread or independent farms, the alternatives have included organizing into associations and federations (e.g.

FEAP) and alliances (e.g. GAA and Shrimp Producers Association of Thailand) that include suppliers of inputs and processors/ exporters). The “CSR function” or parts of a CSR unit’s functions are performed to some extent and in a disinterested manner consistent with their mandates, by organizations like the Network of Aquaculture Centres in Asia and the Pacific (NACA), the South East Asian Fisheries Development Center (SEAFDEC), INFOFISH and FAO. They develop with other stakeholders guidelines for responsible farming and strategies for communicating, sharing and promoting awareness and adoption.

In the context of communicating social risk, a “CSR” action (whether by the industry itself or in cooperation with development organizations) contributes through two means:

i. providing intelligence, awareness and insight about what those risks are, and
ii. offering an effective means to respond to them.

The key to both is managing stakeholder relationships. An equivalent activity to managing stakeholder relationships in a sector with many small, poor farmers is getting organized into self-help groups or more formal associations and cooperating with suppliers, buyers, support services, civil society organizations, government and regional and international development organizations. Information flows between stakeholders and the sector can form the base of knowledge about social issues and the nature of those problems. Among the key questions that can be answered by engaging with stakeholders on a particular social issue are:

- What is the issue or problem?
- How complex is it?
- What is its scope?
- Who else has an interest in the problem?
- What is working and not working in the current approach?
- What would be accomplished by engaging others in the dialogue?

A process for internal and external risk sensing, reporting and monitoring should be employed. By partnering with other social actors including civil society organizations, the aquaculture sector can also improve the conditions that pose emerging risks for them in the first place.

Assessing the likelihood of a hazard turning into a social risk may or may not follow the stepwise release, exposure, and consequence and estimation procedure designed for import risk analysis (pathogen risk analysis). Risk assessment of introduction of species would follow exactly the standard procedure up to assessment of its social, environmental and economic consequences. To then assess its social risk, key questions would be:

- What is the likelihood that a challenge is provoked from adversely affected parties or groups taking up their cause?
- What kind of challenge could be expected, from whom or which interest group(s)? and
- What are the likely consequences of a challenge to the aquaculture sector or the industry? The critical question is what would be the most serious consequence from the challenge? Would it be simply an annoyance, would it breed resentment from the community, would it provoke hostile action such as a blockade against the farm or destruction of its structures and equipment, would it result in loss of market, or would it lead to the closure of a farm or an industry? A negative report or public criticism in the local or national media from some person or group would at first glance seem a mild reaction that can be responded to by a media release or a public relations campaign. However, this could readily escalate into (a) a greater issue, say, of human rights, environmental irresponsibility or anti-poor, or (b) a suite of interlinked issues that could be more intractable and expensive to respond to, or (c) a class action. For example, what started as public criticism from an environmentalist in India on a single issue – water abstraction – ended in the Supreme Court ordering the closure of brackish water shrimp aquaculture.

The following steps could be followed in risk assessment with the ultimate aim of determining the likelihood of its occurrence and the seriousness of its consequence/s. For several risks, the exercise would aim at ranking their relative seriousness so that responses could be prepared and set into priorities.

1. Assessment: To provide an example of an assessment matrix for social risks, we pick the farm worker and the “community” as resources under threat.

2. Quantification of social risks allows proper comparison and prioritization against perhaps more easily quantifiable technical risks. It also allows a proper decision as to which risk or set of risks justify and are amenable to more detailed analysis and evaluation. For aquaculture, a risk evaluation matrix could be developed using a rating system for the severity of the consequence of a challenge and its likelihood of occurrence. The information on severity of impact and likelihood of the risk happening could be derived from historical experiences and expert views.

This process should be completed for each of the identified issues with a risk ranking developed and the rationale for assigning these rankings recorded. The actual risk assessment is not just the scores generated during the assessment process. It should include the appropriate level of documentation and justification for the categories selected.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3 point)

1. _____strategies are those that reduce the probability of the risk occurring

   A. Prevention B. mitigation C. coping D. All

2. _____ social risk arrangements refers to Where available and affordable, smallholders and households take advantage of the financial products offered by insurance companies and banks.

   A. Informal B. Market based C. Public D. None

Test II: Short Answer Questions

1. List at least four hazards which affect fish production? (4 point)
2. List the three components of strategic social risk managements (3 point)
3. _____refers a challenge by society to a practice or the practices of an entity – precludes these aforementioned situations in risk analysis (3 point)

You can ask your teacher for the copy of the correct answers.

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Information Sheet-2	Providing Appropriate Personal Protective Equipment Clothing and Equipment

2.1. Requirements of Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) can help protect you from some of the many hazards of commercial fishing. Your safety gear must meet a standard acceptable to work safe, regardless of whether it is your own or provided by the master of the vessel. The following requirements will help protect you from these hazards.

2.2. Types of PPE

Floatation devices

- Wear an approved personal floatation device (PFD) or life jacket when working on the deck of a fishing vessel.
- Wear a PFD or life jacket whenever you are in a seine skiff

Fall protection

- Tie off to a lifeline when working aloft or on deck during adverse weather conditions
- Tie off with a lifeline and safety belt or harness when trap fishing
- Wear personal fall protection equipment if you could fall 3 meters (10 feets) or more, for example, while working over the side of a vessel

Protective clothing

- Dress appropriately for any anticipated adverse weather conditions
- Wear close-fitting. For example, your rain gear should be comfortable enough to allow free movement but so loose that it will get caught in winching or lifting equipment
- Remove any dangling jewelry and migs, to avoid getting snagged by nets, lines or machinery. The exception is a medical alert bracelet (wear it with a transparent band that will hold the bracelet snugly against your skin)
- Wear protective clothing such as wet weather gear or an apron to protect against puntures and abrasions when handling a knife or fish
- When working in a freezer, wear warm clothing including headgear, footwear and gloves

- Wear high visibility apparel when salmon seining or conducting beach operations at night

Hand protection

- Consider gloves and/or protective sleeves there is a chance that your skin could be damaged by equipment, gear, or fish; for examples, when handling rope and moving lines. All type of rope can cause skin burns, and wire rope may have “jaggers” (broken wires that poke out) that can cut or lodge in your skin
- Wear gloves when:

  -Handling (jigging for fish), handling hooks or fish, chopping bait, or hosing down the deck
- Seining during beach tie ups to prevent cuts from barnacles

Head protection

- Wear safety headgear (hard hat) when working under moving equipment or objects that could fall
- Secure the chain strap when working at heights over 3 meters and in rough weather
- Keep your hair (both on your head and on your face) short enough or tied back so it won’t get snagged. Long hair is less likely to get caught in a pulley, winch, or other equipment if you keep it tucked under a hat or pulled back in a ponytail

Foot protection

- Wear waterproof, non-slip footwear such as boots with sunction soles if the deck surface is slippery
- For seining during beach tie-ups, wear boots to prevent slipping on seaweed and slippery rocks

Eye and face protection

- Wear eye protection appropriate for the job, for example, wear safety glasses with side shields or goggles when grinding, working with loose or pointed objects or when exposed to jellyfish
- When working with a hazardous product, check the material safety data sheet (MSDS) or products label to determine whether eye and face protection are required

Hearing protection

- You must wear hearing protection such as earmuffs or earplugs if you will be exposed to loud nose for extended periods. Regular earmuffs or earplugs may not be the right choice. They may block out too much sound for you to communicate effectively with other crew members. There are earmuffs and earplugs that are designed to improve hearing while reducing noise---consider wearing this type of hearing protection while sleeping
- Ear buds (for listening to music) are not approved hearing protection and may prevent you from hearing emergency warning or communication with co-workers.

Respiratory protection

- When working with a hazardous product, check the MSDS or product label to determine whether you need to wear a respirator
- If you required wearing a respirator, you must be trained in the proper use of your respirator including how to wear and how to clean, maintain and store it
- Before you enter a confined space you must be trained in confined space safe work procedures including the need for specific PPE

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3 point)

1. One of the following is head protection equipment?

   A. Goggles B. Hard hat C. Glove D. Boots

Test II: Short Answer Questions

1. List at least four PPE required to operate fish production? (3 point)

You can ask your teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet-3	Identifying of Pest, predators and diseases of fish

3.1. Terminology

Pests: The definition of a pest can vary in detail according to the precise context in which it is considered, but in the widest sense a pest is an insect (or organism) that cause harm to livestock, crops or possessions.

Predator is a biological interaction where one organism, the predator, kills and eats other organisms, its prey. It is one of a family of common feeding behaviours that includes parasitism and micro predation.

Diseases: any deviation from normal physical or physiological conditions.

Aquaculture is the farming and husbandry of aquatic organisms under controlled or semi-controlled conditions. These organisms may be plants, fish or shellfish — oysters, mussels, clams, shrimp, crabs, crawfish. Aquaculture is employed for a variety of ends: fish may be raised to stock public waters for sport fishing and for commercial fishing; it may be to save an endangered species; or it may be to harvest a commercially viable crop in ponds or coastal waters.

3.2. Pests and Parasitic diseases of fish

There are many pests that can afflict fish, but the majorities are readily controlled. Most outbreaks are caused by stress in the fish and rarely do any infestations simply break out in the well-ordered pool. Fish can also suffer from a number of debilitating diseases, which can look quite frightening, but they rarely appear in the well managed water garden. Many infections in ponds break out as a result of the fish being stressed due to poor **water quality,** so check the water quality as a matter of course. Maintenance of good fish health is therefore, is critical to profitable fish culture. Best way to manage fish health is through prevention. Practical health management is based on stress management. This involves preventing and minimizing stress to the fish in the culture environment through:

- **Good water quality management.** This begins by picking a farm site with good water quality and quantity. Maintain water quality at non-stressing levels,
- **Good nutrition.** Feed high quality feed (nutritional and physical aspects) in the proper size and amounts.

- **Good stocks of fish.** Only stock healthy, unstressed and disease- free fish and handle them as recommended.

Remember,

- Fish are cold-blooded animals and respond directly to environmental conditions.
- Aquaculture systems are innately unstable. This is because, their environmental components (chemical, physical and biological) are constantly changing, as fish biomass and nutrient inputs (feed) increase over time. The challenge to the farmer, is to maintain environmental parameters within the fishes normal to tolerance limits during the course of production.
- Catfish do not have scales to protect them so rely on mucous to protect their skin. When the mucous is rubbed off, the catfish are very prone to infection and parasites.
- Fish do not have eyelids and cannot protect their eyes when they are being rubbed against each other or being poured from a basket or net.

Fish Stress

Stress is an abnormal physiological condition of fish that results when the fish's collective adaptive responses to environmental factors are extended to, or approach its limit of tolerance. When fish are stressed, or continuously exposed to stress, their immune system becomes weakened (just as people do when they are poorly nourished, overworked or exposed to harsh environmental conditions). Consequently, their ability to fight disease is reduced and they then succumb to infections and fall sick. In severe or prolonged cases, this may lead to death. Stress can be acute or chronic. Chronic cases are less obvious to the eye but result in reduced feeding response. Other practical on-farm indicators of stressed fish are changes in behavior (such as when a fish prefers to remain alone rather than stay with the rest of the group), changes in their physical appearance (for example, they may become darker, lose fins), reduced feeding response and poorer growth rates.

Common Sources of Stress: Most stress in fish farming arises from physical, chemical, biological and procedural.

Anchor Worm

This is a very tiresome and unpleasant crustacean that is a common parasite of the goldfish and carp family. It is a small creature, rarely more than 6mm (1/4in) long, with a

slender tubular body and a barbed head, which it embeds in the flesh of its host, causing unsightly lesions and tumour-like growths. It often looks particularly hideous, as it develops a light covering of green algal growth.

Treatment: The most practical method of dealing with anchor worm is to capture each infested fish, hold it in a wet cloth and dab the parasite with a 0.1 per cent solution of potassium permanganate, using a small paint-brush. This will kill the creature, which can then be gently withdrawn with tweezers. Finally, treat the wound with a proprietary fungicide. There are also several proprietary parasite cures, which can be added to the water of the pool to destroy anchor worms at the free swimming stage of their life cycle.

Diving Beetles

Young fish may be devoured by the various diving beetles and their larvae, or naiads. The beetles vary in size and colour, but the great diving beetle (Dytiscus marginalis), which is about 5cm (2in) long and has a yellow-bordered, dark brown body, is the commonest. Most pool owners tolerate the activities of diving beetles, regarding them as part of the natural fauna of the water garden and living with the minimal destruction they cause.

Drag on flies: Some water gardeners are concerned about dragonfly attacks on young fish, for these vicious predators are killers. Although adult dragonflies are beautiful to watch, their larvae, or naiads, which spend up to five years living and eventually pupating in the pool, are very destructive, posing a threat particularly to young fish. The naiads live among submerged aquatic foliage. As soon as suitable prey comes into view, this keen-eyed predator will shoot forward its strange face mask. This is like a pair of hooked jaws, which grip the prey and bring it back to the gaping mouth.

Treatment: There is no satisfactory way of dealing with this problem. As the adult stage of the life cycle is so lovely, and most pond owners enjoy the presence of dragonflies flitting above the water, the unfortunate dietary habits of their young are best tolerated.

Fish Louse

There are several species of fish louse, which cause distress to pond fish. They are parasitic crustaceans that cling to the bodies of fish to feed and then drop off to digest their blood meal. Although some have specific host requirements, they all look much the same, having a strange flattened circular carapace with a diameter of up to 1cm (3/8in) and feelers.

3.1. Predators

Predators are a major source of stress to fish and can also cause significant losses. **NOTE:** Large African catfish can predate on smaller ones; so, maintaining uniform sizes within ponds is critical. Predators:

- consume the fish in the pond,
- consume the fish's feed,
- may transmit parasites and other infections to fish,
- scare the fish when they are chasing them up, and
- cause physical injury to several fish in the process of hunting
- May trans-locate fish to a different pond. The wounded fish left in the pond consequently cannot get to the feed as well as the other normal fish. This is because, for example, their eyes might be injured or their open wounds might get infected, etc. Consequently, their growth rate slows and chance of survival drops. Controlling predators is therefore important in commercial production.

Predators may include: birds, predatory fish, mammals (raccoon, mink, skunk, otter, etc.), frog, snakes, human beings, etc.

3.2. Infectious Diseases

Infectious diseases are those diseases caused by organisms and which are capable of passing from infected to healthy one under favorable conditions. Pathogens which can cause diseases comprise: viral infections, bacterial infections, fungal infections, water mould infections, etc.

3.2.1. Bacterial Diseases

Epidemics of bacterial diseases are common in dense populations of cultured food or aquarium fish. Predisposition to such outbreaks frequently is associated with;

- poor water quality,
- organic loading of the aquatic environment,
- handling and transport of fish,
- marked temperature changes,
- hypoxia,
- other stressful conditions.

Most bacterial pathogens of fish are aerobic **gram-negative rods**. Diagnosis is by isolation of the organism in pure culture from infected tissues and identification of the bacterial agent. Sensitivity testing prior to antibiotic use is recommended.

A number of bacteria produce a similar syndrome, generically referred to as **hemorrhagic septicemia**, and characterized by external reddening and hemorrhage in the peritoneum, body wall, and viscera. Morbidity and mortality are highly variable, depending on predisposing conditions such as low dissolved oxygen, other water quality problems, handling stress, or trauma. Ulcerative lesions are common as disease progresses, and mortality can be significant if stress is not controlled. Antibiotic therapy is recommended if fish are dying. Common bacterial isolates from affected fish include *Aeromonas spp* and *Pseudomonas spp*, which are more common in freshwater animals, and *Vibrio spp*, which are more commonly isolated from marine fish.

- ❖ Control is based on removal of predisposing factors. If antibiotic therapy is warranted, the drug selection should be based on sensitivity testing when possible.

Aeromonas salmonicida, a gram-negative, nonmotile rod, is the causative agent of **goldfish ulcer disease** and **furunculosis** in salmonids and is a very important disease of koi and goldfish. The disease also occurs in freshwater and marine species other than the groups mentioned above.

In the acute form;

- hemorrhages are found in the fins, tail, muscles, gills, and internal organs.

In more chronic forms,

- focal areas of swelling,
- hemorrhage, and tissue necrosis develop in the muscles.
- Liquefactive necrosis occurs in the spleen and kidney.

Diagnosis is made by isolating and identifying a pure culture of the organism from infected tissue. Avoidance through use of good quarantine practices, and vaccination when appropriate, is preferable to treatment. Successful treatment is possible, based on appropriate antibiotic therapy.

Vibriosis is a potentially serious, common systemic disease of many cultured, aquarium and wild marine and estuarine fishes; it is less common in freshwater fish. *Vibrio anguillarium* and other *Vibrio spp* are responsible for the disease, which produces systemic manifestations, including hemorrhages and ulcerations of the skin, fin and tail. Diagnosis requires identification of pure isolates from infected tissues. Preventive measures include minimizing stress and crowding. Because *Vibrio spp* are ubiquitous in marine environments, avoidance is difficult. Preventive vaccination with formalin-killed *Vibrio* is used in the salmonid industry. Antibiotic therapy should be based on results of sensitivity testing.

Yersiniosis (enteric redmouth disease) is a serious acute or chronic bacterial disease of intensively cultured salmonids. The etiologic agent is *Yersinia ruckeri*.

- Signs are darkening and hemorrhage of the mouth (red mouth), skin, anus, and fins.
- Chronic signs are associated with inappetence, swelling and degenerative changes of internal organs.
- Mortality rates are variable but are exacerbated by poor water quality and related stressors.

Diagnosis is by isolation and identification of pure cultures of the organism obtained from the internal organs of infected fish. Fish that survive remain carriers and may cyclically shed bacteria, particularly when exposed to stressful conditions and water temperatures of 15–18°C. Depopulation of infected fish and avoidance of introduction of infected fish can be recommended, but preventive vaccination is the usual procedure in endemic areas. Yersiniosis can be treated successfully with antibiotics, which should be selected based on a sensitivity test. Therapy should be continued for at least 14 days.

Edwardsiella tarda causes intestinal disease in a variety of aquatic and terrestrial organisms, including fish, reptiles, and mammals (including humans). In catfish, this bacterium causes a disease referred to as **emphysematous putrefactive disease of catfish**, descriptive of the characteristic malodorous, gaseous lesions. Clinically, affected fish may be unable to swim normally because of abnormal buoyancy created by gas-filled lesions in the skeletal musculature. When lesions burst, they are extremely

malodorous. *E. tarda* has been reported in freshwater and marine aquaria across a fairly wide temperature range. Clinical signs include significant ulceration of skin as well as systemic disease. Antibiotic treatment based on results of sensitivity testing is effective.

Flavobacterium columnarae, the member of this group is responsible for **columnaris disease**, is most common in warm water species of fish. Is gram-negative, rod or filamentous bacteria have a distinctive gliding motion. Skin or gill lesions have slimy or cotton-like surface exudates, which usually cover surface necrosis, ulcerations and marginal hemorrhages. If the disease is diagnosed early in the course of infection, treatment with potassium permanganate or hydrogen peroxide may be effective. If the disease becomes chronic, it may have become systemic, in which case treatment with florfenicol or terramycin is recommended.

- Columnaris disease can be prevented by reducing organic loading and avoiding traumatic injuries. A similar organism affecting marine fish was previously grouped with *F columnarae*, but has been given its own genus and is now named *Tenacibaculum maritinum*.

Gram-positive bacterial infections of concern to fish culturists and aquarists may be caused by *Streptococcus* and related genera, *Lactococcus*, *Enterococcus* and *Vagococcus*. Infections are uncommon but can cause significant mortality (>50%) when they do occur. Chronic infections may continue for weeks, with only a few fish dying each day. Species known to be susceptible include salmonids, assorted marine fish (eg, mullet, sea bass), tilapia, sturgeon, and striped bass. In general, all fish should be considered susceptible. A characteristic manifestation of *Streptococcus* infection is neurologic disease, often manifest by spinning or spiraling in the water column.

Gram stains of pinpoint bacterial colonies reveal typical chains of gram-positive cocci, which allow a presumptive diagnosis. Antibiotic therapy should be based on sensitivity testing. Erythromycin is often the drug of choice. Sources of infection may be environmental or include live foods, amphibians, or previously infected fish. Future epizootics can be prevented if the source of infection is identified and eliminated.

Streptococcus innae has been isolated from tilapia and aquarium fish , has zoonotic potential.

Mycobacteriosis is a chronic or acute, systemic, granulomatous disease that occurs in aquarium fish and cultured food fish, particularly those reared under intensive conditions. Predisposing environmental factors include low dissolved oxygen, low pH and high organic load, all of which are found in recirculating aquaculture systems.

- Correct use of ultraviolet light as a means of disinfecting system water reduces bacterial counts and can be a useful tool in controlling infection in exhibit animals.

The causative bacteria can be any of species of *Mycobacterium*, including *M piscium*, *M marinum* and *M fortuitum*. Signs are variable and nonspecific; they can include emaciation, ascites, skin ulceration and hemorrhages, paleness and skeletal deformities.

A presumptive diagnosis is based on visualization of acid-fast rods in granulomatous material from suspect lesions. There are no effective treatments that eliminate mycobacteria in fish. Mycobacteria can cause zoonotic infections and aquarists should be informed of potential risks if handling or cleaning contaminated fish or exhibits. An infected aquarium should be disinfected before other fish are added. Bleach is not an effective disinfectant against mycobacteria; disinfecttion with alcohol or phenolic compounds is recommended.

3.2.2. Viral diseases

Viral Haemorrhagic Septicaemia: Viral haemorrhagic septicaemia (VHS) is caused by ssRNA enveloped rhabdovirus, known as viral haemorrhagic septicaemia virus (VHSV). VHSV is synonymous with Egtved virus. The virus infects blood cells (leucocytes), the endothelial cells of the blood capillaries, haematopoietic cells of the spleen, heart, nephron cells of the kidney, parenchyma of the brain and the pillar cells of the gills. Spread of the virus causes haemorrhage and impairment of osmoregulation. This is particularly severe in juvenile fish, especially during periods when water temperatures ranging between 4 – 14°C.

Gross Observation: There are no VHS-specific gross clinical signs. General signs are shared with bacterial septicaemias, IHN, osmotic stress, handling trauma, *etc.*, and include increased mortality, lethargy, separation from the shoal, gathering around the sides of ponds, nets or water inlets. The skin may become darkened and haemorrhagic patches may be visible at the case of the fins, the vent and over the body surface. Gill may also be pale. Internal organ changes may or may not be present depending on the speed of onset of mortalities (stressed fish die quicker). Where present these include an accumulation of bloody body cavity fluids (ascites), mucous-filled intestines and pale rectal tissues. Pin-point haemorrhages may also be present throughout the muscle fat (adipose) tissue and swim-bladder.

Control Measures: No treatments are currently available, although DNA-based vaccines have shown some success under experimental conditions. Most control methods aim towards breaking the transmission cycle and exposure to carriers, as well as reducing stress. Pathogenic proliferation occurs at temperatures <15°C and periods of handling stress in sub-clinical populations. Isolation, destruction and sterile/land-fill disposal of infected fish, as well as susceptible fish exposed downstream, along with disinfection of sites and equipment, has proven effective in controlling losses from this disease.

Spring viremia- Rhabdovirus carpio is the causal agent (pathogen) of this disease. Common carp is the host species for this disease and this disease is mainly restricted to European countries. The infected fish becomes black and develops legions on the skin and gills. Bleeding from scales, accumulation of fluid in the body and inflammation of alimentary canal are some other symptoms of this disease.

Fish pox- This disease is also reported in European countries. The epidermis of the infected carp becomes proliferous, that is why the lesions or blisters are formed on the skin.

3.2.3. Fungal Diseases

Epizootic Ulcerative Syndrome (EUS): The mycotic granulomas in EUS-affected tissues are caused by the Oomycete fungus *Aphanomyces invadans* (also known as *A.*

invaderis, A. piscicida, Mycotic Granuloma-fungus (MG) and ERA [EUS-related *Aphanomyces*]). It is also known as Red spot disease (RSD).

Clinical Aspects: Affected fish typically show necrotic dermal ulcers, characterised histologically by the presence of distinctive mycotic granulomas in underlying tissues. The mycotic granulomas in EUS-affected tissues are caused by the Oomycete fungus *Aphanomyces invadans*. Initial lesions may appear as red spots which become deeper as the infection progresses and penetrate underlying musculature. Some advanced lesions may have a raised whitish border. High mortalities are usually associated with EUS outbreaks but, in certain cases, where fish do not succumb to secondary invasion of these gaping wounds, ulcers may be resolved.

Control Measures: Control in wild populations is impossible in most cases. Selection of resistant species for culture purposes currently appears to be the most effective means of farm-level control. Where changing culture species is not an option, measures should be taken to eradicate or exclude the fungus through:

- drying and liming of ponds prior to stocking
- exclusion of wild fish
- use of prophylactically-treated, hatchery reared fry
- use of well-water
- salt bath treatments
- disinfection of contaminated nets and equipment.

Saprolegniasis- This infection is caused by Saprolegnia parasitica. This fungus often infects the fertilized eggs in hatching 'hapas'. Initially, the fungus attacks the dead eggs and thereafter spreads on to the surrounding viable eggs resulting in their spoilage as well.

Branchiomycosis (Gill Rot)- It is caused by the fungi, Branchiomyces sanguinis (in carps) and Branchiomyces demigrans (in pike and tench). Branchiomycosis is a pervasive problem in Europe, but has been only occasionally reported by US fish farms. Both species of fungi are found in fish suffering from an environmental stress, such as low pH (5.8-6.5), low dissolved oxygen, or a high algal bloom. Branchiomyces sp. Grow at temperatures between 57° F and 95°F, but grow best between 77° F and 90°F. The main sources of infection are the fungal spores carried in

the water and detritus on pond bottoms. B. sanguinis and B. demigrans infect the gill tissue of fish. Fish may appear lethargic and may be seen gulping air at the water surface (or piping). Gills appear striated or marbled with the pale areas representing infected and dying tissue. Gills should be examined under a microscope by a trained diagnostician for verification of the disease. Damaged gill tissue with fungal hyphae and spores will be present. As the tissue dies and falls off, the spores are released into the water and transmitted to other fish.

Icthyophonus disease (Swinging disease)- This disease is caused by the fungus, Icthyophonus hoferi. It grows in fresh and saltwater, in wild and cultured fish, but is restricted to cool temperatures (36-68°F). The disease is spread by fungal cysts, which are released in the faeces and by cannibalism of infected fish. Because the primary route of transmission is through the ingestion of infective spores, fish with a mild to moderate infection will show no external signs of the disease. In severe cases, the skin may have a 'sandpaper texture' caused by infection under the skin and in muscle tissue. Some fish may show curvature of the spine. Internally, the organs may be swollen with white to grey-white sores. Diseased fish shows curious swinging movements hence the disease is called as "swinging disease". Along with liver, particularly severely affected organs are: spleen (in salmonids), heart (in herring), kidney (in salmonids), gonads, brain (in salmonids), gills (in salmonids), and musculature and nerve tissue behind the eyes (in sea fish).

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (2 point)

1. One of the following is different from others?
   A. Epizootic Ulcerative Syndrome
   B. *Edwardsiella tarda*
   C. *Mycobacteriosis*
   D. *Flavobacterium*

Test II: Short Answer Questions

1. List some examples of:
   a. Bacterial diseases: _____, _____ (2 point)
   b. Viral diseases of fish:_____, _____ (2 point)
   c. Pests of fish:_____, _____ (2 point)
   d. Predators of fish:_____, _____ (2 point)

You can ask your teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

4.1. Anatomy and physiology of fish

There are few creatures on earth that have developed such an interesting and unique set of physical characteristics as the fish. Their special adaptations have allowed them to survive in an environment completely different from other animals. Water is 800 times denser than air. Water also contains less than 2% of the oxygen contained in the air. Sound and light are much distorted in the water. Yet despite these difficult obstacles in life, fish have some unique anatomical adaptations that allow them to flourish. If aquarium owners have an understanding of these basic adaptations, it will help them to better care for their fish.

Skin: Unlike most land dwelling animals, fish have evolved several unique traits in their outside coverings including scales, fins, and protective mucous. Most fish have 7 fins, although some have 6 and some 8. These fins allow fish to steer and move forward and backward. Because water is 800 times denser than air, fish require a tremendous amount of muscle strength and coordination. The powerful tail fin coupled with a large efficient muscle-filled body gives the fish the necessary strength. On the outside of the skin most fish have compact rows of protective scales. These scales are firmly attached to the skin and are primarily made of hard calcium. The scales offer unsurpassed protection against injury and infection. Catfish have evolved without scales, but some have hard bony plates and others have sharp spines in some of their fins that help keep predators at bay. Over the tops of their scales, fish secrete a mucous covering. This mucus is very effective at trapping and immobilizing bacteria and viruses and even contains antibacterial-like agents that will help kill the trapped bacteria. Another important trait of the mucous is to reduce friction and allow the fish to move through the water more easily.

Swimbladder: The swimbladder is a unique organ found only in fish and is sometimes called the 'air bladder.' It is a smooth, gas-filled organ found in the abdomen of most fish. A fish will either add to or decrease the amount of air in the bladder to help it move

up or down in the water. Without the air bladder, the fish would have to swim continuously to keep from sinking to the bottom. By adjusting the amount of air in the bladder, fish can adjust the depth at which they float and extend very little energy in the process. One other benefit of the air bladder in some species is that it can be used to receive or emit sounds.

Maintaining salt balance

As in people, maintaining the proper level of salt in the fish's body is critical to proper health. Fish face an exceptionally difficult challenge because they live in a watery environment and tend to 'leak' a lot. The concentration of salt in a freshwater fish is much higher than in the surrounding water, so salt is constantly leaking out of the fish into the water. To compensate for this, fish have developed several solutions. The first and foremost is that they ingest a very large quantity of water and as a result produce a large quantity of urine (10-20 times as much as land mammals). Their kidneys extract the small amount of salt from the ingested water and put it back into the fish's bloodstream. The other thing they have is an ion pump in their gills that actually helps take salt out of the water and discharges ammonia and other undesirable products. Saltwater fish have the same problem in reverse. For saltwater fish, the sea water contains a much higher concentration than what is in their bodies. As a result, salt leaks in and the fish has to use its kidneys and ion pumps to excrete extra salt.

Breathing underwater

Breathing underwater is one of the most interesting adaptations of fish. Fish need oxygen just like animals, but the trick is getting the small amount of available oxygen out of the water and into the bloodstream. The way that fish accomplish this is through their gills. The gills contain thousands of tiny capillaries (blood vessels). Water is constantly pumped over the gills through a combination of opening and closing the mouth and muscular contractions that force water over the gills. The oxygen is absorbed out of the water and goes directly into the bloodstream.

Water temperature can greatly affect the concentration of free oxygen in the water. As the water temperature increases, the free oxygen concentration decreases. Stagnant or

poor quality water also contains less oxygen. A fish that becomes stressed or overly excited in water that has low oxygen content can have severe respiratory difficulty and can die. Because the air contains much more oxygen than the water, some people question why fish cannot breathe out of the water. The reason is that the small delicate lamellae (thin branching structures) in the gills will collapse when the fish is out of the water. This will make it impossible for oxygen to be absorbed. To determine how long a fish can be kept out of the water, hold your breath when you take your fish out of the tank. When you need to breathe, then so does your fish.

Sight and sound

Many fish have an excellent sense of sight and fish see colors. They also have ears, however, they do not have external openings. The ears pick up vibrations and help the fish hear and navigate. Fish also have a unique navigational aid unlike anything found on mammals. The structure is called the lateral line and runs along the side of the fish. The lateral line contains small sensory hairs that can detect even tiny vibrations. This extra organ allows fish to navigate and hunt prey even in low light or cloudy water conditions.

4.2. Monitoring health status of stock

4.2.1. Characteristic of Health of stock

- Shining and glossy body color
- Normal food and feeding
- Normal swimming
- No external lesion on skin, gills, head, fin and body surface
- Well respiratory rate
- No change of external organ
- No loss of scale
- No physical damage
- Normal growth
- Color of skin and scale are normal and shiny
- No lesion, ulcer, hemorrhage or parasite on the body, etc.

4.2.2. Characteristics of diseased fish

A diseased fish have the following characteristics:

Head-standing

Head standing is a fish assumes a vertical position in the water with its head down. This is a serious sign, indicating loss of equilibrium and is secondary to gas accumulation in the abdomen or under the skin. This is common in catfish due to the organism *Edwarsiella tarda*.

Flashing

This describes a fish that turns on its side and makes a rapid semicircular swimming motion. These fish will frequently rub on objects in the aquarium as well. Flashing is considered to be a sign of an “itchy” fish. Ectoparasite infestation is most the common cause of this behavior.

Drifting

This is described as aimless, unprompelled, motion through the water. This is generally thought of as indicative of moribund (dying) state

Circling

This may be a sign one-sided blindness or one-sided fin damage. Circling typically becomes apparent prior to recognizable noticeable fin damage.

Color change

This may involve a fish becoming blanched (paleness or decreased intensity of the entire body). This is commonly seen in situations stress as in cold shock or low levels of dissolved oxygen. A specific paleness of the lateral line in neon tetras is highly suggestive of infection with the *Microsporidian Pleistiphora*.

Bottom-sitting

Resting on the bottom is normal behavior for sedentary species and fish that are asleep. Typical fish that are considered sedentary are: plecostomus, bichir, polyterus, lungfish, chinese algae eaters and some catfish. Bottom-sitting may be clinically significant if displayed by a normally active species. If one fish affected, possible contamination of the environment with a toxicant should be investigated.

Fin-nipping

Damaged fins and surrounding tissue are potential sites for bacterial infectious

Chasing

This is the rapid movements of one fish in close pursuit of another. The dwarf gourami is a territorial species that will commonly chase other fish away from its established niche. The hovering angel fish may actively chase more peaceful species housed in the same environment. These type of situations may cause active like guppies and tetra to hide and refuse food, therefore making them more susceptible to opportunistic pathogens in their environment.

Breathing

Breathing right below the water surface-this is a common symptom which might be telling you that the water condition is poor. Usually high level of nitrate (about 300 ppm) will cause this symptom.

Difficult swimming

If fishes are having difficult swimming, it is most likely due to an illness or injury.

Fish swimming quickly

There are several reasons why fish might suddenly begin swimming quickly around the tank, but the two most likely reasons have to do with water quality and breeding. When the water quality drops below acceptable levels, our fish are likely to become stressed and they may react to that stress by exhibiting abnormal behaviors such as swimming quickly or erractically around the tank.

Loss of appetite

Loss of appetite is commonly a symptom of disease fish. In some cases, fish may stop eating simply because they are bored with their diet-some species are motorious picky eaters and may refuse to eat if they are not offered at varied diet. This is very common problem among fish, especially wild-caught specimens, because they are used to eating a widely varied live food diet.

Gasping at surface

Fish is gasping his mouth at the surface, this is a sign of stress brought on by poor water conditions, usually a lack of oxygen.

Strange swimming

When fish are stressed, they often develop odd swimming patterns. If our fish is swimming frantically without going anywhere, crashing at the bottom of his tank, rubbing himself on gravel or rocks, or locking his fins at his side.

Common symptom of diseased fish

Bacterial infections: inactivity, frayed fin, bloated body, cloudy eye, red streaks throughout body, reddening or inflammation of skin, fins or internal organs, bulging eyes, difficult breathing, etc

Parasitic infections: inactivity, loss of appetite, excess mucous or film on body, visible spot or worms, rapid breathing

Fungal infection: erratic swimming, darting, visible cotton like tufts on skin, eye or mouth

4.2.3. Establish monitoring procedures

Any monitoring system developed by the multidisciplinary team should be designed to detect loss of control at a farm relative to its critical limit. The monitoring activity of a farm should be documented in a concise fashion providing details regarding the individual responsible for the observation or measurement, the methodology used, the parameter(s) being monitored and the frequency of the inspections. The complexity of the monitoring procedure should also be carefully considered. The consideration should be emphasis on prevention of abnormal behavior to get good result. For farm, records of monitoring should be acknowledged and dated by a responsible person for verification.

Self-check 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. _____ be a sign one-sided blindness or one-sided fin damage

   A. Circling B. Chasing C. Fin-nipping D. Bottom-sitting

2. _____ is a fish assumes a vertical position in the water with its head down

   A. Circling B. Chasing C. Head-standing D. Bottom-sitting

Test II: Short Answer Questions

1. List at least four characteristic of diseased fish? (4 point)
2. List at least five normal behavior of health fish (4 point)
3. _____ is describes a fish that turns on its side and makes a rapid semicircular swimming motion (2 point)
4. _____is described as aimless, unprompelled, motion through the water (2 point)

You can ask your teacher for the copy of the correct answers.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information Sheet-5	Diagnosing Sick Stock

5.1. Gross Observations

Behaviour

At a time when there are no problems on the farm, “normal behaviour” of the animals should be observed to establish and describe the “normal” situation. Any change from normal behavior should be a cause for concern and warrants investigation. Prior to the clinical expression of disease signs, individual finfish may exhibit increased feed consumption followed by cessation of feeding, or the fish may simply go off feed alone. Taking note of normal feed conversion ratios, length/weight ratios or other body-shape signs is essential in order to detect impending disease. Abnormal behaviour includes fish swimming near the surface, sinking to the bottom, loss of balance, flashing, cork-screwing or air gulping (non-air-breathers) or any sign which deviates from normal behaviour. Bursts of abnormal activity are often associated with a generalised lethargy.

Behavioural changes often occur when a fish is under stress. Oxygen deprivation leads to gulping, listlessness, belly-up or rolling motion. This can be due to blood or gill impairment. Flashing can indicate surface irritation, *e.g.*, superficial secondary infections of surface lesions. Corkscrew and other bizarre behaviour may also indicate neurological problems that may be disease related. Patterns of mortalities should be closely monitored, as well as levels of mortality. If losses persist or increase, samples should be sent for laboratory analysis. Mortalities that seem to have a uniform or random distribution should be examined immediately and environmental factors during, pre- and post-mortality recorded. Mortalities that spread from one area to another may suggest the presence of an infectious disease agent and should be sampled immediately. Affected animals should be kept (isolated) as far away as possible from unaffected animals until the cause of the mortalities can be established.

Surface Observations

Generally speaking, no surface observations can be linked to a single disease problem, however, quick detection of any of the following clinical signs, plus follow-up action

(*e.g.*, removal or isolation from healthy fish, submission of samples for laboratory examination), can significantly reduce potential losses.

Skin and Fins

Damage to the skin and fins can be the consequence of an infectious disease (*e.g.,* carp erythrodermatitis). However, pre-existing lesions due to mechanical damage from contact with rough surfaces, such as concrete raceways, or predator attack (*e.g.*, birds, seals, *etc.*, or chemical trauma) can also provide an opportunity for primary pathogens or secondary pathogens (*e.g.,* motile aeromonads) to invade and establish. This further compromises the health of the fish. Common skin changes associated with disease, which should encourage further action include red spots, which may be pin-point size (petechiae) or larger patches. These tend to occur around the fins, operculum, vent and caudal area of the tail, but may sometimes be distributed over the entire surface. Indications of deeper haemorrhaging or osmotic imbalance problem saredarkened colouration. Haemorrhagic lesions may precede skin erosion, which seriously affect osmoregulation and defense against secondary infections.

Erosion is commonly found on the dorsal surfaces (head and back) and may be caused by disease, sunburn or mechanical damage. In some species, surface irritation may be indicated by a buildup of mucous or scale loss. Surface parasites, such as copepods, ciliates or flatworms, should also be noted. As with the gills, these may not be a problem under most circumstances, however, if they proliferate to noticeably higher than normal numbers, this may lead to secondary infections or indicate an underlying disease (or other stress) problem. The parasites may be attached superficially or be larval stages encysted in the fins, or skin. Such encysted larvae (*e.g.*, flatworm digenean metacercariae) may be detected as white or black spots in the skin (or deeper muscle tissue).

The **eyes** should also be observed closely for disease indications. Shape, colour, cloudiness, gas bubbles and small haemorrhagic lesions (red spots) can all indicate emerging or actual disease problems. For example, eye enlargement and distension, known as “Popeye”, is associated with several diseases.

Gills: The most readily observable change to soft tissues is paleness and erosion of the gills. This is often associated with disease and should be of major concern. Red spots may also be indicative of haemorrhagic problems, which reduce the critical functioning ability of the gills. Fouling, mucous build-up or parasites (ciliate protistans, monogeneans, copepods, fungi, *etc.*) may also reduce functional surface area and may be indicative of other health problems. These may affect the fish directly or render it more susceptible to secondary infections.

Any deviation from normal body shape in a fish is a sign of a health problem. Common changes include “pinhead” which usually affects young fish indicating developmental problems; lateral or dorso-ventral bends in the spine (*i.e.*, lordosis and scoliosis) can reveal nutritional or environmental water quality problems. Another common, and easily detected, change in body shape is “dropsy”. Dropsy is a distention of the abdomen, giving the fish a “pot belly” appearance. This is a strong indicator of disease problems which may include swelling of internal organs (liver, spleen or kidney), buildup of body fluids (clear = oedema; bloody fluids = ascites), parasite problems, or other unknown cause. Dropsy is a common element in many of the serious diseases listed in the *Asia*

5.2. Sample Collection for Disease Diagnosis

All samples submitted for disease diagnosis should include as much supporting information as possible including:

- Reason(s) for submitting the sample (mortalities, abnormal growth, etc.)
- handling activities (net/cage de-fouling, size sorting/grading, site changes, predators, new species/ stock introduction, etc.) environmental changes (rapid water quality changes, such as turbidity fluxes, saltwater incursion into freshwater ponds, unusual weather events, etc.).

This information will help clarify whether handling stress, change of environment or infectious agents may be a factor in the observed abnormalities/mortalities. Such information is necessary for both rapid and accurate diagnosis, since it helps focus the investigative procedures required.

Self-check 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3 point)

1. disease may diagnosed by_____
   A. Gross observation
   B. Surface observation
   C. Laboratory confirmation
   D. All
2. One of the following information is support the sample during submission
   A. Reason(s) for submitting the sample (mortalities, abnormal growth, etc.)
   B. handling activities
   C. Date of sample collection
   D. All
   E. None

You can ask your teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet-6	Investigating and Reporting Diseases Outbreak and Stock Death

9.1. Out break

An outbreak is defined as an unexpected occurrence of mortality or disease. This may be due to significant pathogens or to water quality changes such as plankton blooms or sudden or severe decreases in dissolved oxygen levels. Vigilant monitoring and early detection is the key to good management of emergencies. Emergency disease control requires a coordinated response drawing on significant resources and input from all tiers of government and a range of industry groups. In the event of a disease outbreak, the farm manager initiates quarantine, movement controls and assessments around the initial site which may include the submission of fish and water samples for diagnosis. The significant disease incidences should be reported to the Department of Fisheries within 24 hours. The farm manager will consult with farm and laboratory veterinarian on control strategy based on available information. Successful control may require determination of where the disease might have come from, and where it might have been spread to. Depending on whether disease is in the notifiable livestock disease lists, there might be a need to eradicate by culling affected fish. There might follow a period of quarantine and movement control until surveillance clears the farm of the disease.

9.2. Investigation and report

The Veterinarian may require records and appropriate sampling to determine cause of the outbreak and best course of action. The Veterinarian and/or Fish Health Manager will give instructions for proper sampling. Water and feed samples may be requested. Samples will be properly handled, properly stored and promptly shipped as per the Veterinarian's or Fish Health Manager's instructions.

Parameters that may be useful to maintain records and from part of significant information or history during disease investigations include:

- Source of fish;
- Period on farm e.g. newly arrived;

- Dates of disease onset;
- Age/fish species affected;
- Recent handling, grading, net changes, tank transfer, etc;
- Stocking density;
- Mortality pattern; and
- Water quality/recent weather/tide conditions

Establish existence of an outbreak

"The occurrence of more cases of disease than expected in a given area or among a population of fish over a particular period of time"

- Epidemic applies to situations involving large numbers of fish over a wide geographic area
- An outbreak applies to a localized increase in incidence of disease
- A cluster is an aggregation of disease cases in a given location over a particular period without regard to whether the number of cases is more than expected.

Where do we start?

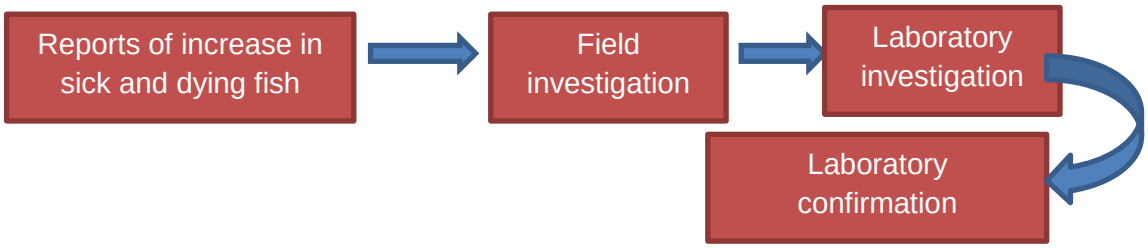

Diagram 1: step of investigation of disease

Subject to the type of reporting, a cluster of cases may/may not represent an outbreak

Other factors to consider:

- Severity of the disease
- Potential for spread
- Availability of control measures
- Political considerations
- Public relations
- Available resources
- Environmental

Standardized approach for field investigation

Fish disease investigation kit for site-based investigation should include:

- Data collection form
- Dichotomous key to reach a preliminary diagnosis
- List of suitable techniques for the preservation, storage and transport of samples collected during the initial investigation.
- List of veterinary laboratories that may be contacted, including contact details.
- Dissecting and sampling instruments and suitable sampling and preservation chemicals and containers

Self-check 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3 point)

1. One of the following parameter is used to maintain records during disease investigations
   A. Source of fish C. Dates of disease onset
   B. Stocking density D. Mortality pattern E. All
2. One of the following is not considered during reporting an outbreak
   A. Severity of the disease
   B. Potential for spread
   C. Availability of control measures
   D. Political considerations
   E. None

Test II: Short Answer Questions

1. List at least four standardized approach for field investigation (4 point)
2. _____is defined as an unexpected occurrence of mortality or disease (2 point)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-7	Collecting Sample

7.1. Introduction

The purpose of this section is to provide guidance to laboratory staff and user groups regarding the proper sample collection and submission procedures. This is an absolute necessity to assure that samples received by the centers are acceptable specimens for definitive pathogen identification.

7.2. Considerations for sampling Fish Populations

Diseases recognition and action- the majority of sampling conducted under the survey will occur when no external signs of diseases exist in wild fish populations. However, the survey may also be helpful in determining the cause of fish kills or monitoring wild population when abnormal behavior pattern, external abnormalities or high mortality are reported for natural fish populations. In this case an immediate response is needed to determine the cause of mortality and determine if infectious agents are present or if adverse environmental conditions exist (low dissolved oxygen, elevated temperature, toxic sign bloom, water contamination, etc.). The following offers guidelines for sampling fish under various scenarios:

- In clinical cases of disease (≥0.5% mortality/day) 10 moribund fish are generally sufficient to detect fish pathogens and make a disease diagnosis
- In survey or monitoring situation where no excessive mortality or clinical disease is apparent, a larger sample size of 60 animals may be necessary to detect infection rates below 5% .however depending up on individual circumstances, sample sizes may vary between 10 and 60 fish. Sample should be examined from several stroches of a stream or body of water to ensure representation of the entire population.
- Donor populations – in some cases natural populations will be used as donor brood stock to provide gametes to a hatchery program involved with a captive brood stock program or restoration activities. When disease history for natural population is needed a minimum of 60 samples from spawning adults is required to detect pathogens at a 5% prevalence and a confidence interval of 95%.

7.3. Sample Collection

Prior to collecting samples the center will contact sampling personnel with instructions on the appropriate type of samples and numbers of fish needed. Partners collecting specimens needed to provide at least one-week advance notice of sample collection. If advance notice is not given lab personnel may not be available to receive and process the submission after it is collected and shipped.

- Live fish are preferred and should be sampled immediately upon removal from water. If this is not possible, fish should be held on ice and processed within 1-2 hours after collection. Whole fish can be packaged or freshly killed (iced) for shipment to the centers for processing within 24 hours.
- Samples for virology should be processed within 48 hours and inoculated into cell culture within 72 hours of sample collections. Upon specimen arrival determine the freshness of the fish. Criteria for this freshness are: smell, appearance of eyes, gills, internal organs and presence of postmortem stiffness (rigormortis). If shipping is delayed beyond 24 hours, some tissues may not be suitable for processing.
- Euthanize the fish or group of fish: use clean sterile dissecting instruments. Clean dissecting tools with soap and water and disinfect with alcohol between the sampling of each individual fish (species) or species group.

Self-check 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. One of the following is true on guideline of sampling fish
   A. In clinical cases of disease 10 moribund fish are generally sufficient
   B. In survey or monitoring situation where no excessive mortality a larger sample size of 60 animals may be
   C. Donor populations
   D. All
2. One of the following is performed during sample collection?
   A. Sampling
   B. Labeling
   C. Transporting
   D. Analysis

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-8	Drawing conclusions from relevant information

8.1. Gathering information for drawing conclusion

On-site, first- hand observations and data usually provide far more persuasive evidence in judicial hearings than evidence derived from literature. However, familiarity with the literatures and other sources of information is essential to well-rounded conclusion.

8.2. Equipment needed for investigation at field site and draw conclusion

Before going to the site of a fish kill, make sure that you are prepared and have the equipment needed. Remember that your investigation could result in litigation and that your records, methods, and analysis may be used and challenged in decision.

The lists that follow should assist investigators in making a determination of the needed supplies. Not all of the equipment and supplies will be needed for every fish kill investigation. Make a checklist of the items you will need. It is better to have too many supplies than not enough; a shortage will delay the investigation and could result in the loss of critical evidence.

It is vital that all supplies and materials be checked or replaced regularly to ensure that they are fresh and maintained in a state of readiness. Bacteriological media should be stored as slants 20ml screw-cap tubes and tightly capped to prevent drying. The tubes should be replaced monthly with fresh media.

Steps of drawing conclusions: Each case history should be presented in four parts:

- a description of the site and of the kill,
- the procedures follow during investigation,
- the results of laboratory and field work, and
- the assignment of the cause. At the end of each part, you are urged to **write down any conclusions** you might have reached before proceeding to the next part.

Example

A. The case of the Botched Batch (Scenario)

Commercially fishermen on a large river reported that many dead fish were appearing in their nets. There had been a recent rise in water level after prolonged drought. No dead fish were noted before or during the rise, but they were seen shortly afterward. Upon visiting the site, the observer noticed many small and some large dead fish, and some large fish that were listless and lethargic. If disturbed, some affected fish showed convulsions. A check variety of species was affected. A check of the water revealed the following characteristics: PH: 7.5, dissolved oxygen, 7 ppm; temperature, 27”C; and hardness, 230ppm (as CaCO3). The river water seemed normal and was otherwise unaffected. Samples collected from the river revealed a abundance of live algae of many species, absence of live benthic organisms, and many dead crayfish. A check of a tributary in the area indicated many live fish of all sizes, many benthic organisms, live crayfish and algae of many species. Physic-chemical characteristics of the tributary were as follows: PH, 7.5; dissolved oxygen, 7ppm; water temperature, 25”C and hardness, 218 ppm.

B. What preliminary conclusions can be reached on the bases of the above conclusions?

1. The source of problems was upriver
2. The cause was not related to an oxygen depletion
3. The causes was not an infectious disease because so many different kinds of organisms were affected
4. The cause must have been a toxic substance because a wide array of fish died first
5. The toxic substance was something other than a herbicide. It might have been insecticides, pesticides or other chemical because it kill fish, benthos and large crustaceans, but not algae.

C. How should the investigator proceed?

1. Conduct survey of the river upstream from initial site to a point where the fish are alive and the biota normal
2. Collect water samples to be analyzed for pesticides

3. Select moribund (not dead) fish, collect tissue samples of blood, brain and live, as well as whole fish. Freeze samples and send them to an analytical laboratory along with the water samples
4. Check all tributaries and potential point sources in the vicinity just downstream from where normal biota are observed. Collect samples of sediment, water and moribund fish as in (2) and (3) for chemical analysis
5. Collect similar samples from tributary where aquatic life was not affected
6. When the suspected cause has tentatively been identified, contact individuals or companies in the area that may be possible sources.

D. Information derived from laboratory and field work

1. The survey of the river indicated that the fish kill could be traced to a single tributary on which several industrial plants were located.
2. The kill zone ended at a landfill site adjacent to the stream
3. A check of the site showed that the recent high water had eroded the bank between the stream and the landfill and that dumped material was now in contact with stream flow
4. A large quantity of a dark, viscous substance covered a large area of the landfill
5. A laboratory analysis revealed that the dark substance contained a very high concentration of endrin
6. Water samples taken upriver from the mouth of the stream contained no endrin, but samples immediately below the mouth contained significant amounts
7. Sediments samples taken from site up-stream from landfill contained no endrin, but high concentration were present in the immediate area where the landfill abutted the stream
8. Blood, brain and liver showed low level of many pesticides and 0.15 to 0.22mg/L of endrin
9. A check of toxicity information on endrin revealed that concentration of 0.19 mg/L or more in the brain induce convulsions and narcolepsy and are lethal to fish
10. Rechecked of the landfill site revealed evidence identifying the pesticides company as the source of the dark substance

11. Detailed discussions with plant personnel at pesticide company revealed that a production run of endrin had “gone bad” was terminated and was dumped into the land fill

E. Final conclusion

Endrin poisoning resulted from illegal dumping cause death of fish

Self-check 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (2 point)

1. One of the following is the end part of presented case
   A. Description of the site and of the numbers of kill,
   B. The procedures follow during investigation
   C. The results of laboratory and field work
   D. Write down any conclusions

Test II: Say True or False

1. On-site, first- hand observations and data usually provide far more persuasive evidence in judicial hearings than evidence derived from literature (2 point)
2. All of the equipment and supplies will be needed for every fish kill investigation (2 point)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask your teacher for the copy of the correct answers.

Operation Sheet- Collecting, labeling and shipping sample

Sequence of collection, labeling and shipping sample from sick stock

The following sequence is provided as a step-by-step example of collecting, labeling and shipping sample.

- Ship samples in small/medium mailing cartons or plastic coolers lined with a plastic trash bag. Group the samples by type in separate Ziploc bags that are labeled with the number of samples, location, species and date.
- Place an adequate amount of ice around the insulating layer of packing materials. Seal outer trash bag to prevent leakage.
- Close, seal and label the ice chest with laboratory address, be sure to include the center contact's (name and phone number)
- Appropriate shipping labels should also be affixed to ensure proper handling during shipment and upon receipt of containers.

  Live fish- Do Not Freeze…….. …for live fish samples

  Refrigerate but Do Not Freeze ……. virology or sets of samples that include both bacteriology and virology
- Transport within 24 hours

LAP TEST	Performance Test

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

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

Task-1 Collect, label and shipping live fish

LG #75	LO #2- Implementing control and prevention measures against predators, pests and diseases

Instruction sheet

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

- Identifying and implementing the prevention and control measures of predator, pest and diseases of fish stock
- Selecting and implementing preventive measures
- Pests, Predators and Diseases control methods

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

- Identify and implement the prevention and control measures of predator, pest and diseases of fish stock
- Select and implement preventive measures
- Pests, Predators and Diseases control methods

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet-1	Identifying and Implementing Prevention and control methods

1.1. Definition

Prevention: Preventative medicine programs may include strategic deworming, insect control, vaccination, or immunization, adaptation of animals to specific environment and ecology, quarantine and isolation of animals.

Control: is the reduction of the morbidity and mortality from diseases, and is a general term embracing all measures intended to interfere with the unrestrained occurrence of disease, whatever its cause.

Eradication: totally elimination of the diseases from the promises.

1.2. Levels of disease prevention

Primary prevention is aimed at maintaining a healthy population; i.e., preventing the occurrence of disease. **Secondary prevention** (also called disease control) attempts to minimize resultant damage after disease has occurred and primary prevention has failed. **Tertiary prevention** consists of rehabilitation after primary and secondary prevention has failed.

Primary prevention involves the healthy population. Secondary and tertiary Prevention is aimed at the diseased or patient population. The economic aspect of disease prevention is of paramount importance; particularly in considering food animals. Simply stated, as one progresses from primary through secondary to tertiary prevention, the cost per animal unit usually increases.

1.3. General principles of fish diseases prevention and control

The ways of prevention and contingently of medical treatment of fish are very specific and often different from those in warm-blooded animals. They require a thorough knowledge of the environment of fish. Preventive arrangements are consisting of complicated set of treatments elaborated on the base of a good knowledge of the etiology of disease and host (fish) biology. It concerns the elimination or restriction of infection (invasion) sources and the possibilities of its further expansion likewise the enhancement of condition of fish organism in the way to be able to withstand the

infection (invasion). The prevention is of basic importance in diseases elimination. No specific therapeutics were developed for a number of diseases up to now and the result of the application of effective, experimentally verified medicaments, is often reversely affected by the operational conditions and/or the technology of rearing. The medical treatment becomes economically unrenumerative in this way.

Preventing disease by observing the essential principles of the fish health management is the most cost effective management scheme for aquaculture. The principles include understanding and attending to:

- Species biology, including all known and important genetic considerations
- Nutrition
- Water quality
- Quarantine
- Sanitation, and
- Disinfection

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. understanding and attending the following principle is used for disease prevention

   A. Water quality B. Quarantine C. Sanitation D. Disinfection E. All

2. _____ refers to totally elimination of disase in promises

A. Prevention B. Control C. Eradication D. B and C

Test II: Short Answer Questions

1. _____is the reduction of the morbidity and mortality from diseases (4 point)
2. List at least three principles of prevention disease (2 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-2	Selecting and Implementing Preventative measures

2.1. Introduction

In addition, some treatments cannot be performed in certain periods, e.g. in growing season, during the wintering, or in some fish culture units (e.g. large ponds). That is why it is much more important to prevent from the diseases than to recover them. The effective preventive treatments are to be applied above all in specialized fish culture units with closed warm water system, in early fish fry rearing, hatcheries, trout farms, wintering ponds and storage reservoirs.

2.2. Methods of Diseases Prevention

Generally accepted and effective principles are as follows:

a) **Providing water sources free of pathogens**

Underground waters are the most suitable water sources free of pathogens. These sources are limited both for trout farms and hatcheries and for other special fish culture units at present. The surface water from rivers and channels is used as the source of inflow water in most cases. In these situations, suitable filters can partially reduce the numbers of invasion stages of parasites in inflow water, above all when supplying smaller reservoirs with intensive culture. Bars are usually placed before these filters to separate rough particles. Sand filters are consisted of a set of sedimentation divisions terminated by filter with fibre and sand. These type of filters catch above all the heavier parasite stages unable to move actively (e.g. spores). Lower efficiency is registered in elimination of moving parasites like e.g. infusorians.

The water from the pond with fish stock is quite unsuitable for these purposes (esp. as the source of inflow water for trout farms, hatcheries and units for early fish fry stages).
Chemical treatment of inflow water is an emergency arrangement with often undesirable parallel affects. Disinfection of the water entering fish culture units by UV radiation is not still a usual way although it can be considered as the simple method how to destroy viruses, bacteria and moulds germs. Since the inflow water from rivers and channels is slightly turbid and contents a number of suspended solids and dissolved compounds, the disinfective efficiency of UV radiation is markedly reduced in these situations.

It is very profitable to supply the individual ponds and/or reservoirs independently, not through flowly. The water from each pond or reservoir should be drained separately and should not flow into any other. Especially quarantine ponds and other reservoirs can be separated by this way.

b) **Protection from the transfer of pathogens**

This principle means above all the transfer of pathogens by uncontrolled transport of fish and spawns. The transport of fish with unknown health condition is to be avoided in principle. All transported fish are to be accompanied by veterinary certificate confirming that fish were examined before transporting them, they are healthy and originate from the environment in which no important transfer diseases appear. The list of these diseases is precisely stated in veterinary instructions. Except of the internal survey for each country also the list of diseases stated in international codex is obligatory for veterinary service. This list is currently specified with the development of diagnostic methods and improvement of knowledge about individual fish diseases. Some viral and bacterial diseases can be transfered also by spawns. Their transport must be completed by the same veterinary certificate like fish transport from this reason.

Fish introduced from other territories must be subjected to quarantine for one year regardless if native or extraneous species. The duration of quarantine can be prolongated e.g. in the case of fish imported from abroad until the period of 3 years. Prolongated period of quarantine is of special importance especially in spawners predestined for further reproduction of imported species. The selfsustaining in stock production in individual farms and similar organizations is a significant way of prevention from dissemination of fish diseases. Only fish previously examined, free of diseases and relevantly treated by medicinal baths are to be stocked into ponds and fish culture units. The stocking of fry originating from semi-artificial and artificial spawning not contacted with fish of higher age categories also minimizes the danger of infection.

The prevention from introduction of coarse fish into ponds and fish culture units is the other important arrangement protecting the stock against transfer of pathogens. These fish are above all the source of ectoparasites, dangerous especially in the period of

decreased resistence of fish. Except of this they can transfer also some other pathogens which can result in heavy losses in important fish species. Adequate bars and filters can serve for prevention from coarse fish penetration.

The protection of piscivorous birds to step into fish culture units (esp. trout farms) is the prevention limiting the expansion of some fish diseases. Protective nets are used to prevent the birds from running in. The numbers of piscivorous birds are regulated in localities where overpopulated.

Preventive control of snails (*Lymnaea* sp.) as intermediate hosts of some fish parasites can be performed by **biological** (introduction of black carp - *Myelopharyngodon piceus* or 3-years-old tench *Tinca tinca*), mechanical (placing nets in the inflow), physical (drying and freezing of the bottom) and chemical (application of molluscocides) ways. Safe and harmless removing of dead fish is a significant way how to prevent from further transfer of fish pathogens. Fresh or slightly decayed dead fish are decontaminated in the nearest veterinary facility. Lower masses of dead fish are to be burnt or burried into deep pits (aprox. 2 m) in distance of at least 20 m from the pond bank. The bottom of this pit and dead fish must be covered by burnt or chlorinated lime. The layer of at least 60 – 80 cm of the soil must cover the content of a pit.

c) **Disinfection of ponds, fish culture units and equipment; winter freezing and summer drying of ponds**

Disinfection is of a big importance in prevention and elimination of fish diseases. Preventive disinfection protects the fish stocks against pathogens. Hygiene of environmental conditions for fish is improved by this way. Focal disinfection is performed for control of the focus of dangerous fish disease.

Natural physical phenomena are fully used for disinfection in intensive fish culture due to their ecomical convenience. It concerns the drying and freezing of the pond bottom. The most of pathogens die after perfect drying of the pond bottom when its relative moisture had dropped on 10 – 15 %. The perfect freezing of the wet places and sun radiation (above all by its UV rays) have a very favourable effect in our conditions. The

influence of these natural physical phenomena is exploited by summer drying and winter freezing of water reservoirs (ponds). Summer drying is a radical, long-term intervention during which all pathogens are controlled due to the perfect drying of the pond bottom. The aim of winter drying is to destroy the pathogens by freeze. It safely leads to destruction of leeches (*Piscicola geometra*), fish lice (*Argulus* sp.), predatory larvae of water insects, eggs and spores of parasites and also other pathogens. Employing the natural ways for disinfection has an disadvantage in usually long-term duration (a number of months up to one year).

d) **Optimization of environmental conditions**

The optimization of natural environmental conditions is the main pre-condition how to ensure the good health condition of stock during the rearing period. The following principles must be ensured:

- optimal water quality without stressing physico-chemical effects. Keeping the oxygen concentration on optimal level and protection against water pollution are of special importance,
- maximum development of natural food resources by the adequate interventions, feeding fish by supplementary feed mixtures in sufficient amount and quality (the attention should be paid on the quality of individual feed components and biofactors), basic preventive arrangements protecting the early developmental stages and young fish from bacteria and protozoans, including sufficient amount of natural food of appropriate size and species composition,
- responsible establishment of maximum stocking density. Inadequately high stocking density results in stress behavior, worsened condition and resistance, and makes the expansion of diseases easier. The stocking density is of special importance in trout farming and fish culture in special intensive units (but also in ponds),
- Prevention from stress situations evoked by other factors, above all manipulation during fishing out, transport and long-term storage.

e) Vaccination

f) Quarantine and isolation

g) **Regular control of health condition and preventive treatment of fish**

Preventive control of health condition is to be carried out in hatcheries and early fry rearing units twice a week, and in highly productive intensificated ponds, trout farms and fish culture units with recycling warmed water weekly. Other stocks (esp. in usual pond culture) are investigated monthly. Health condition of fish is always to be controlled before fishing out, transporting fish and stocking. Preventive treatment can be suggested on the base of investigational results. This treatment is performed above all by the application of medicaments into the water environment and feeding by medicated feeds.

Prevention of predator

I. Predatory bird and their management

Cultured fish can be more or less susceptible to bird predation depending on the physical location, design and construction of an aquaculture facility.

Facility location, design and construction

- locating aquaculture sites near known bird migratory routes or flyways will mean more visits and/or predation
- when aquaculture facilities are located in isolated areas, heavy losses of fish can result when birds have easy access to fry and fingerlings
- man-made and natural objects, such as fences, telephone and light poles or vegetation, provide attractive perching, hiding, nesting and hunting structures for bird predators. Try to reduce the number of these structures around the aquaculture facility
- increasing the pond's shore water depth to a minimum of 1 m and steepening embankments will decrease predatory birds' ability to feed

Stocking

- stock ponds or raceways with larger fingerlings. This approach will decrease predation levels because larger fish are usually less vulnerable to predation
- reducing the number of fish in a structure may reduce its attractiveness to bird predation, as birds prefer densely stocked ponds.

- when stocking ponds, release fingerlings at several locations in open water, which will decrease the chance of fingerling mortality due to weed entanglement and/or bird predation
- the use of stocking cages for up to two weeks can help prevent fish mortality caused by weeds, predatory birds and toxic bottom water
- fish that feed at the water's surface are more susceptible to predation; avoid floating feed if possible
- stocking at dusk provides a greater opportunity for fish to adapt to new surroundings.

Observing bird hunting and feeding can confirm the damage to your aquaculture site. Fish are often swallowed whole, leaving few direct signs of damage behind. In these cases, the presence of bird excrement (whitewash), bird feathers and/or footprints may be the only signs of predation.

The only assurance of eliminating bird predation at aquaculture facilities is total exclusion of birds from fish holding facilities. However, total exclusion may be impractical for many facilities, due to size of operation, expense, or interference with management activities. Satisfactory results may be obtained with the use of partial exclusion and non-exclusion barriers, if combined with other control methods. Which control method(s) to use depends on a number of factors, including the number and species of birds involved, the severity of the predation problem, type and size of facility to be protected.

Barriers

Two types of physical barriers can be used for managing bird predation:

1. complete enclosures that prevent predators from gaining access
2. partially-covered systems that interfere with the feeding behaviour of predators

Complete enclosures exclude all predators-

Complete enclosure (caging) of ponds and/or raceways with screens or nets.

- all exclusion structures should be long-lasting and strong enough to withstand the weight of several large birds. They should keep the barrier from sagging to within the bird's striking distance to the water

- the barrier should be visible to birds to minimize accidental injury or entrapment
- exclusion structures should allow for facility maintenance, feeding, harvesting and other operations
- total exclusion is the only method that can provide long-term control against all bird predators

Partially covered systems-interferes with predators feeding behaviour

Partially covered systems include overhead wire, line, net, screens, perimeter fencing and devices that discourage birds from entering the facility.

- overhead lines and wires - heavy gauge monofilament lines, high-tensile galvanized or stainless steel wire suspended in a grid pattern or in one direction over the water surface
- spacing between wires or lines varies with bird species
- overhead line/wire systems are most effective against flying predators
- wading birds can access ponds by landing on shore and walking to the water. These areas should also be protected by perimeter fencing

Electric wires and perimeter fencing

- charges must be non-lethal to humans and birds.
- fences used in combination with overhead lines/wires may be successful at deterring both wading and flying predators

Frightening techniques –

Frightening devices and techniques discourage birds from feeding, roosting or gathering at a location. Frightening techniques rely on sight and/or sound stimuli to discourage birds from remaining at a site by making the birds believe the site is dangerous for them. Success in frightening birds away depends on the number of devices used, how and where they are administered and if their use precedes the establishment of the birds' feeding habits.

- frightening techniques are most applicable for short duration problems (1 to 3 days), as birds will quickly lose their initial fear
- start the frightening regime before the birds establish regular feeding patterns
- change the location of frightening devices often, particularly noise-making ones

- long term results may be achieved by using a combination of methods and by frequently alternating the devices used

Noise

- noise devices should start and stop at varying intervals and be moved to various locations frequently
- distress calls - recording of species-specific distress calls, should be used as soon as birds arrive
- cracker shells - modified cartridges that contain a firecracker fired from a shotgun
- whistle bombs, screamers, screamer rockets, bangers - 15 mm cartridges fired into the air from a hand-held .22 caliber pistol
- automatic exploders - propane gas or acetylene gas is used to operate a small canon equipped with an electronic timing mechanism, which emits loud explosions at adjustable time intervals

Visual scare devices

A variety of visual devices are available for scaring night-feeding birds. As with noise-making devices, the effectiveness of visual scare devices is often short term, as birds quickly become accustomed to them. These devices are more effective when used in combination with other methods.

Scarecrows and predator models

- models or silhouettes of humans and/or predators placed in strategic locations at a facility
- change location of models and silhouettes frequently
- effectiveness increases with the addition of pyrotechnics fired from the same area
- construction flashers, area lights, revolving beacons and strobe lights
- a variety of light-emitting devices can be used to confuse, frighten, temporarily blind and interfere with activities of night-feeding birds

II. **Predatory fish and their management**

Prior to stocking, drain or net ponds to remove fish eating species. Barrier screening on both the inlet and outlet of the pond is usually effective for keeping out larger fish.

III. **Mammal predators and their management**

Chewed or partially eaten fish may be a sign of predatory mammals at an aquaculture facility. Mink, racoon, skunk and otter can cause problems in some areas but to a much lesser extent.

IV. **Humans Beings (poachers)**

Provide security to your premises by fencing off and keeping the place active. Some places have gotten local authorities to recognize how harmful theft is to the development of commercial fish farming in their area and have enlisted their help in prosecuting fish farm thieves. As well, be a good neighbor and make sure others appreciate the fact your farm is there. This can create “social pressure” to reduce thievery.

V. **Frogs and Snakes**

The populations of frogs and snakes can be controlled by;

- Keeping premises around clean and clear.
- Do not allow bushes to grow around the ponds.
- Water channels should also be kept clean and clear.
- Screen the ponds as recommended.
- Screens within the water channels also help reduce frogs’ access to the ponds. Frogs tend to come into pond areas via the water channels. Short grass around the ponds reduces hiding places for the snakes and frogs, which makes them more vulnerable to predation by hawks.

VI. **Lizards and Otters**

Clear the bush around so that they have no nesting close by. Set traps to catch monitor lizards and otters. Dogs are also very good at chasing away these predators

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List at least five methods of prevention of infectious diseases? (4 point)
2. List at least three method of bird predatory prevention (3 point)
3. List two types of barrier (2 point)
4. List the methods of controlling population of frog and snakes (3 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-3	Pests, Predators and Diseases Control methods

1.1. Definition

Control refers to the actions and programmes directed towards reducing diseases incidence (new infections, infestations, pests,etc.). Control aimed at reducing the incidence of infectious disease or their risk factors can be considered as primary prevention of infectious diseases. Primary prevention protects health through individual and population wide measures, including such actions as maintaining god nutritional status, immunizing against infectious, providing safe water, protect from enemies and ensuring the proper disposal of wastes.

1.2. Methods of Control

Several methods of controlling bird predation are practised with varying degrees of success. Small ponds and raceways can often be covered with nets or wire-mesh, but it is intriguing to see how some birds learn in the course of time to gain access through such protective covers. Devices like flash guns, sirens, klaxon horns, gongs, scarecrows, bamboo rattles and bells have all been tried with initial success.

Frogs and toads have been reported to destroy the larvae and juveniles of fish, particularly of tilapia in African ponds. Some of the aquatic snakes prey on juvenile fish. Other predators are crocodiles, alligators and large lizards. All these can more easily be prevented from entering farms with proper fencing and by keeping the pond banks and surrounding areas free from dense growths of vegetation. The snapping turtle has been found to prey on catfish, but other turtles usually only compete with fish for space and food.

Otters (*Lutra* and *Aeonyx*) are probably the most destructive of the mammalian predators. They live in the immediate vicinity of water and burrow into the banks under the roots of trees. Otters are nocturnal in habit and hunt for fish mainly on clear nights. They attack relatively large fish, eat the best parts and leave the rest. The recommended control measure is to catch them with special otter traps. Large traps with sturdy solid teeth have to be used as otters can easily escape from smaller traps.

The traps should be set in passages generally used by the animals to enter the farm; the passages can be identified by the otters' webbed footprints and excrement. Hunting them from their holes with the help of trained otter dogs and proper fencing of the farm are other means of control.

Among the losses sustained by predation should be included poaching by man, which is extremely difficult to prevent. This problem is experienced worldwide, but its severity varies with the system of culture (e.g. pond culture, cage culture, raceway culture, etc.) and the socio-cultural background of the neighborhood communities. The risk becomes greater when the crop is ready for harvest and the culture system makes it easy to catch large quantities in a short period of time with little effort, as in cage farms. On the other hand, in intensive farming systems using limited space, it will be possible to exercise greater vigilance than in large pond farms covering hundreds of hectares. Traditional anti-poaching measures include the employment of reliable watchmen, use of trained watchdogs, placing hidden obstructions in ponds to prevent seining and fencing of farm areas. In recent times, several types of burglar alarms and even electrified fencing have been tried with varying degrees of success.

Use of non-selective pesticides: Even though the selective treatments to eradicate predators, weed fish or pest animals described above are valuable in combating specific individual infestations, there are several pesticides and poisons that could be used to eradicate some or all of the predators, weed fish and pests simultaneously. The use of natural products like tea seed cake and derris powder has been very popular among aquaculturists for this purpose, because these are not harmful to man in small amounts and lose their toxicity in water within a short period. The use of chlorinated hydrocarbons (e.g. DDT, Endrin, Chlordan, gamma BHC), although effective, has to be avoided because of their long-term residual effects. On the other hand, organophosphate pesticides like Gusathion do not leave a toxic residue for more than two weeks or so after application.

Biological Control: Broadly defined, biological control, or biocontrol, is a strategy in which living organisms control populations of pest species. Biocontrol agents may

include predators, parasites or pathogens consumers, or genetically modified organisms (i.e. organisms that carry genetic constructs used in biocontrol).

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. _____ is defined as a strategy in which living organisms control populations of pest species (4 point)
2. List at least four methods of control of diseases of fish (6 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask your teacher for the copy of the correct answers.

LG #76	LO #3- Treat Ill Fishes in Stock

Instruction sheet

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

- Collecting, labeling and shipping specimens
- Providing treatment for sick stock
- Complying with holding period of drug
- Monitoring infestation/infection of stock
- Modifying treatment program
- Notifying senior personnel advise
- Identifying stock diseases
- Maintaining record

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

- Collect, label and shipping specimens
- Provide treatment for sick stock
- Comply with holding period of drug
- Monitor infestation/infection of stock
- Modify treatment program
- Notify senior personnel advise
- Identify stock diseases
- Maintain record

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet-1	Collecting, Labeling, Packaging and Sending Specimen

1.1. Sample Collection and label

Prior to collecting samples the center will contact sampling personnel with instructions on the appropriate type of samples and numbers of fish needed. Partners collecting specimens needed to provide at least one-week advance notice of sample collection. If advance notice is not given lab personnel may not be available to receive and process the submission after it is collected and shipped. All samples submitted for diagnosis should include as much supporting information as possible including:

- reason(s) for submitting the sample (*i.e.* health screening, certification)
- gross observations, feed records, and environmental parameters
- history and origin of the fish population date of transfer and source location(s) if the stock does not originate from on-site.

These information will help clarify whether handling stress, change of environment or infectious agents are causes for concern. It will also help speed up diagnosis, risk assessment, and husbandry management and treatment recommendations.

The sample may be fish, dead tissues or water.

I. Fish Sample

Sample characteristics:

- Sample should be representative
- Moribund fish: at different stages of the disease (early, peak, late stage),
- Includes healthy fish: for comparison with those showing clinical signs of the disease
- Freshly dead fish: (2-4 hrs after death as maximum)
- Size of sample varies according to (Age, Size, Suspect disease (Acute toxicity (1-5 fish), Infectious diseases (small fish: 10-15 fish & large fish: 5-10 fish)
- Sample should not include dead fish due to (Fish tissues rapidly decomposed (PM autolysis), once fish started decomposition protozoa and viruses leaves fish body, so you will not be able to diagnose those diseases).

II. Water Sample

Sample characteristics

- Sample should be representative collected from three points (inlet, outlet and the middle of the pond)
- Sample should be taken in a separate container
- Sample should be taken under complete aseptic condition using sterile glass bottle (500 ml)
- Bottle should be only opened under water surface at depth not less than 0.5 meter

1.2. Packaging and shipping specimen

Samples should be transported in sealed, unbreakable, containers. It is usual to double pack samples (*i.e.* an unbreakable container within a second unbreakable or well-padded container). Many postal services and transport companies (especially air couriers) have strict regulations regarding shipping chemicals, including preserved samples. If the tissues have been adequately fixed, most fixative or storage solution can be drained from the sample for shipping purposes. As long as sufficient solution is left to keep the tissues from drying out, this will minimise the quantity of chemical solution being shipped. The carrier should be consulted before samples are collected to ensure they are processed and packed according to shipping rules.

- Containers should be clearly labeled with the information described for live specimens
- The name and telephone number of the person responsible for picking up the package, or receiving it at the laboratory, should be clearly indicated
- Where possible, ship early in the week to avoid delivery at the weekend, which may lead to improper storage and loss of samples
- Inform the contact person as soon as the shipment has been sent and provide the name of the carrier, flight number, waybill number and estimated time of arrival, as appropriate

Live fish are preferred and should be sampled immediately upon removal from water. If this is not possible, fish should be held on ice and processed within 1-2 hours after

collection. Whole fish can be packaged or freshly killed (iced) for shipment to the centers for processing within 24 hours.

- Samples for virology should be processed within 48 hours and inoculated into cell culture within 72 hours of sample collections. Upon specimen arrival determine the freshness of the fish. Criteria for this freshness are: smell, appearance of eyes, gills, internal organs and presence of postmortem stiffness (rigormortis). If shipping is delayed beyond 24 hours, some tissues may not be suitable for processing.
- Euthanize the fish or group of fish: use clean sterile dissecting instruments. Clean dissecting tools with soap and water and disinfect with alcohol between the sampling of each individual fish (species) or species group.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3 point)

1. One of the following is true about shipping of sample?
   A. Containers should be clearly labeled with the information described for live specimens
   B. The name and telephone number of the person responsible for picking up the package, or receiving it at the laboratory, should be clearly indicated
   C. Where possible, ship early in the week to avoid delivery at the weekend
   D. All

Test II: Short Answer Questions

1. List the information must provide on collected samples (4 points)
2. Samples for virology should be processed within ___ hours (3 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-2	Applying Treatments

2.1. Introduction

Fish are subjected to therapy in those cases when a disease is so developed that the life or performance of the fish is immediately endangered or expected to be endangered in the subsequent period. Therapeutic treatment should be regarded as emergency measure resorted to when prevention has failed.

2.1. Therapeutic Methods

The therapeutic treatments may be as follows:

a. application of therapeutic substances and preparations to the aquatic environment (therapeutic baths for fish and eggs)
b. administration of therapeutic substances in feed
c. administration of therapeutic substances via a probe
d. administration of therapeutic substances by means of injections

Application of therapeutic substances and preparations to the aquatic environment (therapeutic baths for fish and eggs)

Therapeutic substances are put into water to control ectoparasitic, fungal and bacterial diseases of the body surface and the gills. In some cases the therapeutic baths can also be used (after absorption of the active substances via the skin) for controlling the causative agents of internal diseases.

According to the length of exposure, the therapeutic baths are subdivided as follows:

- immersion baths (up to 5 minutes)
- short-term baths (5 minutes to 2 hours)
- long-term baths (2 hours to several days)

Table 1: Chemical substances used for therapeutic baths of fish

Type of therapeutic bath		
Immersion	Short-term	long-term
Lysol	NaCl	malachite green
lime milk	Formaldehyde	trichlorphon
$KMnO_4$	malachite green	acriflavin
ammonia and	malachite green	antibiotics
Trypaflavin	and formaldehyde	Metronidazol
malachite green		NaCl
$CuSO_4.5H_2O$	$KMnO_4$	formaldehyde $KMnO_4$

To perform the therapeutic baths effectively and to avoid losses of the fish, a number of general principles must be respected, including:

a) The state of health of the fish stock must be continuously monitored so that the most effective therapeutic bath can be promptly chosen and applied: fish in an advanced phase of a disease are exhausted and weak and can be easily killed by exposure to the drug in the bath.

b) The results of examination of the fish serve as a basis for determining the type of therapeutic bath. Most of the therapeutic preparations are toxic to the fish at higher concentrations, so the instructions have to be strictly adhered to. The substances and preparations used for the baths must be fresh, packed in original containers. The dose to be used in the bath must be accurately calculated to avoid poisoning the fish by overdosage, or to avoid a poor effect if the dose is too low. If the instructions state a range of doses between two limits, then the lower amount is given to the weakened fish and the higher one to fish in good condition. The drugs must have been dissolved before application to the water; the application itself is performed by spraying over the water surface. With the substances and preparations used for long-term therapeutic treatment of fish in reservoirs and ponds, there should be a satisfactory difference between the lethal concentration (LC) for the causative agent of the disease and the LC for the fish: the therapeutic index* is to be at least 4 or above 4, 10 at the maximum.

These therapeutic means must be readily soluble in water and must easily break down.

c) Fresh and uncontaminated water must be used to prepare the solution for the bath. The physico-chemical characteristics of the water influence the effectiveness of the therapeutic substances and preparations and also their toxicity to the fish. The most important water characteristics include temperature, pH, concentration of organic substances, acid capacity (alkalinity), ∑ Ca + Mg and others.

d) A tolerance test must have been conducted before any bath. The tolerance test is a bioassay on several fish to see the safety or harmfulness of the therapeutic bath for the fish stock to be treated under the existing conditions.

e) The therapeutic baths themselves are carried out in all-glass tanks, fibre-glass tubs, vats, fibre-glass plastic troughs, in concrete or earth storage basins or straight in the ponds. It is also possible to subject the fish to short-term therapeutic baths in the transport boxes during shipment if the shipment time is the same as, or shorter than, the recommended exposure time. The fish should have been given no feed before an immersion bath or a short-term bath to avoid increased need for oxygen (for example, one to three feedings are skipped on the trout farms). Fish exposed to long-term baths, with several days' exposure times, have to be fed with supplementary feeds.

f) When the treatment is finished the fish should be removed from the bath and put into clean (preferably flowing) water. If the treatment was performed in a whole pond, the inlet source must be strong enough to allow for rapid dilution of the bath solution. All regulations and standards regarding surface water quality conservation must be respected in discharging the used therapeutic solution outside the fish culture facility. In the majority of cases the used solutions are disposed of outside the aquatic environment: for example, they are left to seep into the ground in places free of the danger of penetration into surface or underground waters.

g) The effectiveness of the therapeutic baths must be checked by macro- and microscopic examination of 5 fish at the minimum from each pond or tank after

the rinsing of the treated fish in clean water. This must be done immediately after the bath, within one day of the termination of the bath at the latest.

h) It is a general principle that market fish should not be treated by therapeutic baths 14 days before shipment to the market. Treatment of market fish in malachite green bath must be avoided for 6 months before assumed time of consumption.

i) All labour safety precautions must be taken during the treatment of fish by therapeutic baths.

Therapeutic baths of the eggs

Malachite green, formaldehyde and sodium chloride are most frequently used in fish culture practice for the control of the fungal and bacterial diseases of fish eggs. Malachite green bath provides a good treatment of the eggs of carp, tench, sheatfish, pike, whitefish and salmonids; its concentrations range between about 5 and 10 mg per litre and exposure times are 5 to 30 minutes once to twice daily. Malachite green is not used for the treatment of the eggs of herbivorous fishes: formaldehyde is better for this purpose, its concentration being 0.05 to 0.35 ml per litre and exposure time 10 minutes once in two hours. Formaldehyde bath can also be used for the treatment of other fishes eggs. Salmonid and whitefish eggs may also be subjected to an immersion bath of sodium chloride at a concentration of 20–50 g per litre. Acriflavin (500 mg per litre, 20–30 minutes) is also recommended for these fishes. Besides these traditional preparations, combined-action iodine-detergent, Jodonal preparations such as e.g. Wescodyne or Incodyne have recently been used on an increasing scale: these preparations control fungi and bacteria as well as the virus diseases of fish eggs.

Administration of therapeutic substances in feed

Administration of drugs contained in feed is now practiced increasingly frequently in all types of fish culture. This approach is advantageous, hence promising, mainly from the point of view of fish farm operation. With cyprinids, the stock must have been attracted and concentrated, as far as possible, around the feeding places, and habituated to the administered feed, before the treatment itself can be started. Administration of the same feed as normally, but containing the drugs, may be performed when there is plenty of oxygen in the water and the fish take the feed greedily. In larger water reservoirs it is difficult to habituate the fish to regular feeding, especially in those reservoirs where a

larger amount of natural food is available. With salmonids it is very easy to administer drugs with feeds. Before the treatment it is recommended to skip one feeding to be sure the fish will take the medicated feed as soon and as greedily as possible. The disadvantage is that the diseased fish take successively decreasing amounts of the feed offered to them. Heavily infected or invaded individuals do not take food at all, so the treatment has no effect on them. The therapeutic drugs are administered either as medicated granulated feeds or are admixed to the feeds straight on the fish farm.

Administration of therapeutic substances via a probe

This method of drug administration is resorted to in exceptional cases to treat limited numbers of fish, e.g. for the control of both riocephalosis and caviosis in the brood fish at sites with the occurrence of these diseases, before the brood fish are transported to another area or country. The therapeutic substance, e.g. nitrosamine piperazine salt, is dissolved in semiliquid starch gel, which is prepared by boiling about 60 g of food starch (Solamyl) in 1 litre of water. In cyprinids the drug is administered via a thick-walled elastic hose of plastic material, connected with a syringe. The hose is introduced along the central longitudinal axis of the upper palate. The moment when the hose hits the pharyngeal teeth can be clearly identified (by feeling the mild stroke). At this moment the hose should be inserted, with slight twisting, between the pharyngeal teeth and the crushing plate. The hose should be pushed in very lightly and only to a depth where it opens into the gullet, and then follows the administration of the drug.

Administering therapeutic substances by injection

In the past the injection method of administration of therapeutic substances was used on mass mainly in the treatment of stock carp. Intraperitoneal administration (into the body cavity) was used mainly with chloramphenicol and later also with the vaccine against spring viraemia (prevention of the disease). However, mass use of these treatments is now becoming less common because of the great laboriousness and of the frequent mechanical injuries and stresses. The therapeutic and preventive substances are administered in feed, as far as possible.

Nevertheless, injection treatment will continue to be practiced in small groups of fish, especially the brood fish. Brood fish may receive in this way, for example, different

antibiotics, vaccines, sexual hormones (in the pre-spawning period) and other substances; T-globulin injections are used in Poland to increase non-specific resistance of brood fish and their progenies. The drug or sexual hormone is injected into the body cavity (intraperitoneal administration) or into the muscle (intramuscular administration).
For the intraperitoneal injection, the site where the needle is to be injected is on the left side of the fish body at the point of intersection of two fictitious lines, the first starting at the base of the pectoral fin and runing along the longitudinal axis of the body and the other starting at about the centre of the pelvic fin and running perpendicularly to the first one. The angle at which the needle is introduced into the body is also important. In the scaleless fish it should be 20 to 30 degrees, in scaly fish it should be 10 to 15 degrees, the needle passing between two successive scales. The drug flows easily from the needle introduced in the body wall, visible blotches occur under the skin.

For the intramuscular administration to the carp, the site of injection is on the left flank 1 to 2 cm behind the fore end of the dorsal fin and 3 to 4 cm below it. With other fishes the injection site is on the boundary between the first and second third of the body, 2 to 3 cm below the upper line. The needle and the injection site should be wiped with a pled get or sponge, dipped in 1 % solution of potassium permanganate.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

Test II: Short Answer Questions

1. List at least four methods of therapeutic treatment in fish stock (4 point)
2. List three types of therapeutic bath (3 point)
3. List Chemical substances for:
   a. Immersion bath:_____, _____, _____
   b. Short term: _____, _____, _____
   c. Long term:_____, _____, _____

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-3	Complying withholding periods

Product withdrawal times must be observed to ensure that a product used in a target animal does not exceed legal tolerance levels in the animal tissue at the time the edible portion is made available for human consumption. Following proper withdrawal times helps to ensure that products reaching consumers are safe and wholesome. Withdrawal information is found on the product label, package insert, or feed tag of any approved product. Withdrawal requirements for drugs used in an extra-label manner must be determined by the prescribing licensed veterinarian. Prescribing veterinarians may wish to refer to the provided information on drug metabolism in fish and may be helpful in determining proper withdrawal times for extra-label drug use.

Withdrawal times are usually reported as a specific number of days. Each withdrawal day is a full 24 hours, starting from the last time an animal receives or is exposed to a regulated compound. Withdrawal time restrictions may also apply to the use of treated water for swimming, livestock watering, crop or turf irrigation, potable drinking supply, or other purposes.

Table 2: Withdraw period of drugs

Species	Withdrawal period, days		Temperature, ^{o}C
	Oxyteracycline (OTC)	Oxolinic acid (OXA)	
Milkfish	22	27	28.7 - 31.5
Hybrid red tilapia	26	17	28 - 30
Mangrove red snapper	21	18	26 – 29.5
Orange- spotted grouper	21	17	25 – 29.5
Black tiger shrimp	17	19	29-31

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say True or False (2 points)

1. Following proper withdrawal times helps to ensure that products reaching consumers are safe and wholesome.
2. Withdrawal information is found on the product label, package insert, or feed tag of any approved product

Test II: Short Answer Questions

1. Each withdrawal day is a full __ hours, starting from the last time an animal receives a regulated compound. (4 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-4	Monitoring infestations/infections

4.1. Definition

Monitoring is the ongoing efforts directed at assessing the health and disease status of a given population

Objective of monitoring fish:

- Surveillance for disease incursions - early detection;
- Check efficacy of treatment or control programs;
- Collate information to develop future risk mitigation measures
    - Information should include environmental & husbandry factors that may influence disease, e.g. stocking age, grading, stocking density, feeding regimes, weight gains

4.2. Monitoring

Appropriate time of monitoring

- Preferably well before fish are stocked into a facility. Some disease may not present clinically or be present in such low numbers that they escape detection. Sources with a known health status from 1-2 years of active monitoring are recommended.
- During the stressful periods, usually 1-2 weeks post-stocking or any handling or transfers between facilities. If sources with a known health status are used, then monitoring during this period will determine what diseases can occur from opportunistic organisms and aid in future disease prevention programs.
- Benefit in monitoring larger grow-out fish as disease outbreaks can still occur. Reports have been made of streptococcosis in association with muddy runoff during heavy rains. Toxic algae blooms may occur in certain sites in association with certain seasonal conditions. Such monitoring will help the development of future mitigation procedures.

Record keeping is essential for long term planning and comprehensive evaluation of fish health and production. It generates data which can indicate trends, and aids traceability of events and their impacts. Such information are necessary to have a data based

approach to improving fish health management, recognition of health or production issues and ensuring quality assurance of farm product particularly with respect to food safety.

Fish will be monitored at least once daily for any unusual behaviour, visible lesions or other signs of disease. Changes in behaviour and physical condition will be reported to farm manager on duty. Changes can be physical such as scale loss, parasites, and external injury or behavioural such as abnormal swimming or schooling behaviour or increased respiration. Any unusual behavioural changes or physical signs of disease affecting a significant percentage of fish stock in a unit, facility or site should be further investigated (See further page 34-37). Regular monitoring of fish stocks to establish normal baseline information of growth rates and disease present on a particular site or facility is useful in fish health management, developing future preventative measures such as vaccinations, improving techniques that involve handling, scheduling the timing (seasons) and age of fish stocked on site.

Weight checks and grading are good opportunities for spotting any abnormalities in fish, and samples can be taken for further examination. Less than expected optimal growth rates may be an indication of subclinical disease. Such trends may not be obvious at a point in time until sufficient data has been collected over a period of time. Simple diagnostic techniques such as examination of tissue smears or wet mounts of skin scrapings or gills are surprisingly useful in demonstrating disease agents.

Self-check 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. One of the following is objective of monitoring fish stock?
   A. Surveillance for disease incursions
   B. Check efficacy of treatment or control programs
   C. Collate information to develop future risk mitigation measures
   D. All
2. Fish monitored at least once daily for _____
   A. Any unusual behaviour, visible lesions or other signs of disease.
   B. Changes in physical condition
   C. Changes in behaviour
   D. All

Test II: Fill blank space

1. _____ is the ongoing efforts directed at assessing the health and disease status of a given population (4 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-5	Modifying Treatment Program

5.1. General information

Antibacterial chemotherapy has been applied in aquaculture for over 60 years. The discovery of antibacterials changed the treatment of infectious diseases, leading to a dramatic reduction in morbidity and mortality, and contributing to significant advances in the health of the general population. One of the most widely used antibacterial agents for therapy of systemic bacterial infections in farmed fish is oxytetracycline (OTC). Antibacterials are used both prophylactically, at times of heightened risk of disease and therapeutically, when an outbreak of disease occurs in the system. The removal of antibacterials from fish medicine would cause great welfare problems. There are many antibacterial drugs for animal health. However, pharmacological research on aquaculture drugs has focused mainly on a few antibacterials widely used in aquaculture.

5.2. Modify treatment program

If the following situation is occurred will be treatment program modifying is:

Failure of antibacterial therapy

Treatment failure has many causes. The selected antibacterial may be inappropriate because of misdiagnosis, poor drug diffusion at the site of the infection, inactivity of a given drug at the site of infection, failure to identify the aetiological agent including inaccurate results of laboratory tests, resistance of pathogens, intra-cellular location of bacteria, metabolic state of the pathogen, or errors in sampling. Other factors that may contribute are inadequate dosage or the use of drugs with low bioavailability. When failure occurs, diagnose must be reassessed and proper samples collected for laboratory analysis. Patient factors such as the persistence of foreign bodies, neoplasia, and impairment of host defences are important to consider. It is important also to ensure that persons medicating their own animals comply with dosing instructions.

Treatment options in various aquaculture systems

Another important factor influencing treatment is the type of culture system. The four major types of culture system are aquaria, ponds, cages and flow-through systems.

Toxicity to the host

Antibacterial that are sufficiently non-toxic to the host are used as chemotherapeutic agents in the treatment of the infectious diseases of humans, animals and plants. Direct host toxicity is the most important factor limiting drug dosage. Tolerance studies must be carried out to determine the safety of the product to the target fish species. Also, it is important for the clinician to report adverse drug events to legal authorities.

Environmental impact of antibacterial use in aquaculture

Aquaculture is so integrally linked to the surrounding environment that if sustainable practices are not employed, the degradation of the surrounding environment will ultimately lead to the degradation of the industry itself. The wellbeing of the environment – in cases of disease and treatment – is related to two aspects of biota conservation; the transmission of microbial pathogens to wild populations and the pollution from chemotherapeutics. The extensive use of veterinary pharmaceuticals is supposed to represent a daunting public health risk, resulting not only in the emergence and spread of resistant bacteria, but also in other human, animal and environmental impairments.

Drug resistance

One of the draw backs in the use of antibiotics is the development of antibiotic resistant bacteria that could compromise the treatment of human infection.

Drug residues

Residues of antibiotics present in fish may pose a risk to the health of the consumers.

Self-check 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. One of the following cause failures of treatment?
   A. Misdiagnosis
   B. poor drug diffusion at the site of the infection
   C. inactivity of a given drug at the site of infection
   D. failure to identify the aetiological agent
   E. All
2. Selection of drug considered:
   A. Drug resistance
   B. Drug toxicity
   C. Agent susceptibility
   D. All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-6	Obtaining appropriate approval for use of restricted chemicals

6.1. Introduction

Use of unapproved drugs or misuse of approved drugs in aquacultured fish poses a potential human health hazard. These substances may be toxic, allergenic, or carcinogenic, and/or may cause antibiotic resistance in pathogens that affect humans. To control this hazard, drugs for use in food animals, whether they are for direct medication or for addition to feed, generally must be approved, conditionally approved or index listed by FDA (Federal Food, Drug, and Cosmetic). Off label use in animals of approved human or animal drugs is permissible in certain circumstances. Drugs on the Index of Legally Marketed Unapproved New Animal Drugs for Minor Species may not be used in food animals except in early nonfood life stages of food producing minor species in certain circumstances.

Under certain conditions authorized by FDA, unapproved new animal drugs may be used in conformance with the terms of an Investigational New Animal Drug (INAD) application. Reasons for the use of drugs in aquaculture include the need to (1) treat and prevent disease, (2) control parasites, (3) affect reproduction and growth, and (4) provide tranquilization (e.g., for weighing). Relatively few drugs have been approved for aquaculture. This factor may lead to the inappropriate use of unapproved drugs, general-purpose chemicals, or approved drugs in a manner that deviates from the labeled instructions.

When a drug is approved by CVM, the conditions of the approval are listed on its label. These conditions specify the species for which the drug is approved for use; indications (disease or other circumstances) for use; dosage regimen; and other limitations, such as route of administration and withdrawal time. Labeled withdrawal times must be followed to ensure that no harmful drug residues are present in the edible tissue of the animal when harvested for human consumption and offered for sale.

Only a licensed veterinarian may legally prescribe a drug under conditions that are not listed on the label (extra-label use). This includes: use in species not listed on the label; use for indications (disease or other conditions) not listed on the label; use at dosage levels, frequencies, or routes of administration other than those stated on the label; and deviation from the labeled withdrawal time. A veterinarian is a person licensed by a state, territory, or foreign government to practice veterinary medicine.

The proper use of regulated products in aquaculture promotes human, aquatic animal, and environmental health and safety. Judicious use of regulated products ensures, to the greatest extent possible, the effectiveness of the products used and reduces overuse and unnecessary expense. By using regulated products properly, aquaculturists comply with the state and federal laws and maintain public trust and consumer confidence in cultured aquatic animals and seafood products.

Drugs, biologics, pesticides, and disinfectants can be costly, but when properly applied, they can be important tools in preventing significant economic losses and promoting animal welfare. However, these tools will not be optimally effective if the underlying problem is misdiagnosed or left uncorrected, or if the regulated products are not used as intended. Productivity is not the same as production efficiency, and greater yields based upon increased dependence on drugs or other regulated compounds do not necessarily translate to greater profits. Aquaculture facilities that can only raise fish through continuous reliance on regulated products to control disease or pests often find themselves out of business. Common sense and good culture practices can reduce the need for regulated products and increase the efficiency and/or cost-effectiveness of aquaculture operations.

6.2. Rule and regulation of handling drug

There are numerous best management practices that users can employ to use regulated products safely and effectively in aquaculture, including:

- Diagnose the problem(s) before applying any regulated product.
- Seek professional advice on when and how to use regulated products.

- Use regulated products only for those species and indications listed on the label (exception - some drugs may allow extra-label use if specifically prescribed by a licensed veterinarian).
- Read and follow the product label directions for use.
- Use the proper dosage, amount, or concentration for the species, area, and/or specific condition; apply the full exposure regimen regardless of whether the signs which led to treatment are diminished.
- This is especially important when administering antibiotic and other compounds to which resistance could develop.
- Minimize handling and consider withholding feed on days when fish are to be treated.
- Use the correct method and route of application or administration (e.g. spraying aquatic vegetation, static [pond, tank or raceway] or continuous flow [tank or raceway] immersion water treatment, injection, or oral administration [medicated feeds]).
- Calculate withdrawal times accurately. Identify treated populations or stocks of production and holding units with clear markings.
- Do not use antibiotic drugs or medicated feed for disease prevention.
- Do not substitute unlabeled or industrial grade products for trade-name products that are labeled and approved for aquaculture or aquatic site uses.
- Keep accurate records. Consider the environmental impact of discharging treated water, including possible effects on non-target organisms.
- Adopt a producer quality assurance program (e.g., Hazard Analysis and Critical Control Points - HACCP) that provides guidelines for preventing tissue residue violations and for producing high quality, wholesome products for consumer use.
- Be aware of requirements concerning personal safety measures and proper procedures for farm workers and pesticide applicators that handle or apply regulated products.
- Consider the economic consequences, both short- and long-term, of treatment before using a regulated product.

Self-check 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say True or False (3 point)

1. The proper use of regulated products in aquaculture promotes human, aquatic animal, and environmental health and safety
2. Diagnose the problem(s) before applying any regulated product is good drug handling practice
3. Uses of expired drug has great advantage on effectiveness of treatment

Test II: Short Answer Questions

1. List at least five best management practices that users can employ to use regulated products safely and effectively in aquaculture (5 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 8 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-7	Notifying senior personnel significant changes to treatments

7.1. Antibacterial usage suggestions in aquaculture

When it is apparent that a treatment is necessary, the following check-lists may be useful:

Before treating:

1. Accurately determine the water-volume, flow-rate, and temperature.
2. Accurately determine the number and total weight of fish in the rearing unit.
3. Confirm the identity, expiration date, and active ingredient concentration of the regulated product to be applied.
4. Double-check treatment calculations. Beware of confusion from mixing metric and standard units.
5. Have aeration devices ready for use if needed.
6. If treated water is to be discharged, make sure all appropriate permits are in place and regulatory authorities have been notified.
7. If possible, conduct a bioassay on a small group of fish before treating the entire population in the rearing unit.

When treating:

1. Dilute the regulated product with rearing water before applying it (or follow product directions).
2. Ensure that the regulated product is well-mixed and evenly applied in the rearing units.
3. Observe the fish closely and frequently during treatment for signs of distress.
4. Monitor the temperature and dissolved-oxygen levels in the rearing unit during treatment.
5. Except for oral treatments, discontinue feeding during treatment. Fish are unlikely to feed during treatment, and uneaten feed will foul the system and may reduce the efficacy of some treatments.
6. Discontinue treatment and restore normal culture conditions if the fish become distressed.

After treating:

1. Observe the fish frequently for at least 24 hours following the treatment.
2. Do not stress the treated fish for at least 48 hours.
3. Recheck the fish to determine the efficacy of the treatment

Self-check 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List at least three precondition (3 point for each)
    a. Before treatment
    b. During treatment
    c. After treatment

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating – 3.5 points** **Unsatisfactory - below 3.5 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-8	Identifying Diseases

8.1. General Indicators of Disease

- Sudden massive mortality
- Constant or increasing mortality over time
- Individual fish separated from others on the bank, bottom, or surface
- Reduced feeding activity
- Fish congregating at inlets, aerators, or surface
- Change in water appearance (i.e. green to brown bloom)
- Equipment failure (aerators not running)
- Changes in smell (algae, H_2 S, ammonia, or dead fish)
- Increased numbers of predators or scavengers

8.2. Specific Indicators of Disease

Behavioral signs

- Anorexia
- Lethargy
- Erratic swimming, porpoising, spiraling, or bobbing
- Flashing and rubbing
- Loss of equilibrium
- Gulping at water surface

Gill lesions

- Bleeding
- Color change: brown, mottled, white or pale
- Swelling
- Adherent debris
- Areas of tissue destruction or loss of gill filaments
- White spots

Skin lesions

- Abrasions, erosions, or ulcers
- Excessive mucus or dryness

- Hemorrhage
- Areas of discoloration
- Perforations
- White spots
- Wooly or cottony appearance
- Swollen belly with free fluid Bulging eyes Physical deformities (Read more Page 23-30 and 34-37)

Self-check 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List at least four general indicator of presence of disease in stock? (4 point)
2. List some sign (indicator) of diseases from sick stock on the following organs (4 point for each):
   d. Gills:_____,_____,_____
   e. Skin:_____,_____;_____

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-9	Maintaining Records

9.1. Introduction

It is critical to establish, and record, normal behaviour and appearance to compare with observations made during disease events. Record keeping is, therefore, an essential component of *effective* disease management. For fish, the following factors should be recorded on a regular basis.

9.2. *Gross Observations*

These can be included in routine records of fish growth that, ideally would be monitored on a regular basis, either by sub-sampling from tanks or ponds, or by estimates made from surface observations. For hatcheries, critical information that should be recorded include:

- feeding activity
- growth
- mortalities

These observations should be recorded daily, for all stages, including date, time, tank #, brood stock (where there are more than one) and food source. Dates and times of tank and water changes, pipe flushing/back-flushing and/or disinfection, should also be recorded. Ideally, these records should be checked (signed off) regularly by the person responsible for maintaining the facility. For pond or net/cage sites, observations which need to be recorded include:

- growth
- fouling
- mortalities

These should be recorded with date, site location and any relevant activities (*e.g.*, sample collection for laboratory examination). As elsewhere, these records should be checked regularly by the person responsible for the facility.

9.3. Environmental Observations

Environmental observations are most applicable to open water, ponds, cage and net culture systems. Information that should be recorded include:

- weather
- water temperature
- oxygen
- salinity
- turbidity (qualitative evaluation or Secchi disc)
- algal blooms
- human activity (handling, neighbouring land use/water activities)
- pH

The frequency of these observations will vary with site and fish species. Where salinity or turbidity rarely vary, records may only be required during rainy seasons or exceptional weather conditions. Temperate climates may require more frequent water temperature monitoring than tropic climates. Human activities should also be recorded on an “as it happens” basis, since there may be time-lag effects. In all cases, date and time should be recorded, as parameters such as temperature and pH can vary markedly during the day, particularly in open ponds and inter-tidal sites. It may not always be possible to monitor oxygen levels in the pond. However, the farmer should be aware that in open non-aerated ponds, oxygen levels are lowest in the early morning when plants (including algae) have used oxygen overnight. Photosynthesis and associated oxygen production will only commence after sunrise.

9.4. Stocking Records

All movements of fish into and out of a hatchery or site should be recorded, including:

- the source of the brood stock/eggs/larvae/juveniles and their health certification
- the volume or number of fish
- condition on arrival
- date and time of delivery and name of person responsible for receiving the fish
- date, time and destination of stock shipped out from a hatchery or site.

Such records are also applicable (but less critical) to movements between tanks, ponds, cages within a site. Where possible, animals from different sources should not be mixed. If mixing is unavoidable, keep strict records of which sources are mixed and dates of new introductions into the holding site or system.

Self-check 9	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. One of the following record is obtained from gross observation

   A. Mortality B. Weather C. Water temperature D. Salinity

Test II: Short Answer Questions

1. List at least four information should be recorded from: (3 point)
   b. Gross observations:_____,_____,_____
   a. Environmental observations:_____,_____,_____

You can ask your teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

LG #77	LO #4- Monitoring and reviewing clean-up activities and operations

Instruction sheet

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

- Collecting and disposing dead stock
- Carrying out Clean-up activities
- Advising senior personnel on the effectiveness of control operation
- Undertaking repairs and maintenance on equipment

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

- Collect and dispose dead stock
- Carry out clean-up activities
- Advising senior personnel on the effectiveness of control operation
- Undertake repair and maintain on equipment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet-1	Collecting and disposing dead stock

1.1. Stock Mortalities

All aquaculture operations experience stock mortality and/or harvest of unsaleable stock. Disposal of dead fish also requires consideration of appropriate biosecurity handling procedures.

The Department has a Fish Health Unit that provides a range of services to investigate the health problems of wild and farmed fish stocks, including 'fish kills' or sudden mortalities. In the event of large unexplained mortalities, licensees must contact the Fish Health Unit and assist them to determine the cause of death and degree of risk posed by such deaths. This includes collecting key data and samples to allow a thorough investigation into the cause of the fish kill. To minimise the risk of potential transfer of disease through either carcasses or equipment, the following basic protocols should be adhered to:

- Biological material should be separated from other waste and kept away from water bodies and other contaminates pathways to minimise the risk of spreading pathogenic agents.
- Personnel should maintain appropriate hygiene procedures including the use of safety gear (e.g. gloves).
- In the event of a fish kill, key data and samples should be stored to allow a thorough investigation.
- No disposal of stock mortalities or culls at sea (it is an offence under the *Environmental Protection Act 1986* to do otherwise). All stock mortalities must be placed in sealed containers for transport, returned to the mainland and disposed of in landfill according to local waste authority regulations.
- Dead fish should be disposed **according to ecologically sustainable development** principles:
    - ✓ Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem

1.2. Disposing dead fish stock

- To discourage scavenging or predation by marine fauna, dead stock will be removed from sea cages on a daily basis and disposed to landfill on the mainland in accordance with waste management authority regulations. Under no circumstances is biological waste to be disposed of at sea. To minimize mortality, the following control techniques should be implemented:
- Minimize stock stress during inspections and dead stock collection.
- Implement a Veterinary Health Plan and promptly address any health or welfare problems (in consultation with fish health experts where appropriate).
- Maintain complete records of each inspection, including number of mortalities removed and likely cause of death (determined by appropriately-competent person). Mortalities can then be subtracted from total population to maintain population estimates.
- the identification of appropriate insurance brokers and marine mutual associations,
- Daily removal (weather permitting) and disposal of dead or moribund (wounded or sick) stock to ensure predatory species are not attracted to the farm as well as limit any risk of disease spread.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. One of the following is minimize the risk of potential transfer of disease

A. Biological material should be separated from other waste

B. Personnel should maintain appropriate hygiene procedures including the use of safety gear (e.g. gloves)

C. In the event of a fish kill, key data and samples should be stored to allow a thorough investigation.

D. All

E. None

3. One of the following is **correct** about disposing of dead stock

A. Minimize stock stress during inspections and dead stock collection.

B. Maintain complete records of each inspection, including number of mortalities removed and likely cause of death the identification of appropriate insurance brokers and marine mutual associations

C. Daily removal (weather permitting) and disposal of dead or moribund (wounded or sick) stock

D. All

Test II: Short Answer Questions

1. List the principles of disposing dead stocks? (4 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-2	Carrying out Clean-up activities

2.1 General Principles

The cleaning and disinfection of equipment, materials, and premises is done to prevent or mitigate the spread of foreign animal diseases during an outbreak. As part of a wider response, this helps to stabilize animal agriculture, the food supply, the economy, and to protect public health and the environment. This standard operating procedure provides State Animal Health Officials, Animal and Plant Health Inspection Service personnel, and Incident Management Teams with guidance on choosing and using optimal cleaning and disinfection methods following an foreign animal diseases outbreak in domestic livestock.

Disinfection is employed as a common disease management tool in aquaculture establishments. It may be used as a routine practice in biosecurity programmes designed to exclude specific diseases, as well as a routine sanitary measure employed to reduce disease incidence within farms, or it may be used in disease eradication (stamping out) efforts. The specific reason for disinfection will determine the disinfection strategy used and how it is applied. The general principles pertaining to disinfection of aquaculture establishments involve the application of chemical treatments in sufficient concentrations, and for sufficient periods, to kill all pathogenic organisms that would otherwise gain access to surrounding water systems. As the inherent toxicity of disinfectants prohibits safe use in open water, or open water systems, disinfection can only reasonably be applied to hatcheries and tank holding facilities. In addition, as some aquaculture establishments are generally seawater based, compounds produced during seawater disinfection (residual oxidants) must also be disposed of carefully.

2.2 waste disposal and management system

Fish Feed and Fish Faeces

Fish feed and fish faeces waste from marine based aquaculture can potentially have a significant impact on the environment. This is particularly true where there are low currents, tides and wave amplitude that, in turn, drive minimal water exchange. The risk of waste accumulation for any aquaculture operation needs to be managed. To address

this issue, fish feed and faeces waste should be managed according to best-practice techniques, including:

- Rotation of stock
- Fallowing or resting of sites
- Stocking densities appropriate to site water flow, depth and sediment type characteristics
- Appropriate feeding methods to minimize over feeding

Stock Mortalities and Culls (See information sheet 1, 111-112)

Harvesting and Processing Wastes

The only processing permitted to be undertaken at sea is harvesting, slaughtering, bleeding, washing and chilling of fish. Any additional processing must take place at an approved facility on land. Organic waste, including blood water, must be sealed in watertight containers, taken to the mainland and disposed of in landfill under the relevant waste authority regulations.

Sewage

Sewage must be either:

- treated, using a sewage disposal system
- stored in tanks on the vessel and disposed of on land at a licensed disposal site in accordance with Local Government Authority by-laws.

Rubbish and Pest/Scavenger Control

Waste material (e.g. empty feed bags, old ropes, floats, net mesh and any other discarded equipment, as well as staff domestic waste such as food scraps, papers, plastic packaging, etc.) must be placed in sealed waste containers and/or securely stowed on board the vessel and disposed of in landfill. Management regulations Such waste should be removed daily to prevent local build-up of material that can attract pests (e.g. insects) and scavengers (e.g. silver gulls).

Oil and Oily Waste

To reduce the potential for oil and oily wastes (including fuel) generated through vessel operations to enter the environment, any used oil or oil-soaked absorbents must be securely stored in tanks on the vessel and disposed at an appropriately-licensed oil recycling facility. Containers used to transport such wastes must be sealed and secured for the duration of their relocation.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: choice best answer

1. Fish feed and faeces waste should be managed according to: (4 point)
   A. Rotation of stock
   B. Fallowing or resting of sites
   C. Stocking densities appropriate to site water flow, depth and sediment type characteristics
   D. Appropriate feeding methods to minimize over feeding
   E. All
2. One of the following is true?
   A. Management regulations Such waste should be removed daily to prevent local build-up of material that can attract pests
   B. Waste materials must be placed in sealed waste containers and/or securely stowed on board the vessel and disposed of in landfill
   C. Sewage must be either treated, using a sewage disposal system or stored in tanks on the vessel
   D. All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-3	Advising senior personnel on the effectiveness of control operation

3.1. Introduction

A review should be carried out of obligatory training and education requirements covering fisheries management, fishing and aquaculture vessel personnel, vessel inspection and accident investigation departments and harbour management. The review should include, but need not be limited to, training facilities and cover subject matters within the fisheries and aquaculture sectors, including the training of trainers. Information collected in the review should include:

- the number of qualified trainers and their specializations, as well as the number of extension specialists;
- the availability of qualified examiners in areas of certification of fishing vessel personnel and personnel engaged on vessels supporting the aquaculture sector;
- the names of universities and technical colleges for the education and certification of naval architects, marine engineers and electrical engineers and, where applicable, trades colleges related to ship and boatbuilding; and
- in the event that training services are not available in the State concerned, an indication of where and how such services are obtained.

3.2. Shipbuilders, boat builders and safety equipment suppliers

Shipbuilders

A review of the shipbuilding sector may be considered to apply to the larger fishing vessels, as well as vessels in support of aquaculture, and to shipyards expected to be capable of designing and constructing ships. Of direct interest would be the level of qualifications and skills of the senior staff and the skills of the workforce, in general, by virtue of the fact that such shipyards should be able to meet the design and construction requirements set out in national legislation. In the event that no shipyard exists, the review should extend to the availability of such facilities within the region.

Boat builders

In cases where the national fleet consists mainly of smaller vessels, an inventory should be prepared setting out the number of boatyards and their capabilities and locations.

Furthermore, the extent to which such boat builders comply with regulations governing accreditation should be carefully examined. With regard to accreditation, the review should examine the manner in which the required skills are attained and, in the process, identify the role of the government in training.

Safety equipment suppliers

How and where safety equipment that meets the criteria set out in national regulations can be obtained should be carefully reviewed, together with import regulations, where this is the case. In the event that safety equipment has to be imported and import duties applied, the reviewers should also control where, when and why such tariffs apply. Should safety equipment be produced locally, it would be necessary to verify that the specifications comply with the standards set in internationally agreed, legally binding instruments, as and where they relate to fishing vessels and vessels used in support of aquaculture activities.

3.3. Legal Requirements

Legal requirements for institutional cooperation may be included in primary legislation and, for example, provide for a permanent coordination body and set requirements for the exchange of information or joint action, etc. Nevertheless, in the review of legislation, it would be essential to document the:

- terms of reference of an existing marine accident and investigation board or for the establishment of such a board;
- status of existing national legislation directly or indirectly related to safety in capture fisheries and aquaculture, such as legislation for the design, construction and equipment of vessels, fisheries management, merchant shipping,6 occupational safety and health (OSH) and others;
- procedures and conditions for the issue of an authorization to fish and for the registration of a fishing vessel;
- identification of procedures and conditions for the authorization of aquaculture and small-scale and subsistence fishing operations; and
- provisions for the registration of support vessels in fishing operations and aquaculture that are not considered to be fishing vessels.

Legislation for the design, construction and equipment of fishing vessels and vessels supporting aquaculture activities should be examined and the responsible ministries identified as regards:

- inclusion or revision of construction standards for fishing vessels and aquaculture support vessels (including vessels used for the carriage of live fish);
- vessel safety certification requirements to be set out in national regulations;
- accreditation of shipbuilding/boatbuilding companies (within the country) and an outline of their capabilities, including details of accreditation schemes that may be in place;
- requirements for the approval of technical specifications for the production (and importation) of safety equipment, machinery and services facilities, and the identification of approved manufacturers and suppliers within the country; and
- requirements for the carriage of ship-to-shore/ship-to-ship communication systems and procedures for the reporting of the position of a vessel at sea.

Legal obligations of vessel owners reporting incidents and accidents in relation to their vessels and crew members should be examined. In so doing, particular attention should be given to:

- the maintenance of records listing incidents, accidents and near misses (in the operational log of the vessel) and procedures for reporting to the appropriate administration (by radio where deemed necessary);
- Such requirements in legislation in relation to the insurance of hull and machinery, crew members, excess liabilities and as appropriate, for protection and indemnity coverage;

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

1. Training is required for all of the following except

   A. Manager B. Shipbuilder C. Boat builder D. None

Test II: Short Answer Questions

1. List at least four information collected in reviewing/Training (4 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask your teacher for the copy of the correct answers.

Information Sheet-4	Undertaking repairs and maintenance on equipment

4.1. Introduction

Coastal fishponds require some essential equipment and facilities which are used for varied purposes. Such equipment may be used for maintenance and repairs, harvesting the crop, monitoring and maintaining water quality, excluding predators and pests, and other miscellaneous facilities for maximizing the use of various inputs.

4.2. Repair and maintain tools and equipment

Digging tools

Most of the maintenance and repair works in fish farms are devoted to dikes. Practically, the same implements in manual construction work are also being used in making repairs of dikes. Digging tools, flatboats, wooden dugouts and rafts as previously mentioned are most appropriate for work like digging out trenches and backfilling them with puddled soil to repair leakage/seepage, and for deepening canals and other similar jobs. Maintenance of digging tools are easily done by cleaning and rubbing with oil or grease to prevent them from rusting. Boats should be protected against the sun by putting them under the shed. Dugout boats, when not used, may also be filled with water to prevent the walls from cracking when exposed under the sun.

Levelling tools

Practical and simple equipment have also been devised for levelling fishpond bottoms. The simple manual mud rake is a good example, while in Indonesia, a levelling board manned by four or more men is also used

Desilting equipment

For manual removal of silt in fishpond bottoms or canals, a simple metallic or wooden shovel has been devised and used in Thailand and Indonesia. If the area to be desilted is extensive, a type of silt or sludge pump can be used. This can be a small unit so that it can be portable and can be transferred to the various areas of the pond system.

Nets and traps

Fingerling seine

The industry has designed various types of nets for use in fishpond operations. The fingerling seine, which is used for catching milkfish fingerlings and shrimps juveniles, is a fine-meshed rectangular net, about two to four meters long by one meter wide. It is supported by two poles at both ends with floats of wood, rubber or synthetic material on the upper side and sinkers of lead on the opposite side.

Fingerling suspension net

A fingerling suspension net is usually a standard equipment in brackishwater fish farms. This is a rectangular or square net 2 to 3 meters wide by 3 to 5 meters long. Double line of coarse twine line the margins, the net has meshes of 0.5 to 1.0 cm square mesh. It is used to hold fingerlings during counting or before transport.

Gillnet seine

This is a harvesting net of about 1.5 to 2.0 m wide by 30 to 50 m long. It should have a float line at one of the long sides and lead line on the opposite side. It is made of coarse thread of nylon with mesh of 4 to 5 cm square mesh. To catch fish, this seine is dragged over the pond from one end to the other. The fish are gilled on the net but some jump over while small ones pass through the net meshes so that this net is usually used for partial harvesting.

Cast net

The net is a versatile net for fishermen as well as for fish farmers for small-scale individual catching or sampling. In fish farm, this net can be used for sampling stock of fish or shrimp to monitor growth or for partial harvesting when required.

Self-check 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4 point)

Test II: Short Answer Questions

1. List at least four tools used for fish production? (4 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask your teacher for the copy of the correct answers.

Operation Sheet- Cleaning fish pond

Sequence of cleaning fish pond

The following sequence is provided as a step-by-step example of cleaning fish pond.

- Start by removing the edge plants and then the floating ones, pot and all. Put them in the shade.
- Use a bucket to draw water off the top (the cleanest part) of the pond. Place a children's wading pool in a shady spot and fill it with the water, which will be the right pH and temperature to hold the fish.
- Start removing the remaining water with a pump or siphon (a length of garden hose will do). As the water level drops, remove the submerged plants and put them in the wading pool, too.
- When the pond has been half drained, remove the fish with a net and transfer them to the wading pool. Cover it with a mesh screen, in case you have any fish that are likely to jump and flop out
- While there is still water at the bottom of the pond, clean the sides with a soft-bristled scrubbing brush. Continue to drain until the bottom layer of cruds is in sight. Then stop pumping and remove the remaining debris with a dustpan
- Rinse the sides of the pool with a hose and then remove the pump and rinse that. Gently scrub the bottom
- Replace the plants before you begin refilling. Use a water conditioner, available from pet stores or aquarium suppliers, to neutralize chlorine in the new water. Return the water that you saved in the extra containers to the pond, and allow the clean fish pond to warm up a bit before putting the fish and the water from the wading pool back in

LAP TEST	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2** hour. The project is expected from each student to do it.

Task-1 clean fish pond

References

Books and Scientific Journal

1. Alaa, E.E. (2016): Clinical and laboratory manual of fish diseases. LAP lambert academic publishing, 129 pages.
2. American Fisheries Society Fish Culture Section (2011): Guide to Using Drugs, Biologics, and Other Chemicals in Aquaculture, 65 pages.
3. FAO (2015): Technical guide for fishiery responsible. Fishing oprators, best practice to improve safety at sea in fishiries sector, Rome, 217 pages.
4. FAO and WHO, (2012): Code of practice for fish and fishery products. 2nd edition. Rome, 250 pages.
5. Przemyslaw, G., Ratna, G., Maciej, M., Michael, J., Joseph, D. and Matthew, S. (2019): Biological control of invasive fish and aquatic invertebrates: a brief review with case studies. *Management of Biological Invasions*, 10 (2): 227‑254.
6. Selim, S. and Cavit, K. (2011): Antibacterial Drugs in Fish Farms: Application and Its Effects. *Recent Advances in Fish Farms*, **12**: 218-250.

Website:

1. **https://www.worldcat.org/title/manual-of-diagnostic-tests-for-aquatic-animals/oclc/320804994**
2. **https://www.aquaculturecouncilwa.com/wp-content/uploads/2019/05/FHMP20Template20V3.pdf**
3. **http://www.fao.org/3/e7171e/E7171E07.htm**
4. https://www.environment.gov.au/system/files/resources/97ff9461-5ccf-49cb-9368-8bde5f243c0b/files/guidelines.pdf
5. https://www.mdsg.umd.edu/sites/default/files/files/What_is_Aquaculture.pdf
6. https://usaidgems.org/Documents/complianceTopics/ST_Pesticides_Safer_UseCompliance_Cairo_10Oct2012.pdf
7. https://www.google.com/search?q=corrective+measures+of+abnormal+behaviour+of+fish%2C+pdf&oq=corrective+measures+of+abnormal+behaviour+of+fish%2C+pdf&aqs=chrome..69i57.29229j0j15&sourceid=chrome&ie=UTF-8
8. https://www.fws.gov/policy/aquatichandbook/volume_2/chapter2sampcollect.pdf
9. **https://www.aphis.usda.gov/animal_health/emergency_management/downloads/sop/sop_cd.pdf**

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The trainers who developed the learning guide

No	Name	Qualification	Educational background	Region	E-mail
1	Dr. Milkessa Tessema	A		Oromia	mengistut38@gmail.com
2	Dr. Derara Dejene	A		Oromia	deraradejene@yahoo.com
3	Dr. Addisu Bedeshu	A		Oromia	addisubbedashu@gmail.com
4	Dr. Abate Worku	A		Oromia	Abateworku4@gmail.com
5	Dr. Boki Negasa	A		Oromia	bokanegesa@gmail.com
6	Dr. Bikila Emiru	B		Oromia	Biqilaaimmiruu59@gmail.com
7	Dr. Kumera Lemmessa	B		Oromia	kumelame@gmail.com