

## **II: PRINCIPLES OF 80:20 POND FISH CULTURE**

### **INTRODUCTION**

Fish farming is the raising of fish for profit in managed unnatural aquatic ecosystems, such as ponds, raceways and cages. "Sustainable" farming depends on the farmer's ability to manage two sets of principles; business and production. Ponds are the primary ecosystems for farming fish, probably accountable for >95% of total world production. Fish culture technologies in ponds are primarily influenced in order by nutrition quality and quantity, water quality and fish stock quality. The primary challenge of technology management is to manage these factors at optimum qualities for the species being cultured but at densities much greater than densities that could naturally exist in nature. Using biological, physical and chemical factors and a good understanding of the natural laws that govern them, fish culturists create and temporarily maintain the unnatural aquacultural ecosystems by controlling nutrition, water quality, and stock. Although fish culturists have the ability to create and maintain unnatural aquacultural ecosystems, they do so only within the same natural laws that govern natural ecosystems. These natural laws are the "ecological principles of aquaculture" that also govern all fish culture technologies no matter how advanced, how intensive, where located or other factors. Learning these principles and how to apply them are fundamental to practical management of aquaculture ecosystems for profit.

All sections of this manual are based on these ecological principles of aquaculture as they specifically relate to fish culture in ponds. This section discusses the fundamental principles of pond fish culture generally and 80:20 pond fish culture specifically.

### **80:20 POND FISH CULTURE CONCEPT**

In China by the early 1990s, traditional fishpond production systems were no longer ecologically and economically viable. However, China has the greatest opportunity for fish farming of any country in the world, because of the highest market demand for cultured fishes, already established culture species with high consumer demand and culturability, more than half of the world's fish ponds, an emerging aquafeed industry and strong government support. A more modern, scientifically based fish pond production system(s) was needed that would be both ecologically and economically viable and could be nationally adopted without significant changes in existing technology components. A feed-based system, combining traditional Chinese polyculture technology and modern monoculture technologies (e.g. channel catfish farming in the U.S.), was developed and termed "80:20" pond fish culture. The concept of 80:20 pond fish culture is to raise crops of fish in ponds where approximately 80% of the harvest weight is composed of only one feed-taking "high-value species" with high consumer demand, and approximately 20% is composed of "service species" such as filter fishes that help clean the water and predaceous fishes that control wild fish and other competitors.

The objective of 80:20 pond fish culture technology is to provide farmers and government decision makers with a feed-based production technology more economically and technically efficient than the traditional pond fish polyculture systems standard in China until now. In practice 80:20 may be used for production of fry to fingerlings and fry or fingerlings to market

size. Any feed-taking, pond cultured fish species may be used as the primary 80% species. While the 80:20 technology system is fundamentally the same for all warmwater, feed-taking species, feed requirements and some other components of the technology will vary with species. In China the technology is well developed for growout production of common carp, Nile tilapia and channel catfish. Improved feeds are needed for other species. Nevertheless, the technology is essentially developed for crucian, wuchang and black carps, and basically developed for grass carp. All of these species are being successfully produced using the technology. However, trials are underway to further develop and perfect adequate feeds for these species by year 2000.

Application of 80:20 technology is less complex than traditional, mixed species technology. The basic stages of applied 80:20 technology are as follows:

1. Preparation of pond for stocking fish using standard methods.
2. Stock pond with uniform-size fingerlings of a select feed-taking species (e.g. crucian carp) and relatively uniform-size fingerlings of filter fish (silver carp) that will compose approximately 80% and 20%, respectively, of total fish weight in the pond at harvest. Largemouth bass, mandarin fish or other predaceous species may be stocked as a component of the 20% group to control any anticipated reproduction or wild fish contamination.
3. Feed the 80%-group fish with a nutritionally complete, high physical quality feed according to prescribed schedule and methods. Otherwise manage the pond using standard methods, expecting relatively less incidence of disease and reduced need for aeration or water flushing than for traditional polyculture systems.
4. Harvest the entire fish crop all at once ending the culture period. All individual fish composing the primary 80% species population should be marketable and of relative uniform size. Cropping is a management option during mid-season where market prices are highly favorable.

The 80:20 technology was specifically developed for China without deviating significantly from the basic components of the traditional China fish farming "industry". Both 80:20 and traditional technologies use the same fish species that consumers demand and for which farmers are already producing stock. Both use the same ponds and production facilities. On established farms the new technology requires no capitalization and may be adopted by all pond farmers by simply changing composition of stocked fish species and using a new feed/feeding system. However, there are some fundamental differences between 80:20 and traditional polyculture technologies (Table II-1). Note that differences include factors that range from marketability through technical management to environmental quality. Also note that 80:20 fish culture is superior in every factor compared except yield. Yields may be higher with traditional polycultures because:

1. Stock weights are usually as much as 300% higher.
2. Multiple species and multiple sizes of individuals within the species will give higher yields than an 80% single species of a single size class plus the 20% service species.

3. Traditional technology is designed for high yield and 80:20 technology is designed for high profit, which requires maintaining environmental quality by limiting nutrient inputs and thereby limiting yield.

Technical management is easier, control of the pond ecosystem much higher and production results more predictable with 80:20 technology compared to traditional technology. The technology meets sustainable criteria of ecological and economic viability. Compared to traditional technology 80:20 has much less impact on the environment, because it generates less wastes, produces no accumulation of waste, requires no water discharge and is a more efficient user of resources.

The following are some general economic factors compared between traditional and 80:20 fish cultures where total yields are approximately the same:

1. Stock - Total fish weights, size groups, holding facilities and handling labor are greater for traditional.
2. Stocking - Labor for multiple species, multiple stockings are greater for traditional.
3. Aeration - Equipment wear and energy requirements are greater for traditional.
4. Water exchange - Water amount, equipment wear and energy required are greater for traditional.
5. Feed - Quantity of feed ingredients and costs to gather, transport and store are greater for traditional.
6. Feeding - Labor required to feed fish is greater for traditional.
7. Disease management - Fish stress and disease, and drugs and chemicals to control diseases are greater for traditional.
8. Pond upkeep - Labor to remove bottom organic mud is greater for traditional.
9. Growth rate, feed efficiency and survival are higher in 80:20.
10. Costs - Capital investment and every operating cost are greater for traditional.
11. Profits - Return on investment is greater for 80:20.

Table II-1. Relative comparison of some traditional and 80:20 pond fish culture factors.

<b>Factor</b>	<b>Traditional</b>	<b>80:20</b>
Objective	High yield Production oriented	High profit Market oriented
Fish market value	Low	High
Market target	Live	Live or product
Market prices	Seasonal, fluctuating	Stable
Stock system	Mix of 6-7 species	1 primary (80%)+ 1 or 2 service (20%)
Primary species	Mix 1-4 sizes/species Filter feeders (60%)	1 uniform size/species Feed consumers (80%)
Feed type	Fresh organics; single ingredients; compound pellets; low nutrient & physical quality	Nutritionally complete & high physical quality pellets
FCR	High	Low
Feed pollution	High	Low
Environment quality	Low	High
Pump/aeration	High	Low
Disease problems	High	Low
Harvest	Multiple (4-5/season)	Single (crop option)
Yield	High	Moderate to high
Marketable weight	75%	100%
Labor required	High, intensive	Low, extensive
Feed price	Low-moderate	Moderate-high
Nutrition cost	High	Moderate
Total farm costs	High	Moderate
Fish market price	Low	High
Gross/net incomes	Low	High