BACKGROUNDER

The Hidden Costs of Mangrove Services: Use of Mangroves for Shrimp Aquaculture

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Mangroves are a dominant ecosystem of tropical and sub-tropical coasts. They not only provide valuable goods (e.g. wood and fish) but also vital ecological and other services (e.g. sequestration of carbon, navigable waterways and prevention of coastal erosion).

Some 63,000 km^2, or about a third of the world's mangrove, occurs in Southeast Asia, much of it in Indonesia. This is only about 2% of the total land area, which makes mangroves a scarce and very valuable resource. These mangroves are also the most luxuriant and most biologically diverse in the world. Yet, they are being destroyed at a very alarming rate: conservative estimates suggest that there is now only half the area of mangrove there was 50 years ago.

The three major threats to mangroves are human population pressures, large-scale harvest for wood chips used by the rayon industry and conversion to aquaculture ponds:

The development of shrimp aquaculture ponds has been responsible for much of the mangrove destruction in the past 20 years or so. The driving force is the high demand for shrimps in the developed countries and the governments of developing countries grossly undervaluing their mangroves*. There is one huge hidden cost - the oxidation of mangrove carbon:

Measurements suggest that mangroves are able to sequester some 1.5 tonnes of carbon per hectare per year**. This is approximately equivalent to the amount of carbon a motor vehicle releases to the atmosphere each year (assuming each car uses approximately 2,500 litres of petrol per year). Indonesia, with her 4.5 million hectares of mangrove can use her mangroves to scrub the carbon dioxide emissions of some 5 million cars. This surely is a bargaining chip for any carbon trading!

The upper layers of mangrove sediments have a high carbon content (a conservative estimate is 10%). Each hectare of mangrove sediment would then contain some 700 tonnes of carbon per metre depth. Digging up 2 metres of soil to create ponds could result in the potential oxidation of 1,400 tonnes per hectare per year. Assuming that only half of this will become oxidised over a period of 10 years, we are looking at the return of 70 tonnes of carbon per hectare per year to the atmosphere. This is some 50 times the sequestration rate. This means that by converting a mere converting a mere 2 percent of mangroves to aquaculture ponds, all the advantages of mangroves as a sink of atmospheric carbon will be lost!

Sustainable solutions

Many large areas of pristine luxuriant mangroves have been harvested for wood chips by the rayon industry, leaving tracts of degraded mangroves. These may eventually recover but would take a much shorter time had the harvest been sustainably managed. The problem is essentially one of mangroves being grossly undervalued and economic exploitation with little or no regard to environmental sustainability.

In fact, mangroves can be very successfully managed for sustainable timber production – the Matang Mangroves in western Peninsular Malaysia are a classic example.*** The management system, first started at the beginning of the 20th century, is based on a 30 year rotation. Small areas are clear-felled in a patchwork manner, and allowed to regrow before the next harvest.

This management system can be suitably modified and applied to the harvesting of mangroves for wood chips so that the rayon industry can be more ecologically friendly as well as socially and politically more correct. In the long-term, this can only result in a win-win situation that ensures the sustainability of both the mangrove ecosystem and the exploiting industry.

Human population growth

Many mangroves have virtually disappeared as a result of human population growth and immigration to the coastal zone (e.g. Jakarta Bay, Manila Bay and Singapore). This is essentially a socioeconomic problem of human population regulation, which is outside the scope of this paper. However, urbanisation and its associated problems are discussed in another paper in this session.

The coastal zone

Removal of mangroves is just one of the ever-increasing range of stresses being put on the coastal zone. Occupying just 20% of the global land surface, it is home to more than half the world's population, a figure that is rapidly increasing. Associated with this land-use change are problems of pollution, exploitation of coastal fisheries and degradation of coastal ecosystems.

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* Ong, J.E., Gong, W.K. & Chan, H.C. (2001). Governments of developing countries grossly undervalue their mangroves? pp. 179-184 *in*: UNEP, 2001. *Proceedings of the International Symposium on Protection and Management of Coastal Marine Ecosystems.* Bangkok, Thailand, 12-13 Dec. 2000. EAS/RCU UNEP Bangkok, Thailand 279 pp.

Gong, W. K. & Ong, J. E. (1990). Plant biomass and nutrient flux in a managed mangrove forest in Malaysia. *Estuarine, Coastal and Shelf Science* **31: 519-530.
Ong, J.E. (1993). Mangroves – a carbon source and sink. *Chemosphere* **27**: 1097-1107.

*** Ong, J.E. (1982). Mangroves and aquaculture in Malaysia. *Ambio* **11**: 252-257.

Some Further Relevant Papers

1. Ong, J.E. (1982). Mangroves and aquaculture in Malaysia. *Ambio* **11**: 252-257.
2. Gong, W. K. & Ong, J. E. (1990). Plant biomass and nutrient flux in a managed mangrove forest in Malaysia. *Estuarine, Coastal and Shelf Science* **31**: 519-530.
3. Ong, J.E. (1993). Mangroves – a carbon source and sink. *Chemosphere* **27**: 1097-1107.
4. Ong, J.E (1995). The ecology of mangrove conservation & management. *Hydrobiologia* **295**:343-351.
5. Ong, J. E., Gong, W. K. & Clough, B. (1995). Structure and productivity of a 20 year-old stand of *Rhizophora apiculata* mangrove forest. *J . Biogeography* **22**: 417-424.
6. Ong, J.E., Gong, W.K. & Chan, H.C. (2001). Governments of developing countries grossly undervalue their mangroves? pp. 179-184 *in*: UNEP, 2001. *Proceedings of the International Symposium on Protection and Management of Coastal Marine Ecosystems.* Bangkok, Thailand, 12-13 Dec. 2000. EAS/RCU UNEP Bangkok, Thailand 279 pp.

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