

Water Quality Management Issues in Lingayen Gulf, Philippines and Some Proposed Solutions

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The need to formulate and implement an integrated coastal area management plan in Lingayen Gulf, Philippines has been recognized in the light of increasing conflicts of use, resource depletion and degradation, particularly its deteriorating water quality. Lingayen Gulf, a semi-enclosed body of water located in the northern part of the Philippines is a major fishing and tourism area in the country.

The Gulf is the catchment basin of major rivers in the region and consequently of the pollutants within its immediate vicinity. Pollution coming from point and nonpoint sources is identified and includes high microbial levels from domestic sewage; trace metals from mining activities; and siltation and sedimentation resulting from logging and mining operations and explorations. Implications of pollution from such sources on health, socioeconomics and ecology are discussed. Several recommendations to mitigate the adverse effects of sewage contamination, mining exploration and logging are proposed.

Lingayen Gulf is a semi-enclosed body of water located in the northern part of Luzon Island, Philippines. With an area of 2,100 km², the Gulf spans two provinces, Pangasinan and La Union. Pangasinan Province is characterized by extensive floodplains while La Union is flat with some portions characterized by high relief areas. The Agno, Bued, Patalan and Dagupan rivers drain into Lingayen Gulf.

The increasing concern for the continuing deterioration of the quality of the coastal waters of Lingayen Gulf stems from the potential economic and social costs that may result as a consequence of neglect, irresponsibility and abuse in the utilization of the Gulf.

Benefits from the Gulf are numerous. For instance, small-scale fisheries alone reported a total of 19,118 tons in 1987 (BFAR, 1987). Moreover, brackishwater aquaculture of shellfish and finfish serves both local and export markets. Other thriving industries are based on aquarium fish and processed shells (ornamental shellcraft).

The tourism industry which promotes mainly primary contact sports and recreation such as swimming, snorkeling, skin- and scuba diving and underwater photography is also thriving.

Water Quality Problems in Lingayen Gulf

Activities along the coast such as aquaculture and agriculture have introduced fertilizers and pesticides into the Gulf while activities farther inland such as logging, mining and gold panning processes in the watershed have increased silt/sediment load and trace metals. Furthermore, the rapid population increase and the consequent concentration of human settlements along the coast have further aggravated the already deteriorating condition of the Gulf in terms of increased volume of domestic waste, untreated sewage and garbage.

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Microbial contamination

Microbial (total coliform and *E. coli*) contamination of the coastal waters can be attributed to the inadequate sewage system of the urban centers and the absence of sewage treatment facility (TCI, 1985; CSWCD, 1988). Raw domestic sewage is directly discharged into the coastal waters. With the high rate of population increase around the Gulf, contamination from domestic sewage is expected to increase several fold by the year 2000 (TCI, 1985).

Epidemiological concern arises from the fact that aquaculture sites for shellfish (oysters) and finfish (milkfish, groupers, siganids) for export and local consumption are located within the tidal influence of Dawel and Dagupan rivers which have been classified by the Seafarming Research and Development Center as unfavorable for oyster growing in terms of microbial content (Palpalatoc et al. 1986). Philippine water quality criteria for coastal and marine waters require that waters utilized for the propagation and harvesting of shellfish for commercial purposes (Class SA) shall have a geometric mean of the most probable number (MPN) of coliform of 70 MPN/100 ml during a 3-month period and that the limit indicated shall not be exceeded in 20% of samples taken during the same period (DENR, 1989). Dawel River which joins the Dagupan River 1 km from Lingayen Gulf produces 86.6 tons of oyster per year. It showed a high value of 24,000 for both total coliform/100 ml and fecal coliform /100 ml for May 1989 with other months registering lower values (SRDC, 1989).

Fertilizers and pesticides

Among the readily available commercial pesticides are 2,4 D amine, malathion, paraquat, dieldrin and aldrin (FPA, 1988). Many of the synthetic organochlorine and organophosphate pesticides have been found to be present in the tissues of marine organisms (Taylor, 1989) and are considered hazardous even at low concentrations (Eisler, 1972). Fertilizers commonly used are urea, ammonium phosphate, ammonium sulfate and ammonium nitrate (FPA, 1988). In La Union Province there are 270,910 ha of agricultural land while in Pangasinan irrigated rice land comprises 90,282 ha. The chemical inputs applied to these farms find their way to the Lingayen Gulf during periods of heavy rains and flash floods.

Coastal aquaculture practice along Lingayen Gulf involves the application of fertilizers (e.g., chicken manure, urea and 16-20-0) and various pesticides in tidal ponds. A total of ninety eight per cent of the 2,674 ha of ponds surveyed in 1988-89 used pesticides at 150 ml/ha at 5 cm water depth (Palma, in press). During tidal flushing the Gulf serves as the ultimate recipient of the used water containing fertilizers and pesticides from these ponds; however, their levels in the Gulf have yet to be determined.

Mining

Trace metals (mercury, cadmium, zinc, lead, copper and iron) levels in the water column were found to be within permissible levels (Dela Rosa et al. 1985). Levels in sediments (in $\mu\text{g/g}$) were as follows: Cu, 33 to 406; Zn, 40 to 383; Pb, 21 to 251 and Fe, 3,533 to 62,000. At present there are no Philippine standards for permissible levels of trace metals in sediments.

The possibility of resuspension of these metals into the water column through bioturbation by benthic organisms (Suchanek and Colin, 1986; Cheng-Han and Lick, 1988) and their eventual bioavailability to marine organisms are a cause for concern.

Along the upland Baguio Mining District are six major mining corporations registered as presently exploring and mining for gold and silver, three of which are exploring and mining for copper in addition to gold and silver. Exceptionally high levels of these metals and sediments (suspended solids) were detected (TCI, 1985; Maaliw et al. 1989) along Agno River specifically below the mine tailings dams especially during the wet season when typhoons and storms destroy parts of the dams. Direct discharge of the tailings into the nearby creeks and into the rivers have been documented (TCI, 1985).

Gold panning, a lucrative livelihood activity in the Baguio Mining District, is a suspected source of mercury contamination. Gold panners usually recover 7-8 g of gold per day along the tributaries; they are suspected of still employing the crude but cheap amalgamation process of gold extraction.

Siltation

Large volumes of silt and sediment are continually being deposited into Lingayen Gulf via the river systems and during flooding of the floodplains of Pangasinan. In 1983-84, studies showed that stations along the Limahong Channel and mouth of Agno River exceeded the Classes SC and SD waters in terms of dissolved and suspended solids (Class SC are marine and estuarine waters whose best uses are for the propagation and growth of fish and other aquatic resources while Class SD are marine and estuarine waters ideally used for cooling and processing (DENR, 1989)).

Furthermore, sediments deposited in irrigation canals have resulted in reduced productivity of agricultural lands. Desilting of canals has cost the government Philippine Pesos 3.75 Million in 1979 (Junio, 1979) which in 1989 has almost doubled to Philippine Pesos 6.4 Million (NIA, personal communication).

The volume of silt has increased tremendously due to the increased rates of erosion arising from unregulated logging in the upper watershed area, the increased slash and burn activities intended to convert forest lands to agricultural farms, and mining exploration and operation which removed the original forest cover (NIA, personal communication). Sheet erosion occurs especially during the wet season; the flash floods carrying tons of sediments into the Gulf with the plume sometimes reaching several kilometers offshore.

In addition, serious coastal erosion occurs in several parts of Lingayen Gulf, especially in the eastern coast. Causes of coastal erosion are destructive wave action, typhoons and tropical storms and mining for minerals (Wong, 1989).

Ecological impacts of heavy load of sediment include the smothering of benthic organisms especially in coralline areas and the reduction of primary productivity due to increased turbidity.

Proposed Solutions

Aside from the problem of environmental degradation, other issues which have been identified in the Lingayen Gulf are resource use conflict and overexploitation of the resources. In response to these issues, an integrated coastal management plan is presently being formulated for Lingayen Gulf. Several Task Forces have been formed to address the management issues.

The Task Force on Environmental Quality Management has been organized to plan for the immediate and long-term solutions to the water quality problem. It aims to formulate specific management policies and identify strategies and recommendations to reduce the degradation of water quality and ultimately to improve the present quality of the coastal waters of Lingayen Gulf. The proposals recommended for implementation are as follows:

1. *Preparation of a master plan for a sewerage system in Region I.*
As an initial step aimed at reducing microbial contamination and possible nutrient enrichment and eutrophication, a master plan must be prepared for submission to the Philippine National Government for financial support.
2. *Water quality monitoring of the six major river systems discharging in Lingayen Gulf.*
This proposal aims to determine levels of heavy metals, pesticides, microbial contamination and other physico-chemical parameters in Lingayen Gulf over a 3 year period.

3. *Surveillance, enforcement and monitoring of mining operations within the Baguio Mining District.*
This is aimed at determining compliance with Pollution Rules and regulations.
4. *Epidemiological monitoring.*
It is proposed that presence of microbial organisms (fecal coliform), enteropathogens such as *Salmonellae* and parasitic helminths (e.g., *Ascaris*, *Trichiuris*) be determined for marine organisms cultivated and harvested for commercial purposes (e.g., oysters).
5. *Establishment of a pilot solid waste disposal system for urban centers.*
This recommendation aims to address indiscriminate solid waste disposal through institutionalized and systematic solid waste collection.
6. *Upper watershed management and rehabilitation plan.*
A protection scheme through community contracts and surveys of watershed is proposed.
7. *Information-education campaign on environmental protection.*
Targets are users of forest resources such as "kaingeros" or slash and burn farmers, loggers, upland residents and support groups and nongovernmental organizations.
8. *Training program to upgrade the technical capability of the research institutions and regulatory agencies within Lingayen Gulf.*
Technical personnel will undergo training on environmental management and scientific methodologies and procedures on environmental surveillance.

It is hoped that with the strong political will and enthusiasm prevailing in the region, the coastal resource management plan for Lingayen Gulf will be adopted by the Regional Development Council and immediately implemented. The active participation of government line departments and agencies in collaboration with nongovernment organizations is necessary for the successful implementation of the various action plans. It is believed that the immediate resolution of the conflicts and management issues would promote the long-term sustainability of economic and social benefits for the residents of the coastal areas within Lingayen Gulf.

(Note: The earthquake which occurred on July 16, 1990 in the northern part of the Philippines destroyed infrastructure in the commercial centers, damaged fishponds and coastal residences amounting to Philippine Pesos 5-10 Billion. The national government will undertake massive rehabilitation of the coastal municipalities as its priority which may affect the timetable for implementation of the integrated coastal area management plan).

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