International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 12, December-2014

An Assessment of Aquaculture Production and Water Monitoring Practices in Selected Provinces in Mindanao, Philippines

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***Abstract*—Aquaculture is the fastest growing form of food production in the world. It is also a significant source of protein for people in many countries. Globally, nearly half the fish consumed by humans is produced by fish farms. Aquaculture contributes significantly to the country's food security, employment and foreign exchange earnings.**

In the Philippines, aquaculture is very popular in the farm level. Occupying in the production of aquaculture products like milkfish, tilapia, seaweeds, oyster, mollusk, mussel and shrimps provides increased rural employment, livelihood and food security hence, improving the productivity of aquaculture industry. However, there are several issues and concerns confronting the aqua farmer that affect their productivity. In this study, an assessment was conducted on the existing practices of aqua farmers in water monitoring system in selected provinces in Mindanao.

Results of this assessment study are valuable inputs in coming up with an innovative real-time water quality monitoring device to improved yield production and mitigate fish kill in aquaculture industry.

Keywords*—assessment, aquaculture production, water monitoring

I. INTRODUCTION

Aquaculture is the fastest growing form of food production in the world. It is the farming of aquatic organism in natural or controlled marine or freshwater environments. Over the last three decades, the global aquatic systems have been subjected to massive pressures from fishing and other types of fishery resources exploitation with indicative fall of the marine capture production and an evident growth in aquaculture [1]. Fish exports from developing countries have surpassed traditional export crops such as sugar, beverages and meat.

At present, the fisheries sector in most developing countries continue to exhibit steady growth in production, consumption and trade. The livelihood of 520 million people depends on fisheries and aquaculture. One third of the world's population rely on fish and other aquatic products for at least 20% of their protein intake and fish provides more than 50% of all the protein and material consumes by 400 million of the world's poorest people and is also an important source of other nutrients such as vitamins A,B and D, Calcium, iron and iodine [2].

Aquaculture offers a significant opportunity for improving food security and nutrition by providing nutritious, yes affordable protein to many millions of people worldwide. The increase in global population, gradual depletion of finite resources required form sustainable expansion and development of aquaculture poses threats to future fish global protein supply [3]. Over and above, the impacts of climate change are also posing threats to sustainable aquaculture development thus requiring focused implementation of mitigation and adaptation strategies

In Southeast Asia, aquaculture is a major food producing sector, contributing 43% of the world's supply. It is a major economic activity, which produces the man source of dietary protein for the expanding populations in the region. However, outbreaks of known and emerging fish diseases construe to threaten aquaculture, bringing considerable economic losses worldwide.

Aquaculture in the Philippines has a long history and involves many species and farming practices in diverse ecosystems. Most of the production comes from the farming of seaweed, milkfish, tilapia, shrimp, carp, oyster and mussel [4].Aquaculture contributes significantly to the country's food security, employment and foreign exchange earnings. Aquaculture is growing much faster than capture fisheries. However, the global position of the Philippines in aquaculture production has fallen steadily from 4th place in 1985 to 11th place in 2005 [2]. The Philippines now contributes only a little over one percent of global farmed fish production compared to five percent previously.

Aquaculture industry experienced huge fish kill specifically, in Lake Sebu, South Cotabato [5], MatinaAplaya, Davao City [6], Barangay Tambac, Dagupan City [7], Lake Buhi, Bicol Province [8], Taal Lake, Talisay, Batangas [9], Anda, Bolinao in Pangasinan [10] which was more or less 15 to 2,000 tons of massive fish kill that cost P5 million to P142 million, respectively damaged the

aquaculture industry. Moreover, from the Philippine Disaster Report of 2009, there were 31 cases of fish kill from 2000 - 2009 [11].

Critical are the questions of social equitability and food safety in the fisheries industry as to who is benefiting from the resources: the rich investors using modern fish farming technologies or the common fisher folk relying only on the tradition low-input- low output kind of farming.

Small scale aqua farmers and workers remain poor because farming is unprofitable and can no longer support even the most basic needs of the aqua farm household. Poverty in aquaculture industry needs to be addressed without them losing the interest in fishing. For the aquaculture industry to remain viable and gain competitive advantage in the global market there has to be assurance of a steady supply in the market.

This study assessed the current status of aquaculture practices and monitoring system that would address the declining production of fish in selected provinces in Mindanao, Philippines. Results will provide guidelines and baseline information to the small-scale aqua farmers as well as the local government units (LGU) in monitoring practices. The objectives of the study were the following; (a) to assess the current status and practices of aquaculture in selected provinces in Mindanao; (b) to determine the water quality monitoring practices in aquaculture in selected provinces Mindanao; and, (c) to determine the existing facilities and equipment and the frequency of water monitoring of aqua farmers in selected provinces.

II. METHODOLOGY

Assessment was made in order to determine the current aquaculture production and existing practices of aqua farmers in selected provinces. This includes the practices in water monitoring for small-scale aqua farmers.During assessment, personal interviews, site visit, survey for nearby areas and second hand information through e-mail, calls and web site visit method were employed.A questionnaire was also made in the assessment of the aqua farmers.Results of the assessment were analyzed and interpretedas basis in coming-up with findings of the study.

III. RESULTS AND DISCUSSION

Fig. 1 shows comparative data for volume of production of fisheries for the year 2012 and 2013. For the first quarter of 2013, the total fisheries production of the Philippines shows an increased compared with previous year. In the four sectors, commercial fisheries posted the biggest production followed by fisheries, aquaculture and municipal fisheries [12].

In Fig. 2, the status of aquaculture in Mindanao for 2012 is shown.The ARMM region has the biggest production, followed by Zamboanga Peninsula and the Northern Mindanao.Fig. 3 depicts the classification of aquaculture according to environments: Brackish water, fresh water and maritime or sea water that are employed in Mindanao.Region 10 has the greater area for brackish water. On the other hand, Region 11 has larger areafor marine water and Region 12 for the fresh waterenvironment. As shown in Fig. 4, major lakes

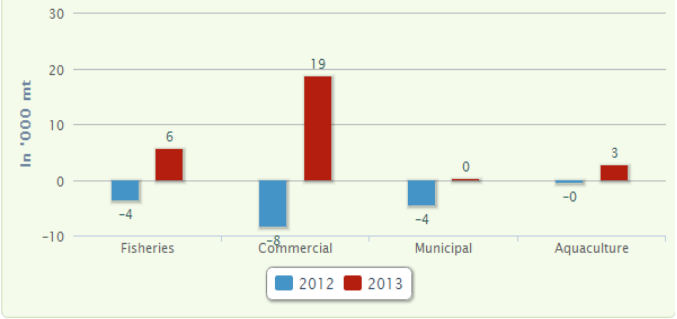


Fig.1. Fisheries: Volume of Production by Sector in Philippines
Source: Bureau of Agricultural Statistics

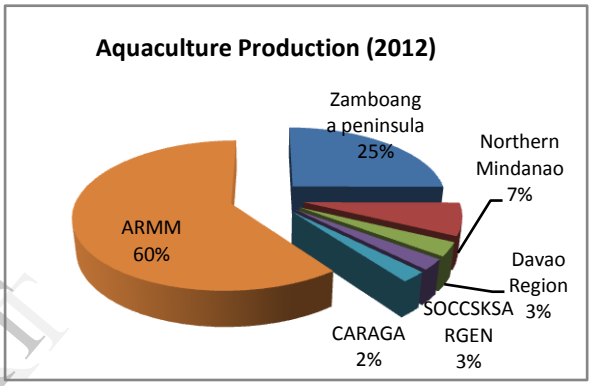


Fig. 2.Aquaculture Production in Mindanao (2012)
Source: Bureau of Agricultural Statistics

in Mindanao can be found in the province of Lanao del Sur (Region 12).

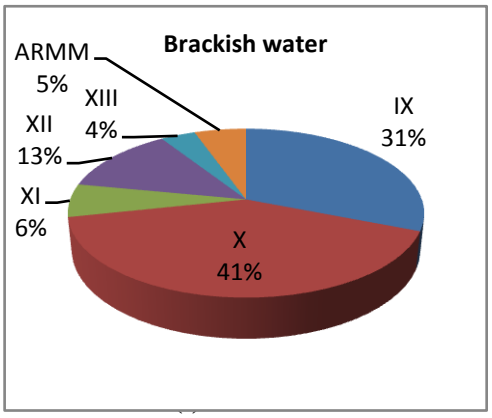
Fig. 5 shows the number of aquaculture operators in Mindanao. Majority of the aqua farmers are engaged in fish pond production while less than 10% of the farmers engaged for oyster and mussel farming and other activities. As shown in Fig. 6,majority of the farmers involved in aquaculture production are small-scale, in which the fish pond area they owned is less than 300 square meters.

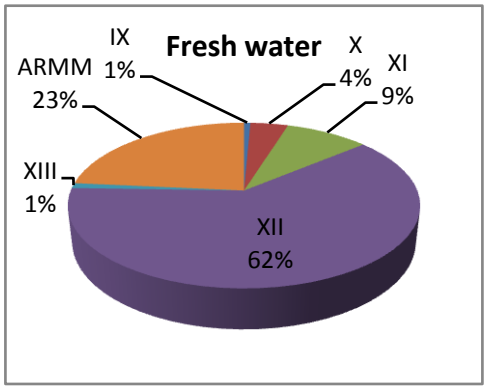
In Fig. 7, the frequency in which the regions in Mindanao monitor the water quality is shown. Majority of provinces monitor the quality on monthly or on seasonal basis. The existing facilities and equipment used in monitoring for the LGU are the following: pH meter, refractometer, secchi disk, thermometer, water analysis laboratory. Based on the data collected, small-scale aqua farmers do not have any facilities, hence, they will need the services of other government offices and private agencies for the conduct of the water laboratory analysis.

The following are the common practices in aquaculture in which has a negative impact on the environment [4]:

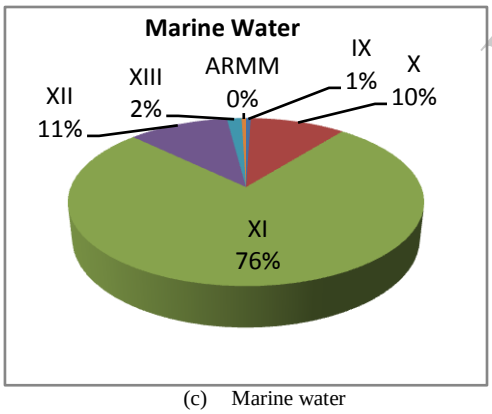
a.) Poor siting which may include conversion of sensitive habitats, setting up of structures such as seaweed floats in coral reef areas, and ponds which require too much pumping

of groundwater.The lack of appropriate planning and zoning is amain reason for poor site selection;





(b) Fresh water



(c) Marine water

Fig. 3.Aquaculture according to environments

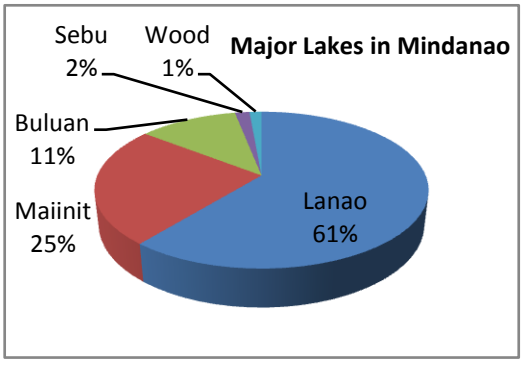


Fig. 4. Major Lakes in Mindanao

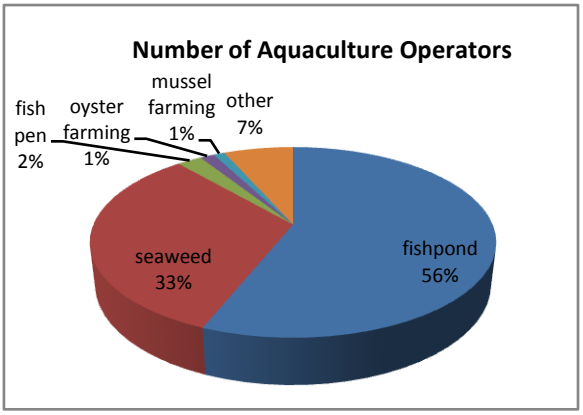


Fig. 5. Number of Aquaculture Operators

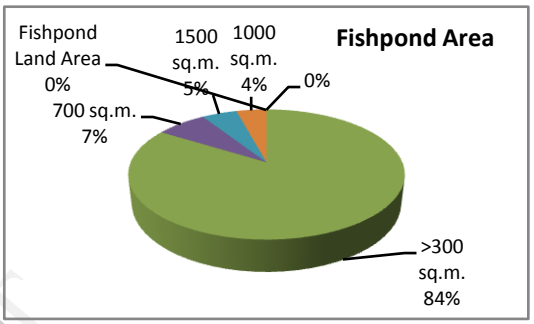


Fig. 6. Fishpond Area of a small-scale aqua farmer

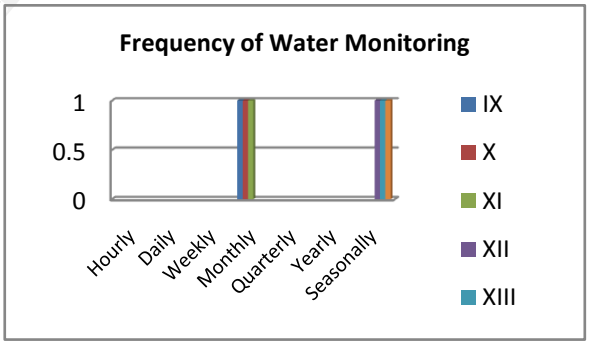


Fig. 7. Frequency of Water Monitoring

b.) Overcapacity refers to the establishment of structures such as cages and pens beyond the carrying capacity of the lake, river, or coastal area. Too many pens that obstruct the free flow of water and physical congestion are tell-tale signs ofovercapacity:

c.) Overstocking is similar to overcapacity but limited to the confines of a cage or pen or pond unit. Means that the number of fish (fry or fingerlings) stocked is beyond the recommended number. Overstocking ultimately results to higher demand for feed, higher wastage and increased demand for oxygen and nutrients from thewater; and,

d.) Overfeeding either too much feed or use of inefficient feeds with low-quality binders, i.e., the feed crumbles and settles to the bottom before it is eaten. Usually done to hasten

growth of fish and result inbigger sizes. These practices mentioned above are apparent among aqua farmers, thus fish kill occur. Fish kills, red tide, eutrophication and other forms of aquatic pollution are among the negative impacts of aquaculture which should be managed, avoided and mitigated.

Based on BFAR Fish Health Section monitoring records that commenced in 1998, there are 192 cases of fish kills with almost half of the causes being attributed to aquaculture [4] (see Fig. 8).

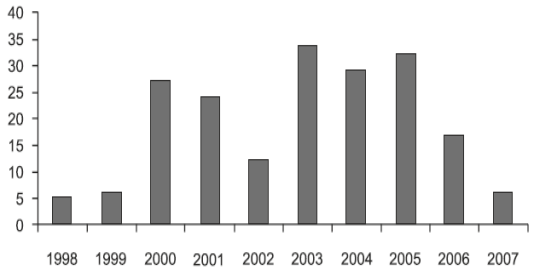


Fig. 8. Number of fish kills occurrences in the Philippines (1998 – 2007)

Also,Table 1 shows the fish kill cases that occurred in the Philippines in aquaculture industry.

TABLE 1. FISH KILL CASES IN THE PHILIPPINES (2008 – 2012)
Source: BFAR, Philippines

No.	Event/Location	Date	Count (Estimate)	Species	Cause/ Remarks
1	Taal Lake, Batangas	January 5, 2008	50 metric tons	Tilapia	May linked to volcano activity and large fish farm
2	Taal Lake, Batangas	May 29, 2011	750 metric tons	Tilapia / Milk fish	Cause by Oxygen depletion & overstocking
3	Mataasnakahoy, Cuenca, Lipa City	June 3, 2011	2,000 metric tons	Tilapia / Milk fish	Overstocking and polluted water
4	Davao City	June 3, 2011	400 metric tons	Tilapia/ Milkfish	Pollutions
5	Lingayen Guld, Anda, Pangasinan	May 30, 2011	500 metric tons	Milk fish	Oxygen depletion and climate change
6	Lake Sebu, South Cotabato	January 31, 2012	49 metric tons ($88,000)	Tilapia	DO depletion
7	Laguna de Bay –Jala-jalaCalamba, Sta. Cruz	May – June 2012	>10 metric tons	Tilapia / Carp	DO depletion
8.	Lake Bito, MacArthur, Leyte	May 14, 2012	400 metric tons	Tilapia	Contamination
9.	Anda, Pangasinan	December 28, 2012	752 metric tons	Milk fish	Overstocking

According to RA 9275, LGUs are responsible for the management and improvement of water quality within their territorial jurisdictions. Through the Environment and Natural Resources Office (ENRO), established through the LGC, the following duties have been assigned, *i.e., monitoring of water quality*, emergency response, and prevention and control of water pollution. In provinces/cities /municipalities where there are no ENROs, the local executive concerned may, with the approval of the Secretary of the Department of Environment and Natural Resources (DENR) designate any of his official and/or chief of office preferably the provincial, city or municipal agriculturist, or any of his employee who must have sufficient experience in environmental and natural resources management, conservation and utilization [14]. Hence, it's the role of the Local Government Unit to ensure proper collection of data in the monitoring of the water quality.

IV. CONCLUDING REMARKS

Aquaculture the fastest growing sector in fisheries and it is relied upon for food, income and employment. Assessment showed that Mindanao will continue to flourish in aquaculture industry however several issues confronting the aqua farmers that would affect their productivity.

Fish kill and other forms of aquatic pollution are among the negative impacts of aquaculture which should result to low production. Results of the study can be a valuable input and motivation to develop an innovative real-time water quality monitoring device to improved yield production and mitigate fish kill/ mortality in aquaculture industry.

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