Impact of Global Warming on Wetlands: A Case Study of Lucknow District

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Abstract

Wetlands are one of most productive environments and provide a wide variety of benefits. They are important repositories of biodiversity and play a critical role in the health, livelihood and economic prospects for the nearby rural population. Wetlands are under imminent threat by nature in form of global warming and by civilization in form of encroachments and reclamation of wetlands for farming and settlement. Along Indo-Gangetic plain wetlands have receded more than half of its size in last 50 years. Present paper attempts to analyse impact of climate change on wetlands of Lucknow. Methodology included analysis of temporal mapping of wetlands using Survey of India topographical maps (SOI) and satellite data, climatic data of area and ground verification for encroachment impacts. Results indicate that wetland of Lucknow are receding with exponential rate attributing to Global Warming, encroachment by human for settlement and agricultural activities.

1. INTRODUCTION

Wetlands are among the world's most productive environments (Voogt, K. D. 2000) and provide a wide variety of benefits. They are important repositories of aquatic biodiversity and play a critical role for the rural poor as they impinge on their health, livelihood and economic prospects (Sharma, D. 2013). It provides biological productivity, habitat for many species, fodder, fuel, food & livelihood for people, flood control, water purification, recreational and aesthetic values and recharging ground water sources. The value of ecological services per unit area resulting from wetlands is much higher than that of other ecosystems. During the past decade, progress has been made in understanding how ecosystems provide services, and how service provision translates into economic value (Daily 1997, MA 2005, NRC 2005). In one of the most widely cited ecosystem service valuation studies, Costanza et al. (1997) estimated the value of the services provided by Earth's ecosystems to be at least $33 trillion per year. However, these services have traditionally been undervalued as they often fall outside conventional markets. In this regard, monetary valuation will let the common people realize the actual value of natural ecosystems and here comes the role of ecosystem service studies (Sarkar et al, 2016).

Few people realise the range of products that can be derived from wetlands: food such as fish, rice and cranberries; medicinal plants; peat for fuel and gardens; poles for building materials; and grasses and reeds for making mats and baskets and thatching houses. These complex habitats act as giant sponges, soaking up rainfall and slowly

releasing it over time (WWF, 2016). Wetlands are like highly efficient sewage treatment works, absorbing chemicals, filtering pollutants and sediments, breaking down suspended solids and neutralising harmful bacteria. The most significant social and economic benefit that wetlands provide is flood control. Peatlands and wet grasslands alongside river basins can act like sponges, absorbing rainfall and controlling its flow into streams and rivers (WWF, 2016). When peat becomes completely saturated and unable to absorb any more water, surface pools and peatland vegetation – including sedge meadows and some types of forest – help to slow and reduce runoff (WWF, 2016). They are also the most biologically diverse ecosystems on Earth. Thus, attempt should be made to gather its economic, social and environmental benefits in favour of local people. Along with it viable wetland ecosystem will insure sustainable development of the area.

2. STUDY AREA

The district Lucknow is geographically located at 26° 30' to 27° 10' N latitude and 80° 34' to 81° 12' E longitude. It is bounded by Sitapur district from North, Raebareilly district from South East, Barabanki district from North East, Hardoi District from North West and by Unnao district form South West. The river Sai forms the only natural boundaries for a short distance on the South and West. The Lucknow district has an irregular quadrilateral shape with an average length of 72.5 kms and average width of 40.3 kms. The district is located in the central part of the Uttar Pradesh. Administratively the district is sub divided into four Tehsils (Lucknow Sadar, Malihabad, Mohanlalganj and Bakshi ka Talab) and 8 blocks. Lucknow district administers 2,528 square kilometers of areas. Total population of Lucknow district is 4,589,838 out of which 66.21 percent is urban population (3,038,996). The average population density is 1,816 persons/square km. The percentage decadal growth rate is 25.82%

(Census- 2011) with varying density of population which exhibit the impact of geomorphic, topographical and climatic features. As per 2011 census, 33.79% population of Lucknow districts lives in rural areas of villages. The total Lucknow district population living in rural areas is 1,550,842 of which males and females are 813,752 and 737,090 respectively. In rural areas of Lucknow district, sex ratio is 906 females per 1000 males. If child sex ratio data of Lucknow district is considered, figure is 928 girls per 1000 boys. Child population in the age 0-6 is 222,592 in rural areas of which males were 115,432 and females were 107,160. The child population comprises 14.19 % of total rural population of Lucknow district. Literacy rate in rural areas of Lucknow district is 67.82 % as per census data 2011. Gender wise, male and female literacy stood at 76.42 and 58.29 percent respectively. In total, 900,857 people were literate of which males and females were 533,656 and 367,201 respectively (Censes, 2011).

3. CLIMATE CHANGE AND WETLAND

Impacts of climate change range from the direct effects of changes in climatic variables (e.g. temperature, precipitation and drought) to indirect effects through interactions with non-climatic drivers (e.g. land and water use, species interactions, and disturbances such as bushfire, salinisation, eutrophication and acidification).

4. AIM AND OBJECTIVES

i. Mapping and study of wetlands of Lucknow district to understand their status and indentify issues involved with their degradation.

ii. To address livelihood issues linked with wetland conservation and its resources.

iii. To analyse impact of climate change on wetland of study area.

iv. It will help in understanding impact of wetland change on local people and their economy. To identify damage already occurred to wetlands.

v. To suggest concrete plans for wetland ecosystem management and preparing climate change resilient societies for future.

5. DATA USED

Survey of India topographical maps (SOI) were used for identifying wetland area of south west Lucknow. Toposheets were also used for referencing purpose. Remote sensing data of Google Earth was used for identifying wetlands for present time. As remote sensing techniques require field observations called "ground truth" in order to signify research quality and thematic accuracy. Such work involved visiting a number of test sites, usually taking Ground Control Point and Verification of Wetlands. The location of the features is recorded using the GPS.

6. METHODOLOGY

Generation of spatial framework in GIS environment for database creation and organisation following steps were taken.

i. Geo-referencing Survey of India topographical maps (SOI) and satellite data.

ii. Identification of wetland using supervised method.

iii. Generation of base layers (rail, road network, settlements, drainage, administrative boundaries) from satellite image.

iv. Mosaicing/edge matching to create district and state level database.

v. Preparation of map compositions and generation of statistics.

6.1 Wetlands of Lucknow

The total wetland area in the district is 9607 ha. Lakes/Ponds, River/Stream, and ox-bow lakes/ cut-off meanders are the major natural wetlands. Waterlogged and Tanks/ponds are the major man made wetlands of the district. In addition, 775 small wetlands (<2.25ha) mainly ponds are identified. Detailed estimates of wetlands in

Lucknow are given in table no 1. Aquatic vegetation was observed in many wetlands and covered an area of 3573 ha in post-monsoon season while 1363 ha in pre-monsoon season. Water spread area in post-monsoon season is 3573 ha. Where as in pre-monsoon season the water spread area is 1363 ha. Low turbidity is observed in most of the wetlands. (National Wetland Atlas, 2010).

Table-1: Area estimates of wetlands in Lucknow.

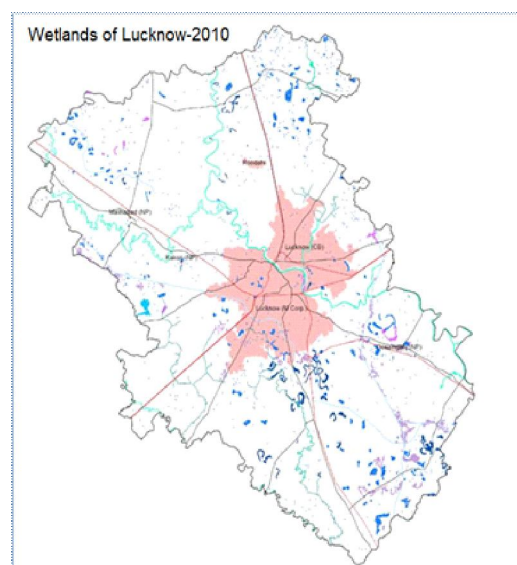| Sr. No.	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
					Post-monsoon Area	Pre-monsoon Area
	Inland Wetlands - Natural					
1	Lakes/Ponds	67	1948	20.28	687	471
2	Ox-bow lakes/ Cut-off meanders	50	1308	13.62	251	283
3	High altitude wetlands	-	-	-	-	-
4	Riverine wetlands	1	3	0.03	0	3
5	Waterlogged	21	385	4.01	186	17
6	River/Stream	61	2073	21.58	1968	1850
	Inland Wetlands - Man-made					
7	Reservoirs/Barrage	1	193	2.01	112	39
8	Tanks/Ponds	102	908	9.45	297	198
9	Waterlogged	90	2014	20.96	1589	837
10	Salt pans	-	-	-	-	-
	Sub-Total	**393**	**8832**	**91.93**	**5090**	**3698**
	Wetlands (<2.25 ha), mainly Tanks	775	775	8.07	-	-
	Total	**1168**	**9607**	**100**	**5090**	**3698**
	Area under Aquatic Vegetation				3573	1363
	Area under turbidity levels					
	Low				3565	2266
	Moderate				1353	1101
	High				172	331

Fig.1: Wetland of Lucknow District
Source: National Wetland Atlas: Uttar Pradesh (2010).

6.2 Receding Wetlands of South West Lucknow

India has a wealth of wetland habitats of immense ecological importance and exhibit enormous diversity based on origin, geography, hydrological regime and substrate types (Verma 2001, National Biodiversity Action Plan, 2008). However receding wetlands are of serious concern of national level. Climate changes and other anthropogenic activities are regularly shrinking and degrading wetlands throughout India. In present study a total area of 124.53 sq km of South West Lucknow was studied to identify loss of wetland. For the purpose Survey of India topographical maps (SOI) of 1972 was used as base map. Using appropriate methodology the total area under wetland for 1972 was calculated 2.92 sq km (Figure 2). Similarly wetland of 2016 was calculated using Google Map and total area was calculated 0.25 sq km (Figure 3).
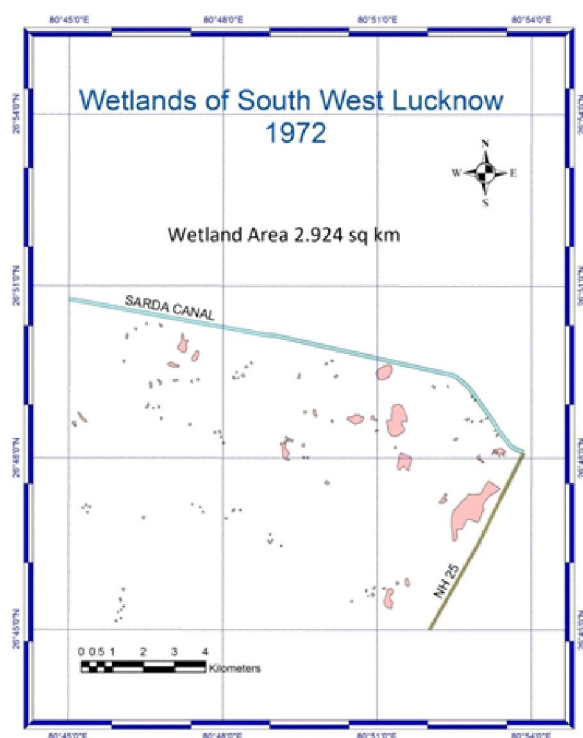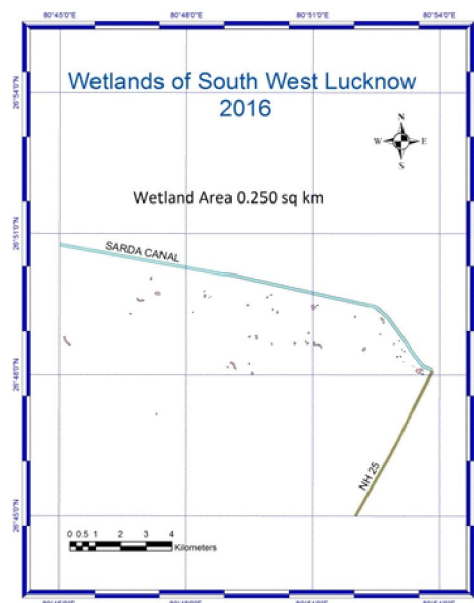

Fig.3: Wetland of South West Lucknow, 2016.

Note: Created using Google Earth Satellite data 2016.

Table-2: Comparative change in Wetland area.

Year	Wetland Area (in sq km)
1972	2.925
2016	0.251
Total Change	2.674
Percentage change	91.438

The result indicates the wetlands are receding exponentially since last few decades. From 1972 to 2016 the percentage change in wetland area is calculated 91.438%. It receded from 2.925 sq km to 0.251 sq km in span of 44 years. The change is wetland area in not only attributed to global warming but encroachment for residential and agricultural activities are also important.

7. CONCLUSION

Wetlands of Lucknow need serious conservation to be more viable for ecosystem of Awadh plain. A holistic view of Wetlands is necessary which looks

Fig.2: Wetland of South West Lucknow, 1972.

Note : Created using Survey of India topographical maps (SOI).

at each identified Wetlands in terms of its causal linkages with other natural entities, human needs, and its own attributes (National Environment Policy, 2006). Wetlands in Lucknow needs measures like Community Participation, Capacity building, Survey and Assessment, Catchment Area Treatment, Restoration Measures, Biodiversity Conservation, Pollution Control etc. Apart from this environmental education and awareness is key element for conservation. Thus, it becomes important to identify and restore lost and receded wetlands for sustainable development.

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