

Proliferation of Asian Reservoirs: The Need for Integrated Management

Throughout Asia the pace of reservoir development is accelerating. By the year 2000, the extent of these new ecosystems will have increased by 500-600%, from 3 to 20 x 10⁶ ha (see Table). Reservoirs and man-made lakes will comprise the greatest areas of standing waters in the region, far greater than the area of natural inland waters. Most of these

BARRY A. COSTA-PIERCE
ICLARM
and
OTTO SOEMARWOTO
Director
Institute of Ecology
PPSDAL (IOE) UNPAD
Bandung 40132, Indonesia



Aquaculture and fisheries activities in the Saguling Reservoir, West Java, Indonesia. A family integrated pond is in the foreground with floating net cage culture in the background. Note the small fishing boats on shore and near the cages. Photos by B. Costa-Pierce.

set of problems. The roots of these new problems can generally be traced to two areas—lack of comprehensive, integrated planning and resettlement efforts, and lack of ecological and environmental surveys concomitant with the engineering and construction phase of the projects.

Environmental Impact

As a result of this lack of planning and research, the impact of new reservoir development can be devastating on the environment and its people. According to a recent article entitled, "Togo to Follow Atlantis?" (Sharma, Y. 1986. U.N. Develop. Forum, 14: 11), the Akosombo Dam on the River Volta in Ghana has been blamed for the erosion of some 135 m of coastal land since 1980. Erosion threatens port facilities, historic sites, and a phosphate enrichment factory that provides 50% of Togo's export income. Erosion has also undermined entire towns along Ghana's coast. It has been realized only now that the

Areas (x 10⁶ ha) of present and future reservoirs and natural waters in parts of Asia.

Country	Present (1984)	Future (circa 2000)	Rate of increase (%)	Natural waters ^a
Bangladesh	0.16	0.80	400	0.30
Burma	0.20	1.50	650	0.60
India	2.00	5.00	150	0.70
Indonesia	0.13	0.50	286	9.95
Kampuchea	0.08	2.00	2,400	0.50
Laos	0.05	5.00	9,900	0.50
Malaysia	0.02	0.15	650	4.23
Nepal	0.02	0.10	400	0.01
Philippines	0.03	0.50	1,586	0.40
Singapore	0.002	0.003	50	0
Sri Lanka	0.13	0.25	92	0.22
Thailand	0.30	3.00	900	0.60
Vietnam	0.20	1.50	650	0.50
Total	3.322	20.303	511	18.51

^aNatural waters includes lakes, marshes, floodplain lakes, and freshwater swamps.

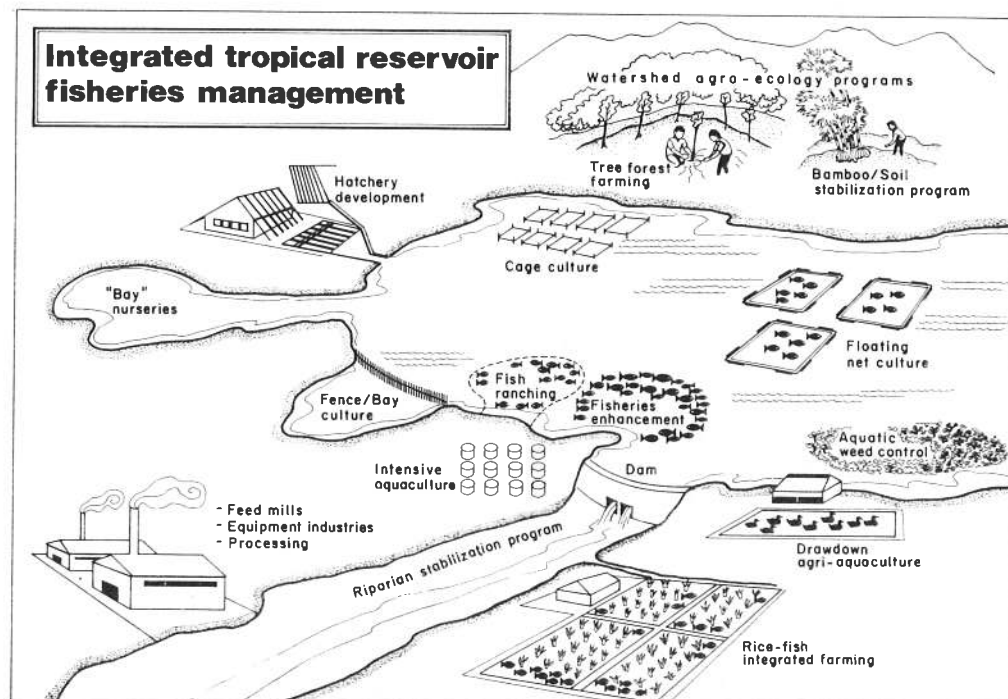
new reservoirs will be constructed in some of the most densely settled areas of the world.

Hydroelectricity

The dramatic increase in new reservoirs in Asia and throughout the world arises mainly from the increased need to develop adequate supplies of electricity, irrigation and drinking water for growing populations. Recent Indian studies have estimated that the demand for electricity in the year 2000 will be four times greater in Bangladesh and three times greater in India, Pakistan and Nepal. Nations can initiate extensive upgrading of grid capacities, thereby insuring more reliable electricity, and expand services to rural areas by developing their hydroelectric capacities. Hydroelectricity serves as a substitute for imported oil and saves valuable foreign exchange.

New reservoir development allows the intensification of agriculture, providing secure water supplies to seasonal cropping areas, while opening new land to agricultural development. The Pantabangan Dam in Central Luzon, Philippines, for example, has allowed year-round rice cultivation on some 100,000 ha of agricultural lands previously limited by seasonal drought. Reservoirs can provide easy access to drinking water for thousands of people now burdened by the daily task of carrying water.

On the other hand some reservoirs in the tropics have proved a mixed blessing, often creating a new, more disrupting,





Sociocultural/economic survey team of IOE/ICLARM interviewing an Indonesian fish-farmer and his family.

improperly-sited dam acts as a sink for almost all of the sediment once carried to the Gulf of Guinea by the River Volta. This sediment deposition partly compensated for the erosive action of waves along the coast.

Reservoirs also upset the detrital food webs of coastal ecosystems, causing irreparable damage to coastal fisheries. Organic matter previously transported in suspension to the coast by fast-flowing tropical rivers sinks to the bottom of the newly-formed reservoirs, disrupting the flow to the coast of organic carbon, the basic resource and starting material for all detrital food chains. Dramatically lower in-shore fishery yields result. Lower yields in the southern Mediterranean have been blamed on the disruption of organic matter flows to the coast resulting from sedimentation behind the Aswan High Dam on the River Nile in Egypt.

Further ecological impacts of reservoir development can now be observed on a global to micro-environmental scale, from climate modification to species extinction. For the inhabitants of a region, new reservoirs can mean the loss of homes, cultural heritage, income, and labor opportunities from productive lands.

Opposition

Virulent opposition to some reservoirs in the Philippines has fueled increased insurgency activities. New reservoirs mean relocation and resettlement of thousands of displaced persons. Often resettlement activities are unplanned, and are simply an afterthought to completion of the engineering phase of the dam and actual generation of power, supply of irrigation

or drinking water. Official commitments to the displaced people are believed to be completed when compensation for land, homes and labor is paid. If the people are resettled in the region of the reservoir, increased population pressures on surviving agricultural and natural ecosystems result, contributing to a vicious cycle of poverty, malnutrition and social unrest.

Indonesian Reservoir Project

Two new reservoirs in West Java, Saguling (filled in 1985) and Cirata (to begin filling in 1987) are the subjects of a scheme to develop aquaculture and fisheries for some 1,500 displaced families from the inundated areas. The goal of the project to connect large-scale resettlement with aquaculture and fisheries development is unique. There are no comparable experiences anywhere else.

The Institute of Ecology (Lembaga Ekologi) of Padjadjaran University in Bandung, West Java, has been conducting pre-inundation studies on the socio-cultural, economic and ecological relationships in the reservoir areas since 1979. The studies probably comprise the most comprehensive information on the subject to date.

The Indonesian state electric company (PLN, Perusahaan Umum Listrik Negara) has contracted the Institute of Ecology (IOE) and ICLARM to provide support services to the West Java Fisheries Agency (WJFA) in the resettlement program. IOE/ICLARM will also establish and run pilot-scale facilities in floating net, cage, pen, running water, drum, and integrated farming culture systems as well as develop small-scale hatcheries for the most promising species. Training

Indonesian farmer posing on the bank of his carp nursery pond. Note rattan "bowl" used to measure quantity of fingerlings for sale.



Naga, The ICLARM Quarterly

of local farmers and scientists will be conducted around the reservoirs, at IOE, and at ICLARM headquarters in Manila. Such efforts should result in a comprehensive fisheries and aquaculture development and management plan for reservoirs, a plan that could be a model not only for Indonesia, but also elsewhere throughout the tropics (see Figure).

Comprehensive Planning

The IOE/ICLARM project emphasizes not only technology but also planning, sociocultural, economic and marketing studies. The program is innovative because of the involvement of fisheries and environmental scientists from the initial design and engineering phases, and because of the appointment of a Resettlement Coordinating Board consisting of IOE, PLN, WJFA, ICLARM and Indonesian government officials.

Surveys are being conducted by an IOE/ICLARM team to document the amazing variety of aquaculture and fisheries activities in West Java. The survey team is endeavoring to find the best available technologies that have potential for direct implementation and employment generation in and around the reservoir regions. From its initial surveys the group has uncovered a wide variety of small-scale common carp, goramy and tilapia culture systems, and productive integrated farming systems that have great potential for implementation in the reservoir drawdown area. In the Subang Regency over 4,000 ha of continuous rice-fish culture exist, consistently producing three crops of juvenile and two crops of table-sized fish, with two rice crops per year.

The Sundanese people of West Java have a long, detailed history in aquaculture, and are proving to be masterful aquaculturists and craftsmen. To date both floating net and integrated pond culture systems are financially viable and have attracted the interest of Bank Rakyat Indonesia. The bank is providing credit to displaced fishfarmers. In the Saguling reservoir some 144 floating net culture systems producing common carp now exist; over 50 are under construction and integrated culture systems are proliferating in the reservoir drawdown area.