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Wet land Management: A Case Study of Village Mokhra

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Abstract: The ecological equilibrium and the survival of the local inhabitants in the surrounding area are both supported by wetlands. As a "transitional portion" between terrestrial and aquatic ecosystems, they are described as areas where shallow water covers the land or where the water table is typically at or near the surface. Wet lands may be manmade to natural and land locked to open. They are increasingly getting due consideration because of their remarkable recognition in contribution to a healthy environment. Regarding the wellbeing of the surrounding environment, wetland health is of utmost importance. Waterfowl can rest and find sanctuary in wetlands, which are crucial sites for wildlife to reproduce and feed. Wetlands contain a variety of wetland values and are crucial for supporting species diversity, just like any other natural environment.

In the present study an attempt has been made to understand the physical health of manmade wetlands (Ponds) and their possible effects on the surrounding area. Village Mokhra of district Rohtak in Haryana (India) has selected for a case study. There are 30 wetlands in the research region, the bulk of which have been excavated for farming (horticulture and field crops), fishing, and livestock husbandry. These wetlands are perennial in nature. The wetland has seen a number of adverse effects as a result of the study area's shifting land use pattern during the past fifteen years. Wetlands diverse land use practice in their catchment area was intensively studied. Fertilizers used in agricultural fields in the catchment area of the wetlands cause nutrient enrichment of the water in about 56.66 percent wetlands, resulting in algal bloom. The BOD value in most of the Wetlands 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 and in majority of the wetlands the water quality indicators like Ammonia, DO, COD, BOD and EC are within moderate range. But in few Wetlands the ammonia content DO and BOD are all above the recommended range, which call for immediate management intervention. An attempt has also been made to suggest a management plan for the well being wetlands.

Introduction: Natural wetlands as common property resource provide many services and commodities to adjacent population. They perform numerous valuable functions such as

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recycle nutrients, purify water, attenuate floods, recharge ground water, and also serve in providing drinking water, fish, fodder, fuel, wildlife habitat, control rate of runoff area, buffer against erosion and recreation to the society. Wetlands are acclaimed for their ecological importance in respect to their rich aquatic biodiversity and role in controlling hydrological regime of the area.

The man made wetlands on the other hand, though created for some specific purposes 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 (Village Mokhra) has experienced drastic change in land use pattern together with an increase in the population figure in the last fifteen years. As a consequence majority of wetlands have been subject to reduction in their areal coverage and deteriorating health condition. Many of the wetlands are being silted due to disposal of domestic waste, and soil deposits. Barely anyone has recorded increase in depth mostly due to wetland excavation. Since the wetland water quality depends principally on the runoff from their catchment area, hence wetlands have been intensively studied with diverse land use 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. The interaction of man with wetlands during the last few decades has been of concern largely due to the rapid population growth accompanied by intensified commercial and residential development further leading to pollution of wetlands by domestic sewage, and agricultural run-offs as fertilizers, insecticides and feedlot wastes. The fact that wetland values are overlooked has resulted in threat to the source of these benefits.

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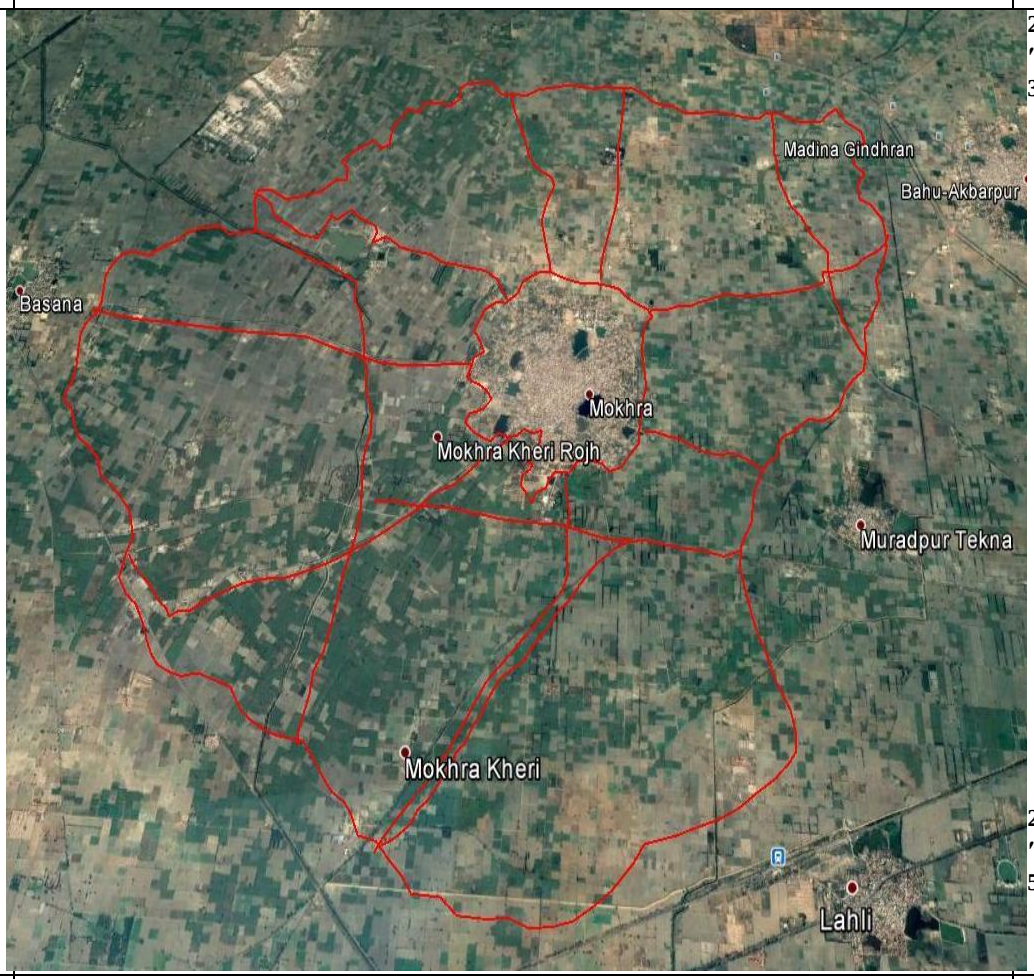
Figure 1

Location of Village Mokhra

76°22′09″ E 76°28′47″ E		
28°55′ 35″N		**28°55′ 35″N**
28°50′ 53″N		**28°50′ 53″N**
76°22′09″ E 76°28′47″ E		

Source: Image@2016 CNES/Airbus, Google Earth

Study Area: Mokhra village in the district of Rohtak has been selected for the present study. 221.41 Hecatre land is occupied by wetlands in the study area. All the wetlands fall within the inland manmade category. The study area is located within the jurisdiction of Mokhra Khas (10780 Hhectare) , Mokhra Kheri(1287 Hectare) & Mokhra Rozh (1269 Hectare)

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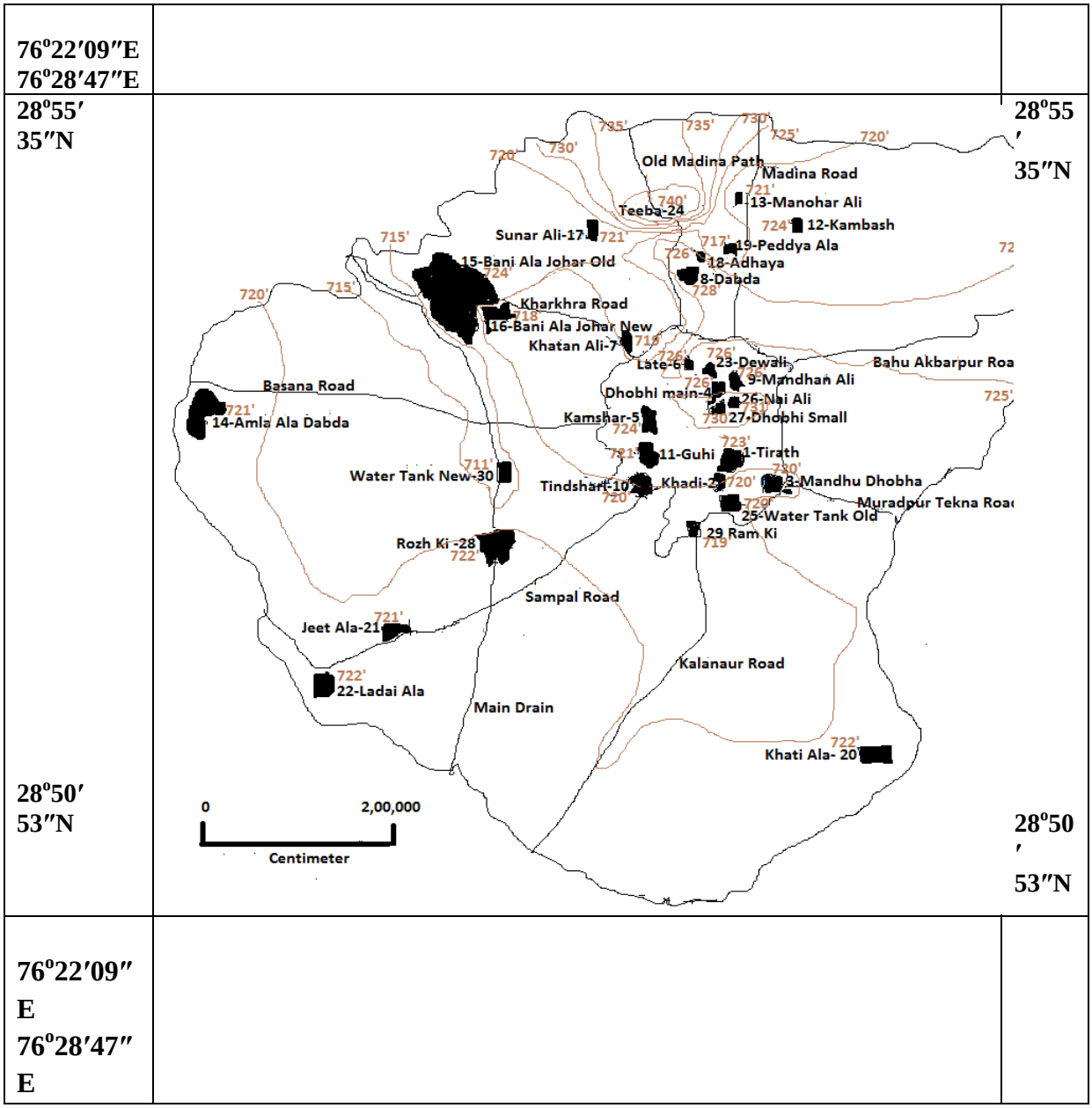
Gram Panchayat of the Block Meham in Rohtak district. The study area has an area of 13336 hectare located between 28°50′ 53″N to 28°55′ 35″N and 76°22′09″E to 76°28′47″E (Figure 1). The study area experiences a subtropical monsoon climate. Total 30 wetlands were identified and intensively studied.

Figure-2

Location of Surveyed Wetlands of Mokhra Village in 2001



Source: Source: Field survey with GPS coordinated with Image@2001 CNES/Airbus, Google Earth

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Objectives:

1.To assess the recent areal change of the wetlands.

2.To identify the major uses of the wetlands.

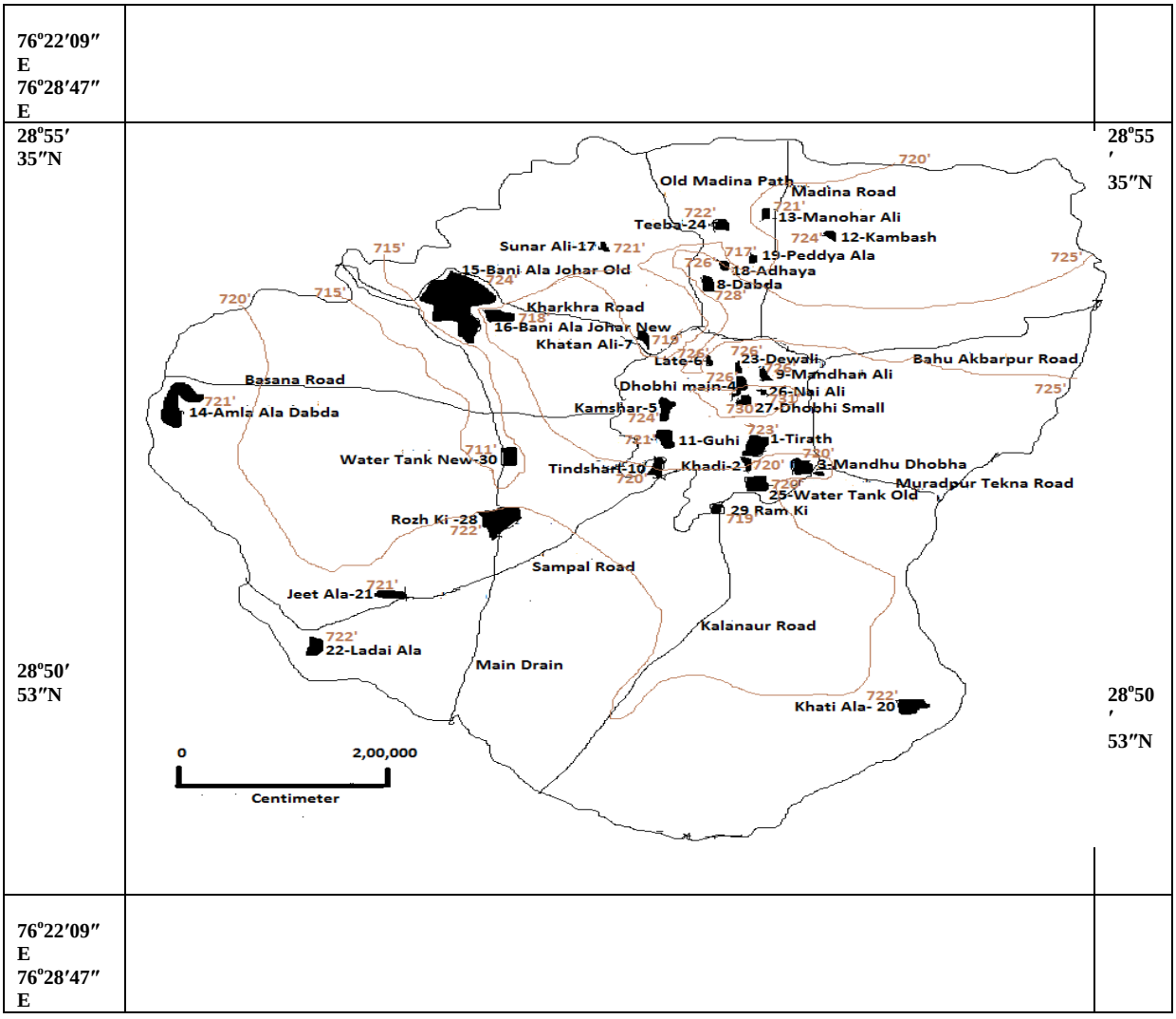
3.To determine the water quality of the wetland.

4.To Know the perceptions of the local people about the wetlands.

5.To suggest some management options for the selected wetlands.

Figure-3

Location of Surveyed Wetlands of Mokhra Village in 2016



Source: Source: Field survey with GPS coordinated with Image@2016 CNES/Airbus,

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Google Earth

Methodology: The study was carried out in 30 wetlands located across the village (Figure 2 & Table 1). The perception of the local people regarding the wetlands uses, threats and surrounding land use was based on questionnaire schedule. The questionnaire emphasized upon the threats faced by the wetlands and their effect on the water quality. The wetlands were studied for water quality analysis having different land use practices in their catchment area, like agricultural fields and settlement area. Water quality testing was done to find out the pH, electrical conductivity (EC), hardness, NH4-N, alkalinity, phosphate (P2O5), dissolved oxygen (D02), dissolved carbon-dioxide (DCO2), COD, BOD and Chlorophyll content (Table 3). For determining the temporal change in area of the wetlands two satellite images of 2001 and 2016 were considered. GPS coordinates of the wetlands were taken in order to precisely locate them on the satellite image.

Table-1

Profile of Wetlands of Village Mokhra

Index No.	Name of Wetland	Location of Wetland	Wetland Altitude	Wetland Area in Hectare (2001)	Wetland Area in Hectare (2016)	Areal Change in Wetland	Use of Wetland /Challenges/ Surrounding
1	Tirath	28°53′07″N 76°25′49″E	723′	15.00	14.54	-0.46	Live stock rearing and fishing/Pollution/Residential area
2	Khadi	28°53′01″N 76°25′47″E	720′	5.75	4.10	-1.65	Domestic waste dumping /Pollution/Residential
3	Mandhu Dhoba	28°52′60″N 76°26′04″E	720′	3.76	3.46	-0.30	Live stock rearing/Pollution/Residential
4	Dhobhi	28°53′29″N 76°25′46″E	726′	8.80	7.70	-1.10	Domestic waste dumping/Pollution/Residential
5	Kamshar	28°53′21″N 76°25′23″E	724′	8.30	6.23	-2.07	Live stock rearing and fishing/Pollution/Residential
6	Late	28°53′38″N 76°25′34″E	726′	1.00	0.50	-0.50	Domestic waste dumping/Pollution/Residential
7	Khatan Ali	28°53′45″N 76°25′13″E	719′	3.98	3.40	-0.48	Live stock rearing/Pollution/Fields
8	Dabda	28°54′09″N 76°25′34″E	728′	4.16	4.16	00	Live stock rearing, Horticulture and fishing/Fields
9	Mandhan Ali	28°53′32″N 76°25′53″E	726′	5.90	4.20	-1.70	Live stock rearing/Pollution/Residential
10	Tindshari	28°52′59″N 76°25′20″E	720′	9.40	8.31	-1.09	Live stock rearing and fishing/ Pollution/ Residential
11	Guhi	28°53′11″N 76°25′23″E	721′	9.40	7.62	-1.78	Domestic waste dumping/Pollution/Residential
12	Kambash	28°54′32″N 76°26′13″E	724′	1.80	1.39	-0.41	Live stock rearing/Pollution/Fields
13	Manohar Ali	28°54′32″N 76°25′53″E	721′	2.08	2.08	00	Live stock rearing/ Pollution/Fields
14	Amla Ala Dabda	28°53′16″N 76°22′46″E	721′	22.10	20.78	-1.32	Live stock rearing, Horticulture and fishing/Pollution/Fields

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15	Baniwala Johar-old	28°53′56″N 76°24′12″E	724′	70.15	59.56	-10.59	Live stock rearing, Horticulture and fishing/Pollution/Fields
16	Baniwala Johar - New	28°53′50″N 76°24′27″E	718′	10.50	9.00	-1.50	Live stock rearing, Horticulture and fishing/Pollution/Fields
17	Sonar Ala	28°54′13″N 76°25′17″E	721′	1.55	0.60	-0.95	Live stock rearing/ Pollution/Fields
18	Adhaya	28°54′11″N 76°25′38″E	726′	0.70	0.70	00	Live stock rearing/Fields
19	Pedda Ala	28°54′20″N 76°25′50″E	717′	1.10	0.65	-0.45	Live stock rearing/ Fields
20	Khati Ala	28°51′40″N 76°26′40″E	722′	8.25	6.93	-1.32	Live stock rearing, Horticulture /Pollution/Fields
21	Jeet Ala	28°52′14″N 76°24′07″E	721′	8.05	6.23	-1.82	Live stock rearing, Horticulture/Pollution/Fields
22	Ladai Ala	28°51′56″N 76°23′44″E	722′	7.10	5.54	-1.56	Live stock rearing, Horticulture /Pollution/Fields
23	Deewali	28°53′36″N 76°25′45″E	726′	3.30	2.77	-0.63	Devoted to local deity/ Residential
24	Teeba	28°54′32″N 76°25′40″E	722′	00	4.90	+4.90	Horticulture/Pollution/Fields
25	Water Tank Old	28°52′54″N 76°25′47″E	720′	6.23	6.23	00	To meet the demand of potable water/ Residential
26	Nai Ali	28°53′26″N 76°25′54″E	731′	3.15	2.08	-1.07	Domestic waste dumping /Pollution / Residential
27	Dhobhi-Small	28°53′23″N 76°25′48″E	730′	5.10	4.80	-0.30	Domestic waste dumping/Pollution/Residential
28	Rozh Ki	28°52′41″N 76°24′35″E	722′	18.40	16.62	-1.78	Live stock rearing, Horticulture /Pollution/Fields
29	Ram Ki	28°52′46″N 76°25′41″E	719′	2.10	1.39	-0.71	Live stock rearing/ Pollution/Residential
30	Water Tank	28°52′60″N 76°26′04″E	711′	4.85	4.85	00	To meet the demand of potable water
				251.96	221.41	-30.55	

Table-2

Position of Anthropogenic Substance in Wetlands of Village Mokhra

Index No.	Name of Wetland	Color Haze Unit 5-15	Presence of Odor/ Agreeable	Vegetation Buffer	Aquatic Vegetation	Fishing	Agricultural manures	Domestic Waste	Silting	Turbidity NTU 1-5	Total Dissolved Solid 500-2000 mg/l	Taste Agreeable	Anthropogenic Indicator
1	Tirath	Green (20)	Yes (30)/ Sewage Odor	Wetland bank Stabilization,	Parrot Feather(sub merged)(	Yes (6)	No (00)	Yes (26.10)	8.90	7.5	2630	No	14.50

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				Trees, (15)	10)								
2	Khadi	Yellow or Brown colour(40)	Yes(50)/ Sewage Odor/ Garlic odor/ Bad odour	Wetland bank Stabilization,(2.0)	Water hyacinth(20.6)	No	No	Yes(45)	16.00	11.7	3200	No	21.70
3	Mandhu Dhoba	Green (18)	No Sewage Odor / Musty smell	Wetland bank Stabilization, (24)	Parrot Feather(sub merged)(20)	Yes (12)	Yes (9.50)	Yes(31.10)	8.60	6.9	2450	Yes	15.40
4	Dhobhi	Yellow or Brown colour	Yes Sewage Odor / Garlic odor/ Bad odour	Wetland bank Stabilization,	Water hyacinth	Yes	Yes	Yes	15.80	11.10	3150	No	19.60
5	Kamshar	Green	No	Shrubs, Trees, Native Grass,	Parrot Feather (sub merged)	Yes	Yes	Yes	11.10	6.90	2390	Yes	14.40
6	Late	Yellow or Brown colour	Yes/ Sewage Odor/ Garlic odor/ Bad odour	Wetland bank Stabilization,	Water hyacinth	No	Yes	Yes	15.25	10.50	3090	No	20.70
7	Khatan Ali	Green	No	Trees, Native Grass, Cropland	Parrot Feather (sub merged),	No	Yes	No	10.25	6.20	2290	Yes	17.20
8	Dabda	True color	No	Wetland bank Stabilization, Shrubs, Trees, Native Grass,	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emergent)	Yes	Yes	No	2.15	4.20	1300	Yes	5.90
9	Mandhan Ali	Reddish and Greenish	Yes/ Sewage Odor	Trees,	Parrot Feather (sub merged),	Yes	Yes	Yes	7.05	9.20	2490	No	10.70
10	Tindshari	Green	No	Trees,	Parrot Feather (sub merged)	Yes	Yes	Yes	12.10	5.20	2380	Yes	16.70

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11	Guhi	Yellow or Brown color	Yes/ Sewage Odor/ Garlic odor/ Bad odor	Wetland bank Stabilization,	Water hyacinth, Parrot Feather (sub merged)	No	Yes	Yes	15.90	10.20	3170	No	20.40
12	Kambash	Reddish and Greenish	No	Shrubs, Trees, Native Grass,	Parrot Feather(sub merged), Cord Cane, Spike Rush,Duck Potato,Bulrush,Cat Tail(Emegent)	No	No	No	5.90	2.30	1270	Yes	8.20
13	Manohar Ali	Reddish and Greenish	No	Wetland bank Stabilization, Trees, Native Grass,	Parrot Feather(sub merged)	No	No	No	6.40	4.60	1470	Yes	9.20
14	Amla Ala Dabda	Green	Yes/ Algae odor/ Earthy odor/ Musty smell	Wetland bank Stabilization, Trees, Native Grass,	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emergent)	Yes	Yes	No	11.90	5.10	1600	Yes	16.10
15	Banwala Johar-old	Yellow or Brown color	Yes/ Algae odor/ Earthy odor/ Musty smell	Wetland bank Stabilization, Shrubs, Trees, Native Grass, Cropland	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emegent)	Yes	Yes	No	11.00	5.40	1690	Yes	22.10
16	Banwala Johar - New	Yellow or Brown color	Yes/ Algae odor Earthy odor / Musty smell	Wetland bank Stabilization, Shrubs, Trees, Native Grass, Cropland	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush,	Yes	Yes	No	22.20	4.60	1580	Yes	21.20

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					Cat Tail(Emegent)								
17	Sonar Ala	Reddish and Greenish	No	Wetland bank Stabilization, Native Grass, Cropland	Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emegent)	No	No	No	7.50	3.70	1230	Yes	8.60
18	Adhaya	True color	No	Wetland bank Stabilization, Shrubs, Native Grass, Cropland	Parrot Feather(sub merged)	No	No	No	2.90	2.90	1000	Yes	5.40
19	Pedda Ala	True color to Brownish	No	Wetland bank Stabilization, Shrubs,	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emegent)	No	No	No	3.10	3.20	1140	Yes	4.50
20	Khati Ala	Yellow or Brown colour	Yes/ Algea odor Earthy odour / Musty smell	Wetland bank Stabilization, Shrubs, Trees, Native Grass, Cropland	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emegent)	No	Yes	No	14.05	3.00	1310	Yes	19.30
21	Jeet Ala	Green	Yes/ Algea odor/ Earthy odour/ Musty smell	Wetland bank Stabilization, Shrubs, Trees, Native Grass, Cropland	Parrot Feather (sub merged), Cord Cane, Spike Rush ,Duck Potato, Bulrush, Cat Tail(Emegent	Yes	Yes	No	13	3.80	1680	Yes	17.10

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					)								
22	Ladai Ala	Green	Yes/ Algea odor/ Earthy odour/ Musty smell	Wetland bank Stabilization, Shrubs, Trees, Native Grass, Cropland	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emegent)	Yes	Yes	No	12.20	2.60	1630	Yes	14.60
23	Deewali	True color to Brownish	No	Trees,	Parrot Feather(sub merged)	No	No	No	0.50	2..00	720	Yes	4.10
24	Teeba	Green	No	Cropland	Parrot Feather (sub merged), Cord Cane, Spike Rush, Duck Potato, Bulrush, Cat Tail(Emegent)	No	Yes	No	10.30	4.10	1510	Yes	15.70
25	Water Tank Old	Apparent color	No	Wetland bank Stabilization	Parrot Feather (sub merged),	No	No	No	1.10	1.90	490	Yes	3.20
26	Nai Ali	Yellow or Brown colour	Yes Sewage Odor / Garlic odor/ Bad odour	Trees, Native Grass,	Water hyacinth, Parrot Feather (sub merged)	No	Yes	Yes	17.05	8.90	3410	No	19.64
27	Dhobhi-Small	Yellow or Brown colour	Yes/ Sewage Odor/ Garlic odor	Wetland bank Stabilization,	Water hyacinth, Parrot Feather (sub merged)	No	Yes	Yes	17.50	11.30	3340	No	20.90
28	Roz h Ki	Yellow or Brown colour	No	Wetland bank Stabilization, Shrubs, Trees, Native	Parrot Feather (sub merged), Cord Cane, Spike	Yes	Yes	No	11.50	4.60	1130	Yes	20.40

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				Grass, Croplan d	Rush ,Duck Potato, Bulrush, Cat Tail(Emegent)								
29	Ram Ki	Gree n	No	Trees, Croplan d	Parrot Feather(s ub merged),	No	Yes	Yes	10.6 0	4.80	2110	Yes	16.50
30	Wat er Tan k	App arent color	No	Wetland bank Stabiliza tion	Parrot Feather(s ub merged),	No	No	No	1.05	1.30	390	Yes	2.50

Table-3

Position of Physical Substance in Wetlands of Village Mokhra

Index No.	**Name of Wetland**	**pH 7.5-8.5**	**EC Imhos/cm**	**Hardness<100 mg/1**	**NH_4-N <0.25 mg/1**	**Alkalinity100-150 mg/1**	**P_2O_5 0.2-0.5 mg/1**	**DO_2 5-10 mg/1**	**D.C O_2 5-10 mg/1**	**COD mg/1**	**BOD mg/1**	**Chlorophyll mg/1**	**Physical Indicator**
1	Tirath	7.40	1.10	2.30	3.60	235	-	10.50	24.15	61	3.90	2.60	9.28
2	Khadi	7.90	1.21	2.78	4.51	270	1.0	8.00	29.30	90	8.10	3.46	16.42
3	Mandhu Dhoba	7.80	2.37	2.45	3.61	236	-	10.00	25.50	60	4.20	4.00	8.93
4	Dhobhi	7.60	1.00	2.75	4.50	274	0.70	8.02	27.80	92	8.12	3.90	15.90
5	Kamshar	8.10	4.10	2.17	3.65	242	-	9.30	26.28	64	4.45	3.10	10.72
6	Late	7.75	1.17	2.69	4.45	269	0.12	8.56	29.50	99	8.56	2.15	15.71
7	Khatan Ali	7.90	1.96	2.33	3.62	240	-	10.56	26.13	52	4.16	5.15	10.35
8	Dabda	9.10	7.13	1.21	2.45	200	-	10.15	21.00	39	4.30	6.20	3.21
9	Mandhan Ali	7.70	0.96	1.69	3.45	220	-	11.50	24.00	61	3.90	3.65	6.78
10	Tindshari	8.05	3.90	2.25	3.67	248	-	9.35	24.90	64	3.96	3.85	12.14

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11	Guhi	8.0	1.05	2.73	4.35	272	0.90	8.45	28.15	73	8.50	3.10	16.07
12	Kambash	7.45	0.76	1.62	3.41	228	-	11.52	21.15	32	2.60	5.30	5.72
13	Manohar Ali	7.35	0.91	1.68	3.49	222	-	11.65	22.10	39	2.70	6.90	6.10
14	Amla Ala Dabda	9.30	7.10	2.35	3.71	238	-	10.63	25.00	42	3.98	7.30	11.78
15	Baniwala Johar-old	8.90	7.04	2.63	4.15	292	-	10.20	32.5	60	5.17	9.20	10.70
16	Baniwala Johar - New	8.0	1.09	2.71	4.05	255	-	9.90	31.10	57	5.20	9.10	12.5
17	Sonar Ala	6.95	0.85	1.71	3.51	230	-	11.65	23.50	48	2.98	6.13	6.80
18	Adhaya	6.95	0.62	1.19	2.95	195	-	12.60	20.90	36	2.20	5.10	3.58
19	Pedda Ala	7.20	0.56	1.25	2.63	180	-	12.85	20.18	52	2.42	4.90	3.90
20	Khati Ala	7.10	1.10	2.65	4.10	278	-	10.10	29.40	47	5.00	6.15	13.92
21	Jeet Ala	7.05	1.37	2.19	3.71	240	-	10.60	25.10	39	4.05	7.90	5.50
22	Ladai Ala	6.85	1.50	2.23	3.73	244	-	10.65	25.50	35	3.95	7.20	12.14
23	Deewali	6.90	0.42	1.14	2.56	150	-	12.90	20.90	40	2.10	2.90	1.80
24	Teeba	7.30	0.90	2.40	3.69	245	-	10.65	26.30	58	4.30	8.80	10.40
25	Water Tank Old	7.8	0.10	1.04	1.90	105	-	13.00	15.10	29	1.90	1.90	2.80
26	Nai Ali	8.05	1.17	2.77	4.52	269	0.40	8.35	27.30	75	8.65	3.90	17.10
27	Dhobhi-Small	8.10	1.13	2.71	4.49	276	-	8.60	27.90	84	8.70	3.20	17.50
28	Rozh Ki	7.4	1.27	2.61	4.03	265	-	10.40	27.90	53	4.35	6.80	11.43
29	Ram Ki	6.99	1.13	2.47	3.68	248	-	10.70	26.10	70	7.10	2.80	10.53
30	Water Tank	7.8	0.11	1.05	2.10	101	-	13.10	15.40	28	2.00	1.45	2.10

Result and Discussion: All the selected wetlands except index no 15 are manmade and most of them are perennial in nature. Some wetlands have good vegetation buffer (25.50%), surrounded with shrubs, trees, Native grass and cropland etc. Out of the 30 selected wetlands almost 60 % have their water covered with moss, reed grasses, water hyacinths etc. The water color varies from Wetland to Wetland. Some Wetlands have water which is greenish, reddish or whitish in color. Most wetlands have been excavated for storage of excess rain water and use it during dry period and for bathing of animals. Wetlands have linkages with local deity and ecosystem. So the Wetlands have some primary as well as some secondary uses. Majority of the Wetlands are used for domestic purposes like fishing, washing, and bathing. (Table 2)

Problems of land use change: The changing land use pattern of Village Mokhra in the last fifteen years has affected many of the wetlands adversely. Large scale acquirement of land

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for various purposes has degraded the wetlands. A comparative analysis of satellite images (2001 and 2016) reveals that majority of the Wetlands have experienced reduction in their area and only in few cases the area of the Wetland has increased or unchanged. Some Wetlands have been partially filled up for construction purpose.(Figure 3) Majority of the wetlands are facing the problem of decrease in area mainly due to construction of roads (03.76%) and construction of houses (06.35%), and extension of cultivated area (2.00%).

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 that in recent times many of the wetlands do not have adequate water even during the rainy season due silting .They are not excavated seasonally, hence ground water is not recharged causing depletion of ground water in some areas. Diversion of water from wetlands for various purposes and depletion of ground water table due to over extraction of ground water may also be some of the probable causes of insufficient water in some of the wetlands. The Bharat Chemical factory located in Mokhra and tubewell bored in fields may play a major role in ground water extraction. This has now become a vital problem for the wetlands of Village Mokhra. The trend suggests that in future, some of the Wetlands may extinct.

Problem related to deteriorating water quality: Water quality of Wetlands is directly related to human population and its various activities. Due to anthropogenic activities wetlands have experienced changes in water quality, quantity, and increasing pollutant input from various sources like runoff from agricultural field, and residential areas. Here 56.67% Wetlands are surrounded by agricultural fields. Wetlands are also used for irrigation purpose during the water deficit months of winter and summer season.

Table 4

Standard Requirement of Physical Indicator

pH	EC Imhos /cm	Hardness< 100 mg/1	NH4-N<0.25 mg/1	Alkalinity100-150 mg/1	P_2O_5 0.2 - 0.5 mg /1	DO_2 5-10 mg /1	$D.CO_2$ 5-10 mg/1	COD mg /1	BOD mg /1	Chlorophyll mg/1
6.5-8.5	0.0003 mm/hos – 0.0007 mm/hos/cm	<100 mg/1	<0.25 mg/1	100-150 mg/1	0.2-0.5 mg/1	5-10 mg/1	5-10 mg/1	60mg.1	2 mg/1	-

Source: Chapman,D (1966) "Water quality assessment-A guide to use of biota, sediments and water in environmental monitoring"

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Both organic and inorganic fertilizers are used in the agricultural fields. But the farmers use mostly inorganic fertilizers including 10:26:26,15:15:15 Urea N+P+K and Sulphate. Along with these, various types of pesticides are also being used including DDT, Indofil, Phibidol, Ruccer and Thaidon. These are major sources of pollution to the wetlands. These pesticides drain to the wetlands through surface runoff and causes death of fish and other microorganisms. Fertilizers used in agricultureal fields in the catchment area of the wetland causes nutritient enrichment of the water, resulting in algal bloom. Algal bloom referes to the high nutrient condition in a Wetland 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 study area in recent times. About 35% Wetlands are characterized with algal bloom. In all situations green algal bloom has been found.

Use of pesticides often has a negative 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 odor is an indicator of water quality and about 53.33% Wetlands are facing this problem.

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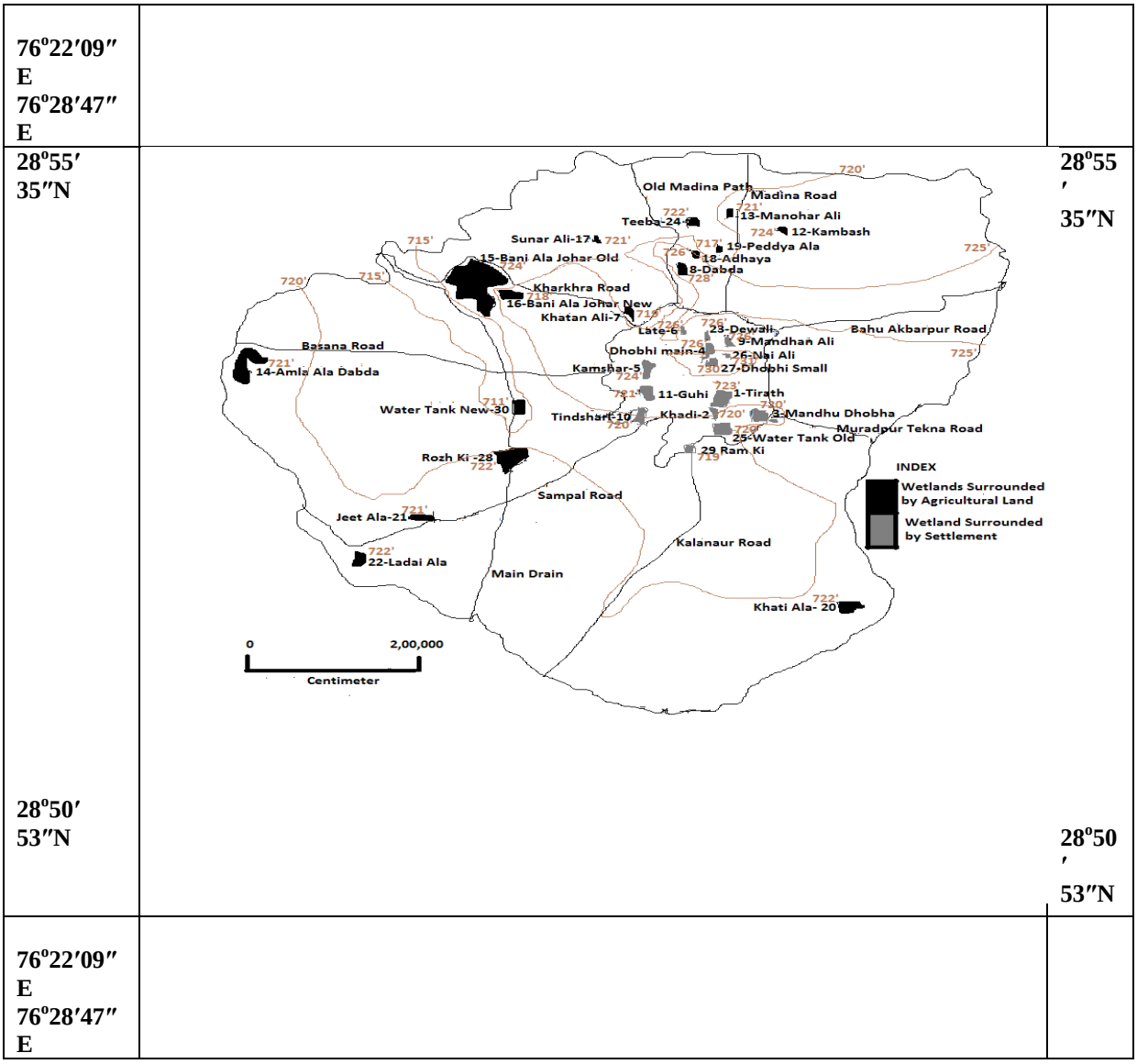
Figure 4

Wetlands in Village Mokhra Categorized According to Contiguous Land use



Source: Field survey with GPS coordinated with Image@2016 CNES/Airbus, Google Earth

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 . Here the pH value of most water samples range from low acidic to low alkaline (6.5-7.5). The pH of pure water is 7. In general, water with a pH lower than 7 is considered acidic,

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and with a pH greater than 7 is considered basic. The normal range for pH in surface water systems is 6.5 to 8.5, and the pH range for groundwater systems is between 6 to 8.5. High acidic value is noticed especially in wetland 5,8,14, and 15 which is high in organic matter. The electric conductivity of most water is >2.00 mm/hos/cm. But in Wetland no 3,5,8,10,14 and 15 this value is far above the normal range. The ability of the water of these wetlands to conduct an electric current is above 2 mm/hos/cm, which is extremely high compared to other wetlands. Normally the expected EC concentration should be 0.0003mm/hos - 0.0007mm/hos/cm . Higher value of EC suggests that the welands are suffering from water pollution mostly by the presence of dissolve solids. The electrical conductivity of the water depends on the water temperature: the higher the temperature, the higher the electrical conductivity would be. The electrical conductivity of water increases by 2-3% for an increase of 1 degree Celsius of water temperature.

While the electrical conductivity is a good indicator of the total salinity, it still does not provide any information about the ion composition in the water.The same electrical conductivity values can be measured in low quality water (e.g. water rich with Sodium, Boron and Fluorides) as well as in high quality irrigation water (e.g. adequately fertilized water with appropriate nutrient concentrations and ratios).

The hardness of natural water depends mainly on the presence of dissolved calcium and magnesium salts. Hard water has high mineral content .Hard drinking water may have moderate health benefits, but can pose serious problems in domestic settings, hard water is often indicated by a lack of suds formation when soap is agitated in water, and by the formation of lime scale in kettles and water heaters. Wherever water hardness is a concern, water softening is commonly used to reduce hard water's adverse effects. The total content of these salts is known as general hardness . The recommended range of hardness level should be100mg/1. High range of hardness level can have negative impact on Wetland ecosystem. All the assessed Wetlands indicate high hardness value ranging from 104 -278 mg/1. 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 101-298 mg/l. The acceptable range is 100-150 mg/1. Wetlands 18,19,23,25 and 30 only have alkalinity within range. 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 Wetlands because it is actively taken up by the plants. The standard limit is 0.2mg/1 for surface inland water . This parameter is very crucial and ecologically elusive as it has a tendency to precipitate by many captions occurring in lakes and accumulates at the bottom of the lake inaccessible to the phytoplankton. In most of the surveyed Wetlands phosphorus content is almost nil except in Wetland no. 2,4,6,11 and 26. The presence of amount of phosphorous in wetlands is indicating water pollution by discharging sewage and domestic effluents. These Wetlands also have the chance for algal bloom because when the phosphate level is more than 0.025mg/1 algal bloom occur . The DO levels are seen to range from 8.45-13.10mg/l. DO

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levels of 9.00mg /1 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. Here DO value in all water bodies is above the recommended range. The dumping of domestic waste which is rich in organic content and nutrients may be the main cause behind low DO level. The high value of DO is found due to higher photosynthetic activity (Table 3).
The concentration of CO_2 range should be less than 3Oppm/1. When this value is exceeded, it becomes very harmful to the living organisms. Here majority of the Wetlands are within the normal range except Wetland no.15 and 16 which is undoubtedly is a matter of great concern.
The concentration of COD observed in the surveyed Wetlands ranges from 28 mg/1-99 mg/l. In normal surface water the range of COD value is 60mg/1 or less. In Wetland no.1,2,4, 5,6,9,10,11,26,27,and 29 this parameter is above standard requirement , which indicates that these Wetlands 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/1, whereas, those receiving waste water may have value of 10mg/1 . Here, in most of the Wetlands the BOD value is higher than the recommended range. This indicates almost the entire Wetland is receiving much more amount of waste water including sewage and domestic effluents. (Table 4).
The chlorophyll content depends on how much nutrient load is supplied to the water body. Here high amount of chlorophyll occurs in Wetland no. 2,4,5,6,7,10,11,14,15,16,20,22,24,26,27,28 and 29 due to large amount of discharge of nutrient from the surrounding agricultural and settlement area.
Wetland Id. 2,4,6,11,26 and 27 located near settlement area is full of hydrophytes including algae, moss, water hyacinth and has lower dissolved oxygen (DO) than BOD . 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. All the wetlands shows higher hardness level than recommended , which is also indicating that wetlands receive a large amount of nutrient from surface runoff Chemical compounds, including detergent also mixed the wetlands. The chlorophyll content is 0.556mg/l which is indicating that the Wetland is progressively approaching a eutrophic state. The recommended range of EC in most of Wetlands is 1.45 to 8.80 mm/hos/cm . With the high amount of EC this Wetland indicates accelerated water pollution by dissolved solids and materials from surface runoff .
I have to do from here

Wetland 1,2,3,4.5,6,9,10,11,23, 26,27 and 29 is surrounded by settlement area are full of water hyacinth and have lower DO than BOD .(Figure 4). Here the water quality is highly acidic due to addition of domestic waste and sewage which has high organic matter content. Due to surface runoff the hardness label is also high, . In case of NH_4 $P,0_5$ and EC, the readings are much higher than the acceptable range in normal fresh water Wetlands. Here water quality is totally degraded by the dissolved solids, sewage and domestic waste from surface runoff.. The pH level does not alter so easily due to high buffer capacity. That is why

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water almost remains highly acidic, containing high organic content. High amount of dissolve CO_2 is very harmful to living organisms. When the COD content is high the water is totally polluted and may also experience algal bloom. So there is need emergency treatment.

Management category: The management priority of the wetlands of study area , 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 management authority of 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 D which indicates high conservation need, ii) Category C indicating ecological enrichment iii) Category B recommending multiple use of the wetlands and iv) Category A represents those wetlands which need no conservation. (Figure 5)

To represent these management categories, a graphical plot has been used where the x axis represents physical indicators and the y 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).

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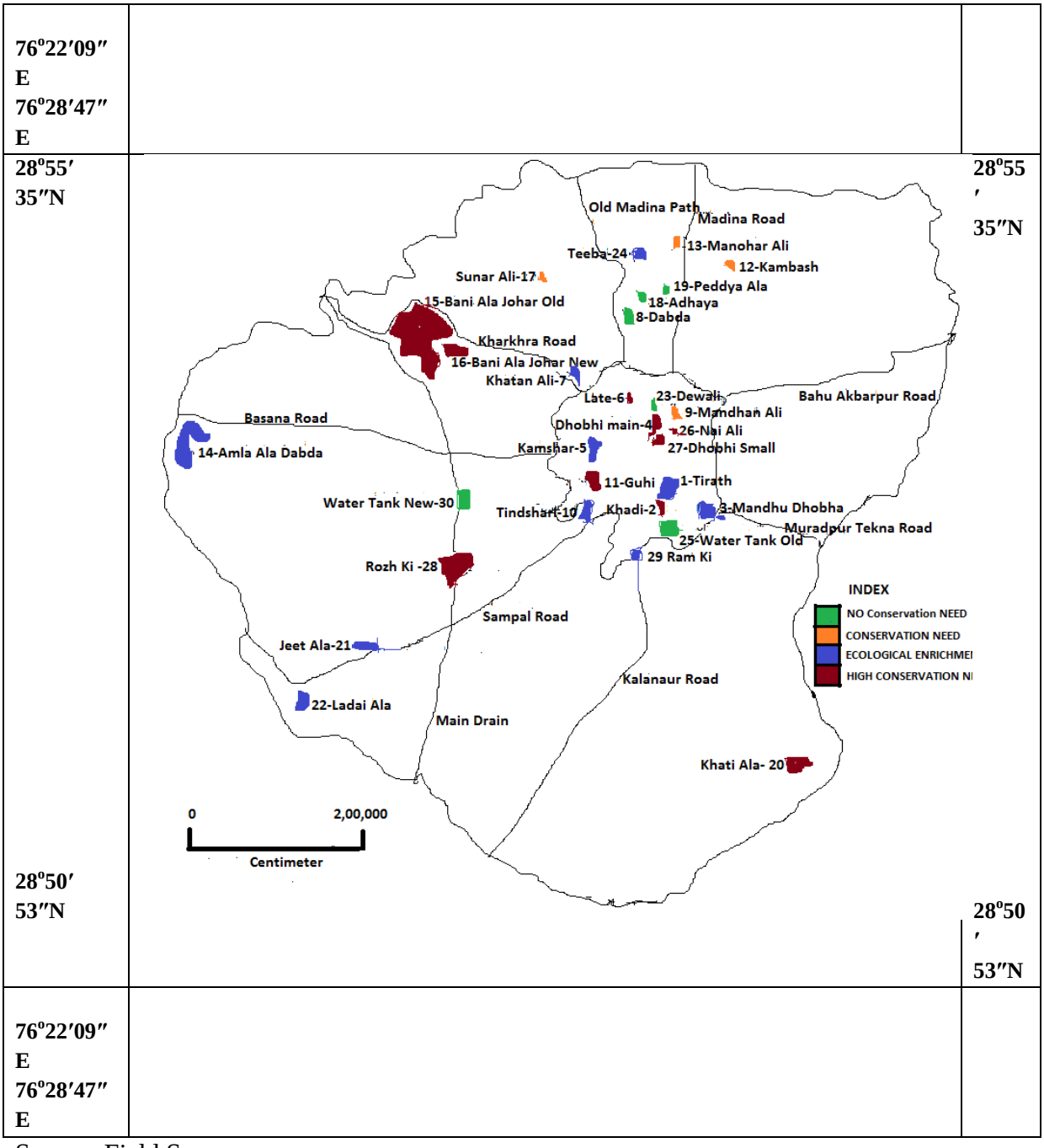
Figure-5
Proposed Wetland Management Categories in Mokhra Village



Source: Field Survey

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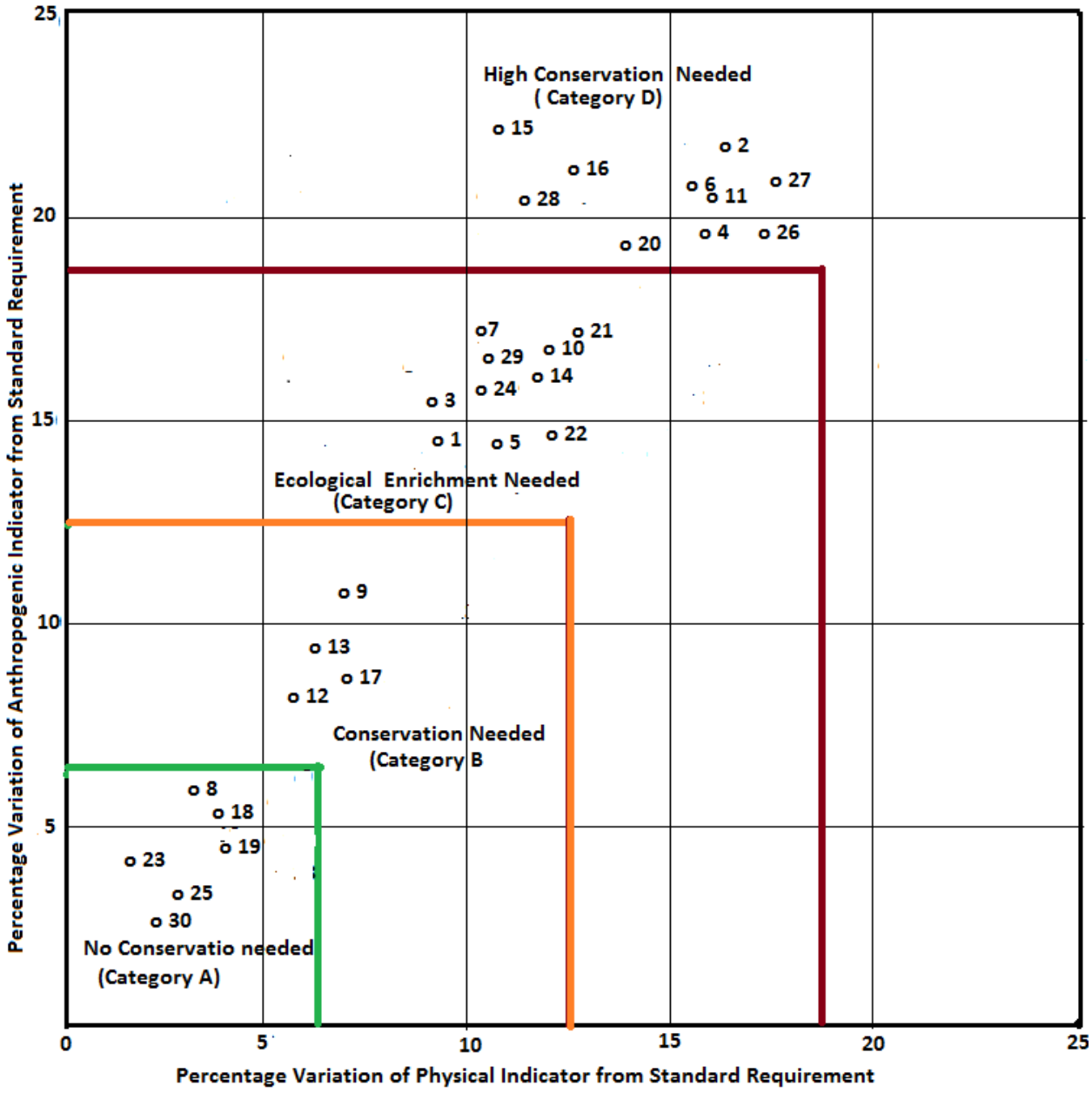
Figure-6

Proposed Wetland Management Categories in Mokhra Village



The wetlands having Index No. 8,18,19,23 ,25 and 30 falls in the category A , zone of No Conservation Needed, 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 color, which for most of the wetlands are clear with rarely found hydrophytes. In most cases DO is

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much more than BOD. Majority of the wetlands are used for fishing purpose, few being used for bathing of Animals. These wetlands are linked with some deity or other pious reasons. So these wetlands are relatively safe and there is no requirement for management practices.

The wetlands having index no. 9, 12, 13 and 17 falls in the categorized B zone conservation needed, which are significantly degraded, possessing few natural attributes and human use. Here wetlands are characterized with poor or partial vegetation buffer with reddish or greenish water color. 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. 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.

Wetlands with index no. 1,3,5, 7,10,14,21,22, 24 and 29 belong to category E. These have moderate degree of natural attributes. Wetlands in this category have been modified but do not have clearly recognized 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 enrichment can be done by using the wetlands for fishing, aquaculture etc.

Wetlands with Index no 2, 4, 6,11,15,16,20,26,27 and 28, fall in the D 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 favorable habitat for aquatic plants. As a result the wetlands are totally or partially filled with hydrophytes, which increase the BOD by reducing the DO. Finally after being putrefied the rotten hydrophytes spread a foul odour. All these wetlands are subject to mixing of detergent and chemical fertilizer which to certain extent can change the water quality. Here wetlands are used for multipurpose which has some probable impact on the hydrological regime. Besides detergent domestic sewage, garbage and even cattle wastes are directly dispose in the wetland. 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 utilization as we as for improvement in the quality with aim to achieve sustainable development. In the study area maximum Wetlands are created for livestock rearing and irrigation. The Wetlands 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

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problems. An integrate 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 Wetlands. While using fertilizer and pesticides the farmers should be more aware to use these in prescribed amount only. The use of organic fertilizers should encourage than chemical fertilizers. Finally the existing area under wetland should be extended and diversified land use system should be introduces to get maximum benefits from the wetland.

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