

Minimizing the social impacts of dam construction

by Otto Soemarwoto

Dams often have serious ecological and social impacts: in the Saguling case they were indeed very large. But the people adapted and developed fisheries and were able to benefit significantly from the project.

INDONESIA DEPENDS very much on exporting oil for its foreign currency earnings. When oil prices dropped dramatically in 1986 the country suffered heavily, and so is now diversifying its energy production to coal and particularly to hydro. It is clear, however, that dams can have very serious negative social, health, and environmental impacts, and if these impacts are not identified when dams are being planned, and the means sought to mitigate them as part of the plan-

ning process, then the environmental and social costs may well exceed the benefits of the dam.

The Saguling dam

The Saguling dam was built across the Citarum River, creating a reservoir of about 6000 hectares. It is located in West Java, about 30km west of Bandung, the capital of the West Java Province. Downstream of Saguling are the Cirata dam (1986), and the Jatiluhur dam

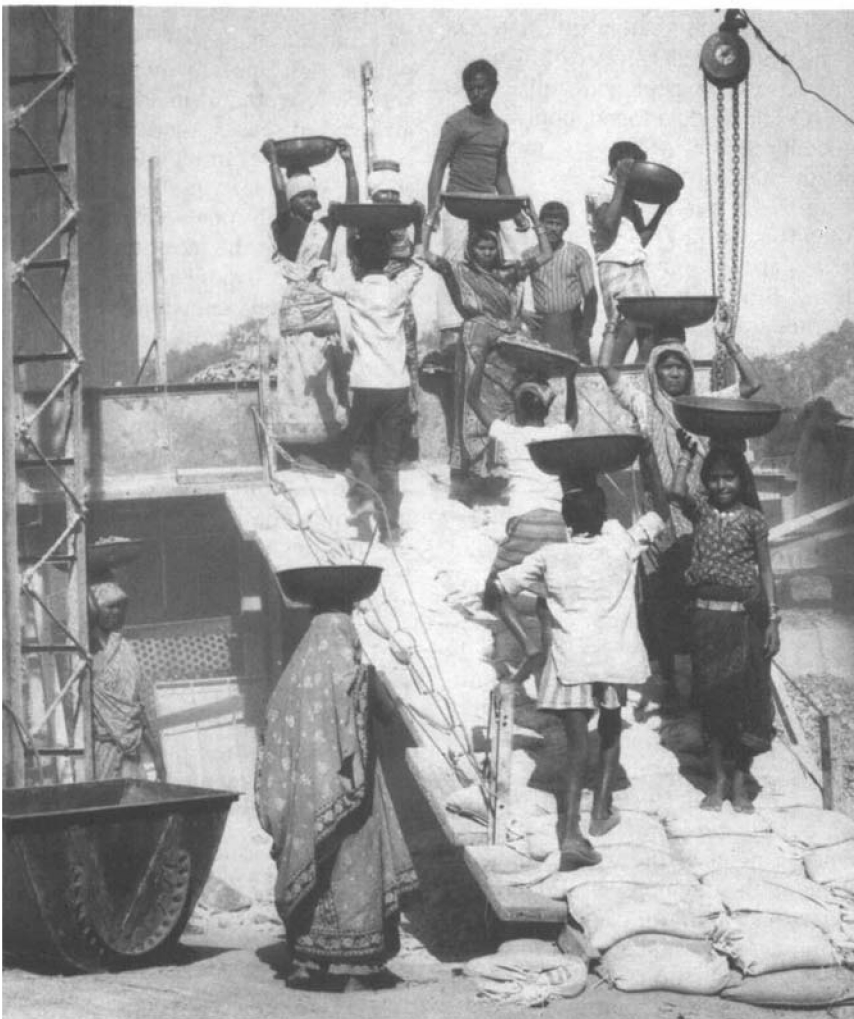
(1960s). The main purpose of the Jatiluhur dam is to provide irrigation water for the lower northern plains of West Java, but it also produces electricity, provides water to Jakarta, and controls floods. Saguling and Cirata were built almost exclusively for the generation of electricity.

Since the dams were funded partly by the World Bank, an Environmental Impact Assessment (EIA) was required for each dam. The Institute of Ecology (IOE) of Padjadjaran University was commissioned to carry out these EIAs. Five options for the resettlement of the people of Saguling were suggested, one of which was fisheries development.

Major impacts

Saguling is densely populated; the inundated area contains close to 14 000 people. The main occupation was agriculture and related activities. The inundated valleys consisted of fertile rice fields and drylands, while the upland fields above the valleys were mostly dry, rainfed, lands. Because of the high population density and a high population growth rate, many people were encroaching into forests, causing considerable deforestation. Marginal lands, such as steep river banks, were also taken into cultivation. The combination of extensive deforestation, steep slopes, high rainfall, and inappropriate farming techniques has, resulted in high erosion rates in the Citarum river basin and its sub-river basins. Based on these observations it was concluded that because of its deteriorating condition, the river basin would eventually collapse.

The proposed dam project would inundate close to 5000ha of agricultural land, further reducing the land/man ratio, which was already low. Research to determine the existence of any protected or endangered species showed only several birds, which would be able to escape the flood, although eggs and young would be lost. The IOE study showed that besides the people directly affected by the inundation, those living above the high water line who depended on resources



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Recruiting local people for construction is the first step in ensuring that there are tangible local benefits.

below would suffer too. Since only about four per cent of the families were willing to be moved outside Java and the majority of people preferred to resettle in villages around the reservoir, population pressure would increase and exacerbate the erosion problem. Clearly, the Saguling area was facing a difficult dilemma: without the project it was heading towards collapse, but with the project Saguling would face an accelerated collapse. Ways and means had to be found to resolve this dilemma.

Fishing options

The studies showed that the Sundanese people who inhabited the area had a deep-rooted culture of fisheries. It was possible that although land was being lost, a new resource could be formed in its place, i.e. a water body which could be used for fisheries development. It was judged that, with proper training and extension, the probability was high that the people would be willing to adopt fisheries as their new livelihood.

Experience elsewhere showed that capture-fisheries usually develop spontaneously. A second possibility was aquaculture. In the Mekong river the people traditionally culture fish in floating cages. Experiments on floating nets (modifications of the floating cages) were successfully carried out by the Fresh Water Fisheries Research Institute at Lido Lake, near Bogor, and subsequently at Jatiluhur Lake. The latter experiment was also used to train the prospective fish farmers of Saguling. When the Saguling Lake was formed, floating nets were constructed there by PLN to serve as demonstration plots.

In the meantime, the people were also constructing floating cages made of bamboo. These were modifications of traditional cages, which are usually small and anchored to the bottom of shallow streams by pens. In Saguling the cages were floated on used metal barrels. The evidence in a 1979 report also suggested that pen culture in Saguling Lake's many small bays could work. A small bay could easily be fenced and fish cultured in the enclosure.

The production of capture-fisheries developed rapidly at first, but soon declined dramatically. The decline was a result of overfishing and of the development of a *hampal* (a predator fish species) population,



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If the people already have a tradition of fishing and an acceptable species is viable, fish culturing could be very profitable.

which has entirely dominated the fish population of Saguling. To improve the capture-fisheries it has been recommended that the government:

- stock the reservoir periodically with *Oreochromis mosambicus* and the Nile tilapia;
- introduce the freshwater sardine from the Ubolratana reservoir in Thailand, which is known to be very productive and can withstand high fishing pressures; and
- limit the number of fishermen by issuing personal licences.

In the end, floating cage culture and pen culture did not develop well either. Cage culture failed because the cage was an unwieldy structure which was awkward to handle, and when a leak occurred it was difficult to repair. Harvesting the fish was also difficult. Our experiments with the pen culture gave good results, and people were starting to build them. The rainfall in the dry season of 1987 was exceptionally low, however, and the Cirata dam, which had just been finished and was located downstream of the Saguling dam, had to be filled. Furthermore, the rice fields in the northern plains of West Java required more irrigation water

because of the exceptional dry season, so the water level of Saguling Lake dropped to very low levels until almost the end of 1988. Thus it had become impossible to operate the pen cultures.

Success

The floating nets, however, were developing very fast, and by the end of 1988 there were about 1300 of them. By this time production from Saguling already accounted for about 20 per cent of the total fresh-water fish production of the entire district of Bandung. The fish produced was valued at about Rp5 billion/year. This was about two-and-a-half times the value of the rice produced in the rice fields in the inundated areas before the dam, and the number of nets was still only 25 per cent of the potential number recommended by IOE. Several factors contributed to this very fast development.

The floating nets are very well suited for the culture of the common carp, which is preferred by the Sundanese and is cultured widely in West Java. The Sundanese were already very familiar with the culture of this fish, and the market

already well developed, so there were no major difficulties encountered in the adoption of this fish. Profits from the floating nets were very high, varying between Rp130 000 and Rp540 000/net/3 months. The nets usually measure 7m×7m and are 2.5m deep.

The average fish farm unit consists of three nets, employing on average 1.5 people/farm unit, including the owner. Our survey showed that the people who were employed on the floating nets earned on the average 230 per cent of their pre-inundation income, and their nutrition was much improved by their increased consumption of fish. With 1300 nets in use, about 650 people were directly employed by the floating nets. IOE estimated that a maximum of 1 per cent of the total reservoir surface area could be used for aquaculture without danger of pollution. On the basis of this estimate and considering also the fluctuations of the reservoir surface, on the average about 5000 floating nets could be operated, if evenly distributed around the lake. Judging from the experience in the past, this number would be reached within two to three more years at the latest. Eventually 2500 people would be directly employed using the floating nets. The 14 000 people who were displaced by the dam and had an annual population growth rate of 2.16 per cent would by that time number around 18 000, or 4000 families. Hence, about 62.5 per cent of the heads of the displaced families could be employed on the floating nets. In addition jobs have been created in the construction of nets, the marketing of fish, the production and marketing of fingerlings, and the production of fish feed. As an illustration, with a stocking density of 2.4kg/m³, the existing 1300 nets need 130 tons of fingerlings per month. With a price of Rp2400/kg this amounts to more than Rp300 million. It is difficult, however, to quantify the number of jobs created, since many merchants do not trade fish specifically from Saguling or produce fingerlings for Saguling only.

Naturally the success of Saguling has not been without problems. Although the floating nets give handsome economic returns, they are highly capital intensive. The construction of a unit of a floating net of 7m×7m×2.5m costs about Rp390 000. At a seeding density of 2.4kg/m³ the cost of fingerlings is Rp720 000 and feed Rp750 000.

Clearly, only the well-to-do people are able to run such enterprises. Efforts were therefore made to reduce the costs so that poorer people would be able to benefit from the development.

The farmers usually use double nets to reduce the risk of fish loss should the net be damaged. Experience has shown, however, that the risk of damage was negligible. By improving the techniques of construction and using single nets, the cost of construction was reduced from Rp390 000 to Rp280 000. Further experiments also showed that strong bamboo rafts could be built without barrels. The cost of such construction with single nets was only Rp180 000. Another development was the construction of very cheap small-scale floating nets for the production of Nile tilapia fries, using banana stems as floats. The cost of the raft itself was only Rp2000 to Rp3000, and with the nets Rp35 000.

Spin-off ventures

Feeding experiments with the common carp showed that fish feed made from earthworms gave similar results to commercial feed, while rabbit meat, which the Sundanese raise for dung but do not eat, gave slightly lower growth. It was also demonstrated that the broodstock of fish which were given earthworms as a supplement in their feed produced twice as many eggs and fish larvae compared to those which were fed only on commercial feed. Furthermore, fertilizing the fishponds with the earthworm castings also increased the production of fingerlings three to four times. The production of rabbits and earthworms can easily be done by poor people, since it requires only minimal skill and capital investment. There are indications that the number of rabbit and earthworm farmers is growing.

Another approach to the problem of operational cost was to lower the density of fish stock in the net. Experiments demonstrated that by lowering the density the cost of feed and seed stock was reduced by 60 per cent. Since the supply of fingerlings cannot currently meet the demand, the reduction in stocking density will not affect the fingerling producers.

There are other problems which are beyond the control of IOE. The first one is that word about the profitable fish farming has spread

and has started to attract capital from cities. If this continues, it would compete with the relatively weak farmers and could put them out of business, or reduce them to low-paid labourers instead of owner/operators.

A second problem is the threat of pollution. Saguling is located just downstream of the city complex of Bandung-Cimahi-Padalarang, which has a large population and active industrial development. Domestic and industrial wastes are released into the Citarum with little or no treatment, and as a result the Saguling reservoir is quite polluted and apt to worsen. Should this downward trend of the water quality continue, Saguling could become unsuitable for aquaculture, specifically for the common carp which is the most desired fish species. A plea has been made to the government to solve this problem.

Dam construction has been sharply criticized because of its negative impacts, but many of the traumas can be avoided if the people in the area are recognized to be an invaluable resource, if they have the right to enjoy the fruits of development, and if mitigating measures are taken as early as possible. It is suggested that as soon as the decision for the construction has been taken, plans should be made for:

- Recruiting the local people for construction work which suits their skills and educational level. This effort can be enhanced by giving them the necessary training.
- Channelling electricity to the surrounding villages for lighting the people's homes and public buildings, including the houses which will be used for resettlement, and for developing village and home industries.
- Using these developments as incentives for the people from the inundated areas to move to areas above the high water line as early as possible.
- Developing fisheries in the reservoir and training the people to enable them to use the new opportunities.

By taking these steps the forced resettlement could become a voluntary one, but only if there are opportunities and benefits for those who move to areas above the high water line.

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