THAI AGRICULTURAL STANDARD

TAS 7417- 2009

GOOD AQUACULTURE PRACTICES
FOR FRESHWATER AQUATIC ANIMAL FARM

National Bureau of Agricultural Commodity and Food Standards

Ministry of Agriculture and Cooperatives

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TAS 7419-2009

GOOD AQUACULTURE PRACTICES

FOR FRESHWATER AQUATIC ANIMAL FARM

National Bureau of Agricultural Commodity and Food Standards
Ministry of Agriculture and Cooperatives

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Technical Committee on the Elaboration of Thai Agricultural Standard for Good Aquaculture Practices for Freshwater Aquatic Animal

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Fish and fishery products are of economical significance of Thai export products.. Moreover, the consumers worldwide now pay more attention on food safety and environmental issues. The Committee of Agricultural Standards therefore deems it necessary to establish the Thai agricultural standard on good aquaculture practices for freshwater aquatic animal farm as guidance to improve freshwater aquatic production and product quality to be accepted by both domestic and international consumers.

The standard is based on the information of the following documents:

Department of Fisheries. 2008. Good Aquaculture Practices (GAP) for Freshwater Aquaculture.

CAC/RCP 52-2003, Rev 2-2005. Code of Practice for Fish and Fishery Products. Joint FAO/WHO Food Standards Programme, FAO, Rome.

NOTIFICATION OF THE MINISTRY OF AGRICULTURE AND COOPERATIVES
SUBJECT: THAI AGRICULTURAL STANDARD:
GOOD AQUACULTURE PRACTICES FOR FRESHWATER AQUATIC ANIMAL FARM
UNDER THE AGRICULTURAL STANDARDS ACT B.E. 2551 (2008)

Whereas the Agricultural Standards Committee deems it necessary to establish an agricultural standard on Good Aquaculture Practices for Freshwater Aquatic Animal Farm as a voluntary standard in accordance with the Agricultural Standards Act B.E. 2551 (2008) to promote such an agricultural commodity to meet with quality standard and safety.

By virtue of Section 5, Section 15 and Section 16 of the Agricultural Standards Act B.E. 2551 (2008), the Minister of Agriculture and Cooperatives, hereby issues this Notification on Establishment of Thai Agricultural Standard: Good Aquaculture Practices for Freshwater Aquatic Animal Farm (TAS 7417-2552) as voluntary standard, details of which are attached herewith.

Notified on 29 September B.E. 2552 (2009)
Theera Wongsamut
(Mr.Theera Wongsamut)
Minister of Agriculture and Cooperatives

THAI AGRICULTURAL STANDARD

GOOD AQUACULTURE PRACTICES FOR FRESHWATER AQUATIC ANIMAL FARM

1. Scope

This Thai Agricultural Standard applies to good aquaculture practices (GAP) at all stages of farm practices in freshwater aquatic animal culture including harvesting and post-harvest handlings prior to transportation in order to produce products of good quality and safety for consumption. This standard, however, does not cover hatching and nursing.

2. Definitions

For the purpose of this standard:

2.1 Freshwater aquatic animal means animals living entirely or most of the time in freshwater or most of the life-cycle living in freshwater such as river, canal, swamp, and reservoir.

2.2 Freshwater aquatic animal farm means site for freshwater aquatic animal farm consisting of ponds, cages, feed preparation area, buildings and facilities for sanitation services.

2.3 Pond means man-made water storage for freshwater aquaculture such as earthen pond, cement pond, canvas pond and plastic pond.

2.4 Cage means tool used for freshwater aquaculture by hanging or floating in the water resources. It has a variety of shapes such as polygon or round and made of fishing net or wood. It may be stationed with pillars or floating cage with or without frame.

2.5 **Veterinary drug** means any substance applied or administered to any food-producing animal, whether used for therapeutic, prophylactic, or diagnostic purposes or for modification of physiological functions or behaviour.

2.6 **Residues of veterinary drugs** mean the veterinary drugs as in 2.5 including parent drug, metabolites and associated impurities in the animal tissue, produce and products of animal which are used for human food.

2.7 **Major requirement** means the mandatory requirement that shall be fully complied with. In case of non compliance, it will seriously affect the quality of freshwater aquatic animal as well as safety for consumers. It means that the requirement shall be complied with relevant laws and regulations as well.

2.8 **Minor requirement** means the requirement that shall be mostly complied with. In case of non compliance, it will affect the health of freshwater aquatic animal or product quality.

3. REQUIREMENTS AND INSPECTION METHODS

Good Aquaculture Practices for freshwater aquatic animal are as in Table 1.

Table 1 Requirements and Inspection Methods

(Section 3)

Items	Requirements	Inspection Methods	Compliance levels
1. Site 1.1 Pond	1.1 .1 Farm shall be registered with the Department of Fisheries.	1.1.1 Check the farm registration document.	Major requirement
	1.1.2 Farm shall be kept distance from polluted sources.	1.1.2 Visual inspection for the risk of pollution.	Minor requirement
	1.1.3 Availability of good water inlet and outlet system	1.1.3 Visual inspection of the system of water inlet and outlet and the design of water supply among ponds to prevent cross contamination.	Minor requirement
	1.1.4 Conveniently access from both outside and inside the farm to facilitate farm operation and transportation of the produce.	1.1.4 Visual inspection	Minor requirement
	1.1.5 Essential basic infrastructure shall be available.	1.1.5 Visual inspection.	Minor requirement
1.2 Cage	1.2.1 Farm shall be registered with the Department of Fisheries.	1.2.1 Check the farm registration document.	Major requirement
	1.2.2 Farm shall be located in the area of which water quality suitable for freshwater aquatic animal culture.	1.2.2 Check water quality or record of water analysis.	Minor requirement
	1.2.3 Farm shall be kept distance to polluted sources.	1.2.3 Visual inspection of farm surroundings.	Minor requirement

Items	Requirements	Inspection Methods	Compliance levels
	1.2.4 Conveniently access from both outside and inside the farm to facilitate farm operation and transportation of the produce.	1.2.4 Visual inspection.	Minor requirement
	1.2.5 Essential basic infrastructure shall be available.	1.2.5 Visual inspection.	Minor requirement
	1.2.6 Permit shall be granted for cage farming and cage shall be set in the permitted area.	1.2.6 Check the permission document.	Major requirement
	1.2.7 Cages shall not obstruct the water flow and water way transportation.	1.2.7 Inspection of the cage location and water flow.	Minor requirement
2. General management 2.1 Pond	2.1.1 Operate according to the Department of Fisheries Manual on Aquatic Animal Farm or other practices according to the technical recommendations.	2.1.1 Interview farmers.	Minor requirement
	2.1.2 Availability of farm location and layout.	2.1.2 Check map and layout.	Minor requirement
	2.1.3 Effluent shall be complied with relevant laws and regulations.	2.1.3 Check the result of effluent test.	Major requirement
	2.1.4 Attend technical meeting or training program on farm management, use of production inputs, harvesting, and relevant laws, and regulations.	2.1.4 Check evidence of the meeting or training.	Minor requirement

Items	Requirements	Inspection Methods	Compliance levels
2.2 Cage	2.2.1 Operate according to the Department of Fisheries Manual on Aquatic Animal Farm or other practices according to the technical recommendations.	2.2.1 Interview farmers.	Minor requirement
	2.2.2 Availability of farm location and layout.	2.2.2 Check map and layout.	Minor requirement
	2.2.3 Surface area of the site shall not exceed the permitted area granted by the Department of Fisheries.	2.2.3 Inspection of the permitted area granted by the Department of Fisheries.	Minor requirement
	2.2.4 Attend technical meeting or training program on farm management, use of production inputs, harvesting, and relevant laws, and regulations	2.2.4 Check evidence of the meeting or training.	Minor requirement
3. Inputs	3.1 Healthy and non-infectious fry shall be used.	3.1 Check fry purchasing record.	Minor requirement
	3.2 Availability of fry movement document (FMD)	3.2 Check the copy of FMD.	Major requirement
	3.3 Use feed, feed supplement and vitamins registered with the competent authority (in case such inputs are subject to registration) and valid date of expiration.	3.3 check label of feed, feed supplement and vitamins	Major requirement
	3.4 Any inputs other than 3.3 shall be free from contamination.	3.4 Check the test report.	Major requirement

Items	Requirements	Inspection Methods	Compliance levels
	3.5 In case the feed is prepared on the farm, feed ingredients shall be free from veterinary drugs and legally prohibited substances.	3.5 Check the test report.	Major requirement
	3.6 Feed prepared on the farm shall meet hygienic requirements and be safe for aquatic animals and consumers.	3.6.1 Visual inspection of feed preparation. 3.6.2 Check the record of feed preparation.	Minor requirement
	3.7 Feed prepared on the farm shall meet nutrient requirements of target aquatic animal.	3.7.1 Inspection of the feed ingredients. 3.7.2 Check the report of feed quality analysis (if any).	Minor requirement
	3.8 All inputs shall be safely and appropriately stored in good hygienic condition.	3.8 Visual inspection of the input storage.	Minor requirement
4. Health management 4.1 Pond	4.1.1 Pond and equipment shall be properly prepared to prevent the introduction of aquatic animal diseases.	4.1.1.1 Visual inspection. 4.1.1.2 Check the record of the pond and equipment preparation.	Minor requirement
	4.1.2 In case where aquatic animal shows any abnormal symptom, management measure shall be taken into consideration prior to applying veterinary drugs and chemicals. Preliminary diagnosis shall be carried out, including corrective action and records.	4.1.2.1 Check the record of corrective actions in case where aquatic animal shows any abnormal symptom. 4.1.2.2 Check the record of farming activity on daily basis.	Minor requirement

Items	Requirements	Inspection Methods	Compliance levels
	4.1.3 If sick aquatic animal is found and veterinary drugs or chemical treatment is necessary, apply only registered veterinary drugs or chemicals [1], and strictly follow the instruction on the label.	4.1.3 Check the record of the use of veterinary drugs and chemicals including withdrawal period.	Major requirement
	4.1.4 Prohibited veterinary drugs and chemicals shall not be used.	4.1.4.1 Visual inspection. 4.1.4.2 Check the application record of veterinary drugs and chemical.	Major requirement
	4.1.5 In case of disease outbreak, farmer shall immediately inform the competent authority and appropriately manage the carcass and water discharge.	4.1.5.1 Check the record of corrective actions in case of disease outbreak. 4.1.5.2 Check the record of the carcass and water discharge management.	Major requirement
4.2 Cage	4.2.1 Cage shall be properly and appropriately prepared and installed to prevent environmental impact and disease outbreak.	4.2.1 Check the record of cage preparation and installation. 4.2.2 Visual inspection of cage location.	Minor requirement
	4.2.2 Cage and equipment shall be periodically cleaned throughout the production process.	4.2.2 1 Check the record of the cage cleaning.	Minor requirement
	4.2.3 The health of aquatic animal shall be regularly monitored and taken care of.	4.2.3.1 Interview farmers. 4.2.3.2 Check the record of health management.	Minor requirement
	4.2.4 In case where aquatic animal shows abnormal symptom, appropriate corrective actions shall be carried out immediately.	4.2.4 Check the record of corrective actions in case where aquatic animal shows abnormal symptom.	Major requirement

[1] According to the Hazardous Substance Act 1992, responsible by Department of Fisheries.

Items	Requirements	Inspection Methods	Compliance levels
	4.2.5 If sick aquatic animal is found and veterinary drugs or chemical treatment is necessary, apply only registered veterinary drugs or chemicals [2], and strictly follow the instruction on the label.	4.2.5 Check the record of the use of veterinary drugs and chemicals including withdrawal period.	Major requirement
	4.2.6 Prohibited veterinary drugs and chemicals shall not be used.	4.2.6.1 Visual inspection. 4.2.6.2 Check the application record of veterinary drugs and chemicals.	Major requirement
	4.2.7 In case of disease outbreak, farmer shall immediately inform the competent authority and appropriately manage the carcass.	4.2.7.1 Check the record of corrective actions in case of disease outbreak. 4.2.7.2 Check the record of the carcass management.	Major requirement
5. Farm sanitation 5.1 Pond	5.1.1 Household discharge shall be separated from the culture pond.	5.1.1 Visual inspection.	Major requirement
	5.1.2 Toilet shall be hygienically designed in separated area and prevent possibility of sewage contamination to culture pond.	5.1.2 Visual inspection.	Major requirement
	5.1.3 Availability of sanitary system for waste disposal from the culture e.g. carcass	5.1.3.1 Visual inspection. 5.1.3.2 Check the record of waste disposal management.	Major requirement
	5.1.4 Equipment and tools shall be orderly stored, clean, in hygienic manner and proper maintenance for use.	5.1.4 Visual inspection.	Minor requirement

[2] According to the Hazardous Substance Act 1992, responsible by Department of Fisheries.

Items	Requirements	Inspection Methods	Compliance levels
	5.1.5 Availability of good management of waste disposal to prevent fly, rodent and cockroach as well as pet digging	5.1.5 Visual inspection of the management of waste disposal.	Minor requirement
5.2 Cage	5.2.1 Toilet shall be hygienically designed in separated area and prevent possibility of sewage contamination to cage location.	5.2.1 Visual inspection.	Major requirement
	5.2.2 Equipment and tools shall be orderly stored, clean, in hygienic manner and proper maintenance for use.	5.2.2 Visual inspection.	Minor requirement
	5.2.3 No littering of garbage or waste in the area of cage location. It shall be properly discarded or destroyed.	5.2.3 Visual inspection of the management of waste disposal.	Minor requirement
6. Harvest and post-harvest handlings	6.1 Availability of harvesting plan	6.1 Check the harvesting plan document.	Minor requirement
	6.2 Availability of Movement Document (MD)	6.2 Check the copy of movement document.	Major requirement
	6.3 Veterinary drugs or chemical residues shall not be found or exceeded the maximum residue limits.	6.3 Check the test report of residues of veterinary drugs and chemicals.	Major requirement
	6.4 Availability of good management and hygienic handlings of aquatic animal during harvest and post-harvest in order to obtain good quality and safe product for consumers	6.4 Check the record of management and handlings during harvest and post-harvest.	Minor requirement

Items	Requirements	Inspection Methods	Compliance levels
7. Record keeping	7. Important data shall be recorded at all stages of production and regularly updated.	7. Check data recorded.	Minor requirement

4. Judgment Criteria

Judgments for inspection decision are as follows:

4.1 All of the "major requirement" level shall be complied.

4.2 All of the "minor requirement" level shall be complied not less than 60%. The improvement up to 80% shall be fulfilled within 2 years.

5 Guidance on Good Aquaculture Practices for Freshwater Aquatic Animal Farm

The recommendations on good aquaculture practices for freshwater aquatic animal farm are to provide farmers with good management practices so as to achieve good quality and safety to consumers. The details are described in Appendix A.

APPENDIX A
Guidance on Good Aquaculture Practices for Freshwater Aquatic Animal Farm (Section 5)

For the development of freshwater aquatic animal production system to be in line with international standard, farmers shall follow good aquaculture practices so as to visualize and understand the practical concept of standard operation procedures. Principles of the freshwater aquatic animal production take into consideration of the following factors:

A.1 Site

Site is the first priority which farmer shall consider prior to farming commencement. The location of freshwater aquatic animal farm shall be complied with relevant laws and met with the technical requirements in order to obtain quality products with minimal problems. The recommendations are as follows:

A.1.1 Pond

A.1.1.1 Farm registration is required by contacting the designated competent authority at the local offices. The registered information will be useful for relevant government agencies to locate the farm and to provide assistance to the farmers. Farmers shall provide legal document on land use rights, or lease contract for farm registration.

A.1.1.2 Farm shall be kept distance from or not affected by polluted sources, such as industrial factories and waste from communities. Practically, farm shall be kept distance from the polluted sources; however, polluted sources are now widely expanded and closer to aquaculture farm. Therefore, soil and water samples shall be taken for analysis to assess the suspected risk factors from such sources. By current technology on aquaculture, appropriate method for preventing the impact from pollution can be applied. Moreover, farm site shall not be, if possible, located in the area prone to flooding in order to avoid damage and contamination. In case farm is located in flooding area, protection shall be provided.

A.1.1.3 Good design of water inlet and outlet system shall be provided in order to prevent cross contamination among ponds and between inside and outside of farm. In addition, such good system can save energy and cost of water pumping in and out of the farm as well as facilitate the farm management.

A.1.1.4 Farm site shall be conveniently accessed such as road for cars, river or canal for boats to facilitate the transport of fry, feed and inputs. Such convenient accessibility is essential for cost-effective production and maintaining freshness of products to markets or processing plants. It is also convenient for visitors and inspectors to visit the farm.

A.1.1.5 Farm site shall have essential basic infrastructures according to farm area condition for convenience of farm management such as electricity for water pump and aerator, or diesel engine water pump, tap, or underground water, or rain water or clean water that fits for consumption.

A.1.1.6 Earthen pond shall be impervious in order to reduce the leakage during the culturing period. Soil shall have appropriate properties or be able to be improved for safe aquaculture practices.

A.1.2 Cage

A.1.2.1 Farmers shall register their farms with the competent authority at the local office. The registration will be necessary for official and related authority for identification of location and facilitation of government support.

A.1.2.2 Cage shall be located in the area where water source is of good quality, suitable, sufficient and of good circulation. Water quality suitable for freshwater aquaculture shall have pH 6.5-8 and dissolved oxygen not less than 4 mg/l.

A.1.2.3 In general, cage site shall be located away from polluted sources. In case the cage is subjected to tide or upstream or downstream area, farmer shall acquire information demonstrating the cage is not affected by such pollution. For instance, information of pesticide analyses shall be obtained if there is waste water discharging from upstream paddy field, or information of Biochemical Oxygen Demand (BOD) analyses if there is factory (such as sugar factory, paper and pulp factory, or rice mill) located upstream.

A.1.2.4 Cage site shall be conveniently accessed such as road for cars, river or canal for boats to facilitate the transport of fry, feed and inputs. This convenience is essential for cost-effective production and for maintaining freshness of products to markets or processing plants. It is also convenient for visitors and inspectors to visit the farm.

A.1.2.5 Cage shall have necessary basic infrastructures according to farm area condition for convenience of farm management such as electricity for water pump, aerator, or diesel engine water pump, tap, or underground water, or rain water or clean water that fits for consumption.

A.1.2.6 Permission from competent authority shall be obtained to orderly place cages such that it will not have negative impact on water source surrounding the cages.

A.1.2.7 Besides the concern of the environment, placement of cages shall be in the area where it will not obstruct the water flow and the water passage; otherwise the cages may reduce the flow speed of water or cause social problems and water transportation. In addition, area for cage culture shall be opened, no strong flow of water or wind nor crowed by aquatic plants which hinder water flow through the cage.

A.2 General Farm Management

Farm management is a plan to prepare for rearing which is vital for successful aquaculture. If farmers can apply the practices well, suitable to the site and season, there will be only few problems on daily basis. The recommendations are as follows:

A.2.1 Pond

A.2.1.1 Farmer shall follow the manual on freshwater aquatic animal farm published by the Department of Fisheries or other equivalent technical manuals. The recommended practices for earthen pond aquaculture are as follows:

A.2.1.1.1 Pond Preparation

Freshwater aquatic animal farm requires good preparation. In particular, the old culture pond may have the decayed bottom where disease and hydrogen sulfide (H_2S) are accumulated. This may contribute to negative impact on the health of aquatic animal. Therefore, preparation of a new and old pond shall be done as follows:

(1) New Pond

Problem involving acidic soil can be found in new pond. It can be observed by the orange-red rust or yellow colour of soil in the pond. In general, this soil indicates pH 2 - 3 and may not be suitable for aquatic farming because the acidic soil will result in acidic water. In such case, it is recommended to fill water into the pond to cover soil surface for approximately 7 days, and then drain water and repeat this until the pH of the soil reaches 6.5 to 8.5. Liming can also be used to adjust pH of the soil by scattering 200 to 300 kg of lime per rai around the area. However, if there is not enough water supply, amount of lime shall be increased to 400-500 kg per rai until the pH is adjusted as required. Also, chicken or cow manure, dried or decomposed for 60 days, can be used.

(2) Old Pond

After each harvest, sludge at the bottom of pond shall be taken out prior to pond drying process. This sludge shall not be left on the dike or drained directly to the public water resource. It shall be collected in a sludge pond or plowed with tractor approximately 2 to 3 times to incorporate oxygen into the soil and then dried for 2 weeks before the next crop. The dike shall be adjusted to be ready for use. If there is waterlogging at the bottom of the pond where some other aquatic animals remain, saponin at the concentration of 15 mg/l to 25 mg/l depending on the salinity of water, or 1 g of 100% rotenone solution per 1 m^3 of water in culture pond, or 20 g of 5% rotenone solution per 1 m^3 of water in culture pond shall be diluted and splashed into the pond (rotenone is toxic to fish and insects). Liming shall be used to disinfect and improve quality of the bottom of the pond thereafter.

A.2.1.1.2 Water preparation

Due to the fact that freshwater aquatic animal farming technique is differed among species, water preparation techniques are different accordingly. However, the principles are the same. After pond preparation, water shall be pumped into the pond to 30 to 50 cm in depth, filtered with double layers of green cloth filter net (mesh size of 24-26 meshes/inch) to protect larvae

from predators and other larvae from nature. For the first preparation, the dried or 60-day fermented compost at the rate of 100-150 kg/rai or ami-ami at the rate of 100-200 l/rai shall be spread around the pond and left for 7-8 days until the water turn green. This produces natural feeds in terms of phyto- and zooplankton. (Be careful when using ami-ami as it will cause rapid reduction of dissolved oxygen in the water. This could lower the dissolved oxygen value in the pond and cause death of aquatic animals in very short time). Subsequently, the pond shall be filled with water up to 1.0 to 1.2 m depth. If possible, dissolved oxygen value shall be analyzed prior to fry stocking stage.

During culturing period, natural feed shall be produced at all times in order to save the cost of feed as well as to balance the ecosystem in the pond. This can be done by applying the principle of "small amount but high frequency" of the dried or 60-day fermented compost at the rate of 25-50 kg/rai/month or ami-ami at the rate of 10-20 lit/rai/month. (For this period, the dissolved ami-ami solution shall be spread around the pond and used with care as it could cause rapid reduction of dissolved oxygen in the water. This could harm aquatic animals). Moreover, farmer shall not overfeed during this period because the leftover feed will be the major cause of water pollution.

A.2.1.1.3 Water quality for culture pond
Water quality suitable for culture pond shall be as follows:
(1) pH of 6.5 - 8.5
(2) BOD not exceed 20 mg/l.
(3) Dissolved Oxygen (DO) not less than 3 mg/l.
(4) NH_3-N not exceed 1.1 mg/l.
(5) Alkalinity not less than 50 mg/l.

A.2.1.1.4 Procedures for resolving low level of dissolved oxygen

Level of dissolved oxygen in the pond shall not be less than 3 mg/l. However, the lowest level of dissolved oxygen in water of the pond will commonly occur in early morning. Farmer shall regularly check dissolved oxygen or observe whether there are numbers of aquatic animals swimming at the surface. In such case, aerator shall be operated to increase dissolved oxygen or exchange water in the pond. In addition, temporarily stop feeding or decrease the amount of feed shall be practiced.

A.2.1.1.5 Water exchange

In case where water quality is not suitable and it is necessary to exchange or refill water from outside the farm, water shall be filtered with double layers of green cloth filter net (mesh size of 24-26 meshes/inch) to protect larvae from predators and from nature. Effluent from water exchange or during harvest shall not be discharged directly to the public water resources. In case effluent is discharged directly to the public water resources, its parameters shall meet the specification required by laws.

A.2.1.1.6 Feeding

Feeding can be done either by sowing or using feed container. The amount of feed and number of meals in a day shall be suitable for species and age of each aquatic animal. Farmers can start feeding with small amount at several spots and observe the feeding behavior. For instance, if aquatic animals snatch feed which is thrown into the pond, it can be interpreted that the feed are insufficient. In this case, new feeding spots shall be increased. If the aquatic animals do not seem to be interested in the feed, farmers shall stop feeding and remove the leftover feed from the pond before it sinks to the bottom because this would easily cause the decay at the bottom of the cage or pond.

A.2.1.2 Farm map and layout shall be made available for transport of aquatic animal fry, delivery of inputs, feed, being visited by visitors, fishery extension officers, farm inspection officers, harvest and transport of aquatic produce by the collectors who distribute the produce. Moreover, farmer shall have farm layout for management and planning purposes.

A.2.1.3 Effluent shall be treated prior to discharging. If farm size over 10 rai, the effluent parameters shall meet specification required by laws as follows:
A.2.1.3.1 Herbivorous Freshwater Aquatic Species
(1) BOD not exceed 20 mg/l.
(2) Suspension solid not exceed 80 mg/l.

A.2.1.3.2 Carnivorous or Omnivorous Freshwater Aquatic Species
(1) BOD not exceeded 20 mg/l.
(2) Suspension solid not exceed 80 mg/l.
(3)NH_3-N not exceeded 1.1 mg/l.
(4)Total Nitrogen not exceeded 4.0 mg/l.
(5)Total Phosphorus not exceeded 0.5 mgP/l.
(6) pH 6.5-8.5
Source: Notification of the Ministry of Natural Resource and Environment entitled Specification of the Standard Controlling Discharge of Effluent from Freshwater Aquatic Animal Pond (B.E. 2550)

A.2.1.4 Technical meeting or training program on farm management, use of production inputs and harvesting and laws and regulation relevant to freshwater aquatic animals farming shall be provided to enhance and develop knowledge of farmers and other relevant workers in applying good aquaculture practices correctly and appropriately.

A.2.2 Cage

A.2.2.1 Farmers shall prove that their farm practices followed the manual of freshwater aquatic animal cage published by the competent authority or responsible agency, or other relevant technical information. The guidance is as follows:

A.2.2.1.1 Cage sizes and materials, i.e. wood, bamboo, nylon, green cloth filter net, are varied depending on species and size of aquatic animals and location of the farm. Generally, farmers are to use the cage size of 3x3x2.5 m^3 or 4x4x2.5 m^3 or 5x5x2.5 m^3. The following shall be considered in freshwater aquatic cage culture:

(1) Cage location

Cage location shall not obstruct water transport. Setting the cage along the banks is recommended for culturing in canal. In a larger area, the size of cage location can be expanded as appropriate but it shall not obstruct water traffic. The cage shall not be lined up more than 4 or 5 rows.

(2) Cage interval

Cage interval shall be at least 50 cm to ease water flow through the cage, and minimize waste accumulation at the bottom of the cage. Furthermore, the depth of the cage shall not be deeper than 1 meter from the bottom even in the driest season.

A.2.2.1.2 Size of aquatic animal fry and stocking density

Size of the aquatic animals for stocking varies with the mesh size of the cage, while stocking density depends on the size of the aquatic animals. In addition, season is also vital to stocking density. In case of the winter season, the stocking density shall be lower than other seasons because aquatic animals are weaker and more susceptibility to disease. Conditions of the water source are other important factors for stocking density. For example, stocking density in still water such as dam or reservoir shall be less than in the river, which has more suitable flow speed and better quality of water.

A.2.2.1.3 Regular cleaning of the cage shall be done, especially for the cage located in the area of still water which can accumulate waste and later cause problem of water pollution.

A.2.2.1.4 In case of low dissolved oxygen in the water, aeration is recommended. This can also be done by exchange of water through the cage by aerator, or pumping the water from the cage up to the air by electric pump.

A.2.2.1.5 Feeding

Feeding can be done either by sowing or using feed container. The amount of feed and number of meals in a day shall be suitable for species and age of each aquatic animal. Farmers can start feeding with small amount at several spots and observe the feeding behavior. For instance, if aquatic animals snatch feed which is thrown into the pond, it can be interpreted that the feed are insufficient. In this case, new feeding spots shall be increased. If the aquatic animals do not seem to be interested in the feed, farmers shall stop feeding and

remove the leftover feed from the pond before it sinks to the bottom because this would easily cause the decay at the bottom of the cage or pond.

A.2.2.2 Cage map and layout shall be made available for transport of aquatic animal fry, delivery of inputs, feed, being visited by visitors, fishery extension officers, farm inspection officers, harvest and transport of aquatic produce by the collectors who distribute the produce. Moreover, farmer shall have farm layout for management and planning purposes.

A.2.2.3 The number of cages shall not exceed the capability of the water source in order to prevent the negative impact and preserve the sustainability of the environment. The total number of cages shall not exceed that is permitted by the Department of Fisheries.

A.2.2.4 Technical meeting or training program on farm management, use of production inputs and harvesting and laws and regulation relevant to freshwater aquatic animals farming shall be provided to enhance and develop knowledge of farmers and other relevant workers in applying good aquaculture practices correctly and appropriately.

A.2.2.5 Farmers shall manage the area, buildings, cages, and culture according to good hygienic practices both inside and outside the cage. Equipment shall be cleaned and kept orderly.

A.3 Inputs

There are varieties of inputs for aquatic animal farming such as fry, feed, feed supplement, vitamins, probiotic, veterinary drugs, liming, salt and chemicals. However, selection of the inputs depends upon age and size of the aquatic animal, stocking density, methods of aquaculture and harvest size. Recommendations are as follows:

A.3.1 Selection of good quality fry

Quality of fry is an important factor for the success of farming. Good quality and healthy fry, which can better adapt to the environment, or fry from the brood stock with good growth rate are other factors for farmer shall be taken into account. Before purchasing, farmer shall request for reliable documents. In addition, appropriate stocking density of the fry shall be considered as over stocking density will cause stress and sickness easily, which will create problems and slow growth.

A.3.2 Farmer shall request official fry movement document (FMD) from hatchery in order to ensure product quality and traceability in case any problem occurs.

A.3.3 In case of using manufactured inputs such as feed, feed supplements, and vitamins purchased from factory or distributor, they shall be registered products with the competent authority and label specified nutrition values, production and expiry dates. Before use, farmer shall observe the label to ensure that the feed is in good condition. There shall not be

laceration of the package, excessive moisture, mold, and the product shall be within the expiry date to ensure good quality of feed.

A.3.4 Inputs excluding feeds, feed supplements, vitamins, minerals, and other relevant feedstuffs shall be free from prohibited veterinary drugs and chemical residues according to the official notifications e.g. nitrofuran, chloramphenical, and malachite green. For instances, colouring solution for adjusting water quality shall not contain malachite green; or fine rice bran shall not contain nitrofuran, or chloramphenical; or antibiotics permitted to use shall not be contaminated with nitrofuran, chloramphenical or malachite green.

A.3.5 In case of feed prepared on farm, raw materials such as fish meal, soybean meal, rice bran, and broken milled rice shall be free from prohibited veterinary drugs and chemicals according to official notifications in order to avoid residues of veterinary drugs and chemicals in the animal tissues.

A.3.6 Tools and equipment for preparing feed on farm shall be clean and hygienic. For instances, prior to or after using those tools and equipment they shall be clean and dried up, maintained to be ready for use and kept orderly. In addition, preparing feed on farm shall be hygienic, clean, and safe for the aquatic animals and consumers. For instance, ingredients and feeds shall be placed on clean containers, not to contact directly to the ground or the processing floor to protect them from germs and hazardous substances residues. Attention shall be paid to prevent contamination from cockroaches, flies, birds, rats, dogs and cats during the feed preparation process

A.3.7 Feed prepared on farm shall have appropriate quality to meet the nutrient requirements of aquatic animals. Low quality feed will cause slow growth rate which will require longer culturing period, high cost of production, and undersized aquatic animal. These will certainly cause low price of the product.

A.3.8 Inputs shall be properly and orderly stored, and clearly separated and defined in a hygienic and safe condition in the warehouse and designated area, away from heat, moisture, sunlight, rain, strong wind, with good ventilation system. In addition, the warehouse shall be protected from disease carriers of aquatic animals and human such as rats, cockroaches, flies, birds, dogs, and cats etc. The inputs shall be placed on a pallet, not contact the ground, to prevent from deterioration. For example, feed bag shall be kept in a warehouse and separated from other inputs on a pallet approximately 10 cm above the floor and away from the wall to protect moisture causing the feed to be easily moldy. Veterinary drugs shall be stored in accordance with the instruction specified in the label or attached document. Prescribed veterinary drugs shall be kept separately from others. Veterinary drugs and chemicals for different aquatic animals shall be kept orderly in groups, in closed containers and away from children and pets.

A.4 Health Management for Aquatic Animal

Protection is the best measures to control and manage aquatic animal health. Major factors which shall be considered in aquatic animal farming are management and environment.

Improper management, such as too high stocking density, mismanagement in production system or farming in vulnerable environment such as climate fluctuation, polluted water, and accumulation of leftover feeds, will lead to stress and causing disease infection of the aquatic animals. The use of veterinary drugs and chemicals for treatment of disease shall be the last option. Better management will result in better health to recover from sickness. Prevention and treatment of disease depend upon the cause of disease. Recommendations for aquatic animal health management are as follows:

A.4.1 Pond

A.4.1.1 Proper preparation of pond and equipment appropriate for culture can prevent disease. In particular, improper preparation of earthen pond used to rear the aquatic animals can cause diseases. Equipment shall be regularly cleaned because they may be in contact with the animals and cause infection, for instance, dirty feed container and leftover feed will be deteriorated and harbor diseases. Wounded animal or animal wounded by scratching with container will be susceptible to the disease and become weak and finally infected.

A.4.1.2 When the aquatic animals show abnormal sign, the causation shall be considered before applying veterinary drugs or chemicals. After the cause is found, corrective actions on farm and environmental management and improvement shall be taken. For example, a lot of animals floating on the water surface in early morning indicate insufficient dissolved oxygen, therefore aeration shall be carried out by using aerator or spraying water through the air down to the pond using electric pump. If there are other associated occurrences, such as dark green color in the pond which indicates over blooming of phytoplankton, water exchange and reduction of the additional feed shall be undertaken. Farmer shall record the symptoms of aquatic animals and other analysis report, where possible, together with each corrective action for further diagnosis of the symptoms effectively.

A.4.1.3 Where necessary, registered veterinary drugs and chemicals shall be used. Prohibited veterinary drugs and chemicals shall not be used. The instruction on how to use them, especially the withdrawal period, shall be strictly followed. The use of veterinary drugs and chemicals shall be recorded each time and used under advice of veterinarian or fishery officer with expertise in aquatic animal disease. The expired drugs shall not be used. Records shall be kept for at least 2 years.

A.4.1.4 Nitrofuran, chloramphenical, and malachite green, etc., which are prohibited veterinary drugs and chemicals, shall not be used.

A.4.1.5 Normally, immediate inspection for the cause of death shall be conducted but in the case of outbreak, where large number of death occurred, the competent authority shall be promptly notified. Appropriate methods for carcass disposal e.g. burning, burying with the use of disinfectant or lime, etc. shall be used. Water from the infected pond shall be disinfected and treated before discharge.

A.4.2 Cage

A.4.2.1 Cage preparation is very important and necessary for culture such as cleaning and unblocking the mesh of cages to improve water circulation. If the cage has been used for diseased aquatic animals, the cage shall be disinfected by chorine, formaldehyde or potassium permanganate before reuse to prevent the spreading of disease. Cage setting location is also an important factor to be considered in order to prevent negative effect on the environment, and accumulation of feed leftover around the cage.

A.4.2.2 Cage and equipment shall be regularly cleaned throughout the culture process to allow water flow in out at all time in order to remove the waste. In this case, the good condition for culture will be maintained at all time and will encourage the animals to move and grow more rapidly.

A.4.2.3 The aquatic animal's health shall be regularly monitored and taken care of, together with checking water quality, for example random checking or observing the abnormal signs, namely floating on the water surface, imbalance swimming, anxious sign, and improper water quality, etc., shall be regularly done. In case of problems, diagnosis shall be conducted so that the corrective action can be appropriately taken prior to disease spread.

A.4.2.4 When the aquatic animals show abnormal sign, the causation shall be immediately identified and corrective actions on farm and environmental management and improvement shall be taken before applying veterinary drugs and chemicals. For example, if there is unusual number of animals floating on the water surface, water quality shall be analysed and the daily record of animal's health from the past week shall be checked in search for the cause of problem. At the same time, the symptoms of aquatic animals and corrective actions implemented shall be recorded. In case of low level of dissolved oxygen, spraying water through the air using electric pump, cage cleaning, and reducing feed shall be considered.

A.4.2.5 Where necessary, registered veterinary drugs and chemicals shall be used. Prohibited veterinary drugs and chemicals shall not be used. The instruction on how to use them, especially the withdrawal period, shall be strictly followed. The use of veterinary drugs and chemicals shall be recorded each time and used under advice of veterinarian or fishery officer with expertise in aquatic animal disease. The expired drugs shall not be used. Records shall be kept for at least 2 years.

A.4.2.6 Nitrofuran, chloramphenical, and malachite green, etc., which are prohibited veterinary drugs and chemicals, shall not be used.

A.4.2.7 Immediate inspection for the cause of death shall be conducted. Transfer of the aquatic animals, where necessary, shall be done carefully and gently. In the case of outbreak competent authority i.e. veterinarian or fishery officer or local officer of the Department of Fisheries shall be immediately notified. Appropriate methods for carcass disposal e.g. burning, burying with the use of disinfectant or lime, etc. shall be used. In such case, the waste water from treating of infected animal shall be disinfected and treated before discharge.

A.5 Farm Sanitation

Cage and pond culture shall require good management including farm sanitation as it is necessary for keeping good quality of aquatic products. Daily supervision of farm sanitation will facilitate farmer establishing farm standard in compliance with recommendations as follows:

A.5.1 Pond

A.5.1.1 Discharge from household shall be separated from farm in order to prevent contamination in the water system of the farm, or the release to the pond or farm nearby. For example, household discharge shall not be drained to the same furrow of farm water system or reservoir.

A.5.1.2 Lavatory shall be completely separated from the farm area. Waste management system shall consider hygienic condition. It is needed to ensure that waste water cannot leak to the farm system. Bacteria contamination, a major cause of gastrointestinal disease, shall be monitored by collecting water sample for analysis of coliform bacteria. Immediate response to such problem shall be conducted. The number of coliform bacteria shall not exceed 5,000 most probable number per 100 millimeters (MPN/100ml), and the fecal coliform bacteria shall not exceed the natural level. In case that the number of bacteria exceed the value specified by the standard, it is an indication of contamination of waste disposal from lavatory, household, or pets.

A.5.1.3 Availability of proper treatment system of aquaculture waste i.e. aquatic animal's carcass, veterinary drug and chemical containers required for disposal method of burning or bury depending on type of waste.

A.5.1.4 Tools used on farm shall be orderly arranged, clean, in hygienic condition, and maintained to be ready for use. Workers' housing, office, feed store, warehouse, feed preparation area, and buildings shall always be kept clean and well maintained.

A.5.1.5 Good management system and routine collection for garbage are required. Trash bin shall have lid in order to prevent fries, rodents, cockroach, and pets. Garbage shall be correctly abolished in designated area using the proper method.

A.5.2 Cage

A.5.2.1 Lavatory shall be completely separated from the cage area. Sanitary condition shall be considered to ensure that waste will not leak and contaminate the system. In case that lavatory is located on land, sewage shall not be directly discharged or leaked to the cage area.

A.5.2.2 Tools used on farm shall be orderly arranged, clean, in hygienic condition, and maintained to be ready for use. Workers' housing, office, feed store, warehouse, feed preparation area, and buildings shall always be kept clean and well maintained.

A.5.2.3 Garbage shall not be discarded to the cage area. Garbage collection area shall be properly arranged and well managed. Trash bin shall have lid in order to prevent fries,

rodents, cockroach, and pets. Garbage shall be correctly abolished in designated area using the proper method.

A.6 Harvest and Post-harvest Practices

Harvest is the final step in the aquaculture which is vital for maintaining quality of the products. As the aquatic products will be sold for human consumption, farmer shall therefore pay attention to the following recommendations:

A.6.1 Farmer shall have a good harvest plan and rapid distribution emphasizing on freshness of the product and harvest of healthy aquatic products in order to keep premium quality. The good plan is also to avoid contamination of aquatic products during harvest and post-harvest.

A.6.2 The Movement Document (MD) issued by the Department of Fisheries or equivalent authorized agency shall be made available to provide consumers or relevant stakeholders or processing its background information on the source of aquatic animal products for further consumption.

A.6.3 During the process of freshwater aquaculture grow-out period in the pond or cage, tissue sample of the aquaculture product shall be randomly checked by the authorized laboratory or well recognized institute accredited by international standard organization at least once a year. The analyses are for the veterinary drugs and chemicals which are allowed and prohibited for use according to the official notification as well as bacteria causing the gastrointestinal disease. The prohibited veterinary drugs and chemicals shall not be found. The allowed veterinary drugs and chemicals and bacteria causing the gastrointestinal disease shall not exceed the maximum limits specified by the standard.

A.6.4 For good quality and safety of freshwater aquaculture product, guidelines for management method and maintenance during harvest and post-harvest process shall be as follows:

A.6.4.1 During the aquaculture, farmer shall not bring pets (e.g. duck, chicken, cow, dog, cat, etc.) close to cultured pond or cage area. In case of using pet to protect farm’s asset, farmer shall keep their defecated waste away from cultured area and frequently clean the area.

A.6.4.2 Some freshwater aquaculture products may have problem with muddy taste such as in tilapia meat. The cause of muddy taste is mainly due to the accumulated consumption of blue-green algae in the pond. Recommendations for solving this problem are as follows:

A.6.4.2.1 In order to reduce the blue-green algae in the water, compost shall not be used at least 2 months prior to harvest; additional feed or supplementary feed shall be provided, together with water exchange. However, the caution shall be emphasized on over-feeding of supplementary feed because accumulated feed is a source of blue-green algae blooming.

A.6.4.2.2 Muddy taste in the meat shall be determined by tasting the steamed fish sample without seasoning. If the meat does not contain muddy taste, the product can be sold.

A.6.4.3 Prior to selling product, feeding shall be stopped one day before harvest for self adjustment and defecation of the aquatic animals. This way, quality and freshness of the aquatic product can be kept during transportation as well as can prolong rotting.

A.6.4.4The personnel handling and relating to aquaculture animal shall be healthy and has no infectious diseases which are not accepted by the consumers. Worker(s) who has been infected shall take leave and return to work after recovery.

A.6.4.5 Tools, equipment, and harvesting method shall not cause negative effect to the quality of aquatic animal and post-harvest storage as well as cause contamination affecting food safety. Harvested products shall not be directly contacted on the ground.

A.6.4.6 Equipment used with aquatic animals e.g. media immersing and transporting, etc. shall be clean and made of strong materials withstanding corrosion; and be in good condition and ready for use. After work, all equipment shall be immediately cleaned and stored so as not to harbour the microbes.

A.6.4.7 Clean and chemical-free ice shall be used. Reuse of the ice is not recommended.

A.6.4.8 Aquatic transport shall be designed in order to prevent heat during the transportation. Area for transferring the aquatic product shall be made of materials easy to be cleaned, preventing dust, and avoiding moisture losses caused by sunlight and wind.

A.6.4.8.1 In case of transporting dead aquatic animals, they shall be chilled immediately after harvest to maintain freshness as much as possible. The use of ground or flake ices is recommended because smaller size of ice has larger contact surface with the product, thus can chill the product faster. Water used for cleaning aquatic animal shall be clean and not be reused. For best quality, pack the product in appropriate-size container after putting the ice at the bottom. Then the product shall be packed in alternate layers with ice to preserve the quality and freshness of the aquatic animal.

A.6.4.8.2 In case of transporting live aquatic animals, container used during transport shall be designed for heat protection. Aeration shall be used during the transportation. Area for transporting aquatic product shall be made of materials easy to be cleaned and preventing dust. During transportation, the use of ice is recommended in order to numb the aquatic animal and reduce the damages that may occur. However, the temperature shall not be too low that can cause injury to the animal. Injured, infected, or dead aquatic animals shall not be included in the transporting container. They shall be separated from the healthy animal and other species during the transportation to reduce the possibility of contamination.

A.7 Record keeping

To ensure that the aquaculture management system can be efficiently implemented and improved from time to time, it is necessary to have a good data keeping system and to record every step of the aquaculture, such as rearing management, seed sources, health check, growth rate, feeding, the use of veterinary drugs and chemicals, purchasing document or source of production inputs, analysis result of residues from laboratory, official document

related to purchasing aquatic animal seeds. Farmers can use this information in reviewing previous farm practices in order to improve efficiency of farming system of the next crop. It can help solving the problems in farm practices such as disease outbreak. In addition, farmer shall analyze the record of each batch, and record shall be kept for at least 4 years.