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Assessment of Containment Measures Implemented through the Analysis of the Catch Data of Knifefish (*Chitala ornata*) in Laguna De Bay

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Abstract
Aim: This study assessed the containment measures implemented through the analysis of knifefish catch data in Laguna de Bay from 2014 to 2019.
Methodology: The study area is Laguna Lake, the largest lake in the Philippines, divided into four bays: West Bay, Central Bay, East Bay, and South Bay. Secondary data was collected from the Bureau of Fisheries and Aquatic Resources-National Inland Fisheries Training Center (BFAR-NIFTC), covering a 5-year period from 2014 to 2019, including total fish catch per fishing gear. Time series analysis was used to determine the increase/decrease of knifefish catch, and regression analysis was used to establish the impact of BFAR's containment program.
Results: The assessment revealed an average of 79,533 kg of knifefish catches per month, totaling 5,169,674 kg from 2014 to 2019, with the greatest catch in the West Bay. Regression analysis showed a significant relationship between the intensive collection program by BFAR and the number of knifefish caught.
Conclusion: There was a significant linear relationship between the intensive implementation of the collection program of BFAR and the catch/population of knifefish in Laguna de Bay. There was an inversely proportional relationship between the sudden slowdown in fishermen's efforts due to low buying prices and the catch/population of knifefish.

Keywords: *Knife fish, Chitala ornata, Assessment, Laguna de Bay, Containment Measures*

INTRODUCTION

The knifefish (*Chitala sp.*) is a freshwater species customarily sold as an exotic aquarium fish and favored by enthusiasts of the trade. Knifefish have two types: one that feeds on plankton, and one that feeds on regular-sized fishes. The type of knifefish that is now abundant in Laguna de Bay, Southeast Asia's third-largest inland water body and the Philippines' largest freshwater lake, is the carnivorous Knifefish (*Chitala ornata*), which belongs to the second type.

In countries like Vietnam, knifefish are regarded as delicacies. However, in the Philippines, particularly in Laguna de Bay, these fish are considered pests because they prey on local species such as tilapia, milkfish (bangus), silver perch (ayungin), and Manila catfish (kanduli), among others. This situation has adversely impacted the livelihoods of local fisherfolk who rely on their catches from Laguna de Bay for their daily income and sustenance.

In 2012, field surveys done by the BFAR-NIFTC showed that knifefish are affecting local fisherfolk residing in 1 city and 12 lakeside municipalities in Laguna province, 4 municipalities in Rizal province, and 2 cities in the National Capital Region (BFAR-NIFTC, 2018).

Thus, BFAR-NIFTC, together with local government units (LGUs) situated along the lakeshore of Laguna de Bay and other national government agencies organized an Inter-Agency-Technical Working Group (IA-TWG) composed of: DA-BFAR (BFAR-NIFTC & BFAR-IVA), LLDA, DSWD, DILG, DOST-PCAMMRD, DTI, DENR, TESDA & FARMC that spearheaded the project on the Containment of Knifefish Infestation in Laguna de Bay which implemented several containment measures to address this problem (BFAR, 2013).

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One of the containment measures implemented by BFAR-NIFTC in collaboration with the LGUs is the collection and retrieval program whose enforcement in 2017 was affected by a fishing ban imposed on Laguna de Bay in compliance with the Department of Environment and Natural Resources (DENR) Board Resolution no. 518, series of 2017 (Encelan, 2017).

However, a research revealed that knifefish infestation is still a major problem in Laguna de Bay, which affects thousands of fisherfolk who are dependent on the lake for their livelihood (Luna, 2020). This seemed to indicate that the containment measures undertaken by BFAR-NIFTC with various LGUs and the IA-TWG to address the proliferation of knifefish in Laguna de Bay were not sufficient to reduce the infestation.

Background

The Knifefish has a silvery gray color with numerous black spots in white rings (Punongbayan, 2012). It has razor-sharp teeth, a bony tongue, two nasal tentacles above its mouth, and a sharp gill that can cut across fish meat like a knife. It grows no longer than 20-50 cm if cultured in a fish farm but grows to about 100 cm (1m) and weighs 5 kg (11lb) in the wild. An adult clown knife fish has 7 to 10 dark spots on the lower side of their body.

Figure 1. Knifefish (*Chitala Ornata*) Source: BFAR, 2020

Knifefish are not native to the Philippines. They come from South America, Asia (India), and Southeast Asia, particularly in Borneo, Thailand, Sumatra, Malaysia, Vietnam, Cambodia, and Laos (Towers, 2013; Encelan, 2017). They are usually found in lakes, swamps and river backwaters, prefer still waters, and can survive in waters with low oxygen. The knifefish was accidentally introduced in Laguna de Bay in 2009 when super typhoon Ondoy (international name Ketsana) caused flash floods in Metro Manila and inundated a hobbyist fish farm, resulting in the fish's escape to the lake (Luna, 2020).

Review of Related Literature

The proliferation of knifefish in Laguna de Bai posed a threat to the fishing industry of the said lake. Hence, containment measures were implemented by BFAR, IA-TWG, and the LGUs surrounding the lake. The containment program for knifefish infestation in Laguna de Bay aimed to achieve the following objectives: (1) to assess the socio-economic and environmental impacts of knife fish on the fisheries and fisherfolk, (2) to implement practical strategies in containing the proliferation of knifefish, and (3) to promote the fish's value-adding technologies as an additional source of income for the affected fisherfolk. The collection program was implemented for five (5) years, from 2012 to 2017 (BFAR-NIFTC, 2016).

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An inter-agency Technical Working Group (IA-TWG) for the containment of knife fish proliferation in Laguna de Bai was also created on June 14, 2013, during the "National Forum on the Containment of Knifefish in Laguna de Bay" held at Taguig City University. The TWG was composed of different government agencies (i.e., DA-BFAR (BFAR-NIFTC & BFAR IV-A), LLDA, DSWD, DILG, DOST-PCAMRRD, DTI, DENR & FARMC). The BFAR also entered into a Memorandum of Agreement (MOA) with 12 municipalities of Laguna for the enormous task of collecting knifefish. BFAR released P10 million for the initial implementation of the said collection activity (Encelan, 2017). Every fisherman was paid twenty pesos (P20.00) for every kilo of knifefish caught (BFAR-NIFTC, 2013).

Another strategy employed by BFAR-NIFTC in containing the knifefish is value-adding, whereby its economic utilization is being considered to support the livelihood of the affected fisherfolk. Under this strategy, knifefish is considered raw material for food such as burger patties, nuggets, hotdogs, fish balls, siomai, and kikiam, which are common finger foods in the country. It is also being considered as a source of fish feed and as a handicraft product (Towers, 2013). Training on the value-adding of knifefish was also conducted for the residents along the coastal municipalities of Laguna de Bay (Towers, 2013). In addition, a knifefish processing plant was also launched on February 10, 2015, in Sitio Balanga, Brgy. Pinagbayanan, Pila, Laguna, to support the livelihood project spearheaded by Laguna Lake Development Authority (LLDA), BFAR, Department of Trade and Industry, and Department of Social Welfare and Development (LLDA FB page notes, 2015).

Aside from the above, BFAR-NIFTC also distributed fishing gear to fisherfolk to improve the collection of knifefish from affected localities along Laguna de Bai. The agency also planned to conduct research on the feasibility of using electrofishing (Towers, 2013). DOST-PCMARRD also allotted P4.89 million for the execution of a scientific program through the University of the Philippines Los Baños-Limnological Research Station entitled "Assessment and implementation of catch and management strategies for the invasive knifefish in Laguna de Bay". The research program aims to provide analytical tools and data to improve the effectiveness of the current continuing initiative to reduce the knifefish population. The said program also examines the aggregation and migration pattern of adult and juvenile knife fish to confirm "site fidelity" (Fernandez, 2018).

Statement of the Problem

This study assessed the containment measures implemented through the analysis of knifefish catch data in Laguna de Bay from 2014 to 2019.

Specifically, it answered the following questions:

1. Were there any significant reductions and/or increases in the population of knifefish proliferating in Laguna de Bay during the study period?
2. How much reduction and/or increase was detected during the study period?
3. What are the impacts of the containment measures implemented by BFAR in reducing and/or increasing the knife fish infestation in Laguna de Bay?
4. What are the possible policy implications of these changes to the community and its stakeholders?

HYPOTHESIS

The proliferation of invasive species, such as the knifefish, in Laguna de Bay suggests an alteration in the water body's productivity, which negatively impacts the community and its stakeholders. It is assumed that measures implemented by its stakeholders did not result in the reduction of the negative impact of the invasive species.

Theoretical Background and Conceptual Framework

The assessment of the infestation of knifefish in Laguna de Bay is considered anthropogenic in origin. However, the implementation of containment measures considers other factors such as social, economic, environmental, and political. Hence, the analysis used the Ecosystems Approach to Fisheries model as its conceptual framework in its analysis.

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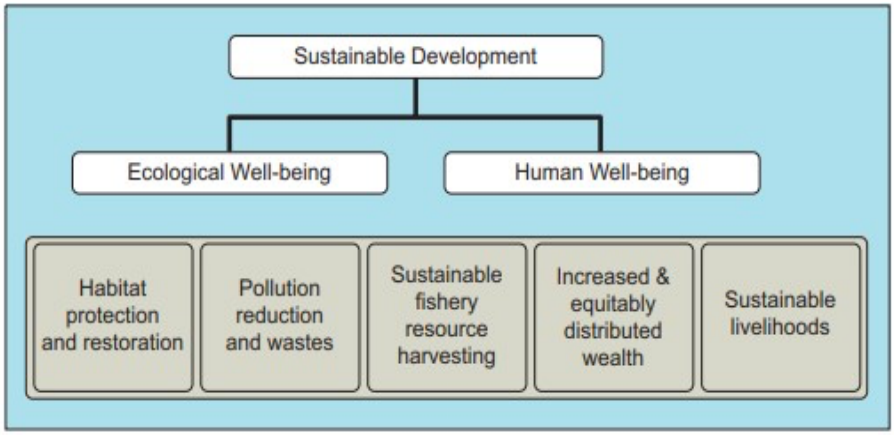

Figure 2. Ecosystems Approach to Fisheries Framework Source: FAO, 2009

METHODOLOGY

Brief Description of the Project Area

Laguna Lake, also known as Laguna de Bay, is the largest lake in the Philippines. According to LLDA, it has an aggregate surface area of 900 km2 with an average depth of 2.5 meters and an average elevation of 12.50 meters. Laguna de Bay is divided into four (4) bays, namely West Bay, Central Bay, East Bay, and South Bay (ADB, 2005). Talim Island separates the West and Central Bay, whose division was due to the considerable bathymetrical differences between these areas (Delos Reyes, 1994). Pasig River is the lake's outlet to Manila Bay.

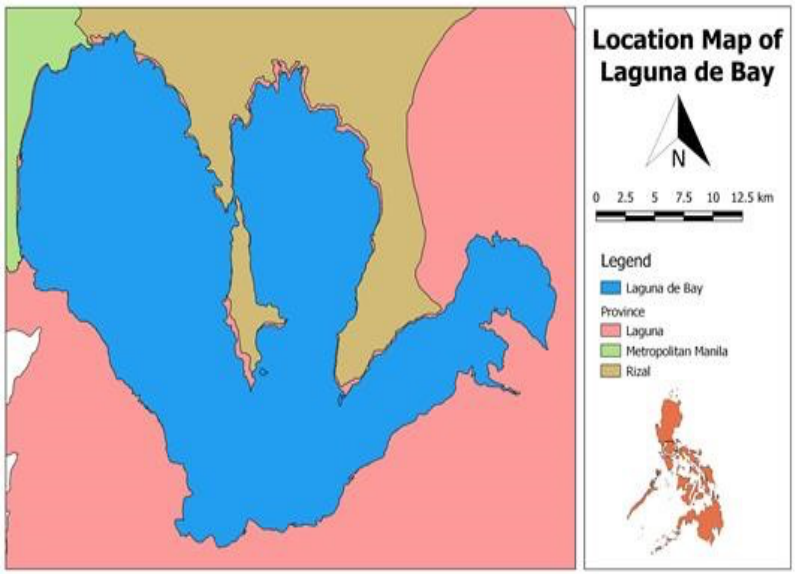

Figure 3. Location Map of the Study Area

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Data Collection

The data was collected by the assigned enumerator from the Bureau of Fisheries and Aquatic Resources-National Inland Fisheries Technology Center (BFAR-NIFTC) in Tanay, Rizal. The data covered a 5-year period from 2014 to 2019 that includes the total fish catch of Laguna de Bay per fishing gear on a per-month basis. The data gathered also included information on the different species commonly caught in the West, South, East, and Central Bays.

Methods of Analysis

A time series analysis was used to determine the significant increase/decrease of the catch of knifefish within the period of 5 years from 2014 to 2019, which could also help in forecasting future scenarios. Moreover, a regression analysis was utilized to establish whether the containment program of BFAR has an impact on the catch/population of Knifefish in Laguna de Bay. A correlation was also employed to ascertain whether the containment program has a positive or negative linear relationship with the catch/population of knifefish.

RESULTS AND DISCUSSION

The data gathered showed an average of 79,533 kg knifefish catches per month for the whole lake. The monthly catch ranged from a maximum of 228,306 kg to a minimum of 33,734 kg. The total knifefish collected from 2014 to 2019 was 5,169,674 kg.

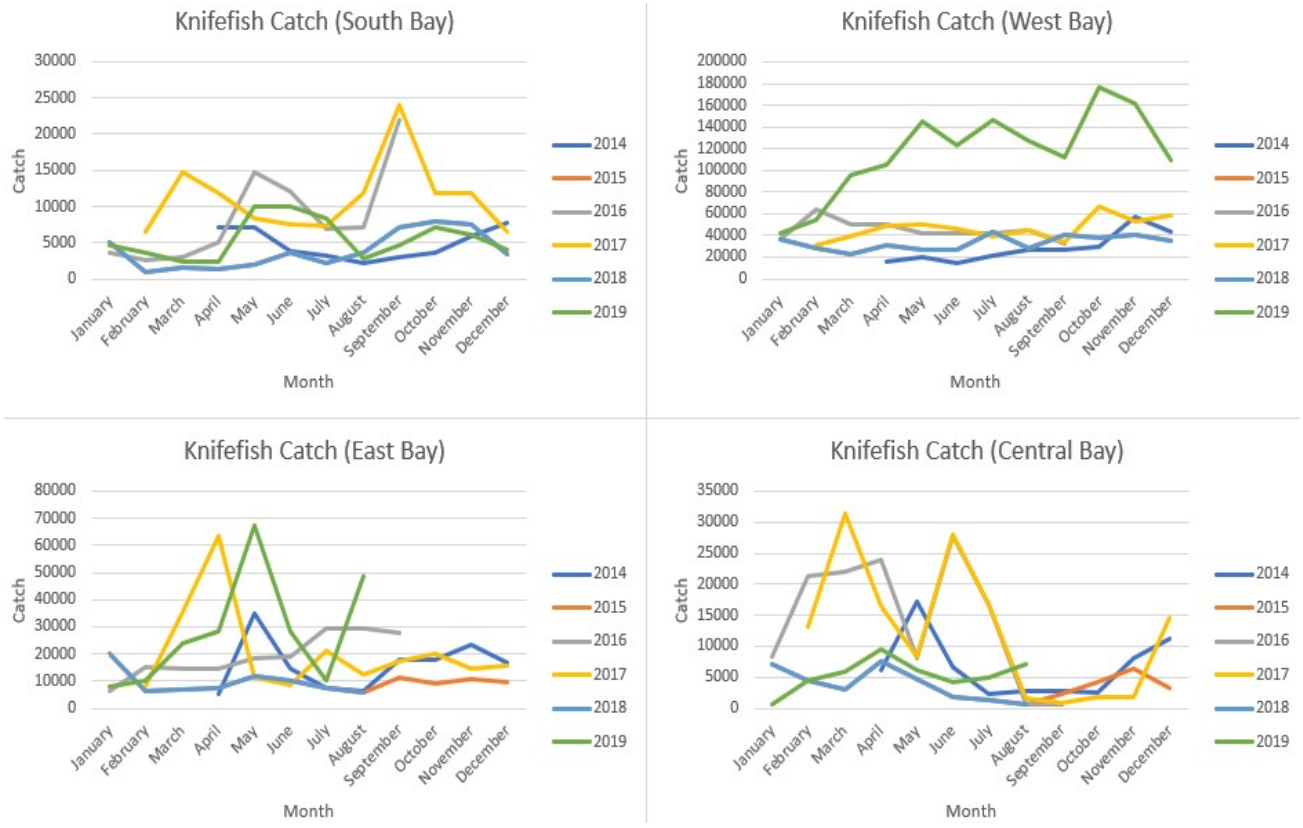

Figure 4. Catch Count of Knifefish in the Four Bays of Laguna Lake, 2014-2019 Source of Data: BFAR-NIFTC, 2020

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Figure 4 shows the monthly catch of knifefish from Laguna de Bay. The peak months of catch in the lake are from April to May, which coincides with the spawning period of the knifefish (Castro, 2018). The greatest number of knifefish catches on a per month basis was in the West Bay, where a surge in catch/population was also highest in 2019. It is also in the West Bay area where the highest volume of knifefish catch throughout the whole implementation period of the BFAR Knifefish containment program was found.

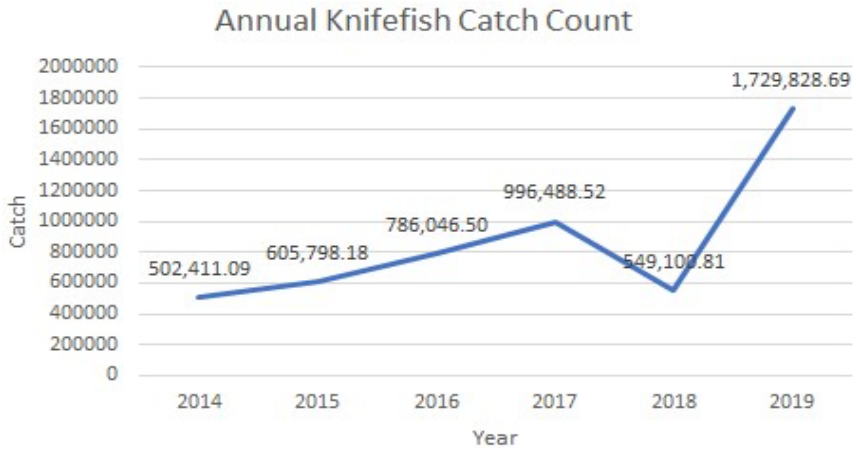

Figure 5. Annual Knifefish Catch Count from 2014 to 2019. Source of Data: BFAR-NIFTC, 2020

There was also a slow but steady increase in the knifefish catch from 2014 to 2017 as shown in Figure 5. This could be due to the intensive implementation of the collection and retrieval program of BFAR-NIFTC, IA-TWG, and the LGUs, coupled with a big budget for the program. However, in 2018, there was a sharp decline in the total catch/population of knifefish. This could be attributed to the sudden slowdown in the effort of fishermen to catch knifefish due to the low buying price of Php 20.00/kg by BFAR-NIFTC that seemed to contribute to the surge in the population of the Knifefish in the lake in 2019. In addition, the fisherfolk also lamented the late releases of payments under the Cash-for-Work program of DSWD, which in turn affected the retrieval process (Melo, 2020). Since fisherfolk rely on knifefish catch for their source of income, delayed payments, and low buying price would significantly affect their motivation to catch the knifefish and participate in the collection program. In 2019, an all-time high catch/population was recorded for the program. This increase could be attributed to the suspension of funds downloaded to the coastal LGUs of the lake for the massive retrieval and collection of knifefish due to the 2019 local elections, consequently contributing to the surge in their population, which poses a threat to other fish species and the biodiversity of the lake.

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Table 1. Correlation Result

	Average	Presence of BFAR Program
Average	1	
Presence of BFAR Program	-0.2727	1

The result of the correlation analysis indicates a very weak negative correlation between the sudden slowdown in the effort of fishermen to catch knifefish and the actual catch of Knifefish in Laguna de Bay. The table above also showed an inversely proportional relationship between the two variables. Thus, one could infer that the sudden slowdown in the effort of fishermen to catch knifefish due to low buying prices in 2018 led to the light implementation of the program and the suspension of funds downloaded for the massive retrieval and collection of knifefish to coastal LGUs in the lake due to the 2019 local elections has contributed to the surge in the population and catch of the Knifefish in the lake.

Table 2. Regression Result

Multiple R	0.272698
R Square	0.074364
Adjusted R Square	0.059671
Standard Error	42284.18
Observations	65

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	9.05E+09	9.05E+09	5.061319	0.027968
Residual	63	1.13E+11	1.79E+09		
Total	64	1.22E+11			

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	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	94955.4	8631.222	11.00139	2.65E-16	77707.28	112203.5	77707.28	112203.5
Presence of BFAR Program	-24449.4	10867.68	-2.24974	0.027968	-46166.8	-2732.1	-46166.8	-2732.1

The result of the regression analysis also showed that there is a significant relationship between the intensive collection program implemented by BFAR-NIFTC and the number of the knifefish caught with a confidence level set at 95%. This means that the program has a direct impact on the catch, and ultimately on the population, of knifefish in Laguna de Bay.

CONCLUSIONS AND RECOMMENDATIONS

The statistical findings of the study yielded the following conclusions:

1. There was a significant linear relationship between the intensive implementation of the collection and retrieval program of BFAR and the catch/population of knifefish in Laguna de Bay;
2. There was an inversely proportional relationship between the sudden slowdown in the effort of fishermen to catch knifefish due to the low buying price and the number of catch/population of knifefish in Laguna de Bay; and
3. The highest monthly catch of knifefish was in the West Bay of the lake.

Based on the findings above, the following are the recommended actions:

1. The continuous intensive implementation of the knifefish collection and retrieval program of BFAR in Laguna de Bay;
2. A follow–up study is suggested utilizing the same methods or levels of variables in the containment program of knifefish in the four (4) bay areas of Laguna de Bay;
3. Formulation of a policy on the containment of knifefish by the IA-TWG (i.e., BFAR, LLDA, DSWD, DTI, DOST-PCAMMRD, TESDA, FARMC), LGUs, academe, private sector and other stakeholders of Laguna de Bay;
4. Capability building program (such as training and seminars) for the fisherfolk involved in the collection program of knifefish about the proper collection procedures (specifically on the determination of age, spawning, and maturity of knifefish), utilization, and disposal; and
5. Conduct Key Informant Interviews (KII) and focus group discussions (FGD) with key management personnel from BFAR, LLDA, LGUs, and other major stakeholders, such as fish pen and fish cages operators, FARMC, and private companies engaged in knifefish processing business.

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