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Comparative analysis of management practices and profitability among crap polyculture, stringing catfish and Vietnam koi farming in Bangladesh

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Abstract
Aquaculture practices in Bangladesh are growing very fast. Different culture systems are being practiced for different fishes. These culture systems have different management practices and profit levels. Chandpur and Lakshmipur districts in Bangladesh became famous for carp polyculture and other fish farming in the recent years. The study compared the farm management practices, disease prevention and disease control, including the profitability among Carp polyculture, Stringing Catfish (shing) and Vietnam koi farming systems in Bangladesh during August 2019 to July 2020. Data about management, production cost, the prevalence of diseases, and benefit of the three culture systems were collected from nine farms (three from each culture system). Among these three farming systems better management was found in carp polyculture, where in carp polyculture 19,513 individuals were stocked in a hectare composed of Tilapia (9,880 individuals ha^{-1}), Catla (494 ind. ha^{-1}), Rui (1,974 ind. ha^{-1}), Mrigel (988 ind. ha^{-1}), and Common Carp (2,470 ind. ha^{-1}). Stocking density of Vietnam Koi and stringing catfish (Shing) were 203,035 and 329,251 ind. ha^{-1} respectively. The highest net profit was found in Shing monoculture (696,893 BDT ha^{-1}) followed by Carp polyculture (181,450 BDT ha^{-1}) and Koi farming (128,440 BDT ha^{-1}). The production of all farming systems was significantly different from each other, but the net profit of Shing farming was significantly higher than carp polyculture and koi culture ($p<0.05$). The most common diseases i.e., fin and tail rot, argulosis, epizootic ulcerative syndrome (EUS), nutritional and environmental problems were found during the farming period. As preventive measure farmers used NaCl, $CaCO_3$, and $KMnO_4$. For the treatment of diseases, Benzalchronium Chloride 80% solution, Vimermectin BP 1% solution, Ascorbic acid, etc. were used. The outbreak of fish disease, unexpected flood, and excess leasing cost, high feed price, low fish price, etc. were identified as major concerns in fish farming. Farmers can use this information of this study for appropriate management of aqua-farms, prevention and control of diseases, and the selection of profitable culture systems.

Keywords: Aquaculture, fish health management, Indian major carps, *Anabas testudineus*, *Heteropneustes fossilis*, aqua drugs and chemicals

Introduction
Bangladesh is a developing country. Every day new ideas for development are being introduced by the youth of the country. They are now not wanted to depend on job sectors only. They are enhancing their knowledge in different sectors and contributing their learning in both the sectors of agriculture, fisheries, and animal farming. This is helping the country to be self-dependent and reduce the problem of unemployment. The total fish production was 4.277 million MT in FY 2017-18, of about 56% was contributed from aquaculture (DoF, 2018) [1]. According to FAO, inland open water capture and aquaculture production in Bangladesh ranked 3rd and 5th in 2018 in the world respectively. The aquaculture production per hectare in Bangladesh is much less than China (FRSS, 2009; Dey, 2005) [12, 7]. Even though Bangladesh becomes one top fish producers in the world, per capita fish consumption is less than the recommended minimum per capita consumption (18 kg/year) of fish (FAO, 2020) [9]. However, the production from aquaculture is growing faster than inland capture and marine capture fisheries. Among the cultured species, carp, catfishes and perches contributed the most production (Faruk *et al*., 2018) [10].

Farmers prefer to culture both indigenous and exotic carps in polyculture system. Some farmers cultured catfish and Vietnam Koi in a monoculture system. Among the carp species four indigenous and twelve exotic carps were most frequently cultured in Bangladesh (Rahman, 2005; DoF, 2012) [14, 8]. Among the aquaculture production, 88.18% are carps and 11.82% are non-carps (FRSS, 2009). Besides the carp species, stinging catfish (*Heteropneustes fossilis*), walking catfish (*Clarias batrachus*), climbing perch (*Anabas testudineus*), pabdah catfish (*Ompok pabda*), Nile tilapia (*Oreochromis niloticus*) etc. are cultured both in monoculture and polyculture systems (Das, 1928; Hasan *et al*., 2010; Faruk, 2018) [6, 13, 10]. Currently, most of the fisheries are focusing on mixed cultivation of fish utilizing different types of carps, stringing catfish, Pabda and Vietnam koi in mixed culture system. Different culture systems have different management practices with different profit levels. To identify the most profitable culture system, we need to study the complete management, production and profit level of different culture systems practiced in Bangladesh. This study performed a comparative analysis of the management practice of Carp polyculture, Stringing Catfish (Shing) and Vietnamese Koi culture systems considering the profitability of the three fish farming systems to identify the highest profitable fish culture system with the lowest cost and effort of management.

2. Materials and Methods

2.1 Study sites and duration

The survey was performed in nine Farms of Fisheries at Chandpur and Laxmipur district situated in the southwest part of Bangladesh, for one year (Figure 1). The farms were Al Noor Agro Farm, Rasel Motsho Khamar, Nazim Motsho Khamar, Mofijul Fish Farm, Nazim Fish Farm, Farhad Motsho Hatchery, Dinesh Fish Farm, Roshni Motsho Hatchery, Tajul Motsho Hatchery.

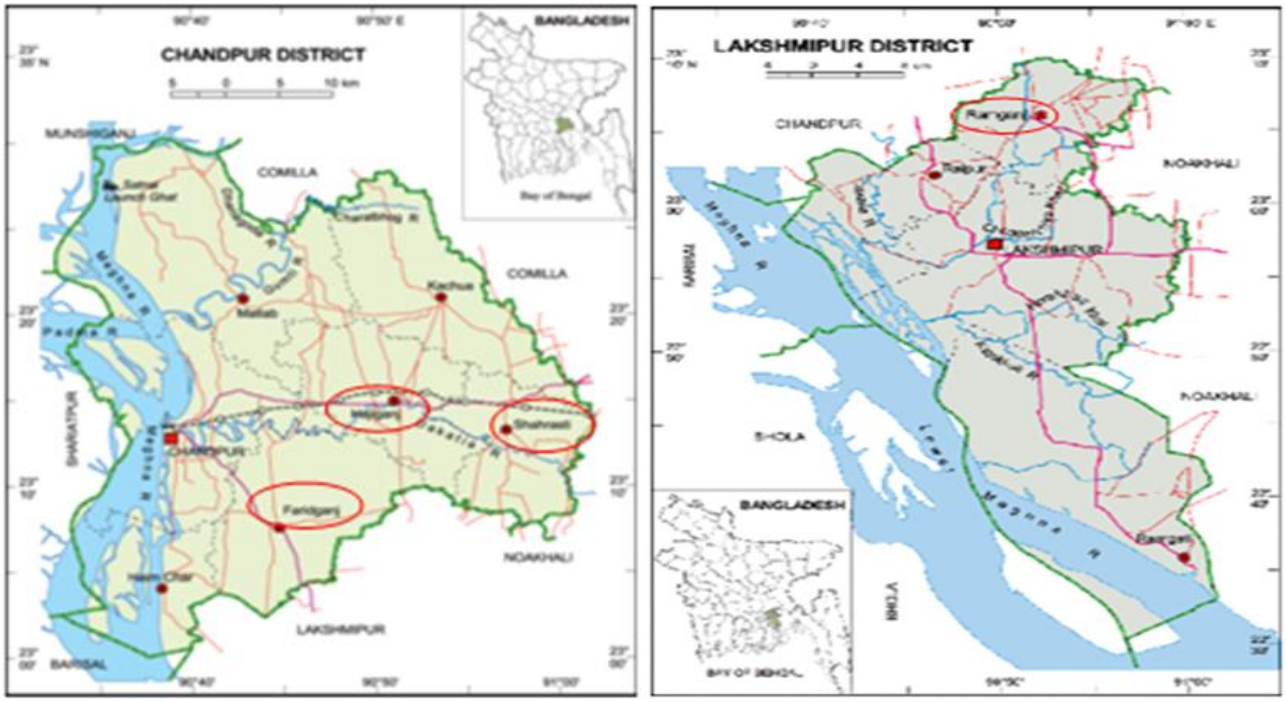

Fig 1: Map of chandpur and lakshmipur districts showing sampling locations.

2.2 Detail of the aquaculture farms studied

Among the nine farms three of them were Carp polyculture fisheries farm, three were stringing catfish (Shing) monoculture fisheries farm and three were Vietnam koi monoculture fisheries farm (Table 1).

Table 1: Detail of the aquaculture farms studied

Sl. No.	Name of the Farm	Area	Location	Name of the Owner	Culture System	Name of the cultured species
1.	AL Noor	0.405 ha	Purbo	Azizul	Polyculture	Tilapia, Catla, Rui,
	Agro Farm		Bigha,	Haque		Mrigel, Carpio,
			Ramgonj,	Dalim		shing Kalibaush,
			Lakshmipur			
2.	Rasel	0.809 ha	Noagaon,	Md.	Polyculture	Tilapia, Catla, Rui,
	Motsho		Ramgonj,	Ismail		Brighead Carpio,
	Khamar		Lakshmipur	Hossain		Mrigel,
3.	Nazim	0.607 ha	Keroa,	Md	Polyculture	Tilapia, Catla, Rui,
	Motsho		Faridganj,	Nazim		Brighead Carpio,
	Khamar		Chandpur	Bhuiyan		Mrigel
4.	Mofijul Fish	0.405 ha	Ichapura,	MD.	Monoculture	Vietnam Koi
	Farm		Haziganj,	Mofijul		
			Chandpur	Islam		
5.	Nazim Fish	0.405 ha	Shurshui,	Md.	Monoculture	Vietnam Koi

	Farm		Shahrasti,	Nazim		
			Chandpur	Hossain		
6.	Farhad	0.607 ha	Shurshui,	Farhad	Monoculture	Vietnam Koi
	Motsho		Shahrasti,	Hossain		
	Hatchery		Chandpur			
7.	Dinesh Fish Farm	0.243 ha	Aligonj, Hajiganj, Chandpur	Dinesh Kumar Singho	Monoculture	Shing
8.	Roshni Motsho Hatchery	1.214 ha	Sahar Bazar, Faridganj, Chandpur	Md. Mizan Miah	Monoculture	Shing
9.	Tajul Motsho Hatchery	0.405 ha	Das Para, Ramganj, Lakshmipur	Md. Tajul Islam	Monoculture	Shing

2.3 Identification of Target group
A huge number of people were engaged in the sector of fisheries in Bangladesh. For this very study, the people who were connected with the projects of different types of fisheries were focused as a targeted group. Nine farms of different fish culture were being visited to collect information and data from the fish farmers.

2.4 Formation of the questionnaire
The questionnaire was one of the most important parts of the process of surveying. To meet the targeted objectives of the study, a set of the questionnaire were made and face to face interview has been taken. Questions were related to the culture of different types of fisheries and the management cost comparing with the profit margin mainly focused during the interviews. Final data were collected using a structured questionnaire after pre-testing in a field situation and then performing necessary modifications.

2.5 Data collection
The study has been processed for one year. Data collection programs were followed at two districts. One was at Chandpur and another one was at Lakshmipur in Bangladesh. The primary and secondary sources of data were analyzed for the present study. During the study, period tools were used to collect primary data such as QI (questionnaire interview) and FTFD (face to face discussion). Primary data were collected from Fish farmers of different cultures of fisheries through QI and FTFD. The secondary information has been collected from different books, journals, reports, thesis papers, and the internet.

2.5.1 Questionnaire based interview
During the study period, a total of nine fisheries farms were randomly selected for questionnaire interviews from Bangladesh regarding the management practice and profitability of Carp polyculture, Stinging catfish, and Vietnamese koi. The questionnaire interviews were done at mentioned farms of the different fish cultures of the selected area.

2.5.2 Face to face discussion
To meet the objectives it was not enough to collect only the information through the questionnaire. For getting the detailed information it was mandatory to talk with the owners of the Farm face to face. Every owner was asked a question face to face and the answers were discussed in detail to calculate the total management cost and profit amount of the different fish culture processes.

2.5.3 Data processing and analysis
The collected data were documented a sequential form for future use. Then the data were analyzed using MS Word and MS excel, and then presented in the tabular and graphical forms. One way analysis of Variance (ANOVA) was performed using SPSS software version 20 @ 5% level of probability and Duncan Multiple Range test.

3. Results
3.1 Management and production of Carp polyculture
While collecting data for knowing the management and production of Carp Polyculture three polyculture fish farms have been visited and much information has been collected. The first step was knowing about the types of fishes those are being cultivated in the farms, the second part was to understand the type of the ponds, the third step was to collect the information about pre-stocking, stocking, and post-stocking management system. Most of the three farms have been following almost the same management system for the carp polyculture. On the other hand, the production of the fishes in carp culture has also been calculated and it is seen that the entire three farms produce almost the same amount of fishes during the cultivation (Table 2). In carp polyculture farming average production was high in tilapia fish farming but the price is much lower than other fish species (Figure 2). The most priced fish in carp polyculture was Catla with a high price average value of nearly 300 BDT/KG (Figure 2). The production cost of Catla farming is less costly than others because they mostly consume the natural feed.

Table 2: The selling price of different species in carp polyculture farming

Species	F1 (BDT/Kg)	F2 (BDT/Kg)	F3 (BDT/Kg)
Tilapia	100	110	115
Catla	280	320	275
Rui	220	200	260
Mrigel	140	120	130
Carpio	130	120	125
Kalibaush	200	160	140
Brighed	160	150	155

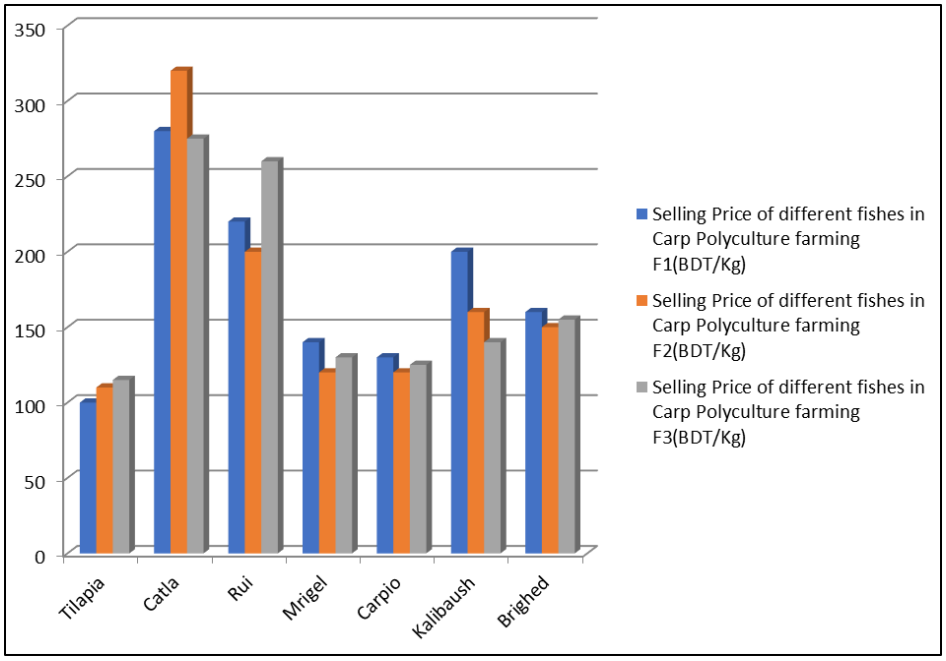

Fig 2: Selling prices of different species in carp polyculture farming

3.2 Management and production of stringing catfish

Different types of questionnaires have been asked for collecting the data for knowing the management process and profitability of Stinging Catfish. Three stinging fish farms have been visited for knowing the real picture of monoculture fisheries. Here the farms are calculated as F1, F2, and F3 (Table 3). The pre-stocking, stocking, and post stocking are being observed with a detailed investigation. In the study, the preparation for monocultural ponds is being followed closely. It is seen that almost every mono-cultural farmer follows the same process of management and preparation for the cultivation.

The stocking density of stringing catfish was comparatively higher than any other farming conducted in this study. From three stringing catfish farm F2 maintains high stocking density with 1,666 No. /decimal (Table 3). But the fish rate was comparatively high in F1 culture systems with a high rate of 425 BDT/KG (Figure 3).

Table 3: Stocking density & Selling Prices of Stringing Catfish from three farms (F1, F2 and F3)

Farms	F1	F2	F3
Stocking Density No./decimal	1333	1666	1000
Price of Shing (BDT/kg)	425	350	400

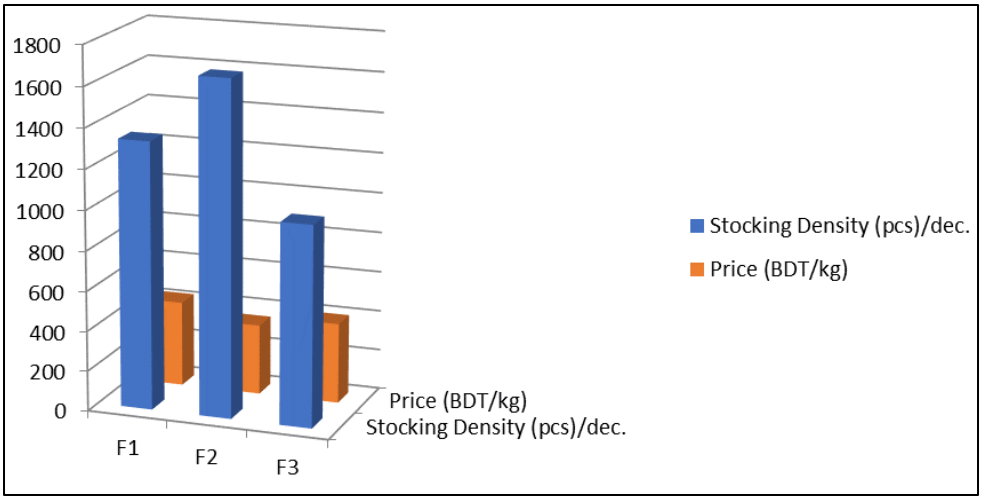

Fig 3: Stocking density & selling price of Stringing Catfish

3.3 Management and production of Vietnam Koi

Different types of questionnaires have been asked for collecting the data for knowing the management process and profitability of Vietnamese Koi. Three Koi fish farms have been visited for knowing the real picture of monoculture fisheries. Here the farms are calculated as F1, F2, and F3 (Table 4). The pre-stocking, stocking, and post stocking are being observed with a detailed investigation. In the study, the preparation for monocultural ponds is being followed closely. It is seen that almost every mono-cultural farmer follows the same process of management and preparation for the cultivation. Production of Vietnam koi was comparatively higher in F3 culture systems followed by F2 and F1. But F3 made more profit due to comparatively high price of Vietnam koi during sales (Figure 4).

Table 4: Production and income in Vietnam koi farming

Topics	Vietnam Koi farm		
	F1	F2	F3
Production/Ha	11.115	13.338	15
Total Income/Ha (BDT)	122350	128300	134670

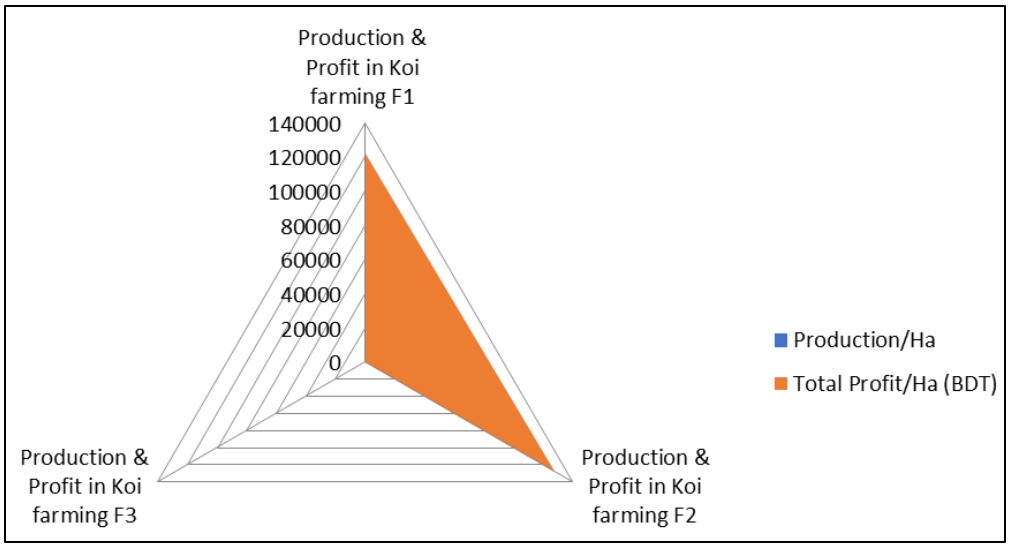

Fig 4: Graphical presentation of production and income in Koi farming

3.4 Comparison of management practices among carp polyculture, stringing catfish and Vietnam Koi culture systems

Almost similar pre-stocking management practices were followed by all farming systems (Table 5). However, 500g/decimal lime was used in all the farming systems. In Carp polyculture farming six carp species (9,633 ind./ha) and monosex tilapia (9,880 ind./ha) were stocked, but in Koi and Shing farming single species were stocked at the rate of 203,035 ind./ha and 329,251 ind./ha respectively (Table 6). During post stocking management, carp polyculture maintain higher management policy by maintaining Proper utilization of supplementary feed, regular fertilization, pre-winter liming, application of growth promoter (Table 7). The highest prevalence of diseases was observed in carp polyculture followed by Shing and Vietnam koi farming (Table 8). Nine different types of diseases were reported by the respondents. Among them, bacterial diseases were found in all culture systems followed by fungal, parasitic, nutritional, and environmental. The highest production was found in Vietnam koi farming followed by Carp polyculture and shing farming (Table 9). Carp polyculture, shing farming, and Vietnam koi culture were significantly different (Table 10). Among the production of Carp polyculture, Stringing catfish farming and Vietnam koi farming average profit was highest in shing culture followed by carp polyculture and koi monoculture.

Table 5: Pre-stocking management practices in different culture systems

Management practices		Culture Systems			
		Carp polyculture (Score 1-3)	Shing culture (Score 1-3)	Koi culture (Score 1-3)	
Dike Preparation (Without net)		2	2	2	
Dike Preparation (With net)		1	1	1	
Removal of Aquatic Weeds (partially)		2	2	2	
Removal of Predator (Completely drying & using Poison)		2	2	3	
Liming	Dose 1: 500 g/decimal	3	3	3	
	Dose 2: 400 g/decimal	2	1	1	
	Dose 3: 200 g/decimal	1	2	2	
Fertilization		3	2	2	
Dose 1: Inorganic (TSP 1.50 kg/decimal)		2	2	2	
Dose 2: Organic (Cow dung 1.0 kg/decimal)		1	1	1	
Bottom (without Outlet)		2	2	2	
Total Score		21	20	21	

Table 6: Comparative Stocking Management in different culture systems

Stocking management practices	Culture Systems		
	Carp polyculture (Score 1-3)	Shing culture (Score 1-3)	Koi culture (Score 1-3)
Conditioning of fry before stocking	3	2	3
Stocking density (Ind./ha)	-	-	-
Tilapia (9,880)	3	-	-
Catla (494)	3	-	-
Rui (1,976)	3	-	-
Mrigel (988)	3	-	-
Carpio (2,470)	3	-	-
Kalibaush (1,235)	3	-	-
Bighead (2,470)	3	-	-
Koi (2,03,035)	1	-	3
Shing (3,29,251)	1	3	-
Re-stocking in case of partial harvest	1	1	1

Table 7: Post-stocking management practices in different culture systems

Management practices		Culture Systems		
		Carp polyculture	Shing culture	Koi culture
		(Score 1-3)	(Score 1-3)	(Score 1-3)
Supplementary feed	Dose 1: 4-5% body weight	3	-	-
	Dose 2: 3-4 % body weight		3	3
Regular fertilization	TSP+Urea 300gm/dec	3	-	-
Pre-winter liming	Stone lime 500gm/dec	2	3	3
Growth Promotor	-	3	3	3
Immunostimulants	-	3	3	2
Time of feeding	Twice a day	3	3	3
Pellet Feed	Protein < 25%	3	-	-
	Protein 25- 30%	-	-	3
	Protein >30%	-	3	-
Total Score		20	18	17

Table 8: Disease management practices in different culture systems

Name of Disease	Symptoms	Preventive Measures	Control Measures	Culture systems			Percentage (%)
				Carp polyculture	Shing culture	Koi culture	
				(Score 1-3)	(Score 1-3)	(Score 1-3)	
Bacterial (Vibriosis, Fin and Tail Rot, Dropsy)	Fins & tail loss, White spots on body surface	$KmNO_4$, Salt	Benzalcronium Chloride 80% Solution. Dose: 5ml/5 feet water depth/decimal	3	3	3	100
Fungal (EUS, Saprolegniasis)	Red color on body surface, Respiratory distress	$KmNO_4$, Lime	Alkyldimethybenzylammonium Chloride. Dose: 6ml/6 feet water depth/decimal	3	2	2	78
Nutritional (Scoliosis, Lordosis)	Deformation of gill cartilage, impaired wound healing	$KmNO_4$ & Salt	Ascorbic Acid (Vit-C). Dose: 8gm/kg feed	2	1	1	36
Parasitic (Argulosis)	Arugulas on the body surface, fish stretching against objects	Lime & Salt	Vimermectin b.P 1% solution.	3	1	1	56
Environmental (Gas bubble Diseases)	Fish lying upside down on the water surface.	$KmNO_4$, Lime	Gasonil (Disinfectant) & Probiotics.	1	1	1	33
Total				13	8	8	61

Table 9: Contribution of different fish species in Production per hectare

Fish Stocked	Production per hectare (MT)		
(No./Ha)	Carp polyculture	Shing culture	Vietnam Koi culture
Tilapia (9,880)	4.423	-	-
Catla (494)	1.243	-	-
Rui (1,976)	1.816	-	-
Mrigel (988)	0.939	-	-
Carpio (2,470)	0.76	-	-
Kalibaush (1,235)	0.238	-	-
Bighead (2,470)	0.511	-	-
Vietnam Koi (2,03,035)	-	-	13.091
Shing (3,29,251)	-	6.32	-
Other Fish	0.1	-	-
Total	10.03	6.32	13.091

Table 10: Comparative analysis of cost & benefit in different studied culture systems

Culture Type	Farms	Production (MT/Ha)	Average Product-ion (MT/Ha)	Total Income (BDT/Ha)	Average Income (BDT/Ha)	Total Cost (BDT/Ha)	Average Production Cost (BDT/Ha)	Total Profit (BDT/Ha)	Average Net Profit (BDT/Ha)
Carp Poly-culture	F1	10.65	10.03^{b}	18,74,400	16,74,420^{b}	16,61,900	14,92,970^{ab}	2,12,500	1,81,450^{b}
	F2	9.79		15,56,610		14,06,260		1,50,350	
	F3	9.65		15,92,250		14,10,750		1,81,500	
Shing Culture	F1	6.5	6.32^{c}	27,62,500	24,86,333^{a}	20,30,300	17,89,440^{a}	73,22,00	6,96,893^{a}
	F2	5.75		20,12,500		15,25,300		4,87,200	
	F3	6.71		26,84,000		18,12,720		8,71,280	
Vietnam Koi Culture	F1	11.115	13.091^{a}	11,11,500	13,06,630^{b}	9,89,150	11,78,190^{b}	1,22,350	1,28,440^{b}
	F2	13.338		14,00,490		12,72,190		1,28,300	
	F3	14.82		14,07,900		12,73,230		1,34,670	

* Letters in the form of superscript following the numbers indicate the significant level at $p<0.05$

4. Discussion

Aquaculture plays a significant role in providing employment of million of people, ensuring food security, eliminate malnutrition and fisheries commodity export (Finegold *et al.*, 2009) [11]. Therefore, a study with aim of comparing the management practices among carp polyculture, stringing catfish, and Vietnam koi farming and compare the benefits obtained from these practices at different production scales in Bangladesh.

The production of fishes depends on various factors including Good Management Practices (GMP) to proper maintenance. The study was carried on where the area of the farm was not so big to avoid a statistical error. This study carried with three farms of carp polyculture, where results revealed a significant difference between the other two farming systems of Shing farming and Vietnam koi farming. Annual carp production in carp polyculture was 10.03 (MT/ha) which was comparatively than a study revealed by Ali *et al.* (2016) [23]. In this study annual production of fishes in carp polyculture was 10.03 (MT/ha). The annual net profit from carp polyculture was 181,450 (BDT/ha), which was comparatively higher profitable. Ali *et al.*, (2016 [23]) revealed that carp polyculture was a profitable business.

It was found that the average annual per hectare production of crap polyculture was 3,602 kg. The gross margin per hectare was BDT 83,762. Net returns were estimated at BDT 70,845 per hectare. Most of the resources (inputs) were inefficiently utilized in the carp polyculture. Net profit from these studies was varied because the study of Ali *et al.*, (2016) [23] was performed with only carp species.

But this study carried carp polyculture along with Tilapia farming where 50% extra production came from tilapia fishes. Their study revealed the stocking density was almost similar to this study of carp farming but monosex tilapia was extra production contributing 4.36 (MT/ha) of total 10.03 (MT/ha). The profit margin and production were almost similar to the study carried by Ali *et al.*, (2016) [23].

The results of the study revealed that the average stocking density of Vietnam koi was 822 (Individual/decimal). Average production from Vietnam koi culture was 13.091 (MT/ha) where the survival rate was also significant. The total annual profit from Vietnam koi culture was estimated at 128,440 (BDT/ha). In Vietnam Koi (*Anabas testudineus*) culture, it was reported that Food Conversion Ratio (FCR) of the supplementary feed was 1.63, the survival rate 70%, the production 167 kg/decimal and net benefit 548,455 BDT with a cost-benefit ratio of 1.43 (Faruk, 2018**)** [10]. Thus, monoculture of Vietnam Koi culture with supplementary feed was as economically feasible.

During the production of stringing catfish (*Heteropneustes fossilis*) farming, the annual production was 6.32 (MT/ha), where the annual profit was 696,893 (BDT/ha). Production and profit both can be increased by the application of modern farming techniques (Chakraborty and Nur 2016) [5]. The study revealed the different significance levels due to different management practices in both culture systems.

Results revealed by Chakraborty and Nur (2016) [5] were significantly different from the studied result because that data was from super-intensive farming. Aquaculture production mostly depends on the availability of quality feed. It was observed that all of the fishermen of the study areas used supplementary pellet feed. The use of commercially available pellet feed has been widely adopted in semi-intensive aquaculture to obtain higher production. Farmers feed their fish with quality feed at 3-5% of their body weight twice a day from evening to dawn followed by 2-5% of body

weight for Carp polyculture farming. In the case of shing and Vietnam koi culture, farmers feed fish twice daily from evening to dawn with a high-quality feed of 3-5% of body weight, followed by 2-5% of body weight.

During the farming period, the majority of the farmer reported suffering from several diseases such as vibriosis, EUS (Epidemic Ulcerative Syndrome), saprolegniasis, and red spot disease, and argulosis. In the case of carp polyculture, the most common diseases reported by farmers are fin and tail rot disease, saprolegniasis, motile Aeromonas of septicemia, argulosis disease, etc. The most common diseases reported by farmers who culture monosex tilapia were argulosis affecting all fish species in the pond, especially juvenile fish. Therefore, different chemicals (Oxitertracycline, $KMnO_4$, and Ivermectin, Erythromycin) were used for the disinfection and treatment of the affected fish.

Among three polyculture systems, the highest average fish production in carp polyculture was 10.03 MT/ha/yr in followed by Shing culture 6.32 MT/ha/yr, and Vietnam koi farming was 13.091 MT/ha/yr. Despite higher annual production among the three farms, Vietnam koi farming reported not making much profit compared to Shing culture and Carp polyculture. From the study it was stated that annual net profit in carp polyculture was 181,450 BDT/ha/year, followed by Shing culture BDT 6,96,893/ha, Vietnam koi farming (BDT 1,28,440/ha) respectively. The highest average net profit came from Shing monoculture during farming (Table 10).

This study is important to identify the most profitable culture system and species, how to be managed a farm, and how much minimum capital is required to operate a fish farm. The economic comparison among different fish farming systems will provide necessary information how to manage a fish farm commercially in a sustainable way. As the capture fisheries in the world are being overexploited, the aquaculture is growing fast to fulfil the rising demand of aquatic animals.

Due to COVID-19, fish farming was interrupted through reducing the demand of fish, increasing the production cost, losing employment for closing production in many small farms (Admin 2020) [2]. The crisis has exacerbated underlying inequalities and malnutrition burdens amongst the poorest. Many workers subsisting on daily wages have seen their incomes disappear and have faced difficulties buying food as a result. A drop in demand for fresh produce including fish from aquaculture was reported at the beginning of April. Due to noble Covid-19 production of fish through farming rapidly increased because a huge number of people became jobless and engaged them in fish farming. Al through this period carried a revolution in fish production but some farmers did not make a profit due to fewer prices of fishes. As we know, a huge amount of fishes exported to a foreign country every ever and earn huge remittance. Before spreading Of Novel Covid-19 China and European Union was our big raw white fish market. Due to covid-19, our fish production increased but the farmer was not benefited as per their profit level due to low fish price.

To conclude, the present study showed that stringing catfish culture is more profitable followed by carp polyculture and Vietnam Koi culture. From the present study, it is evident that Chandpur and Laxmipur district is very rich with versatile aquaculture resources that could make that one of the ideal freshwater fish production areas of Bangladesh. However, this study has revealed very poor utilization of inland open water-bodies and the existence of some major constraints in pond fish production in the Chandpur and Laxmipur district. The fish production will reach high beyond the fish demand in the study area if the huge area of inland water bodies could bring under proper management and aquaculture technologies and existing pond fish farming production could be raised. Therefore, Governmental and Non-governmental initiatives are crucial to resolve existing problems and to ensure higher fish production. On the other hand, personally many entrepreneur and young generation can share their hand for the better development of this sector. In this present year when Covid-19 has been affected many people lost their job and their livelihood in the capital. Maximum people have to leave Dhaka city because of their financial crisis. Many of them made their mind not to come again to this city. They have started cultivating rice in their land and fish in their ponds which were not used in previous days. Many young generations decided to make so many big projects for different types of fish culture at their village. They have seen that the most demanding business is only the production of food because in case of any pandemic and unexpected situation the only need is the food supplement. Many youths and educated people have started poultry farming of chicken and duck. Many have taken the initiative to cultivate their lands, and many have started polyculture and monoculture fisheries in their ponds because the management of their own or personal pond does not cost them much. They can earn money in a very short time spending a small amount of money. This concept is a blessing for the development of the country because of the people of the country are self-dependent the country will be self-dependent automatically. Even though the aquaculture as well as total national fish production is gradually increasing in Bangladesh, the seasonal water bodies and the floodplain areas could be utilized for aquaculture production under community based fisheries management to increase the total national fish production (WFC, 2005) [15].

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