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Assessing the Level of Aquaculture Biosecurity Regulations Compliance in Ibadan, Nigeria

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In Nigeria, aquaculture is a potential economic investment, but different challenges resulting in numerous losses affect the final fish product and returned on investment. This paper among other things will assess the level and problems of aquaculture biosecurity regulations compliance and its limitations in Ibadan, Nigeria. It will suggest measures and propose actions, plans or statute which will strengthen aquaculture through the development of aquaculture biosecurity regulations in Nigeria to meet international standard. A total of 100 catfish farms were randomly selected and visited for questionnaire administration and 80 questionnaires were retrieved and used for data analysis from 10 0ut of 11 local governments that make up Ibadan. Farmers responses to problems of aquaculture biosecurity compliance were ranked using Likert 5-point scale and data analysed using Anova and Chi-square. The analysis shows that the mortality occurrence in farms is different at α =95% in all the local government areas while the levels of mortality in farms is the same. (P>0.05). Mortality disposal varies across the farms with (38.8%) farmers buried dead fish while 6 farms (7.5%) leave their dead fish to be consumed by other fish. But the analysis of data concludes that disposal of mortality in farms is different (P<0.05) in all the local government areas. The application of disinfectants to cure or prevent the spread of diseases shows that most farms 60% use Oxytetracycline, 32.5% apply Formalin and 7.5% applied chloramphenicol. Also, drug application in farms is the same within local government (P>0.05) but different (P<0.05) among local government areas. Unknown sources dominate sources of fish seed supplied for ponds stocking. Farm effluents are wrongly disposed while 3 farms (3.75%) refined their effluent, 73 farms (91.25%) discharge their effluent into nearby streams/rivers. For aquaculture to thrive and be productive in Ibadan, modern farming methods/techniques, which demand a holistic approach must be adopted.

Keywords: Biosecurity, compliance, mortality, disinfectant.

INTRODUCTION

Aquaculture loses millions of dollars in revenue annually due to aquatic animal diseases. Disease outbreaks continue to threaten profitable and viable aquaculture operations throughout the world. As a result, aquaculture biosecurity programs that address aquatic animal pathogens and diseases have become an important focus for the aquaculture industry. (O'Bryen. 2006)

Aquaculture either as an economic windfall for developing countries, or as one of the most environmentally-destructive food industries, has come under increasing scrutiny and criticism as the world tries to supply food for a population exceeding six billion. (Tisdell, 1999). Aquaculture increasing global importance is directly related to the contribution it makes in reducing the gap between supply and demand for fish products.

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In Nigeria, total domestic fish production is far less than the total domestic demand. (Zango-Daura (2000). Nigeria requires about 1.5 million tonnes of fish annually. This is what is needed to meet FAO's recommended minimum fish consumption rate of 12.5 kg per head yearly to satisfy basic protein needs (Zango-Daura, 2001)

According to Faturoti (2010) "Aquaculture has been clearly demonstrated to be an economically viable, private enterprise in Nigeria, with some 2,642 fish farms inventoried and counting. Aquaculture has great potential for food production and the alleviation of poverty for people living in coastal areas, many of whom are among the poorest in the world (Tisdell, 1999)

This paper adopted the basic biosecurity model as stipulated by Boyd, 1999 and the FAO Code of conduct on Responsible Aquaculture.

The objectives of this paper are to evaluate and analyze farms compliance to aquaculture laws and regulations in strengthening aquaculture biosecurity development in Ibadan, Oyo state, Nigeria and to assess the problems and limitation of aquaculture biosecurity compliance in Nigeria farms using Ibadan as a case study.

LITERATURE REVIEW

This paper evaluates the importance of aquaculture globally, the role that Aquaculture plays in Nigeria in the areas of food security, poverty alleviation and generation of income. The potential for the development of aquaculture in Africa, the threat posed by aquatic animal disease and pathogen incursions to this development and the importance of maintaining strict biosecurity, particularly addressing aquatic animal health and biodiversity, through establishing and implementing a sound biosecurity strategy for Nigeria.

Biosecurity is the protection of living organisms by the Exclusion of Pathogens and Other Undesirables. (Tisdell, 1999). Thus, biosecurity in aquaculture is the protection of fish or shellfish from infections (viral, bacterial, fungal, or parasitic) agents.

Better analysis of risk and climate change in the aquaculture sector would provide a basis for advising governments and industry appropriate management strategies (Arthur et al, 2009)

In aquaculture, biosecurity is a collective term that refers to the concept of applying appropriate measures (e.g. proactive disease risk analysis) to reduce the probability of a biological organism or agent spreading to an individual, population, or ecosystem, and to mitigate the adverse impact that may result not only to fish and its environment but also to human (Arthur et al., 2004).

Aquaculture continues to grow from the mid 1980s, experiencing an annual growth of 8% per year. (Katunguka-Rwakishaya, 2009). Globally, consumer demand for farmed fish continues to rise as levels of wild fish capture have depreciated since 1980s to around 90-93 million tons per year. FAO estimates an additional requirement of 40 million tons of aquatic food by 2030 (aquaculture) FAO report further revealed that in 1980 only 9 percent of fish consumed by the global human population came from aquaculture. In 2004, this figure rose to 43 percent comprising 45.5 million tons of farmed fish. Freshwater and marine capture fisheries currently produce 60 million tons for human consumption. Nearly half of all the fish products consumed are now from aquaculture (FAO, 2004)

AQUACULTURE DEVELOPMENT

It has been reported that China has farmed fish for over 3,000 years, and the country continues to dominate the aquaculture industry by producing 83% of the world's aquaculture output (FAO, 1998). The other notable producers include India (6%), Philippines (4%), Indonesia (3%), Republic of Korea (2%), and Bangladesh (1%), majority of which are in the developing world. (Emerson, 1999). Carp production accounts for 50% of aquaculture production measured as weight or value, even though it has been observed that everything from sea cucumbers to sea horses is farmed. But the vast majority of production is carp, accounting for over 50% of aquaculture production measured as weight or value.

The remaining top cultured species include kelp, oysters, shrimp and salmon. Seaweed farming accounts for another 7.7 million tons. (Emerson, 1999). Aquaculture will continue to be one of the most viable methods to supply growing world population needs, but the challenge to maintain profitability and environmental compatibility is daunting. All too often, governments fail to provide the needed economic, legal, and social support to ensure economic and environmental sustainability. (Muir.J.C et al, 1999). The main laws leading the fisheries sector in Nigeria are the Sea Fisheries Decree 71/1992 and the Inland Fisheries Decree 108/1992. These laws are developed by several regulations, among which the Sea Fisheries Regulations 1995 on Fish Inspection and Quality Assurance are the main texts concerning the control of fishery products.

AQUACULTURE LEGISLATION AND REGULATIONS IN OTHER COUNTRIES

Legislation and regulations of aquaculture practice in several countries for which information was available as reported by (FAO, 1979) that most of the countries do not resemble one another in size or in any of the attributes listed in the regulation, but their experience in aquaculture promotion and control may nonetheless be helpful in highlighting ways of developing a legal system of aquaculture practice in Nigeria.

An example is Japan, in spite of its position as a leading aquaculture nation; He does not have a single, cohesive aquaculture statute. Instead, the authority for Government support and control of fish farming is derived from a series of laws relating principally to fisheries for wild stocks and water pollution control, as well as to certain restricted aspects of aquaculture. It is chiefly from these laws that regulations related to fish farming are derived.

Aquaculture is important in the Philippines, and this importance is increasing under an active policy on the part of the Government to encourage and promote the industry. The Philippines are substantially advanced in aquaculture development than most developed nations in Asia, surrounded by warm seas; cage and pen culture is a major kind of fish farming in the Philippines, brackish water culture is also common in the Philippines, being one of the most useful kind of fish farming, with highly unpolluted water.

Aquaculture in Israel is somewhat different in the regards that on the one hand the industry is a highly important supplier of protein (56% of the fish produced in the country are from farms), and the Government gives aquaculture strong policy and technical support. On the other hand, the Government is obliged to limit the expansion of fish farming because of the shortage of fresh water in Israel. At the national level, Australia has a comprehensive biosecurity program (AQUAPLAN) in

place that provides an overall management strategy for aquatic animal health (Findlay 2003).

Aquaculture in England and Scotland faces problems associated with developed countries: shortage of suitable land and water areas where fish farming can be conducted and a maze of regulations and restrictions scattered through various laws. Licensing is complicated, involving many agencies. Expansion and development of the industry in England is hampered by the lack of a single unifying act.

THE TERM BIOSECURITY

Biosecurity is defined by the US poultry industry as "cumulative steps taken to keep disease from a farm and to prevent the transmission of disease within an infected farm to neighboring farms." (Holmer et al 2001,). Biosecurity is a team effort, a shared responsibility, and an on-going process to be followed at all times. From the breeder to the hatchery, to grow-out operators, biosecurity measures have to be observed to contribute to the success of the industry. The major components of biosecurity, as practiced by the poultry industry, include: isolation, traffic control, sanitation, and rodent and insect control. The purpose of these practices is to prevent the introduction of pathogens and to provide the best living conditions for the health of the animals. Also FAO, 2004 defined biosecurity as "an essential group of tools for the prevention, control, and eradication of infectious disease and the preservation of human, animal, and environmental health." (O'Bryen and Lee 2003). The occurrence of disease is a combination of the health of the animal, the condition of the environment, and the presence of a pathogen. Klesius (2003) used the disease continuum model to illustrate how outbreaks of disease were the result of a weakened immune system of the culture animals, caused by neuroimmune changes resulting from stresses and infection. (Boyd, 1999).

IMPLEMENTATION OF BIOSECURITY AT NATIONAL LEVEL

The ultimate objectives of Biosecurity at the national level are to protect domestic agricultural production and natural resources from biological hazards and to safeguard the health of consumers in the food chain. (Lee, 1999).

LEGISLATIVE REVIEW AND ASSESSMENT

The general objectives of legislation are to protect rights and establish responsibilities as well as to enable the meaningful participation of all stakeholders, from central institutions to local communities. Good legislation establishes predictable rules delegates clear and appropriate authority for the exercise of public powers, which can encourage investment and facilitate the operation of markets while protecting public interests such as the conservation of natural resources.

An assessment of national legislation on Biosecurity should evaluate both compliance with international obligations and the allocation of roles and responsibilities of sectoral bodies in the management of biological risks for food and agriculture.

There are no laws or regulations on some or all of the elements of Biosecurity as in the case of Nigeria, therefore an entirely new legislation must be drafted. In other aspects, there may be an existing legal framework, but there are outdated or insufficient, or rife with overlaps and gaps, and thus call out for a complete overhaul. In others yet there may be some minor changes, for example to add a few specific obligations or to enhance coordination among government bodies.

Effective institutional coordination avoids duplication, inconsistency and disputes among the relevant agencies and also helps improve efficiency in the application of sanitary and phytosanitary measures. The call to embrace Biosecurity approach at national level in Nigeria calls for the harmonization of national legislation with international instruments.

INSTITUTIONAL ARRANGEMENT

Nigeria Fisheries Legislation

Legislation as regards fisheries management in Nigeria has been grouped as follows (NIOMR, 1999)

The sea fisheries Decree makes it illegal for anyone to operate or navigate any motor fishing boat within the Nigerian territorial waters and the EEZ without licence. It stipulates the penalties and vests the enforcement in the Minister of Agriculture. The licensing supplement stipulates the requirements and procedure for licensing and penalties for default. The Exclusive Economic Zone Decree delimits the extent of the zone under the Nigerian government jurisdiction, in accordance with the United Nations Convention on the law of the sea. Its supplement, the EEZ Fishing Regulation, states the conditions for exploitation of the resources by Nigerian-owned boats or partnerships as may be permitted; and for conservation with penalties attached to default.

THE NATIONAL FISHERIES AUTHORITY

The Federal Department of Fisheries (FDF) is one of the 8 professional departments of the Federal Ministry of Agriculture and Rural Development, under the authority of a Federal Minister. The Ministry has the mandate to formulate national agricultural policies and promote agricultural development. The Federal Department of Fisheries is headed by a Director who is responsible to the Minister through the administrative head of the Ministry; the permanent Secretary.

The FDF is responsible for advising the Minister on national fisheries policy, and for implementing a programme of fisheries development in all its ramifications. The mandate for fisheries research is assigned to 2 Research Institutes, which relate very closely to the FDF under the authority of the same Minister. Training of fisheries personnel is the responsibility of 2 specialized Colleges of Fisheries, which rose from being units of the Research Institutes to autonomous institutions under the Federal ministry of Agriculture.

METHODOLOGY

Data Collection

Data for this study were collected using a questionnaire survey. Prior to designing the survey, a focus group workshop consisting of major stakeholders (catfish farmers, extension workers and university researchers) in catfish farming was organized by CAFAN (Catfish Farmers Association of Nigeria) which was held in Ibadan, a major catfish production area in Nigeria to collect comments, opinions, and suggestions about strict compliance to aquaculture biosecurity regulations by fish farmers in Ibadan. Ibadan is the third largest city in Nigeria by population (after Lagos and Kano), and the largest in geographical area. Its population is about 5.6 million, according to the 2006 Census. It is made up of 11 (eleven) Local Government Areas (LGAs).. Ibadan covers an area of 128 km2. The importance of Ibadan is enhanced by the presence of the University of Ibadan and University College Hospital

(UCH). Ibadan has been the administrative and capital city of Oyo state since the Old Western region. It is located in the south-western part of Nigeria. Ibadan is bounded in the North by Oyo/Iseyin, in the South by Ogun state, in the West by Eruwa and in the East by Ikire. Ibadan people speak mainly Yoruba language, one of the largest tribe in Nigeria and majority of the people are farmers who deal with Agricultural products with strong market tradition and a well developed system of periodic market places. Aquaculture projects in Ibadan the Oyo state capital started in the mid 50s with the establishment of Agodi fish farm in Ibadan by the British colonial Government after the commissioning of Payan Fish farm near Jos, Plateau state in 1954 (Nigeria Institute of Freshwater Fisheries Research (2000). The research work was carried out from 100 fish farms randomly selected and visited for questionnaire administration in order to collect information on strict compliance to regulations regarding farm establishment and farm management. Also, oral interview were used to cover areas that are not stated in the questionnaire.

The Federal Department of Fisheries (FDF), Oyo State Department of Fisheries, and Catfish Farmers Association of Nigeria (CAFAN) Oyo State Branch were contacted for the list of viable farms within the study area (Ibadan)

MATERIAL AND METHOD

Secondary data was collected from Oyo state fisheries department for ten out of eleven local government areas that comprises Ibadan municipal, data for Ibadan South East L.G.A was not available while a total of 419 farms was provided (Table 1)

PILOT TESTING

The procedure of pilot testing the questionnaire using the method described by Feather (1976) reveals some corrections to the original questions in order to answer the research questions.

ADMINISTRATION OF QUESTIONNAIRE

In all, a total of 100 fish farms were randomly selected comprising of 10 fish farms from each of the 10 L.G.A and a structured questionnaire was designed and administered to answer the various research questions.

Initially, a reconnaissance survey was carried out on some of the fish farms scheduled for the research. During this period additional farms (20) were discovered through snowballing effect and some farms (15) from the list above were found to be out of operation.

During the visitation, interviews were conducted for owners/managers of fish farms and their responses were carefully recorded. Simple random sampling design was used to administer the questionnaire.

ANALYSIS OF COLLECTED DATA

In the analysis and presentation of the collected data, since the measurement of the data constituted an ordinal scale, non-parametric techniques of statistical treatment were employed. Only frequency counts and percentages were used.

Two main types of analysis were employed: The Use of frequency counts and percentages of farms as response, and the use of Likert 5-point scale to rank farmers.

The statistical formula used is:

Percentage = X/Y x 100%

Where X = Summation of required response
Y = Summation of the entire returned questionnaire for each local government areas.

Farmer's compliance to aquaculture biosecurity was analyzed using descriptive analyses. All statistical analyses were conducted using SPSS for Windows (v17.0) and Microsoft Excel 2007. Weighted mean Analysis using Rahji and Bada 2010 psychometric model. In this, and for each problem identified, the product of the Likert Scale values of 1 to 5, and the number of times a preference is recorded for it are summed up to obtain the weighted scores.

The weighted scores are then divided by the sample size of the respondents to obtain the weighted means. These are used to rank the problems in terms of their severity

RESULTS AND DISCUSSIONS

From 80 farms (Respondents) 57 farms representing 71.25%, mean 5.79±0.37 and standard deviation 2.83 experiences high mortalities, from this figure, farms from Ibadan south west have 8 farms with mean 3.70±0.21, standard deviation 0.67 while Ibadan North and Lagelu farms contribute 7 farms each with means 3.75±0.25, 3.67±0.24 and standard deviations 0.71, 0.71 respectively. Mortality occurrence and levels in farms was the same for all the local government areas. But, the mortality occurrence in farms is different in all the local government areas while levels of mortality in farms are the same. Another problem encountered in most farms was the ability to manage mortality. Different methods was discovered and the research work revealed that out of 80 farms 31 farms (38.8%) with mean 5.68±0.53, S.D 2.95 buried their mortality, 27 farms (33.8%), mean 6.08±0.53, S.D 2.71 burn their mortality, 20 farms (20%), mean 5.83±1.30, S.D 3.19 use their mortality as fish feed while 6 farms (7.5%) with mean 5.18±0.77 and S.D 3.17 convert their mortality into fertilizer.

The project also revealed that mortality disposal in farms is the same in all the local government areas. Methods of mortality disposal in farms are different in all the local government areas.

This research work also shows that 28 farms representing 35% with mean 4.90±0.54 and standard deviation 2.85 reported that the common fish around nearby streams and rivers is Catfish with most occurring in Ona-ara and Ibadan Northeast LGA. 31 farms (38.75%) also reveals that Tilapia with mean 6.00±0.56 and standard deviation 3.05470 are common around farm's environment while 21 farms (26.25%) with mean 6.26±0.55, and standard deviation 2.58844 identified others (frogs, toads, crabs, alligators, etc) as being very eminent. The distribution of fish species in most of the inland water bodies in the country follows the pattern of the Niger-Benue River systems and their tributaries.

Similarly, a majority of the reservoirs in the country has tilapia as the dominant species. (Ita,1993) The spread of pathogens by introduced species could occur either by bringing new pathogens to the new environment, or by harboring existing pathogens. This is a serious concern for many aquatic species that are transferred between regions/countries (FAO/NACA, 2001). Tilapias are relatively resistant to disease compared to other species, although a number of bacteria and parasites are known to affect their health (Shoemaker et al., 2000). These pathogens may not be specific to tilapias.

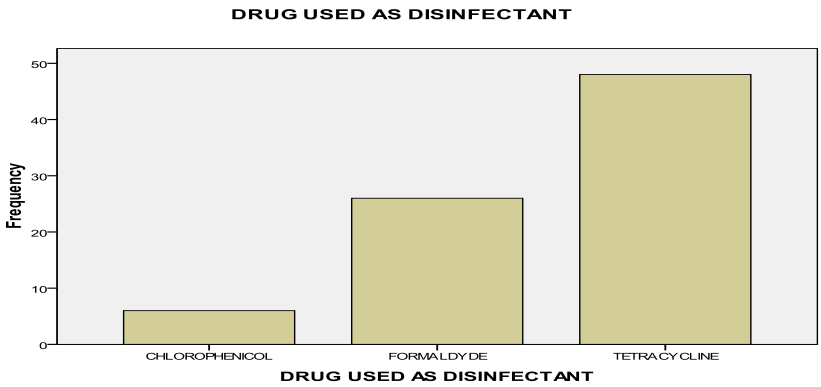

Figure 1: Drug Used As Disinfectant

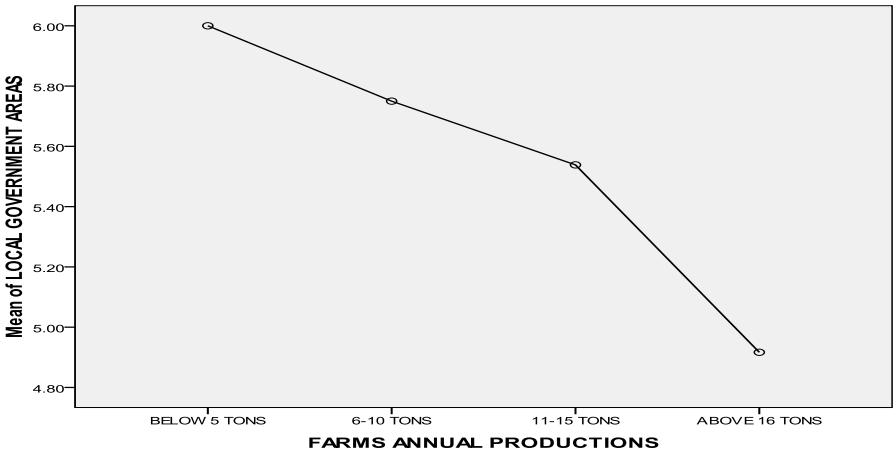

Figure 2: Farms Annual Output

Table 1: Farms Owners According To Gender

L.G.A	No of farms	Male owner	Female owner
Ibadan South-East			
Ibadan South-West	27	25	2
Ibadan North	22	22	-
Ibadan North-East	10	8	2
Ibadan North-West	7	7	-
Akinyele	66	64	2
Lagelu	102	99	3
Ido	47	44	3
Oluyole	38	37	1
Egbeda	78	74	4
Ona Ara	22	19	3

Source: Oyo state Fisheries Department, 2009

Table 2: Summary Of Farmers Response On Issues Affecting Aquaculture Biosecurity Compliance In Ibadan

ITEMS/PROBLEMS	STRONGLY AGREE (5)	AGREE (4)	NEUTRAL (3)	DISAGREE (2)	STRONGLY DISAGREE (1)
Proper Quarantine	0	0	3	37	40
Dead fish disposal	1	11	28	40	0
Drying and liming	10	40	20	10	0
Disinfection procedure	0	1	10	50	19
Juveniles for stocking	1	1	60	9	9
Regular checking	0	1	5	40	34
TOTAL	**12**	**54**	**126**	**186**	**102**

Table 3: Weighted Scores And Means Of The Assessed Problems

PROBLEMS	WEIGHTED SCORE	WEIGHTED MEAN	RANK
Proper Quarantine	123	1.54	6
Dead fish disposal	213	2.66	3
Drying and liming	350	3.63	1
Disinfection procedure	153	1.91	5
Use of juveniles for stocking	216	2.70	2
Prevent disease infection by regular checking	133	1.66	4

Source: farms survey, 2011

The dominance of tilapias in the Lake was associated with an outbreak of trematodes (parasites) that affect several native cichlid species. To effectively prevent the spread of pathogens, the precautionary approach is warranted (e.g., FAO/NACA, 2001).

The research also revealed that the abundance of this common species is different from one local government to another, but the same categories of species are common everywhere.

This paper also reveals that 3 farms (3.75%) discharge their effluents directly into nearby streams/rivers. This was against Boyd, (1999) stipulation that every aquaculture venture shall design and operate aquaculture facilities in a manner that minimizes the effects of effluent on surface and ground water quality and sustains ecological diversity. The application of disinfectants to cure or prevent the spread of diseases from one farm to another shows that most farms 48 representing 60% uses Tetracycline (Oxy tetra.) (With Ibadan Southwest contributing 8 farms and Ibadan North having 2 farms), 26 farms representing 32.5% apply Formalin while 6 farms representing7.5% add chloramphenicol.

This research discovered that 20 farms (25%) with mean 5.45±0.74, S.D 2.94 produce their fish seed from their owned hatcheries (inside), 44 farms (55%), mean 5.93±0.45, S.D 2.78 buys fish seeds from outside with the source not ascertained or certified this also goes against the FAO recommendation that the purchase of fingerlings/post larvae should be from a producer selling certified specific pathogen free (SPR) stock. While 16 farms (20%), mean 5.44±0.74, S.D 2.94 depends on both for stocking and restocking of their farms. Ibadan Northeast has 4 farms with owned hatcheries while farms from Egbeda, Ibadan Northwest and Ido contribute the least (1 farm each) The total farm output per annum reveals that 39 farms (48.75%) out of 80 farms randomly selected produce below 5tons, 16 farms (20%) produces between 6-10tons per annum, 13farms (16.25%) has their production ranging between 11 and 16tons while 12 farms (15%) produces above 16tons per annum.

This further shows that farms from Ibadan Southwest contribute 6 farms producing below 5ton followed by Farms from Lagelu LGA with 5 farms. 2 farms each from Egbeda and Ona-ara produces fish above 16tons per annum. The descriptive analysis indicates the following means and standard deviations (Below 5 tons, 6.00±0.46 and 2.89)77,(6-10tons, 5.77±0.77 and 3.09), (11-15 tons, 5.54±0.75 and 2.70), (Above 16 tons, 4.92±0.89 and 3.09).

CONSEQUENCE (SEVERITY) OF AQUACULTURE BIOSECURITY COMPLIANCE ISSUES

The research examined 6 problems of risk as presented to the respondents. To measure the fish farmers' perception about the potential impacts of compliance to any of the problems, fish farmers were asked to rate (on a 5-point Likert scale) the potential of the problems that affect their productions on each of the 6 risk factors. These problems were rated on a scale of 1 to 5, with, 1 representing very low or minor impact, and 5 representing very significant or severe impact. In measuring and interpreting the perceptions of aquaculture biosecurity compliance management strategies in fish farming, we used the average scores of all catfish farmers included in the analyses.

There were considerable variations in the answers given on ccompliance problems, as indicated by the large standard deviations of most variables. This suggests that perceptions on aquaculture biosecurity compliance are very personal and specific across farmers. However, fish farmers were relatively in agreement when evaluating the impacts of some risk problems such as: (1) Proper drying and liming of ponds before stocking, (2) use of juveniles for stocking, (3) Proper dead fish disposal, (4) Prevent disease infection by regular checking, (5)Proper disinfection procedures (6) Proper quarantine application to incoming fish to farm. This fact is indicated by

the rather low standard deviations of these variables, being 0.86, 0.76, 0.73, 0.65, 0.64 and 0.57 respectively. These are also rated with the highest scores in terms of their potential to affect farmers' productivity. This might suggest that these sources of problems are obvious and important risks that all fish farmers often face and perceive in their production activities. The ranking of the issues using weighted mean indicates that drying and liming of ponds before stocking with mean 3.63 was ranked 1st among farmers opinions in Ibadan (See Table 3), the farmers were very much aware but compliance to the proper and accurate lime applications was lacking. For example the type of lime used and the approved measure of application as well as duration or recommended time of application is not strictly followed.

The use of juveniles for pond stocking with mean 2.70 is ranked 2nd meaning that most farmers realized that stocking pond with big size fish will also increase the growth and survival of fish in ponds but this also depends on the management of ponds. But most farmers in Ibadan use small size fish (fingerlings) because of its low cost compare to big size fish (juveniles). Other issues that affect biosecurity compliance are the proper methods of dead fish (mortality) disposal which is ranked 3rd with weighted mean 2.66. Most farmers buried their dead fish after exposing them to bacteria deterioration. This tends to increase the chances of bacteria survival and spread of infection in farms.

Other issues that also affect biosecurity compliance is the regular checking of ponds for early detection and prevention of disease in farms with mean 1.66. This was also ranked 4th, farmers believe on this issue, but full compliance was not possible among farmers in Ibadan, the reason given was that most farmers devote their time to other activities given only a few time for fish feeding and management. Disinfection procedure with mean 1.91 was another issue which was ranked 5th, fish farmers in Ibadan uses different crude methods and substandard drugs to either prevent or cure fish infections in farms. Farmers were not aware of the proper disinfectant to be used as recommended by laws for the proper aquaculture management.

The application of proper quarantine measure for any fish coming to farms was another big issue with mean 1.54 and ranked 6th. Most farmers in Ibadan did not believe that it exists in aquaculture system, and so many did not know about its importance in fish farming.

The gender of farm owner from this research also reveals that more men are involved in the practice of aquaculture representing 79% while 21% engaged are females. This might be due to the heavy task involved in the whole operation process.

CONCLUSION AND RECOMMENDATIONS

As the aquaculture industry continues to grow, the threat of infectious diseases to fish production facilities will continue. New diseases are being discovered or are emerging in new locations, while the risk of disease in production settings cannot be completely eliminated, the use of biosecurity measures on farms in Ibadan and Nigeria will help to prevent disease introductions and spread. This research shows that despite huge drugs (Medication and vaccination) traditionally used for treating diseases in fish the rate of mortalities resulting from infection was high confirming to widely accepted fact that they cannot, in isolation, prevent losses due to disease, (Boyd, 1999). The occurrence of disease is a combination of the health of the animal, the condition of the environment, and the presence of a pathogen. Unless the background challenge from disease causing organisms can be controlled, and good management practices strictly followed, medication and vaccination alone are not capable of adequately protecting fish stocks. Fish must be given an environment in which the level of infection is controlled to the point where vaccination and medication can achieve beneficial effects. For aquaculture to be productive in Ibadan, modern farming, which demands a holistic approach must be adopted.

Other issues this research mentioned includes sources of fish seed for ponds stocking, here fish from unknown sources dominate supply which was against the rule that all incoming fish into farms must be from properly inspected and health approved sources. The removal or disposal of mortalities from farms must be on a daily basis, although must mortalities are not removed immediately due to the fact that some may not float. The research also shows that most farms bury their mortalities, but the rule says bury with quick lime (1 lb / cubic foot) or burn. Finding from this research also revealed that the majority of the farms visited discharge large volume of effluent into nearby streams/river the main source of water in their farm, this causes serious problems for both the environment itself and the fish quality and yield due to disease spread out and contamination by toxic substances in the product that might be harmful for human health.

In Nigeria, since there are no laws and regulations on aquaculture biosecurity, efforts by government should be geared towards developing one, also government must ensure enforcement as well as surveillance towards compliance to such laws and regulations as long term measure. Whether or not a special aquaculture statute exists in a country, it would be helpful to the industry for the government to provide a guide to the procedures necessary to start and operate a commercial fish farm.

On the part of investors on aquaculture, effort should be made towards ensuring total compliance to best management practice as well as applying the concept of a global code of conduct for responsible fisheries as this would reduce lost of fish resulting from diseases and infection.

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