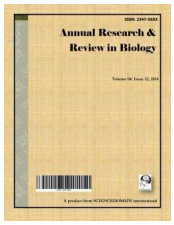

Annual Research & Review in Biology
8(2): 1-10, 2015, Article no.ARRB.20038
ISSN: 2347-565X

SCIENCEDOMAIN *international*
www.sciencedomain.org

Effect of Aquaculture Feeding Practices on Commercial Fish Farming in Rawalpindi District, Pakistan

Atufa Kawan[1*], Zubair Anjum[1], Durre Shahwar[2], Maratab Ali Awan[3] and Faraz Akrim[2]

[1]Department of Zoology, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.
[2]Department of Wildlife Management, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.
[3]Fish Hatchery Rawal Town, Islamabad, Pakistan.

Authors' contributions

This work was carried out in collaboration between all authors. Author AK designed the study, wrote the protocol and interpreted the data. Author ZA did the proofreading of the manuscript. Author DS anchored the field study, gathered the initial data and performed preliminary data analysis while authors MAA and FA managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARRB/2015/20038
Editor(s):
(1) George Perry, Dean and Professor of Biology, University of Texas at San Antonio, USA.
Reviewers:
(1) Keshav Kumar Jha, Rajiv Gandhi Central University, India.
(2) S. Radhakrishnan, UAE University, United Arab Emirates.
Complete Peer review History: http://sciencedomain.org/review-history/11167

Original Research Article

Received 8th July 2015
Accepted 5th August 2015
Published 29th August 2015

ABSTRACT

A field survey was carried out in three tehsils namely Rawalpindi, Gujar khan and Kahuta) of Rawalpindi district. A predefined questionnaire was used to gather the information. In the studied farms the average stocking rate of 1200 fingerlings/acre with average weight of 4 grams were stocked. The fingerlings were fed with constant feeding rate of 3% of their body weight. On average the fish ponds have been fertilized with 9-12 $kg^{-1}acre^{-1}week^{-1}$ cow dung and poultry droppings as organic fertilizer, 5 kg/acre/week urea and 3 $kg^{-1}acre^{-1}week^{-1}$ DAP (diammonium phosphate) as inorganic fertilizer. Highest production obtained with balanced supplemented followed by standard feed and conventional feed for *Labeo rohita* (373.56, 344.26 and 286.40 kg/acre/year respectively).

**Corresponding author: E-mail: atufa.zaheer@gmail.com;*

Cirrhinus mrigala highest production was with balanced supplemented and standard feed (304.22 and 282.71 kg/acre/year) and lowest with conventional feed (207.22 $kg^{-1}acre^{-1}year^{-1}$), *Ctenopharyngodon idella* highest production was with balanced supplemented feed (361.24 $kg^{-1}acre^{-1}year^{-1}$) and lowest production (212.15 and 205.31 kg/acre/year) with both standard and conventional feed and *Hypophthalmichthys molitrix* production was non significant for balanced supplementary feed (309.53 $kg^{-1}acre^{-1}year^{-1}$), standard feed (194.24 $kg^{-1}acre^{-1}year^{-1}$) and conventional feed (133.90 $kg^{-1}acre^{-1}year^{-1}$). The present study and statistical analyses revealed that the balanced supplementery feed produced a significant yield in carp culture. Based on this study, the balanced supplementery feed ingredients are highly affected by fishes and its inclusion in formulated feed for beneficial to carp culture.

Keywords: Aquaculture; feeding practices; fish farming; Rawalpindi; Pakistan.

1. INTRODUCTION

Fisheries play an important role in Pakistan's economy and it is also considered to be an important source of livelihood. Apart from marine fisheries, inland fisheries (based on rivers, lakes, ponds, dams, etc.) and commercial fish farming is also a very important activity throughout the country [1]. Rawalpindi District (l latitudes 32° 30' to 34° 30' N, and longitudes 72° 30' to 73° 30' E) constitutes the eastern half of the Potohar uplands. In the North's and East the area is bounded by the Himalayan foothills, in the South by the Salt range and in the West by Attock District and the Gandhara range. This district contains two main Rivers namely Korang and Sowan which comprise the main drainage of the potohar uplands. The main culturable fishes in this area are Grass carp, Silver carp, Thalia, Rohu, Mori and Bighead carp. Their food requirement is approximately 3% of their body weight and the main ingredients of their food are Green fodder, Rice bran, Rice Polish, Oil cakes, Maize gluten [2].

Adequate nutrition is required to fish for their growth, continued existence and reproduction. A great variety of food in natural conditions is available to fish, including phytoplankton, zooplankton, periphyton, benthos, Nekton and plants which are present all over the year [3]. There is a vital role of supplementary feeding in semi intensive and intensive fish culture where it is vital for maintaining a high density of fish than the natural fertility of the water can support [4]. The growth rate of fish is significantly affected by the quality and quantity of feed that a fish consumes, feed adaptation and chemical composition (protein, fat, carbohydrate etc.) [5,6,7].

We can increase the fish production with exact use of fertilizers and supplementary feeds in carp polyculture system. The most important use of pond fertilization is to expand the creation of plankton, which has served as a primary food of the fishes. As fertilization raises the both autotrophic and heterotrophic levels, it resulted in the increase in fish production [8]. By means of feeding and fertilization fish production could be increased up to 5,000 kg/ha [9]. The use of fertilizers increases the rank of primary productivity, dissolved oxygen, pH and total phosphorus [10]. They take part in the formation of soil structure and boost fish production with no threat of dietary diseases as well. As a result of fertilization the growth of fish is powerfully associated with raise in phytoplankton and zooplankton productivity. The use of organic and inorganic fertilizers in polyculture system provides the fundamental nutrients and elements which are essential for the production of phytoplankton and zooplankton; they serve as a most important source of food for fish [11]. With context to the previous data this present study was designed to study the effect of aquaculture feeding practices on commercial fish farming in Rawalpindi district.

2. MATERIALS AND METHODS

2.1 Study Area

The study area was the Rawalpindi district (latitudes 32° 30' to 34° 30' N, and longitudes 72° 30' to 73° 30' E) which covers 528 km^2 of land in the Potohar area in northern Punjab. The District comprises six tehsils namely Rawalpindi, Murree, Kotli Sattian, Kahuta, Gujar Khan and Taxila. The total area of the district is 5,286 square kilometers. The standard rainfall of the district is 1,550 millimeters. The mean utmost temperature is 17.7℃ and minimum 2.6℃ during January so it is the coldest month (Regional Agromet Centre, Shamsabad, Rawalpindi). The mean yearly rainfall in summer is 685 mm and about 228 mm in winter [12].

2.2 Sampling Method

Fifteen private fish farms were randomly selected for this study. Out of these 5 fish farms of Rawalpindi Tehsil, 5 fish farms of Gujar khan Tehsil and 5 fish farms of Kahuta Tehsil were surveyed. The list of private fish farms located in District Rawalpindi was obtained from the Fish Seed Hatchery Rawalpindi, Rawal Town, Islamabad, Pakistan.

2.3 Data Collection

On a preliminary basis, questionnaires were designed after conducting a thorough study of the objectives of the study and by consulting the Fish Seed Hatchery Rawalpindi, Rawal Town, Islamabad. Questions were formulated by keeping in mind all the important aspects of the study.

In each interview, information was generated regarding farm's name, farm location, type of feeds have balanced supplementary feed (rice polish, fish meal, soybean meal), standard feed (rice polish) and conventional feed (fodder); Types of fertilizers (Organic, Inorganic and combinations of both), species of fish in the pond, and production in kg/acre/yr.

Before conducting this study some questionnaires have been filled with farmers and when it was ensured that the information provided by farmers were correct, then little bit modification has been done in questionnaires for the collection of data in the future (see Annexure I).

2.4 Statistical Analysis

The significance of the difference between mean production of four fish species using three different feed combinations at 15 farms was determined by one way analysis of variance (ANOVA). To determine the difference within means least significant difference test (LSD) was calculated at 5% level of significance.

3. RESULTS AND DISCUSSION

A survey of 15 private fish farms was carried out with the objective to study the effect of aquaculture feeding practices on commercial fish farming in Rawalpindi district. A predefined questionnaire was used to gather the information and the list of farms located in District Rawalpindi was obtained from the Fish Seed Hatchery Rawalpindi, Rawal Town, Islamabad, Pakistan.

3.1 Fish Species Used in Polyculture System

The farmers used the following species in polyculture, Indian major carps Rohu: *L. rohita* and Mori: *C. mrigala* and Chinese carps namely Silver carp: *H. molitrix* and Grass carp: *C. idell*. The results of the present study are supported by [13] that in the selection of species for polyculture, main value was given to indigenous carps including, rho: *L. rohita*, catla: *C. catla*, mrigal: *C. mrigala* and sometimes calbasu: *L. calbasu*. It is reported by [14,15] that polyculture of fish with different feeding behavior in one pond is ideal while the greatest utilization of all necessities of life attains without causing any injury to each other and an anticipated production of fish may be obtained if stocked in the right ratios, combinations and densities.

3.2 Stocking Rates

Farmers purchased fish seed from Department of Punjab fish hatchery, Rawal town Islamabad. Farmers applied polyculture stocking method using indigenous carps (Rohu and Mori) with the combined of Chinese carps (Silver carp and grass carps) to improve yield by the maximum utilization of natural food present in pond without interspecies competition.

In all farms the average stocking rate of fingerling was 1200 $acre^{-1}$ with average weight of 4 gram fingerling as per recommended by Department of Fisheries, Government of the Punjab with a preferable combination of Rohu, Mori, Thalia, Silver carp and Grass carp. The food preference of various species proposed for culture, a rational stocking procedure has been determined by [16]. Stocking rates under various polyculture are given in Table 1.

3.3 Feeding Practices

In studied farms three different feeding practices, i.e. balanced supplementary feed (BSF), standard feed (SF) and conventional feed (CF) were used. Five farms of each feeding practice were observed (Table 2). The fingerlings were fed with constant feeding rate of 3% of their body weight. On average the fish ponds have been fertilized with 9-12 $kg^{-1}acre^{-1}week^{-1}$ cow dung and poultry droppings as organic fertilizer,

5 $kg^{-1}acre^{-1}week^{-1}$ urea and 3 $kg^{-1}acre^{-1}week^{-1}$ DAP as inorganic fertilizer. Higher fish production was gained from ponds which were fertilized with both organic and inorganic fertilizers [17,18,19].

3.4 Fish Production

Fish production in, $kg^{-1}acre^{-1}year^{-1}$ in all studied farms of Rawalpindi district is shown in Table 2. The production of Rohu (*L. rohita)* yield showed significant difference in between feeds (BSF; SF and CF), the difference was P = 0.0054. The Rohu yield was significantly higher in BSF fed farm groups followed by the SF and CF fed farm groups.

The production of *C. mrigala* (Mori) was significantly different with different feeds (P= 0.0061) viz. Balanced supplementary feed, standard feed and conventional feed are shown in (Table 3). The production of *C. mrigala* (Mori) was significantly higher with balanced supplementary feed (304.22 $kg^{-1}acre^{-1}year^{-1}$) and standard feed (282.71 $kg^{-1}acre^{-1}year^{-1}$) than the rest of the feed. While the effect of two feeds (balanced standard feed and conventional feed) on Mori's production was non-significant from one another.

The production of Grass carp (*C. idella*) was statistically different with different feeds (P= 0.0006) namely balanced supplementary feed, standard feed and conventional feed (Table 3). The significantly higher production of Grass carp (*C. idella*) with balanced supplementary feed (361.24 kg/acre/year) than rest of feed i. e. standard feed (212.15 $kg^{-1}acre^{-1}year^{-1}$) and conventional feed (205.31 $kg^{-1}acre^{-1}year^{-1}$) (Table 2).

Table 1. Stocking rates under various polyculture systems (Ahmad, 1990)

Combination system	Total seed recommended/Acre	Percentage of various species					
		Rohu	Mori	Thaila	Gulfam	Silver carp	Grass carp
First	2024	30	30	40	-	-	-
Second	2227	30	20	40	10	-	-
Third	2430	20	20	15	10	25	10

Table 2. Type of Feeding practices and fish production in the various aquaculture farms from Rawalpindi District

S. no	Name of farm	Types of feed	Production (kg/acre/year)				Total production
			Rohu	Mori	Grass carp	Silver carp	
1	Azam fish farm	BSF	348	319	203	174	1044
2	Sadiq fish farm	BSF	325.83	283.33	158.66	252.16	1019.98
3	Tanveer fish farm	BSF	352	246.4	309.76	696.96	1605.12
4	Nawaz fish farm	BSF	313.97	294.55	223.94	187.52	1019.98
5	Ahmad fish farm	BSF	379.8	300	111	253.2	1044
6	Hayat fish farm	SF	298.8	215.8	348.6	132.8	996
7	Mughal fish farm	SF	272.57	203.14	385.71	110.57	971.99
8	Mardan fish farm	SF	361.2	292.2	215	163.4	1031.8
9	Manzoor fish farm	SF	324.43	302.59	171.54	233.42	1031.8
10	Nawaz fish farm	SF	308.5	205.8	346.5	147	1007.8
11	Raja Muhammad Raziq fish farm	CF	278.8	213.2	315.38	176.61	983.99
12	Nasir fish farm	CF	373.5	224.1	249	149.4	996
13	Sardar fish farm	CF	459.26	402.49	235.08	232.24	1329.07
14	Mubasir Hussain fish farm	CF	351.12	270	210.33	176.53	1007.98
15	Shaukat hayat fish farm	CF	273.33	198.16	410	102.5	983.99

BSF – Balanced Supplementary Feed; SF – Standard Feed; CF – Conventional Feed

The production of Silver carp (*H. molitrix*) was non significant different with different feeds (P= 0.1377) viz. Balanced supplementary feed (194.24 $kg^{-1}acre^{-1}year^{-1}$), standard feed (309.53 $kg^{-1}acre^{-1}year^{-1}$) and conventional feed (133.90 $kg^{-1}acre^{-1}year^{-1}$) is shown in (Table 3).

Overall comparison of three different types of feeding practices revealed that the maximum production of Rohu (373.56 $kg^{-1}acre^{-1}year^{-1}$), Mori (304.22 $kg^{-1}acre^{-1}year^{-1}$), Grass carp (212.15 $kg^{-1}acre^{-1}year^{-1}$) and Silver carp (194.24 $kg^{-1}acre^{-1}year^{-1}$) was obtained with balanced supplementary feed (Rice polish, Fish meal, Soybean meal). The present results are in concordance with [20] that significantly higher net production of major carps in ponds treated with rice polish as compared to those ponds which were not treated with rice polishing. Artificial feed was found to be useful in many ways included direct utilization of feed and indirect leftover feed responsible for the increase in plankton productivity [21,22,23,11]. The yearly production (2871.67 $kg^{-1}acre^{-1}year^{-1}$) *Catla catla, Labeo rohita* and *Cirrhina mrigala,* from artificial diet. Ingredients of feed were fish meal, wheat bran and cottonseed meal [24].

Under artificial feed and inorganic fertilization (single super phosphate) the gross fish yield of major carps as 2153.75 kg ha^{-1} per 9 months has been described by [25]. Our results are in concordance with [26] that the higher production of *L. rohita* with artificial feeds (comprising of rice bran, fish meal, soybean, oil cake) 178.95 g and 383.88 g with glutton, fish meal, wheat meal. [27] reported maximum body weight gains in fingerlings of Major carp (*C. mrigala)* with soybean meal. So this entire study shows that soybean meal is a highly delightful ingredient for a fish judge against two other ingredients.

In the present study, we have higher production of Silver carp (309.53 $kg^{-1}acre^{-1}year^{-1}$) as compared to rest of fish species. The results of our study are in concordance with [28] observed the higher net production of Sharpunti (888.39 $kg^{-1}ha^{-1}120\ day^{-1}$) with rice bran and organic and inorganic fertilizers (urea, TSP and cow dung). According to [29] the production of *B. gonionotus* was significantly higher (23.84 $kg^{-1}ha^{-1}6\ months^{-1}$) in those ponds in which supplemented feed rice bran used. The results of another study which was carried out on the production of *B. gonionotus* showed that 1,952 $kg^{-1}ha^{-1}5\ months^{-1}$ only with rice bran [30]. The maximum increase in production of Nile tilapia (5867 $kg^{-1}ha^{-1}year^{-1}$) was gained with formulating feed (consisting of cottonseed meal, shrimp meal, wheat bran) respectively [31]. The difference in result may be due to different species, climatic factor and fish size.

In present study the highest production of *Grass carp (C. idella)* (361.24 kg/acre/year) and lowest production of Silver carp (*H. molitrix)* (133.90 kg/acre/year) with respect to *L. rohita* (286.40 $kg^{-1}acre^{-1}year^{-1}$) and *C. mrigala* (207.22 kg/acre/year) was observed with conventional feed (Table 4). The results of our study are

Table 3. One way analyses of variance of various fish production

Fish species	Source	Degree of freedom	Sum of square	Mean square	'F' value	'P' value
	Feed	2	19671.5	9835.75	8.33	0.0054*
L. rohita	Error	12	14171.5	1180.96		
	Total	14	33843.0			
	Feed	2	25951.9	12976.0	8.03	0.0061*
C. mrigala	Error	12	19400.0	1616.7		
	Total	14	45351.9			
	Feed	2	25951.9	12976.0	8.03	0.0061*
C. mrigala	Error	12	19400.0	1616.7		
	Total	14	45351.9			
	Feed	2	77645	38822.4	14.7	0.0006*
C. idella	Error	12	31610	2634.2		
	Total	14	109255			
H. molitrix	Feed	2	79630	39815.1	2.35	0.1377 ^{NS}
	Error	12	203341	16945.0		
	Total	14	282971			

** = Significant at 0.01%; ^{NS} = No Significant at 0.01%*

Table 4. Comparison of production means of species by LSD test

Feed	*Labeo rohita*	*Cirrhinus mrigala*	*Ctenopharyngodon idella*	*Hypophthalmichthys molitrix*
1	373.56 A	304.22 A	361.24 A	309.53 A
2	344.26 A	282.71 A	212.15 B	194.24 A
3	286.40 B	207.22 B	205.31 B	133.90 A
LSD	47.355	55.406	70.725	179.38

(α = 0.05); Means sharing similar alphabet are statistically non-significant

supported by [9] maximum weight gain (0.58 g and 0.42 $g^{-1}day^{-1}$) and survival rate for both *C. Idella* and hybrid grass carp fingerlings have been observed feeding with duckweed. Another study was conducted by [32] on larger grass carp hybrids (259.5 and 173.5 g) in a closed circulating system. In his study, he found that hybrids fed only duckweeds or trout chow gained (0.60 and 0.46 $g^{-1}day^{-1}$) correspondingly. The dissimilarity in growth rates might be due to factors like water, temperature and fish size.

In line to present research [33] also reported the lowest production of *L. rohita* and *C. mrigala* in the ponds in which fish meal was replaced with canola meal. Decline in production of different fish species was also observed with plant foods [34]. The regularly used feed ingredient such as fish meal is considered to be the greatest ingredient for fish growth due to its adaptability with the protein necessity of fish [35].

4. CONCLUSION

From our study it is concluded that balanced supplemented feed (fish meal, rice polish and soybean) can be included in the feed formulation for culturable carps to obtain maximum growth. Plant based feed ingredients with addition of animal based feed in polyculture system shows better results as a plant based feeds have high quantity of digestible proteins and are more effective to get higher production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Qasim M, Sheikh AD, Abbas M, Kashif M. Economics of fish production and Marketing in saline areas of the central Punjab. Pak. J. Agri. Sci. 2004;41:3-4.
2. District Officer, Fisheries. Fisheries extension service; 2006. (Accessed on the 20th of June 2012)
3. Narejo NT, Dars BA, Achakzai GD. Preparation of low-cost fish feed for the culture of *Labeo rohita* (Hamilton) in glass aquaria. Sindh Univ. Res. J. Sci. Ser. 2010;42(2):07-10.
4. Ashraf M, Ayoub M, Rauf M. Effect of different feed ingredients and low-temperature on diet acceptability, growth and survival of mrigal, *Cirrhinus mrigala*, fingerlings. Pakistan J. Zool. 2008;40(2): 83-90.
5. Erfanullah JK, Jafri AK. Growth rate, feed conversion ratio and body composition of Catla catla, Labeo rohita and Cirrhinus mrigala fry fed diets of various. J. World Aquaculture Soc. 1998;28(1):84-91.
6. Hassan MA, Jafri AK, Alvi AS, Rana S, Nazura U. Dietary energy and protein interaction and approach to optimizing energy, protein ratio in Indian major carps, Cirrhinus mrigala (Ham.) fingerlings. J. Aquaculture. Tropics. 1996;10(3):183-191.
7. Jena JK, Aravidakshan PK, Suresh C, Muduli HK, Ayyappan S, Chandra S. Comparative evaluation of growth and survival of Indian major carps and exotic carps in raising fingerlings. J. Aquacult. Tropics. 1998;13(2):143-149.
8. Garg SK, Bhatnagar A. Effect of fertilization frequency on pond productivity and fish biomass in still water ponds stocked with *Cirrhinus mirgala* (Ham). Aquaculture. 2000;31:409414.
9. Ekram. The potential of periphyton-based aquaculture systems. An unpublished PhD Dissertation, Wegenin Univ., Netherland. 2002;72.
10. Qin J, Culver DA, Yu N. Effect of organic fertilizer on heterotrophs and autotrophs; implication for water quality management. Aqua. Res. 1995;26:911-920.
11. Javed M, Sial MB, Zafar SA. Fish pond fertilization. Influence of broilers manure fertilization on the growth performance of

major carps. Pakistan J. Agri. Sci. 1990;27(3):212-215.

12. PCO. District census report of Rawalpindi, 1998. Population Census Organization Statistics Division Government of Pakistan, Islamabad. Census Publication. 1999;23:13-17.
13. Ahmed M. Status and potential of aquaculture in small water bodies (ponds and ditches) in Bangladesh. ICLARM Tech. Rep. 1992;37:36.
14. Halver JE. Special methods in pen fish husbandry. Akademiai Nyomda, Budapes. 1984;146.
15. Rahman MA, Rahman MR, Rahman MS. Evaluation of growth and production of the Mahseer, *Tor putitora* (Ham.) in polyculture with indigenous major carps. In Siraj S. S., A. Christianus, N. C. Kiat, S. S. De Silva (Eds). Mahseer: The Biology and Conservation. Malaysian Fisheries Society Occasional. Kuala Lumpur, Malaysia. 2007;14:161-175.
16. Ahmed Z. Economics of fish farming in District Sahiwal. M.Sc. Thesis, University of Agriculture Faisalabad; 1990.
17. Boyed CE. Fertilization of warm water fish ponds. Journal of fish soil and water conservation. 1981;36:142-145.
18. Clifford HC. El manoejo de Camaronicultura: Camaron 94. Mazatlan, Mexico. 1994;18.
19. Diana JS, Lin CK, Schneebergeer PJ. Relationship among nutrients inputs, water nutrient concentrations, primary production, and yield of *Oreochromis niloticus* in ponds. Aquaculture. 1999;92: 323-341.
20. Ahmed I, Abbass K, Hafeez-ur-Rehman M. Growth performance of major carps in semi-intensive ponds supplemented with rice polishing. Pakistan Vet. J. 2005;25(2).
21. Boyd CE. Summer algal community and primary productivity in fish ponds. Hydrobiolgia. 1973;41:357-390.
22. Huq N. Feeding of fish. Proc. East Pak. Fishery Office Conf., Dhaka; 1957.
23. Javed M. Effect of artificial feed on the growth of *Labeo rohita.* M.Sc. Thesis, Dept. Zoology and Fisheries, Univ.of Agri., Faisalabad; 1984.
24. Javed M, Hassan M, Javed K. Fish pond fertilization. V: Effect of artificial feed on the growth performance of major carps. Pakistan J. Agri. Sci. 1993;30(1):7-12.
25. Sheri AN, Sial MB, Javed M, Sarwat F. Nutrient requirements of the fish. 2. Fertilization with SSP and artificial feed supplementation of pond. Pak. J. Agri. Sci. 1987;24(1):24-31.
26. Ahmed MS, Shafiq K, Kiyani MS. Growth performance of major carp, Labeo rohita fingerlings on commercial feeds. J. Plant and Animal Scien. 2012;22(1):93-96.
27. Inayat L, Salim M. Feed conversion ratio of major carp, Cirrhinus mrigala fingerlings fed on soybean meal, maize and maize gluten. Pak. Vet. J. 2005;25(1):13-16.
28. Moniruzzaman M, Mollah MFA. Effects of rice bran on growth and survival of Thai sharpunti *Barbodes gonionotus* in earthen ponds. J. Bangladesh Agril. Univ. 2010; 8(1):161-171.
29. Kohinoor AHM, Akhteruzzaman M, Sahah, MS. Production of *Puntius gonionotus* (Bleeker) in ponds. Bangladesh J. Zool. 1993;21(2):77-83.
30. Hussain MG, Akhteruzzaman M, Karim KATA, Shah MS. Semi-intensive culture of *Puntius gonionotus*. Bangladesh. J. Fish. 1989;12(2):45-52.
31. David L, Cherop L, Munguti J, Chhorn L. Growth and economics of *Nile tilapia* (*Oreochromis niloticus* L.) fed on two formulated diets and two locally available feeds in fertilized ponds. Dept of Zool. Univ. Moi. Eldoret, Kenya. 2004;1-7.
32. Sutton JR. Further observations on a fish production system that incorporates hydroponically grown plants. Prog. Fish-Cult. 1982;44(1):55-59.
33. Abbas S, Ahmed I, Hafeeze URM, Mateen M. Replacement of fish meal by canola meal in diets for major carps in fertilized ponds. Pak. Vet. J. 2008;28:111-114.
34. Abbas K, Ahmed I, Hafeez URM. Growth performance as influenced by partial replacement of fish meal with plant proteins in the diet of major carps. Indus J. Biol. Sci. 2005;2(2):219-226.
35. Alam AK, Maughan EE, Matter WJ. Growth response of indigenous and exotic carp species to different protein sources in pelleted feeds. Aqua. Res. 1996;27(9): 673-679.

ANNEXURE I

Questionnaire

Interviewer (Name and Signature) _____
Date_____

1. General Information

1.1 Name_____ Contact No. /NIC_____
1.2 Village_____ Teh._____ District_____
1.3 Farm Address_____
_____
_

2. Specific Information

2.1. Type of Farm	Extensive	Semi Extensive

2.2 In charge	Owner/Operator	Manager

2.3 Education	Uneducated	F.A.
	Primary	B.A.
	Matric	M.A./M.Sc.
	Other	

2.4 Have you got training in Aqua Culture? _____ Key: 1= Yes; 2= No

2.5 Primary profession

Fish Farming		Business	
Fish Marketing		Employee	
Farming		Other	

2.6 Age of fish farm_____

2.7 What is the length of your experience in fish farming? _____

2.8 From where did you obtain experience? _____

3. Method of Stocking

Monoculture	
Polyculture	

3. Fertilizers

Type of Fertilizer	
Cowdung	
Poultry Droppings	
DAP	
Urea	
TSP	
Others	

4. Feeding

Type of Feed	Ingredients
Balanced supplemented feed	Rice polish, Fish meal, Soybean meal
Standard feed	Rice polish
Conventional feed	Fodder

5. Feeding Techniques:

Techniques	X
Chatta	
Pot	
Thaila	
Frame	
Macheanical/Automated	
Other	

6. Production level

Type of Fish	Production /kg/acre/year
Rohu	
Mori	
Grass carp	
Silver carp	

Any suggestion for the betterment of Fish Farming.

……
……
……

Expressions of Interviewer.

……
……

Duration of Interview **Hour** **Minute**

Signature …… **Date** ……

Ending of Interview **Hour** **Minute**

Name Of interviewer ……..

Investigating Supervisor ……..

Name of Person who enters the data ……..

Name of Reviewer ……

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/11167