3. EMERSED PLANTS

3.1 Cattail (*Typha sp.*)

Cattails are marginal plants that grow 180 to 240 centimeters tall. The leaves are long and narrow with sheathed stem. Cattails have thick branching rootstocks. Thousands of seeds are produced in cylindrical spikes which are brown when mature.

Control	:	Mechanical
Recommendation	:	Early removal

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FISHPOND Management

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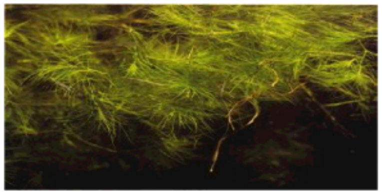
Appendix 1

Some Aquatic Weeds Growing in Fishponds in Central Luzon

1. SUBMERSED PLANTS



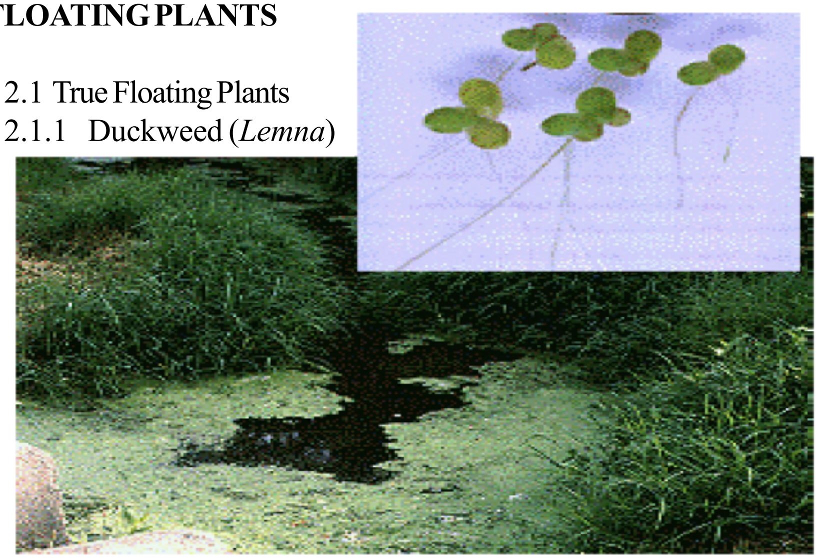
1.1 Bushy Pond Weed (Najas sp.)

The bushy pond weed is a very common submersed plant. It resembles Bermuda grass but grows underwater. The leaves are narrow and ribbon-like and deep green to purplish green in color.

Control : Mechanical
Prevention : Shading phytoplankton

2. FLOATING PLANTS

2.1 True Floating Plants
2.1.1 Duckweed (*Lemna*)



The duckweed is a small, floating plant, green in color and about one centimeter long across with two to four leaves. Extending beneath each leaf is a single, short root.

Duckweed floats freely and is moved by wind current.

Control : Mechanical, by net, rake or similar device
Prevention : Avoid introduction

tilapia responds better with the application of animal manure than with artificial feeds. The nutrients and organic matter content of manure increase the water-holding capacity of soil, decrease the rate of evaporation and increase enzymic activity, all of which increase fertility and crop yield (Schroeder, 1980). Animal manures contain the major inorganic nutrient components: nitrogen (N), 72 to 79 percent; phosphorus (P), 87 percent; and potassium (K), 82 to 92 percent, in addition to such trace elements as calcium (Ca), copper (Cu), iron (Fe) and magnesium (Mg) (Taiganides, 1978). Urine which comprises about 40 percent by weight of the total daily excreta has higher nitrogen and potassium levels than feces. Phosphorus comes mainly from feces except from pigs which have more nitrogen and potassium. Animals fed with roughage ration excrete more potassium than those fed with high concentrate rations.

The chemical composition of manure also varies depending upon the animal species, age and condition of animals, nature and amount of manure, and the handling and storage of the manure before use.

2.1.1 Manures in the food web

The information on the dynamics of the food web is still incomplete. Nevertheless, Schroeder (1980) and Woynarovich (1980) stated that manure may enter the food web in several ways:

(a) As food consumed directly by fish

Most laymen think that animal manures are applied in ponds to feed the fish. This may be true. The response of fish to manuring depends on the method of fertilization used. When manures are applied extensively in heavily stocked and not well-fertilized ponds, the fish will consume the manure as food. This observation prompted scientists to test the use of manure as an ingredient of fish feed pellets. The experiments were done in tanks and cages to avoid or minimize the presence and contribution of plankton normally abundant in ponds. The results showed that the fish fed with the manure-mixed pellets failed to grow to a size comparable to those which were fed with conventional pellets. It was

9. HARVESTING

For better regulations of fish density in ponds, harvesting methods that efficiently remove most of the fish should be employed. A small number of fish left in the pond after harvest will probably by caught during the following harvest. However, if they rare too numerous, the growth rate of the fish stocked in the following production cycle may be affected.

9.1 Thinning

Partial harvest can begin in the later part of the growing season. Wild spawning normally occurs in this part of the culture period when the fish reach sexual maturity. The population should be thinned out to allow further growth of the remaining fish. Either fingerlings or marketable size fish are partially removed. If thinning is done for marketing only, a net with a mesh that can catch the desired size for fish should be used. This will allow small fish to escape and grow bigger faster.

The principle of thinning or selective harvesting should not be abused. In tilapia culture thinning is effective only if done once. Total harvest of tilapia must be done one to two months after.

9.2 Seining

Although seining is often recommended in harvesting fish in the pond, it is not an effective method to insure total harvesting of the stock. Tilapia often burrow themselves into the mud to escape from the net.

9.3 Draining

Although seining, which is the fastest method of harvesting, the pond should be drained so as to eliminate all the predatory species and competitors and the fish which may have escaped from the net.

If needed, the pond should be poisoned to insure the total elimination of any species left in the pond. Draining is necessary as exposure of the pond bottom to sunlight will increase its fertility.

nutrients, are eaten by pelagic as well as bottom-feeding fish. Spataru (1976) and Collis and Smitherman (1978) showed that bottom feeding tilapia consume detritus as well as plankton in significant quantities. Schroeder (1980) cited three studies which concluded that the microbial community in detritus provided essentially all the nutritional requirements of fish.

2.1.2 Application

Proper manure application is essential for maximum fish yields. According to Schroeder (1980) an even distribution of manures over the pond area is desirable. Over fertilization may result in the accumulation of manure at the pond bottom. Accumulation of more than a few millimeters of manure at any portion of the pond will result in anaerobic digestion which will produce an interstitial pH of about 6.5. Ammonia concentration will increase while microbial production will decrease. High microbial activity and production will only be found within the initial one-or two-millimeter layer of the sediments. Therefore, continuous gradual application of manure should be done to avoid manure overload.

There seems to be a maximum amount of organic matter that a pond can digest per unit of time (Schroeder, 1980). Broussard et al. (1982) attained an extremely high production of *Tilapia nilotica* (SEAFDEC strain) in manured ponds at the Freshwater Fish Hatchery and Extension Training Center (FFH-ETC), Muñoz, Nueva Ecija. This was due to the use of a fertilization rate of 3,000 to 4,000 kilograms per hectare per month of chicken manure applied weekly. The fertilization rate mentioned still needs verification. A study of the FFH-ETC using five different manuring rates showed that a total production of 35.91 kilograms per hectare per day of tilapia can be attained by applying 5,000 kilograms of chicken manure per hectare per month. Schroeder (1980) reported that fish yields of 20 to 32.5 kilograms per hectare per day over 120 days were attained with swine manure in polyculture systems.

2.1.3 Storage

Animal manure can have a greater fertility effect when properly collected, stored, and used. When exposed to rain, manure will lose does not inhibit the growth of *T. aurea*. It is possible that common carp can increase the growth of tilapia. Common carp, when large enough, prey on tilapia fry (Spataru and Hepher, 1977).

8.2.2 Predators in tilapia ponds

The use of predatory fish in tilapia ponds is not widely applied and is practiced mainly on an experimental scale. Nevertheless, most tilapia fish-farmers are intrested to know more about this.

Bardach *et al*. (1972) stated that growing of carnivorous fish sometimes reduces costs of production by taking advantage of inexpensive sources of food. Wild spawning is a familiar problem in raising tilapia, and introduction of a piscivorous fish like mudfish (*dalag*), catfish (*hito*), or goby (*biya*) may have an immense contribution in solving te problem, if properly employed. Predators will control wild spawning. However, they should be relatively smaller than the stocked fish, and should not breed spontaneously in the ponds.

8.3 Monosex Culture

The culture of a single sex tilapia population lengthens the culture period. The fish can be gown to an older age, thus a larger size is attained. IN tilapia, the males are highly preferred. Male tilapia grow two to three times faster than the females.

8.3.1 Manual sexing

The sexing of tilapia is done by observing the genital papilla of the fish. The male has one orifice while the female has two orifices. Usually, the female has a smaller genital papilla.

It is advisable to sex tilapia at a younger stage. However, less error is committed when sexing bigger tilapia of about 35 grams.

Manual sexing is laborious, time-consuming, and may entail great mortality due to excessive handling. Disregarding females for culture may not be economical.

kilograms per hectare per month in addition to chicken manure which is applied at 3,000 kilograms per hectare per month. The 16-20-0 grade fertilizer is more readily available than other fertilizers with higher phosphorus content.

3. WATER MANAGEMENT

Availability of good quality water is a basic and very important consideration in culturing fish. The water should be free of toxic-chemical contamination and of unwanted predatory or wild fishes, and must be available when needed. Oftentimes, however, such ideal conditions are rare, if not absent, in most small –scale fishpond operations.

3.1 Source

In Central Luzon, particularly in Nueva Ecija and Bulacan, water sources for freshwater fishponds are deep wells and communal irrigation canals; in Bataan, free-flowing wells and springs; in Tarlac, rivers, deep wells and rainwater; and, in Zambales, deep wells and streams.

Precautionary measures should be employed when using water from rivers, streams, and communal irrigation systems. A simple biossay can be done by using tow simple techniques: two or three fish are placed in a pail full of water from the source to be tested and observed for at least one-half day; or, a *hapa* or scoop net wit three to five fish situated 25 to 50 meters upstream of the water source. The water is safe for use when the fish remain alive after the test period. Ocular inspection or nasal testing to determine the presence of toxic substances is generally ineffective.

3.2 Depth

The definite water depth for any specific culture unit or species of fish is not well defined. Nevertheless, deeper water impedes high fluctuation levels of water temperature. Breeding of tilapia is enhanced with accuracy. In practice, however it is unnecessary and uneconomical to balance supplemental diet for fishponds according to the absolute nutrient requirements of the fish (National Academy of Science, 1977).

Supplemental feeding may be needed when culturing tilapia in ponds. Guerrero (1983) reported that supplemental feeding of *T. nilotica* may be needed during the second and/or third months of culture if plankton growth decreased and growth of fish is slow.

8. CULTURE SYSTEMS

8.1 Monoculture

The very common and widely adopted culture practice in the production of food fish in the country is monoculture. Monoculture is the rearing of a single species of fish in a pond (Stickney, 1979).

(a) Yield

A survey conducted by Sevilleja (1983) in Central Luzon indicated an average annual fish yield of 1,011 kilograms per hectare which is still below the projected target yield of four to six tons per hectare per year by Guerrero (1983a).

(b) Problems

Tilapia fish-farmers are commonly beset with basic technical problems regarding the use of the right amount and method of fertilization, use of appropriate stocking densities, control of aquatic weeds and predators, water management, and harvesting techniques which have been discussed.

It must be pointed out that the most economical stocking rate is not necessarily that which results in the highest growth rate per fish per day, but rather that which results in the highest yield per unit area. Performance of the selected tilapia strains should also be considered. Some strains of *T. nilotica* were found to be inferior. The inferior strains do not respond well to fertilization, reproduce prolifically and cease to grow earlier (M. Broussard, personal communication).

In many tilapia ponds, wild spawning is very common. Indiscriminate spawning may reduce fish yields to uneconomical levels.

long as other factors are not limiting, the growth of fish per day will be better. However, the growth of fish will be slow at higher density stocking because the capacity of the natural food to support the fish population will be limited to a certain extent. The maximum physiological growth of tilapia is attained at low stocking density (J. Chervinski, personal communication).

Various stocking rates have been reported. Guerrero (1983a) recommends a stocking density of 10,000 to 20,000 tilapia fingerlings per hectare for plankton ponds. Also, a stocking rate of 20,000 to 30,000 tilapia fingerlings is being used by Mr. Magno Velayo of Gapan, Nueva Ecija (Guerrero, 1983b). Sevilleja (1983) reported an average stocking rate of 12,748 fingerlings per hectare per cropping for tilapia monoculture in Central Luzon.

The Freshwater Fish Hatchery and Extension Training Center in Munoz, Nueva Ecija recommends a stocking rate of 20,000 to 30,000 tilapia fingerlings per hectare per month in well-fertilized ponds when using the Center's strains of tilapia. According to M. Broussard, less fingerlings are produced at a stocking density of 30,000 fingerlings per hectare.

4.1 Factors that Influence the Selection of Stocking Densities in Ponds

A common mistake in grow-out production of tilapia in ponds is the selection of proper stocking densities. The failure to select the most appropriate stocking density will result in poor growth and low market value of the fish produced. To insure profit, the stocking densities in ponds must be selected based on the following factors:

(a) Market demand

Market size preferences vary, depending on the place. In many rural areas, smaller fish (less than 100 grams) are highly saleable. Nevertheless, in commercial fishpond operations that require middlemen in the marketing of the produce, large fish command higher prices than small ones.

weed growth. Ponds are so designed that sufficient water is available all year round to maintain water levels to the maximum.

(b) Pond fertilization

The effect of pond fertilization on weed control is indirect. Application of fertilizer induces and maintains the growth of phytoplankton that shade pond bottom. Hence, the growth of submerged weeds is prevented.

6. PREDATORS AND OTHER PESTS

Fish production in ponds is commonly affected by some pests and predators. Predators are organisms which prey on the fish being cultured and the animals that complete for food or space are called competitors.

6.1 Birds

Herons, kingfishers and other birds should be discouraged from frequenting the ponds. They devour fish and fingerlings. Birds are also carriers of parasites. They are kept away by shooting or trapping. Ponds constructed without shallow areas are not attractive to birds.

6.2 Snakes

Snakes prey on small fish. Nevertheless, there are but a few to worry about. Banks and dikes must be kept clean to prevent snakes from harboring in the ponds.

6.3 Frogs

Fry and fingerlings are eaten by frogs. Tadpoles also compete with the fish for space. Frogs are seldom found in well-fertilized and well stocked ponds. Their presence can be controlled by removing their egg sacks from the pond water.

widely used manure by fish-farmers. Its use insures much higher yield than when cow or carabao manure is used. The capacity of the pond to accommodate fish can be further escalated when inorganic fertilizer like 16-20-0 is added with the manure into the pond.

Fertilizers are more effective in supporting higher fish population when they are applied in short and regular intervals, i.e., daily or weekly application. (For further discussion on pond *fertilization*, please refer to Section 2, *Pond Fertilization*.)

(e) Fish-farmer's resources

Low-density stocking may be recommended for the fish-farmers belonging to the low-income group. The high production inputs required in higher stocking density may prohibit its adoption by the farmer. The recommended stocking ratio must conform with the ability of the fish-farmer to supply the needed inputs.

5. AQUATIC WEEDS

Generally, aquatic weeds are abundant in freshwater ponds. However, a well-managed culture pond should not have weeds or floating aquatic plants at all.

5.1 Adverse Effects of Aquatic Weeds

(a) Stickney (1979) stated that aquatic plants impede solar exposure of the pond water. The productivity of the pond is influenced by photosynthesis. Light must penetrate sufficiently into the water to promote photosynthetic activity.

(b) Aquatic weeds utilize soil nutrients that might otherwise support the growth of phytoplankton. An experiment at Auburn University showed how water hyacinths remove nutrients in the water and reduce phytoplankton production.

(c) Growing weeds hinder effective grazing of stocked fish and expose them to predation by other aquatic animals. Another problem resulting