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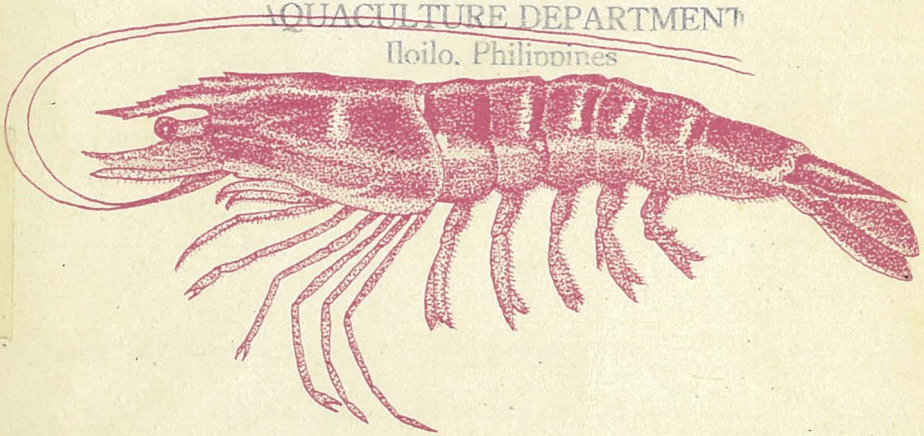
NURSERY MANAGEMENT OF PRAWNS



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This manual has been adapted and edited by the SEAFDEC Secretariat.

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INTRODUCTION

In 1942, Dr. Motosaku Fujinaga was the first scientist to successfully hatch prawn eggs and able to rear them to the postlarval stage. By applying the technique evolved by Dr. Fujinaga, a system of nursery management of penaeid prawn was later developed and became known as the Japanese method. After improvements over a number of years, this method has been used for the successful production of larvae on a large scale. When Western experts who were interested in the rearing of prawn larvae studied the Japanese method and applied it in their own countries, they came to the conclusion that it had some weaknesses. The Western experts, therefore, presented a new technique called the Galveston method, which derives its name from the place called Galveston where the method was first applied by an American scientist.

Both above-mentioned methods were the origin of techniques for rearing penaeid prawn that were developed by several countries, and adapted to the local conditions. At Jepara, Indonesia, for example, the Brackishwater Pond Institute is developing a breeding system for

penaeid prawn that differs in several respects from the above methods. There are also differences between the Japanese and the Galveston methods, e.g., in the type of tank used and the technique for rearing larvae.

EXISTING CULTURE METHODS

The Japanese method uses large square tanks of 150 tons and 200 tons. Because of the large volume of water which such tanks contain, it is difficult to control the water temperature.

The Galveston method on the other hand uses a small-sized cone-shaped tank between 2 and 3 tons, so that the temperature is easily controlled. The Jepara method uses a 6- to 10-ton tank. With tanks of this size, it is not necessary to control the temperature, because the volume of water is such that no very great change in temperature occurs.

To prevent a decrease in the water temperature especially at night-time, the tank should be covered with a plastic sheet.

The system using large tanks as applied in Indonesia gives rise to problems mainly as regards stocking. Obtaining a large quantity of gravid females is always a problem. A 60-ton tank requires at least ten such females. To catch that number in one sea-going operation is very difficult. By using a medium-sized tank, one gravid female is sufficient for a profitable operation.

Culture of larvae under the Japanese method is generally carried out at a relatively low density of about 10 to 40 larvae per litre, whereas the Galveston method stocks a high density of about 250 larvae per litre. Because of this high density, the culture requires much more care in the Galveston method than in the Japanese method. Stocking in the Jepara method is at a density of 50 larvae per litre.

In the Japanese method feed is provided in the culture tank by adding fertiliser for growing plankton, mainly diatoms. The fertiliser generally used is KNO_3 (2 ppm concentration) and K_2HPO_4 at 0.2 ppm (Shigueno, 1969). In Japan this system is feasible and it gives satisfactory results because the fertiliser induces the blooming of *Skeletonema costatum*. The growth rate of this diatom remains constant and controllable.

Adding fertiliser to the culture tank in Jepara has a negative effect on the growth of the larvae. The reason is that excessive plankton blooms occur. Their growth is uncontrollable because of the high light intensity. The water first becomes dark brown and, within two to three days, it changes to milkish-white. This indicates that ciliated protozoa and bacteria have begun to multiply. Within a short time the larvae population decreases or may even be wiped out completely.

In addition the fertiliser also induces the growth of diatoms in genus *Liomophora*. These diatoms in small numbers are not a danger to the larvae. But they may have a harmful effect if they occur in large numbers. These diatoms

attach themselves to the larvae's bodies. Thereby they imped the larval movements and also restrict their ability to feed. In the end, the larvae die of starvation.

At Jepara the fertiliser used is KNO_3 1 ppm K_2HPO_4 0.1 ppm. It often causes the excessive growth of *Chaetoceros*, one of the common diatoms use as food for prawn larvae. However, if the diatom density in the culture tank reaches more than 30,000 cell/cc when the larvae are at the zoeal stages, the excessive availability of food might cause the faeces of the larvae to become so long that they enwrap the larval bodies. The larvae being thus unable to swim, would finally die. As in the case of other plankton, the blooming of *Chaetoceros* is followed by the growth of ciliated protozoa and bacteria that have harmful effects on the larvae.

The Japanese method of providing feed through adding fertiliser in the water in the culture tank differs from the Galveston method. In the latter method feed is prepared from cultured stock of *Skeletonema* and *Brachionus* in a separate tank. *Skeletonema* is harvested by using a sand filter and is given to larvae at the zoeal stages. This method is also used in Indonesia because of its relatively low cost. The principle of the sand filter is that it filters the dirt in the water while the plankton are retained. In this way, the plankton *Skeletonema* can be collected and stored to be ready as feed for the larvae. It is usually stored in a cool place, such as an air-conditioned room, in order to keep the plankton alive. Fresh water is added to the *Skeletonema* by letting it float on the water of the rearing tank.

This method of culturing plankton in a separate tank prevents the contamination of the water in the larval culture tank by the fertiliser. Fertiliser, such as KNO_3/K_2HPO_4 in a certain concentration, is liable to kill the larvae. In the long run, the accumulation of fertiliser in the culture tank may have an indirect harmful effect on the larvae. Fertiliser may induce excessive plankton bloom in the tank.

Efforts have been made by the Jepara Brackishwater Pond Institute to simplify prawn nursery techniques so that they can be easily applied. The plankton are not harvested in advance but are poured directly into the rearing tank. To transfer plankton to the rearing tank, an ordinary pail may be used. The transfer should be done carefully and gradually to reduce the effects of a sudden change of water quality.

There are several ways of reducing the adverse effects of adding fertiliser. Firstly, the maximum growth of plankton should be monitored. This can be deduced from the plankton's density and the number of days of culturing. The blooming of *Skeletonema* or *Tetraselmis* will occur within four to five days in the normal healthy culture. The maximum number of *Skeletonema* has been known to reach about 3 million cell/cc in a 400 litre tank, while the number of *Tetraselmis* has reached 0.5 million cell/cc in a 3-ton tank. The best time for harvesting the plankton is when maximum growth has been reached. This will ensure that most of the fertiliser has been used by the plankton. Thus, the accumulation

of the fertiliser in the culture tank is so limited that it poses no danger to the larvae. Moreover eutrophication can be reduced.

Another means is to cover the surface of the tank with bamboo matting. The objective is to reduce the light intensity entering the rearing tank. Thus, although the process of eutrophication still takes place, the blooming of plankton is controllable due to the low light intensity.

In the Japanese method, the larvae are hatched and cultured in the same tank. After the spawners have been removed from the tank, the tank is further used as the culture tank. In the Galveston method, on the other hand, separate tanks are used for hatching and culturing the larvae. The cone-shaped tank is used for larval culture. Another tank for spawning and hatching is needed. At Jepara both methods are applied. In fact the method by which nauplii are transferred from the spawning tank to the culturing tank gives a better result.

TANK PREPARATION

Although tank preparation seems simple, it is of prime importance for the successful rearing of larvae. Before use, the tank should be cleaned to remove the dirt that might have adverse effects on the larvae. The cleanliness requirements of tanks may vary according to the purpose for which they will be used. For prawn rearing, the tank should be free from living

organisms adhering to the tank walls. Contamination of inorganic material in small amounts is allowable. However it is necessary to remove all organic matter especially ammonia or ammonium compounds. The prawn larvae are very sensitive to poisonous gases. Ammonia no higher than 1.3 ppm is liable to kill prawn larvae.

After cleaning the tank walls it is best to keep them dry for two to three days to make sure that all aquatic organisms have died. Thorough drying is also intended to prevent diseases. If there is not sufficient time to let the tank dry out properly, a chlorine solution can be used to clean the sides of the tank in order to remove any adhering organisms. This solution in the form of hypochlorine can be bought from a chemist at a relatively low cost. The sides of the tank are washed with a cloth soaked in a solution of chlorine at 100 ppm (100 ml chlorine solution of 10% to 1 m^3 of water). Prior to filling the tank with water, it must be left to dry for one to two hours. This is to ensure that all chlorine is removed to avoid the poisonous effect that chlorine would have on the larvae or on the plankton.

The tank is filled up with filtered sea water after it has been properly cleaned. The water used in the hatching and rearing tank should be free from pollutants such as heavy metals and organic materials. The sea water used should be clean, with a salinity of 30 ppt.

During the dry season the salinity is 34 ppt. It is therefore necessary to reduce the salinity by adding fresh water. It has been observed that the appropriate salinity is between 28 and 32 ppt.

During the rainy season, the salinity in the sea water is low. Therefore, it is necessary to increase the salinity in order to ensure successful larvae rearing. This can be done by adding salt in solution. It is best to use natural salt that contains none of the processing chemicals which are detrimental to the prawn larvae.

If salt is added directly to the water, turbidity will result from the impurities in the salt. To keep the water clear, the salt should first be dissolved in a separate vessel and the solution left undisturbed to allow the impurities to settle. Generally within one or two days clear water with a high salinity can be obtained. This high salinity solution is then poured into the water, in order to increase the salinity.

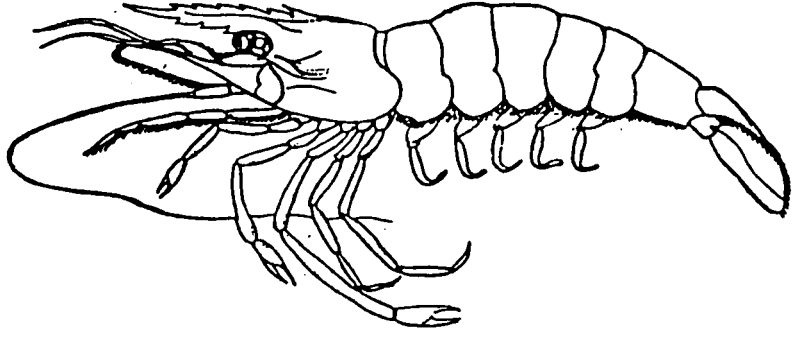
The spawning tank should be filled with sea water to a depth of 40 cm. Some airstones should be scattered on the bottom of the tank in order to provide weak aeration. The air speed should be 2-4 litres/minute/3 m^2. This is meant to keep the movement of the water constant. Strong aeration may disturb either the spawners or the eggs that have already been laid. On the other hand, weak aeration has an adverse effect on the spawning capacity of the spawner, as well as on the number of eggs that will hatch.

The intensity of the light entering the tank should be limited. Since spawning takes place better in darkness, lamps around the tank should be switched off. If spawning should occur during moonlight, it is very important to cover the tank with bamboo matting or a cloth. Bright light may cause partial spawning, that is,only a portion of the eggs is laid. In such a case, the eggs remaining in the body of the spawner may be absorbed.

The tank should be checked to ascertain that everything is in order after the preparations. The main points to be checked are intensity of aeration, water depth, and salinity. The mature females can then be placed in the tank.

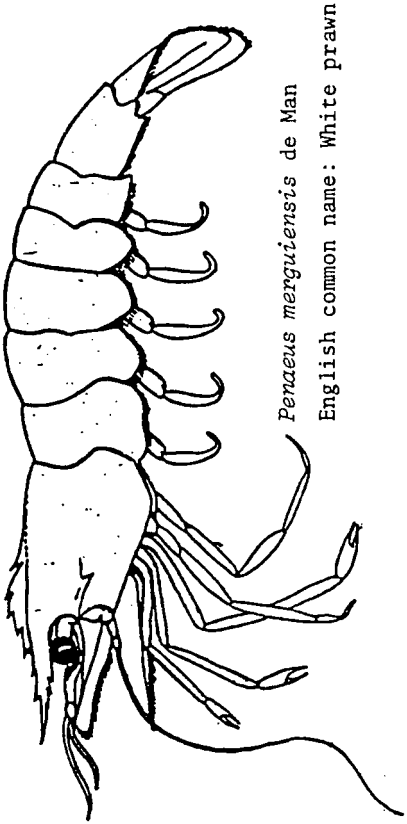
REARING OF LARVAE

Spawners at the stage of full gonad maturity (third stage) may release the eggs during the first night after having been transferred to the spawning tank. If the spawners do not release the eggs during the first night, they should not be fed the next evening in order to avoid the eggs being absorbed. During the following night, the eggs should be released. The spawners should be returned to the copulation tank if the eggs are not released. Generally when a spawner is returned to the copulation tank, the unlaid eggs are absorbed.



Penaeus monodon Fabricus

English common name: Giant tiger prawn



Penaeus merguiensis de Man

English common name: White prawn; Banana prawn

Tiger prawn *(Penaeus monodon)* spawn during the night, whereas Banana prawn *(Penaeus merguiensis)* sometimes spawn in the afternoon. The egg hatches to become a nauplius within 2 to 16 hours. The nauplius undergoes metamorphosis six times within 46 to 50 hours until it becomes a zoea. The rate of development of nauplii is influenced by the chemical and physical conditions of the water, mainly temperature and salinity. Generally an increase in temperature as well as salinity up to a certain limit will accelerate the growth of the nauplii.

Soon after the eggs have hatched and become nauplii, aeration in the tank should be increased. The intensity of aeration should be around 10 litres/minute for a depth of 50 cm, the total aeration being calculated on the basis of one aerator per one m^2. Thus for a tank of 4 x 4 m^2 in size at least 16 aerators are needed, placed at regular intervals at the bottom of the tank. To attain the highest efficiency of aeration, airstones that produce small bubbles should also be used. The airstones should be placed 50 cm from the sides of the tank. This is to avoid crushing some nauplii to death against the sides of the tank if airstones are placed too close to the sides.

Nauplii need not be fed because they have enough reserve food in their yolk-sacs. The diatom culture of *Skeletonema* and *Tetraselmis* should start two days prior to the spawners being moved to the spawning tank in order to be ready as feed for the zoeal larvae.

At the nauplius stage, the tank should be covered with bamboo matting to reduce the light intensity. This can also reduce mortality as well as prevent the excessive plankton bloom. Temperature fluctuations are controlled by covering the tank in order to provide suitable conditions enhancing the larval growth rate.

After the nauplii have developed into zoea, the larvae need to be fed. *Skeletonema* or *Tetraselmis* can be poured directly into the larval tank a few hours before the nauplii change into zoea. The timing to add diatom culture into the tank should be carefully monitored.

Direct feeding of *Skeletonema* or *Tetraselmis* into the larval tank has an advantage of reducing the density of larvae in the tank. As the larvae develop and grow larger, the density should be reduced to avoid the crowding effect. At the nauplius stage, the appropriate density should be 50 individuals per litre. This can be decreased to 35 - 40 individuals per litre by adding water.

The ratios of *Skeletonema* or *Tetraselmis* added to the water of the nursery tank at zoea stage I is 5,000 - 10,000 cell/cc; at zoea stage II 10,000 - 15,000 cell/cc; and at zoea stage III 15,000 - 20,000 cell/cc. At the mysis stages (M I, M II, M III), *Skeletonema* and *Tetraselmis* can be given at a density of 20,000 cell/cc.

Rotifer can also be given besides *Skeletonema* and *Tetraselmis*. It can be given at zoea stage III. The optimum daily amounts are shown in Table 1.

Table 1. Optimum amount of Rotifer adjusted to the development stages of larvae

Stage	Total amount of Rotifer/ml of Water/day
Zoea I	-
II	-
III	3.0
Mysis I	4.0
II	5.0
III	6.0

Besides the food mentioned above, fresh "tahu" (a Chinese cake made of soybean flour) has given satisfactory results. It should be shredded and added with freshwater before feeding it to the larvae. To obtain small particles, "tahu" is crushed by a blender or passed through a filter. It is given as soon as the nauplii have developed into zoea. The disadvantage of "tahu" as a feed for larvae is that the particles sink rapidly and settle at the bottom of the tank.

Table 2 shows the size of the particles and the total weight of "tahu" required at the various stages of larvae reared in a tank of 5 tons with a density of 40 zoea/litre, and given five times a day, namely, at 7.00, 12.00, 16.00 19.00, 22.00 hrs.

From mysis I stage onwards larvae of penaeid prawn are no longer filter feeders. Therefore the size of a particle is not as critical as at the zoea stage. Taking into account that "tahu" sinks easily, the size of the particle for the mysis stage should be around 75-105 micron to reduce the speed at which the particles settle. For postlarvae the particles can be larger because postlarvae are bottom feeders and will eat the feed that sinks to the bottom of the tank.

Table 2. Particle size and total weight of "tahu" required at different stages of larval development

Stage		Particle size (micron)	Total weight of "tahu" (gramme)
Zoea	I	35 - 48	10
	II	48 - 75	15
	III	48 - 75	20
Mysis	I	75 - 105	25
	II	75 - 105	30
	III	75 - 105	30
Postlarva	1	105	35
	2	105	40
	3	105	45
	4	105	45
	5	105	45
	6	105	45
	7	105	45
	8	105	45
	9	105	45

The best feed for postlarvae is nauplii of *Artemia salina*. However, the eggs of *Artemia* must be imported from abroad at a relatively high cost. *Artemia* eggs should first be hatched in a separate tank before they are given as feed. Hatching lasts about 24 hours, after which the nauplii are washed in sea water. Hatching can also take place in a pail, at a density of 2 g of *Artemia* eggs per litre of sea water.

Owing to *Artemia* spawn being difficult and costly to obtain, pellet feed containing about 60 per cent of protein can also be given five times a day at the postlarval stages. The pellet consists of particles of about 200 microns.

After the postlarvae have reached stage 9, they are transferred to the fry tank. To avoid mortality among the postlarvae/fry as a result of this transfer, it is necessary to slowly acclimatize them to the new conditions.

ACCLIMATIZATION OF FRY

Acclimatization, the process whereby an animal that is being reared is gradually accustomed to the conditions of its new surroundings, includes adaptation to all aspects of the new environment. A new environment may bring about physiological and behavioral changes in the organism.

High mortality often occurs after the fry are released into the fry tank. This is a serious problem. It is due to lack of attention to the difference between the surroundings to which the postlarvae were accustomed and the conditions of the fry tank at the time of transferring the fry. Death may be caused by physiological stress owing to a sudden change of environment.

Temperature and salinity are the two most important factors in acclimatization. Temperature has a direct influence on the physiology of the animal, mainly on its metabolism. Salinity is one of the factors that affects the osmoregulation process. Several marine animals are unable to adjust to the new salinity because their osmoregulatory abilities are limited. Thus the salt concentration in their body fluids may change beyond their tolerance. The tiger prawn however is one of the marine animals that is able to live in sea water as well as in brackish water. The salt concentration in the body fluid regulate in response to new salinity.

In view of the above, physiological adaptation is very important when releasing fry into a tank. Prawn rearing requires high salinity, but the degree of the salinity of the water into which the fry are released may vary. The salinity of the water in the fry rearing tank must be determined before the fry are transferred.

If there is a difference in the salinity in the rearing tank and the fry tank, alteration of salinity should be carried out in the fry rearing tank. The method of lowering salinity is to decrease the water in the fry tank, and to replace it gradually with fresh water as follows: the water level of the tank is lowered by 5 to 10 cm, then brought up to its previous level by adding fresh water. The same can be done the next day and repeated several times until the required salinity is reached. High salinity usually hinders the growth rate of prawns. Salinity alteration can also be carried out in the rearing tank.

NOTES

Routine Activities of a Prawn Nursery Operation

The larval stage is the critical stage in the life cycle of the prawn. Hence the care taken in rearing the larvae determines the success or failure of prawn culture. The larvae should be given special attention throughout 24 hours of the day, if necessary. There are many routine activities in the rearing of prawn larvae which may appear simple, yet if they are not carried out properly, the efforts put into rearing the prawn will have been in vain and material inputs will have been wasted.

In the preparation of the tank, its sides must be properly cleaned. Filtered sea water is strongly recommended.

After a spawner has released all of its eggs, the percentage of eggs hatched should be ascertained by the use of a microscope. Experience has shown that if 60 per cent of the eggs hatch, the larvae are healthy. If the percentage is below 30 per cent, then the larvae are usually weak. Therefore, it is necessary to monitor the percentage of eggs hatched.

When the eggs hatch, the larvae population should be assessed. The practical method in determining the larval density is to take a sample in a 1-litre basin. This basin is usually transparent. This process should be repeated many times. By knowing the volume of water in the tank and the average density per litre of water, population density can be determined (individual/litre).

In order to reach a more accurate assessment, the following steps should be taken:

(a) Population assessment should be carried out in the morning, when there is less sunlight, and the larvae are not forming schools in one spot. Larvae gather in clumps in response to positive phototaxis.

(b) Random sampling is necessary. The habit of larvae to congregate where there is an aerator should be taken into account. Thus some samples should be taken from a part of the tank where there is an aerator and from other parts without aerators.

(c) Population assessment of nauplii and zoea can be done by using a long pipette for counting the larvae that have been collected in the basin. At the mysis and postlarval stages it is best not to use a pipette, due to its large size.

(d) Population assessment using a basin of a known capacity can be carried out only up to mysis III or postlarva 1. After postlarva 2 the behaviour of larvae has changed to that of bottom organisms.

Population assessment using a basin has additional advantages, such as:

(i) The condition of the larvae can be ascertained by observing their swimming, colour, and behaviour in response to light.

(ii) The stage of development of the larvae can be estimated. This is very important for determining the kind and optimum amount of feed required.

(iii) A rough estimation can be made of the condition of the living food and the amount of particles suspended in the larval rearing water.

(iv) It reveals whether the larvae have been given sufficient feed or not. At the zoea stage this can be determined from the length of the faeces.

(v) If there are some dead larvae in the basin, appropriate measures should be taken quickly.

After the larval population assessment, efforts to prevent the larvae from being affected by any adverse effects should be made without delay. For example, if the population is very dense, a proportion of the larvae should be removed to another tank. During population assessment care must be taken not to cause any stress to the larvae.

Another routine activity of prawn nursery operations is to observe the water quality. In the Jepara method the tank water is never changed, so the quality of the water must be kept in a condition favourable to the growth of the larvae. This can be done by covering the tank with bamboo matting to prevent the plankton from blooming. The bottom of the tank must also be cleansed thoroughly to remove left-over food and other impurities.

All actions that have been taken in regard to each tank in which larvae are being reared should be recorded. This record can later on be evaluated for further improvement. The record should also cover weather conditions, temperature, salinity of the water in rearing tanks, total population, feed, and other relevant information.

LIST OF SAFIS EXTENSION MANUALS

SEC/SM/1 Khumua liang pla namcheut (Freshwater Fish Farming: How to Begin)-- in Thai

SEC/SM/2 Oyster Culture

SEC/SM/3 Mussel Culture

SEC/SM/4 Ang pagpuna ug pagtapak sa pukot (Net Mending and Patching)-- in Cebuano-Bisaya

SEC/SM/5 Mussel Farming

SEC/SM/6 Menternak Ikan Airtawar (Freshwater Fish Farming: How to Begin)-- in Bahasa Malaysia

SEC/SM/7 Makanan dan Pemakanan Udang Harimau, *Penaeus monodon* (Nutrition and Feeding of Sugpo, *Penaeus monodon)* -- in Bahasa Malaysia

SEC/SM/8 Macrobrachium Culture

SEC/SM/9 Selection of Marine Shrimp for Culture

SEC/SM/10 Culture of Sea Bass

SEC/SM/11 Smoke-Curing of Fish

SEC/SM/13 Cockle Culture

SEC/SM/14 Net Mending and Patching

SEC/SM/15 Kanliang hoy malangphu (Mussel Farming)-- in Thai

SEC/SM/16 Nursery Management of Prawns

SAFIS

o What is SAFIS?

SAFIS is the Southeast Asian Fisheries Information Service. It is a project of the SEAFDEC Secretariat set up to provide extension materials for small-scale fishermen and fish farmers in the region.

o What are its objectives?

The immediate objectives are to collect and compile fisheries extension manuals, brochures, pamphlets and related aids for small-scale fisheries development, and to translate selected literature into local languages for distribution to fisheries extension workers in Southeast Asia.

o What services will SAFIS provide?

SAFIS will attempt to provide information and publications such as:

- lists of available texts in fisheries extension services,
- translation of suitable manuals,
- manuals of appropriate technologies,
- photocopies of appropriate fisheries extension literature,
- a current awareness service of regional fisheries.

o How much will these services cost?

A nominal cost of US $0.15 per page will be charged for photocopying, handling, and surface mail. Airmail costs will be extra. The publication cost per manual will vary according to the book.

SAFIS is the Southeast Asian Fisheries Information Service. It is a project of the SEAFDEC Secretariat set up to provide extension materials for small - scale fishermen and fish farmers in the region. For additional information, contact the Project Leader of SAFIS

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