UNIT 1
SCOPE AND DEFINITION OF AQUACULTURE

The word " aquaculture", though used rather widely for over a decade to denote all forms of culture of aquatic animals and plants in fresh, brackish and marine environments, is still used by many in a more restrictive sense. For some,it means aquatic culture other than fish farming or fish husbandry, whereas others understand it as aquatic farming other than mariculture. It is also sometimes used as a synonym for mariculture. However, the term aquaculture is sufficiently expressive and all-inclusive. It only needs a clarification that it does not include the culture of essentially terrestrial plants (as, for example, in hydroponics) or of basically terrestrial animals. However, when it needs to be used to denote (i) the type of culture techniques or system (e.g. pond culture, raceway culture, cage culture, pen culture, raft culture); (ii) the type of organism cultured (e.g.fish culture or fish husbandry, oyster, mussel, shrimp, or seaweed culture); (iii) the environment in which the culture is done (e.g. fresh water, brackish water, salt water, or marine aquaculture or mariculture); or (iv) a specific character of the environment used for culture (e.g.cold water or warm-water aquaculture, upland, low land, inland, coastal, estuarine), the use of restrictive terms would probable be more appropriate.

While aquaculture is generally considered as a part of fisheries science, there is now a tendency to denote the distinction between the two by using the term "fisheries and aquaculture", because of some of the basic differences in development and management.

VOCABULARY

Words and phrases		**Meaning**
scope /skoup/	(n)	Phạm vi, lĩnh vực, tầm xa
definition/,defi'niʃn/	(n)	Định nghĩa, lời định nghĩa
Define	(v)	Định nghĩa, xác định
Aquaculture	(n)	nuôi trồng thuỷ sản
aquatic /ə'kwætik/	(adj)	ở nước, dướI nước, thuộc về nước
culture/'kʌltʃə/	(v,n)	chăn nuôi, trồng trọt, canh tác
decade/'dekeid/	(n)	Một thập kỉ
denote /di'nout/	(v)	Biểu thị, chỉ rõ, bao hàm
fresh/freʃ/	(adj)	Ngọt, mớI, tươi, sạch
brackish /'brækiʃ/	(adj)	lợ, hơi mặn
marine /mə'ri:n/	(adj)	ở biển, thuộc về biển
environment /in'vaiərənmənt/	(n)	môi trường, hoàn cảnh
restrictive /ris'triktiv/	(adj)	Hạn hẹp, giớI hạn

Sense	(n)	Ý nghĩa, phạm vi, chiều hướng
husbandry /'hʌzbəndri/	(n)	canh tác, chăm sóc, nuôi dưỡng
synonym /'sinənim/	(n)	từ đồng nghĩa
Mariculture	(n)	nuôi hảI sản
Term	(n)	thuật ngữ, thờI hạn, nhiệm kì
sufficiently /sə'fiʃənt/	(adv)	Đầy đủ, có khả năng
expressive /iks'presiv/	(adj)	Diễn đạt được, có ý nghĩa
inclusive /in'klu:siv/	(adj)	Gồm cả, bao hàm, kể hết mọI thứ
clarification /,klærifi'keiʃn/	(n)	Sự làm rõ ràng, làm minh bạch
clarify /'klærifai/	(v)	Gạn lọc, rõ ràng, minh bạch
essentially /i'senʃəl/	(adv)	thiết yếu, không thể thiếu, cần thiết
terrestrial /ti'restriəl/	(adj)	ở trên mặt đất, ở trên cạn
plant /plɑ:nt/	(n)	cây cỏ, thực vật
hydroponics /'haidrou'pɔniks/	(n)	Kỹ thuật trồng trọt trong nước thuỷ canh
pond culture	(n)	nuôi ao
raceway culture /'reiswei/	(n)	nuôi nước chảy
cage culture	(n)	nuôi bè, nuôi lồng
pen culture	(n)	nuôi đăng quầng
raft culture	(n)	nuôi mảng (nhuyễn thể)
organism /'ɔ:gənizm/	(n)	sinh vật, cơ thể, bộ phận, cơ quan
oyster /'ɔistə/	(n)	Hầu, sò
mussel /'mʌsl/	(n)	Vẹm, điệp
shrimp /ʃrimp/	(n)	tôm, tôm biển
seaweed /'si:wi:d/	(n)	rong biển
specific /spi'sifik/	(adj)	Đặc trưng, riêng biệt
character /'kæriktə/	(n)	Đặc điểm, tính cách
coastal /'koustəl/	(adj)	vùng bờ biển, miền ven biển
estuarine /'estjuərain/	(adj)	vùng cửa sông, cửa sông ven biển
appropriate /ə'proupriit/	(adj)	thích hợp, thích đáng
Consider	(v)	xem xét, cân nhắc, lưu ý tớI
fisheries science	(n)	khoa học nghề cá
tendency /'tendənsi/	(n)	Xu hướng, khuynh hướng
distinction /dis'tiŋkʃn/	(n)	Điều khác biệt, sự phân biệt, đặc điểm riêng
development /di'veləpmənt/	(n)	Sự phát triển, sự tiến triển

management /'mænidʒmənt/	(n)	Sự quản lý, sự điều khiển, sự quán xuyến

II. Grammar

The Active Voice and The passive voice.

The Active voice	**The Passive voice**
Subject + verb + object	**Subject + verb (to be) +past participle (p2)**

Note that **The passive voice** is used when it is not necessary to mention the doer of the action (or when it is not so important who or what does/did the action) as we are more interested in what is/was done.

Examples:

- Many still use the word "aquaculture" in a more restrictive sense.

→ *The word " aquaculture" is still used by many in a more restrictive sense.*

- People generally consider aquaculture as a part of fisheries science.

→ *Aquaculture is generally considered as a part of fisheries science.*

III. Reading tasks:

Task 1: *Comprehension questions*

1. What does the word "**aquaculture"** mean?
2. How do some people understand the word " aquaculture"? What about you?
3. Which fields does not the term "aquaculture" include?
4. What are the types of culture techniques or system?
5. Name some of the types of organism cultured that you know?
6. What is the environment in which the culture is done?
7. List some specific characters of the environment used for culture.
8. Are there any distinctions between " aquaculture " and " fisheries science"?

Task 2: *Match the word in column A with its appropriate definition in column B.*

Column A	**Column B**
1.Husbandry	*a.operating or living or growing in water*
2.cage culture	*b.the practice of cultivating the land or raising stock*
3.Marine areas for aquaculture	*c.plants that live predominantly or entirely on land*
4.fresh water	*d. plants that live predominantly or entirely in the water*
5.terrestrial plants	*e.an aquaculture production system where fish are held in floating net pens*

6.Fisheries science	*f.water with salinity less than 0.5%.* *g.water contains between 0.5 to 30 grams of salt per litre*
7.Aquatic	*h.the academic discipline of managing and understanding fisheries*
8.brackish water	*i.sea areas that are planned for aquaculture purposes.*

Task 3: **Fill in each blank with a suitable word from the box:**

Fishing cultivation produced farming aquatic techniques source raised maximize

Aquaculture is a form of agriculture that includes the …(1)…….., propagation and marketing of …(2)…….. organisms. Aquaculture shares many similarities in concept to many land based agriculture industries such as cattle …(3)…….. and many of the same management…(4)…… are used in aquaculture. Like more traditional forms of agriculture the goal of aquaculture is to …(5)…….. production at a minimal cost to maintain a profit margin.

Aquaculture is poised to become an important …(6)……. of protein for the world's growing population. Because the capture …(7)…… industry has peaked and is likely to decline as wild stocks are diminished, Aquaculture will become an important source of seafood products. Already nearly one third of all aquatic products consumed in the United States were …(8)……. on fish farms. Almost all of the catfish and rainbow trout, half the shrimp, and one third of all salmon consumed in the United States are…(9)…… on fish farms. The aquaculture industry of the United States, however, is very small compared to the industry in other nations.

Task 4: Sentence transformation

Write a new sentence which has similar meaning to the first.

1.Based on the culture environment, we can classify aquaculture into 3 main types: fresh-water, brackish and marine culture.

Based on the culture environment, aquaculture ……

2.It is estimated that the share of aquaculture in total fishery production in 2003 is 35.08%, up from 29.16% in 2001.

The share of aquaculture in total fishery production in 2003 ……

3.In export processing, people have applied advanced technologies including post-harvest preservation, surimi production, winter-sleep (hibernation) in transportation of fresh fish, individual quick freezing (IQF), etc. .

Advanced technologies ……

4.Aquaculture is sometimes defined as the production and husbandry of aquatic animals and plants in a controlled environment.

We sometimes……..

.

Task 6: Find the equivalent words or phrases in Vietnamese

Words and Phrases	**Meaning**
Marine fishing	
Coastal resources	
offshore fishing	
aquaculture production	
aquaculture farms	
agriculture techniques	
recirculating systems	
extensive farming operations	
intensive operations	
Culture environment	

Optional reading

Aquaculture is already becoming an important factor in the world's fish markets. World aquaculture production doubled between 1984 and 1995 to nearly 21 million metric tons and was worth over $36.2 billion U.S. dollars. However, if aquaculture is to continue to grow its operations must be environmentally stable as well as profitable. This is no small challenge, as aquaculture, in its modern form and capacity is a relatively new industry and more research is required to determine at what level and in what manner aquaculture should be practiced to maintain an environmental balance. Unfortunately, many of the existing aquaculture farms were not designed to be environmentally friendly and, in some cases, no attention to the environment was given during their construction and operation. Such aquaculture projects are sources of significant biological, chemical, and nutrient pollution . If these problems are not addressed, the aquaculture industry may collapse.

Despite the environmental dangers of improperly run aquaculture projects, many believe that with the right management and precautions, aquaculture farms can operate with a minimal environmental

impact. An environmentally friendly operation offers many significant advantages. The first is from an energy and production standpoint. Fish farming can be ten times more efficient than other forms of agriculture, such as cattle farming. Whereas a single acre of land can produce 1,000 pounds of beef, one acre of fish farms can produce 10,000 pounds of fish. Fish are also more efficient at converting food matter into flesh than most other animals.

If aquaculture is so productive and potentially environmentally friendly, then why isn't it a much larger source of food and resources. One answer is that aquaculture in its modern form and size is a relatively new industry and is decades behind other agriculture techniques technologically. Another reason is that aquaculture, as implemented thus far, has not proven to be environmentally friendly.

Aquaculture is not one set of techniques, rather it is a myriad of processes that involve the cultivation of hundreds of varieties of fish, shellfish, and aquatic plants. There are four main aquaculture techniques, pond, cage, raceway, and recirculating systems. Each of these operations is further categorized by its production output. Extensive farming operations are low density projects where little effort is used to stimulate rapid growth and development, often for environmental or economic reasons. The second category, intensive operations, apply to projects with high production densities, often the result of chemical or other inputs that increase the yield.

UNIT 2
SITE SELECTIONS FOR AQUACULTURE

Although many of the factors to be investigated in the selection of suitable sites will depend on the culture system to be adopted, there are some which affect all systems, such as agro-climatic conditions, access to markets, suitable communications, protection from natural disasters, availability of skilled and unskilled labor, public utilities, security, etc. It is possible to find solutions when these factors are unfavorable and present problems, but it would involve in increased investment and operating costs and would affect profitability. In the case of small-scale aquaculture, it is necessary to determine that the selected site has easy access to materials that can not be produced on the farm and that the necessary extension services are available.

All available meteorological and hydrological information about the area (generally available from meteorological and irrigation authorities), such as range and mean monthly air temperature, rainfall, evaporation, sunshine, speed and direction of winds, floods, water table, etc., have to be examined to assess their suitability.

In land-based aquaculture, the most commonly used installations are pond farms and hatcheries. Since most such farms have earthen ponds, soil characteristics, the quality and quantity of available water and the ease of filling and drainage, especially by gravity, are basic considerations. For freshwater pond farms, the land available consists mainly of swamps, unproductive agricultural land, valleys, stream and riverbeds exposed due to changes of water flow, etc. Land elevation and flood levels have to be ascertained. The maximum flood level in the last ten years or the highest astronomical tide (in the case of brackish water sites) should not be higher than the normal height of the dikes that will be constructed for the farm. It will be advantageous to select land with slopes not steeper than 2 percent. The area should be sufficiently extensive to allow future expansion and preferably of regular shape to facilitate farm design and construction.

The nature of the vegetation indicates the soil type and elevation of the water table. Obviously dense vegetation, particularly tall trees, make clearing more difficult and expensive. Land under grass or low shrub is much better suited in this respect. However, in areas exposed to strong winds and cyclones or similar weather conditions, sufficiently tall vegetative cover around the farm can serve as effective windbreakers. High ground-water level may create problems in farm operation, as drainage will become difficult and expensive. The use of mechanical equipment for pond construction will also become inconvenient.

Among the other important general factors to be considered are the existing and future sources of pollution and the nature of pollutants. In this connection, information on development plans for the neighborhood areas will be necessary. It will be useful to ascertain the past use of the site, if any. Croplands that have been

treated for long periods with pesticides may have residues that are harmful to fish and shellfish. If the site is located adjacent to croplands that are sprayed from air or land, there is the risk of contamination occurring directly or through run-off water. Similarly, the possible effects of discharges from the pond farms into the waterways and irrigation systems in the neghboring area should be considered. This can greatly influence the attitudes of the neighborhood communities to the proposed farming and hence their future cooperation.

When a hatchery is planted in connection with a pond rearing facility, the selection of its site depends on the location of the nursery and rearing ponds. The more important consideration is the unrestricted availability of good water quality, such as from springs, tube wells, reservoirs, etc. If earthen nursery ponds are to be constructed alongside the hatchery, it is necessary to ensure the quality of the soil for pond construction and pond management. In many modern hatcheries, fry rearing is mostly done in tanks and troughs, with as much control over ambient conditions as possible. So the main consideration is the availability of essential utilities like electricity. The situation is very similar for the selection of sites for raceway farms. When the raceways are made of cement concrete, the main consideration is the availability of adequate quantities of good quality water and essential utilities.

The choice of sites for integrated aquaculture, such as fish culture combined with crop and livestock farming, is governed by factors other than their mere suitability for aquaculture. Land available for integrated aquaculture is generally agricultural land, even if it is somewhat less productive. A satisfactory irrigation system is likely to have been developed for agriculture, in which case water and soil management can be expected to be easier. Since integrated farming is based on the recycling and utilization of farm wastes, problems of pollution can be expected to be minimal.

Words & phrases	Word forms	Meaning
agro-climatic	(adj.)	thuộc về khí hậu nông nghiệp
disaster/di'zɑ:stə/	(n.)	thảm hoạ
availability/ə,veilə'biliti/	(n.)	Tính chất có sẵn, khả năng có được
public utility /'pʌblik ju:'tiliti//	(n.)	lợI ích công cộng
profitability/profitə'biliti//	(n.)	Khả năng có lãi
meteorological/,mi:tjərə'lɔdʤikəl/	(adj.)	thuộc về khí tượng
hydrological/,haidrou'lɔdʤi/		thuộc về thuỷ học
irrigation/,iri'geiʃn/		thuỷ nông, thuỷ lợi
evaporation/i,væpə'reiʃn/		sự bốc hơi
assess/ə'ses/		lố vào, sự tiếp cận
suitability/,sju:tə'biliti/		
installation/,instə'leiʃn/		sự lắp đặt, cơ sở
hatchery /'hætʃəri/		trạI giống

earthen/'ə:θən/		
rainfall/'reinfɔ:l/		lượng mưa
water table		mức nước ngầm
drainage/'dreinidʤ/		sự thoát nước
gravity/'græviti/		trọng lực
swamp/swɔmp/		đầm lầy
elevation/,eli'veiʃn/		sự tôn cao
shrub/ʃrʌb/		Cây bụi
cyclone/'saikloun/		Cơn lốc xoáy
valley/'væli/		Thung lũng
bed/bed/		nền, lòng, đáy
ascertain/,æsə'tein/		Xác định, nắm được
dike /daik/		Đê, bờ đê
astronomical/,æstrə'nɔmikəl/		thuộc về thiên văn, mạnh mẽ
slope/sloup/		độ dốc
steep/sti:p/		
expansion/iks'pænʃn/		sự mở rộng
facilitate/fə'siliteit/		Làm thuận tiện
mechanical		thuộc về cơ khí, máy móc
pollutant/pə'lu:tənt/		chất gây ô nhiễm
neighbourhood		Vùng lân cận
pesticide/'pestisaid/		thuốc trừ sâu
adjacent/ə'dʤeizənt/		kế cận, liền kề
contamination/kən,tæmi'neiʃn/		sự nhiễm bẩn, sự ô nhiễm
attitude		Thái độ, quan điểm
discharge/dis'tʃɑ:dʤ/		Tuôn chảy, sự tuôn chảy
residue/'rezidju:/		tồn lưu, vật chất tồn lưu
reservoir/'rezəvwɑ:/		hồ chứa
nursery/'nə:sri/		Ao ương, ao dưỡng cá con
trough/trɔf/		máng
ambient/'æmbiənt/		Xung quanh, bao quanh
adequate/'ædikwit/		đủ, đầy đủ
integrated/'intigreitid/		hợp thành hệ thống, bổ sung cho nhau
livestock/'laivstɔk/		vật nuôi, gia súc
govern/'gʌvən/		điều khiển, kiểm soát
satisfactory/,sætis'fæktəri/		thoả mãn, vừa ý
recycling		sự quay vòng, tái chế

II.Grammar

Conjunctions

A conjunction joins two parts of a sentence. Here are some example conjunctions:

Coordinating Conjunctions	Subordinating Conjunctions
and, but, or, nor, for, yet, so	although, because, since, unless
Coordinating conjunctions are used to join two parts of a sentence that are grammatically equal. The two parts may be single words or clauses, for example: - *Land elevation* **and** *flood levels* have to be ascertained. - *The water was warm,* **but** *I didn't go swimming*.	**Subordinating conjunctions** are used to join a subordinate dependent clause to a main clause, for example: - *I went swimming* **although** *it was cold*.
Coordinating conjunctions always come between the words or clauses that they join.	**Subordinating conjunctions** usually come at the beginning of the subordinate clause.

Though/ although normally introduce clauses of concession

E.g:

- *Although* many of the factors to be investigated in the selection of suitable sites will depend on the culture system to be adopted, there are some which affect all systems, such as agro-climatic conditions, access to markets, public utilities, etc.

Because/ as/ since introduce clauses of reason

E.g:

- *Since* integrated farming is based on the recycling and utilization of farm wastes, problems of pollution can be expected to be minimal.
- High ground-water level may create problems in farm operation, *as* drainage will become difficult and expensive.

III. Reading tasks:

Task 1*:* Decide whether the following information is *true (T)* or *false (F)* or *no information (NI)*

1.Agro-climatic conditions are among the factors that affect the adopted culture system.

2.The extension services are now available for small-scale aquaculture

3.All available meteorological and hydrological information about an area is generally provided by its meteorological and irrigation authorities.

4.In land-based aquaculture, the size of the farm must be large enough for future expansion.

5.It will be disadvantageous to select land with slopes steeper than 2 percent.

6.Lands under grass or low shrub make clearing more difficult and expensive
7.The discharges from the pond farms into the waterways and irrigation systems in the neghboring area can greatly influence the attitudes of the neighborhood communities to the proposed farming and hence their future cooperation.
8.In many modern hatcheries, the availability of essential utilities like electricity can largely affect the fry rearing.
9.The recycling and utilization of farm wastes helps to reduce the problems of pollution.

Task 2: *Match the word in column A with its appropriate definition in column B.*

Column A	Column B
evaporation	the consequence of a natural hazard (e.g. volcanic eruption, earthquake, or landslide) which affects human activities
flood	the interdisciplinary scientific study of the atmosphere that focuses on weather processes and forecasting (in contrast with climatology).
natural disasters	the process by which molecules in a liquid state (e.g. water) spontaneously become gaseous (e.g. water vapor).
meteorology	an overflow of an expanse of water that submerges land, a deluge
hatchery	the natural or artificial removal of surface and sub-surface water from a given area
integrated aquaculture	refers to the different sizes of mineral particles in a particular sample
ground-water	water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations
irrigation system	a facility where eggs are hatched under artificial conditions, especially those of fish or poultry
soil type	a practice in which the by-products (wastes) from one species are recycled to become inputs (fertilizers, food) for another
drainage	the artificial application of water to the soil usually for assisting in growing crops

Task 3:*Gap filling*

Vegetation cover Accessibility Proximity to your home
Multiple uses of the ponds Proximity and size of market
Availability of inputs

There are other site characteristics which are also important to consider during selection.

(a) **…….:** if there are big trees or a dense population of smaller trees, clearing the land will be difficult and costly. Open woodland, grassland, old paddy fields or land covered with low shrubs permit easier and cheaper construction.
(b)…….. **:** the use of artificial feeds on a commercial farm, pond management and marketing will require good access by road to the site. On the other hand, for subsistence ponds or small-scale operations, access on foot or by bicycle or motorbike might be sufficient.
(c) ……..**:** it is always best to live close to your ponds. It will be easier to manage them and to protect them against poaching. For larger farms, a place must often be built for people who are looking after the ponds.
(d)…… **:** it is sometimes advantageous to be able to use your ponds for purposes other than fish farming such as livestock watering, gardening or domestic use. Such integrated fish farming should be well planned.
(e)……. **:** once harvested, your fish should preferably be sold fresh, as soon as possible and with the least costs. You should know in advance how many fish you will be able to sell in one day and plan your pond sizes and harvests accordingly.
(f) ……..**:** if your fish farm requires regular inputs such as feed ingredients and juvenile fish, they should be available locally. You might also want to hire casual labour to help you from time to time. Spare parts and supplies might also be necessary.

Optional reading

Water is the medium surrounding aquatic animals and their well being is dependent on the abundance and quality of the available water. A regular, abundant water supply is essential for the maintenance of healthy fish stocks. This applies particularly for those species that need flowing water with high oxygen levels (for example the salmonids). A reasonably abundant supply is also required for native fishes, particularly during spring and summer when water temperatures can exceed 30^{o} C and poor water quality conditions can develop, necessitating a rapid exchange of water. A supply of good quality water is essential. Poor water quality reduces fish survival and growth. Water quality variables need to be monitored regularly as they interact and can change from acceptable levels to lethal levels within several days, particularly during summer. Source water for fish farms can be drawn from many sources; for example runoff, rivers, creeks, impoundments, small dams, lakes, irrigation canals and underground (bore water). The type, size, location and topography of a farm will determine the best or most practical source of water. Some sources of bore water are deficient in oxygen and contain excess nitrogen and harmful gases such as methane and hydrogen sulfide,

and minerals such as lead, zinc and iron. These limitations can generally be overcome by storing and aerating the water in a reservoir before use. Avoid water from domestic supplies as it contains chemicals such as chlorine, which can be toxic to fish. The cost of supplying water to the site may be a major factor determining the economic feasibility of a fish farm. Pumping costs are high and must therefore be minimized. Utilize gravity flow, as it is efficient and cheap.

UNIT 3

THE FISH POND ENVIRONMENT

Most fish are still cultured in simple ponds with limited; if any water exchange. The great variety in fish yields reported for such systems (50-13,000 kg/ ha/yr.) reflects the wide variation in species employed , local conditions and levels of management. The limited water exchange allows a build up of nutrients supporting the growth of natural feeds, especially if fertilizers, manure or other waste products are added. Thus, natural feeds in the pond may reach levels far in excess of those found in most natural aquatic systems. Since the density of fish that can be grown in a volume of water is , within limits, directly related to the abundance of food , this can improve yields without the use of costly feed inputs. The stimulation of natural feeds can be based on almost any nutrient source, whether used singly or in combination with others. The system is thus extremely flexible and ideal for accepting the range of raw materials available in integrated farming. The basic principle of pond feeding is that nutrients dissolved in water and sunlight energy are converted into usable cell material for consumption by the fish.

Green, eutropic phu duong, water is typical of fertilized warm water fishponds. This is often the simplest and most obvious sign that the natural web of food organisms within the pond is productive, and that yields of stocked fish will usually be higher than in a natural system. Indeed, such is the quality of this natural feed that fish yields may reach or exceed those possible conventional fish feeds.

The algae, or phytoplankton, are the primary and most obviously natural food in a fertilized pond. They basically fix nutrients in the water in a form available as food for plankton-eating fish by means of photosynthesis. Production is thus related to both nutrient and sunlight energy input; tropical ponds, receiving high levels of sunlight, have the greatest potential for production of natural feeds. These in turn form the basic of a balance of animal and plant communities, forming a web of feeding relationships. This solar-powered food production is often termed the “autotrophic”pathway. Phytoplankton are also essential in producing oxygen in the pond. A second fundamental system, the “heterotrophic” pathway, is based on the breakdown of dead plant and animal material in the pond by bacteria. Up to certain limits, increases in nutrient input results in an increase in phytoplankton, bacteria and zooplankton dong vat phu du production, allowing a consequent increase in organisms feeding on them.

The relative quantities and types of food organism within the pond define the potential for fish yield. Actual yield depends further on the type and numbers of fish stocked, as different species feed on different feed organisms, ranging from phytoplankton to macrophytes thuc vat lon, zooplankton, bacteria and detritus mun ba huu co. In most case the basis for fish yield is the light-limited “ autotrophic” phytoplankton production, though in heavily manured ponds the

heterotrophic use of wastes by bacteria and protozoa nguyen sinh dong vat may also be important. In all cases, the primary goal of successful pond operation is the managing of the different pond organisms to maximize the opportunities for fish feeding and growth, and to maximize the absorption of waste materials and their conversion into more useful and stable products.

exchange(v.)	/iks'tʃeindʤ/	Trao đổI
yield(n,v.)	/ji:ld/	sản lượng, đạt được
variation (n)	/,veəri'eiʃn/	sự biến đổI, sự thay đổi
species (n)	/'spi:ʃi:z/	Loài, loại
nutrient(n)	/'nju:triənt/	chất dinh dưỡng
manure(n,v)	/mə'njuə/	Phân chuồng
reach(v)	/ri:tʃ/	đạt tới
excess (v)	/ik'ses/	vượt quá, dư thừa
density (n)	/'densiti/	mật độ, sự đông đúc
abundance(n)	/ə'bʌndəns/	Sự phong phú, dồI dào
stimulation(n)	/,stimju'leiʃn/	sự thúc đẩy, sự kích thích
combination(n)	/,kɔmbi'neiʃn/	sự kết hợp, sự phốI hợp
flexible(adj)	/flexible/	Linh hoạt, mềm dẻo
raw material		Nguyên liệu thô
dissolve(v)	/di'zɔlv/	Hoà tan, làm tan
convert(v)	/kən'və:t/	Biến đổi
consumption(n)	/kən'sʌmpʃn/	sự tiêu thụ
eutropic(adj)		Dinh dưỡng phù hợp
conventional(adj)	/kən'venʃənl/	Thông thường, theo truyền thống
algae(n)	/'ælgə/	tảo
phytoplankton(n)		thực vật phù du
primary(adj)	/'praiməri/	đầu tiên, sơ cấp
fix(v)	/fiks/	định hình, cố định
photosynthesis(n)	/,foutə'sinθisis/	sự quang hợp
plankton-eating fish		Cá ăn thực vật phù du
autotrophic(adj)	/,ɔ:tə'trɔfik/	tự dưỡng
fundamental (adj)	/,fʌndə'mentl/	Nguyên tắc cơ bản
heterotrophic(adj)	/,hetərou'trɔfik/	dị dưỡng
breakdown(n)	/'breikdaun/	sự phân rã, sự suy tàn
zooplankton (n)		động vật phù du
macrophyte(n)		thực vật lớn, bậc cao
detritus(n)	/di'traitəs/	Mùn bã hữu cơ
protozoa(n)	/protozoa/	động vật đơn bào, nguyên sinh
absorption(n)	/əb'sɔ:pʃn/	sự hút, sự hấp thu

I.Fill in the blanks with a suitable words from the box:

Mariculture	**Aquaculture**	**Aquaculture milieu**	**Aquafeed**
Algaculture	**Aquaculture facility**	**Aquaculture production system**	
Aquatic organism			

(1)…….means the propagation, rearing, enhancement, and harvest of aquatic organisms in controlled or selected environments, conducted in marine, estuarine, brackish, or fresh water.
(2)……. means any land, structure, or other appurtenance that is used for aquaculture, including, but not limited to, any laboratory, hatchery, pond, raceway, pen, cage, incubator, or other equipment used in aquaculture.
(3)……. means any species or hybrid of aquatic animal or plant, including, but not limited to, "fish," "fishes," "shellfish," "marine fish," and "organisms"
(4)……refers to aquaculture practiced in marine environments.
(5)…….the production of seaweed and other algae
(6)……. An ecological description for a location of interest to aquaculture resulting from the possible combination of environmental descriptors (e.g. physico-chemical water quality) and/or the type of ecosystem (e.g. inland or coastal, natural or modified, standing or running water).
(7)…….what is being cultured, giving also hints on how this is done, and possibly the aquaculture milieu in which it takes place.
(8)……Feed to be used in aquaculture.

UNIT 4
FISH –RICE SYSTEMS

Fish culture can be integrated with agriculture in ways other than utilizing waste or by-products. Growing fish on the same piece of land as other aquatic crops, especially rice, can bring advantages to both crops whilst intensifying land and water use.

Rice and fish are considered complementary and basic foods in South East Asia, where the practice of fish-in-rice culture is most developed. The potential for its development elsewhere, however, is clear in that **rice** constitutes the world's major food source, **using 50% of world's arable** land. Other aquatic macrophytes, however, are far less widely grown but may be of considerable importance locally. They will often have potential for contributing to increased and diversified food supply, especially if their production is integrated with fish culture. In many areas fish culture in ponds may mot be feasible for reasons such as lack of land tenure or high capital cost and risk. In such cases stocking of fish with aquatic crops may be the only practical alternative permitting fish production and increasing returns on the use of land.

Intensification of rice growing practices, particularly the introduction of high yielding varieties (HYV) of rice, **has caused a decline in fish/ rice culture** mostly through effect of pesticides on the growth and survival of fish. In the longer term, the development and use of pesticides less toxic to fish, together with a greater understanding of biological pest control, should further stimulate fish-in-rice culture. Also, there is great potential in growing fish with other aquatic crops such as lotus and water chestnut.

It is accepted that the stocking of fish in paddy fields more effectively uses the available food and space. This is particularly true if a polyculture of fish is used. The stocking of fish to feed on competing phytoplankton and submerged weeds benefits the rice, particularly if done at the start of rice production. The stocking of macrophagous tilapias within one week of transplanting rice, was claimed by Mortimer (quoted by Pullin, 1983) to control weeds, while stocking 5-9 weeks after transplanting was not effective. The activity of feeding fish and their excretion can also improve paddy fertility to the benefit of rice production. Recent research in China suggests that this fertilization effect is more marked in less fertile fields, and can be cumulative over a few years.

I.Fill in the blanks with a suitable words from the box:

Micro-scale- aquaculture **Intensive- Aquaculture** **Integrated aquaculture** **Extensive- aquaculture** **Cage- culture** **Culture system** **Pond- culture** **Brackish water aquaculture**

(1)……..Aquaculture system sharing resources - water, feeds, management, etc. - with other activities; commonly agricultural, agro-industrial, infrastructural (wastewaters, power stations, etc.).
(2)…… Aquaculture system with a very small annual production output (max. 5 kg per unit and 100 kg total), made of a single production unit (e.g. cage or pond); usually individual or family run; low input levels, limited or no external assistance. Own food supply often a motive.
(3)…….**s**ystem of culture characterized by (i) a production of up to 200 tonnes/ha/yr; (ii) a high degree of control; (iii) high initial costs, high-level technology, and high production efficiency; (iv)tendency towards increased independence of local climate and water quality; (v) use of man-made culture systems.
(4)……Production system characterized by (i) a low degree of control (e.g. of environment, nutrition, predators, competitors, disease agents); (ii)low initial costs, low-level technology, and low production efficiency (yielding no more than 500 kg/ha/yr); (iii) high dependence on local climate and water quality; use of natural waterbodies (e.g. lagoons, bays, embayments) and of natural often unspecified food organisms.
(5)…….the cultivation of aquatic organisms where the end product is raised in brackish water; earlier stages of the life cycle of these species may be spent in fresh waters or marine waters
(6)……..Culture of stocks in cages.
(7)……Common term used to describe the cultivation of organisms in land-based ponds.

I.**Comprehension questions**

1.What is fish-rice system?

2.Where is the practice of fish-in-rice culture most developed?

3. What causes difficulties to fish culture in ponds in some areas?

4.Which is the main factor that result in the decline in fish/ rice culture when intensification of rice growing practices are applied?

5.What are the benefits of fish-rice system?

Decide whether the following statements are true(*T*), false(*F*) or not given (*NG*)

1. Rice and fish culture use up to 50% of world's arable land

2. In many areas, fish culture in ponds may not be done due to lack of land tenure or high capital cost and risk.

3. The use of pesticides less toxic to fish, together with a greater understanding of biological pest control, should further decline fish-in-rice culture.
4. A polyculture of fish can effectively utilize the food and space in paddy fields
5. The stocking of fish to feed on competing phytoplankton and submerged weeds benefits the rice at any time of the year.

II.Matching

Column A	Column B
1.by-products	a capacity to yield large crops of rice
2.capital cost	a flooded parcel of arable land used for growing rice and other semiaquatic crops.
3.Intensification	the total cost needed to bring a project to a commercially operable status.
4.high yielding varieties (HYV) of rice	the process of eliminating waste products of metabolism and other non-useful materials.
5.biological pest control	a method of controlling pests (including insects, mites, weeds and plant diseases) that relies on predation, parasitism, herbivory, or other natural mechanisms.
6.paddy fields	a secondary or incidental product deriving from a manufacturing process
7.excretion	a method of increasing the yield of rice produced in farming
8.paddy fertility	a group of genetically enhanced cultivars of crops that have an increased growth rate, an increased percentage of usable plant parts or an increased resistance against crop diseases.

III.Decide whether the following statements are advantages or disadvantages of fish-rice culture:

1An increase in income from the production of both rice and fish
2.A reduction in insect pests, such as leaf-hoppers, stem-borers…
3.Can be risky (e.g. flooding, drought, poaching, poisoning, etc.) compared to rice monoculture
4.A reduction in using fertilizers
5.Require more water than rice culture alone
6.Utilize the poor soil
7.Requires a significant amount of labour
8.The recycling of nutrients by the fish through feeding and depositing feces in the soil.

9.An increase in rice yields
10.Difficulty about fingerlings: not suitable quantity or size (requires big size), not available at the right time

UNIT 5
NATURE AND SOURCE OF LIVE FOODS

Aquaculture animals have to obtain all their nutritional requirements except for part of the mineral requirements, through the foods they consume. In nature, most of them subsist on live foods consisting of plants and animals obtained from the environment, but some do ingest and possibly utilize detritus along with associated organisms. These foods are generally very rich in essential nutrients.

There is a difference of opinions on the food value of bacteria, although fair quantities can be found in the alimentary tract of aquaculture species, particularly in detritus and periphyton feeders. Experience in aquaculture seems to show that most adult finfish and crustaceans can be weaned to accept inert foods, even though there are advantages in providing some live food. But larval stages of any of these species have to depend entirely on live food. The initial source of food for many larval organisms is phytoplankton. This is probably associated with the size of the larvae at hatching. After a certain period of time, the larvae of most species, except molluscs, can be fed exclusively one zooplankton or other animal species, or a combination of plant and animal matters. It is possible to obtain both types of food from nature.

But it will be more convenient to culture algae under controlled conditions for hatchery use. In nursery and grow-out ponds, they are generally produced as a result of the biological cycle initiated by mineral nutrients in solution. Using the sun's heat and light, they transform the inorganic matter and carbonic acid in solution into organic matter, in the form of vegetable tissues consisting of plankton and periphyton. Of particular interest in pond culture of bottom-feeding fish is the production of benthic algal complexes which also include animal species and bacteria associated with detritus.

Light penetration is an important factor in photosynthesis and, therefore, in the growth of aquatic algae and macrophytes. Since aquaculture is generally done in shallow waters, the light intensity at the bottom usually exceeds 1 percent incident, which is the accepted compensation depth for aquatic plants. Even on ponds with highly turbid water, some photosynthetic activity takes place and this is further enhanced by water circulation.

Among the major nutrient required by plants are phosphorus and nitrogen, primarily PO_4 and NO_3. Nitrogen is removed from water as nitrates (NO_3) by plants. Nitrogenous wastes are excreted by animals and nitrogenous compounds are released during the bacteriological decomposition of plant and animal matters. They are eventually transformed into ammonia, which undergoes nitrification to nitrate through a nitrite (NO_2) as a result of the action of aerobic bacteria. Phosphorous is an important major nutrient because it plays a key role in photosynthesis and intermediary metabolism and forms a constituent of nucleic acid and proteins. Available carbon is also of major important as its deficiency is

reflected in decreased production. The ratio of carbon, nitrogen, phosphorus required by most species of phyto-plankton is about 106: 16:1.

I.Answer the following questions:

1.What is photosynthesis? And what factors affect photosynthesis?
2.What kinds of food do fish eat during the early stages?
3.What are major nutrients required by aquatic plants?
4.Explain the way that nitrogen is transformed into nitrates?
5.What is the ratio of carbon, nitrogen, phosphorus required by most species of phyto-plankton?

II.Decide whether the following statements are true (T), false (F) or no information (NI):

1. Aquaculture animals have to obtain all their nutritional requirements through the foods they are fed.
2. The food value of bacteria is relatively high as fair quantities can be found in the alimentary tract of aquaculture species.
3. Larval stages of many aquaculture animals have to depend entirely on live food.
4. At a certain period of time, the larvae of mollusks can be fed exclusively one zooplankton or other animal species, or a combination of plant and animal matters.
5. On ponds with highly turbid water, photosynthetic activity is hardly taken place and this is further reduced by water circulation.
6. Phosphorus, nitrogen and carbon are among the major nutrient required by plants.
7. It is highly suggested to culture algae under controlled conditions for hatchery use.

III.Matching:

Column A	Column B
organism	an unwanted or undesired material or substance
alimentary tract	the biological oxidation of ammonia with oxygen into nitrite followed by the oxidation of these nitrites into nitrates.
decomposition	a living thing (such as animal, plant, fungus, or micro-organism)
food value	the amount of nutrient in food that is available through digestion
organic matter	the system of organs within multicellular animals that takes in food, digests it to extract energy and nutrients, and expels the remaining waste
aerobic bacteria	the break down of tissue of a formerly living organism into simpler forms of matter.
nitrification	an organism use oxygen to oxidize substrates (for example sugars and fats) in order to obtain energy.
waste	matter which was once part of a living organism or produced

	by a living organism

IV.Decide the following statement are advantages or disadvantages of Extensive and Intensive Systems

-Requires less water, hence lower pumping costs
-Requires abundant water and subsequent pumping cost
-Fewer disease problems
-More disease problems
-Fewer water quality problems
-Closer monitoring of water quality required
-Lower feed costs
-high feed costs
-Control of disease, water quality and weed and algae growth may be difficult and costly
-Monitoring and control of disease is relatively easy
-Less control over size of fish.
-Monitoring size and culling easy,

System	Advantages	Disadvantages
Extensive		
Intensive		

I.Reading comprehension

Water

Aquaculture requires large volumes of good quality water. While you may be able to fill a pond with your garden hose, it may take six months to do so. Normally, a well or surface water source (river, stream or spring) is required. Surface sources may be polluted, intermittently available (affected by weather, e.g. drought) or contain wild fish populations which might be introduced into your pond. Wild fish can be a source of disease and will often compete with cultured fish for feed. Many of the most successful aquaculture operations in the U.S. depend on large aquifers (underground water supplies) for water needs. Typically, commercial aquaculture requires a water flow rate of 25-40 gallons/minute, on demand, for every surface acre (4 acre-feet) of pond water.

Water must be of high quality and free of pollutants, sewage and toxic contaminants. Generally, water that is safe for livestock and domestic use or that supports wild fish populations is safe for aquaculture. However, livestock and aquaculture do not mix. Manure from just a few farm animals can pollute a pond.

There are several chemical characteristics of water that are desirable for good fish growth. Water should have a pH of 6.5-9.0, total alkalinity of 75-250 mg/l and total hardness of 75-250 mg/l. Total hardness and alkalinity should not be less than 20 mg/l. Low alkalinity and acid water are usually related to acid soils. Agricultural limestone can be used to raise pH, alkalinity and hardness to the minimum required levels in soft, acid water. If striped bass or red drum are being considered, calcium hardness and total alkalinity between 100-250 mg/l are preferable; a calcium hardness value of 250 mg/l is ideal. Often, well water contains no oxygen and high levels of carbon dioxide and nitrogen, necessitating aeration before use or pH testing.

Answer the following questions

1. What are the sources of supply for a pond's water needs?
2. What are some desirable chemical characteristics of water for good fish growth?
3. Why must water for the cultured ponds be of high quality?

Decide whether the following statements are true (T), false (F) or no information (NI)

1. Wild fish can cause disease for the cultured fish in your pond.
2. Water that is safe for livestock and domestic use or that supports wild fish populations is rarely safe for aquaculture.
3. Well water contains oxygen and low levels of carbon dioxide and nitrogen often needs aeration before use or pH testing.
4. Among the most successful aquaculture operations in the U.S., many of them depend on underground water supplies for water needs.

I. Reading comprehension

In recent years significant improvements have been made to the VAC system with significant increases in fish yield. In upland areas, farmers have also been able to manage stream flows and make them pass through series of VAC ponds where significantly higher fish yields are achieved. The improved practice has potential for application in several other countries in the region, where farmers have relatively small farm holdings.

Human waste is a critical agricultural input in the VAC systems, aside from on-farm produced livestock feed, particularly rice bran and sweet potato. The complementary linkage of all farm components can best be studied with a cropping calendar that includes fish, rice, livestock and other crops.

The lowland systems are significantly different from the upland systems in terms of resource availability and use. Three systems are distinguished: (a) suburban, (b) intensive (i.e. rice production) and (c) lowland (i.e. flood prone environments).

The VAC systems are traditional and farmers and researchers have developed more intensive approaches over the last decade, since economic changes have taken place. They are less specific in their application requirements than Chinese systems presented in this volume. Recent research efforts should be summarized quantitatively to reflect present levels of benefits.

Answer the following questions

1.What are the important agricultural inputs in the VAC systems?
2.Where can the VAC system be applied?
3.What are the significant differences between the lowland and upland systems?

Decide whether the following statements are true (T), false (F) or no information (NI)

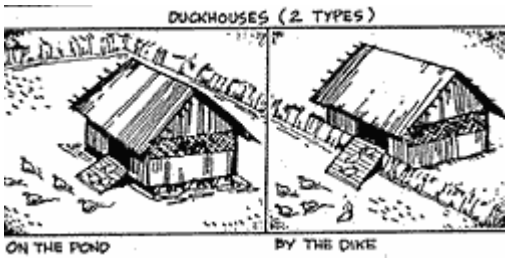
1. In recent years significant improvements have been made to the VAC system, especially in fish yield.
2. More intensive approaches have been developed in the VAC systems for the last ten years.
3.The improved practice of the VAC systems has potential for application in all countries , where farmers have relatively small farm holdings.

I.Reading comprehension

Raising ducks over fishponds fits very well with the fish polyculture system, as the ducks are highly compatible with cultivated fishes. The system is advantageous to farmers in many ways:

1. Ducks fertilize the pond by their droppings when given free range over the pond surface. Ducks have been termed as manuring machines for their efficient and labour-saving method of pond manuring, resulting in complete savings on pond fertilizer and supplementary fish feed which accounts for 60 percent of the total cost in conventional fish culture.

2. Ducks keep water plants in check.



3. Ducks loosen the pond bottom with their dabbling and help in release of nutrients from the soil, which increase pond productivity.

4. Ducks aerate the water while swimming; thus, they have been called «biological aerators.»

5. Duck houses are constructed on pond dikes; hence, no additional land is required for duckery activities.

6. Ducks get most of their total feed requirements from the pond in the form of aquatic weeds, insects, larvae, earthworms, etc. They need very little feed, and farmers normally give kitchen wastes, molasses and rice bran, for the purpose.

Answer the following questions

1.Why have ducks been called “biological aerators”?
2.What are the daily normal foods from the fishponds for the ducks?
3.What may be the disadvantages in raising ducks over fishponds?

Decide whether the following statements are true (T), false (F) or no information (NI)

1.Besides duck houses, some more land is needed for duckery activities.
2.Most of the ducks’ feed requirements are from kitchen wastes, molasses and rice bran.

Raising ducks over fishponds, we can save on pond fertilizer and supplementary fish feed up to 40 percent of the total cost in comparison with the conventional fish culture.

II.Matching the words or phrases in column A with words or phrases in column B

Column A	Column B
Aquaculture equipment	Organisms that inhabit, and complete their life cycle, in aquatic media.
Aquaculture of shrimp	The aquaculture ponds facilities, used for commercial production of fish, for the purpose of generating profit.
Aquatic organisms	The basic and detailed design engineering of the fish aquaculture system, the production ponds, and water supply and drain systems and other support systems.
Aquaculture system	Fish produced using organic concepts and natural procedures, minimizing input of artificial man-made compounds.
Commercial fish pond	The controlled production of fish in constructed facilities in captivity, using freshwater as culture media (e.g: Tilapia farming).
Fish farm design	Specially designed equipment used for aquaculture (for example: aerators, fish-elevators, transfer-tanks, size-sorting machines, feeding machines, etc.)
Fresh water fish farming	The means, facilities, utilities and equipment that enable commercial production of aquatic organisms, throughout their life cycles and in captivity.
Organic fish	The controlled production of shrimp in constructed facilities.

III.Rewrite the sentences

A.Rewrite the sentences

1.We should lay out the ponds and buildings for efficient and economic operation and the best utilization of the land

The ponds and buildings should …….

2. In extensive aquaculture systems, people ofteb stock fish at relatively low densities in earthen ponds.

In extensive aquaculture systems, fish …….

3.To understand how the food and nutrients cycles of the pond operate & interrelate is essential for the effective management of ponds.

It is…….

4.Digestion may be defined as the preparation of food by the animal for absoption.

We may……..

5.In the developing world, small individual farmers undertake most aquaculture operations

Most ……

B.Combine two sentences

1.Cage culture has both advantages and disadvantages. These advantages and disadvantages should be considered carefully before it becomes the aquaculture production system.

2.Fixed cage is a type of fish cages. This tye of cage is normally restricted to shallow areas with suitable subtrates usually in fresh water system.
3.Protein requirements for certain species depend on various factors. These factors can be counted as: species of fish, density, environmental quality and so on.
4.In most of the countries, there are fisheries departments & groups of fisheries scientists. The chief aims of these departments & groups is to study the breeding of fish & their growth in confined waters.
5.Cage culture only need invest a little capital , simple technology. However, we have results better than the other forms of the aquaculture production system. (But)

I.Reading comprehension:

Basic procedures involved in the management of pen and cage culture are very much like **those** in pond culture, starting with completion of construction and preparation of the culture facilities for stocking, rearing, and harvesting. Slight variations in specific activities exist, however, as the result of the very nature of the system. For example, it is obviously not possible to apply fertilizers, lime, and pesticides since the system has open water exchange between the inner compartment and the outside environment.

Soon after construction of the pen/cage is completed, preparations are made to procure fry/fingerlings for stocking. Milkfish pens have a nursery compartment into which milkfish fry are grown for 3-4 weeks to 12 cm long fingerlings which can be released into the grow-out compartment.

The nursery pen and the grow-out compartment are prepared for stocking by clearing the bottom of predatory fish like Megalops cyprinoides and Elops hawaiiensis. The milkfish fry/fingerlings from the nursery pen are stocked in the rearing pen at 20 000-50 000 per ha where they are cultured to marketable size.

On the other hand, cage-reared fish may or may not be fed supplemental or artificial diets depending on the stocking density used and the level of technology in the country. Cage feeding trials in the Philippines showed the adequacy of a ration composed of 77% rice bran and 23% fish meal with feed conversion ratios of 2.2-2.8. Current feed practices in freshwater cage culture involve the provision of supplemental feeds using readily available ingredients like rice bran and poultry feeds. Other countries use artificial feeds based on simple diets preferably prepared in pelleted form for best results.

At the end of the culture period, the fish are harvested from pens using harvesting nets (e.g., gill nets, cast nets, seines) or from cages by lifting the cage and causing the fish to collect in one corner for scooping out using a pail.

A.Answer the following questions:

1.Where and when can milkfish be released into the grow-out compartment?

.....
.....
.....
.....

2.How are the fish harvested in the cage culture?

.....
.....
.....
.....

3.What does the word "**those**" in the text refer to?

.....
.....
.....
.....

B.Decide whether the following statements are true (T), false (F) or not given (NG)

Statements	T	F	NG
4. Basic procedures involved in the management of pen and cage culture are exactly the same as **those** in pond culture.			
5. It is obviously impossible to apply fertilizers, lime, and pesticides as the system has open water exchange between the inner compartment and the outside environment.			
6. Cage-reared fish are often fed supplemental or artificial diets regardless to the stocking density used and the level of technology in the country			
7. Rice bran and poultry feeds are used as supplemental feeds in freshwater cage culture in some countries.			

II.Fill in the blanks with a suitable word in the box:

toxic	harm	aquaculture	surface	underground
quality	harmful	sources		essential

A large volume of good quality water is (1).....to support an aquaculture operation. Normal sources include farm dams, rivers, impoundments, irrigation channels and (2).....(bore) water. Chemical laboratories can test samples to determine if the source is of an appropriate quality for aquaculture. Seasonal changes in the quantity and (3).....of water should also be considered. Care must be taken with water used from surface sources to ensure that there are no toxic chemicals, such as pesticides, herbicides or heavy metals, present in the water. Water containing high levels of organic matter should also be avoided. Bore water, and sometimes artesian water, can be excellent for (4)..... The water is generally free of pathogens, predators, pollution and has a relatively constant temperature all year. However, some bore water can contain excess levels of nitrogen, carbon, total dissolved salts and (5).....gases such as methane and minerals such as lead, zinc and iron. Storing and aerating the water can remove the gas (usually carbon dioxide) problems. Generally, water that is safe for livestock or supports wild fish populations is safe for aquaculture. Domestic water supplies can contain chlorine which is (6)..... to fish.

III.Matching the words or phrases in column A with words or phrases in column B

Column A	Column B
1.Aquaculture production system	a. Aquaculture system sharing resources - water, feeds, management, etc. - with

	other activities; commonly agricultural, agro-industrial, infrastructural.
2 Fish farm design	b. the cultivation of organisms in land-based ponds.
3. Integrated aquaculture	c. Aquaculture system that is designed and operated on a sustainable basis, minimizing long-term environmental impact.
4. Organic fish farming	d. Generally, fish that spawn at temperatures above 60°F
5. Pond drainage systems	e. Microscopic plants suspended in water with little or no capability for controlling their position in the water mass;
6 Environmentally sustainable aquaculture	f. The outlet structures from an aquaculture pond or tank, including monk regulator, drain pipe and drain canal, allowing discharge or re-circulation, as required.
7. Warm Water Species	g. Aquaculture production procedures which maximize natural processes and avoiding artificial, made inputs.
8. Phytoplankton	h. The basic and detailed design engineering of the fish aquaculture system, the production ponds, and water supply and drain systems and other support systems.

1..... 5.....

2..... 6.....

3..... 7.....

4..... 8.....

IV.Rewrite the sentence so that its meaning is the same as the given sentence:

1.Farmers have used poultry manure widely in both fresh and brackish water aquaculture.

Poultry manure .....

.....

2.Low temperatures reduce the amount of waste that can be processed by a given area of fish ponds.

The amount of waste.....

.....

3.If the ricefield is basin-shaped, this can save a lot of construction work.

The basin-shaped ricefield can help.....

.....

4.Reducing feeding costs of more intensive systems by fertilising ponds with poultry manure is a good strategy and that strategy has attracted attention by farmers and researchers alike.

Reducing feeding costs of more intensive systems by fertilising ponds with poultry manure is a good strategy that.....

.....

..

Name: **Class:**

ESP FINAL TEST
(Time : 60')

Test code:03

I.Reading comprehension:

One of the major constraints of the rice-fish system can be the submergence of the paddy fields due to seasonal floods, which leads to either loss of fish or a mixing of these with those from neighbours, which are then found in the ricefield once the flood pulse recedes. Studies have shown that the existence of tilapias can increase the biomass of harvestable snakeheads in ponds. Changes in water flows and access to ricefields after modification of fish culture may be more of a problem.

The role of perennial water availability for continuous fish holding capability, i.e. a deeper sump or pond, may be considered. **This** may be valuable given marketing problems and for improving the availability of fish. Ponds allow more flexible marketing. While fish raised in ricefields may only be available for a short period, the option of storing them in a pond extends the fish availability season. Water conservation in rice-fish culture requires a deeper pond to be part of the rice-fish system.

In areas where per capita fish consumption is high, the cash saved from having to purchase fish can be a strong incentive to raise fish in ricefields. In irrigated areas, a high-input rice-fish system can improve subsequent crop yields and/or reduce nutrient requirements.

Economics of the system can vary. In northern Viet Nam, for example, income from the rice-fish system is often 1.5 to 1.7 times higher than from the rice-only system. While rice productivity in the rice-fish system is 10-17 percent higher compared with the rice-only system, the total rice production is often only 3-5 percent higher when considering the rice cultivation area lost to the trench. Another benefit of the system as experienced in northern Vietnam is the 50-65 percent reduced use of pesticides compared to the rice-only system

A.Answer the following questions:

1.What is considered as one of the main disadvantages of the rice-fish system?

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2.What does the word "**this**" in the text refer to?

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3.How many times can the income from the rice-fish system be higher than from the rice-only system?

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B.Decide whether the following statements are true (T), false (F) or not given (NG)

Statements	T	F	NG
4. Changes in water flows and access to ricefields after modification of fish culture may be one of the constraints			

of the rice-fish system.			
5. In irrigated areas, a high-input rice-fish system can lead to the reduction of the subsequent crop yields as well as the nutrient requirements.			
6. A benefit of the rice-fish system as experienced in northern Vietnam is that it uses only 35-50 percent of pesticides compared to the rice-only system.			
7.The total rice production in the rice-fish system is 10-17 percent higher compared with the rice-only system.			

II.Fill in the blanks with a suitable word in the box:

aquaculture	coastal	extensive	integrated	intensive
practices	inland	techniques	culture	environment

A number of aquaculture practices are used world-wide in three types of (1).....(freshwater, brackishwater, and marine) for a great variety of culture organisms. Freshwater aquaculture is carried out either in fish ponds, fish pens, fish cages or, on a limited scale, in rice paddies. Brackishwater aquaculture is done mainly in fish ponds located in (2).....areas. Marine culture employs either fish cages or substrates for molluscs and seaweeds such as stakes, ropes, and rafts. Culture systems range from (3).....to intensive depending on the stocking density of the culture organisms, the level of inputs, and the degree of management. In countries where government priority is directed toward increased fish production from (4).....to help meet domestic demand, either as a result of the lack of access to large waterbodies (e.g., Nepal, Central African Republic) or the over-exploitation of marine or inland fisheries (e.g., Thailand, Zambia), aquaculture practices are almost exclusively oriented toward production for domestic consumption. These (5).....include: (i) freshwater pond culture; (ii) rice-fish culture or (6).....fish farming; (iii) brackishwater finfish culture; (iv) mariculture involving extensive culture and producing fish/shellfish (e.g., oysters, mussels, cockles) which are sold in rural and urban markets at relatively low prices.

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III.Matching the words or phrases in column A with words or phrases in column B

Column A	Column B
1. Mariculture	a. The stage in a fish's life from the time it hatches until it reaches 1 inch in length.
2. Concrete pond	b. The various, mostly microscopic, aquatic organisms (plants and animals) that serve as food for larger aquatic animals.
3. Fresh water fish farming	c. The first production stage in fish farming, nursing fry (about 1.0 gram) to fingerling (60-100 gram).
4 Cold Water Species	d. aquaculture practiced in marine environments.
5. Fry	e. The controlled production of fish in constructed facilities in captivity, using freshwater as culture media (e.g: Tilapia farming).
6. Plankton	f. The means, facilities, utilities and equipment that enable commercial production of aquatic organisms, throughout their life cycles and in captivity.
7. Fish nursery	g. Generally, fish that spawn in water temperatures below 55°F.
8. Aquaculture system	h.A type of aquaculture pond used for intensive and super-intensive production of fish, shrimp and other aquatic organisms.

1.....

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IV. Rewrite the sentence so that its meaning is the same as the given sentence:

1.The type of poultry production system can greatly influence the amount of fish produced.

The amount of fish produced can be greatly influenced by the type of….....

2.Fish species is a critical factor in determining loading rates of poultry waste **since** there is a range of sensitivity to dissolved oxygen among the commonly cultured fish species.

As.....

3.Poultry raised on a balanced ration produce a higher quality, more nutrient dense waste than those fed a supplementary feed.

Poultry fed a supplementary feed don't. produce a higher quality , more nutrient dense waste than those fed on a balanced ration.....

4.Pond construction costs can be minimised by building on land with a gentle slope.

Building ponds on land with a gentle slope can help minimise pond construction costs .....

ADVANTAGES OF INTEGRATING FISH FARMING

Once agricultural activities on a farm have been diversify by raising different kinds of drops or animals. The different activities become integrated when the waste products from one activity are used for the production of another

PRINCIPLES OF INTEGRATED FISH CULTURE

The biology of a fish pond

Fish are not the only organisms living in the water of a pond. Food for the fish also grows naturally in a pond. The naturally occurring food sources include very small plants (algae or phytoplankton) and very small animals (zooplankton). Both these sorts are too small to see with the naked eye. If a large amount of algae is present, the water will have a green colour.

Water plants are larger plants, which can be seen with the naked eye, and grow in the fish pond all the year round. Some grow on the bottom of the pond, some in the water and others float on the surface of the pond. Some fish species eat water plants.

The water in a pond must be of good quality so that the fish will be healthy and grow well. In order to grow, fish need oxygen. This is produced mainly by the algae floating in the water, which makes the water green in colour. Climate is important as it determines the temperature of the water in the pond. The higher the water temperature the faster the algae and zooplankton grow. However, most tropical algae, zooplankton and fish species grow fastest at a water temperature between 25 and 30^0 C.

Water quality

The two most important factors which determine the quality of the water are the temperature of the water and the amount of oxygen dissolved in the water. The plants in the pond (especially algae) produce oxygen with the help of sunlight , some of this oxygen they use themselves. The more sunlight the pond receives the higher the oxygen production.

When it is dark no oxygen is produced by the plants as there is no sunlight. As oxygen continues to be used by all living organisms in the pond water, however, the amount of oxygen in the water decreases during the night. In the early morning the amount of oxygen in the water is at its lowest level, as fish, algae and zooplankton have been using oxygen all night, and no oxygen production has taken place.

The oxygen content of the water is usually highest at the end of the afternoon, as oxygen is produced throughout daylight hours.

Climate also influences the oxygen content of the water. The amount of oxygen in the water depends on the temperature of the water. Less oxygen can dissolve in warm water than in cold water. However, fish need more oxygen in warm water as they are more active. The optimal temperature varies depending on the fish species but the average is between 25 and 30^0C.

Algae produce less oxygen in cloudy weather, as less sunlight falls on the water. Windy conditions lead to a rise in oxygen content as more air mixes with the water.

Fertilizer application has a large influence on the oxygen content and the living conditions