Local Fish Conservation with the Construction of Fishway Facilities to Connect the Lakes of the Pupuk Kujang Biodiversity Park

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Abstract

Background : There are eight lakes in the Pupuk Kujang Biodiversity Park, with a total area of approximately 17.5 hectares (175,960.04 m^2). Overfishing by local communities in lakes 6, 7, and 8 TKHPK areas causes a decline in several local fish species. Also, the decrease in local species' diversity is because ponds 1 - 3 are not connected to ponds 4 - 8. As a result, the fish are like being confined within a certain lake boundary without any way to get out and break free. This condition automatically becomes a threat to preserving its population in nature because, in its life cycle, fish require migration to find food, reproduce, and seek protection and living habitat in better water conditions. The management of PT Pupuk Kujang has launched a local fish conservation program, which is becoming scarce in the TKHPK lake waters, by building water channel tunnels that function as a fishway to connect one lake to another. **Aims:** This research aims to identify the determining factors that affect the success of the conservation of local fish conservation in TKHPK lakes.**Settings and Design:** The design of this study was descriptive analysis.**Methods and Material:** Data were collected by observation and document tracing.**Results:** The results showed an increase in identified local fish species, including tawes (Puntius javanicus), baung (Hemibagrus nemurus), ompok (Ompok bimaculatus) and boboso (Oxyeleotris marmorata).**Conclusions:** By constructing a fishway facility in the TKHPK lake and conserving local fish, the lake ecosystem rehabilitation program will maintain a balance in the food chain, control insect populations that cause chikugunya and malaria, and control aquatic weed populations.

Keywords: Fish way, Lake, Local Fish

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Introduction

The Pupuk Kujang Biodiversity Park (TKHPK) area contains 2 (two) main ecosystems: the dry land ecosystem of pamah and the swamp of pamah freshwater. Geomorphological investigation showed that the PT Pupuk Kujang area formed from volcanic sediment and cut off by several river flows. Therefore, this area is considered a riparian ecosystem of pamah (lowland) fertile and nutrient-rich lands, with trapped water basins forming swamps (1). [i]. Wetland ecosystem, swamp, and freshwater Pamah river have a hydrological function as a regulator of the surface water flow system and filling of the groundwater basin. Ecologically, its function includes, among other things, habitat for various animals. Examples are groups of animals such as fish, mammal, reptiles (snakes, frogs, and other reptiles), birds, insects, and other invertebrates such as shellfish (with or without shell), worms, slugs and simple group (protozoa) (2).[ii]. These animal groups inhabit specific ecological niches in wetlands for breeding, raise offspring, and forage for food and shelter, maintaining a balanced ecosystem (3).[iii]

Table 1. The type of fish in PT Pupuk Kujang Lake in 1977

No	Family and Species	Local Name
1	*Puntius javanicus*	tawes
2	*Oxyeleotris marmorata*	boboso
3	*Cypriniformes*	karper
4	*Ophiocephalus striatus*	gabus
5	*Puntius binotatus*	beunter
6	*Aplocheilus panchax*	kepala timah
7	*Dermogenys*	julung-julung
8	*Trichogaster pectoralis*	sepat
9	*Macrognathus aculeautus*	sili

In 2014, we conducted a pre-survey of the diversity of local fish species in the lake/pond and collected data on fish species in each lake/pond. The data on the types of fish in the PT Pupuk Kujang lake/pond water lake/pond based on location are grouped into two locations, namely lake/ponds 1 - 4 and lake/ponds 5–8. Based on these activities, there are differences in the amount of diversity of local fish species in lakes/ponds 1–4, there are six types of fish and lakes/ponds 4–8, there are four types of local fish. This condition was increasing in the period 2010 – 2014 (4). [iv].

Table 2. The types of local fish d in PT Pupuk Kujang Lake in 2014

No	Family an Species	Local Name	Lake/pond	
			1–4	5–8
1	*Puntius javanicus*	tawes	√	√
2	*Oxyeleotri marmorata*	boboso	√	√
3	*Cypriniformes*	karper	√	√
4	*Ophiocephalu striatus*	gabus	√	√
5	*Puntius binotatus*	beunter	√	-
6	*Aplocheilus panchax*	kepala timah	-	-
7	*Dermogenys*	julung-julung	-	-
8	*Trichogaster pectoralis*	sepat	√	-
9	*Macrognathus aculeautus*	sili	-	-

In May 2015, the management of PT Pupuk Kujang launched a local fish conservation program by building fishway facilities and restoring plants that function as fish spawning ground such as ketepeng in small rivers that flow into ponds/lakes.

Figure 1. The 6th Lake/Pond of PT. Pupuk Kujang

This research aims to identify the determining factors that affect local fish conservation success in TKHPK lakes.

Subjects and Methods

This research was conducted for 6 (six) months, from September 2018 to March 2019. Sample identification was carried out at the PT Pupuk Kujang Laboratory. Qualitative fishing involved using fishing gear, gill net, measuring 1 inch, 1¼ inch, 2 inch, and 3¼ inch, fish pot, 1-inch and 2-inch gill nets, dipnet), and fishing rod (fish line). Quantitative fishing involved catching fish to determine the value of CPUE (Catch per Unit Effort); the tool used is a gill net with a diameter as above, 50 meters long per net with 50 vertical (upright) meshes (5).[v]

Results

A. The Diversity of Local Fish Species in TKHPK Lake

There were eight local fish species in lakes/ponds 1 –4 and seven local fish species in ponds/lakes 5 - 8. Most of the local fish caught during this study were Oxyeleotri marmorata (boboso) and Ophiocephalu striatus (gabus). These types of fish migrate to ponds/lakes 1 - 4 for foraging for food (amphydromes), spawning (diadromes), and evacuation to avoid bad environmental quality. According to Tjahjo et al. (2000)[vi], species of river fish often move to waters with better water quality (6).

Table 3. The types of local fish in TKHPK Lake (PT Pupuk Kujang) in 2019

No	Family and Species	Local Name	Lake/Pond	
			1–4	5–8
1	*Puntius javanicus*	tawes	√	√
2	*Oxyeleotri marmorata*	boboso	√	√
3	*Cypriniformes*	karper	√	√
4	*Ophiocephalu striatus*	gabus	√	√
5	*Puntius binotatus*	beunter	-	√
6	*Aplocheilus panchax*	kepala timah	-	-
7	*Dermogenys*	julung-julung	-	-
8	*Trichogaster pectoralis*	sepat	√	√
9	*Macrognathus aculeautus*	sili	-	-
10	*Hemibagrus nemuru*	baung	√	√
11	*Ompok bimaculatus*	ompok	√	√

The existence of a fish way facility has an effect on the increasing diversity of local fish species. Found two species of local fish that are becoming rare, namely, Hemibagrus nemuru and Ompok bimaculatus.

Figure 2. Oxyeleotri marmorata

These fish species from the small rivers in the TKHPK core zone attempt to enter the pond/lake, searching for food (amphydromes), spawning (diadromes), and for evacuation to avoid bad environmental quality. According to Tjahjo et al. (2000), species of river fish (freshwater fish) often ventilate further to avoid the water quality that has decreased to waters with better water quality (6).

Figure 3. Oxyeleotri marmorata

The small river flows in the TKHPK core zone integrated with ponds/lakes 2 focus on efforts to restore the sustainability of local fish habitat. The stream in the core zone is the most optimal spawning ground for egg and larval development. The egg-to-larva phase is a critical time because they cannot avoid being attacked by predators (7).[vii]. Also, small rivers are susceptible to potential pollution from channels outside the PT Pupuk Kujang area.

From the secondary data of PT Pupuk Kujang in 2015, small rivers in the TKHPK area were littered by profit-oriented waste trucks that disposed of untreated waste. After management investigated, the perpetrators were arrested, and there is no more pollution of the rivers in the TKHPK area. Within 2 (two) weeks of observation and testing of water quality samples, the river can be naturally purified so that the whole river is not considered polluted. But if the liquid waste that enters is large and continues and contains toxic substances, the river's natural homeostatic limit will be exceeded. It can be said that the river no longer has a natural homeostatic mechanism, so that the water is permanently changed or even completely damaged (8).[viii].

Figure 4. The specie of ketepeng around a small river which functions as a fish spawning ground

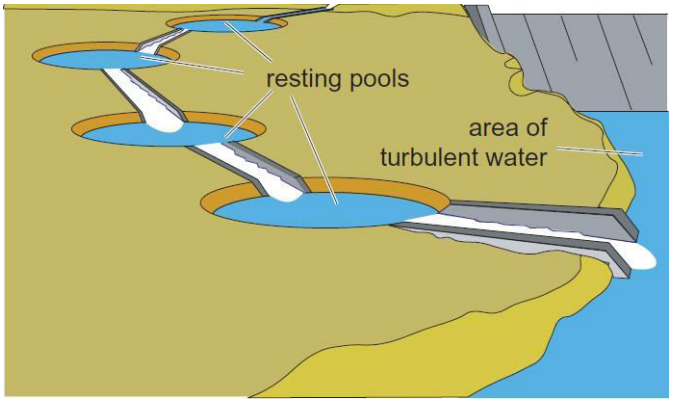
For the criteria for the availability of water sources, small rivers in the TKHPK area as natural clean water production by the manager are maintained by the contours of the edges and their morphology as a place for spawning several aquatic species. Ketepeng plant species were found around small rivers where this type of ketepeng plant has a function to spawn fish. Aquatic animals

function to balance the environment's natural conditions, including controlling insect populations, including malaria and chikungun (1).

B. The Construction of Fishway Facilities at TKHPK

The fish way construction is an effort to accommodate local fish for migration and interaction between ponds/lakes from upstream to downstream, looking for food (amphibious) and spawning (diadromes). The fish way dimension design's determination is based on the difference in height between ponds/ lakes, physical structures, and body lengths of the largest fish species. Another important thing that is determined is the resting zone that must be provided when constructing the fishing route (9). [ix]. Resting pools in TKHPK ponds/lakes are ponds / lakes 2, 3, 4, 5, 6, and 7.

Figure 5. Fish route technique between resting pool with a winding design between lake / TKHPK pond



From the observation of fish migration after the fish way facility was built in TKHPK lakes / ponds are based on environmental factors that directly or indirectly play a role in fish migration, namely:

1. High and low water levels

High and low water levels in TKHPK ponds/lakes are highly influenced by seasons. For example, during the dry season at the time of research, pond/lake levels tend to be low. Apart from being influenced by the season, the TKHPK lake/pond's water level conditions can also be regulated by adding the water discharge from pond 6, which comes from Curug. These current conditions influence fish migration through passive transport of fish eggs and juveniles from the spawning area to the breeding area and might be oriented as opposite currents when adult species migrate from ponds/lakes 5 and 6, which are food areas, to spawning areas, namely ponds/lakes. 2, 3, and 4.

Figure 6. The catch of baung fish in the 6th pond/lake using gillnet traps (gillnet)

Observations of adult local fish type Ophiocephalu striatus that have just spawned also use the current to return to the pond/lake 2, 3, and 4, which are food areas.

2. Light Intensity

Changes in light intensity greatly affect the distribution pattern of fish. Still, fish response to changes in light intensity is influenced by fish species, temperature, and water turbidity levels. Fish tend to form small groups during the day and spread out at night (10).[x]. The six-month observation results carried out sampling at night in each pond/lake, obtained samples of the same fish species in ponds/lakes 1, 2, 3, 4, 5, and 6. The following presents the complete distribution of local fish species in each TKHPK pond/lake.

Table 4. Types of local fish found in Lake 1 - 8 TKHPK (PT Pupuk Kujang) in 2019

No	Famili dan Spesies	Danau / Kolam							
		1	2	3	4	5	6	7	8
1	*Puntius javanicus*	-	-	√	√	-	√	√	√
2	*Oxyeleotri marmorata*	√	√	√	√	√	√	√	√
3	*Cypriniformes*	√	√	-	√	-	√	-	√
4	*Ophiocephalu striatus*	√	√	√	√	√	√	√	√
5	*Puntius binotatus*	-	-	-	-	-	√	√	√
6	*Aplocheilus panchax*	-	-	-	-	-	-	-	-
7	*Dermogenys*	-	-	-	-	-	-	-	-
8	*Trichogaster pectoralis*	√	-	√	√	-	√	√	√
9	*Macrognathus aculeautus*	-	-	-	-	-	-	-	-
10	*Hemibagrus nemuru*	-	-	√	√	-	√	-	√
11	*Ompok bimaculatus*	-	-	-	√	-	√	√	√

C. The Aspects of Conservation of Fish Resources in Lake TKHPK

Conservation efforts are very important for the sustainability of fish resources in TKHPK ponds/lakes, especially species of fish under threat of sustainability, such as Hemibagrus nemuru and

Ompok bimaculatus. In-situ conservation of fish resources that can be carried out, based on recommendations from the Indonesian Directorate General of Aquaculture (2000) include: 1) efforts to protect lake bodies, such as in the catchment area, protection from pollution, control of the use of biological resources fisheries, and lake area management arrangements (rules and regulations); 2) development of reservoir and restocking areas, based on the results of this research, the development of reservoirs and restocking areas can be carried out at station one where there is a lot of water plant vegetation; 3) socialization of the conservation of fish resources from lake ecosystems to local communities, aiming to unify views of the benefits and impacts that occur if the lake community is damaged on fishery resources and the environment; 4) efforts to protect the area around the lake, including reforestation and land-use arrangements in land-use on the basis of suitability and conservation; 5) institutional fostering and community empowerment, such as regulating the number and fishing gear that the community can use. These efforts must involve the government, law enforcement officials, and communities around the conservation area (11). [xi]

These current conditions influence fish migration through passive transport of fish eggs and juveniles from the spawning area to the breeding area and might be oriented as opposite currents when adult species migrate from ponds/lakes 5 and 6, which are food areas, to spawning areas, namely ponds/lakes. 2, 3, and 4.

Discussion

The results showed an increase in identified local fish species, including tawes (Puntius javanicus), baung (Hemibagrus nemurus), group (Ompok bimaculatus) and boboso (Oxyeleotris marmorata). The lake ecosystem rehabilitation program by constructing a fishway facility in the TKHPK lake and conserving local fish, maintaining the balance of the food chain, controlling insect populations that cause chikungunya and malaria diseases, and controlling aquatic weed populations.

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