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# Understanding local fish consumption behavior in Laguna Lake watershed area, Philippines

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**In recent years, Laguna Lake has deteriorated significantly due to agricultural, domestic and industrial waste. This paper examines local residents' fish consumption behavior in the Laguna Lake watershed area in the Philippines. The data utilized in this study was collected through the "LakeHEAD" household survey (*n*=389), conducted by the Research Institute for Humanity and Nature and University of the Philippines at Los Baños in 2012. How socio-demographic (location and education) and cognitive factors (for example, the perceptions of Laguna Lake pollution caused by domestic waste and/or heavy metals) affect consumers' behavior regarding fish consumption was examined by distributing questionnaires to the local households. According to the descriptive statistics, most of the local residents (over 80%) considered Laguna Lake as polluted by domestic waste and/or heavy metals. However, the majority of residents (over 70%) still consumed fish; bangus (*Chanos chanos*), tilapia (*Oreochromis niloticus*) and kanduli (*Arius dispar*) from the Laguna Lake. In addition, there is a strong relationship between the geographical distribution of the residents and their respective fish consumption behavior (*p* <0.001), as residents living the nearest to the lake were more likely to demonstrate a significant increase in fish consumption which is mostly due to easier access to the fish resources. It is therefore, necessary to promote public education programs focusing on food safety and illness mitigation.**

**Key words:** Education, fish consumption behavior, food safety, Laguna Lake, perception, water pollution.

## INTRODUCTION

Laguna Lake, also known as Laguna de Bay, is the largest lake in the Philippines, and is well known for the multitude of ecosystem services that it provides (Lasco and Espaldon, 2005). However, in recent years, the water quality has seriously deteriorated due to agricultural, domestic and industrial waste (Beveridge, 1984; Lasco and Espaldon, 2005; Montenegro, 2006; Su and Cervantes, 2008). As a result, there has been an increase in heavy metal concentration in the sediment and water of the lake (Cuvin-Aralar, 1990) with domestic waste being the most predominant driver of change, accounting for 70% of the deterioration of water quality

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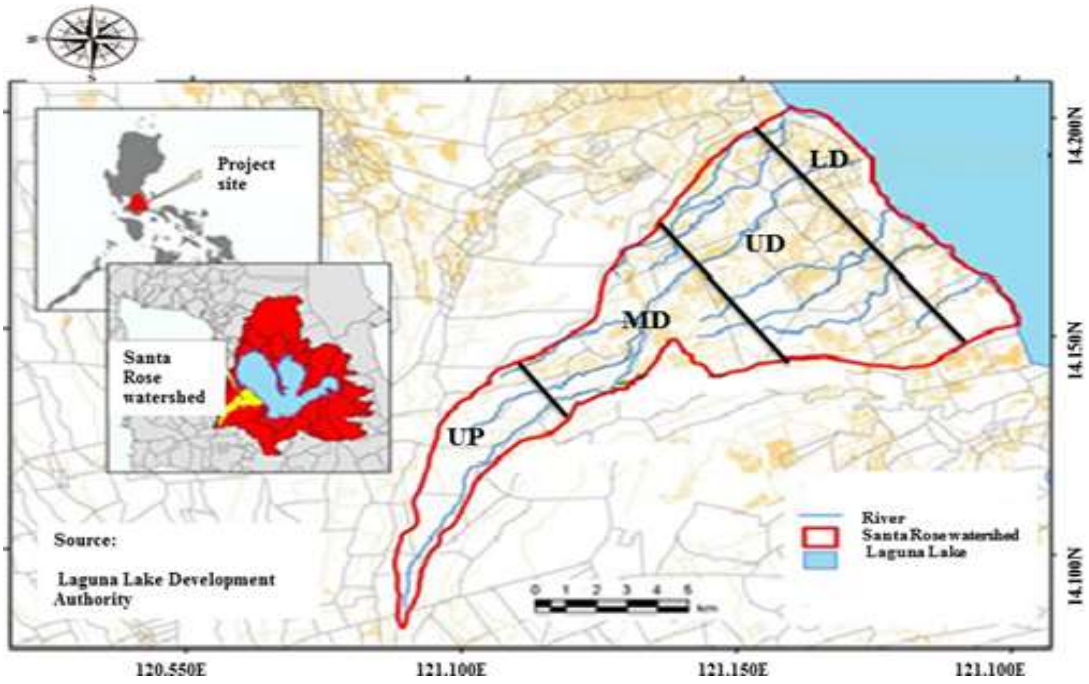


**Figure 1.** Study area: Santa Rose watershed area.

(Israel, 2008).

Fisheries are one of the most significant economic activities in the lake, with bangus (*Chanos chanos*), tilapia (*Oreochromis niloticus*) and kanduli (*Arius dispar*) being the primary production species, consumed largely by the locals, especially the lower socio-economic classes, as their price level remains low (Israel, 2008; Saguin, 2014). Bangus, tilapia and kanduli caught in Laguna Lake (Cuvin-Aralar and Aralar, 1993; Lasco and Espaldon, 2005; Chavez et al., 2006; Africa et al., 2009; Molina et al., 2011; Molina, 2012) were contaminated with heavy metals from industrial and domestic waste (Monila et al., 2011; Monila, 2012; Paraso and Capitan, 2012; Saguin, 2014), and the consumption of such catches may involve health risks for the local residents (Lasco and Espaldon, 2005; Panganiban et al., 2012).

Past research in the Laguna Lake area focused mainly on the degree of water quality and fish stock abundance levels (Chavez et al., 2006; Rosales and Rollon, 2011). There is a lack of research regarding the relationship between the Laguna Lake residents' perception of water pollution and their fish consumption behavior (Tan et al., 2010; Molina, 2012). Globally, overall consumption behavior is influenced by socio-demographic factors (such as education level, income and occupation) and cognitive factors (for example, perception and understanding of food safety) (Dosman et al., 2001; Goktolga et al., 2006; Ozilgen, 2011). People who have received a higher level of education tend to understand the food safety risks and know how to avoid or mitigate risks, such as the risk of food additives, food contamination, pesticides in food than people with less education (Dosman et al., 2001). In this study, we focused on socio-demographic factors (location and education) and cognitive factors (perception of domestic waste and heavy metals) of residents in Laguna Lake area. We analyze the following four hypotheses:

H1. Residents living in areas closer to Laguna Lake consume more fish from the lake;
H2. Residents who receive higher education consume less fish from Laguna Lake;
H3. Residents who believe that the water of the lake is polluted by domestic waste are less likely to consume fish;
H4. Residents who believe that the water of the lake is polluted by heavy metals are less likely to consume fish.

## METHODOLOGY

The research took place at the Santa Rose watershed area, which is one of the 24 sub-watersheds of Laguna Lake (Figure 1). It is located 30-40 km southeast of Metro Manila, spanning 5,543 ha, with a population of 248,890 inhabitants (Philippine Statistics Authority National Statistics Office, 2010).

### Household survey

The data utilized for this study was collected through the "LakeHEAD" household survey (n=389), conducted by the Research Institute for Humanity and Nature in Japan, and University of the Philippines at Los Banos in 2012. The villages (*barangays*) of the Santa Rose sub-watershed area were classified

**Table 1.** Descriptive statistics of socio-demographic and cognitive factors.

| **Socio-demographic factors** | | | |
|---|---|---|---|
| **Areas (n=183)** | | **Education (n=118)** | |
| 1. Upstream | 20% | 1. No formal education | 7% |
| 2.Midstream | 36% | 2. Elementary school level | 76% |
| 3. Upper Downstream | 19% | 3. Above high school level | 17% |
| 4. Lower Downstream | 25% | | |
| **Cognitive factors: the Laguna Lake is polluted by domestic wastes and/or heavy metals** | | | |
| **Domestic wastes (n=172)** | | **Heavy metals (n=124)** | |
| 1. Agree | 81% | 1. Agree | 84% |
| 2. Disagree | 19% | 2. Disagree | 16% |

| **Residents fish consumption behaviors (*n*=183)** | | | |
|---|---|---|---|
| | **Bangus** | **Tilapia** | **Kanduli** |
| Yes | 73% | 72% | 81% |
| No | 27% | 28% | 19% |

**Table 2.** Relationship between residents' fish consumption behavior and areas (n=183).

| **Area** | **Bangus** | | **Tilapia** | | **Kanduli** | |
|---|---|---|---|---|---|---|
| | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| Upstream | 7% | 93% | 5% | 95% | 20% | 80% |
| Midstream | 21% | 79% | 25% | 75% | 6% | 94% |
| Upper Downstream | 15% | 85% | 10% | 90% | 20% | 80% |
| Lower Downstream | 54% | 46% | 59% | 41% | 52% | 48% |

into four groups according to their geographical distribution: upstream: UP (the farthest from the lake), midstream: MD, upper downstream: UD and lower downstream: LD (the closest from the lake). A questionnaire was distributed to 389 households, comprising 11 barangays, from March until April 2012. Out of the 238 returned questionnaires (response rate = 61%), a total of 183 were usable.

### Questionnaire contents

The residents' fish consumption behavior was assessed by asking if they consumed the three most important commercial fish species (bangus, tilapia and kanduli) from Laguna Lake (1. yes, 0. no). The socio-demographic factors included the areas respondents were living in: 1. upstream, 2. midstream, 3. upper downstream, and 4. lower downstream, and education levels 1. never received a formal education, 2. elementary school level, 3. above high school level; The Philippines education system includes three levels: elementary school, high school and university. We also asked about the residents' perception about pollution of the Laguna Lake water by domestic waste (1. agree, 0. disagree) and/or heavy metals (1. agree, 0. disagree).

### Statistical analysis

Initially, using IBM-SPSS Version 22, the descriptive results of the socio-demographic and cognitive factors were summarized for the statistical analysis. Then, a logistic regression analysis was performed, in order to understand how the socio-demographic and cognitive factors under examination influence the local residents' fish consumption behavior. The statistics were tested at significant level at $p<0.05$.

## RESULTS

The descriptive statistics indicated that the majority of the locals (>80%) recognized that Laguna Lake was polluted by domestic waste and/or heavy metals (Table 1). These results correspond with the findings of Su and Cervantes (2008) that showed that the majority of respondents identified reasons of the pollution of Laguna Lake as the existence of domestic waste and heavy metals. Nevertheless, the majority of local residents (>70%) consumed fish captured in the Laguna Lake.

The consumption of bangus, tilapia and kanduli were varied among the areas under examination. The area with the highest levels of consumption was the nearest to lake (lower downstream: above 50%), and the one with the lowest levels of consumption was the one located farthest from the lake (upstream: below 10%) (Table 2).

The rest of the examined factors did not appear to

**Table 3.** Logistic regression model to predict residents' consumption behavior of bangus (*Chanos chanos*) with socio-demographic and cognitive factors as independent variables. N = 77, β = standardized coefficient, Exp (B) = odds ratio.

| Variable | *β* | Wald | Exp (B) | *P*-value |
|---|---|---|---|---|
| Areas | 0.829 | 24.016 | 2.291 | <0.001 |
| Education | 0.000 | 0.001 | 1.000 | 0.974 |
| Domestic wastes | -0.019 | 1.519 | 0.982 | 0.218 |
| Heavy metals | 0.002 | 0.128 | 1.002 | 0.720 |

**Table 4.** Logistic regression model to predict residents' consumption behavior of tilapia (*Oreochromis niloticus*) with socio-demographic and cognitive factors as independent variables. n= 77, β = standardized coefficient, Exp (B) = odds ratio.

| Variable | *β* | Wald | Exp (B) | *P*-value |
|---|---|---|---|---|
| Areas | 1.013 | 32.134 | 2.754 | **<0.001** |
| Education | 0.003 | 0.259 | 1.003 | 0.611 |
| Domestic wastes | -0.019 | 1.573 | 0.981 | 0.210 |
| Heavy metals | 0.001 | 0.035 | 1.001 | 0.852 |

**Table 5.** Logistic regression model to predict residents` consumption behaviors of Kanduli (*Arius dispar*) with socio-demographic and cognitive factors as independent variables. n = 77, β = standardized coefficient, Exp (B) = odds ratio.

| Variable | *β* | Wald | Exp (B) | *P*-value |
|---|---|---|---|---|
| Areas | 1.629 | 29.418 | 5.101 | <0.001 |
| Education | 0.001 | 0.019 | 1.001 | 0.891 |
| Domestic wastes | -0.010 | 0.365 | 0.990 | 0.546 |
| Heavy metals | 0.004 | 0.359 | 0.996 | 0.549 |

affect the residents' consumption behavior ($p$ >0.05) (Tables 3 to 5).

Furthermore, the logistic regression revealed that the residents' location affected their consumption behavior of the three commercially important fish (bangus: $p$<0.001, tilapia: $p$<0.001, kanduli: $p$<0.001). Residents living closer to the lake were more likely to consume fish, mostly due to easier access to the fish resource.

## DISCUSSION

The study concluded that fish consumption behavior is not related to the perception of domestic waste and/or heavy metal pollution directly. Fish is the primary source of animal protein for the local people and they may face health issues related to the consumption of contaminated fish, particularly if they lack understanding of the concept of food safety.

Nonetheless, it is widely accepted that heavy metals intake through fish consumption can be reduced with the utilization of various cooking methods (Atta et al., 1997; Gokoglu et al., 2004; Musaiger and Souza, 2008; Ganbi, 2010; Talab et al., 2014). The most suitable methods for reducing heavy metal concentration are grilling and baking, as these methods remove salts, along with the amino acids and proteins bonded with heavy metals (Atta et al., 1997; Gokoglu et al., 2004; Ganbi, 2010). However, in the Philippines, the most commonly used methods to cook fish, namely frying and boiling (Bayaga-Tiangson and Deveza, 2005), are not that effective in heavy metal removal. Frying, for example, does not reduce heavy metal concentration due to evaporation and loss of moisture (Musaiger and Souza, 2008; Diaconescu

et al., 2013; Talab et al., 2014). Therefore, it is necessary to promote cooking methods with increased effectiveness in heavy metals removal to the local residents. In addition, the cooking methods promoted should take into consideration the access to technology. For example, modern cooking methods such as microwaves and halogen can significantly reduce heavy metal concentration in fish (Talab et al., 2014), but the local residents may not be able to adopt them as they might not have access to microwave and halogen technology.

Additionally, fish consumption behavior was found not to be related to the level of education. Even though food safety education is included in the curriculum of elementary schools in the Philippines, specific instructions that residents can follow in their daily lives, such as how to avoid eating contaminated fish, are severely lacking (The Department of Education, 2013). Thus, residents can only rely on practical knowledge on avoiding intake of contaminated fish, regardless of educational level. Moreover, the lack of individual knowledge about the risks may make people less likely to take preventive actions. Consequently, it is necessary to promote education programs for local people and school students focusing on matters of food safety. Such programs could include, but not be limited to, increasing the numbers of food safety books available in public libraries, promotion of cooking methods to reduce heavy metals concentration in elementary schools, and distribution of children`s books on food safety.

Furthermore, as expected, we found that residents who were living closest to the lake were most likely to consume fish captured in the Laguna Lake. This implies that residents who can easily access the local fish and consume them regularly, face higher contamination risk, since Laguna Lake has been polluted. There is an urgent need for the implementation of outreach programs providing food safety information, in order to raise awareness towards fish consumption to reduce heavy metals intake.

In addition, in developing countries like the Philippines, poor households spend 30-50% of their income on rice. Moreover, the rice price crisis has had a great impact on their food consumption behaviors. The price of ordinary rice increased by 44.2%, from 21.28 peso/kg in 2006 to 30.69 peso/kg in 2009 (Ronalo et al., 2011). A family of five spends around 5.513 pesos (approximately 125US dollars) monthly to fulfill their basic food needs (The Full Year Official Poverty, 2012). As the locals face significant income constraints, they depend on fish from Laguna Lake, as these fish are the only affordable source of animal protein (Israel, 2008; Saguin, 2014) It was concluded that the increasing rice price and low income also influenced residents' food expenditure which determine their consumption behavior, turning them towards cheap commodities, such as fish. It is important, therefore, that the residents realize how risk perception affects their daily lives and health.

Lastly, food safety is closely related to concerns over public health issues all over the world, and is becoming more and more important in many developing countries. Government should take responsibility of the protection of the public and provide opportunities for locals to engage in social learning regarding food safety. However, developing countries in general lack trained personnel, as well as information about food safety, as compared to developed countries (Dewaal and Robert, 2005). Thus, practical food safety education should be promoted not only in developed countries but also in developing countries.

## Conflict of interests

The authors did not declare any conflict of interest.

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