

Chapter 12

CASE STUDY—A DAM IN INDONESIA

This chapter is based on presentation notes used at the Manila workshop by Edy Brotoisworo of the Environment Division of ADB. These notes drew on a draft paper on the subject prepared for a World Bank sponsored conference held in Jakarta in 1989. That paper was entitled "Making Dams Work for Displaced Populations: Aquaculture at Saguling Dam, Indonesia" and was written by Otto Soemarwoto. As Professor of Environmental Bio-Management and Director of the Institute of Ecology at Padjadjaran University, Bandung, Indonesia, Soemarwoto led the team that prepared the original environmental impact statement on the basis of which the resettlement strategy for the project was approved. Some excerpts from his original paper have been incorporated into this chapter as boxed quotations.

Making Dams Work for Rural Development

This is the story of the resettlement of people in the Saguling Dam project in Indonesia. Saguling Dam was built in 1985 for the purpose of electric power generation on the Citarum River in West Java, close to the town of Bandung and not far from Jakarta. Earlier, in 1975, two other dams had been built lower down the river to facilitate irrigation development on the coastal plain. The Curug and Jatiluhur dams also had minor generating capacity but their main objective was the delivery of assured irrigation water to 280,000 hectares (ha) of paddy fields. The Jatiluhur dam inundated 8,300 ha and the Curug another 700, so local officials had recent experience of resettlement issues before work began on Saguling dam. The Saguling dam was later, in 1988, followed by the Cirata dam. Between them they had installed power generating capacity of 1,200 megawatts with provision for later expansion.

Saguling is a rockfill dam nearly 100 meters (m) high and over 300 m long. It inundated about 5,600 ha. Of this about 2,260 ha was rice fields, 344 ha were plantations, 133 ha were village settlements, and the remaining 745 ha consisted of roads, rights of way, and the riverbed itself. The whole of Java is very densely settled and this river valley in West Java is no exception. The total of 5,600 ha inundated accounted for a population of 13,737 (about 245 per square kilometer [sq km]) and densities in adjacent locations in the catchment and upper catchment were even greater. In fact, in the upper catchment densities ranged from 281 to 6,183 per sq km with an average of over 1,000 sq km.

Partly as a result of this high density of population, the vegetative cover in the upper catchment had been severely depleted and there was a threat of serious environmental damage with erosion rates averaging 3.35 millimeters per year. The majority of families in the area were engaged in subsistence agriculture and historic records since independence show that there had been a shift of production away from dry field cultivation of coarse grains and cassava towards mixed gardens and the introduction of rice into the wet lowlands. The people were poor, getting poorer, and the dam would deprive many of them of their present livelihoods. With or without the dam, the outlook for them was bleak.

Of the 13,737 people (2,974 families) displaced by the dam, only 4 percent could be interested in the idea of transmigration to one of the outer islands under existing government

programs. Nearly everyone wanted to be resettled on land belonging to their own village that would remain above the high water line (HWL) of the dam, or to somewhere nearby. However, this would just intensify the pressure on available resources. To make matters worse, 63 percent of the rice fields and 35 percent of the dry fields inundated were owned by people who already lived above the HWL. There were other ways in which those above the HWL were dependent on the inundated resources. For instance, in terms of the field work they obtained. This degree of dependence is illustrated by landownership groups in Table 12.1.

Table 12.1
Saguling Dam — Income Dependence for those above HWL
on resources below HWL

Dependency Level (Percent of Income)	Landowner		Farm Laborer		Total	
	No. of Families	Percent	No. of Families	Percent	No. of Families	Percent
Less than 25	1,780	28	419	33	2,199	29
25-49	2,733	43	432	34	3,165	42
50-75	1,525	24	267	21	1,792	23
Greater than 75	318	5	152	12	470	6
Total	6,656	100	1,270	100	7,626	100

In terms of overall living standards, the inundation by the dam would deprive many people of land or work opportunities and result in a rise from 28 to 55 percent of the population that was below the official poverty line. This meant that, without remedial steps being taken, the number of families falling below the poverty line would rise from 2,136 to 4,194. Conversely, whereas before the project 72 percent of families had incomes above the poverty line, after, only 45 percent would be above the poverty line unless something were done to create new opportunities. Such new opportunities were needed not just for those displaced, but also for those living above the HWL, and so not displaced from their home, but who would lose either land or work opportunities. This is a total of about 10,000 people.

Because of the existing high intensity of land use and population pressure, there was no scope for providing new land for the land lost and, apart from those few who were willing to transmigrate to other islands, other nonland based resettlement and rehabilitation alternatives needed to be identified. The project itself creates two new facilities. These are the reservoir/lake and locally available electricity. Resettlement options were then offered to those affected taking into account the water resources, industry, and tourism that could be generated in the local vicinity. The full range of options was:

- Transmigration
- Absorption into the project construction team
- Resettlement in other programs
- Fisheries projects on the reservoir
- Assistance in following another career (own choice)

The fisheries projects based on the reservoir were expected to include three possibilities. These were lake-based fish capture, lake aquaculture (captive farming in floating nets), and, running water fisheries. Some of the steps taken on the background research that became the basis for an extension program are set out in Box 12.1

Box 12.1

Saguling Dam—Research and Extension Approaches to Aquaculture

“A literature study revealed that in the Mekong River Region of Southeast Asia, the people had a tradition of fish culture in floating cages which gave high economic returns. This technology was unknown in Indonesia, although fish cages penned to the bottom of shallow rivers and streams (karamba) were widely practiced in West Java. It was therefore recommended that PLN [The National Power Company] conduct experiments on floating cages and nets, the latter being a modification of the former by substituting nylon nets for the bamboo or wood material of the cage.

“The recommendation was also based on the observation that the people in the Saguling area had a long tradition of aquaculture, albeit not in lakes but in ponds and rice fields, and that the fish farmers were innovative and responded readily to new technologies. Therefore, the probability that they would be willing to adopt aquaculture in the new reservoir was judged to be high.

“At the request of PLN, the Research Center for Fresh Water Fisheries conducted experiments with floating nets at Lido Lake near Bogor with good results. Subsequently, experiments were carried out at Jatiluhur which had more similar conditions to Saguling than Lido. These latter experiments were also used to train people from Saguling.

“When the Saguling reservoir was filled and the water quality became suitable for aquaculture, PLN in cooperation with the Faculty of Agriculture, Padjadjaran University, constructed demonstration plots of floating nets in the new reservoir. At the same time UPTD also started its extension activities.”

Source: “*Making Dams Work for Displaced Populations: Aquaculture at Saguling Dam, Indonesia*” by Professor Otto Soemarwoto and presented at a World Bank sponsored conference in Jakarta in 1989.

In addition, it was proposed to introduce agri-aquaculture along the lake margins where dry season cropping on the exposed lake bottom would be followed by wet season fish culture on the same land, now flooded. With an average slope of about 7 percent, 1,222 ha were identified in the highest part of the inundated land that had an expected flooding period of 241 days each year. An assessment of the overall impact of the different fishing approaches is provided in Box 12.2.

Box 12.2 Saguling Dam—Fish Capture and Culture

“Capture fisheries developed rapidly in the new lake, but over-fishing soon occurred. Fish predator species also became dominant. As a result, the harvest dropped to very low levels of only one-two kg/ha/year, although theoretically the yield in Saguling could reach 45 kg/ha/year. Capture fishing has the advantage that it can be done with little investment and therefore, it can provide a new source of income for the people resettled around the reservoir shoreline. Efforts are being made to increase the productivity of capture fisheries by introducing a freshwater sardine (*Clupeichtys aesarnensis*) from the Ubonratana reservoir in Thailand. This fish species inhabits the pelagic zone which in Saguling lake is uninhabited. It is highly productive and can stand high fishing pressures. Studies showed that the ecology of Saguling was very similar to that of Ubonratana and that with proper precautions possible negative side effects would be minimal.

“The floating net culture developed very rapidly in the initial post-impoundment period, but the floating cages and the pen culture did not. The pen culture could not develop because the water level of Saguling between 1986 and late 1988 was low due to an exceptionally dry season. Much water was needed for the irrigation of the rice fields in the lower plains of West Java and water was also used to fill the just completed Cirata Reservoir downstream.

“The experience of the fish farmers showed that while floating cages and floating nets gave similar economic returns, large floating cages were unwieldy, making repair and harvest difficult. Therefore, the farmers preferred the floating nets and their number went up steeply, while the use of floating cages declined for good technical reasons and finally disappeared from Saguling.”

Source: “*Making Dams Work for Displaced Populations: Aquaculture at Saguling Dam, Indonesia*” by Professor Otto Soemarwoto and presented at a World Bank sponsored conference in Jakarta in 1989.

While some of the affected people opted for each of these approaches, the real success story attaches to the introduction of lake-based aquaculture. The capture program was started early with the introduction of freshwater sardines from Ubonratana in Thailand. However, the development was so rapid that the stocks were over-fished and those involved lost confidence in the reliability of this activity as a secure source of income. Likewise, other approaches were open to seasonal vagaries and uncertainties, but the floating net system seems to have been immune to most of these.

The construction was a bamboo raft with old asphalt barrels to act as floats and nylon nets suspended and anchored in the reservoir by concrete blocks. Each net is 7 meters square and 2.5 meters deep. The fish cultivated are common carp which are harvested after 3 months, giving 3 harvests a year. Each unit consists of 3 nets and needs a workforce of 1.5 adults (including the owner). A further 4.8 jobs are to be had from construction, maintenance, repair, and supply of seedstock (fish fingerlings).

It was determined that, for reasons of health and practicality, only one percent of the surface could be occupied by such rafts. Even so this would allow for the development of 5,800 units each having three nets. If that stage of development was reached, more than 12,000 people would gain employment from the enterprises. The experimental unit of three

nets showed net financial returns of Rp962,000 per year and this translated into annual net returns on commercial units of Rp583,000-750,000, averaging Rp667,000 per year. Income for the families involved increased by 230 percent compared to the base observed prior to the project. A set of keys to the success of such resettlement is provided in Box 12.3.

Box 12.3
Saguling Floating Net Project—Keys to Success

- The people were accustomed to the skills and disciplines of fisheries
- A reliable market was available
- Strong support from local and provincial government, including establishment of a Resettlement Coordination Board at national and provincial levels
- Experimental work done at a nearby lake (Jatiluhur) prior to implementation provided an opportunity to give training to those participating from Saguling
- Coordination between the National Power Company (PLN) and the Directorate General of Fisheries
- Establishment of demonstration units of the floating net system in Saguling
- Establishment of a cooperative among the fishermen
- Setting up a licensing system for floating net fisheries
- Fish population conservation measures established and enforced
- The seriousness of PLN managers in handling all project impacts:
 - Environmental awareness on the part of project managers; and
 - Willingness to include environmental and social considerations in the project planning, execution and operation.

While the general impact was highly positive with the dam being locally regarded as the thing that brought prosperity to the region, there were also some problems. The very profitability of the enterprises has attracted interest from outside the local community. By March 1989, 1.4 percent of unit owners were from Jakarta or other nearby towns. Investment from outside the region would normally be most welcome, but a high level of external control of the facilities and the supply lines could result in the local community being pushed back to the position of wage laborers or worse. A local cooperative and the power to enforce a more selective licensing policy could avoid the disadvantages involved.

The aquaculture itself, and also the new industrial development and residential wastes finding their way into the reservoir, have diminished the quality of the water even for aquaculture. Some gases have reached toxic levels on occasion and algal blooms have occurred. This will require close monitoring and the introduction of regulations and incentives to control the activities most at fault.

The floating net program was not carried out as an integrated part of a holistic scheme to handle the needs of the entire population. Erosion and pollution problems proved very difficult to handle and need to be more closely integrated into other aspects of the project. In any case, the fisheries alone was not enough even for those who selected this approach to their rehabilitation. Because of the delay between the loss of their land and the availability of the dam for the floating nets to be set up, there was a need for income supplements of some other kind. Nevertheless, looking back at the experience, it can be said that the resettlement through fisheries was a significant success story in the tortuous history of resettlement.