

Enhancing the Fishery Resources in Philippine Lakes: The Philippine National Inland Fisheries Enhancement Program

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This article is based on the paper presented by Dr. Adelaida L. Palma during the Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region organized by the Southeast Asian Fisheries Development Center on 27-30 July 2015 in Pattaya, Thailand. In her paper, Dr. Palma discussed the efforts of the Philippines through its Bureau of Fisheries and Aquatic Resources (BFAR) - Inland Fisheries Technology Center (IFTC) in enhancing fish production from 36 lakes and reservoirs in the sixteen regions of the country. Specifically, BFAR-IFTC conducts research and develops rehabilitation measures for indigenous freshwater fish species, e.g. *Leiopotherapon plumbeus*, *Anabas testudineus*, *Clarias macrocephalus*, *Ophicephalus striatus*. As part of the promotion of its initiatives, BFAR-IFTC established a network of private hatcheries to sustain the fish fingerling requirements. A prototype model of such initiatives is the physical restoration and reconstruction of the fisheries in 7-ha Dagatan Lake.

about 106,330 ha of swamplands, 19,000 ha of reservoir and dams, and 31,000 rivers with total area of approximately 10,892,300 ha (Pongsri *et al.*, 2015). These resources host some 340 freshwater fishes (Fishbase, 2015), 16% of which

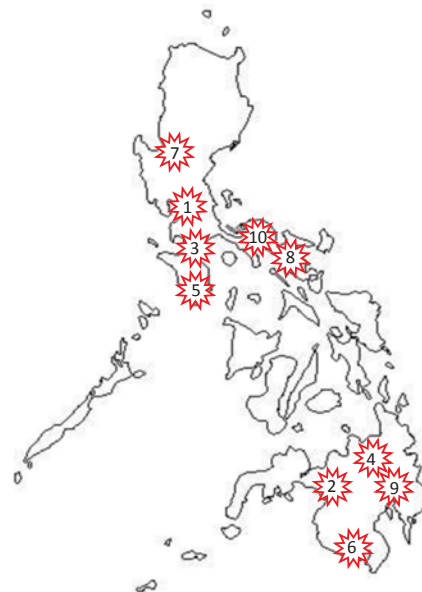


Fig. 1. Map of the Philippines showing the 10 major lakes of the country

The Philippines embraces more than 80 lakes with a total area of more than 200,000 ha (Palma, 2016), 10 of which could be considered major lakes in view of their surface areas and economic importance (Box 1, Fig. 1). In addition, there are

Box 1. Ten major lakes in the Philippines

1	Laguna de Bay: Total area: 93,000 ha; depth: 2.8 m; located in Luzon Island of the Philippines. Third largest freshwater lake in Southeast Asia; and hosts 34 species of zooplanktons and 33 fish species, 14 of which are indigenous and 19 are exotic or introduced.
2	Lake Lanao: Located in Lanao del Sur in Mindanao Island; surface area: 34,000 ha; maximum depth: 112 m: one of the 15 ancient lakes in the world; home to 18 endemic species of cyprinid fish and 42 endemic freshwater crab species.
3	Lake Taal: Located in the Province of Batangas; surface area: 23,420 ha; maximum depth: 198 m; at center lies a volcano island with its crater lake considered as the world's "largest lake on an island in a lake on an island;" host to the world's famous freshwater sardine (<i>Sardinella tawilis</i>) locally known as <i>tawilis</i> .
4	Lake Mainit: Located in northeast Mindanao and bounded by Surigao del Norte and Agusan del Norte Provinces; surface area: 17,340 ha; maximum depth: 223 m; haven to 12 species of fish, 2 of which are endemic, i.e. <i>bolinao</i> (<i>Neostethus thessa</i>) and <i>baguan</i> (<i>Hypseleotris agilis</i>).
5	Lake Naujan: Located in the Island of Mindoro; surface area: 8,125 ha; lowest depth: 50 m; habitat of the endangered freshwater crocodile (<i>Crocodylus mindorensis</i>) and several commercially important species of fish, i.e. <i>Mugil dussmiere</i> (local name: banak), <i>Chanos chanos</i> (milkfish or bangus), <i>Caranx sexfasciatus</i> (talakitok), a species of shrimp (<i>Atya</i> sp.) and bivalve <i>Corbiculla</i> sp. (<i>tulya</i>).
6	Buluan Lake: Bordered by Maguidanao and Sultan Kudarat Provinces; surface area: 6,134 ha; elevation: 4.3 m; home to the country's nine commercially important fish species, i.e. climbing gourami (<i>Anabas testudineus</i>), snakehead murrel (<i>Channa striata</i>), milkfish (<i>Chanos chanos</i>), walking catfish (<i>Clarias batrachus</i>), common carp (<i>Cyprinus carpio carpio</i>), sundari bele (<i>Glossogobius giuris</i>), Mozambique tilapia (<i>Oreochromis mossambicus</i>), spotted barb or common barb (<i>Puntius binotatus</i>), snakeskin gourami (<i>Trichopodus pectoralis</i>).
7	Pantabangan Lake: Earth-filled embankment on Pampanga River, located in Nueva Ecija Province; surface area: 5,293 ha; elevation: 232 m; provides water mainly for irrigation and hydro-electric power generation.
8	Lake Bato: Located in Camarines Sur Province; surface area: 2,810 ha; depth: 8 m.
9	Pulangi Lake: Artificial lake created by a Hydroelectric project on the Pulangi River in Bukidnon Province; Area: 1,985 ha.
10	Lake Buhi: Located in Camarines Sur Province; surface area: 1,707 ha; average depth: 8 m; one of the few habitats of the world's smallest commercially-harvested fish <i>Mistichthys luzonensis</i> (local name: <i>sinarapan</i>)

Table 1. Total fisheries production of the Philippines (in thousand metric tons (MT)), 2004-2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Production	3,926.2	4,161.9	4,412.2	4,711.0	4,964.7	5,084.7	5,155.7	4,973.6	4,865.7	4,695.4
Marine capture	2,067.1	2,122.2	2,514.8	2,327.8	2,377.5	2,418.8	2,424.5	2,171.8	2,145.2	2,127.4
Aquaculture	1,717.0	1,895.9	2,092.3	2,214.8	2,407.7	2,477.4	2,545.8	2,608.1	2,524.7	2,373.4
Inland capture	142.1	143.8	165.1	168.4	179.5	188.5	185.4	193.7	195.8	194.6

Sources: SEAFDEC (2010); SEAFDEC (2015)

are endemic, 56% indigenous and 28% exotic. In spite of such vast resources, the country's fish production from inland capture fisheries in 2013 comprised only about 4% of its total fisheries production (SEAFDEC, 2015). An analysis of the inland fisheries production trend of the Philippines (Fig. 2) during the past ten years (2004-2013) shows that production stagnated to an average of about 190,000 metric tons (MT) per year (Table 1).

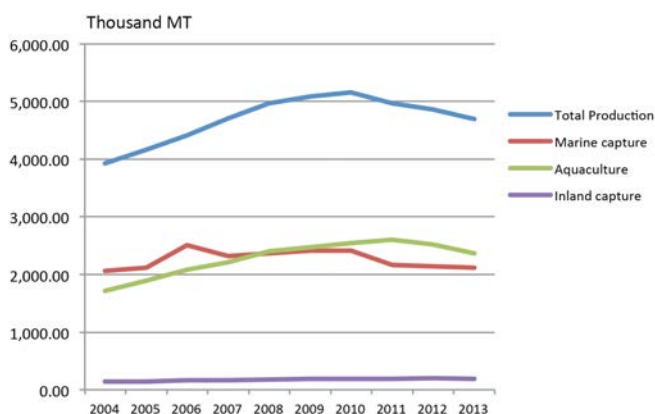


Fig. 2. Total inland fisheries production of the Philippines compared with the country's total fisheries production (2004-2013)

Sources: SEAFDEC (2010); SEAFDEC (2015)

BFAR National Inland Fisheries Enhancement Program

Based on the abovementioned information, production from the country's inland water resources could be lower than 50 kg/ha/year. Considering that these resources could provide the nutritional requirement through food fish for the poor rural people, the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) embarked on an ambitious program of rehabilitating and/or restoring the physical conditions of lakes and reservoirs, specifically focusing on minor lakes as their development had been mostly overlooked or to some extent abandoned for low economic returns. Known as the National Inland Fisheries Enhancement Program (NIFEP), this initiative is mainly aimed at restoring the conditions of lakes to optimize their economic benefits; enhancing the fisheries towards sustainability to alleviate poverty in rural areas; and repopulating indigenous species in support of biodiversity conservation and food sufficiency.

A 5-year program, NIFEP applies scientific approach to fish stocking utilizing the vacant-niche and the food-base approach to maximize production from these resources. This food-base approach explores the natural productivity of lakes and reservoirs, where the available natural food is analyzed qualitatively and quantitatively, and its production capacity is converted into fish production, where the natural food present is matched with the species of fish to be stocked. NIFEP comprises five main components, namely: (1) Social Preparation and Capacity Building — organization of the management teams comprising a national coordinator, regional focal persons and technical support staff; and strengthening of the fisherfolk beneficiaries; (2) Resource Profiling — validation of project sites, upgrading of Regional Water Quality Laboratories, and water quality and productivity profiling; (3) Habitat Restoration — clearing of aquatic weeds and buffer zone rehabilitation; (4) Rationalized Fisheries Enhancement (using the food-base approach to open water stocking) — establishment of habitat structures as specific management areas in coordination with local government units, and introduction of culture-based open water fisheries; (5) Monitoring and Evaluation — making use of fish production/catch survey.

Ongoing Inland Fishery Resources Enhancement Activities of NIFEP

As of 2015, the fishery resources in 16 lakes, reservoirs and dams, and six river sanctuaries have been rehabilitated for additional fish production from inland capture fisheries. These are located in Cordillera Administrative Region (CAR) - 2, Region II - 1, CARAGA Region - 2, Region IV-A or CALABARZON Region - 11, and 6 river sanctuaries also in CALABARZON Region (Table 2). The major activities carried out in these areas include water quality monitoring, promotion of sustainable culture management, restocking and stock enhancement, repopulation of indigenous fish species, habitat restoration, control of invasive and introduced species, and establishment and/or maintenance of fish refuge, among others. NIFEP is targeting to expand its activities to other lakes, reservoirs, dams and rivers in the near future (Fig. 3).

Table 2. Current activities of NIFEP (As of 2015)

Region	Lakes and Dams	Activities
Cordillera Administrative Region (CAR): Abra, Benguet, Ifugao, Kalinga, Mountain Province, and Apayao	Ambuklao Dam and Binga Dam, Benguet Province	<ul style="list-style-type: none"> Water quality monitoring Culture Management Open water stocking Repopulation of indigenous fishes
Region II (Batanes, Cagayan, Isabela, Nueva Vizcaya, and Quirino)	Magat Dam, Isabela Province	<ul style="list-style-type: none"> Water quality monitoring Establishment of Magat Inter-agency Task Force Development of Aquapark to promote culture management Open water stocking Repopulation of indigenous fishes
CARAGA Region (Agusan del Norte, Agusan del Sur, Surigao del Norte and Surigao del Sur)	Lake Mainit, Surigao Province	<ul style="list-style-type: none"> Management of Goby Fisheries Capacity Building
	Lake Mahucdam, Surigao	<ul style="list-style-type: none"> Water quality profiling Proposed establishment of brush park Open water stocking
Region IV-A or CALABARZON (Cavite, Laguna, Batangas, Rizal, and Quezon)	Bal-on Reservoir, Quezon Province	<ul style="list-style-type: none"> Habitat restoration
	6 River sanctuaries, Rizal Province	<ul style="list-style-type: none"> Maintenance of fish refuge Open water stocking
	Laguna de Bay, Rizal	<ul style="list-style-type: none"> Maintenance of Municipal fish sanctuaries Control of invasive species
	7 lakes of San Pablo City and Tadalak Lake in Laguna	<ul style="list-style-type: none"> Capacity Building Open water stocking
	Dagatan Lake, Quezon Province	<ul style="list-style-type: none"> Habitat restoration Buffer zone rehabilitation Water quality monitoring Maintenance of fish refuge Fisheries repopulation

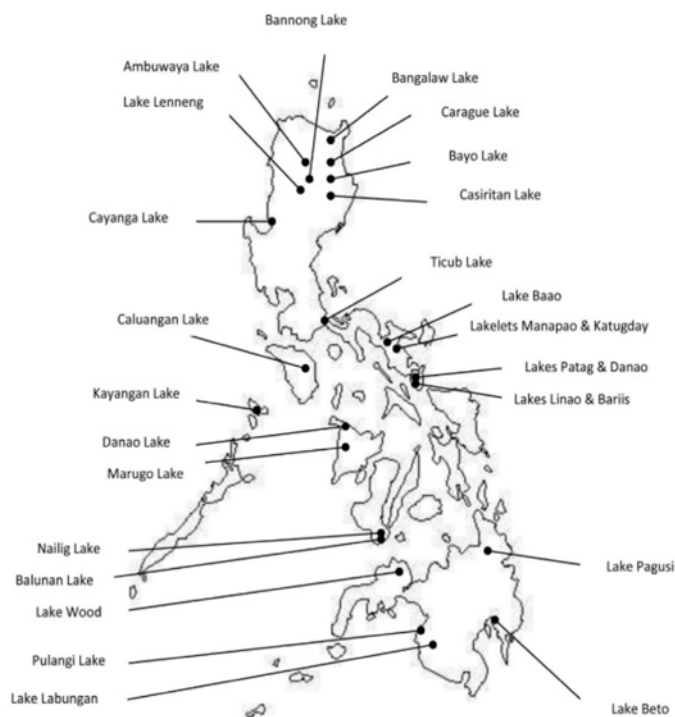


Fig. 3. Map of the Philippines showing the additional sites targeted by NIFEP for resource enhancement (Palma, 2016)

Constraints and Challenges Encountered by NIFEP

During the implementation of inland fishery resource enhancement activities in more than 15 lakes, dams, reservoirs, and river sanctuaries, NIFEP was confronted with various issues and concerns. These include: conflicting legal and juridical mandates between BFAR and the local government units (LGUs) which need to be harmonized; inadequate management skills among fisherfolk that necessitated intensified capacity building; insufficient supply of fingerlings for restocking which calls for the intensification of hatchery activities and networking of existing hatcheries;



Fig. 4. Fisheries in Dagatan Lake, Quezon Province, Philippines (Palma, 2016)

Box 2. Strategies being adopted by the NIFEP of BFAR-IFTC

- Establishment of a national center for indigenous fishes
- Establishment of gene bank for commercially important indigenous fishes.
- Development of breeding protocols for low trophic species
- Repopulation, management and conservation of indigenous fishes
- Development of a network of satellite regional government hatcheries and private hatcheries to supply the fingerling requirements



source of indigenous aquatic species which requires the conduct of surveys; and inaccessibility of the activity sites.

Nevertheless, NIFEP was able to take off and is now working on more than 15 sites with more sites targeted for its future activities. Furthermore, in order to address the aforementioned constraints, NIFEP has adopted several strategies and interventions as shown in **Box 2**.

Using the scheme that had been developed for the implementation of NIFEP, rehabilitation of the fishery resources in Dagatan Lake could be considered successful. Dagatan Lake used to be a thriving water body with rich resources. Specifically, the Lake was once home to economically important freshwater fishes, *i.e.* swamp eel, snakeskin gourami, common carp, tilapia, snakehead, and the native Asian catfish (**Fig. 4**). However, through the years, growth of abundant vegetation was left uncontrolled that choked the fish and other aquatic organisms in the Lake. With economic benefits almost nil, the Lake was eventually abandoned.

Restoring Dagatan Lake and its Fisheries - A success story

Dagatan Lake is a 7-ha freshwater lake located at 13°44' N and 121°18' E in San Antonio, Quezon Province, Luzon Island, Philippines. In spite of its small size, the Lake plays a significant role in biodiversity being one of the last remaining frontiers for some indigenous freshwater fishes, most especially the native Asian catfish *Clarias macrocephalus*. Thus, the need to rehabilitate the Lake which for sometime was abandoned when it was covered with thick aquatic vegetation (**Fig. 5**) that posed serious problems on the conservation of the native catfish species and prevented any economic activity.



Fig. 5. Dagatan Lake before rehabilitation took place (Palma, 2016)





The physical restoration of Dagatan Lake and the reconstruction of its fisheries were the serious challenges encountered by the NIFEP, and called for the harmonization of the legal and juridical mandates between BFAR as the national agency mandated under the Philippine Fisheries Code for the management and conservation of the fishery resources; the Local Government Unit of Quezon Province which has jurisdiction over the management of Dagatan Lake under the Philippine Local Government Code; and the fisherfolk beneficiaries. The series of consultations among the concerned stakeholders resulted in collaborative efforts which facilitated in pooling of funds and resources, mobilization of the local communities, and application of technical tools to revive Dagatan Lake to its natural physical state.

The objective of such effort was to reconstruct the fisheries in Dagatan Lake through a system of managed open water stocking of indigenous fishes, improvement of the coastal buffer zone by the planting of freshwater mangroves, and organization of the Municipal Fisheries and Aquatic Resource Management Council for capacity building. As a result of the restoration and community management of Dagatan Lake, its fisheries had been revived, while its water resource services had also been expanded to provide irrigation and the development of eco-tourism activities.

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