JFLS | 2020 | Vol 5(1) | Pp 5-8

Research Article

The use of pen culture system to control flooding in earthen ponds

Opadokun I.O., Stephens M.O., George A.A. and Bakre L.A.

Lagos State Agricultural Development Authority, Nigeria

ISSN: 2456-6268

ARTICLE INFO
Received: 15 January 2020
Accepted: 10 May 2020
Available online: 18 June 2020

KEYWORDS
Clarias
Earthen ponds
Flood
Lagos
Pen culture

***CORRESPONDENCE**
opadokundipo@gmail.com

ABSTRACT

Pen culture system was established in earthen ponds in flood prone areas of Lagos state in a bid to find solution to yearly huge fish loss in these areas. Based on rural rapid appraisal (RRA) conducted earlier by the Extension Department of Lagos State Agricultural Development Authority (LSADA) to identify areas usually affected by flood, seven locations were identified within Lagos metropolis: Ajah, Ibeju, Ebute afuye, Ibeshe, Gberigbe, Eruwen and Badagry. There were three replicates in each location. The pen inside each pond was stocked with *Clarias gariepinus* juveniles of 25 ± 0.54g average weight by early June and the trial lasted till mid- October. Flood occurred thrice during the trial. There were significant differences ($P<0.05$) in both the recovery rate and fish yield of ponds installed with pen and those without pen. Recovery rate of fish was 81.5 ± 7.93% in pen culture system ponds as against 17.86 ± 1.76% in ponds without pen installation. Fish yield was 574.81 ± 43.08kg in pen culture system ponds compared with 156.62 ± 17.62kg in the control ponds. Economic loss was inversely proportional to the presence of pen in ponds. It was concluded that pen culture system in earthen ponds is a proven solution to constant loss of fish to flood in earthen ponds located in flood prone areas of Lagos state.

INTRODUCTION

Due to the awareness of the profitability in aquaculture and the increase in demand for cost effective high quality protein in an ever growing urban population of Lagos state, Nigeria, many people have diversified into fish farming as a source of living. Several earthen ponds in Lagos state are prone to flood. This is due to poor site selection and some circumstances beyond farmers' control e.g. wrong channelization of water drainage. As a result, millions of naira is lost yearly by fish farmers in such locations (The Sun, 2016) and this has led to some of them abandoning fish farming.

Falaye (2013) reported that of all natural disasters occurring in developing countries, 90% of them are climate, weather and water related. The National Emergency Management Agency (NEMA) reported that heavy rain causes flood in the country due to overflow of river discharge, blockage of drainage system by litters and garbage leading to destruction of roads, bridges and other infrastructure; thus ruining property, killing livestock and fishes, thereby leading to the temporary displacement of people whose homes were inundated. According to Falaye, 2013, fishing and aquaculture facilities located in the flood plains sustained negative effects during the 2012 flooding including loss of fish stock in ponds, destruction of fishing gears, and future production and income losses. Lagos state lies within latitude $6^{o}22'$ to $6^{o}42'$ N and longitude $2^{o}42'$ and $3^{o}42'$ E in the tropics with a total surface area of 357,700 hectares, out of which 60,839 hectares (about 17%) are made up of lagoons, creeks and coastal river estuaries (Opadokun, 2015). Land is very expensive in Lagos State, thus farmers are limited to few choices in terms of agricultural land. It therefore becomes imperative to develop a technology whereby the available land can be used for fish farming.

Several methods have been adopted by several workers to control flood. These include barricading / perimeter fencing of the ponds using bamboo, wire mesh and several other materials. However these are either uprooted by the high tide during flooding or submerged completely whenever the flood rose higher. Pen system is rooted at the bottom of the pond and the dyke serves as protective framework to the pen from the high tide of flood, thus preventing it from being uprooted or collapsing; hence the choice of pen system for this trial. The objectives of this trial were to introduce pen system into flood prone areas in Lagos state; to control loss of fish to flood; to assess the efficiency of pen system in controlling flood in earthen pond and to improve farmers' income.

MATERIALS AND METHODS

The trials were located in flood prone areas of the State. Seven farms were selected all over the State to make seven replicates in all. The locations were Ajah, Ibeju, Ebute afuye, Ibeshe, Gberigbe, Eruwen and Badagry. Preliminary oral interviews were conducted for farmers in the affected areas to ascertain the maximum level that the flood has ever reached in each location. Two ponds of average size of $100m^3$ each were selected in each location to serve as Treatment 1 (Earthen Pond installed with pen system) and Treatment 2 (Earthen Pond without pen system) to serve as control. In treatment 1, each pen was constructed using a network of sliced bamboo (to prevent re-growth of the bamboo planks), racked by about 30cm to the perimeter of pond bottom. Based on the preliminary oral interviews of the farmers, heights of the pens were set to 1.2 ± 0.6m above the dyke level. Thus the total length of the bamboo network was 3.0 ± 0.3m. The bamboo network was surrounded by galvanized wire mesh. The top of the pen was covered by fishing net of 1.5cm mesh size (Fig. 1 and 2). Each pen was provided with an improvised door made with bamboo which formed part of the pen system. Ponds in Treatment 2 were netted with fishing net on top without pen installation.

Fig.1: Pen under construction

Fig.2; Pen at completion stage

In each replicate, 800nos of *Clarias gariepinus* juveniles were stocked were stocked per pond. Feeding was carried out at 3% body weight twice daily (Sotolu *et al.*, 2015). Test cropping was carried out fortnightly and subsequent feed adjusted to accommodate the increase in fish body weight (Obasa *et al.*, 2009). Growth indices were measured as stated below:

MWG (g) =W2 – W1 (Agbabiaka, *et al.*, 2012)

where: MWG = Mean weight gain, W2 = Final mean weight of fish, W1 = Initial mean weight of fish

Total weight (kg) of fish at Stocking = Average weight of fish at stocking * Total number of fish at stocking

Total weight (kg) of fish at harvest = Average weight of fish at harvest * Total number of fish at harvest

Survival rate (%) = Number of fish recovered at harvest/ Initial number of fish stocked * 100.

Specific Growth Rate (SGR) (%/days of fish culture) = 100 * (Ln W2 – Ln W1)/time (Sotolu *et al.*, 2015)

Statistical Analysis

Data were recorded as mean ± standard deviation. All data collected were subjected to descriptive statistics and analysed for significant differences at $P<0.05$ using one way analysis of variance (ANOVA) (Obasa, *et al.*, 2009)

RESULTS AND DISCUSSION

Harvesting was done at all locations after the three flooding periods. Fish recovered were 652 ± 63.48 in ponds installed with pen culture system as against 143 ± 14.04 in the control ponds without pen. This gave a percentage recovery of 81.5 ± 7.93% in ponds with pen structure which was significantly higher ($P<0.05$) than 17.9 ± 1.76% in ponds without pen structure (Table 1).

Tables 2 and 3 show the growth performance of *Clarias gariepinus* in both treatments. Mean weight gain of 858.57 ± 30.92g recorded in ponds with pen installation was significantly lower ($P<0.05$) than 1072.86 ± 89.90g for ponds without pen installation. Feed conversion ratios (FCR) were not significantly different ($P>0.05$) in both treatments. Specific growth rates, though higher in ponds without pen installation, were not significantly different ($P>0.05$) compared to ponds with pen installation.

Flooding is a temporary overflowing of water onto land that is normally dry (SanJoaquin, 2019). Flooding may happen with only a few inches of water, or it may cover a house to the rooftop. There are many possible causes of floods including heavy rain or snowmelt, coastal storms and storm surge, waterway overflow from being blocked with debris or ice, or overflow of levees, dams, or waste water systems. Flooding can occur slowly over many days or happen very quickly with little or no warning, called flash floods (SanJoaquin, 2019).

Flood is as a result of several factors which may include but not limited to poor location of ponds, road construction which leads to diversion of waterways/channels to hitherto dry lands. Blockages of flow channels and canals by incessant dropping of debris into rain water during downpour, some rivers naturally overflow their banks during heavy downpour and escape to nearby farmlands and ponds. This always leads to water finding alternative routes to flow to, which may include farmlands and ponds. Lagos state being a cosmopolitan city has a limited farmland. Hence farmlands located in flood prone areas cannot be relocated but a better way of utilizing existing ponds must be sorted out, hence the implementation of pen culture system in earthen pond.

The high survival rate of fish, 81.5 ± 7.93% in ponds with pen culture system as against 17.9 ± 1.76% in ponds without pen structure proofed that this technology will serve

as an effective control for flood in earthen ponds. Higher MWG of the remaining fish that survived the flood in the control ponds can be traced to larger space availability after the flood which translated to more feed availability and subsequent higher weight gain. This agrees with Arnon *et al.* (2016) who stated that *C. gariepinus* stocked at low and medium stocking density showed significantly higher weight gain, specific growth rate, and final mean weight than those cultured at high stocking density ($P < 0.05$). Ajani *et al.* (2015) opined that performance indicator of *C. gariepinus* fry reduced with increasing stocking density. Jamabo and Keremah (2009) attributed the inverse relationship between stocking density and growth performance to reduced food consumption, lower food conversion rates or increased metabolic cost.

The farmers were convinced that the pen has not only prevented loss of fish to flood but also protect the stock from poaching. Poaching has been a major challenge to fish farmers (Gono *et al.*, 2015; Coastal monitoring, 2019) but with the pen system, farmers now have the confidence that their fish is fully protected from stocking to harvest. Also the stock is protected from predators such as birds, snakes, monitor lizards etc.

The sliced bamboos were still strong in the pond as at the point of harvest. However, the nets that were submerged in the pond rusted before the end of the trial while the nets above water were still intact. Thus a better recovery rate could still be achieved if the submerged nets were coated with marine paint which would prevent rust.

CONCLUSION

The trial showed that pen culture system in earthen pond operation will save farmers from huge loss of fish during raining season, as well as provide adequate security from poaching since the pen can be under lock and key. It is therefore recommended that farmers who have their ponds unavoidably sited in flood prone areas should adopt the pen culture system to prevent loss of fish to flood. Further work should be done on using a quality net that can resist corrosion to construct the pen OR coating the portion of galvanized nets that would be submerged in the pond with marine paint so that the net can last for several culturing period.

ACKNOWLEDGEMENT

We would like to appreciate the Permanent Secretary of Lagos state Ministry of Agriculture, Dr. Olayiwole Onasanya, the Programme Manager of Lagos State Agricultural Development Authority, Dr. O. Pereira-Sheteolu, the Director of Technical Services component, Miss O.O Ola, the Director of Extension services, Mrs. T. Kosoko and all staff of Fisheries subcomponent and Extension agents who assisted in the field work.

Table 1: Survival Rate of *Clarias gariepinus* under pen culture system

	Ponds with pen			Ponds without pen	
Location	**No of fish stocked**	**No of fish recovered**	**% fish recovered**	**No of fish recovered**	**% fish recovered**
Ajah	800	658	82.25	162	20.25
Ibeju	800	576	72.00	130	16.25
Ebute afuye	800	642	80.25	150	18.75
Ibeshe	800	564	70.50	134	16.75
Gberigbe	800	688	86.00	140	17.50
Eruwen	800	734	91.75	158	19.75
Badagry	800	702	87.75	126	15.75
Average	800	652	81.50	142.86	17.86
SD	0	63.48	7.94	14.04	1.76

Table 2: Growth performance of *Clarias gariepinus* under pen culture system (Treatment 1)

Location	MIW(g)	TIW(kg)	MFW(g)	TFW(kg)	MWG (g)	FCR	SGR (%/day)
Ajah	25	20	850	559.3	825	1.15	2.94
Ibeju	25	20	930	535.68	905	1.02	3.01
Ebute afuye	25	20	900	577.8	875	1.14	2.99
Ibeshe	25	20	900	507.6	875	1.17	2.99
Gberigbe	25	20	880	605.44	855	1.14	2.97
Eruwen	25	20	840	616.56	815	1.16	2.93
Badagry	25	20	885	621.27	860	1.12	2.97

MIW=mean initial weight, MFW=mean final weight, TIW=total initial weight, TFW=total final weight, FCR=feed conversion ratio

Table 3: Growth performance of *Clarias gariepinus* in earthen ponds without pen installation (Treatment 2)

Location	MIW (g)	TIW (kg)	MFW (g)	TFW (kg)	MWG (g)	FCR	SGR (%/day)
Ajah	25	20	1020	165.24	995	1.05	3.09
Ibeju	25	20	980	127.4	955	1.02	3.06
Ebute afuye	25	20	1050	157.5	1025	1.10	3.12
Ibeshe	25	20	1075	144.05	1050	1.01	3.13
Gberigbe	25	20	1200	168	1175	1.00	3.23
Eruwen	25	20	1150	181.7	1125	1.07	3.19
Badagry	25	20	1210	152.46	1185	1.01	3.23

REFERENCE

Agbabiaka L.A, Amadi A.S, Madubuko C.U, Nwankwo F.C. and Ojukannaiye A.S. 2012. Assessment of nutrients and sensory qualities of brine treated catfish smoked with two different woods. *African J. of Food Sci.*, 6 (7): 245-248.

Ajani E.K., O. Orisasona and A. Jenyo-Oni. 2015. Growth and economic performance of *Clarias gariepinus* fry reared at various stocking densities. *J. of Fisheries Livest Prod.* 3:136.

Arnon P.S, M.I. Samwel and D.M. Yunus. 2016. Effect of stocking density on growth performance, survival, production, and financial benefits of African sharptooth catfish (*Clarias gariepinus*) monoculture in earthen ponds. *J. of Applied Aquaculture* 28:3

Coastal Monitoring, 2019. Main concerns of fish farms. Retrieved January 14, 2020, from https://www.coastalmonitoring.com/markets/fish-farms

Falaye, A.E., 2013. Impact of climate change on fisheries and aquaculture productivity. In: Proceedings of the 28th Annual conference of the Fisheries society of Nigeria (FISON). Abuja 2013. Pp 19 – 31.

Gono R.K, Muzondiwa J, Chihanga I. and Manhondo P.R. 2015. Socio-economic factors affecting the successful implementation of aquaculture projects in Zimbabwe; a case study of Chivi district. *Liv. Res. for Rural Dev. 27: 27*. Retrieved January 14, 2020, from http://www.lrrd.org/lrrd27/2/gono27027.html

Jamabo N.A. and R.I. Keremah. 2009. Effects of stocking density on the growth and survival of the fingerlings of *Clarias gariepinus* (Burchell, 1822). *J. of Fish. Inter.* 4(4) : 55-57.

Obasa S.O, Olaoye O.J, Akinyemi A.A, George F.O.A, Abdul W.O. and Odusanya A.S. 2009. Utilization of poultry hatchery waste meal as a substitute for fish meal in the diet of African mud catfish (*Clarias gariepinus*) fingerling. *Nig. J. of Fisheries* 6: 1&2. 15-20.

Opadokun, I.O. 2015. Reproductive biology and larval rearing of *Gymnarchus niloticus* (Cuvier, 1829) in Lekki lagoon, Lagos, Nigeria. Ph.D Thesis. University of Ibadan. 179pp.

SanJoaquin. 2019. Flooding. Retrieved January 14, 2020, from https://www.sjready.org/disasters/flooding.html

Sotolu, A.O, S.A. Okunsebor and S.O. Sule. 2015. Growth performance and haematology of *Clarias gariepinus* juveniles fed graded level of *Moringa oleifera* leaf meal. In: Proceedings of the 30th Annual conference of the Fisheries society of Nigeria (FISON). Delta 2015. Pp 235 – 238.

The Sun Nigeria. 2016. Lagos fish farmers lose millions to flood. Retrieved January 14, 2020, from https://www.sunnewsonline.com. 11 September, 2016.