

**AN INVESTIGATION ON THE PARK AND PEOPLE PROBLEMS:
SPECIAL EMPHASIS ON THE IMPACT ON WETLAND SURROUNDING
VEGETATION DUE TO OVERGRAZING OF LIVESTOCK IN KOSHI TAPPU
WILDLIFE RESERVE, NEPAL.**
(A Case Study of Kusaha VDC)

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ABSTRACT

Koshi Tappu Wildlife Reserve (KTWR) is an important wetland area in the floodplain of Saptakoshi River in the east terai of Nepal. It covers about 150 km² area. It is decorated by a total of 515 species of plants consisting submerged, floating species as well as grassland/subannah and riverine forest.

The study was carried out to investigate the impact of overgrazing by livestock on the wetlands surrounding vegetation characteristics of KTWR. Surrounding areas of two wetlands, one from inside the reserve named as 'Station Wetland' (SW site) and other, in the buffer zone, outside the reserve named as 'Khanta Wetland' (KW site) were selected for the study. Station wetland was considered as reference site where there was minimum grazing, whereas, the Khanta wetland was an overgrazed site. Vegetation study was done using 50 x 50 cm quadrat. In each site 10 quadrats were thrown randomly. Species density and abundance of the vegetation were compared from both the sites.

23 species of vegetation are recorded at KW site whereas 17 species were recorded at SW site. Species density of KW site was 10.7 and that of SW site was 17.5. Common floras were *Stellaria sp*, *Cyperus sp*, *Lantana sp*, *Sagina sp*, *Eurya sp*, *Erianthus ravenna*, *Sambucus sp*, *Cynodon sp*, *Vertiveria lawsonii*, and *Polygonum sp*. *Cyperus sp* and *Phragmites karka* were having the highest density whereas *Phragmites karka*, *Carex sp*, *Sambucus sp* were most abundant in KW site. In SW site *Vertiveria lawsonii*, *Cyperus sp*, and *Stellaria sp* were having higher densities and *Rumex nepalensis sp*, *Lencus sp*, *Lantana sp* were most abundant species. The relative abundance and density was higher inside the reserve compared to outside. The vegetations found inside the reserve were relatively taller too.

It has been found that grazing is one of the major threats to the wetlands in Koshi Tappu and is a major issue generating conflicts between local people and management of the reserve. In a typical day almost 1000 livestock were recorded grazing around the wetland outside the reserve.

Key words: wetland, overgrazing, species diversity, and density, Nepal

INTRODUCTION

In Koshi Tappu, the rivers and their associated floodplains sustain the local communities who are dependent upon them for their livelihoods. They provide a variety of products such as thatching material, fuel wood, fodder and timber. Wetlands and around are also sites for livestock grazing, fisheries and recreation. The floodplains, oxbow lakes and other depressions, which retain water after the floodwater had receded, support a rich variety of wildlife including fish. Bank of the wetland's area are also used for growing vegetables like *Nsphrodepis sp* (Niguro). It is an important opportunity for women to generate cash income without having leaved the village (Conservation in Nepal, 1993). These wetlands are degrading and are under considerable threat from fire, overgrazing, over exploitation for fodder, fire wood, extraction, fishing activities, medicinal herbs, cultivating etc. Beside this, local people drain the wetland during summer for various purposes; for cultivation, fishing etc.

Nowadays, livestock grazing is one of the major issues generating conflicts between local people and management of the reserve. Wetlands of buffer zones are extensively used for grazing by local people. Quite often, due to the lack of fencing, domestic animals also enter inside the reserve.

This study tries to examine the impact of grazing in the Khanta wetland surrounding vegetation by the livestock of the people of adjoining settlement i.e., Kusaha VDC ward no.4.

Koshi Tappu Wild Life Reserve

The Koshi Tappu Wildlife Reserve (KTWR) is an important wetland area in the flood plain of Sapta Koshi River in the Terai of east Nepal. It was officially established in 1976 with a 65 sq. km area and was extended to 175 sq. km in 1980 to include the Koshi flood plain lying in parts of Saptari, Udaypur and Sunsari Districts (Bhandari 1992). It was established mainly for the protection of wild buffalo.

Koshi Tappu Wildlife Reserve is recognized as the first Ramsar site in Nepal. It is very much famous for its habitat diversity. 87% of the area of KTWR is occupied by terrestrial habitat and 12.9% by aquatic habitat (WMI/IUCN, Nepal, 1993). Different types of wetlands such as rivers, streams, floodplains, oxbow lakes represent the aquatic habitat. Saptakoshi River is the main wetland habitat of the reserve; Maridhar River runs north to south across the western floodplain of the reserve and joins Trijuga River outside the reserve's boundry. The Trijuga River is originated in the Mahabharat region of the Udaypur district, which enters the reserve from the northwest (DNPWC, PPP, 1998).

Flora

The vegetations of Koshi Tappu Wildlife Reserve are classified into three types. They are

a. Wetland Vegetation

There are many lakes, oxbow lakes and other water bodies in and around the reserve. The wetlands of KTWR are dominated by the plant species like *Hydrilla sp*, *Eichornia crassipes* (water hyacinth), *Nelumbo nucifera* (kamal), *Nymphaea Nouchal* (water lily), *Carex sp* (pater), *Coca sp* etc.

b. Grassland Vegetation

Grassland vegetation is very common in KTWR. More than half of the reserve area is covered by grassland. The grassland of KTWR are dominated by *Catapogonium mucunoides sp*, *Nsphrolepsis sp*, *Lantana camera*, *Cyperus sp*, *Phragmites karka*, *Carex sp*, *Sagina sp*, *Eurya sp*, *Cyanoden sp*, *Vertiveria lawsonii*, *Stellaria sp*, *Sambucus sp*, *Polygonum sp*, *Rumex nepalensis* etc.

c. Forest Vegetation

About 6.3% of the land is covered by forest land in KTWR. *Dalbergia sisoo* (Sisau), *Acacia catechu* (Khair), *Bombax ceiba* (Simal) are the major tree species found in this reserve. *Trewia nudiflora* (Pithari), *Maltotus philippensis*, *Syzygium cumini* (Jamun) are found associated with the major tree species. Besides these, *Strebulus asper* (Kaksi), *Albizia chinensis* (Siris), *Phyllanthus emblica* (Emli) are also found in this reserve.

Brief descriptions of the Kusaha VDC ward no. 4

Kusaha VDC lies in the buffer zone of KTWR in Sunsari district covering an area of 15.99 sq. km. There are 9 Wards in this VDC. The Reserve headquarters lies in Kusaha which is 2.6 km north- west from the east- west highway and approximately 57 km west of Biratnagar by road, the second largest city of Nepal (Bhandari 1992). People's main source of income in Kusaha village is from their Livestock. They usually rear livestock as a stock of property so that they can sell it immediately when they are in need of money. Due to that, the populations of livestock are increasing day by day. To feed all those livestock, they usually take them around in the wetland area and in their private fields. In the village, 95% or the household take their livestock to graze either in the bank of Khanta wetland or in their private land. (Shah 1997)

Most of the people from ward no-4 used to graze their livestock around the reserve because this ward lies close to the reserve area. So, particularly, ward no 4 was being chosen for the study. Different caste people used to live in this ward of Kusaha VDC like Miya, Uranw, Bantar, Koiri, Yadav, Godi Mukhiya, Sardar, Jadav, Muslim, Munsuri, and Rajdobi etc. Jhangar Nach is one of the main cultural dances of this area.

Households with large livestock herd size of Kusaha VDC 4 are given in Table 1.

Table 1: Household with large livestock herd sizes in Kusaha VDC 4

S.No	Villages	Number of Household	Cows	Oxen	Buffaloes	Goats	Pigs
1	Mansuri Tole	45	90	110	22	151	22
2	Office Tole	30	55	32	16	48	0
3	Jhabi Tole	32	105	28	17	21	0
4	Chulahi Tole	30	210	120	52	75	7
5	Kapleshwor Tole	29	58	22	33	21	0
6	Patri Tole	20	121	92	63	72	5
7	Yadav Tole	25	205	144	107	83	0
8	BijatiTole	30	92	122	7	45	0
9	Milan Chowk	30	64	76	26	43	0
10	Ram Tole	35	48	20	15	22	0
11	Total	306	1048	766	358	581	35

The total population of ward-4 of Kusaha VDC is shown in table 2. The people of ward-4 have different occupation according to their caste. More than 75% of this population is mainly dependent on agriculture for their livelihood. Land in this area is mostly used for cultivation purpose. In this ward, the cultivation land is 1533 hectare, grassland is 13 hectare, Orchard is 10 hectare, and swampy area is 34 hectare and areas used for other purpose like building huts, barren land is 9 hectare (Nakarmi 1994).

Table 2: Human population in ward-4 of Kusaha VDC

Gender	Population
Female	493
Male	840
Total	1333

The main objectives of the study were to know the present status of the wetland surrounding vegetation inside the reserve and in buffer zone area and their uses and to know the status of grazing in inside and outside wetland surrounding areas of the reserve.

MATERIALS AND METHODS

a. Field observations and selection of study sites

Number of field observations was made to select appropriate study locations and accordingly reference site and impacted site were identified. The Reference site- Station wetland area (SW) is located inside the reserve and the impacted site – Khanta wetland (KW) area is located in the buffer zone area where excessive grazing by the live stock used to occur.

The Khanta wetland area is about 10 m away from the fences of the reserve where there is no any restriction for grazing and fishing. The water of this wetland is totally covered by the vegetation whereas the Station wetland is located about 50 m far from the fences within the reserve. Except some illegal grazing, no grazing occurs inside the wetland's area. 30m x 21 m grazing area was taken for the study in both the wetlands area.

b. Sampling method and vegetation analysis

Vegetation sampling was conducted by quadrature method. Quadrature size used was 50 cm X 50 cm. Ten quadrates were thrown in each site to take the samples. Species diversity, density, frequency percentage and abundance of the vegetation were calculated for each site based on the samples collected by the quadrates.

c. Grazing estimate

One-day observation of total number of livestock taken for grazing in Khanta wetland (KA) area was done in each one-hour interval of time.

d. *Informal discussion*

Repeated informal discussion with local people and park officials was made at different level in the spirit of getting idea about the use and threats to the wetland and its resources.

e. *Calculation Methods*

The frequency percentage, density and abundance of species were calculated as follows:

$$\text{Frequency \%} = \frac{\text{Total quadrates no. in which species has occurred}}{\text{Total number of quadrates studied,}} \times 100$$

Table 3: Frequency in percentage and Frequency classes (after Raunker, 1934)

Frequency %	Frequency classes
0-20	A
21-40	B
41-60	C
61-80	D
81-100	E

$$\text{Density} = \frac{\text{No of individuals}}{\text{Unit area (m}^2\text{)}}$$

$$\text{Abundance} = \frac{\text{Total no of individual of the species}}{\text{Total no of quadrates in which the species has occurred}}$$

Results and Discussion

The vegetation found around in Khanta Wetland (KW) area is different than that of station wetland. The vegetation in (SW) area is relatively taller than (KW) area. The lists of vegetation found around the Khanta wetland, Station wetland are shown in Table 4.

Table 4: List of Vegetation found in different area of KTWR

S.No	KW site	SW site
1	<i>Catapogonium mucunoides</i>	<i>Rumex nepalensis</i>
2	<i>Nsphrolepsis sp</i>	<i>Lantana sp</i>
3	<i>Eclipta prostrata</i>	<i>Stellaria sp</i>
4	<i>Stellaria sp</i>	<i>Cyperus sp</i>
5	<i>Cyperus sp</i>	<i>Certilla sp</i>
6	<i>Certica astiatica</i>	<i>Nsphrolepsis sp</i>
7	<i>Phragmites karka</i>	Tin patte grass *
8	<i>Lantana sp</i>	<i>Sagina sp</i>
9	<i>Lantana camera</i>	<i>Eurya sp</i>
10	Tin patte grass *	<i>Lencus sp</i>
11	<i>Carex sp</i>	Batpuren *
12	<i>Sagina sp</i>	<i>Sambucus sp</i>
13	<i>Eurya species</i>	<i>Cynoden species</i>
14	<i>Erianthus ravennae</i>	<i>Vertiveria lawsonii</i>
15	<i>Centella hydroeotylic</i>	<i>Erianthus ravennae</i>
16	<i>Sambucus sp</i>	<i>Polygonum sp</i>
17	<i>Cynoden sp</i>	Siris *
18	<i>Vertiveria lawsonii</i>	
19	<i>Erianthus ravennae</i>	
20	<i>Polygonum sp</i>	
21	<i>Ecchhornia crassipes</i>	
22	Wild coriander *	
23	Sahur *	
24	Behaya *	

* Local name

24 different type of flora were found in KW site whereas only 17 species were found in SW site. Common vegetation found in both the sites were; *Stellaria sp*, *Cyperus sp*, *Lantana s*, *Sagina sp*, *Eurya species*, *Erianthus ravennae*, *Sambucus sp*, *Cynoden sp*, *Vertiveria lawsonii*, *Polygonum sp*, Tin patte grass (Local name),. The vegetations which only found in Khanta Wetlands were; *Catapogonium mucunoides*, *Nsphrolepsis sp*, *Eclipta prostrate*, *Certica astiatica*, *Phragmites karka*, *Lantana camera*, *Carex sp*, *Centella hydroeotylic*, *Ecchhornia crassipes*, Wild coriander (Local name), Sahur (Local name), Behaya (Local name). Similiarly, the vegetations found only in Station wetland were; *Rumex nepalensis*, *Certilla sp*, *Nsphrolepsis sp*, *Lencus sp*, Batpuren, Siris

Vegetation Analysis

Data derived from the quadrate sampling of vegetation on species diversity, density, frequency percentage and abundance is given in Table 5 (KW site) and Table 6 (SW site).

Table 5: Vegetation Data of KW site

Sp	Quadrat Number										Total No of individuals	Total No of quadrat of occurrence	Frequency (%)	Freq class	Density	Abundance
	1	2	3	4	5	6	7	8	9	10						
1	0	0	0	1	0	0	0	0	0	0	1	1	10	A	0.1	1
2	0	0	0	0	1	0	0	0	0	0	1	1	12	A	0.1	1
3	3	1	1	1	0	0	1	1	0	0	8	6	60	C	0.7	1.17
4	1	1	0	0	1	0	1	2	1	0	7	6	60	C	0.7	1.17
5	0	1	1	2	1	1	2	1	1	1	11	9	90	E	1.1	1.22
6	1	0	1	1	0	1	0	0	1	0	5	5	50	C	0.5	1
7	0	1	1	1	1	1	0	1	3	2	11	8	80	E	1.1	1.37
8	0	0	0	0	1	0	0	0	0	0	1	1	10	A	0.1	1
9	0	0	0	1	0	1	1	0	0	0	3	3	30	B	0.3	1
10	1	1	0	0	0	0	1	0	1	2	6	5	50	C	0.6	1.2
11	0	0	0	0	0	0	1	2	1	0	4	3	30	B	0.4	1.33
12	1	1	1	1	1	0	0	1	1	1	8	8	80	E	0.8	1
13	1	0	0	0	0	0	1	0	0	0	2	2	20	A	0.2	1
14	0	0	0	0	0	1	0	1	1	0	3	3	30	B	0.3	1
15	1	0	0	0	0	0	1	0	1	0	3	3	30	B	0.3	1
16	0	1	0	0	0	0	1	1	0	2	5	4	40	B	0.5	1.25
17	0	0	0	0	0	1	0	0	0	0	1	1	10	A	0.1	1
18	0	0	0	0	0	1	0	1	1	0	3	8	80	E	0.3	0.37
19	0	1	0	0	0	0	0	1	0	1	3	8	80	E	0.3	0.37
20	0	0	0	0	0	1	0	0	0	0	1	1	10	A	0.1	1
21	0	0	0	0	0	1	0	0	0	0	1	1	10	A	0.1	1
22	2	0	1	0	2	0	1	0	1	1	8	6	60	D	0.8	1.33
23	0	0	1	0	0	0	0	0	0	0	1	1	10	A	0.1	1
24	0	1	1	1	2	1	1	2	0	2	11	8	80	E	1.1	1.37

From the vegetation analysis calculation table it was found that, the frequency percentage in some of the vegetation is very high in KW such as *Cyperus sp*, *Phragmites karka*, *Sagina sp*, *Vertiveria lawsonii*, *Erianthus ravennae*, Behaya. Similiarly, few plant species have higher density upto 1.1, such as *Cyperus sp*, *Phragmites karka*, Behaya. Moreover, the species like *Vertiveria lawsonii*, *Phragmites karka*, *Erianthus ravennae*, Behaya have higher abundance value than other plants in KW site.

Table 6: Vegetation Data of SA site

Sp	Quadrat number										Total No of individuals	Total No of quadrat of occurrence	Frequency (%)	Freq Class	Density	Abundance
	1	2	3	4	5	6	7	8	9	10						
1	0	0	5	0	0	0	0	0	0	0	5	1	10	A	0.5	5
2	0	0	0	0	0	0	4	0	0	0	4	1	10	A	0.4	4
3	3	2	0	2	4	3	2	1	3	2	22	9	90	E	2.2	2.4
4	0	2	3	4	2	1	3	4	3	3	25	9	90	E	2.5	2.8
5	0	0	0	2	0	0	0	0	2	0	4	2	40	A	0.4	2
6	0	0	2	0	3	0	0	3	0	0	8	8	80	B	0.8	1
7	2	3	2	3	0	4	2	3	1	1	21	9	90	E	2.1	2.3
8	3	2	0	0	0	0	2	0	0	0	7	3	30	B	0.7	2.3
9	3	0	0	0	0	0	0	0	0	2	5	2	20	A	0.5	2.5
10	0	0	0	0	3	0	0	0	0	0	3	1	10	A	0.3	3
11	3	0	0	0	0	0	2	3	3	4	15	5	50	C	1.5	3
12	2	0	1	1	1	2	1	1	1	1	11	9	90	E	1.1	1.2
13	2	0	0	0	0	0	0	0	0	0	2	1	10	A	0.2	2
14	0	3	0	3	0	3	5	4	5	3	26	7	70	D	2.6	3.7
15	0	4	0	0	0	0	4	5	0	0	13	3	30	B	1.3	4.3
16	0	0	0	0	0	0	0	0	2	0	2	1	10	A	0.2	2
17	0	0	0	0	0	0	0	0	0	2	2	1	10	A	0.2	2

Similarly, from the vegetation analysis calculation Table 6, it was found that the frequency percentage of some vegetation like *Stellaria sp*, *Cyperus sp*, Tin patte grass, *Sambucus sp* were very high (90%) than others. Like wise, vegetations such as *Rumex nepalensis*, *Lantana sp*, *Erianthus ravennae* have high value of abundance. The plants which have very high value of density were; *Cyperus sp* and *Vertiveria lawsonii*

Table 7: Total number of individuals and species found in each quadrat in SW area site and KW area site

S.N	Site	Individuals	Species	S.N	Site	Individuals	Species
1	1	11	8	11	2	19	8
2	1	9	9	12	2	16	6
3	1	8	8	13	2	13	5
4	1	9	8	14	2	15	6
5	1	10	8	15	2	13	5
6	1	10	10	16	2	13	5
7	1	12	11	17	2	25	9
8	1	14	11	18	2	24	8
9	1	13	11	19	2	20	8
10	1	12	8	20	2	18	8
Total		108	92	Total		176	76

*Site

- 1 = Khanta wetland
- 2 = Station wetland

One day observation was done to count the number of livestock that been grazed on the bank of the Khanta wetland. The data of the observation is shown in the table below.

Table 8: Frequency table of Grazing Livestock in one day observation on the bank of Khanta wetland

S.N.	Animals	Time										
		8 am	9 pm	10 pm	11 pm	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	Total
1	Cows	0	10	30	30	32	35	37	38	30	20	262
2	Oxen	0	15	30	25	25	27	27	30	25	15	219
3	Buffaloes	0	10	35	37	37	40	40	40	30	17	286
4	Goats	0	0	15	20	20	22	22	22	19	9	149
5	Pigs	0	0	5	5	6	4	4	7	7	0	38
6	Total	0	35	115	117	120	128	130	137	111	61	954

The total number of livestock grazing in the bank of Khanta wetland is estimated to be 954 animals per day. The peak hour of grazing on the particular area were from 10 pm -4 pm. The reason behind these could be, the people get busy in doing there household work in morning and evening. So they take their livestock in the late morning till the evening to feed them. From the questionnaire, it was found that about 90 % of the livestock of Kusaha ward-4 graze their livestock in this area. Male cattle are less in grazed number because male cattle remain busy mostly either plugging or pulling carts.

Conclusions and recommendations

The study showed that although under the threat the wetlands areas of Koshi Tappu are having rich vegetation. The vegetation found around in Khanta wetland is different from Station wetland. Species density was recorded high in Khanta wetland but the population density of each species is very low.

The vegetation found inside the reserve are taller than outside. Species diversity is low in Station wetland but the population density is recorded high. Disturbance due to excessive grazing might be the cause for the low abundance and high density of vegetation in the Khanta wetland area.

The quality of the water in Khanta wetland is also relatively more degraded due to soil trampling during overgrazing, erosion and leachate leading to eutrophication. This has also caused the growth of unwanted vegetation in the water bodies in the buffer zone areas. However, due to the presence of large number of swampy, marshy wetlands this area is still rich in floral and faunal diversity. Many birds used to migrate in this area in winter season.

Koshi Tappu Wild Life Reserve is identified as a valued site and merit protection as important site for biodiversity conservation. The world's most threatened wild animals, wild buffalos, is only found in this area in Nepal. Establishment of the biodiversity conservation areas is proposed by combining wetlands found inside and outside the reserve and the forest found within and buffer zone of Koshi Tappu. But, the overuse of the wetland's resources by the local people is slowly threatening these wetlands.

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Fig.1: Location Map of the Study Sites

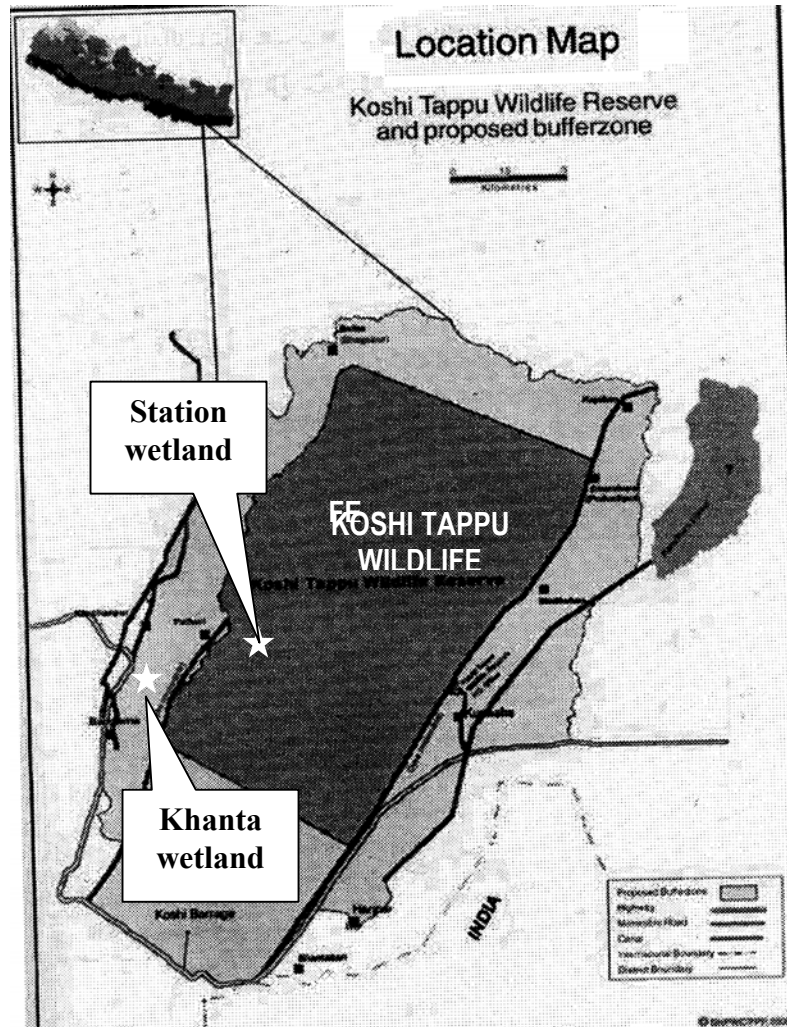


Fig.2: Location of Koshi Tappu Wild Life Reserve

Location Map

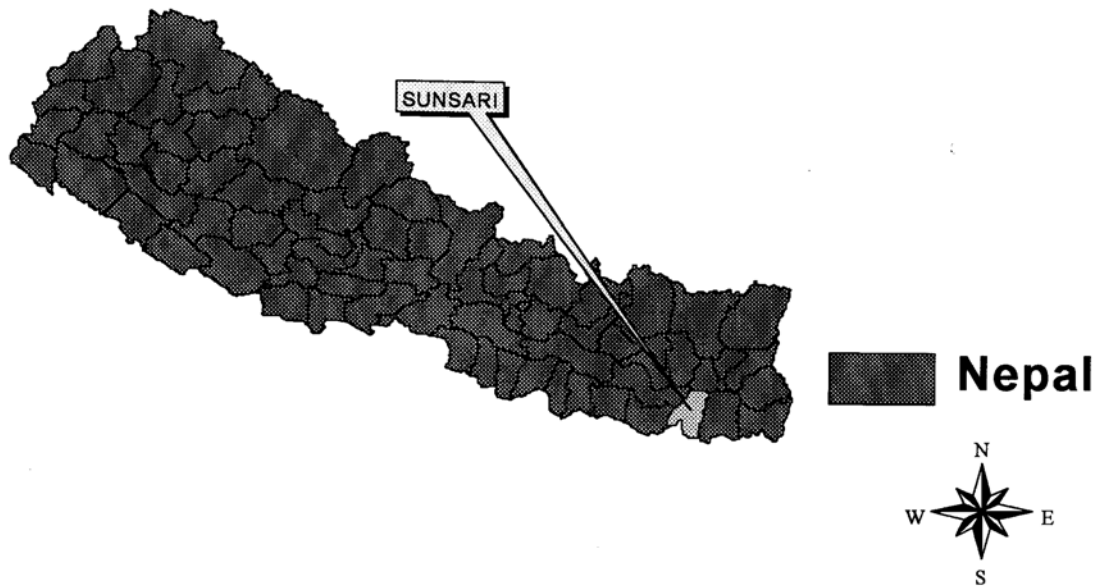


Fig. 3: Detailed Map of the Study Area

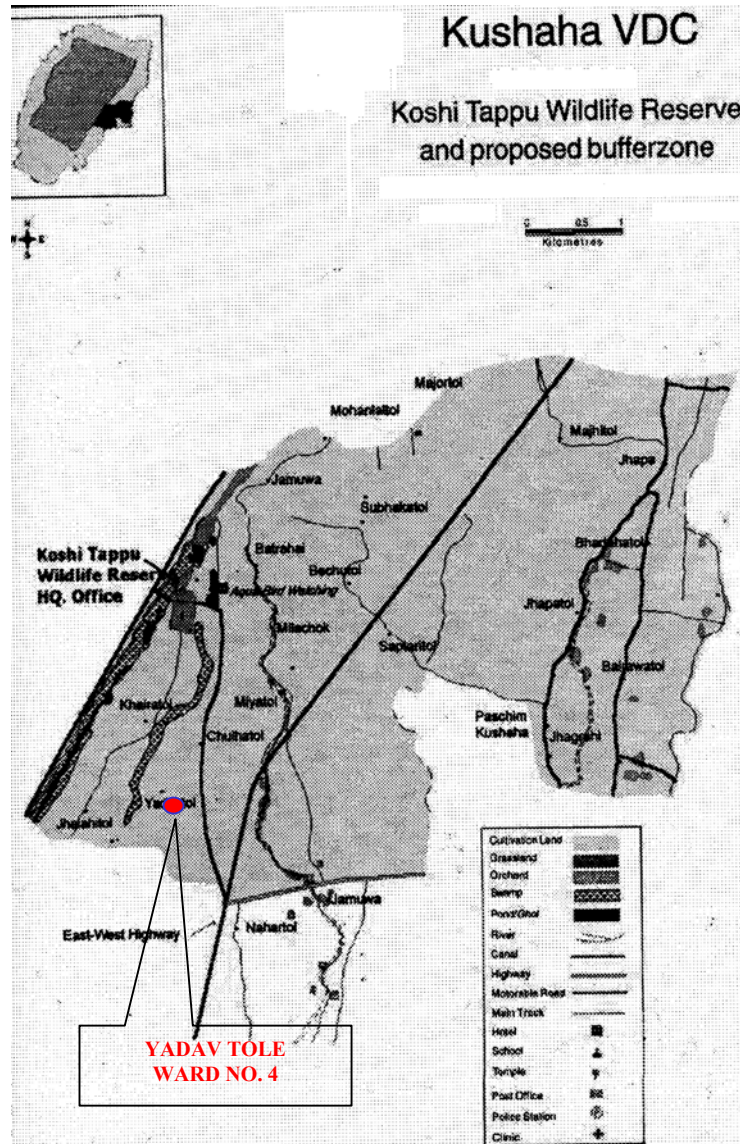


Photo1 : Cattle Grazing around Khanta Wetland Area



Photo2 : Eutrophication in Khanta Wetland



Photo 4 : Station Wetland and Surrounding Area

