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Wetland Uses, Problems and Probable Management Options: A Case Study of Berunanpukuria Village, Barasat, North Twenty Four Parganas, West Bengal.

Subhamita Chaudhury, Sujata Dutta and Chandan Kumar Mondal, Barasat, West Bengal

Abstract

The man made wetlands play a dual role in maintaining the environmental balance of the surrounding area and supporting the life and livelihood of the rural population. The study area, Berunanpukuria village has a large number of such man-made wetlands, majority of which have been excavated for brick-kilns and fishing purpose and are perennial in nature. The changing landuse pattern of the surrounding area, in the last six to seven years has had a number of adverse effects on the wetlands. Forty seven wetlands having diverse landuse practices in their catchment area were chosen for this study, Fertilizers used in agricultural fields in the catchment area of the wetlands cause nutrient enrichment of the water in about 19.15% wetlands, resulting in algal bloom. The BOD value in most of the ponds is higher than the recommended range, indicating an addition of substantial amount of waste water from sewage and domestic effluents. The pH value in almost all water samples range from low acidic to low alkaline condition. In majority of the ponds the water quality indicators like Ammonia, DO, COD, BOD and EC are within moderate range. But in few ponds (example-pond no. 16) the ammonia content, DO and COD are all above the recommended range, which calls for immediate management intervention.

Key words: *wetland, water quality, management*

Introduction

The natural wetlands are acclaimed for their ecological importance, not only for their rich aquatic biodiversity but also for their role in controlling the hydrological regime of the area. Several attempts of restoration and conservation of such wetlands have been documented. The man made wetlands on the other hand, though created for some specific purpose often attain significance for their multiple uses. These wetlands not only play an enormous role in rural livelihood, but also have an important bearing in maintaining the environmental balance of the area. The chosen study area in North 24 Parganas has experienced drastic change in landuse pattern together with an increase in the population figure in the last six years. As a consequence many wetlands have suffered due to reduction in their areal coverage and also deteriorating health condition. Here majority of the ponds are being silted due to disposal of domestic, agricultural and industrial waste. Very few of them have recoded increase in depth mostly due to pond excavation work included under the 100

days work scheme of MGNREGA (Plate 1 See page No. 11). Since the wetland water quality depends principally on the runoff from their catchment area, different types of wetland have been selected with diverse landuse practices in their catchment area. The study aims to categories the wetlands based on their boundary type, hydrological regime, catchment character and primary and secondary uses; assess their problems and suggest some management options.

Study Area

In the district of North 24 Parganas total wetland area is 150206 ha constituting 13.56% of the total wetland area of West Bengal and stands second in position in West Bengal in terms of percentage of total wetland area. Different types of wetlands in West Bengal have been categorised by ISRO into four —1) Inland wetland–natural, 2) Inland wetland–manmade, 3) Coastal wetland–natural and 4) Coastal wetland–manmade. Most of wetlands in North 24 Parganas fall within the Inland wetland–manmade type, including tanks\ ponds or waterlogged area. (National Wetland Atlas: West Bengal, 2010).

The study area Berunanpukuria is a village located within the Icchapur-Nilgunj Gram Panchayat of the community development block–Barasat-I of North 24 Parganas district. Berunanpukuria has an area of 1.571 Km^2, located between 88˚25´47.94˝E to 88˚26´53.15˝E and 22˚44´43.65˝N to 22˚43´52.88˝N. The study area experiences a subtropical monsoon climate. In Berunanpukuria, wetlands are spread all over the village and majority of the wetlands are manmade. Among these 47 wetlands were selected for this study. Most of the studied wetlands are situated in the central and northwestern part of the mouza (Fig.1).

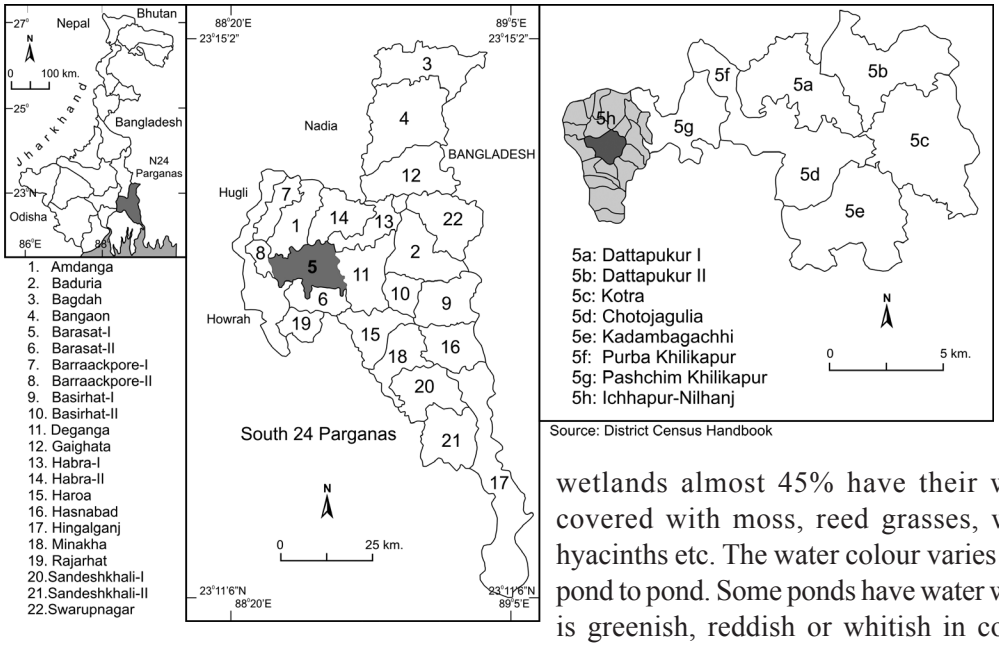
Objectives:

- To assess the recent areal change of the wetlands.
- To identify the major uses of the wetlands.
- To determine the water quality of the wetlands.
- To know the perceptions of the local people about the wetlands.
- To suggest some management options for the selected wetlands.

Methodology

The study was carried out in 47 wetlands selected randomly across the village (Fig. 2). The perception of the local people regarding the wetlands uses, threats and surrounding landuse was based on questionnaire schedule. The questionnaire emphasised upon the threats faced by the wetlands and their effect on the water quality. Based on the response of the respondents, 8 wetlands were selected for water quality analysis having different landuse practices in their catchment area, like agricultural fields, brick kilns and settlement area. Water quality testing was done to find out the pH, electrical conductivity (EC), hardness, NH_4-N, alkalinity, phosphate (P_2O_5), dissolved oxygen (DO_2), dissolved carbon-dioxide (DCO_2), COD, BOD and Chlorophyll content (Table 1 and 2).

For determining the temporal change in area of the wetlands two satellite images of 2005 and 2011 were considered. GPS coordinates of the wetlands were taken in order to precisely locate them on the satellite image.



Source: District Census Handbook

Fig.1 : Location of the study area

Results and Discussion

All the selected wetlands are man made and most of them are perennial in nature (89.63%) but few are seasonal in their character. Some wetlands have good vegetation buffer (21.28%), surrounded with bamboo trees, shrubs, grasses, orchard of mango, banana etc. Out of the 47 selected wetlands almost 45% have their water covered with moss, reed grasses, water hyacinths etc. The water colour varies from pond to pond. Some ponds have water which is greenish, reddish or whitish in colour. Most wetlands have been excavated for brick-kilns (35.3%) and fishing purpose (33.33%) and only few for providing irrigation water to the agricultural field (9.8%), industries (0.98%) and construction purpose (4.8%). So the ponds have some primary as well as some secondary uses. Majority of the ponds are used for domestic purposes like fishing, washing, and bathing (Fig. 3).

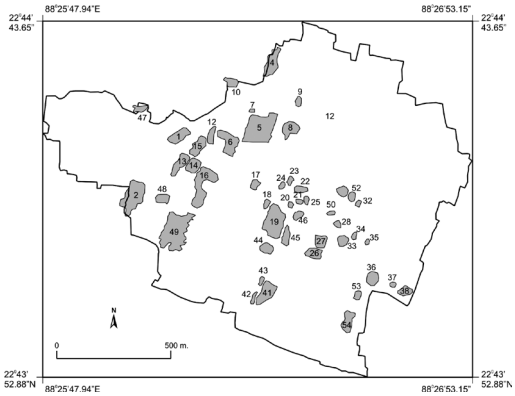


Fig.2 : Location of surveyed wetlands within Berunanpukuria.

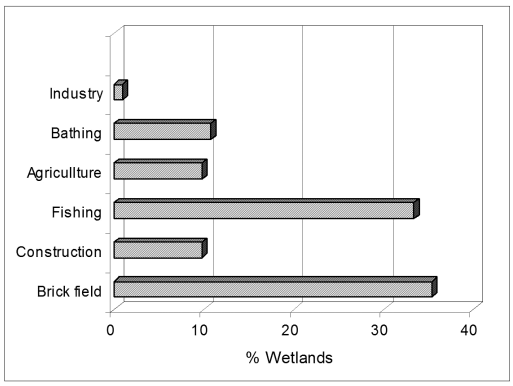


Fig.3 : Purpose of wetland construction in Berunanpukuria

Problems of landuse change

The changing land use pattern of Berunanpukuria in the last six years has affected many of the wetlands adversely. Large scale acquisition of land for various construction purposes has degraded the wetlands. A comparative analysis of satellite images (2005 and 2011) reveals that majority of the ponds have experienced reduction in their area and only in few cases the area of the pond has increased (Fig. 4 See page No.11). Some ponds have been totally filled up for construction purpose. Majority of the wetlands are facing the problem of decrease in area (Plate 2 See page No.11) mainly due to construction of roads (10.87%), construction of houses (15.22%), extension of cultivated area (13.04%), and expansion of industrial area (4.35%).

Problems related to change in water regime

The water regime of the wetlands changes seasonally. In the rainy season the volume of water is maximum, indicating a positive change of water regime and during the water deficit period a negative change is found. But it has been reported by many respondents that in recent times many of the wetlands do not have adequate water even during the rainy season. Diversion of water from wetlands for various purposes and depletion of ground water table due to over extraction of ground water may be some of the probable causes of insufficient water in some of the wetlands (Plate 3 See page No. 12). The Metro Dairy production unit located at Berunanpukuria plays a major role in ground water extraction. This has now become a vital problem for the wetlands of Berunanpukuria. The trend suggests that in future, some of the ponds may become seasonal in character.

Problem related to deteriorating water quality

Water quality of ponds is directly related to human population and its various activities (Prasad *et al.*, 2002). Due to anthropogenic activities wetlands have experienced changes in water quality, quantity, and increasing pollutant input from various sources like runoff from agricultural, residential and brick field areas. Here 23.40% ponds are surrounded by agricultural fields (Plate 5). These are mainly situated in northern, western and southern part of the study area (Fig. 5). The main agricultural produce from the surrounding fields include potato, brinjal, banana, ladies finger, mustard grain, rice and wheat. Wetlands are mainly used for irrigation purpose during the water deficit months of winter and summer season.

Both organic and inorganic fertilizers are used in the agricultural fields. But the farmers use mostly inorganic fertilizers

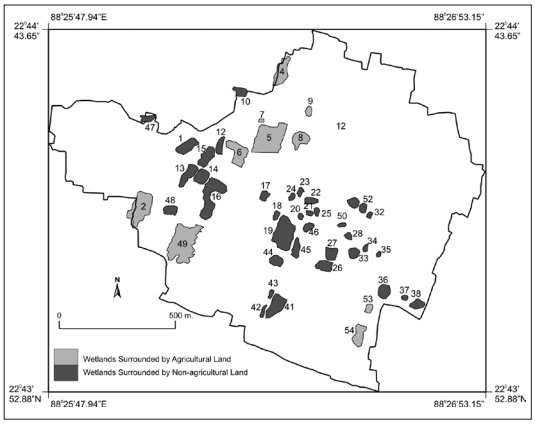


Fig.5 : Wetlands in Berunanpukuria categorised according to surrounding landuse

including 10:26:26, 15:15:15, urea N+P+K and *Suphala*. Along with these, various types of pesticides are also being used including DDT, Indofil, Phibidol, Ruccer and Thaidon. These are the major sources of pollution to the wetlands. These pesticides drain to the wetlands through surface runoff and causes death of fish and other micro organisms (Plate 4 See page No.12) Fertilizers used in agricultural fields in the catchment area of the wetlands causes' nutrient enrichment of the water, resulting in algal bloom. Algal bloom refers to the high nutrient condition in a pond from agricultural land and surface runoff. It decreases Dissolved Oxygen (DO) and increases Biological Oxygen Demand (BOD). It is one of the major problems for the wetlands of Berunanpukuria in recent times. About 19.15% ponds are characterized with algal bloom. In all situations green algal bloom has been found.

Use of pesticides often has a negetive effect on fishes and micro organisms. Although wetlands are capable of absorbing pollutants from the surface water, there is a limit to their capacity to do so. Foul odour is an indicator of water quality and about 31.91% ponds are facing this problem.

Table no 1: Scenario of some selected wetlands in Berunanpukuria

Wetland Id.	Colour of water	Fishing Yes/No.	Presence of odour	Aquatic vegetation	Use of chemical	Location of wetland
4	Greenish and blackish	No	Present	Algae, moss, water hyacinth	Detergent	Near settlement
5	Greenish and blackish	Yes	Absent			Near agricultural land
2	Deep green with light black	Yes	Absent		Detergent, pesticide	Near agricultural land
16	Greenish	No	Present	Algae, moss	Domestic sewage	Near settlement
19	Greenish	Yes	Absent		Detergent	Brick field and settlement
44	Blackish	Yes	Present		Detergent	Brick field and settlement
41	Mainly blackish with light green	Yes	Absent		Detergent	Brick field and settlement
54	Blackish	No	Present	Algae, moss, water-hyacinth	Pesticide	Near agricultural land

Source: Based on field observation and questionnaire survey

To determine the quality of the wetlands the following criteria has been assessed (Table 2).

Table 2: Water testing report of some selected wetlands

Wetland reference no.	pH 7.5-8.0	EC 1mmhos/ cm	Hardness <100 mg/l	NH4-N <0.25 mg/l	Alkalinity 100-150 mg/l	P_2O_5 0.2-0.5 mg/l	D O_2 5-10 mg/l	D.CO_2 5-10 mg/l	COD mg/l	BOD mg/l	Chlorophyll mg/l
4	6.89	1.12	293.94	1.07	190	trace	16	35.4	28	20.5	0.556
5	7.32	0.46	149.65	1.47	95.99	trace	13.12	28	70	7	7.784
2	7.48	0.39	149.27	0.54	100	trace	15.2	23	82	13.27	0.278
16	2.28	7.3	279.42	20	300	3	9.6	42	100	20.15	0.556
19	6.89	0.44	176.6	2.55	100	0.03	7.68	21	28	5.97	6.394
44	7.45	0.67	231.13	0.8	125	trace	12.48	29	58	14.5	1.112
41	7.24	0.32	203.38	0.94	82	trace	11.68	24.6	48	6.24	0.556
54	7.07	0.41	218.64	0.94	110	trace	12.48	24.7	30	7.5	0

Source: Data analysed by Vivekananda Institute of Bio Technology.

The pH indicates the intensity of the acidic or basic character of a solution and is controlled by the dissolved chemical compounds and biochemical processes in the solution. In unpolluted water, pH is principally controlled by the balance between carbon dioxide, carbonate and bicarbonate ions as well as other natural compounds such as humic and fulvic acid (Chapman, 1996). Here the pH value of most water samples range from low acidic to low alkaline (6.5–7.5). High acidic value is noticed especially in pond no. 16 which is high in organic matter.

The electric conductivity of most water is >1.00 mmhos/cm. But in pond no 16 this value is far above the normal range. The ability of the water of that pond to conduct an electric current is 7.30 mmhos/cm, which is extremely high compared to other ponds. Normally the expected EC concentration should be 0.0003mm/hos -0.0007mm/hos (Chapman, 1996). Higher value of EC suggests that the ponds are suffering from water pollution mostly by the presence of dissolve solids.

The hardness of natural water depends mainly on the presence of dissolved calcium and magnesium salts. The total content of these salts is known as general hardness (Chapman, 1996). The recommended range of hardness level should be130mg/l (Alken Murry Corp**)**. High range of hardness level can have negative impact on pond ecosystem. All the assessed ponds indicate high hardness value ranging from 149.65–293.94.

In most of the ponds the ammonia compound is between 2–3 mg/l. But this concentration is comparatively high (20.00mg/l) in the pond no. 16. Presence of high concentration may be a result of domestic sewage discharge and waste effluents which also indicate to organic pollution.

The alkalinity level ranges from 82–300mg/l. The acceptable range is 20–200ppm (Alken Murry Corp**).** Pond no. 16 have excess amount of alkalinity (300 mg/l),

which indicates high buffer capacity to alter pH level (Table 2).

The P_2O_5 or phosphorous is rarely found in high concentration in most of the ponds because it is actively taken up by the plants (Chapman, 1996).The standard limit is 0.2mg/l for surface inland water (Chakrapani and Ramakrishna, 1996). This parameter is very crucial and ecologically elusive as it has a tendency to precipitate by many cations occurring in lakes and accumulates at the bottom of the lake inaccessible to the phytoplankton (Kiran *et al*., 1999). In most of the surveyed ponds phosphorus content is almost nil except in pond no. 16 and 19. Here the value is 3.00 and 0.03mg/l respectively. The presence of high amount of phosphorous in the pond no. 16 is indicating water pollution by discharging sewage and domestic effluents. These ponds also have the chance for algal bloom because when the phosphate level is more than 0.025mg/l algal bloom occur (Alken Murry Corp).

The DO levels are seen to range from 7.68–16.00mg/l. DO levels of 5mg /l are ecologically recommended minimum for sustaining a water body. The recommended DO concentration for a healthy and ideally productive lake water body is 8mg/l (Wetzel, 1973). Here DO value in most water sample is above the recommended range. But in the pond no. 19 the value is slightly low i.e. 7.68 mg/l. The dumping of domestic waste which is rich in organic content and nutrients may be the main cause behind this. This factor helps to increase biological activity (photosynthesis and respiration) which restricted the DO because decomposition process reduces dissolved oxygen. The high value of DO is found due to higher photosynthetic activity (Table 2).

According to Alken Murry Corp. the concentration of CO_2 range should be less than 30ppm/l. When this value is exceeded, it becomes very harmful to the living organisms. Here majority of the ponds are within the normal range except pond no. 4 and 16, where the CO□ value is 35.44mg/l and 42.00 mg/l respectively. This undoubtedly is a matter of great concern.

The concentration of COD observed in the surveyed ponds ranges from 28 mg/l–100 mg/l. In normal surface water the range of COD value is 60mg/l or less (Alken Murry Corp). In pond no. 5, 2 and 16 this parameter is 70, 82 and 100 mg/l respectively, which indicates that these ponds urgently need a water treatment.

In all the cases the BOD value is lower than COD. The recommended BOD concentration for unpolluted water is 2 mg/l, whereas, those receiving waste water may have value of 10mg/l (Chapman, 1996). Here, in most of the ponds the BOD value is higher than the recommended range. This indicates almost the entire pond is receiving much more amount of waste water including sewage and domestic effluents.

The chlorophyll content depends on how much nutrient load is supplied to the water body. Here high amount of chlorophyll occurs in pond no. 5 and 19 due to large amount of discharge of nutrient from the surrounding agricultural and settlement area.

Wetland Id. 4, located near settlement area is full of hydrophytes including algae, moss, water hyacinth and has lower dissolved oxygen (16.00 mg/l) than BOD (20.50mg/l). The DO is low due to discharge of domestic waste which is rich in organic content. The quantity of dissolved calcium

and magnesium indicates the hardness of water. The water of Pond no. 4 shows a hardness of 293.00mg/l, which is also indicating the pond receive a large amount of nutrient from surface runoff. Chemical compounds, including detergent also mix in that pond. The chlorophyll content is 0.556mg/l which is indicating that the pond is progressively approaching a eutrophic state. The recommended range of EC in most of ponds is 0.000300 mmhos/cm to 0.0007 mmhos/cm (Alken Murry Corp). With the high amount of EC (1.12 mmhos/cm) this pond indicates accelerated water pollution by dissolved solids and materials from surface runoff (Table 2).

Wetland id.16 is surrounded by settlement area are full of water hyacinth and have lower DO (9.60 mg/l) than BOD (20.15mg/l). Here the water quality is highly acidic (pH 2.28) due to addition of domestic waste and sewage which has high organic matter content. Due to surface runoff the hardness label is also high, i.e. 279.42 mg/l. In case of NH_4, P_2O_5 and EC, the readings are much higher than the acceptable range in normal fresh water ponds. Here water quality is totally degraded by the dissolved solids, sewage and domestic waste from surface runoff. According to Chapman, (1996), the waters of low alkalinity (< 24 ml/l as CaCO3) have a low buffering capacity and can, therefore, be susceptible to alterations in pH, for example from atmospheric, acidic deposition. In the pond no 16 high alkalinity (300 mg/l) is seen. So the pH level does not alter so easily due to high buffer capacity. That is why water almost remains highly acidic, containing high organic content. High amount of dissolve CO_2 (42.00 mg/l) is very harmful to living organisms. When the COD content is high (100mg/l) the water is totally polluted and may also experience algal bloom. This pond is in need of emergency treatment.

Pond no 19 (situated near settlement area and brick kiln), has also faced health hazards, but algal bloom is not reported here because this pond is primarily used for fish cultivation. The algae are consumed by the existing fish species. Here deposition of fly ash deteriorates the water quality (Table 2).

Management category

The management priority of the wetlands of Berunanpukuria, can be determined based on two major indicators — physical and anthropogenic. In this present work an attempt has been made to assess each wetland and assign proper management option to them. The method applied here has been modified from the methodology adopted for the coastal wetlands of western Australia (Environmental Protection Authority, 1993) and has been modified according to the local characteristics of the study area. In this method four different management categories have been identified on the basis of the above mentioned indicators.

These four management categories are — i) Category H which indicates high conservation need, ii) Category E indicating ecological enhancement iii) Category M recommending multiple use of the wetlands and iv) Category N represents those wetlands which need no conservation.

To represent these management categories, a graphical plot has been used where the x axis represents physical indicators and they axis represents anthropogenic indicators. Scores have been

assigned to each wetland based on these two sets of indicators. While assigning scores to the wetlands, the scoring pattern has been modified in accordance with the regional characteristics. Finally, based on the total score, wetlands were plotted individually on the graph (Fig 6).

The wetlands having Id. No. 1, 6, 14, 17, 18, 19, 22, 26, 27, 28, 32.34, 43, 45, 47, 50, 51 and 52, falls in the zone of category N which have high degree of naturalness with limited human use. Here all the wetlands are surrounded by good vegetation buffer. Water quality remains unaltered probably due to low surface runoff. Other significant characteristics include water colour, which for most of the wetlands are clear with no or rarely found hydrophytes. In most cases DO is much more than BOD. Majority of the wetlands are used for fishing purpose, few being used for bathing or washing. So these wetlands are relatively safe and there is no requirement for forceful management practices. If any kind of attempt is imposed on them, it may have adverse impact on the wetlands.

The M categorised wetlands with Id. 13, 24, 37 and 48 are significantly degraded, possessing few natural attributes and human use. Here wetlands are characterised with poor or partial vegetation buffer with blackish, reddish or greenish water colour. Some amount of domestic waste is disposed in these wetlands, which may be a probable cause for degradation. Due to inferior water quality limited human uses are found. Here wetlands are mainly used either for washing/bathing or for fishing purpose. Some management programme is necessary to improve their water quality.

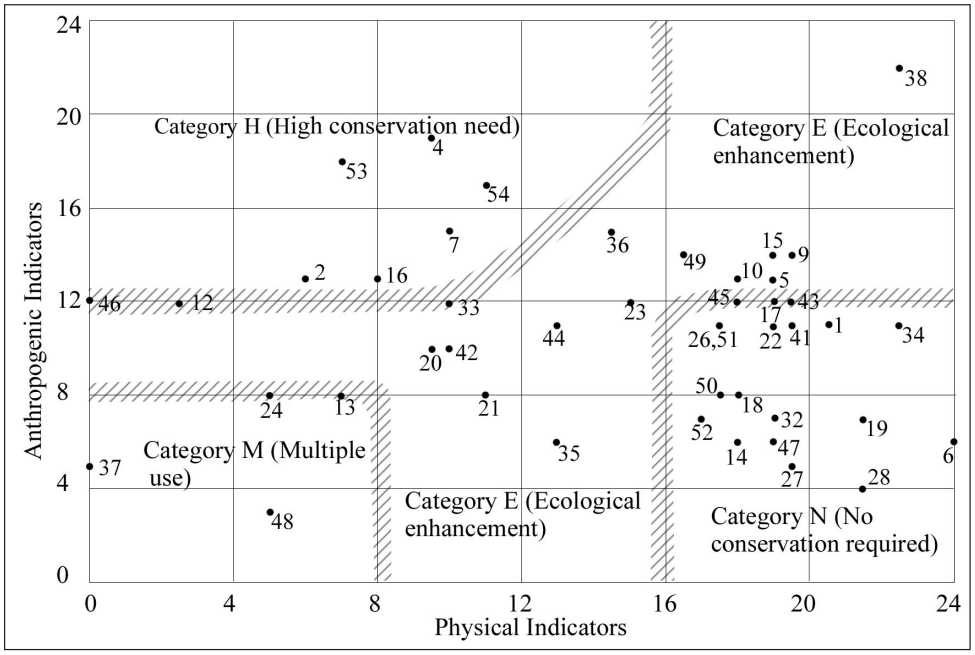


Fig.6: Proposed wetland management categories, modified from Environmental Protection Authority, 1993

The main management objectives should be land use planning, especially addressing the issue of nutrient enrichment and surface water pollution. These wetlands have the scope of being used for multiple purposes (Environmental Protection Authority, 1993).

Wetlands with Id 5, 9, 10, 15, 20, 21, 23, 33, 35, 36, 38 and 49 belong to category E. These have moderate degree of natural attributes. Wetlands in this category have been modified but do not have clearly recognised human uses in this predominantly rural setting. Some of the wetlands in this category may become degraded if uncontrolled developments begin to impinge upon them. So proper management plan are needed .Ecological enhancement can be done by using the wetlands for fishing, aquaculture etc. (Environmental Protection Authority, 1993).

Wetlands with Id. 2, 4, 7, 16, 53, and 54 fall in the H category which possess a low degree of naturalness and there is a high level of interest in using the wetlands for various human purposes. Lack of vegetation buffer together with large amount of waste water being added as surface runoff provides a favourable habitat for aquatic plants. As a result the wetlands are totally or partially filled with hydrophytes (Plate 6 See page No.12), which increase the BOD by reducing the DO. Finally after being putrefied the rotten hydrophytes spread a foul odour. All these wetlands, except Id no. 16 are surrounded by agricultural field. So there are chances of mixing of chemical fertilizer which to certain extent can change the water quality. Here wetlands are used mainly for irrigation purpose which has probable has some impact on the hydrological regime. As several wetlands are used for domestic purpose like bathing or washing, mixing of detergent is becoming a common phenomena. Besides detergent, domestic sewage, garbage and even cattle wastes are directly dispose in the wetlands. The wetlands having Id no. 2, 4, 7 and 53 are suffering from disposal of fly ash (Plate 7a and b See page No.12). These factors have an adverse effect on the health of the wetlands. For this high priority should be given for implementing management plans for these wetlands.

Conclusion

From the above description it can be concluded that wetlands should be properly maintained and preserved for their maximum possible utilisation as well as for improvement in the quality with aim to achieve sustainable development (Ghosh, D., 2005). In Berunanpukuria maximum ponds are created for brick kilns. So the ponds are faced with fly ash problem. So people's awareness is extremely important to save the wetlands from fly ash. The ponds of our study area are facing various problems arising from algal bloom, water pollution, domestic sewage disposal, cattle bathing etc. The local people should be made aware of these problems. An integrated management programme is necessary for that purpose. Improved information base, environmental education and public awareness are the essential pre-requisites for wetland management in this area. To prevent pollution people should avoid domestic disposal in the ponds. While using fertilizers and pesticides the farmers should be more aware to use these in prescribed amounts only. The use of organic fertilizers should be encouraged than chemical fertilizers. Finally

the existing area under wetlands should be extended and diversified landuse system should be introduced to get maximum benefits from the wetlands.

Acknowledgement

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Subhamita Chaudhuri,
Associate Professor,
Department of Geography,
West Bengal State University.
subhamita.chaudhuri@gmail.com

Sujata Dutta
Guest Lecturer,
Department of Geography,
Sree Chaitanya College, Habra.
sujataduttawbsu@gmail.com

Chandan Kumar Mondal
Assistant Teacher in Geography,
Aditya Academy Secondary School,
Barasat.