



The Use of Fertilizers on Aquaculture in China

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Preface

China is the largest country in the world for aquaculture

● total output in 2004: 49 million tonnes, accounting for 70% of the world total

● fish species: over 160

The use of fertilizers for fish farming has grown dramatically in the fast-growing aquaculture industry in China.

This paper is prepared to address the use of fertilizers in aquaculture in China.

I. Principles and functions of fertilizer use in fish farming

water quality parameters in **aquaculture**: Nutrient contents, depth, temperature, pH value, oxygen and the types of salts and their concentrations in the water

Goals of applying fertilizers to the fishponds:

enrich the “poor water” to become “fertile water”

The use of fertilizers in fish farming plays the following roles:

- To enrich the water fertility by increasing the nutrients and organic matter in the water, some of which can become the feeders for fish directly
- To stimulate the growth and reproduction of planktons, algae, and zoobenthos etc. in the water, which form the natural diets for fish

Basic Food Chains in Fishpond

Nutrients from fertilizers →

Green plants (phytoplankton, algae, autotrophic bacteria, etc.) or fish

→ Lower-grade animals or fish

→ Fish

All of the cadavers of livings are decomposed by bacteria and come back to water (**biologically recycled**).

The functions of the fertilization for fish farming

- Some organic and inorganic nutrients from the fertilizers become the feeders of the fish
- The majority of the nutrients from fertilizers provide nutrient source for green plants, algae, and autotrophic bacteria etc., which are among the direct sources of food for fish
- The green plants become the food of lower-grade animals, which in turn is the food for fish

II. The history of the fertilizer use and its consumption in fish farming in China

China has a long history in the use of organic fertilizers in fish farming, dating back to more than 3,000 years ago.

Records:

- “The Scriptures of Fish Farming” in 2,400 years ago
- “The Records in Ling Nang” in late Tang Dynasty

The history of the use of chemical fertilizers in fish farming is relatively short.

- Research began in 1972
- Research expanded to many Chinese provinces in the 1980s
- The use of fertilizer as a major practice accepted by fish farmers since the 1990s

Estimated consumption of fertilizers in aquaculture in China

There are no official statistics of fertilizer consumption in aquaculture industry in China; the consumption of chemical fertilizers estimated in fish farming is based on the areas of fish farms and fish output.

Consumption (net nutrient) 10^4 t

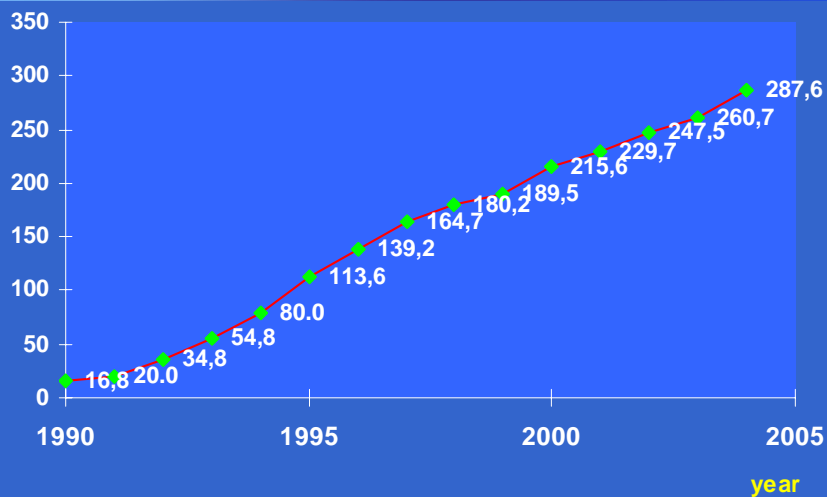


Figure 1 The estimation for the nutrient consumption in aquaculture

1970 to 1989: The research and development phase, fertilizers consumed in fish farming were less than 150,000 tonnes.

1990 to 1997: Fertilizer consumption grew rapidly, increased by nearly 40% year on year, nearly 1.65 million tonnes of fertilizers consumed in 1997.

1998 to 2004: The growth of fertilizer is slowed down with an annual increase by 8.2% on the average. Fertilizer consumption in fish farming in 2004 was 2.87 million tonnes, accounting for 6.1% of the total fertilizer consumption (47 million tonnes) in China.

The forecasts of fertilizer consumption in aquaculture in the future

2005 to 2010: The consumption will increase by 3% annually and reach 3.43 million tonnes in 2010.

2011 to 2015: The consumption will increase by 2% annually and reach 4.52 million tonnes in 2015.

2016 to 2030: The fertilizer consumption will increase by 1% annually and reach 5.24 million tonnes in 2030.

III. The use of fertilizers in fish farming in China

The types of fertilizers :

Nitrogen fertilizers: including urea, anhydrous ammonia, ammonium bicarbonate (ABC), ammonium sulphate, ammonium nitrate (AN), ammonium chloride, etc.

Maximum allowable concentration:

NH_4^+ 5 mg N/L;

$\text{NH}_3 \cdot \text{H}_2\text{O}$ 0.2-1.0 mg N/L;

NO_2^- 0.8mg/L

Concentration greater than the values is under anoxic conditions.

Phosphate fertilizers:

Phosphorus is an essential nutrient for algae. However, phosphorus is normally deficient in clean water.

Fertilizers for common use are:

single superphosphate (SSP), triple superphosphate (TSP), ammonium phosphates (AP), calcium magnesium phosphate (CMP) etc.

Maximum allowable concentration : 0.4 mg P/L

Nitrogen and phosphorus fertilizers are the major fertilizers applied in aquaculture and applied to the fish water at the ratio of 3-4:1.

The balanced N/P ratio is critical to maintain the quantity of phytoplankton in the water body providing adequate food for fish.

Many specialty fertilizers have been developed containing N, P and K, but also Ca, Si and micronutrients in soluble forms.

The Aquaculture Specialty Liquid Nutrient



Other fertilizers: potassium chloride, potassium sulphate, lime, powder limestone and silicon-containing fertilizers

Application needed when Ca below 10mg/L and Si below 0.1-0.4ug SiO₂/L

The usage of chemical fertilizers and its effect

The conditions for fertilizer applications:

pH: 6.5-8.5

soluble oxygen content >5 mg/L

Rainy days and/or high temperature days not suitable for fertilizer applications.

The usage of chemical fertilizers and its effect

Application Rate: N 45 –450 kg/ha, P₂O₅ 30 –250 kg/ha

Use Method: dissolved in water followed by spraying to the fish farms. Phosphate fertilizers are usually first applied, followed by N fertilizers.

The benefits of fertilizer use in fish farming

- Improving water quality and increasing the types and quantity of phytoplanktons
- Improving water quality and increasing the types and quantity of phytoplanktons
- Increasing fish yield and economic returns

IV. Impacts of fertilizer use in fish farming on environment quality

Fertilizer use in fish farming affects the environment in the following ways:

N pollution: Application of 1,500 kg/ha ABC to 2-meter deep water will generate N in the water higher than the allowable level, especially the NH₃ concentration exceeding 14-120 times of the allowable level in the standard of water quality in fishery in China (0.02mg/L), causing damage to the liver and lamella of glass carp.

A report on government vowed to stop the use of fertilizers in the reservoir supplying water for human consumption.

The screenshot shows a web browser window displaying a news article. The browser's address bar shows the URL: <http://218.65.3.170/jjnyj/ReadNews.asp?NewsID=932>. The page header includes the logo for '九江农业信息网' (Jiujiang Municipal Agriculture Bureau) and the text '九江市农业局' (Jiujiang Municipal Agriculture Bureau). The article title is '九江责令停止使用化肥养鱼' (Jiujiang orders to stop using chemical fertilizers for fish farming). The sub-headline is '《都昌大港水库竟用化肥养鱼》追踪' (Tracking the use of chemical fertilizers in Douchang Dapang Reservoir). The main text of the article reads: '本报7月22日报道了湖北老板在都昌县大港水库用化肥养鱼，污染水质一事。5日，记者了解到，目前，有关部门已经对这种化肥养鱼行为进行了制止。本报报道见报后，引起九江市、都昌县有关领导的高度重视，立即对此事进行了调查，证实水库水质确实严重恶化，群众的生产生活用水受到一定程度的影响。为此，水利、水产等部门根据九江市政府批示，责令水库承包人立即停止使用化肥养鱼，并办理养殖证。' Below the main text, there is a section for '相关信息' (Related Information) which states '没有相关信息' (No related information).

P pollution: The application of SSP at the rate of 1,500 kg/ha could increase P concentration by 35-36 times in 2-m deep water, much higher than the allowable level (0.1 mg/L). The plankton normally released back to the water about 54% of the assimilated P as soluble P.

Heavy Metal Pollution: SSP and CMP contain Cd, Pb, Hg, As. The contamination of heavy metals to aquatic products is a potential risk.

In the last 20 years, the use of fertilizers has promoted the development of aquaculture in China and become a major practice to raise fish. However, heavy and over-fertilizations have caused negative impacts on the environment and the safety of water. Therefore, it is important that we develop technology and standards regulating the use of fertilizers in the future.

