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Original Research Article

Chemical and Pesticides uses status in the Chalan *beel*, Bangladesh and its impact on fish Biodiversity

ABSTRACT

Aims: A study was conducted to investigate the present status of agrochemicals used, aquatic resources and impacting on aquatic biodiversity in the Chalan *beel*, the largest *beel* of Bangladesh.
Duration of Study: A period of six months from January to June 2009.
Methodology: The study was based on field survey. A semi structured and structured questionnaires were developed, pretested and adapted prior to the survey proper
Results: The abundance of several species showed decreasing trend from 1982 to 2009. The average total annual fish production of the *beel* was 12,017.57 MT having average fish production of 281.86 kg ha^{-1} during the study period. Crop farmers applied 2.76 kg pesticide ha^{-1} $crop^{-1}$ and average annual chemical fertilizers usage was more than 1,25,000 MT. A total of 108 and 143 large to minor scale fish mass mortality incidences were recorded with estimated fish damage of 2,117 and 2,980 kg respectively during the study period.
Conclusion: It is the obligation of concerned GOs, NGOs and the people of the country to control the gear efficiency in the Chalan *beel*, stop the illegal use of harmful pesticides and provide alternative livelihood options to the resource-poor fishers of the *beel* along with other measures for sustainability of the Chalan *beel* - a major fish reservoir of the country.

Key words: aus, aman, total dissolve solids, residual effect, organic matter

INTRODUCTION

Inland water bodies have been supporting rich and diversified fisheries and thus these are critically important to Bangladeshi people for their food security and livelihood[1]. However, due to sharp decline in fish intake over the last years, we have reached a situation of protein deficiency. At present, fish consumption per capita per day is only 47.19g, whereas the actual requirement is about 49.3 g[2]. For centuries, a delicate cycle of flooding, fish migration between rivers and floodplains, spawning and growing has been maintained in the wetlands of the country. Large areas of permanent, semi-permanent or seasonal wetlands are found in floodplains of lowland rivers with unperturbed hydrology. There are great differences in the area flooded from year to year, and this greatly influences the population dynamics of many fish species[3].

The *beel* is a Bengali term used for relatively large surface, static waterbody that accumulates surface run-off water through an internal drainage channel[4]. This type of shallow, seasonal waterbody is common in low-lying floodplain areas throughout Bangladesh[5]. *Beels* are one of the important sources of our fish supplies in Bangladesh. Natural depressions (beels) comprise about 2.49% (1, 14,161 ha) of total aquatic resources which supplied 75,137 mt (3.08% of total fish production and 7.46%of open water fisheries) in 2006-07[6].

Chalan *beel* is the largest and most important watershed in the North Central Bangladesh. It comprises a series of depressions interconnected by various channels to form one continuous sheet of water in the rainy season (July-November) when it covers an area of about 400 km^2. During the dry winter and summer, the water area decreases down to 52-78 km^2 and looks like a cluster of *beels* of different sizes[5,7]. The Chalan *beel* is a confluence for numerous smaller water ways and, in turn, is drained by channels that flow south, finally discharging into the Padma and Brahmaputra Rivers[8]. The *beel* serves about 5 million people by providing fish and aquatic products, agricultural crops, and pasture lands for the livestock. But now nearly deserted due to different Flood Control Drainage and Irrigation (FCDI) facilities and siltation. A large number of fish and aquatic organisms have been diminished from this water body. About 100,000 fishermen living in and around the *beel* have been severely threatened to the loss of livelihood[5].

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A rich diversity of a species is critical to the ecology and sustainable productivity of the floodplains. While tremendous genetic diversity is embodied from 260 to over 500 fish species which inhabit in Bangladesh's inland, estuarine and coastal waters ever little substantive data on the ecology of these species is available to say something significantly[9,10]. Paul[11] stated that 143 indigenous species and eight exotic species of fish inhabiting in the northeast region of which carps and catfishes are dominant groups. Fish biodiversity has been degraded due to many reasons for anthropological and agricultural encroachment thus the availability of our indigenous freshwater fish species have declined to a great extent over the years and many of them are either rare or at the verge of extinction. Among the 260 freshwater fish species belonging to 52 families many of them are threatened in Bangladesh.

The inland aquatic habitats of Bangladesh are rich in faunal diversity containing at least 260 species of finfish, 60 species of prawn and shrimp, several species of turtles, tortoises, freshwater mussels and other living aquatic organisms[12]. The importance of fisheries in Bangladesh is clearly very large, and given its strategic importance for food security and national development, the fisheries sector has received considerable attention.

Pesticide affects the aquatic ecosystem by interrupting the aquatic food chain of open water fish species and finally results in the loss of abundance of natural species[13]. The inundated floodplains during monsoon are the seasonal habitat of the fish and the residual effects of pesticides applied to these floodplains for agricultural purpose before monsoon lead to the large scale fish killing. Besides fish killing, there are also chronic effects of pesticides including changes in reproductive system, metabolism, growth patterns, food availability and population size and numbers. Rohar and Crumrine[14] reported that the application of the herbicide atrazine to a lentic system resulted in lower periphyton abundance and, as a result, reduced herbivore biomass.

Presently Chalan *beel* like many other *beels* are at the risk of partial or total degradation due to manifold reasons like agricultural encroachment including pesticide usage, siltation along with other anthropogenic activities. However, it is very difficult to say how much degradation has been occurred for sure and how these problems can be solved. Therefore, a comprehensive study on the Chalan *beel* seems to be of timely value and immense necessity. The study was conducted to investigate the present status of pesticide usages and to assess its effects on fish biodiversity of Chalan *beel*. Also the causes of its degradation in relation to the environmental parameters in the Chalan *beel* located in the North West Bangladesh.

1. MATERIALS AND METHODS

2.1 Description of the Study Area

The Chalan *beel* is situated between 24.35° and 24.70° North latitude and between 89.10° and 89.35° East longitudes (Fig. 1). Historically the *beel* spreads over the upazilas (Sub-distrcts) of the districts of Rajshahi (Paba, Bagmara and Mohonpur), Pabna (Chatmohor, Bhangura and Faridpur), Sirajgong (Tarash, Ullapara, Raigonj and Shahjadpur), Natore (Sadar, Singra, Gurudaspur and Baraigram), Naogoan (Manda, Raninagar and Atrai) and Bogra (Nandigram). In present day, the *beel* has been squeezed only in the districts of Pabna, Sirajgonj and Natore due to crisscross roads, embankments and other infrastructural development. Therefore, the research was conducted in three representative cluster sites under the above districts. For data collection, ten upazilas such as Singra, Gurudaspur and Boraigram under the district of Natore, Chatmohar, Bhangura and Faridpur under Pabna and Shahjadpur, Ullapara, Tarash and Raygong under Sirajgong were included (Fig.1).

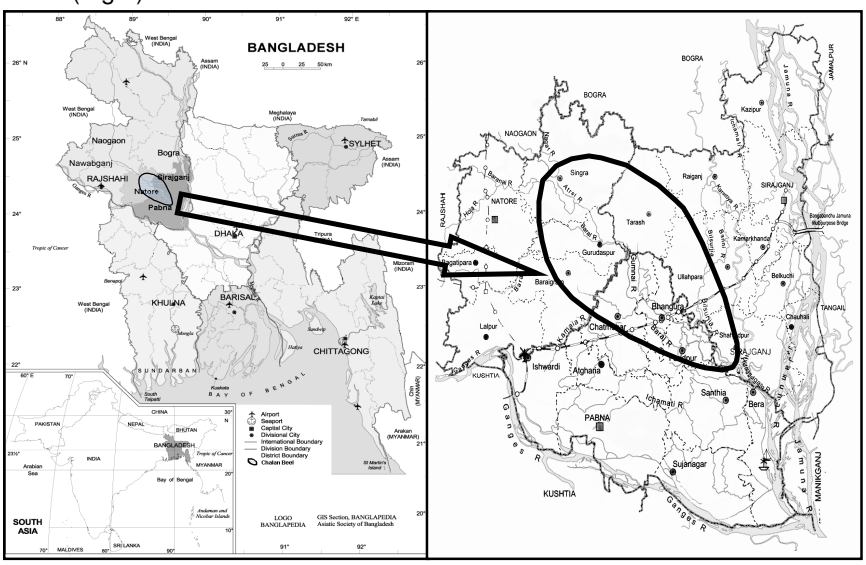

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Fig. 1. The study site "Chalan *beel*" showing in the map of Bangladesh.

2.2 Methodology

The study was based on field survey where primary data were collected both from the fishermen, crop farmers, pesticide dealers and retailers and other local stakeholders living in and around the *beel*. The survey method was chosen for the study because it was thought to be more advantageous and helpful to know the present status of pesticide and other chemicals in the Chalan *beel*. A reasonable size of sample to achieve the objectives of the study was considered keeping in view limitation of time and resources. A stratified random sampling procedure covering all selections among the people with an age of 25 years or more was followed to collect information on a participatory stakeholder approach. The study was based on the data collection from different stakeholders related to pesticides use and detailed of them in Table 1.

Table 1. Number of key informants interviewed in different upazilas.

Sl. No.	Key informants	Activities	Number	Remarks
1.	Pesticides dealer	Interview	1×10 = 10	10 indicate upazila in and around Chalan *beel.*
2.	Pesticides retailers		2×10 = 20	
3.	Upazila Agriculture Officers (UAO)		1×10 = 10	
4.	Upazila Fisheries Officers (UFO)		1×10 = 10	
5.	Crop farmers		4×10 = 40	
6.	Fish farmers		3×10 = 30	
Total			120	

Besides, ten Focus Group Discussions (FGD) were conducted in ten upazilas including all section of resource users and covering all aspects of pesticides. Secondary information from published reports, scientific articles, web sites etc. was also reviewed.
Initially a draft questionnaire was prepared following other relevant questionnaire and information. Then it was pre-tested among 10 respondents from the *beel* area. New information and respondent's attitude was recorded. A semi structured and structured questionnaires were developed, pretested and adapted prior to the survey proper

2.3 Data processing and analysis

The data were generated and subjected to descriptive analyses to characterize the sample pesticide sellers and farmers' crop management practices. Then in all cases statistical analysis was made using analysis of variance (ANOVA) and F-test Methods. Duncan's Multiple Range Test (DMRT) was performed whenever necessary[15].

2. RESULT AND DISCUSSIONS

2.1 Physical characteristics and chemicals used status

The details of physical characteristics of Chalan *beel* area are given in Table 2.

Table 2. Farm physical characteristics in the Chalan *beel*

Characteristics	Natore	Pabna	Sirajgonj
Average annual rainfall (mm)	1620	1529	1376
Average landholding (ha per family)	1.06	0.72	1.19
Cropping intensity (%)	180	164	173
Food grain production (ton.ha^{-1})	3.4	3.1	3.6
Village with pesticide retailer ratio	0.23	0.34	0.27
Pesticide use (kg ha^{-1})	2.87	2.41	3.01

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Details of various types of chemical fertilizers used in Chalan *beel* area are shown in Table 3. Yearly, over 1.25 lac. mt. of various chemical fertilizers were being used which ultimately drained out to the Chalan *beel* causing serious problem. More fertilizers were found to be used in 2008 than that of 2009 which might be due the impact of integrated pest management (IPM) activities and motivation programs through different GOs and NGOs in the Chalan *beel* area.

Table 3. Detailed of various chemical fertilizers used in the Chalan *beel* area in 2008 and 2009

Upazilla	Fertilizers (MT)																	
	Urea		TSP		SSP		DAP		MOP		NPKS		GYPSUM		ZINC		BORON	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Singra	15700	14999	7978	3077	388	3077	809	68	5467	607	160	2326	4788	48	574	177	300	96
Gurudaspur	5506	5651	635	598	-	-	359	380	437	-	-	2	197	273	31	33	-	91
Boraigram	7315	8826	1595	2250	145	301	708	946	1225	1700	56	537	313	672	36	95	6	59
Chatmohar	6658	7050	488	1962	13	3455	690	3115	235	1559	341	725	286	575	44	130	-	133
Bhangura	3412	3600	685	960	1579	1686	1422	1502	497	508	31	36	247	255	37	50	44	73
Faridpur	2530	4300	180	839	39	1825	269	1309	90	494	136	36	105	250	16	40	-	-
Shahjadpur	7900	8008	2601	2889	-	-	-	210	2901	2953	206	7	1204	1372	145	95	6	5
Ullapara	8775	11920	3015	2850	-	-	25	50	2512	2405	230	350	1350	350	148	150	6.5	7
Tarash	5546	1653	2086	360	168	160	700	100	2640	300	800	54	1400	180	110	2	-	-
Raigang	9000	2500	90	250	250	50	420	100	1050	250	50	15	520	150	110	30	10	3
Total	72342	68507	19353	16035	2582	10554	5402	7780	17054	10776	2010	4088	10410	4125	1251	802	372.5	467

**TSP-Triple Super Phosphate, SSP-Single Super Phosphate, DAP-Diammoniaum, Phosphate, MOP-Murate of Potash and NPKS-Nitrogen, Phosphorus, Potassium and Sulpher*

Pesticide use in Bangladesh got started from mid 1950s and gained momentum in late 1960s with the introduction of green revolution through the use of HYV rice in the country[16]. Pesticides have been promoted and increased in Bangladesh mainly due to expansion of agricultural land area and increase in crop production. Farmers have been receiving extension services and considerable subsidies from the government over the years[17,18]. As a result, pesticide usage had been increased abnormally in the Chalan *beel* and the demand of pesticide is increasing day by day. Many farmers used banned and inferior quality pesticides which came through illegal channel from neighboring countries as the price of such type banned or illegal pesticides was relatively lower. As a consequence, water ecosystem is being damaged through using banned pesticide. The indiscriminate use of insecticides and pesticides in the crop fields by the farmers was one of the causes of disappearance of fish from the natural waters in Bangladesh. Not only fish but also other beneficial animals were killed by pesticides and pesticide affected the aquatic ecosystem by interrupting the aquatic food chain of open water fish species and finally resulted in the loss of abundance of natural species[13]. Besides fish killing, there were also chronic effects of pesticides including changes in reproductive system, metabolism, growth patterns, food availability and population size and numbers. Rohar and Crumrine[14] reported that the application of the herbicide atrazine to a lentic system resulted in lower periphyton abundance and, as a result, reduced herbivore biomass.

To address food security, the farmers in the Chalan *beel,* mostly the medium and marginal farmers are engaged in the farming activities in 0.19 million ha of land. *Boro* was the most dominant crop varieties using pesticide and fertilizers in full swing causing loss of fish biodiversity. A number of major to minor fish mass mortality were recorded by the fishery officers during 2008 and 2009 in ten upazilas where the estimated damage was more than three lakh in BDT and the occurrences were increasing year after year. Knight et al.[19] reported that applications of herbicides may cause cross-ecosystem cascades and ecosystems were also impacted by it. Local migrant fish used to breed in mass scale in Chalan *beel* now do not breed.

3.2 Farmers' knowledge on pesticide usage

Lack of proper knowledge of the pesticide users has led to administer widespread and excessive quantity of pesticides. Majority of the respondents (68%) in the survey conducted during the study period agreed that they lacked proper knowledge regarding the residual effects of pesticide use. The insufficient information they received on pesticide use came from pesticide seller (57%), neighboring farmers (26%) and different extension services (18%). About 51% respondents opined that pesticides uses had many harmful effects. Among the harmful effects, 13% respondents thought that pesticides killed useful insects and animals, whereas 11% believed that pesticides had adverse effect on fish biodiversity (Table 4).

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Table 4. Farmers' perception on the adverse effect of pesticide use

Farmer's perception	Response (%)
Pesticide have harmful effect	51.1
Kill beneficial insects and microorganism	12.7
Affect fish biodiversity	10.6
On birds	8.4
On human health	7.3
On agro-bio diversity	6.9
On soil fertility	5.2
Pesticide do not have harmful effect	37.6
Non response	11.3

3. 3 Dynamics of cropping practice

The most important source of people's livelihood in the Chalan *beel* area is agriculture. In Chalan *beel,* there were 8, 10, 30, 35 and 18% of large, medium, small, marginal and landless farmers, respectively engaged in the farming activities in 0.19 million ha of land (Table 5).

Table 5: Crop land area and number of farmers in Chalan *beel* area

District	Area of Crop Land (ha)	Number of farmers					Total
		Large	Medium	Small	Marginal	Landless	
Natore	74,956	6261	14,995	16,129	16,723	16,696	70,804
Pabna	46,093	5667	636	17,985	34,540	5520	64,348
Sirajgonj	67,330	3476	3008	22,944	15,189	12,039	56,656
Total	188,329	15,404	18,640	57,058	66,452	34,255	191,809

**Large farmer: >3.0 ha, Medium farmer: 1.0-3.0 ha, Small farmer: 0.60-1.0 ha, Marginal farmer: 0.20-0.60 ha, Landless farmer: Below 0.2 ha*

High yielding varieties of *boro* and *aman* rice were the most dominant crops occupied about 73% and 25% land area, respectively, whereas only 2% area was occupied by traditional rice varieties. Flood and drainage problems affect annually two thirds of cultivable area of Chalan *beel*. Prior to implementation of the FCD, the cropping area used to suffer from combined effect of river bank spilling of Little Jamuna and Atrai River and runoff during May-October almost every year. The floods adversely affected the late growth and harvest of *Aus, Boro* and the early *Aman* crop.

The provision of drainage and flood control under FCDI offered large opportunities to increase the cropping intensities during the monsoon. As a result, rice production increased but at the same time fish biodiversity decreased overtime due to severe lack of water in the Chalan *beel* and use of high amount of detrimental pesticide in the crop field. The frequent incidences of fish mass mortality have been reported by the Upazila Fisheries Officers in the Chalan *beel* area (Table 6).

Table 6. List of fish mass mortality incidences reported due to over use of different Pesticides in the Chalan *beel* during the study period

Upazilla	2007			2008		
	Number of incidence	Amount of dead fish (kg)	Value of dead fish (Taka)	Number of incidence	Amount of dead fish (kg)	Value of dead fish (Taka)
Major incidences						
Singra	2	125	15,000	1	75	10,000
Gurudaspur	3	175	22,500	2	225	27,500
Boraigram	1	25	3,100	0	0	0
Chatmohar	4	525	7,5000	4	650	105,500
Bhangura	2	155	20,000	3	175	23,000
Faridpur	1	65	8,000	0	0	0
Shahjadpur	0	0	0	2	180	27,000
Ullapara	2	250	32,000	3	450	75,000
Tarash	3	310	45,000	4	560	11,0000
Raigang	1	55	7,500	1	85	13,500

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Total	19	1,685	228,100	20	2,400	391,500
Moderate incidences						
Singra	2	25	3,000	4	75	8,000
Gurudaspur	4	75	8,500	7	75	8,500
Boraigram	1	12	1,500	2	34	4,150
Chatmohar	6	55	7,500	4	45	5,500
Bhangura	3	15	2,500	4	45	6,500
Faridpur	2	25	3,500	5	40	5,500
Shahjadpur	3	35	4,200	7	55	7,200
Ullapara	5	60	8,000	8	60	8,000
Tarash	6	70	8,500	6	80	9,000
Raigang	2	25	3,200	4	35	5,200
Total	34	397	50,400	51	544	67,550
Minor incidences						
Singra	5	5	700	6	10	1,200
Gurudaspur	7	0	0	9	0	0
Boraigram	3	0	0	4	0	0
Chatmohar	6	5	700	5	12	1,500
Bhangura	4	0	0	8	10	1,600
Faridpur	3	5	750	5	2	250
Shahjadpur	4	0	0	7	5	650
Ullapara	8	5	650	10	0	0
Tarash	12	10	1,250	11	15	2,050
Raigang	3	5	680	7	10	1,280
Total	55	35	4,730	72	64	8,530
Grand total	108	2,120	283,130	143	3,008	467,580

Every year incidence of different types of fish mass mortality were recorded by the fishery officer during 2007 and 2008 in ten upazilas where the estimated damage was not so more in monetary value, but the tendency of incidences are increasing day by day. The fish breeding grounds were also destroyed. A large number of deep tube-well, shallow tube-well and low lift pump were used for irrigation purposes in entire *beel* area. Therefore, farmers are more interested in culturing rice crops ignoring the importance of fisheries in and around the Chalan *beel*. In the late monsoon, landowners install the brush park demarking their area with the objective of capturing fish by pumping out the remaining water during winter.

3.4 Scenario of Pesticide use in Chalan beel

It was observed that about 117 different kinds of pesticides were used in the Chalan *beel* area. The dominant pesticides used in Chalan *beel* with their prescribed and used doses are presented in Table 8. The average pesticide use in crop land inside Chalan *beel* was 2.76 kg ha^{-1} $crop^{-1}$. The fish farmers also used several pesticides, eg. Sumithion 50EC, Nogos100EC and Dipterex 80SP during the pond preparation more or less below the recommended level.

Table 7. The common pesticides used by the crop and fish farmers in the Chalan *beel* area

Trade Name	Active ingredient	Recommended dose	Company name
Brifur5G	Carbofuran	10 kg ha^{-1}	ACI BD. Ltd.
Bisterin 5G	Carbofuran	10 kg ha^{-1}	Alfa-Agro BD. Ltd
Alfafuran 5G	Carbofuran	10 kg ha^{-1}	Alfa-Agro BD. Ltd
Chloropyrifos 20EC	Chloropyrifos	740 ml ha^{-1}	Alfa-Agro BD. Ltd
Basudin10G	Dizinon	15 kg ha^{-1}	Syngenta BD.Ltd
Karate 2.5EC	Lambdcyhalothrin	740 ml ha^{-1}	Syngenta BD.Ltd
Furadan 5G	Carbofuran	10 kg ha^{-1}	Padma Oil Company Ltd
Diazinon 60EC	Diazinon	740 ml ha^{-1}	Mcdonal BD.Pvt. Ltd

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Agrifuran 5G	Carbofuran	10 kg ha^{-1}	3-Star Ltd
Forwafuran 5G	Carbofuran	10 kg ha^{-1}	Corbel Co. BD. Ltd
Sumithion 50EC	Fenitrothion	3 mg l^{-1}	-
Nogos100EC	Dichlorvos	3 mg l^{-1}	-
Dipterex 80SP	Trichlorphon	3 mg l^{-1}	-

There are a total of 44 dealers and 791 retailers have been engaged in pesticide trading in the Chalan *beel* area with an average annual turnover of BDT 52 million. In Bangladesh there are more than three hundred commercial pesticides. Among them 102 commercial pesticides have been either banned or cancelled by the authority. In Bangladesh, pesticide use has been almost double since 2000, rising from 15,410 mt. to 29,364 mt. in 2009 (Table 7 and Fig. 2).

Table 8. Group wise pesticide consumption for the year 2002-2009

Name of pesticides		Figures in MT (KL – Kiloliter for the liquid)									
		2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Insecticides	Granular	16971	16147	15023	14282	14061	12113	11781	12335	10138	10113
	Liquid	2698	2583	2543	2523	2511	2008	1831	1497	1286	1150
	Powder	387	327	292	279	268	192	123	115	87	76
Miticide		102	85	71	62	56	37	32	27	25	21
Fungicide		6826	6359	6113	5881	5772	4297	5772	4279	3308	3278
Herbicide		3747	3211	2841	2791	2775	3463	1354	964	901	876
Rodenticide		46	39	28	25	23	23	19	36	31	27
TOTAL		30777	28751	26911	25843	25466	22115	18080	17357	15776	15541

Source: Bangladesh Crop Protection Association (BCPA)

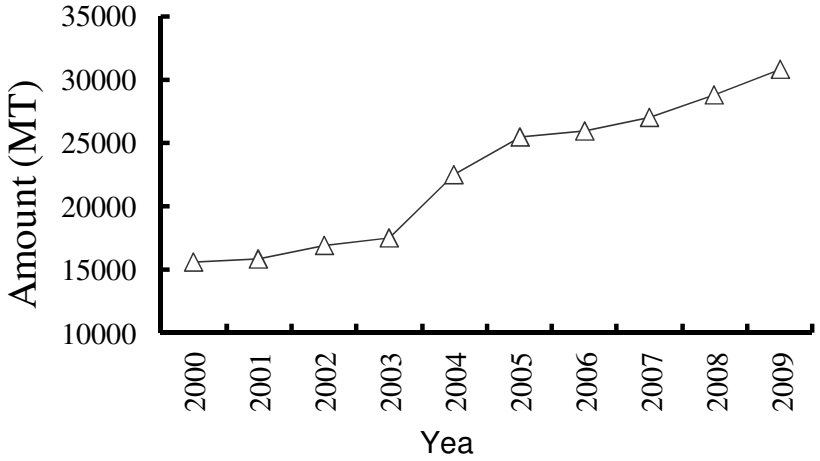

Fig. 2. Pesticide use in Bangladesh

Chalan *beel* occupies around 18% share of the country's total *beel* area but importance is given always on cereal food production ignoring the poor people's access to fisheries as easy protein sources. The development initiatives of the Chalan *beel* only focused on agriculture crop rather than biological management of this rich floodplain system for fish production. The government of Bangladesh has formulated some laws, policies to conserve and protect the environment.

Interestingly, many pesticides found in aquatic systems were not intended or legally registered for application to aquatic systems, but they still[20]. Various government and non-government agencies in Bangladesh have been campaigning against use of pesticides. They have been motivating and suggesting farmer to apply IPM (Integrated Pest Management) and ICM (Integrated Crop Management) for controlling the harmful insects.

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3.5 Impacts on fish biodiversity

It was observed that the fish production in Chalan *beel* reduced by 31%, 52% and 56% in 1992, 2002 and 2009, respectively when compared with the production of 1982. The trend of pesticide usage and fish production is presented in Fig. 3. Initially, the pesticide use was increasing in a slow rate whereas the fish production was decreasing faster. However, in the twenty first century its use increased more and the trend of fish production decease was slower that might be due to the activities of different fisheries development activities in the Chalan *beel* area.

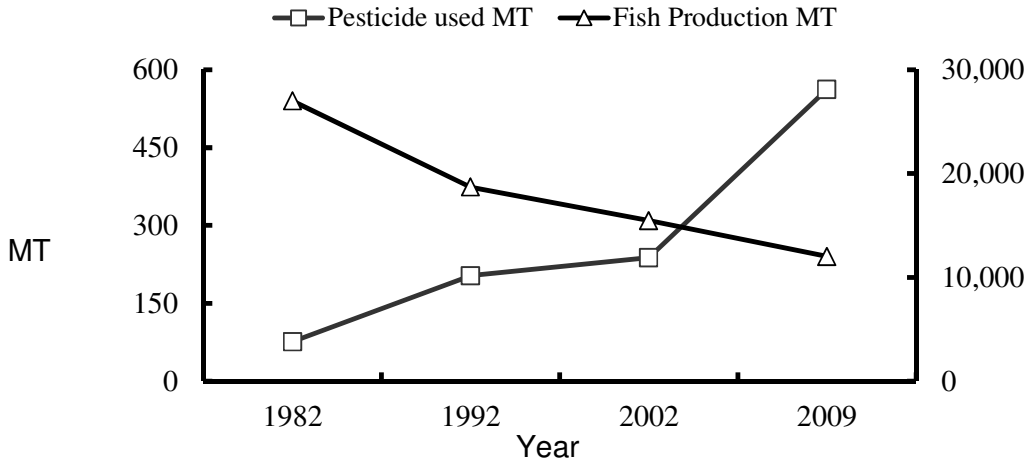

Fig. 3. Trends of fish production and pesticide usage in Chalan *beel*

Natural recruitment of the fish has been declined and a large number of non-migratory, resident fish spawners have mostly lost their breeding grounds. Many valuable indigenous fish species are now under threat, depleted or fully disappeared from the important fish habitats of Bangladesh – the Chalan *beel*. In our study, about eight species viz., *Setipinna phasa, Chitala chitala, Ompok bimaculatus, Pangasius pangasius, Eutropiichthys vacha, Mystus aor*, *Gangata youssoufi* and *Labeo boga* were identified as disappeared from the *beel*. Another 11 species viz., *Rhinomugil corsula, Tenualosa ilisha, Puntius sarana, Rita rita, Ompok pabda, Lepidocephalichthys berdmorei, Labeo calbasu, Labeo gonius, Puntius chola, Chelonodon patoca, Tetraodon cutcutia* were found to be at the verge of extinction. Therefore, pesticides uses in the paddy field had drastically decreased the variety of fishes while many have become extinct for using the pesticides in the paddy fields in the course of time.

The residues of huge amount of pesticide used in the Chalan *beel* area eventually washed out into the surrounding river and *beel* systems. Almost all respondents concluded that the indiscriminant pesticide use and change in cropping practice were responsible for fish biodiversity degradation of the Chalan *beel*. Hossain and Halder[17] reported that 70% farmers agreed that the main cause of disappearance of the fish from the waterbody was the use of excessive and banned pesticide. Lethal dose and even at sub lethal dosage of chemical residues of pesticides largely attributed to cropland runoff contaminants[21] killed fish as well as other aquatic organisms[13].

3. CONCLUSION

Chalan *beel* is a moderate productive water body with decreasing fish species diversity. If fish catches in Chalan *beel* legally and illegally continued to increase without control, then this valuable resource Chalan *beel* would be empty of fish in near future. It is the duty of concerned GOs, NGOs and the people of the country to control the gear efficiency, stop the illegal use of harmful pesticides and provide alternative livelihood options to the resource-poor fishers along with other measures. Thus care must be taken to protect ecosystem and the ecological balance by developing mills and other agricultural development in a planned way in this area. Finally, it is imperative that efforts should be undertaken to develop ecosystem-based management strategies with inputs from scientists, resource managers, policy makers, government and non-government organizations and other stakeholders, with the objectives of enhancing production, maintaining biodiversity in a sustainable manner and improving the livelihoods of the remaining, highly marginal fishermen in the largest *beel* of Bangladesh – the Chalan *beel*.

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