

Limnological profile of Kamal Sagar Wetland of Burdwan Town, West Bengal, India

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Abstract. *Badsha SKA, Jana NC. 2017. Limnological profile of Kamal Sagar Wetland of Burdwan Town, West Bengal, India. Nusantara Bioscience 9: 195-201.* Wetlands, valuable ecosystems that occur extensively throughout the world in all climatic zones, are estimated to cover about 6% of the earth surface. The Kamal Sagar Wetland (KASW) is one of the important perennial wetlands of Burdwan, India. The documentary, field survey with questionnaires and laboratory analysis methods have been used from 2009 to 2013 to access to information, for identifying capabilities and limiting factors of the Wetland. It's physical, chemical and biological parameters have been considered to know the potentialities of wetlands. The results are showing that BOD₅ is high in pre-monsoon season for the presence of hydrocarbon of automobile shops and garbage mixing by the stakeholders. pH is alkaline in all time. Transparency & euphotic limit values are half in summer season than other seasons because of low water depth, turbidity ranges from 60 to 75 NTU, organic carbon ranges from 0.55% to 0.79%. Surface runoff, hydrocarbon, and development activities of Burdwan Town have increased pollution load in this Wetland. It can be considered as important threats for the wetland. It is recommended to make a necessary study on physicochemical and biological parameters of wetland and also the current threats and opportunities.

Keywords: Capability, ecology, limiting factors, sustainability

Abbreviations: BCM = Billion Cubic Meter; BOD: Biological Oxygen Demand; CPCB = Central Pollution Control Board; DFD = Directorate of Fishery Department; DO = Dissolved Oxygen; GT Road = Grand Trunk Road; GOI = Government Of India; KASW = Kamal Sagar Wetland; MCB = Million Cubic Meter; PFI = Population Foundation of India; PH = Potentiality of Hydrogen; PPM = Parts Per Million; PRB = Population Reference Bureau; SDT = Secchi Disc Transparency; TDS = Total Dissolved Solids

INTRODUCTION

Wetlands are valuable ecosystems that occur extensively throughout the world in all climatic zones and are estimated to cover about 6% of the earth's surface. The safety of the Wetland is a new challenge to the Geographer (Reyahi-Khoram and Hosmand 2011). The Kamal Sagar Wetland (KASW) is one of the important man-made perennial wetland of Burdwan Town, West Bengal, India (Badsha and Jana 2014) (Figure-2). This important ecological unit (Biome) lies under the geographic zone of Gangetic plain.

Wetlands ecosystems provide various goods and services that have economic value, not only for the local population living in its surroundings but also to communities living outside the wetland area (Reyahi-Khoram and Karami-Nour 2010). Water resources support rich biodiversity. Since the last decades of 20th century, wetlands have received increasingly greater attention from the viewpoint of their ecology as well as conservation. The Wetlands are now considered to be distinct ecosystems with specific ecological characteristics, functions, values and development of water resources (Rao 2002). Ecology as a science gives suitable guidance in preserving our natural resources. The importance of ecology is such that other fields of great importance like agriculture, forestry, wildlife management, fisheries, oceanography, public health, geology, etc. depend on the study of ecological

problems (Ragothaman and Trivedy 2002).

The Government of India (GoI) has identified that irrigation sector's demand is high than other sectors which are 688 km³ in 2010 that will be 910 km³ by 2025. Non-monsoon seasonal water resources (BCM) from the rainfall is -18.76 BCM in West Bengal whereas it is -1.83 BCM in Barddhaman. For this reason, surface water importance is high (Rudra 2009). Of the little figure, 10% of water resources use for institutional, commercial, and industrial purposes, while the remaining 90% use for domestic consumption in India. In West Bengal, 836.66 MCM and 1144.17 MCM water used in rural and urban areas respectively in 2001, of which 63 MCB and 112 MCB of water demand were recorded respectively in rural and urban areas of Barddhaman district. According to the PFI Projection (PFI-PRB 2007), Barddhaman district is the third most water resource demanded district after Kolkata and North 24th Parganas in West Bengal. According to Goswami (1995, 2002), the Expert Committee on Irrigation of 1987 has not considered the eco-hydrology of the study area during the assessment of both the surface and ground water (Rudra 2009). The study area KASW is a biome or ecological unit of the broad biogeographic zone - Gangetic Plain of India. Gangetic Plain is one of the most fertile regions of the world with nearly 3000-year hectors of Human occupation. The bird life of West Bengal is rich, about 800 species have been identified of which 20 out of

57 valuable species listed for India, according to the report of BirdLife International, 2001 (Islam and Rahamani 2008). The main aim of the study is to know the ecological profile of Kamal Sagar Wetland. Following objectives are adopted to fulfill the main aim of the study: (i) To collect the general information of the study area, (ii) To assess the physicochemical characteristics of the wetland to detect physical, hydrological and biological status and (iii) To assess the present potentialities or capabilities and limiting factors of the KASW.

MATERIALS AND METHODS

Study area

Bardhaman District stands 1st and 2nd positions respectively in respect of the number and area of wetlands in West Bengal state of India. The Kamal Sagar Wetland (KASW) covers 3.96 hectares of Burdwan Town in the District of Bardhaman, West Bengal, India. The geo-reference is 23°15' 28.15" N and 87°50'46.4"E with the altitude of 22 m above sea level (Figure 1).



Figure 1. Study site in Kamal Sagar Wetland, Burdwan Town, District of Bardhaman, West Bengal, India

Physical background

The geology of the study area represents younger alluvium. Soils are antisolts and alfisols. From the topographical viewpoint, this area is a part of the lower Damodar basin. The River Damodar is flowing in the southwest region of Bardhaman District and flowing along the southern side of the study area (KASW). The Changes in river courses are the normal phenomenon in deltaic conditions, The slope is normal and the direction is from West to East and South-east less than 10 (in meters per Km) and elevation ranges between 10-50 meters. The ground water table is high and flows towards southeast. The study area is under monsoon climate. Rainfall status is medium (1200-1400 mm/year) in this study area. Maximum temperature is recorded 40°C (in the month of March) minimum temperature is recorded 6°C (in the month of January). Wet tropical vegetation is scatteredly found in this study area (Badsha and Jana 2014)

Socio-economic background

This region is famous for rice and potato cultivation. Burdwan town is an educational hub of West Bengal. The area is thickly populated. In addition to agriculture and fishing activities, people are engaged in agro-based industries and retail business. The study area is surrounded by a number of large and small town, viz. Durgapur, Panagarh, Guskara, Memari, Shyamsundar, etc. (SOI 1991). According to the Census 2011, the total population of Burdwan Municipality is 3,27,453, whereas the total population of the district is 77,23,663. According to the Census 2011, the total households are recorded 73,036 in Burdwan town (60,000s in 2001), whereas it is 1,693,726 in District Bardhaman (Figure 1) (DSH 2011).

Database

For the fulfillment of aim of present study various governmental and non-governmental documents have been used. Direct field survey data, experiences, data of laboratory analysis, journals, unpublished thesis, books, net documents have been used. Various scientific methods such as American Public Health Association (APHA 2012), Central Pollution Control Board (CPCB) (PFI-PRB 2007) guidelines have been followed for the analysis of soil properties and water quality. Both the observation and field survey method with questionnaires has been used for preparing wetland database. Various survey tools and analytical apparatus have been used such as GPS (Germin), Secchi disc, thermometers, digital camera etc. Maps, software, and satellite imagery have been used for making location map and statistical data representation. The present study was carried out from 2009 to 2013 to recognizing the capabilities and limiting factors (threats) of KASW, Burdwan Town, District of Bardhaman, West Bengal, India.

RESULTS AND DISCUSSION

Physical and hydrological status

The KASW covering 3.96-hectare area was recorded by the Department of Fisheries of Bardhaman District (DFD

2013). West Bengal, India. The subtropical climatic condition surrounding the area caused the various trees and grass cover especially in the south and south-eastern embankment. The University Institute of Technology is located on the eastern side the KASW. Western and Northern part is covered by settlements, shops and G.T. Road which are responsible for the encroachment to KASW. Once a canal was connected with the Kamal Sagar Wetland on the south-eastern side for facilitating the urban drainage but now it is closed. KASW is an important man-made perennial wetland of the Burdwan town with a rectangular shape. The depth of wetland's water varies with seasonal change but not dried in any season of the year. Main sources of water are rainwater and agricultural run-off. Only some species of floating-leaved macrophytes are found in this wetland. Microphytes are absent remarkably in this wetland. On the basis of the wetland area and fish catching, KASW comes the second position after the managed Krishna Sagar Wetland in Burdwan Town. Wetland soil is silty loam.

The depth of KASW ranges between 22-25 feet. About 15 to 20 families are dependent on the economic values of KASW directly. Indirectly other local people including a young group of the society or club's members are involved with the services of KASW. Bengal's favorite fishes are cultivated and marketed by the private entrepreneurs.

A field study showed that the industrial plants are not located around the KASW. Hence KASW is not exposed to industrial wastewater pollution but automobile workshops (truck, motorcycles repairing and washing shops) have become the source of pollution along the northern part of the wetland, close to the Grant Trunk Road. Another source of pollution is domestic sewage which is constantly affecting the western part of the KASW. The major problems associated with the wetland are human interferences, unplanned development activities of the town, depletion of plants and animals.

Water temperature

The water temperature is recorded high in the summer season as 38.5°C. In the monsoon it is 31.7°C. There is no significant difference in surface water temperature in three seasons but its average water temperature (35.10°C) showing the risk according to the CPCB standards (P-value: >30°C) (PFI-PRB 2007)(Table 1).

BOD₅

Based on the existing reports, the maximum amount of five days Biological Oxygen Demand (BOD₅) is recorded during the summer season in 2013. BOD₅ ranges between 4.20 mg/L to 2.58 mg/L. Average BOD₅ is 3.39 mg/L which is beyond the desirable limit of 1-2 mg/L (PFI-PRB 2007) (Table 1).

DO

The maximum value of DO (Dissolved Oxygen) is observed in the summer season. The amount is 5.4mg/L. The DO ranges between 5.4 mg/L to 2.78 mg/L during the survey period. Average DO is 4.09 mg/L. Where the minimum desirable national standard limit is 4 mg/L (PFI-

Table 1. Results of water quality of KASW (2009-2013) of Burdwan Town, District of Barddhaman, West Bengal, India

Wetland's name code	Seasons	Air temp. (°C)	Water temp. (°C)*	Transparency (cm)	Specific conductivity (µmho/cm)	Turbidity (NTU)*	TDS (mg/Lt)	pH *	Dissolve Oxygen (mg/L)*	Alka linity (mg/L)*	Hard ness (mg/L)*	B.O.D (mg/L)*	Salinity (%)	Euphotic limit (cm)
KASW	PRM	41.00	38.50	21.00	0.11	75.00	78.08	7.65	5.40	52.00	45.00	4.20	0.07	52.50
	MON	39.00	31.70	41.18	0.14	60.00	88.96	8.16	2.78	20.00	50.00	2.58	0.08	102.95
	POM	30.00	35.10	31.09	0.13	67.50	83.52	7.91	4.09	36.00	47.50	3.39	0.08	77.73
Average values of KASW		36.67	35.10	31.09	0.13	67.50	83.52	7.91	4.09	36	47.5	3.39	0.08	77.73
Average values of study area as a whole		32.45	-	-	-	111.25	125.83	7.66	3.58	41.06	58.41	1.80	-	-
Standards values (Desirable, PFI-PRB 2007)		-	20-30	-	-	90-240	500 Max (BSI)	6.5-8.5	4 and >4	25-100	75-150	1-2	-	-

Note: PRM = Pre-Monsoon, MON = Monsoon, POM = Post-Monsoon

Table 2. Results of soil properties of KASW (2009-2013) of Burdwan Town, District of Bardhaman, West Bengal, India

Wetland's Name Code	Seasons	Soil temperature (°C)	Soil pH	Organic carbon (%)	Specific conductivity (µmho/cm)	Nitrate nitrogen (g/kg)	Phosphate phosphorus (g/kg)
KASW	PRM	41.00	8.02	0.55	0.09	0.16	0.22
	MON	32.60	8.28	0.79	0.19	0.17	0.24
	POM	16.80	8.15	0.67	0.14	0.17	0.23
Average values of KASW		30.13	8.15	0.67	0.14	0.17	0.23

PRB 2007). So it is not indicating the healthy status of this wetland. According to CPCB guideline especially in the monsoon season's DO (2.78 mg/L) is showing its stressful status (PFI-PRB 2007) (Table 1).

pH

There is no alarming condition of pH according to a national standard. The standard is 6.5 to 8.5, where the study site's pH ranges between 7.65 to 8.16. Average P^H is 7.91 which are in the desirable limits (CPCB) (PFI-PRB 2007) (Table 1).

Transparency (SDT)

The transparency is recorded high as 41.18 cm in the rainy season for huge rain and surface runoff water and low in the summer seasons as 21 cm (Table 1).

Euphotic limit

The euphotic limit ranges between 102.95 to 52.50 cm in the study area and is recorded high in the rainy season as 102.95 cm (Table 1)

TDS

The TDS ranges between 88.96 mg/L to 78.08mg/L. The maximum TDS is recorded in the monsoon season and the lowest value is observed in pre-monsoon season. TDS values are under safe level (PFI-PRB 2007) (Table 1).

Soil pH

The pH values are more or less same at different times. The pH values are recorded as 8.28 in the rainy season and 8.02 in the summer season (Table 2).

Organic carbon

Organic carbon ranges between 0.55% to 0.79%. It is very low in the study area (Table 2).

Nitrate nitrogen

There are no such variations in values in different seasons. The nitrate nitrogen of KASW's soil ranges between 0.16 g/kg to 0.17 g/kg (Table 2).

Phosphate

There are no such variations in values in different seasons. The phosphate of KASW's soil ranges between 0.24 g/kg to 0.22 g/kg (Table 2).

Biotic status

KASW is important so far as conservation status is concerned. Depletion of plants and animal are the major problems of the wetland. Depletion of plants is high than the depletion of animals in this wetland ecology. Few floating-leaved macrophytes like *Eichhornia crassipes* - water hyacinth (local name: *Pana*, Figure 3), *Nelumbo nucifera* (local name: *Padma*) are found in this wetland only. Many habitat and migratory birds such as *Egretta garzetta* (local name: *Chhoto karche bock*), *Phalacrocorax niger* (local name: *Pankouri*), ducks - *Anas platyrhynchos domesticus* (Figure 3) and *Nettapus coromandelianus* (local name: *Balihans*) spend part of their winter times in this wetland as well as local birds such as white breasted kingfisher - *Halcyon smyrnensis* (local name: *Machh ranga*). Based on the results, KASW has no great capability regarding the diversity of animals and plant species. No conservation process is being practiced in this site. There is no intention among the stakeholders to conserve the biological status of the great perspective wetland except catching fishes by the members of the club. The obtained results show that biological status is very poor of KASW. DO is very low from the national standard value for the fishing, wildlife field species. In rainy season DO is recorded as 2.78 mg/L while the national standards for the fishing ground are 4 mg/L (PFI-PRB 2007). The depletion of plants in this wetland is the main reason for decreasing DO and another cause is a high use of oxygen for their respiration of huge bio-organisms. Water temperature of this wetland is at the risky level because of high air temperature of Burdwan town for air pollution. Some temperature absorbing suspended materials may be in the water of KASW. Branch-full trees are to be planted on the embankment of the wetland and sufficient floating-leaved macrophytes are needed to give the shade to the wetland for maintaining national standards of DO. and required water temperature levels. The average BOD₅ level (3.39 mg/L) is beyond the national standards (1-2 mg/L) because of highly functional activities of bio-organisms of this wetland. Increasing temperature trend has increased the organisms in the water of Kamal Sagar Wetland (KASW). Garbage/waste material and hydrocarbon contributed from the automobile shops along G.T. Road and settlements on the embankments are to be checked on regular basis to maintain the Standard BOD₅ level.



Figure 3. Biotic status of KASW, Burdwan Town, District of Bardhaman, West Bengal, India. A. Water hyacinth (*Eichhornia crassipes*), B. Domestic ducks (*Anas platyrhynchos domesticus*)

Stakeholders use wetland water for their fulfillment of daily needs without any payment for management of wetland environment. Water quality and quantity management will improve the ecological balance and wetland services. The Kamal Sagar Wetland has great future prospects. It is obvious that investment of public and private sectors will help to the realization of potentialities of this wetland and urban people will enjoy its graces. Providing an initial training related to environmental conservation and economy of stakeholders will rich the wetland ecologically and economically that will be the remarkable steps towards the sustainable development of wetland environment and regional economy. Keeping in view the ecological status, economic enhancement of local peoples, the location of GT Road, Urban dwellers' demands for substitute food and nature park facilities with amusements, a systematic conservation process is needed for KASW with immediate effect.

Study and investigation of the area can be recommended to determine the depth of water for the measurement of water volume in various seasons. A comprehensive and constant water quality monitoring is recommended for getting maximum services from this wetland. Both the central and state governments should try to put their efforts equally to maintain both the rural and urban wetlands. West Bengal government and Burdwan Municipality should manage the wetland after knowing the ecological and economic status of wetland. The KASW is also important for its location along G.T Road. It is suggested that the authorities should consider and take effort for the declaration of KASW as managed Nature Park like Krishna Sagar Park of Burdwan town and reduce the problems of management due to increase ownership of KASW.

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