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RESEARCH ARTICLE

ASSESSMENT OF AGROCHEMICALS RESIDUE IN FISH PONDS IN AGRICULTURAL AREAS OF IFUGAO PROVINCE

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Abstract

The physicochemical studies were conducted to assess the status of fish pond water and water bodies in Alfonso Lista, Ifugao for their suitability for fish production. Samples of water from five representative barangays and river points were collected and analyzed for physical parameter [pH (6.5 - 8.5), temperature (20°C - 25°C), dissolved oxygen and alkalinity] as well as biological parameter [Ammonia-N, total phosphorus (TP) and nitrate (NO_3)]. Results revealed mean values for pH, temperature, dissolved oxygen and alkalinity which are within the recommended values for aquaculture operation. . However, most of the values recorded in some of the fish ponds have increasing levels of these physical parameters. The result also revealed that means values recorded for ammonia-N, phosphorus and nitrate exceeded recommended levels (50 mg l-1). These high levels can be attributed to agrochemical inputs from the agricultural lands.

INTRODUCTION

Rationale

Agricultural production in the Philippines has attained significant growth in the last few decades. This has been attributed to improved farming practices and managements. One such management is the use of pesticides for the control of pest and disease and fertilizers for the improvement of growth and yield of crops. In the eastern part of Ifugao province, corn farming is one of the major economic activities. In 2013, the province recorded a total corn production of 106, 449 MT (DA-CAR, Annual Report 2013). This is tantamount to tons of fertilizer and pesticide application.

Another aspect of agricultural growth is seen in the integration of crop and fish ponds in the same unit of land. This practice ensures continuous income generation for the farmers. It has become a common practice to establish fish pond in the middle of a corn field especially if the corn farm is located near a stream or river. In as much as this practice of corn-fish pond integration helps the farmer generate income, most farmers are now encountering losses due partially, to the incidence of fish kill, disease outbreaks, poor growth, and poor feed conversion efficiency. These management problems are directly related to poor water quality (EMB, 2004; NEDA, 2004).

Fish pond water qualities are controlled by both natural processes and human influences. Natural factors such as the source of the pond water and the types of rock and soil in the pond watershed influences water quality characteristics. Most serious water quality problems originate from land uses or other activities near or in the pond. Studies have shown that one land use activity that pollutes fish ponds are agrochemical run-off from nearby farms. According to the Philippine 2001-2005 National Water Quality Status Report (EMB, 2006), ground water contamination is mainly caused by salinity, fecal coliforms and nitrates. Very high amount or 37% of the total water

pollution originates from agricultural practices, which include animal waste, fertilizer and pesticide runoff (NEDA, 2004).

Pesticides and fertilizers are beneficial chemicals. They are used to protect against crop losses that result in more efficient food production. Their action slows down the spread of destructive insects. Their effect has led to the reduction in malnutrition and starvation of humans and animals. However, pesticides, fertilizers and other agricultural chemicals are a significant source of water pollution. According to BAS, (2006), cropland is responsible for 96% of nitrates found in rural water supplies. Stinson and Peter, (l991), reported that fish and aquatic animals are exposed to pesticides in three primary ways such as; a) dermally, direct absorption through the skin by swimming in pesticide-contaminated waters, b) breathing, by direct uptake of pesticides through the gills during respiration, and c) orally, by drinking pesticide-contaminated water or feeding on pesticide-contaminated prey.

While herbicides often kill-off desirable plants, fertilizer runoff encourages excessive growth of undesirable ones. Algae bloom, a condition in which algae overbreeds and cover the surface of the pond can reduce the amount of sunlight in ponds and de-oxygenate the water. Eventually, animals and other plants in the pond die from a lack of appropriate nutrition and habitat. Another detrimental effect of agricultural chemical in fish pond is a condition known as; bio-magnification which is the accumulation of pesticides at each successive level of the food chain. When pesticides bio-accumulate (buildup) in the food chain, these build-ups can be passed to human being as the final consumer of the product (W H O, 2004). A study by Bouman et al (2002) found residues of dangerous pesticides in the artesian wells around agriculture areas in Manguang in Ilocos Norte and in other locations in Laguna and Nueva Ecija (Luzon Island).

As reported by W H O, (2004), bio-concentration and bio-accumulation of agricultural pesticides in the food chain has potential of affecting terrestrial consumers, including humans. Health problems related to the central nervous system in fish eating populations around the world has been associated to prenatal exposure to high level of mercury (W H O, 2004). Water quality is the determining factor on the success or failure of an aquaculture operation. Thus, several water parameters are used as a basis for determining quality water that can sustain animal and aquatic life. Such parameters include; temperature, dissolved oxygen, pH Alkalinity as well as substances that causes pollution in fish ponds (Ammonia-N, Total phosphorus (TP), Nitrite and Nitrate).

Integrated farm practices contribute significantly to sustained increase in domestic fish production as well as an income generation for farmers. It is therefore, important to assess the quality of fish pond water to ascertain its suitability for aquaculture operations for a successful production of healthy fish for public consumption. This study therefore, aims at assessing water quality parameter of fish ponds and water bodies in Alfonso Lista, Ifugao, Philippines.

MATERIALS AND METHODS

Study Area

The study as shown in Figure 1 was carried out in five barangay's of the municipality of Alfonso Lista, Ifugao. Alfonso Lista, Ifugao falls within latitude 16°56'36 "N and longitude 121°28'59"E. The five barangay are the most concentrated areas for corn production as well as fish pond establishments. Average annual temperature ranges between s 20°C to 35°C and average rainfall is 1887 mm.

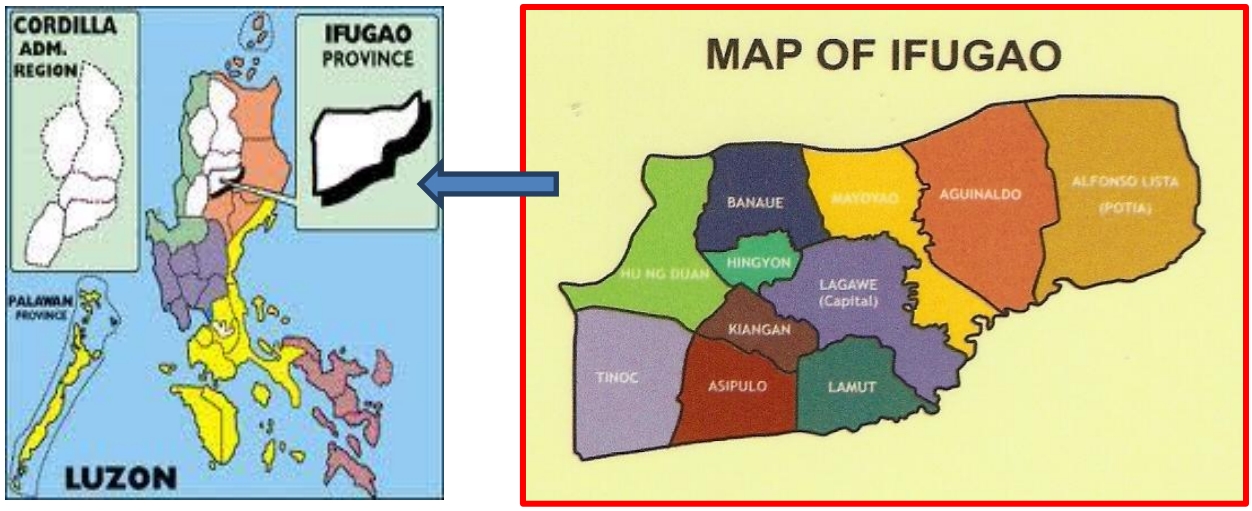

Figure 1: Map of the study area (google, Ifugao Map)

Collection of water samples

Water samples were collected from fish ponds and water bodies (river) from five represented barangays in Alfonso Lista after corn harvest (October, 2014. Five ponds from each barangay and five river spots along the river were sampled. Water samples were collected in 1 liter plastic bottles that were previous cleaned with hydrochloride acid (1:1), rinsed with tap and further rinsed with distilled water. In each pond and river spots, samples were collected without bubbles and covered immediately and submitted within 24 hours to the laboratory of National Institute of Molecular Biology and Biotechnology (BIOTECH) UPLB, Laguna, Philippines.

Analysis of physical parameters

The pH of water samples were measured using pH meter (HANNA pH 211). Temperature was measured by thermometer. Dissolved oxygen (DO) was measured by DO meter (Milwaukee MW 600). Alkalinity was determined by measuring the amount of acid (hydrochloric acid) needed to bring the sample to a pH of 4.5.

Analysis of biological parameters

Ammonia-N was measured by Nessler method (Drum et. al 2002). Total phosphorus (TP) was analyzed from the unfiltered sample as the DIP after persulfate digestion and determined after the Mo-blue method, according to APHA (1998). Nitrate level was determined with an auto analyzer by the Cd-reduction method.

Mean values of physical and biological parameter meters of the water samples from fish ponds and river points from five representative barangays of Alfonso Lista municipality of Ifugao are presented in Table 1. Mean pH values ranged from 5. 8 in fish ponds from barangay Potia to 6.8 in fish ponds in barangay Santa Maria. From the river points, pH ranged from 7.1 in barangay Sta. Maria to 7.4 in barangay Caragasan. pH levels of water samples in this study are within the normal recommended levels. Quality water for fish optimum growth and productivity falls within the pH of 6.5- 8.5. This range is within neutral and alkalinity level which sustains fish live (Pandey and Shukla, 2005). Under pH measures that ranges from 4.0 - 6.5 and 9.0 – 10.00, fish becomes stressful and prolong exposure to such pH conditions results in fish death due to damaged organs (kidney and gills) while lower pH levels increases the toxic level of some elements such as copper, heavy metals as well as hydrogen sulphide (Jhingran, 1988).

Table 1: Soil and Water Analysis of the Study Areas at Alfonso Lista, Ifugao

Water Quality Parameters			Locations / Barangay					
			Potia		Caragasan		Namnama	
			Fishpond	River	Fishpond	River	Fishpond	River
Physical	pH		5.8	7.2	6.5	7.4	5.8	6.7
	Temp	^{0}C	27	25	26	24	27	25

	DO	$mg0_2/L$	6.4	5.5	6.8	4.8	6.5	5.2
	Alk	mg/L	18.6	18.2	18.4	20.2	17.5	18.8
Biological	Am-N	mg/L	2.20	2.10	2.78	2.23	2. 22	2.17
	TP	mg/L	0.120	0.101	0.190	0.124	0.112	0.101
	NO_3	mg/L	0.052	0.023	0.055	0.028	0.053	0.025
			Pinto		Sta Maria			
Physical			Fishpond	River	Fishpond	River		
	pH		5.9	7.02	6.08	7.01		
	Temp	^0C	27	23	27	24		
	DO	$mg0_2/L$	6.6	5.4	5.1	4.2		
	Alk	mg/L	18.9	19.2	18.5	19.1		
Biological	Am-N	mg/L	2.35	2.15	2.25	2.12		
	TP	mg/L	0.182	0.122	0.110	0.070		
	NO_3	mg/L	0.045	0.027	0.037	0.022		

Temp = temperature; DO = Dissolved Oxygen; Alk =Alkalinity; Am-N = Ammonium-N;
TP = Total Phosphorus; NO_3 = Nitrate

The mean temperature recorded from the fish ponds and river points ranged from 26 ^oC to 27 ^oC (fish ponds) and 23 ^oC to 25 ^oC (river points). The lowest temperature from the fish ponds was recorded in Caragasan (26 ^oC) and the lowest temperature in the river was recorded in Pinto (23 ^oC). According to Alabaster and Lloyd, (1980), the ideal temperature range for fish pond is between 20°C - 25°C and the acceptable range is 20°C - 30°C. The values obtained in this study are within this range.

The mean value of dissolved oxygen (DO) recorded from the fish ponds varied from 5.1mg/L in Sta. Maria to 6.8mg/L in Caragasan. In the river points, the mean values varied from 4.2mg/L in Sta. Maria to 5.5 mg/L in Potia. Dissolved oxygen is considered one of the most important aspects of aquaculture. It is needed by fish to respire and perform metabolic activities. Thus, low levels of dissolved oxygen are often linked to fish kill incidents. On the other hand, optimum levels can result to good growth that will yield high production. Mean alkalinity ranged from 17.5 mg/L in Namnama to 18.9 mg/L in Pinto and in the river point, alkalinity ranged from 18.2mg/L in Potia to 20.2mg/L in Caragasan. Alkalinity measures water's ability to resist changes in pH as well as a measurement for the concentration level other minerals that permit suitable water quality. Recommended level of alkalinity is between 50 to 300 ppm (Boyd and Tucker, 1992; APHA, 1998). In this study, most of the mean values recorded for the physical water quality parameters are within the recommended values. However, most values recorded in fish ponds have increasing levels. Figure 2, illustrates the physical characters' of water in the 5 study areas.

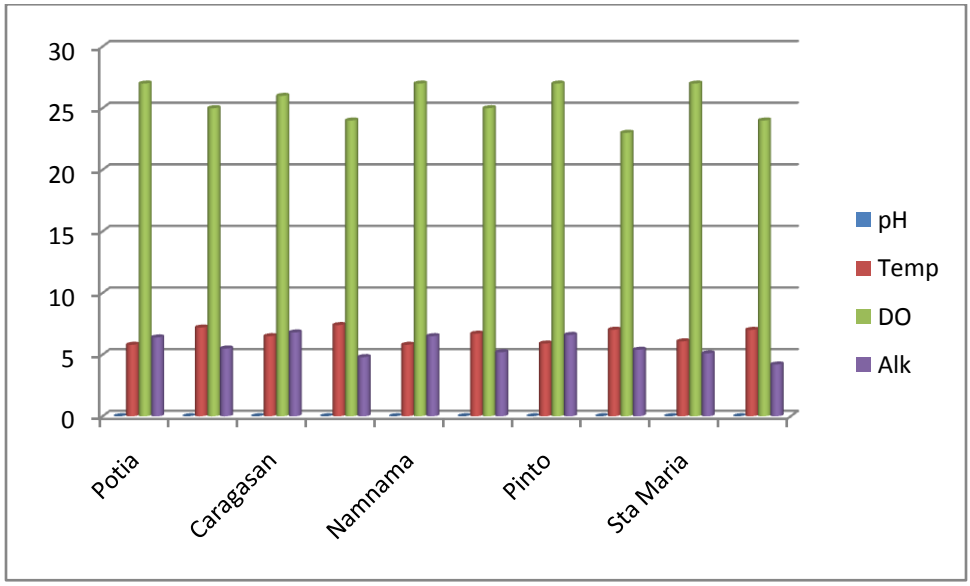

Figure 2: Concentration of Physical parameters of the Study Areas

Biological parameters analyzed in this study from the representative barangays as shown in Figure 3, revealed different concentration. The mean concentration of ammonia-N varied from of 2.20mg/L in Potia to 2.75mg/L in Caragasan. In the river points, mean concentration ranged from 2.10mg/L in Potia to 2.23mg/L in Caragasan (Table 1). High level of ammonia-N can cause stressful condition for fish. Acceptable level ranges from 0.6 to 2 mg/L (Davies, 2008)). In this study, mean values recorded exceeded recommended levels of ammonia-N. High level of ammonia recorded could be attributed to nitrogenous accumulation of left-over protein-rich feed and fish wastes respectively (Swann, 2006).

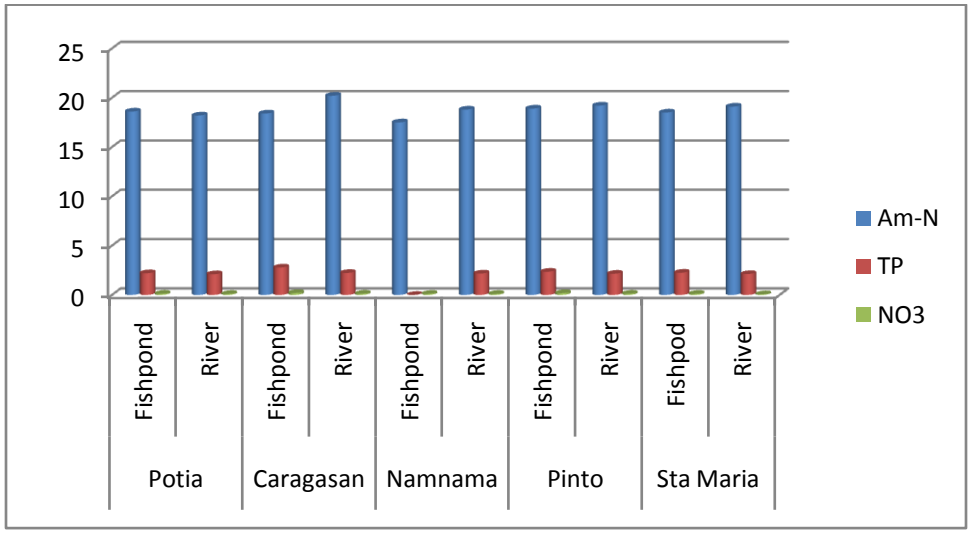

Figure 3: Concentration of Biological Parameters of the Study Areas

Total phosphorus content of the water samples ranged from mean of 0.110mg/L to 0.190mg/L in the fish ponds and 0.070mg/L to 0.124mg/L in the river points. Fish ponds in Caragasan recorded the highest mean values (0.190mg/L) as well as in the river points (0.124mg/L. High level of phosphorus can be attributed to the run off of fertilizers from the agricultural lands use for corn farming as well as decomposition of organic residues (compost). Quality standards on phosphorous are between 0.02 and 0.20mg/L for freshwater aquaculture operation and from 0mg/L to 0.20 mg/L for marine (Boyd, 1992).

Mean nitrate concentration values ranged from 0.037mg/L in the fish ponds in Santa Maria to 0.055Mg/L in Caragasan. In river points, mean values ranged from 0.022mg/L in Santa Maria to 0.028mg/L in Caragasan. These mean values are higher than the recommended values of nitrate (50 mg l-1). This may be attributed to the continuous application of nitrogenous fertilizers in the surrounding agricultural field for corn production. Nitrate is formed through oxidation of nitrite into nitrate by the action of aerobic bacteria leading to the process of denitrification. This normally occurs when water bodies are subjected to enhanced nutrient loading from pollution (Delince, 1992).

CONCLUSIONS

This study has provided basic information on the status of fish pond water and other water body's quality in the municipality of Alfonso Lista, Ifugao. The water samples from fish ponds and river points from the five representative barangays investigated in this study had normal values for physical parameters such pH, temperature, dissolved oxygen and alkalinity. However, most of the values recorded in fish ponds have increasing levels of these physical parameters. Mean values recorded for ammonia-N, phosphorus and nitrate exceeded recommended levels. These high levels can be attributed to agrochemical inputs from the agricultural lands use for corn farming.

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