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WASTE NOT, WANT NOT

by ROWAN SHIRKIE

Waste not, want not. That old saying has taken on a whole new meaning in Israel, Kenya, Malaysia, Peru, and Thailand where researchers are investigating a system of reclaiming and reusing water that combines both low-cost sanitation and food production: using waste treatment ponds to raise fish.

Assisted by grants from Canada's International Development Research Centre, institutions in the five countries will conduct experiments with waste stabilization ponds that exploit the natural action of bacteria and algae to remove human and industrial wastes from water. The treatment and fish production capabilities of various types of ponds will be studied under different conditions, with the health aspects of the system being given a special priority.

Waste disposal presents a considerable problem for most developing countries who cannot afford the high cost of treatment methods common in industrialized countries. Water scarcity, and the growing concern over the health hazards and environmental damage created by inadequate collection and treatment of human and industrial wastes has further spurred the search for low-cost alternatives.

Stabilization ponds represent one of the best alternatives because they are efficient, relatively inexpensive to construct, and easy to maintain. Their mode of operation, which depends on favourable warm temperatures and full sunlight conditions, make them further suited to tropical countries. Add the potential for food production presented by aquaculture and the ponds become almost unbeatable.

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Before the potential of aquaculture in stabilization ponds can be realized on any large scale, however, two areas need to be more fully investigated. The first is the need to eliminate or block any possible transfer of disease-causing organisms, pesticides, or heavy metals through the ponds by the fish raised in them. The second involves design and operation, as conventional stabilization ponds are intended solely for water treatment and discharge and not to accommodate simultaneous aquaculture activities.

Pollutants in wastewater can be changed by biological, physical, and chemical forces. Organic material is decomposed by two bacterial processes: aerobic and anaerobic. In stabilization ponds, bacteria digest the organic matter, converting it to energy byproducts and growing new cell material. Aerobic bacteria require oxygen to grow and therefore prefer the upper layers of a stabilization pond, where they can obtain oxygen from the plant activities of algae. Anaerobic bacteria exist in and near the bottom layers of the pond, where the heavier organic load of settled waste solids and the absence of oxygen provide the proper environment.

Although the initial treatment received in a pond removes many of the pollutants from wastewater, faecal bacteria and a range of viral and parasitic organisms still persist. Often a secondary pond, or series of ponds -- called maturation ponds -- are employed to further treat wastewaters before they are discharged. A properly operated stabilization pond system can remove more than 98 percent of the faecal coliforms in the wastewater. It is in the secondary and maturation ponds that researchers will conduct aquaculture experiments.

Wastes are traditionally added to aquaculture ponds as fertilizer to increase the production of algae, on which the fish subsequently feed. The most popular varieties of fish cultured in this way are Carp and Tilapia, both of which grow rapidly and are highly productive. Adding fish to waste ponds instead of waste to fish ponds makes no radical departure from this widespread and well-understood traditional technology. By mixing species of fish with different feeding habits - polyculture - the range of nutrients available in waste-fed aquaculture ponds are fully used.

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Fish do not seem to be susceptible to infection by the bacteria present in wastes and wastewaters that cause disease in humans. They can, however, carry some of these pathogens on their scales, or as undigested material in the gut. Some fairly simple procedures to remove this danger, such as holding fish in clean water for a time, cleaning and thorough cooking, will be tested as part of present research effort.

However, much remains to be discovered about the effects and modes of transmission of heavy metals and pesticides that may be present in industrial wastewaters or waters polluted by agricultural runoffs. There is evidence that the toxic materials present in such wastes can accumulate in the tissues of fish that ingest them and be passed on to humans. Research conducted by the Ministry of Water Development in Nairobi, Kenya, will examine the effects of wastes from a tannery industry on the performance of a stabilization pond system, and on the fish raised in it.

At the University of Malaya in Kuala Lumpur, two existing ponds and four new ones will be subdivided and stocked with different combinations of fish at different rates. The experimental ponds will be fed "nightsoil" collected from low-income residential areas of the municipality at various controlled loading rates. Maturation ponds receiving the treated effluent will be stocked with fish. Part of the project includes a survey of the traditional practice of dumping wastes in small household or village ponds, to determine their health and production characteristics.

In Israel, the Fish and Aquaculture Research Station of the Agricultural Research Institute at Dor will use four maturation ponds treating domestic wastes from a community of about 5000 inhabitants. Researchers will study the effects of different rates of waste loading, and fish stocking and density rates. They will also study various aspects of the waste stabilization/fish production system under temperate climatic conditions, and the potential use of an aquatic weed (Lemna or "duckweed") for enhancing the treatment processes and providing supplemental fish feed.

In Peru, the Pan American Center for Sanitary Engineering and Environmental Sciences in Lima will evaluate the performance of an existing stabilization pond system, with the aim of developing design criteria for different loading and climatic conditions in Latin America. The Center will focus primarily on the potential for reclamation and reuse of wastewater in irrigation.

In Thailand, the Environmental Engineering Division of the Asian Institute of Technology (AIT) in Bangkok will use 16 fish ponds stocked at four different rates and maintained at four different algal feeding rates. As in the other experiments, the Thai team will closely monitor the characteristics of the fish and treatment at all stages, looking for means to design pond operations to optimize both fish production and wastes treatment. They will focus on the economic and engineering factors that would influence the system's usefulness to rural and urban areas of Thailand and tropical Southeast Asia.

From a planner's or sanitary engineer's point of view, stabilization ponds as a method of waste treatment have the advantages of being efficient, economical, flexible in scale and operation, and well suited to the tropical conditions of many developing countries. But if they can be combined with fish farming or other agricultural activities, such ponds could make the advantages of proper collection and treatment of wastes as obvious and concrete as more food on the table. The cooperation and support at the community level that this particular technology might therefore be able to attract make it likely to deliver health and development benefits long after the planners and engineers have finished their work.

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