(https://www.globalseafood.org)

Responsible Seafood ADVOCATE

Responsibility

Greening the blue revolution

1 April 2005

By Peter Edwards

Synthetic fertilizers appropriate for organic aquaculture

The goal of the International Federation of Organic Agriculture Movements – the worldwide adoption of ecologically, socially, and economically sound systems based on a series of principles of organic agriculture – is exemplary if unrealistic. However, widespread implementation of all the principles for aquaculture, even if it were possible, would be counterproductive for the sustainable development of both small- and large-scale aquaculture for the foreseeable future.

Organic principles and aquaculture

Organic principles encourage farms to evolve into self-contained units with minimal use of external inputs. However, modern, intensive aquaculture facilities mainly use formulated pelleted feeds from agroindustry.

Sampling tilapia in a green water pond fertilized with synthetic fertilizers.

In the process of setting organic aquaculture standards, there has been considerable discussion over the sources and allowable percentages of fishmeal and fish oil in the diets, whether they could be used for direct human consumption, and whether the pellets should only be fed to naturally piscivorous fish such as salmon and sea bass.

Although the feeds are permitted, synthetically produced fertilizers are prohibited in all existing organic agriculture standards. This is in spite of the fact that fertilizers are increasingly used to produce “green water,” a popular term for plankton-based food chains characteristic of many traditional aquaculture systems.

Commercial fertilizers are banned in organic agriculture because of growing concerns over the degradation of land, water, and biodiversity from excessive fertilizer use in terrestrial agriculture. But a case can be made for their use in fish ponds. Currently only organic fertilizers are allowed, provided they are derived from organic crops and livestock farms.

Fertilization focus

The focus on making a distinction between organic and inorganic fertilizers by organic farming seems artificial. The main issue is how to incorporate ecological principles to identify the phytoplankton nutritional needs for natural food production for fish in fertilized ponds.

It is unlikely that fertilized fish ponds pollute the external environment to nearly the same extent as terrestrial crops, because most of the nutrients added to ponds that do not end up in the fish are sequestered in pond mud. They can be periodically removed to fertilize crops and contribute to diversification of farming activities. However, further research on the nutrient budgets of fertilized fish ponds is required to confirm that the large amount of nutrients needed to produce good fish yields indeed do not cause eutrophication.

The fertilization of ponds with synthetically produced fertilizers can be effective both for small-scale farmers to raise fish and for industrial-scale farmers to lower the cost of production, and thus contribute toward development in a more sustainable and balanced way.

Small-scale farms

Poor resource bases are major constraining factors for small-scale fish farmers in developing countries. Many farmers have rain-fed farms of less than 2 hectares on marginal land, and thus have few on-farm resources for fish pond inputs. Small numbers of poultry usually scavenge, which precludes the use of their manure as a pond fertilizer.

Manure from buffalo and cattle is a poor fertilizer for fish ponds due to its low nutrient content and tannins that stain pond water, impeding light penetration into the water column and thus inhibiting the growth of the phytoplankton that feed the fish. What limited livestock manure is available is mainly used to fertilize crops. Most small-scale farmers cannot raise feed lot livestock such as pigs and poultry using off-farm feed due to problems with input supply and marketing.

Integration

Organic farms depend mainly on crop rotations with nitrogen-fixing legumes and green and animal manure to maintain soil fertility, as synthetically produced fertilizers are prohibited. They are mostly mixed farms with integration of crops and livestock production, the former providing feed for the livestock and the latter manure to fertilize the crops.

It is debatable to what extent such integrated crop/livestock systems can develop on most small-scale farms, because the limited area to grow feed for livestock is needed to grow crops for direct human consumption. Thus, small farms often have insufficient fertilizer and feed for fish.

Farmers in several Asian countries now successfully culture fish with synthetically produced fertilizers alone or in part with other inputs. More widespread extension of technologies developed from on-station and on-farm research with farmers would provide a boost to the contribution of aquaculture to rural development.

Large-scale farms

Fish on industrial-scale farms are mainly produced using only rather costly agroindustrial pelleted feeds. A significant reduction in the cost of production could be achieved by using pelleted feed as a supplement in green water ponds fertilized with synthetically produced fertilizers.

A recommendation of the Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP) is to use only urea and triple super phosphate at 28 kg nitrogen and 7 kg phosphorus per hectare per week, respectively, for the first three months, until the 15-gram Nile tilapia stocked at three animals per square meter reach 100 to 150 grams. Then, in addition to fertilizer, pelleted feed with a crude protein content of 30 percent should be applied for three to four months until the fish reach 500 grams.

Optimal fertilization

Fixed rates for pond fertilization as recommended above can be wasteful because they do not consider the fluxes of nutrients in ponds and the actual phytoplankton requirements for nutrients. A relatively simple algal bioassay fertilization strategy has recently been developed by PD/A CRSP that does not require water chemistry, computers, laboratory equipment, technical expertise, or electricity to run. It can be readily carried out by commercial farms and would considerably improve fertilizer nutrient and cost efficiencies compared to the usual fixed-input strategies.

(Editor's Note: This article was originally published in the April 2005 print edition of the Global Aquaculture Advocate*.)*

Author

PETER EDWARDS

Emeritus Professor
AARM/SERD
Asian Institute of Technology
P.O. Box 4
Klong Luang, Pathumthani
12120 Thailand

pedwards@ait.ac.th (mailto:pedwards@ait.ac.th)