Sarus Crane in North Uttar Pradesh: Status Survey of Sarus and mapping of its wetland habitat

Final Report

By

Asad Rahmani

Principal Investigator

Bridesh Kumar, Suhail Ahmad, Prakash Mehta and Fazlur Rahman

Volunteers

BNHS INDIA CONSERVING NATURE SINCE 1883

उत्तर प्रदेश सरकार

सारस संरक्षण समिति

Funded by

Sarus Protection Society, Uttar Pradesh

2019

Sarus Crane in North Uttar Pradesh: Status Survey of Sarus and mapping of its wetland habitat

Final Report

Asad R. Rahmani
Principal Investigator

Bridesh Kumar, Suhail Ahmad, Prakash Mehta and Fazlur Rahman
Volunteers

Funded by
Sarus Protection Society, Uttar Pradesh

2019

Recommended citation: Rahmani, A.R., Kumar, B., Ahmad, S., Mehta, P. & Rahman, F. (2019). Sarus Crane in North Uttar Pradesh: Status survey of Sarus and mapping of its wetland habitats. Bombay Natural History Society, Mumbai, pp 1 - 109.

Design and Layout: V. Gopi Naidu

Cover photographs: Front and back: Dhritiman Mukherjee

CONTENTS

CHAPTER I
1. Introduction 5

CHAPTER II
2. Study Area and Objectives 13

CHAPTER III
3. Results of Surveys 20

CHAPTER IV
4. Congregation of Sarus 39

CHAPTER V
5. Breeding 44

CHAPTER VI
6. Food of Sarus 49

CHAPTER VII
7. Resurvey of Sitapur wetlands 59

CHAPTER VIII
8. Threats to Sarus 66

CHAPTER IX
9. Development of local network 86

CHAPTER X
10. Sarus Workshops 90

CHAPTER XI
11. Recommendations 96

CHAPTER XII
12. Acknowledgements 100

CHAPTER XIII
13. References 101

Appendix I 105

CHAPTER I

Introduction

The Indian Sarus Crane *Grus antigone* is mainly found in north, northwest and central India, and as we go south, its population decreases. It is found in Punjab, Haryana, Uttar Pradesh, western Bihar, Jharkhand, Rajasthan, Gujarat, Madhya Pradesh, Chhattisgarh and northern Maharashtra. There are occasional records from Andhra, Telangana, and Odisha. The largest numbers of Sarus are found in Gujarat, Rajasthan and Uttar Pradesh. Uttar Pradesh can be called the Sarus Capital of India.

Outside India, it is still found in the terai of Nepal, but has become extinct in Pakistan and Bangladesh due to hunting. A subspecies of Sarus *Grus antigone sharpii* is found in Myanmar, Cambodia and Vietnam (extinct?), and Australia.

Sarus is the largest bird of India, and the tallest flying bird of the world. Like most crane species, Sarus is also dependent on marshes and jheels for foraging, resting and nesting, but being adaptable, it frequently uses flooded agricultural fields for foraging and nesting. These fields are surrogate marshes for Sarus. It is not found in large deep wetlands. It is also not found in forested protected areas even though they may have a few marshes (e.g. Dudhwa, Kishanpur) due to the danger of predation by Tiger or Leopard. It is a bird of floodplain shallow seasonal marshes, either developed due to flooding of large rivers or/and created by monsoonal deposition in depressions. Most of these marshes are now more or less taken over by humans for agricultural or industrial purposes, therefore, Sarus has no choice but to live in crop fields.

As Sarus is basically a bird of open marshes and jheels with good submerged vegetation and some emergent vegetation, it cannot survive in intensive sugarcane areas as sugarcane is dense and tall. Nonetheless, it is frequently seen in newly-grown sugarcane below the height of Sarus, but not in tall sugarcane. It is, however, frequently found in paddy and wheat fields, particularly when they are irrigated. It is also found in harvested paddy/wheat fields to feed on fallen grains. It is also seen in wet grasslands, particularly found on the edges of drying up shallow jheels and lakes.

In certain parts of central Uttar Pradesh, village ponds and lakes are termed *jhabbar*, *jhabiria* and *jhabru*. Small and deep village ponds are called *pokhar*.

General Status of Wetlands

According to the National Wetland Atlas, Government of India, there are 7,45,370 freshwater wetlands in India that were mapped by Space Application Centre, Ahmedabad (Anonymous 2011). Out of which, 6,30,869 wetlands are less than 5 ha (84.64%), 44,007 wetlands are between 5 to 10 ha (5.90%) and 53,710 wetlands are 10-50 ha (7.21%). We can say that almost 98% of the wetlands are less than 50 ha. These are the wetlands, which if present in north and central India are important for Sarus. Other figures are also interesting (Table 1). Despite the fact that wetlands from 100 to 500 ha form only 0.83% of the total number of wetlands, area-wise they constitute 12.14%. Below we give some statistics of the wetlands, reservoirs, rivers in India.

Status of Sarus in Uttar Pradesh: by B.C. Choudhury

The state of Uttar Pradesh in the Gangetic flood plains supports 5.1% of its geographic area in the form of wetlands (ponds, oxbow lakes, cut off meanders, water-logged areas, reservoirs, barrages, village tanks and riverine wetlands). A well-recognised wetland species, the Sarus Crane is therefore a widely distributed species in the state. In recent decades, the Sarus is believed to be forced to adapt itself to the changing agricultural landscapes interspersed with diminishing wetlands.

Even from an analysis of the historical distribution range of this species from the year 1890 (Murray, 1888-1890) to 1980s (Gole, 1989) to the year 2000 (Sunder *et al.* 2000) the Sarus had always been abundant in the state of Uttar Pradesh. The state is considered a stronghold of the Sarus Crane population since it supports the highest population of this species in country. The Wildlife Institute of India's countrywide Sarus census conducted during the years 1999 to 2001 had revealed the state of Uttar Pradesh to support the largest population as compared the other states in its distribution range. Sarus census conducted by the Uttar Pradesh Forest Department since 2010 exhibits the presence of Sarus in 55 districts of the total 75 districts of the state. Out of the 9 agro-climatic zones of Uttar Pradesh, the Vindhyan zone does not seems to support the Sarus Cranes. The Sarus population in Uttar Pradesh appears to be concentrated around Etawah-Mainpuri and Shahjahanpur. The Central-western plain, north-eastern plain, western plain, south-west semi arid plain and Terai region have been shown to support significant breeding populations. The Bundelkhand, central plain and the eastern plain do support Sarus but not in the same abundance. In recent years 2013-14, significantly large congregation and breeding populations of Sarus have been located in the north-eastern region of the state in the districts of Maharajgunj, Gorakhpur, Santkabirnagar and Sidharthnagar by the Wildlife Trust of India (WTI). The WTI has identified 27 Important Sarus Wetland Site (ISWS) in the districts of eastern Uttar Pradesh.

Once abundant in the Terai region of northern Uttar Pradesh, particularly from the district of Lakhimpur-Kheri and Pilibhit, the Sarus is drastically decreasing in this region. It is believed that changing agricultural cropping pattern from rice paddy and wheat to sugarcane has impacted the Sarus in this region. Though natural wetlands are the preferred breeding habitat of the Sarus, the bird appears to have adapted itself to a sub-optimal wetland-rice paddy crop field mosaic. The availability of water and aquatic flora and fauna in rice paddy fields for over three months has made the Sarus choose such habitats.

In several wetlands, Important Bird and Biodiversity Areas (IBAs), and other Protected Areas (PAs) of Uttar Pradesh a sizeable population of Sarus survives. The PAs supporting Sarus in Uttar Pradesh are National Chambal Sanctuary, Sur Sarovar Bird Sanctuary, Nawabganj Bird Sanctuary, Parvati-Aranga Bird Sanctuary, Patna Bird Sanctuary, Saman Bird Sanctuary, Sandi Bird Sanctuary, and Bakhira Bird Sanctuary. Though the state has 15 wetland-based bird sanctuaries, there are no specific Sarus Conservation Reserve or Sanctuary in the state. However, 90% of the Sarus population in the state of Uttar Pradesh are present outside the protected area network of the state. The state forest department's Sarus habitat survey reveals that out of around 1,550 Sarus Crane habitation sites, 25% are privately owned, and the others are either government or community owned.

Table 1. Number of natural wetlands in India in National Wetland Atlas, Government of India based on the information of Space Application Centre, Ahmedabad

[Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310 p.]

Size of wetland	No. of wetlands	% of number	Area of wetlands (in ha)	% of area
Less than 5 ha	6,30,869	84.64%	7,91,750.94	7.91%
5-10 ha	44,007	5.90%	3,10,443.91	3.10%
10-50 ha	53,710	7.21%	11,68,652.30	11.68%
50-100 ha	9,051	1.21%	6,24,226.30	6.24%
100-500 ha	6,167	0.83%	12,14,839.89	12.14%
500-1000 ha	736	0.10%	5,11,537.86	5.11%
1,000-10,000 ha	754	0.01%	18,68,069.04	18.67%
>10,000 ha	76	0.01%	35,13,954.78	35.13%
Total	**7,45,370**	**100%**	**1,00,03,475 ha**	**100%**

Table 2. Number and area of reservoirs in India

[Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310p.]

No. of reservoirs	Area of reservoirs (in ha)
3,477	15,967.35
2,138	15,753.69
5,480	140,027
1,628	116,809
1,588	3,43,277.45
256	1,87,119.18
272	7,41,346.78
43	9,56,931.50
Total No.: 14,882	**Total area: 25,17,232.71 ha**

Table 3. Large wetlands such as Pulicat that need different type of management

[Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310p.]

No. of other wetlands	Percentage	Area in ha	% of area
6,27,392	85.89%	7,75,783.59	10.36%
41,869	5.73%	2,94,690.22	3.94%
48,230	6.60%	10,28,624.55	13.74%
7,423	1.02%	5,07,417.29	6.78%
4,579	0.63%	8,71,562.44	11.64%
480	0.07%	3,24,418.68	4.33%
482	0.07%	1,126,722.26	15.05%
33	0.00%	2,557,023.28	34.16%
Total: 730,488	**100%**	**7,486,242.31**	**100%**

According to SAC data, in Uttar Pradesh there are nearly 14,000 wetlands that are below 5 hectares, and more than 10,000 wetlands are between 5 to 50 ha. They constitute nearly 50% of all the wetlands mapped by SAC. These are the wetlands that are useful for Sarus breeding and foraging (Table 4).

Table. 4. Number and area of wetlands (excluding rivers) in Uttar Pradesh, according to SAC data [Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310p.]

Size of wetland (ha)	No. of wetlands	% of number	Area (ha)	% of area
Less than 5 ha	13,973	51.41%	124,203.3	20%
5-10 ha	4,569	16.81%	32,435.39	5%
10-50 ha	6,635	24.41%	14,9971.1	24%
50-100 ha	1,240	4.56%	85,527.86	13%
100-500 ha	703	2.59%	12,9449.8	20%
500-1000 ha	32	0.12%	21,328.87	3%
1000-10,000 ha	27	0.10%	47,765.63	8%
> 10,000 ha	2	0.01%	44,533.67	7%
Total	**27,181**		**63,5215.7 ha**	

Reservoirs of different sizes number nearly 1600 (see Table 5) but such reservoirs are not suitable for Sarus for breeding purposes, except for foraging and wandering. There is another category of wetlands which excludes rivers and reservoir, according to SAC that number more than 25,000 (Table 6).

Table. 5. Number and area of reservoirs in Uttar Pradesh [Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310p.]

Size of reservoir (ha)	Number	Area in ha
Less than 5 ha	1016	2460.19
5- 10 ha	280	1922.22
10 - 50 ha	203	4470.24
50 - 100 ha	35	2463.89
100 - 500 ha	42	9260.82
500 - 1000 ha	12	8196.95
1000 - 10000 ha	18	32333.11
> 10,000 ha	2	44533.67

Coming to the study districts, in Table. 7, basic statistics of different types of wetlands and their respective areas are given.

These statistics apart, what is important for Sarus is a small shallow undisturbed *jheel* of 5-10 ha where it can nest and raise its chicks. The normal pattern of rainfall for 3-4 months is also important. Neither are these *jheels* safe from human overuse nor do we expect that normal rainfall pattern will remain, due to climate change. It will be an understatement to say that most wetlands are under severe stress and some may not even survive the next few years, leaving Sarus with sub-marginal habitats such as paddy fields to nest, where it faces constant disturbance and pesticides.

PHOTO: SARUS TEAM

Sarus signboards, put up by the forest department played an important role in spreading the conservation message. We suggest that more such boards and banners should be put up on the roads

PHOTO: SARUS TEAM

Table 6. Total number of wetlands (excluding rivers and reservoirs) and their areas in Uttar Pradesh (Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310 p.)

Size of reservoir (ha)	Number	% of total numbers	Area (ha)
Less than 5 ha	12,957	50.67%	1,21743.1
5-10 ha	4,289	16.77%	30,513.17
10-50 ha	6,432	25.15%	1,45,500.9
50-100 ha	1,205	4.71%	83,063.97
100-500 ha	661	2.58%	1,20,189
500-1000 ha	20	0.08%	13,131.92
1,000-10,000 ha	9	0.04%	15,432.52
> 10,000 ha	0	0.00%	
Total	25,573		5,29,574.6 ha

Ground water use was the key to the 'green revolution' but now, due to over-extraction, depletion of ground water is going to become a major problem for India's water security. South Asia is the world's largest abstractor of ground water, with over 30 million private irrigation wells and tube wells pumping about 347 BCM/year (~34% of global ground water use) (Hirji *et al.* 2017). Almost 60-80% of the population depends on extraction of ground water for irrigation, drinking or industrial use. Unplanned, intensive, unregulated and unmanaged pumping for irrigation, based on narrow political considerations and rampant corruption, aggravated by free or subsidized electricity, has severely depleted ground water in many areas, causing farmers distress and social unrest. Pollution of ground water is also a huge problem, exacerbated by weak governance and neglect. In the Gangetic floodplains, particularly in the Terai, potential for recharge of ground water and storage is very high, mainly through the protection of natural and man-made wetlands but this aspect is overlooked by policy makers. We need to give more importance to the protection and revival of wetlands, not only for the Sarus Crane and other wildlife, but for our own water security.

Like the tiger is the symbol of forests, an umbrella species, similarly Sarus Crane is the soul of a healthy freshwater wetland. It is a quintessential bird of *pokhar*, *jheel*, *jhabariya*, and *jhabbar*, as small wetlands are locally known.

Table 7. Wetland information of study area based on SAC data

[Reference: Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310p.]

District	Area (sq. km)	Lake/ pond	Oxbow	Riverine wetland	Waterlogged (natural)	River/ stream	Reservoir/ Barrage	Tank/ Pond	Waterlogged (man-made)	Subtotal	Wetland (<2.25 ha	Total
	sq. km	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha
Bareilly	4120	473	574	1370	391	6269	--	59	612	9748	1148	10896
Pilibhit	3499	486	846	34	679	11678	3337	19	539	17615	601	18216
Shajahanpur	4575	1728	789	4597	2066	8285	--	55	1194	18714	1089	19803
Lakhimpur-Kheri	7680	1122	1839	1588	1783	38119	212	74	857	46594	1673	48267
Sitapur	5743	1623	416	216	6692	10094	--	364	1363	20768	2406	23174
Hardoi	5986	9503	2665	2771	3318	12426	3	1600	1829	34115	2993	3710
Bahraich	4420	715	1878	2617	11438	30965	1866	240	1015	50732	886	51618

Sarus Project team members (L to R): Fazlur Rahman, Prakash Mehta, Bridesh Kumar, Asad Rahmani and Suhail Ahmad

CHAPTER II

Study Area and Objectives

In the project proposal submitted to the Sarus Project Society, it was mentioned that the Wildlife Trust of India is working on Sarus Crane in eastern Uttar Pradesh, so the area of northern UP, consisting of Lakhimpur-Kheri, Pilibhit, Bahraich, Sitapur, Maharajganj, Gonda, Basti, and Gorakhpur, are neglected, therefore we will work in these districts. However, it was subsequently found that WTI is was working in Bahraich, Maharajganj, Gonda, Basti and Gorakhpur districts also. Therefore, we concentrated on the following districts: Lakhimpur Kheri, Pilibhit, Shahjahanpur, Hardoi, Sitapur and Bareilly. We made few visits to Bahraich district.

2.1. Objectives

1. Conduct extensive surveys by field work and through networking of Sarus in northern Uttar Pradesh, mainly in the following districts: Pilibhit, Sitapur, Shahjehanpur, Lakhimpur Kheri, Barielly, and Hardoi.
2. Map the major and minor wetlands and record parameters such as GPS location, size, use, vegetation, water availability, ownership, and Sarus use/non use.
3. Develop a network of Sarus Suraksha volunteers at grassroots level.
4. Conduct workshops for local Forest Staff to develop census protocols

2.2. Staff/Volunteers: Due to certain reasons, we could not get good staff, so we used the help of volunteers. We had two types of volunteers: local for doing fieldwork, and technical experts for data analyses and preparation of maps/illustrations. These volunteers were given intensive training in the field, and worked under the direct supervision of the Principal Investigator (PI). They were paid according to the type of work and time spent in the field.

The following were the main volunteers:

Bridesh Kumar, Sohail Ahmed, Fazlur Rahman, and Prakash Mehta

Besides these regular volunteers, we took the help of the staff of WWF (Kabeer Ahmad, Mudit Gupta) and local wildlifers in Bareilly (Sachin Gaur), Pilibhit (Akhtar Mia), (Dudhwa), Sonu Leeladhar.

We also had very useful discussions with Prof. Brij Gopal (Jaipur), Dr. V.P. Singh (Lakhimpur-Kheri), Mr Neeraj Srivastava (Lucknow), Mr. B.C. Choudhury (Dehradun), Prof. Qamar Qureshi (WII, Dehradun), Dr. Ritesh Kumar (WISA, Delhi), Dr. Siddharth Kaul (WISA, Delhi), Mr Sanjay Kumar (Lucknow), Mr. Suresh Choudhury (Katerniaghat Foundation), Dr. Samir Sinha (WTI), Dr. Shalendra Singh (TSA, Lucknow) and many others.

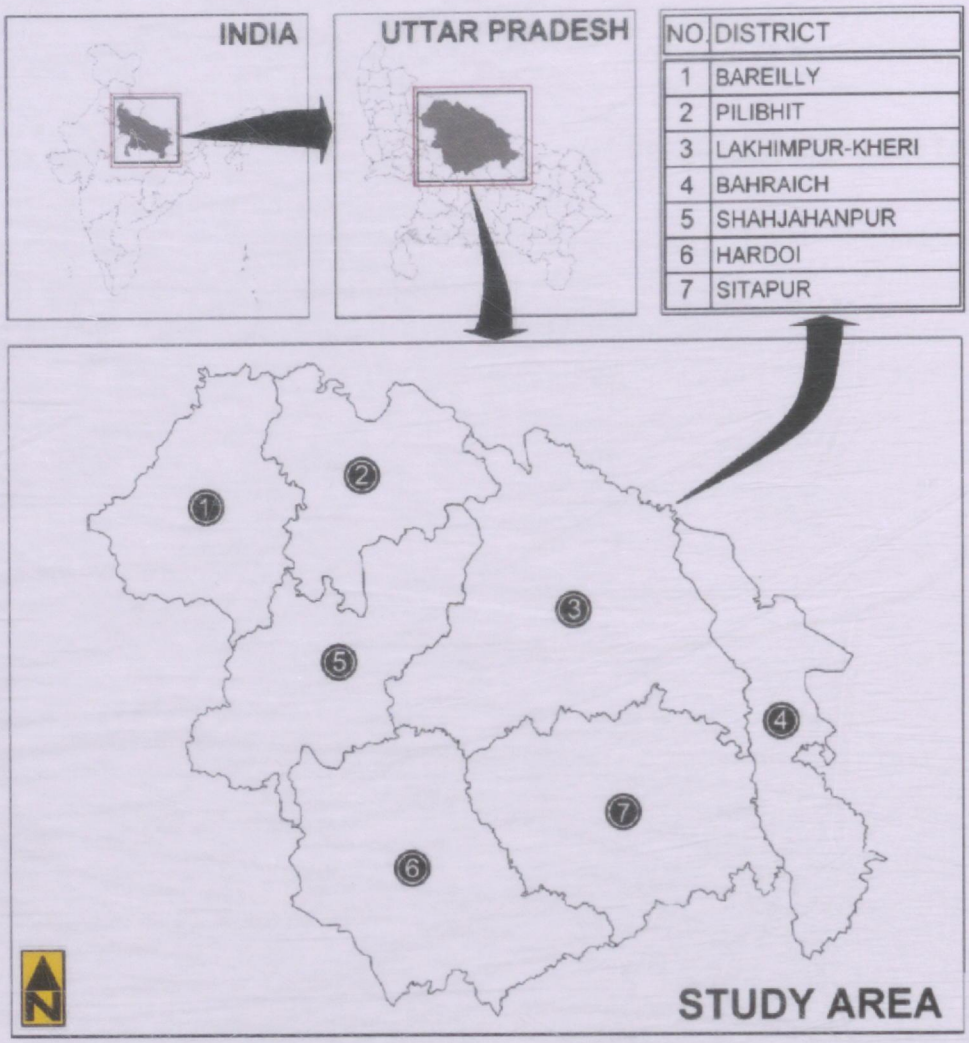


Fig.1. Study area

2.3. Surveys: Intensive surveys were conducted in Pilibhit, Sitapur, Bareilly,Shahjahanpur, Hardoi and Lakhimpur-Kheri districts from July 2017 to June 2019. We used all types of modes to reach wetlands, many times walking for kilometres. We also consulted local people to locate Sarus/wetlands. Sarus Crane was seen in a total of 1,020 sites. Detailed data were taken in proformas. We also conducted People's Perception of Sarus.

Unfortunately, due to drought-like conditions in these districts, we could not collect sufficient nesting data in 2017. Sarus breeding was very poor and very few nests or chicks or juveniles were found. This was reflected in the adult-juvenile ratio seen in early 2018. Fortunately, the rainfall was normal in the monsoon of 2018, so Sarus breeding was more successful.

2.4. Preparation of maps: One of the greatest difficulties that we faced was to get good maps of the wetlands of these districts. We contacted State Remote Sensing Institute, Lucknow but could not get the maps. We also contacted the Wildlife Institute of India, Dehradun but again did not succeed in getting the types of maps that we wanted. Finally, Wetlands International South Asia (WISA), New Delhi helped us. The PI had to make many visits to the WISA office to get the district-wise maps of wetlands of the seven districts in which we were working.

We have taken wetland data (shape format) from Space Application Centre, Ahmedabad (SAC). We also extracted wetland data on Google Earth. We verified wetlands on Google Earth images by maximum zooming, removed flooded crop field data and marked only active wetlands because some of the wetlands from SAC data do not exist anymore on ground. We have prepared Google Earth map of filtered wetland data of SAC. We hired a volunteer (Prakash Mehta) who is an expert in preparing maps and also conducting fieldwork. We prepared the maps with his help.

We also needed the map of distribution of high-tension wires fixed to pylons and electricity wires. The data appears to be 'restricted' so it is not openly available. We request the U.P. Forest Department to get this data, if possible, which will help in overlaying the distribution of Sarus and high-tension wires. High tension and electricity wires are becoming a major reason for the death of Sarus, and this problem will increase as Sarus are more and more disturbed and forced to fly higher by people (unintentionally or intentionally) or by free-ranging stray dogs. Finally, Prakash Mehta prepared the maps of high-tension wires with the help of Google images (pylon locations), and ground truthing. We could not prepare electricity supply maps to villages, houses, and crop fields (for generators) as the wire network was too dense. It was very difficult to get information on the wire network from government offices (at village, tehsil and district level).

Prof. Qamar Qureshi, Scientist G, Wildlife Institute of India, Dehradun helped us in statistical analysis of the breeding and feeding data. We also took help from Dr. Ashfaq Ahmad Zarri, Registrar, Baba Gulam Badshah Memorial University, Rajouri.

Data were taken in set proformas. These proformas were given in progress reports, so they are not included in this report.

PHOTO: BRIDESH KUMAR

PHOTO: ASAD R. RAHMANI

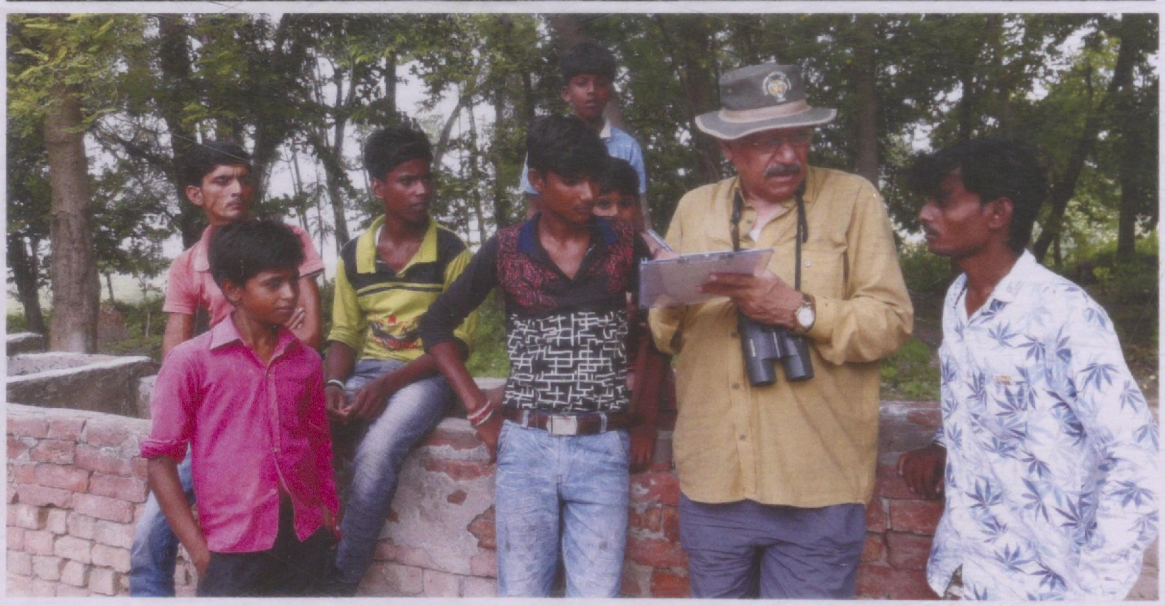


PHOTO: BRIDESH KUMAR

Data on Sarus and wetlands were collected during regular field visits.
The next few pages show the images of the field work

PHOTO: ASAD R. RAHMANI

PHOTO: BRIDESH KUMAR

PHOTO: SARUS TEAM

A total of nearly 250 days were spent in the field in the study area

PHOTO: SARUS TEAM

PHOTO: BRIDESH KUMAR

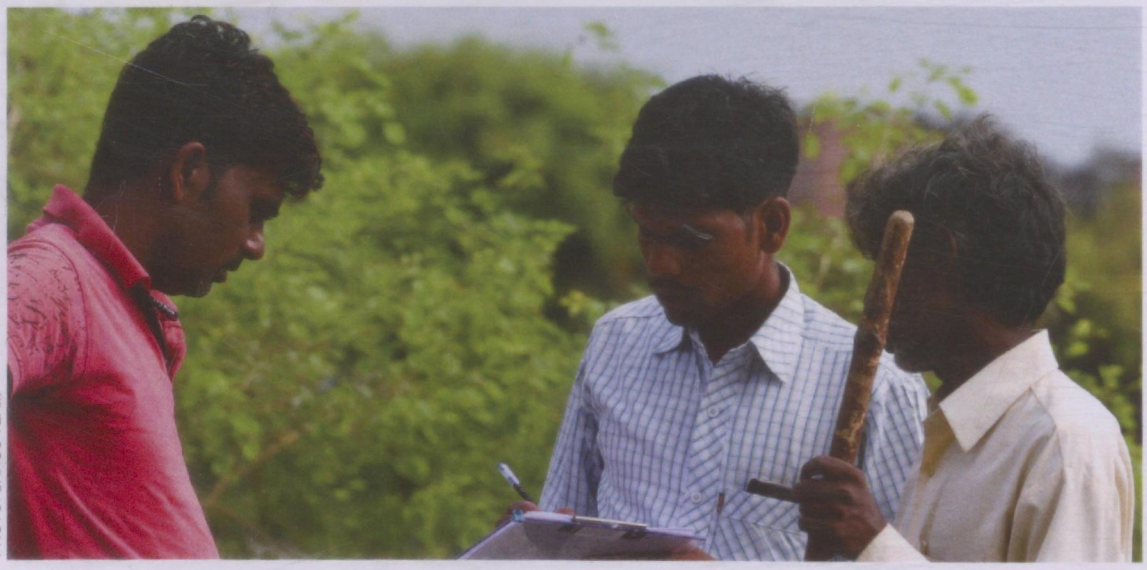


PHOTO: SARUS TEAM

Besides collecting field data, meetings with farmers and villagers were held to discuss Sarus protection

PHOTO: SARUS TEAM

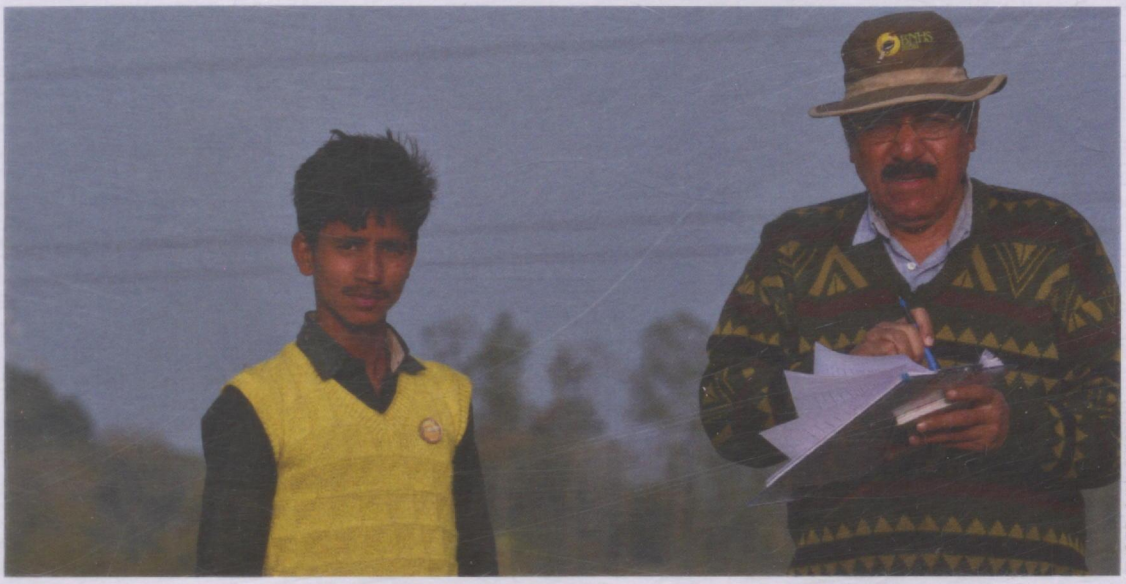


PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

Sarus pins developed by WTI were distributed to people who agreed to become Sarus Mitre

CHAPTER III

Results of Surveys

3.1. Surveys: We tried to cover all the seven districts but due to logistic reasons, some districts could not be covered properly (e.g. Bahraich and Bareilly), but the remaining districts were repeatedly surveyed in all seasons. Some sites were visited only once, but many sites (large wetlands) were visited twice or thrice. We were able to collect Sarus data from more than 1,000 locations (some sites were repeated). Most of the data were collected within 200 m of the Sarus without in any way disturbing the birds.

For collecting data on habitat use and numbers, during our surveys we also noted the distance of Sarus (on first sighting) from us. Most of our observations (85%) of Sarus were within 150 m. As Sarus is a large bird, it cannot be missed if it is in an area. We also scanned the area through binoculars and sometimes we found them 300 to 500 m away. Sometimes we went closer to gather other information about Sarus. However, for analysis purposes, only the first sighting data were taken (Fig. 2).

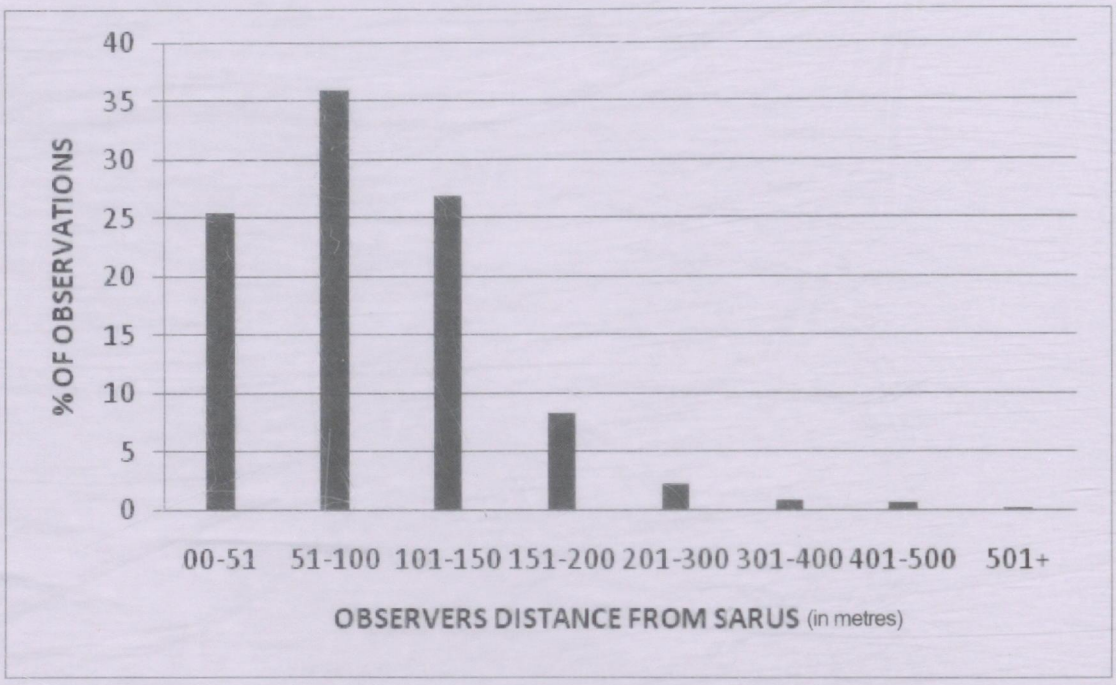


Fig. 2. Distance of observer from the Sarus (n=991)

3.2. Group size of Sarus: It is well-known that adult Sarus lives in pairs, particularly in the breeding season. After the breeding is over, it moves with chicks/juveniles or adults join other Sarus in small or large groups. These groups are generally loose aggregations of pairs/families and not very cohesive. We collected data on group size of Sarus and found that almost 70% of sightings (n=693) were of pairs (Fig. 3). Most of the sightings of three or four birds were parents with juveniles. Sometimes solitary Sarus was seen but it was quite rare (*c.* 5%). We had 10% sightings or 100 sightings of four Sarus. Either these could be two pairs temporarily coming together or a pair with two fully grown juveniles. We had 39 sightings in all of 6-10 individuals and 11 sightings of more than 10 Sarus Cranes. These congregations were mainly seen in winter or in the hot months when Sarus congregate in larger wetlands. These large congregations were seen during the day time. For roost congregation, we have given data separately (see Chapter IV).

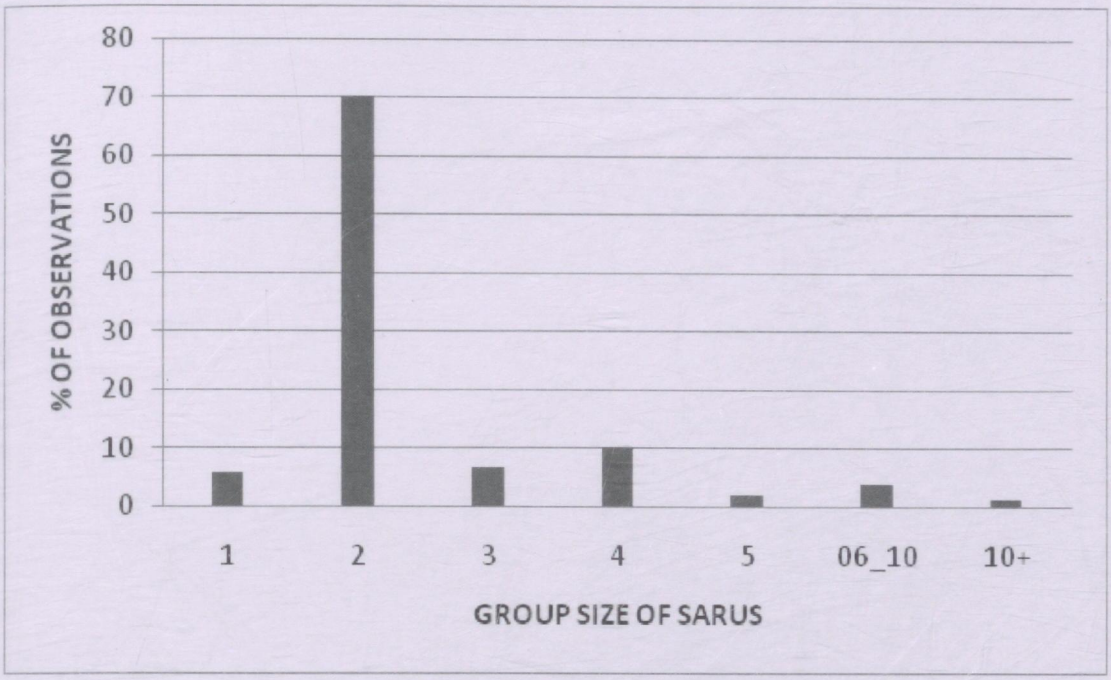


Fig. 3. Group size of Sarus (n=985)

3.3. Sarus and locations of wetlands

According to sources in the Forest Department, Uttar Pradesh has nearly 1,25,000 wetlands. We worked on the wetlands data developed by the Space Application Centre, Ahmedabad (SAC). We took the data but found that there were many wetlands reported by SAC which do not exist any more. Therefore, we did ground-truthing and also confirmed some wetlands from Google maps. Based on our survey work and desk work, we were able to prepare a map of wetlands of the seven districts that were our study area. A total of 2,916 wetlands were identified, varying in size from <5 acres to 100 acres (Fig. 4). District wise data are as follows: Bareilly (179), Bahraich (346), Hardoi (1394), Lakhimpur-Kheri (269), Pilibhit (165), Shahjahanpur (284), and Sitapur (279). On our wetland map, we overlay our records of Sarus sightings (Fig. 5).

Largest number of wetlands are found in Hardoi district, followed by Bahraich district (Fig. 4). However, largest number of Sarus sightings are not necessarily where largest number of wetlands are present, because in the study area most sightings of Sarus were in the crop fields. It should be noted that due to logistic reasons, we could not survey the southern parts of Hardoi and Bahraich districts as thoroughly as we surveyed other districts. Not many Sarus were located on large wetlands, mainly because such wetlands are intensively used by human beings either to grow paddy, water chestnut or fish.

3.4. Size of the wetlands: When we saw Sarus in a wetland, we tried to get the data on the size of the wetland from the villagers or estimated it ourselves. Out of the 380 sightings of Sarus in wetlands, 80% sightings were in wetlands smaller than 50 acres. Most sightings were in smaller wetlands of less than 5 acres, locally known as *jhabar*. Slightly more than 10% sightings were in wetlands of sizes from 51 to 100 acres (Fig. 7). Very few sightings were in wetlands of more than 100 acres, either they were deep or too disturbed due to fishing activities.

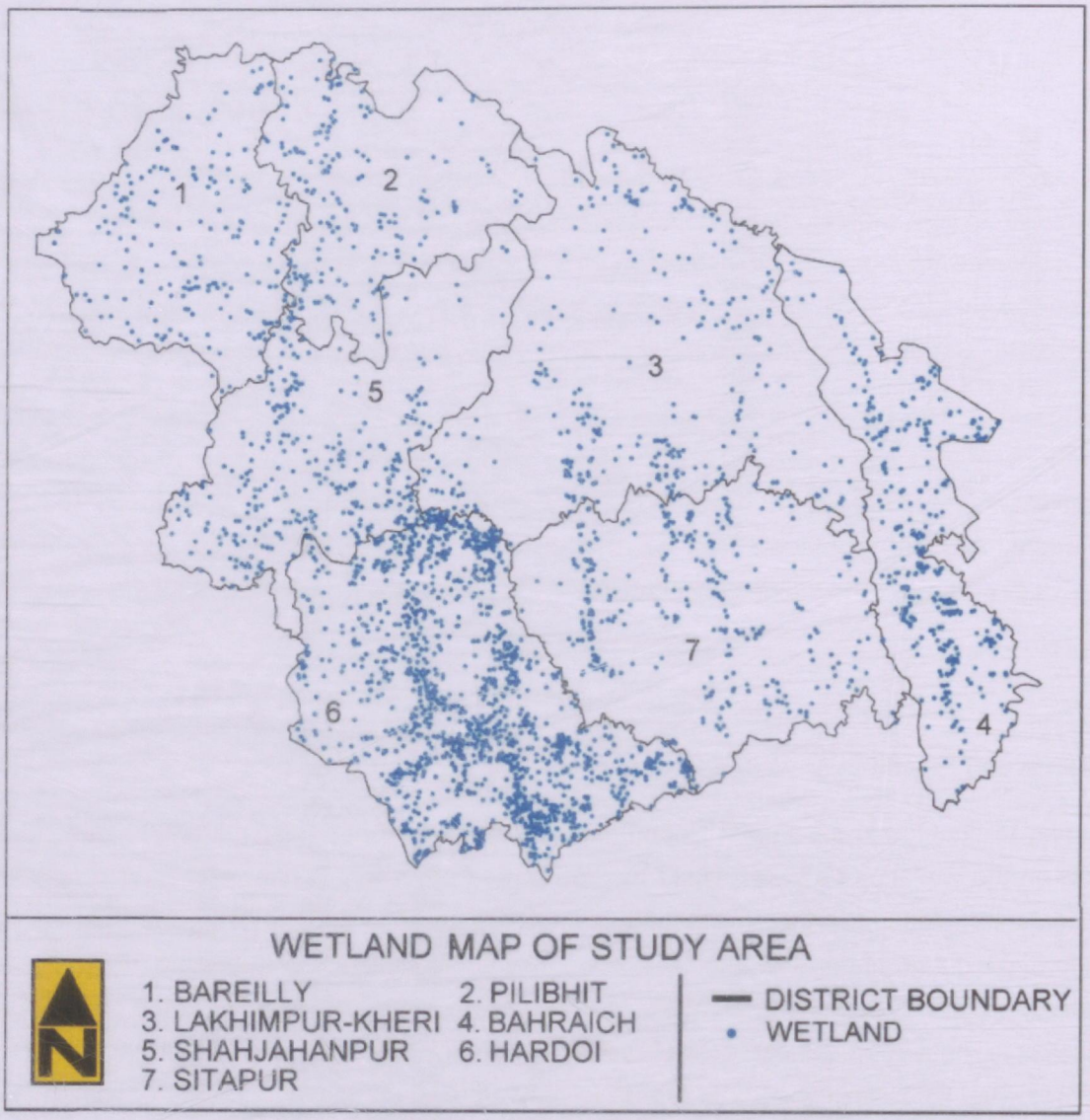


Fig. 4. Wetland locations (>5 acres) in the study area.

3.5. Type of wet areas used by Sarus: We also studied the type of wetlands (including flooded fields) used by Sarus. Whenever we saw a Sarus, we noted the type of habitat (flooded crop field, fallow field, wetland, village pond, river) where it was seen for the first time by us. We found that most sightings (60%) were in the flooded crop fields. These include paddy, young wheat and young sugarcane. Next were in the village ponds called *jhabar*. In the larger wetlands of more than 50 acres (including surrounding crop fields), we had few sightings (Fig. 7).

3.6. Type of crop fields: We also studied the type of crop fields and found that maximum sightings of Sarus (40%) were either in young flooded wheat fields or harvested wheat fields (Fig. 9). Next was in paddy fields. Such sightings were mostly in flooded fields. Interestingly, we also found many Sarus in young sugarcane fields with standing water. Once sugarcane becomes taller than Sarus and dense, the bird is not found. Similarly, in ripe wheat and paddy fields, just before harvesting, very few Sarus were found. In wetlands that are under *singhara* cultivation, Sarus were mostly absent mainly due to disturbance by humans. Same was the case in totally dry fallow fields (particularly in summer). Fisheries ponds despite having water had very few Sarus, perhaps due to the depth of the water and frequent disturbance by pond owners on the presumption that Sarus feeds on fish.

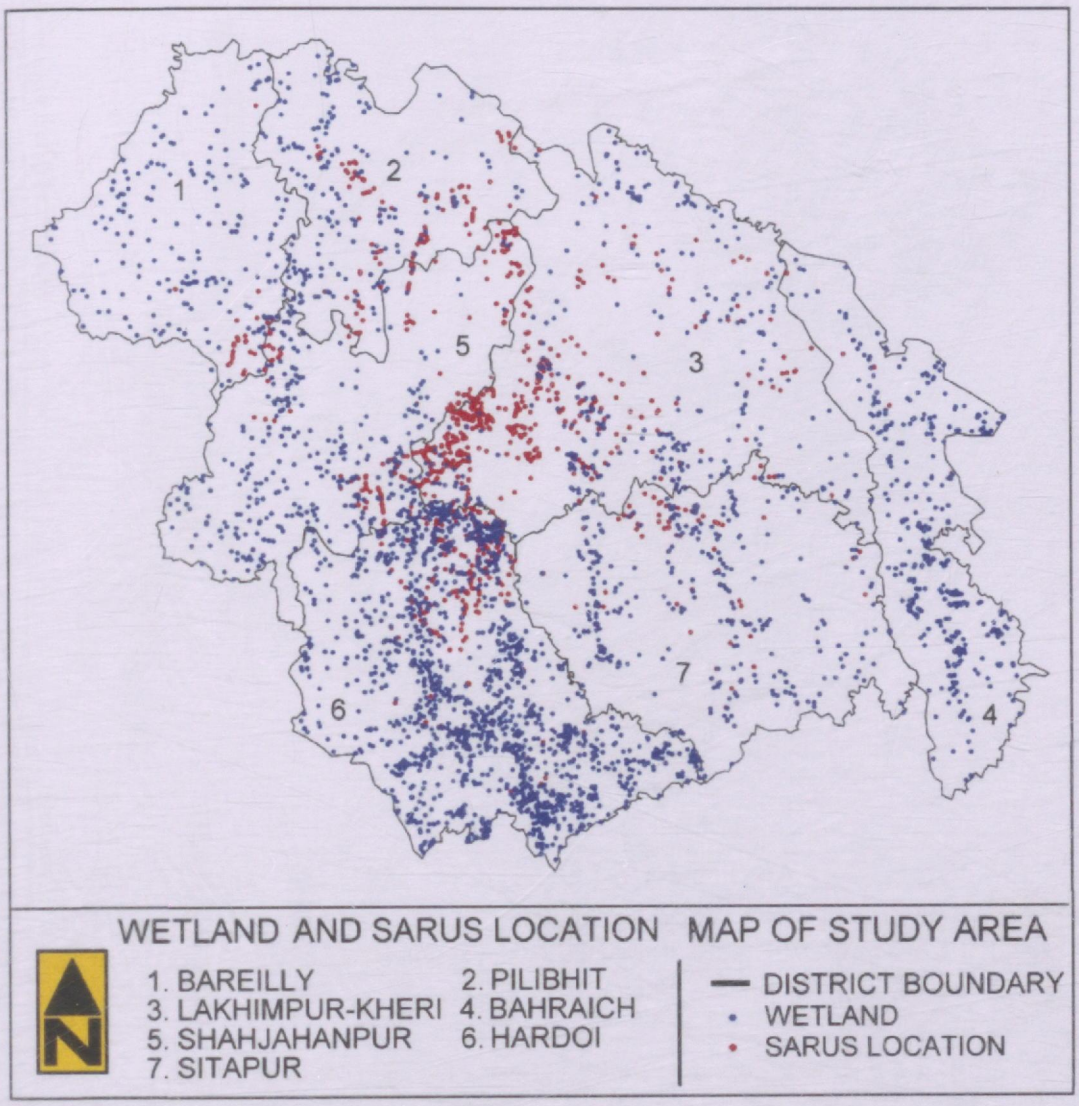


Fig. 5. Distribution of wetlands and sightings of Sarus (July 2017 to June 2019)

All the districts are under intensive cultivation with paddy, wheat and sugarcane as major crops. There are very few natural wetlands left so Sarus mainly forages in these fields, particularly when they are flooded for irrigation. It should be noted that in the whole Terai, flood irrigation is done, where 5 to 15 cm of water is left standing for many days. Such crop fields act as pseudo-wetlands for Sarus, hence nearly 966 sightings were in such crop fields.

Sarus is also seen in fallow fields, particularly wheat and paddy, to pick up the fallen grains. We also had a few sightings (2%) in sarson fields, but no sighting in fish ponds, as mentioned above.

3.7. Broad habitat types: Sarus lives in a matrix of crop fields, fallow fields, and wetlands in a large landscape. We broadly divided Sarus habitat into Standing Crops, Wetland, Fallow, Ripe or Mature Crop field, Young Sugarcane and Miscellaneous. We found that maximum sightings were in the standing crop fields (of wheat, paddy), next were in wetlands (*jhabars*, *jheels*, ponds), then Ripe Crop fields, Fallow fields, and so on (Fig. 10).

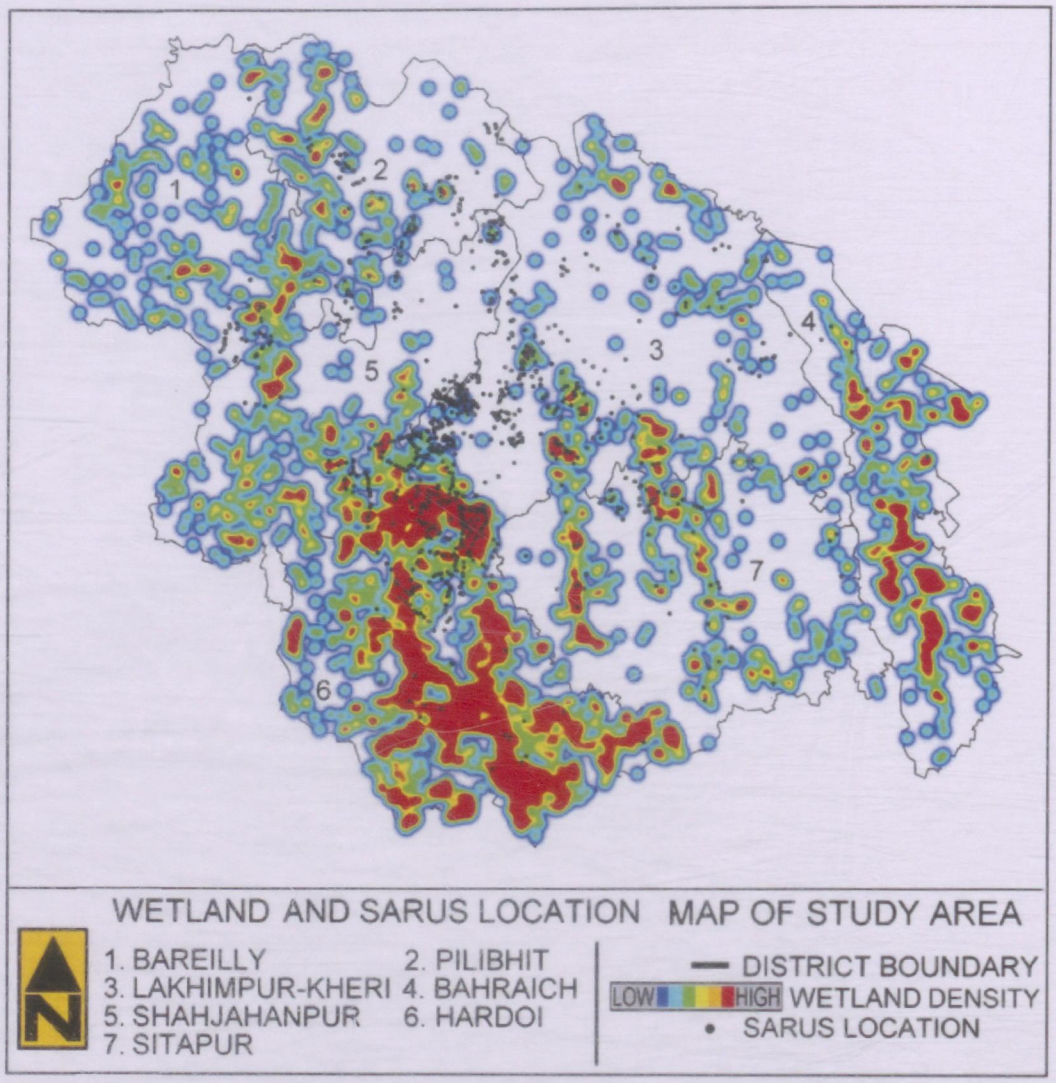


Fig. 6. Heat map and sightings of Sarus (July 2017 to June 2019)

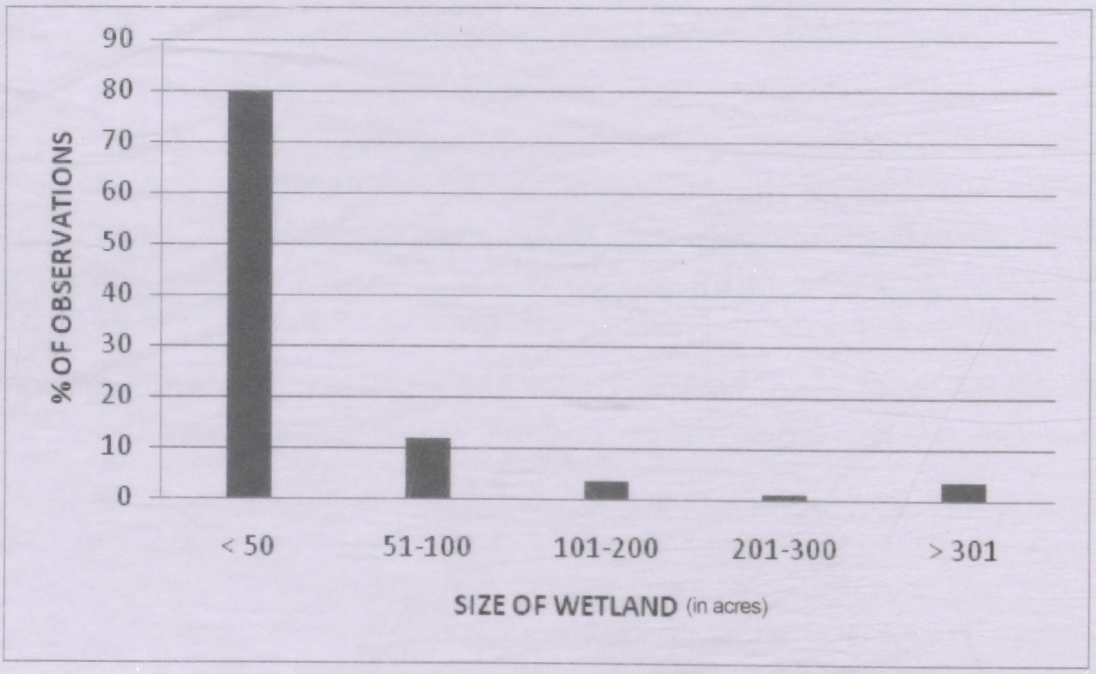


Fig. 7. Size of wetlands where Sarus are found (n=380). Most of the sightings of Sarus were in crop fields, harvested or fallow fields, which is not reflected in this diagram as it deals only with sightings in wetlands

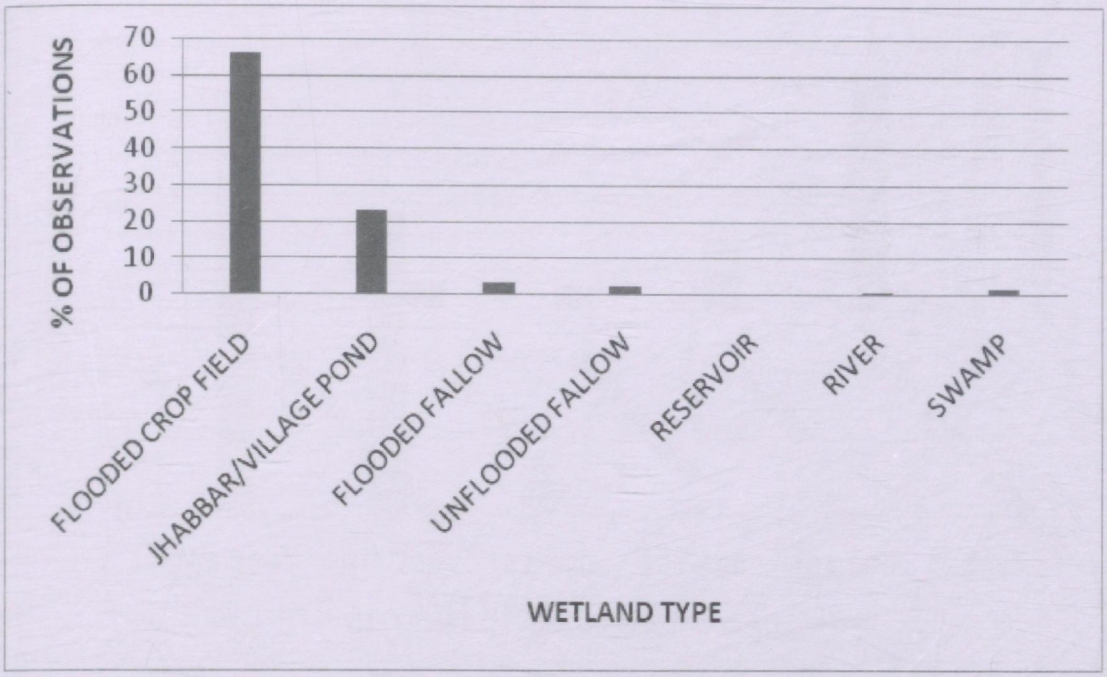


Fig. 8. Type of wet areas where Sarus was found (n=1013)

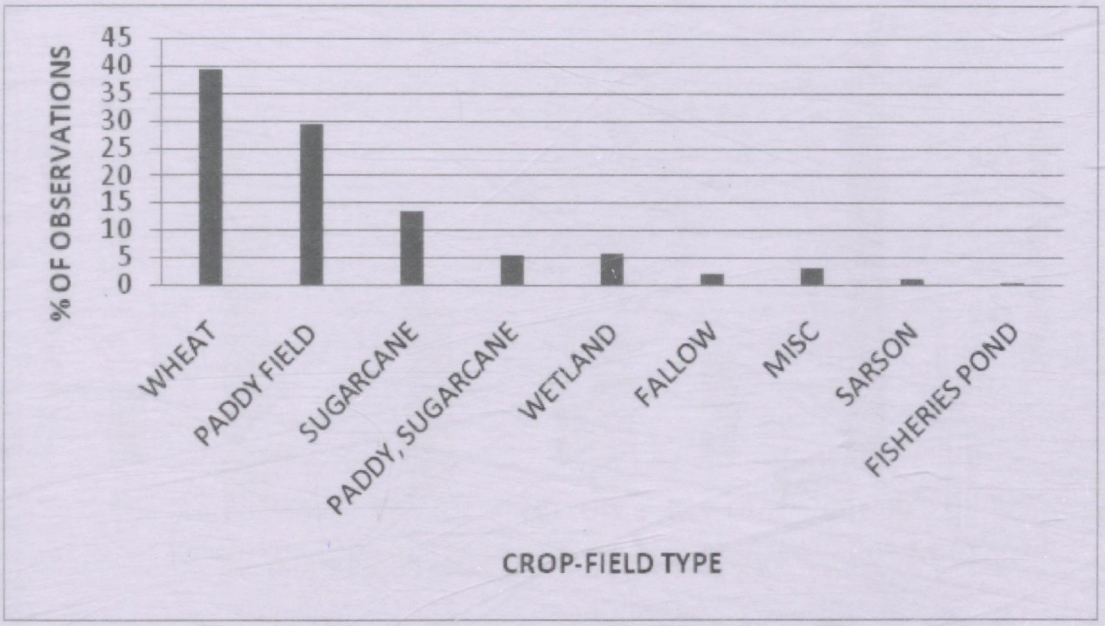


Fig. 9. Type of crop fields where Sarus was found (n=966)

3.8. Sarus and people: We collected data on people's attitude towards Sarus. Our analyses show that most of the people have a positive attitude towards Sarus. One way to judge human tolerance of Sarus was based on how close Sarus is found near people. Out of the 809 sightings of Sarus with people nearby, we found that more than 50% of the sightings of Sarus were within 100 m of people, either working in the crop fields or tending cattle or walking in the field (Fig. 11). As Sarus lives in densely populated landscape, people were never out of sight wherever Sarus was located. Throughout the day, Sarus encounters human beings.

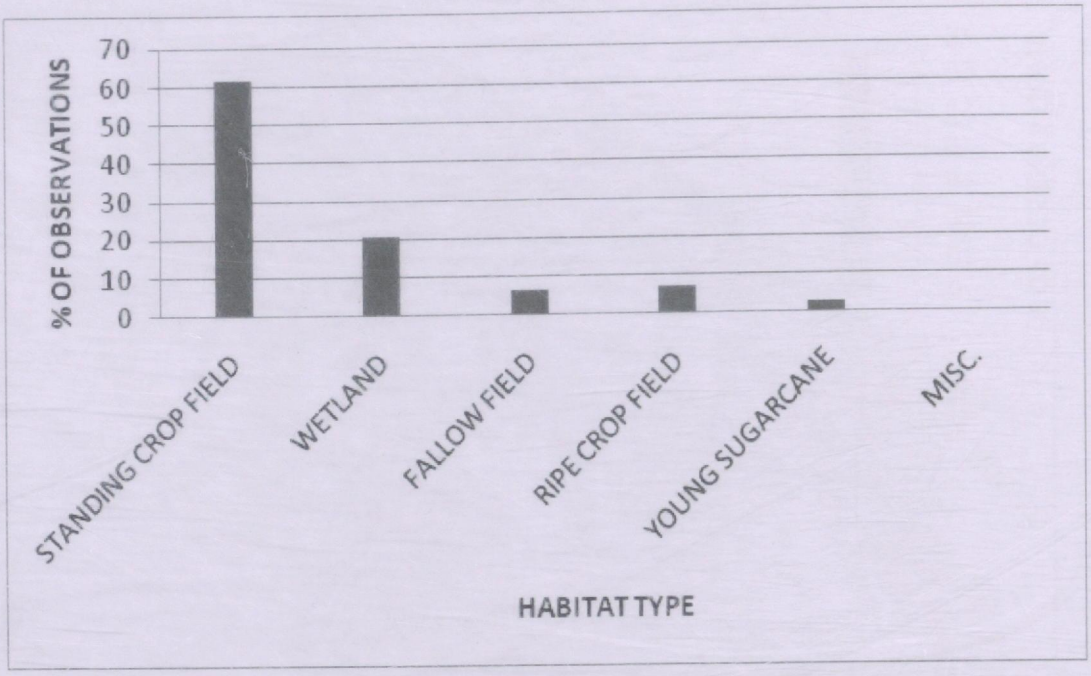


Fig. 10. Major habitat types used by Sarus in the study area (n=987)

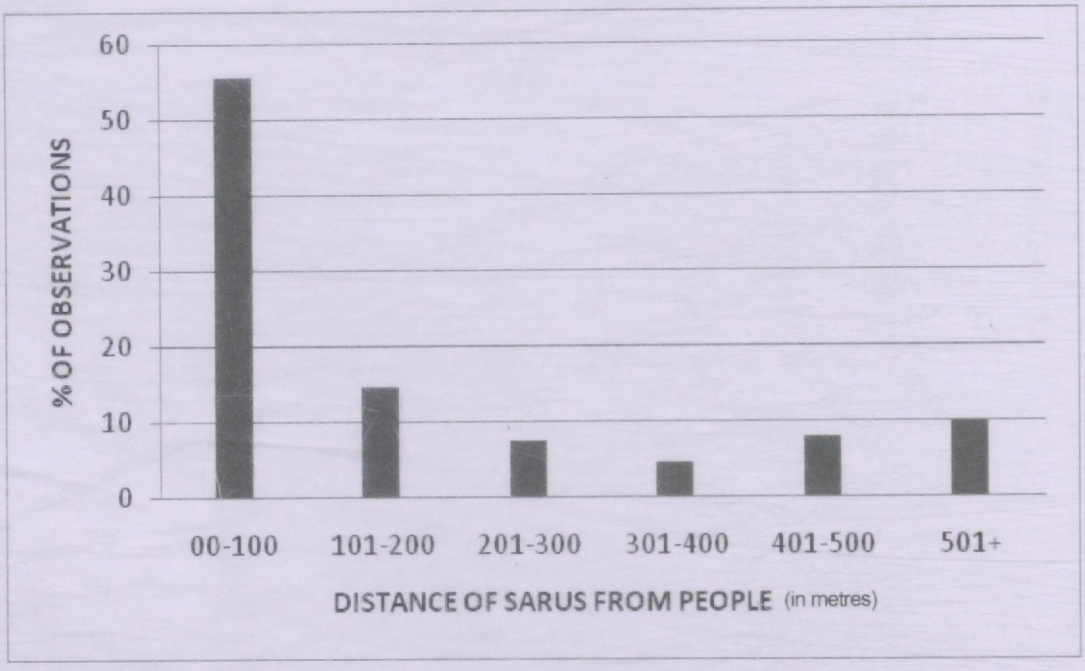


Fig. 11. Proximity of people to Sarus (n=809)

3.9. Distance of Sarus from roads: The state has a huge network of roads. There is practically no area where roads are not found. We found that in the study area, almost all villages are now connected with roads. The type and quality of road can vary but they are present there. Sarus is so used to people and traffic that almost 90% of our sightings were less than 200 m from the road (Fig. 12). There is a bias in this interpretation as the probability of sightings of Sarus from a moving survey vehicle decreases as the distance increases. We also walked for many kilometres on *katcha* roads or bridle paths. We can say that most of our Sarus sightings were within 200 m from the roads. Nonetheless, our data further proves the adaptability of Sarus to live in human-dominated landscape, and within the complex network of the road system.

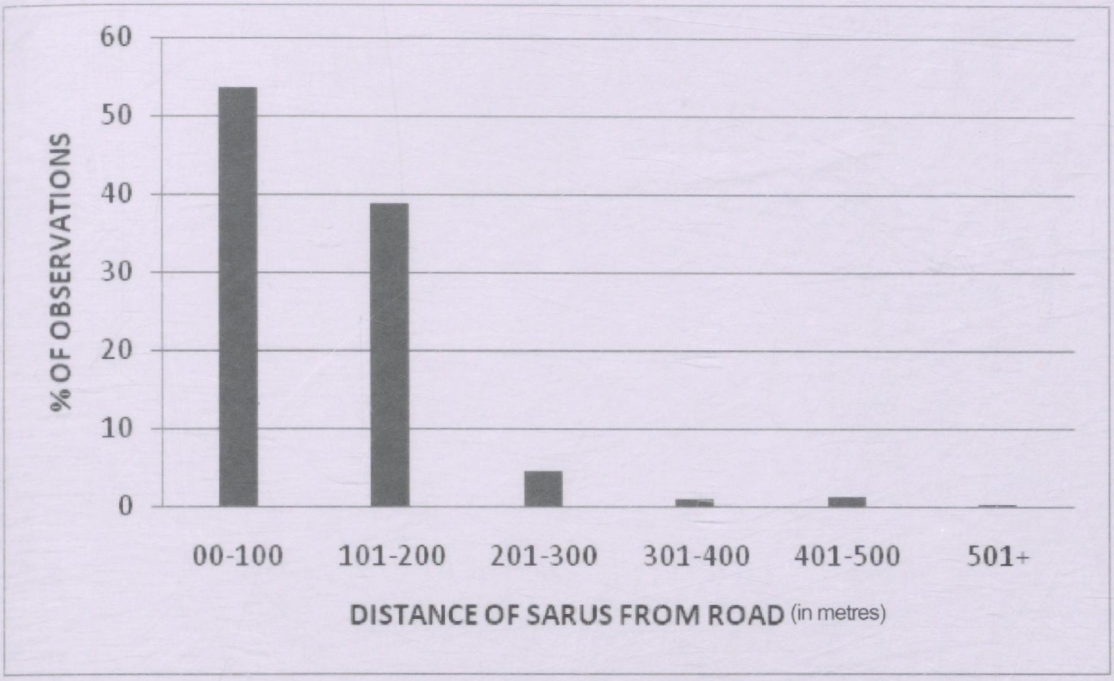


Fig. 12. Distance of Sarus from the nearest road (n=957)

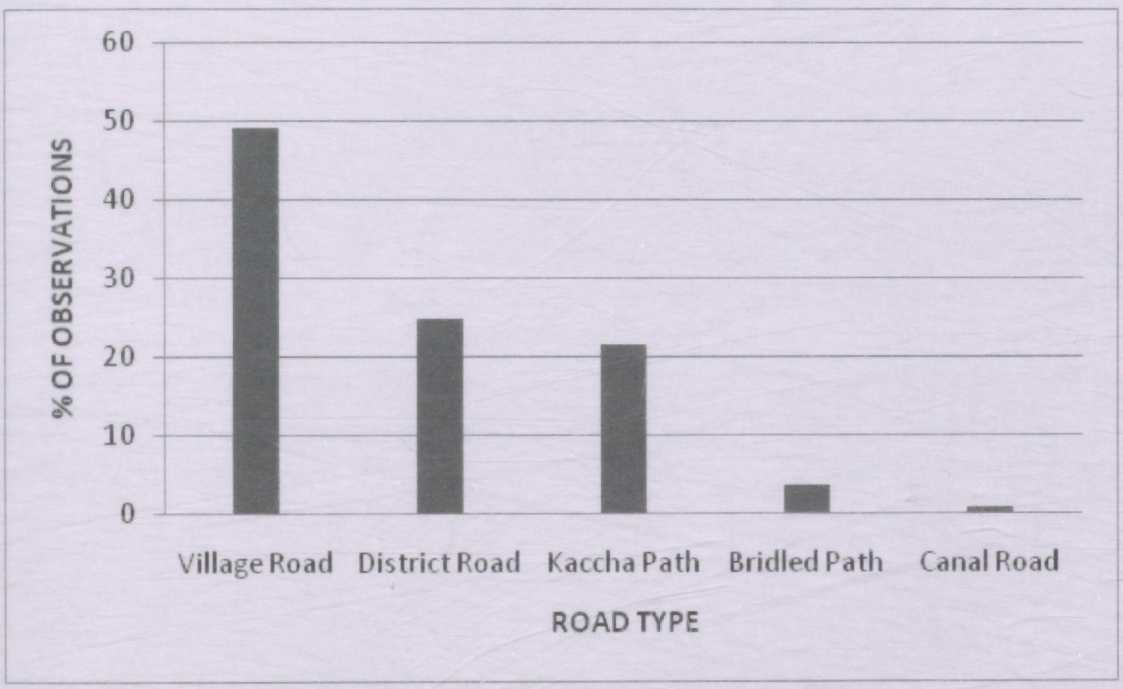


Fig. 13. Sarus sightings from different road types (n=981).
Please note that we did not see any Sarus during surveys from National Highways

3.10. Sarus sightings from different road types: During our survey, we divided the road types into six categories: National Highway, District Road, Village Road, Canal Road, Kachha Path, and Foot path or bridle path. We did not come across Sarus along the high-speed National Highways (a total of nearly 2,000 km National Highway was covered during multiple surveys). Maximum sightings were from Village Road, next was from District Road (Fig.13). Minimum number of Sarus were seen from canal roads. This is due to two main factors: we could generally see only on one side from the canal road, and secondly and perhaps more importantly, near the canals mostly sugarcane is grown which

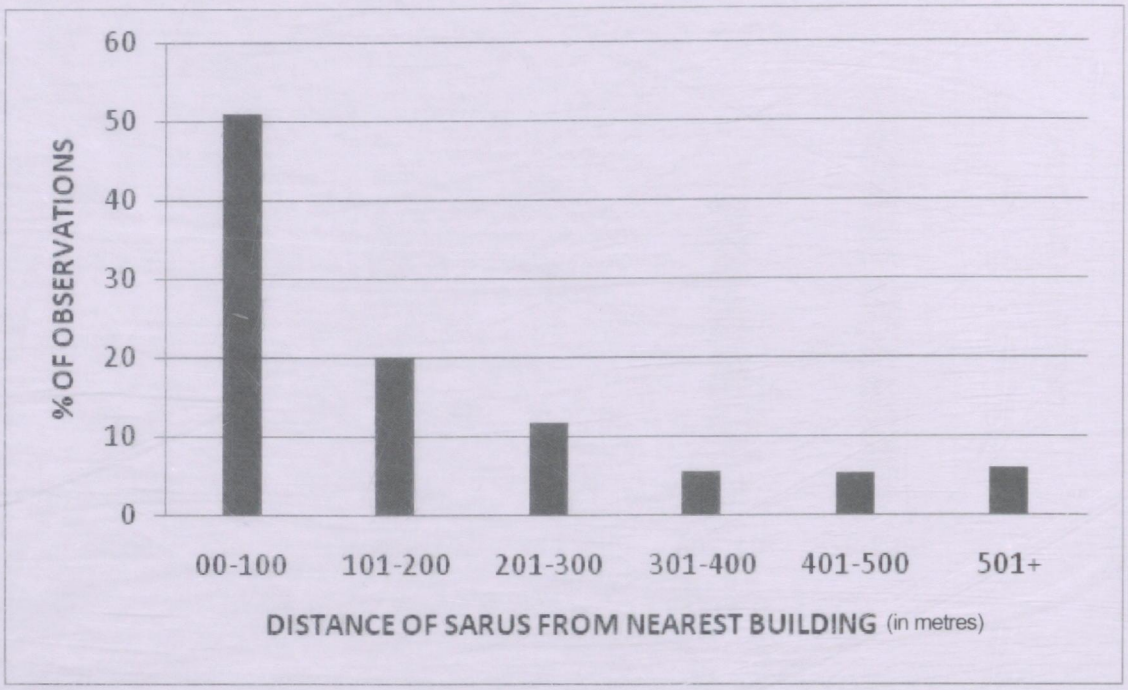


Fig. 14. Distance of Sarus from the nearest human-made structures or buildings (n=535)

is not a suitable habitat for Sarus. This was particularly so in Sitapur, Lakhimpur and Hardoi districts where vast areas are under sugarcane cultivation. For kilometres beside the canal, only sugarcane is grown due to network of channels and easy availability of water.

3.11. Closeness of Sarus to human-made structures: We also collected data to find out how close Sarus is found near human-made structures (house, school, brick kiln, etc). As soon as we located a Sarus, we estimated how close/far it was from human-made structures. We did not count data beyond 500 m. As expected, nearly 70% of our sightings were within 200 m from a human-made structure (Fig. 14). Some birds were seen as close as 10 m from a house or a school. Most of the shallow wetlands are under extensive encroachment, so even if a building was under construction, Sarus would be seen as long as some water was present. Perhaps such sites were their traditional nesting and foraging areas, which will disappear soon. Many large birds use their traditional natal areas even when the habitat has been modified.

PHOTO: NEERAJ SRIVASTAVA

Apart from adult Sarus, we gave special emphasis to note juveniles (above circle) and flock size (below)

PHOTO: DHRITIMAN MUKHERJEE

PHOTO: ASAD R. RAHMANI

Sarus needs shallow wetlands of 5-20 acres for foraging and breeding (above), but it is regularly seen in crop fields (below) which have largely replaced its natural habitat

PHOTO: ASAD R. RAHMANI

PHOTO: CHOTU KHAN

Sarus often nests close to a road (above) or a house (below), sometimes as close as 20-40 m

PHOTO: CHOTU KHAN

PHOTO: DHRITIMAN MUKHERJEE

We noted parameters such as distance from the road, type of road (above) and distance from human-made structures (below)

PHOTO: ASAD R. RAHMANI

PHOTO: DHRITIMAN MUKHERJEE

Weather conditions, coordinates, name of the wetland, village name, distance from village/road, visibility, number of other animals in the area and many more parameters were noted as soon as Sarus was sighted

PHOTO: VIKRAM TIWARI

Table. 8a. Important Sarus Wetlands (ISW)

S. No.	Name of Wetland	Village	Tehsil	District	Latitude	Longitude	Size (Acre)	No. of Sarus	Crop	Notes
1.	Banparwa	Bhatera	Nanpara	Bahraich	27.85406	81.500923	5	1	Standing Crop	More are seen in winter
2	Maili	Bhavni	Mehsi	Bahraich	27.53225	81.464508	10	2	Wetland	More are reported
3	Jhabra	Poltanpura	Nanpara	Bahraich	27.71698	81.524389	150	2	Wetland	More are reported
4	Narwa-Nala	Dharmapur	Mehipurwa	Bahraich	28.1739	81.231765	2000	2	Wetland	More are seen in winter
5	Chittaura (=Ashtwarka)	Kodri	Chitaura	Bahraich	27.32574	81.38628	1000	15-20	Oxbow lake	2-3 pairs nest. Summer congregation
6	Girwa marshes			Bahraich			Unknown	10-20	Marshland	Perhaps the biggest marshland in UP. Sarus mainly seen on the margin during summer. Part of Katerniaghat WLS
7	Kadarganj	Kadarganj	Fareedpur	Bareilly	28.11631	79.518865	0.5	2	Young sugarcane	More are seen in winter and summer
8	Pareda	Pareda	Fareedpur	Bareilly	28.1225	79.525737	0.5	2	Young sugarcane	More are seen in winter and summer
9	Narkunda	Narkunda	Baheri	Bareilly	28.734254	79.453998	5			
10	Pareda Ghaaraha	Pareda	Fareedpur	Bareilly	28.13923	79.529763	0.5	2	Young sugarcane	More are seen in winter and summer
11	Tisua	Tisua	Fareedpur	Bareilly	28.7352	79.597565	0.5	2	Young sugarcane	More are seen in winter and summer
12	Jhabariya	Pihitiya	Shaabad	Hardoi	27.67438	80.103511	3	5	Wetland	More are seen in winter and summer
13	Hathela	Tekra	Hardoi	Hardoi	27.34662	80.171895	25	6	Wetland	Wetland is on both sides of the road. Buildings under construction on both sides.
14	Sandi WLS	Sandi		Hardoi			308	30-50	Wetland	5-6 Sarus pairs breed in and around
15	Jhabar	Cheena	Pehaoni	Hardoi	27.73458	80.20118	8	10	Wetland	More are seen in winter and summer
16	Tevri-Taal	Tevrigaon	Sandila	Hardoi	27.17344	80.319308	100	15	Wetland	
17	Jabalpurwa	Jabalpurwa	Shahabad	Hardoi	27.69445	80.198337	7	15	Wetland	Sarus seen 2+4+2
18	Sakra-Jhabar	Sakra	Shahabad	Hardoi	27.76574	80.117182	25	16	Wetland	10-12 Sarus are always found here, sometimes up to 16 are seen. Resident
19	Jhabar	Rampur	Shahabad	Hardoi	27.67136	80.225942	50	20	Wetland	
20	Jhabar	Lalupurwa	Shahabad	Hardoi	27.72996	80.225025	70	60	Wetland	Sarus group 17+2+1+8-2
21	Jhabar	Ruiya Gadhi	Bilgram	Hardoi			8		wetland	Seen by Abu Arshad
22	Jhabar	Near Ganga	Bilgram	Hardoi			4		Wetland	Seen by Abu Arshad

Table. 8a. Important Sarus Wetlands (ISW) (contd.)

S. No.	Name of Wetland	Village	Tehsil	District	Latitude	Longitude	Size (Acre)	Sarus No.	Crop	Notes
23	Nagariya-Wetland	Nagariya	Gola	Lakhimpur-Kheri	28.16819	80.372581	500	14	Wetland	
24	Jhabar	Naranyanpur	Gola	Lakhimpur-Kheri	28.23511	80.327183	90	15	Wetland	
25	Simrai-Jheel	Simrai	Lakhimpur-Kheri	Lakhimpur-Kheri	28.03629	80.519399	190	20	Wetland	2-3 nest every year. Rohit Kumar Guard, 7080179531.
26	Behind Gola Hydel	Bhusaria	Gola	Lakhimpur-Kheri	28.06502	80.478637	100	40	Wetland	
27	Semrai Wetland	Semrai	Gola	Lakhimpur-Kheri	28.03626	80.57955	198	50	Wetland	Contact: Madan Lal 9670350718
28	Jhabar	Alipur	Gola	Lakhimpur-Kheri	27.9925	80.479835	40	100	Wetland	Two chicks about 70 days old. Sarus congregation during summer.
29	Jhabar	Rajasahib-Kothi	Lakhimpur-Kheri	Lakhimpur-Kheri	27.84041	80.749237	50	10	Wetland	
30	Jhabar	Muradpur	Gola	Lakhimpur-Kheri	28.11858	80.393338	35	12	Wetland	Evening summer count
31	Ghumchai	Dunda	Puranpur	Pilibhit	28.4456	80.057634	25	4	Wetland	More are seen in winter and summer
32	Jhabar	Dunda-Khanpur	Puranpur	Pilibhit	28.43938	80.058865	10	9	Standing Crop	Contact: Shyam Charan 9758240670. Every pair with a juvenile.
33	Jhabar	Maini	Bisalpur	Pilibhit	28.28961	79.866588	50	50	Wetland	23 Sarus include 6 juveniles
34	Deoha river	Jadoupur	Pilibhit	Pilibhit	28.657023	79.780303	50			Seen mainly in summer
35	Mala river	Daulatganj	Pilibhit	Pilibhit	28.626999	79.782440	10			Seen mainly in summer
36	LaloriKhera	LaloriKhera	Pilibhit	Pilibhit	28.612528	79.756774	7			Breeds here
37	Deori	Deori	Pilibhit	Pilibhit	28.604331	79.883972	5			Breeding records
38	Badua-Nala	Puranpur	Puranpur	Pilibhit	28.504005	80.136824	45			Breeding records
39	Maini Jhabar	Maini	Bisalpur	Pilibhit	28 16 982	79 52 251	50	4-6	Wetland	At least two pairs breed occasionally
40	Deoriya	Deoriya	Bisalpur	Pilibhit	28.372511	79.931016	1			More are seen in winter and summer
41	Saddia-Jhabar	Saddia	Banda	Shahjahanpur	28.22121	80.014545	5	2	Wetland	More are seen in summer
42	Fakerganj-Jhabar	Fakerganj	Sadar	Shahjahanpur	27.82528	80.03667	106	30	Wetland	Fazlu has seen 208 Sarus. WTI has seen 96 Sarus
43	Raipur Jhabar	Raipur	Sadar	Shahjahanpur	27 44 984	80 00 421	100	25-50	Marshland	WTI has seen 104 Sarus
44	Jhabar	Khutar	Powayan	Shahjahanpur	28.21675	80.273295	5	2	Wetland	More seen in summer
45	Jhabar	Kadhaiya	Powayan	Shahjahanpur	28.26627	80.292922	10	2	Wetland	Taking of eggs Mahawat community.
46	Jhabar	Laxmanpur	Powayan	Shahjahanpur	28.35005	80.024802	20	2	Wetland	Contact: Basudev 7002095431
47	Jhabar	Muradpur	Powayan	Shahjahanpur	28.24411	80.279653	50	4	Wetland	More are seen in winter and summer

Table. 8a. Important Sarus Wetlands (ISW) (contd.)

S. No.	Name of Wetland	Village	Tehsil	District	Latitude	Longitude	Size (Acre)	Sarus No.	Crop	Notes
48	Nohanna	Akelahanspur	Powayan	Shahjahanpur	28.33167	80.31639	7	2	Wetland	Data on nest reported in nest Proforma. GPS noted in first visit.
49	Pasgwan	Pasgwan	Powayan	Shahjahanpur	28.313318	79.941634	9			
50	Chawa-Begumpur	Chawa-Begumpur	Misrikh	Sitapur	27.72127	80.48815	17	10	Wetland	
51	Badhka	Shahjahanpur	Sidhauli	Sitapur	27.25627	80.88075	96	12	Wetland	
52	Rukundinpur	Rukundinpur	Misrikh	Sitapur	27.61343	80.37637	250	12	Wetland	
53	Badhaila	Badhaila	Biswan	Sitapur	27.49873	80.89387	47	14	Wetland	
54	Nauneri	Nauneri	Sitapur	Sitapur	27.70377	80.7535	300	20	Wetland	
55	Lodhasa	Lodhasa	Mahmudabad	Sitapur	27.29717	81.07308	140	28	Marshland	
56	Kathsaraiya	Behda	Sidhauli	Sitapur	27.28812	80.8769	150	30	Wetland	
57	Benipur	Benipur	Biswan	Sitapur	27.48622	80.97972	30	30	Wetland	
58	Talgaon	Talgaon	Laherpur	Sitapur	27.61958	80.85725	220	52	Marshland	WTI has also identified this wetland
59	Amitia	Amitia	Laherpur	Sitapur	27.74062	80.80367	600	61	Wetland	
60	Bada-Taal	Jyotishah-Alampur	Sidhauli	Sitapur	27.382	80.8509	199	89	Wetland	
61	Baddhar	Alipur	Misrikh	Sitapur	27.7497	80.6139	123	108	Wetland	
62	Ajaipur	Ajaiipur	Biswan	Sitapur	27.66495	81.24743	90	--	Ox-bow lake	
63	Bajehra	Bajehra	Biswan	Sitapur	27.44492	80.88942	22	10	Marshland	At least 2 pairs breed
64	Lauki Nevada	Lauki Nevada	Biswan	Sitapur	27.64883	81.2296	8	8	Marshland	A least 4 pairs breed
65	Sakrankhurd	Sakrankhurd	Biswan	Sitapur	27.56803	81.04677	22	27	Marshland	At least 6 pairs breed
66	Sarwahanpur	Sarwahanpur	Biswan	Sitapur	27.49958	80.8829	16	4	Wetland	2 pairs breed
67	Tendue	Tendue	Biswan	Sitapur	27.54072	80.89585	15	--	Wetlands	
68	Dahawa	Dahawa	Sidhauli	Sitapur	27.35195	80.91998	14	--	Marshland	
69	Shahjanpur	Shahjanpur	Sidhauli	Sitapur	27.25627	80.88075	28	__	Wetland	
70	Shivra	Shivra	Sidhauli	Sitapur	27.38722	80.95512	10		Marshland	
71	Sita-Rasoi	Sita-Rasoi	Sidhauli	Sitapur	27.33515	80.89307	29	--	Marshland	

Table. 8a. Important Sarus Wetlands (ISW) (contd.)

S. No.	Name of Wetland	Village	Tehsil	District	Latitude	Longitude	Size (Acre)	Sarus No.	Crop	Notes
72	Bhaunri	Bhaunri	Sidhauli	Sitapur	27.31765	80.06672	22	__	Wetland	
73	Sihanipara	Sihanipara	Mahmudabad	Sitapur	27.66523	80.72093	1.2	12	Marshland	6 pairs seen
74	Tappa-Khajuria	Tappa-Khajuria	Mahmudabad	Sitapur	27.57323	80.78615	47	__	Marshland	Ask Neeraj
75	AllipurBandia	AllipurBandia	Sitapur	Sitapur	27.7497	80.6139	37	6-8	Marshland	At least 2 pairs breed
76	Keshavpur	Keshavpur	Sitapur	Sitapur	27.71932	80.63313	10	2-4	Marshland	At least one pair breed
77	NaunerJhabber	Nauner	Sitapur	Sitapur	27.70377	80.7535	38	10-20	Marshland	At least 4 pairs breed
78	Chawa-Begumpur	Chawa-Begumpur	Sitapur	Sitapur	27.72127	80.48815	7	4-6	Marshland	At least one pair breed
79	Rukundinpurjhabbar	Rukundinpur	Sitapur	Sitapur	27.61343	80.37637	29	4-6	Marshland	At least 2 pairs breed
80	SinghauraJhabarJheels	Singhaura Jhaber	Sitapur	Sitapur	27.6426	80.52647	10	4	Marshland	Two pairs breed
81	UrdauliJhabbar	Urdauli	Sitapur	Sitapur	27.63905	80.51357	4	10	Marshland	4-6 pairs breed
82	Arsenijhabar I	Arsenijhabar I	Misrikh	Sitapur	27.53898	80.52027	27	55	Marshland	At least two pairs breed
83	Arsenijhabar II	Arsenijhabar II	Misrikh	Sitapur	27.5431	80.52293	9	6	Marshland	At least one pair breed
84	Shivtdhan jheels	Shivtdhan	Misrikh	Sitapur	27.4887	80.52325	6	6-8	Marshland	At least two pairs breed

Table 8b. Important Sarus Wetlands reported by WTI outside our study area

S.No.	Name of wetland	District	Area (ha)	No. of Sarus	No. of nests (year)	Importance of Sarus
1.	Baisarjheel	Maharajganj	230	>70	6-7 (2013)	Congregation and nesting
2.	Kamnahajheel	Maharajganj	210	19	3 (2013)	Congregation and nesting
3.	Paragpur	Maharajganj	100	20	7 (2013)	Congregation and nesting
4.	BadauliBankattijheel	Maharajganj	110	10	2 (2013)	Congregation and nesting
5.	Bisaulijheel	Faizabad	250	8	None	Roosting and foraging
6.	Udhailajheel	Faizabad	75	12	None	Roosting and foraging
7.	Sidsidjheel	Faizabad	85	Unknown number	None	Congregation and nesting
8.	EnjarTaal	Sultanpur	118	Unknown numbers	None	Congregation Site
9.	MadhaniTaal	Basti	10	Unknown numbers	None	Congregation Site
10.	ChadoTaal	Basti	650	>11	Not known	Congregation Site
11.	Bakhirajheel	Sant Kabirnagar	2900	170	7 (2013)	Congregation and nesting
12.	BelduhaTaal	Sant Kabirnagar	110	69	10 (2013)	Congregation and nesting
13.	SemraTaal	Siddhartha Nagar	108	18	5 (2013)	Congregation and nesting
14.	Masai Sagar jheel	Siddhartha Nagar	42	>10	3 (2013)	Congregation and nesting
15.	SondaTaal	Deoria	26	Unknown numbers	2-3	Congregation and nesting
16.	SakrailTaal	Shrawasti	90	Unknown numbers	5 (2013)	Congregation and nesting
17.	Nardahi	Barabanki	35	Unknown numbers	3 (20130	Roosting and nesting
18.	BadharaTaal	Kushinagar	15	>10	2 (2013)	Congregation and nesting
19.	PacharTaal	Kushinagar	2500	10	3 (2013)	Congregation and nesting

Based on our two years surveys, discussion with local experts, and literature review, we have identified 84 sites as Important Sarus Areas (ISA) in the seven districts of our study area (Table 8a). The main criteria for selecting these sites were: i) size and condition of the wetlands; ii) number of Sarus present; iii) Sarus breeding records; presence/absence of major threats; iv) land tenureship; v) representativeness (all districts should be represented); and, vi) support of people (not easy to gauge).

The Wildlife Trust of India (WTI) has identified 27 wetlands in eastern Uttar Pradesh from Pilibhit to Deoria as Important Sarus Wetland Sites (WTI 2015) based on four criteria: a) Congregation sites; b) Roosting site; c) Foraging site; and, d) Nesting site (Table 8b). In the next chapter, we have identified further 19 sites where we saw summer roosts of Sarus. Considering that there are nearly 20 wetland sanctuaries in Uttar Pradesh, we can easily say that a total of 142 sites are identified in the study area (of this project) and beyond that in Uttar Pradesh which can be used for long-term monitoring of Sarus numbers and nesting successes. We have not included the wetlands of Etawah-Mainpuri districts which are famous for Sarus Cranes, as this was beyond the scope of this study.

CHAPTER IV

Congregation of Sarus

Despite the fact that Sarus is frequently seen foraging in fallow land, crop fields, harvested fields and grasslands during day time, it prefers wet areas for night roosting. During monsoon and post-monsoon when it is breeding, it is generally found in wetlands and inundated crop fields, but as summer approaches, most of the smaller wetlands dry up or their water is used up or drained out by farmers. The larger wetlands retain some water where heavy to moderate livestock grazing takes place. People, particularly children, use the dried-up areas for play, putting heavy pressure on the Sarus. During day time, Sarus moves from such areas into crop fields to forage, loaf and congregate. However, for night roosting it goes to wetlands, sometimes flying long distances of 5-10 km.

There are two scenarios in Uttar Pradesh:

(a) In areas with low rainfall and limited ground water, very few wetlands retain water during peak summer months (May and June); only some larger ones do. These remaining wetlands are extremely crucial as Sarus Cranes use them for night roost. For example, in Danauri wetlands in Gautam Budh Nagar, 10-15 Sarus Cranes are seen during day time, but by late evening the population swells to 150-160, as individuals from the surrounding areas come to roost. For example, during a visit on 6 June 2017, only 30-40 Sarus were seen at around 17.30 hrs but soon the numbers rose to 90 as the evening progressed. Similarly, in Lakh-Bahosi Bird Sanctuary, during a visit on 20 May 2019, at 18.30 hrs, we counted eight Sarus in the puddles (most of the water in the sanctuary had dried out) but by 19:15 hrs, the number had gone up to 80 individuals. Another 60 individuals congregated to nearby puddles, thus a total of 140 Sarus were roosting in the Bahosi part of the Sanctuary. Another population was present in Lakh area, about 3 km away.

(b) In the main Terai area where groundwater is high and even in summer, ground water is available to grow paddy or sugarcane, large numbers of newly-irrigated paddy/sugarcane fields are present. Therefore, Sarus does not have to fly to distant wetlands for night roosting. In such areas, large summer roost congregations are generally not seen.

In order to locate important night roost sites, we conducted evening surveys in the summer of May-June 2019. A total of 19 wetlands were surveyed in Lakhimpur-Kheri, Hardoi, Shahjahanpur and Pilibhit districts (Table 9).

In summer, when most of the seasonal wetlands dry up and paddy cultivation is also over, Sarus congregates in the remaining wetlands, particularly for roosting. Therefore, we gave special attention to surveying till late evening the surviving wetlands in Lakhimpur, Shahjahanpur and Hardoi districts. In some areas, we were told that up to 100 Sarus congregate in such drying up wetlands.

However, we found very few such congregations. Lack of large congregations of Sarus indicates that during hot summer months (May-June) Sarus probably moves away from these districts. Another reason could be that 2017 was an insufficient-rainfall year in these districts, and most of the wetlands

Table. 9: Late evening roost count of selected wetlands in 2019 by two volunteers

S. No.	Site Name	Village	District	Date of visit	Coordinates	Total no. of Sarus seen	Total no. reported by locals	Remarks
1	Andhra Talaab	Motipur	Lakhimpur-Kheri	23 May 2019	N 28.117912 E 80.39637	6	Many	2 Juveniles
2	Jhabiriya	Chhatipur Raja	Lakhimpur-Kheri	24 May 2019	N 28.115273 E 80.371958	2+1	10-12	I juvenile. Contact Tilak Ram 7379867154
3	Nagariya Jhabbar	Nagariya	Lakhimpur-Kheri	27 May 2019	N 28.166793 E 80.380233	5	--	1 juvenile
4	Kasrawal Jhabbar	Kasrawal	Lakhimpur-Kheri	28 May 2019	N 27.882183 E 80.114002	51+4	50-60	Regular roost
5	Alipur Jhabbar	Alipur	Lakhimpur-Kheri	28 May 2019	N 27.971503 E 80.459083	76	—	12 Juveniles. Contact Denash Kumar 8112552020
6	Khamirya Jhabbar	Khamirya	Lakhimpur-Kheri	29 May 2019	N 27.868093 E 80.489692	8	Many	1 Juvenile
7	Majra Jhabbar	Majra	Lakhimpur-Kheri	30 May 2019	N 27.916173 E 80.080585	6	40-50	Little water so less Sarus this year
8	Agnepur Jhabbar	Agnepur	Lakhimpur-Kheri	30 May 2019	N 27.865297 E 80.450955	3	--	1 Juvenile. Irrigated crop fields all around
9	Narayanpur Jhabbar	Narayanpur	Lakhimpur-Kheri	3 June 2019		6	Many	Breeds regularly
10	Jhabbar	Dhundegaon	Pilibhit	9 June 2019	N 28.440405 E 80.058903	29	>40	8 Sarus were in nearby crop field
11	Hatela Jhabbar	Hatela	Lakhimpur-Kheri	11 June 2019	N 27.966472 E 80.166695	2	12	More roosting in irrigated fields
12	Pokhri Jhabbar	Pokhri	Hardoi	17 June 2019	N 27.426557 E 80.147705	7	Many	Many roosts in irrigated fields
13	Chabora Jhabbar	Chagora	Lakhimpur-Kheri	20 June 2019	N 27.858597 E 80.163005	3	Many	Many roosts in irrigated fields
14	Allipur Jhabbar	Allipur	Lakhimpur-Kheri	25 June 2019	N 27.782185 E 80.168112	4	Many	Disturbed by JCB of PWD to develop as fish pond
15	Bhagnapur Jhabbar	Bhatla	Lakhimpur-Kheri	26 June 2019	N 27.927342 E 80.135378	6	8-10	Large Jhabbar but mainly dry. Sarus always present
16	Jabalpurwa Jhabbar	Jabalpurwa	Hardoi	28 June 2019	N 27.693138 E 80.200002	8	>15	Few pairs breed regularly. Mainly dry so less Sarus
17	Nevada Jhabbar	Nevada	Hardoi	29 June 2019	N 27.504622 E 80.041822	5	5-6	Not many Sarus roost as irrigated field all around
18	Jarona Jhabbar	Jarona	Hardoi	30 June 2019	N 27.745938 E 80.181993	9	>20	Good roosting site of Sarus when other wetlands are dry
19	Mastipur Jhabbar	Mastipur	Lakhimpur-Kheri	1 July 2019	N 27.780273 E 80.16014	10	30-35	One died of electrocution a few years ago

PHOTO: VIKRAM TIWARI

In peak summer months of May-June, when shallow wetlands dry up, Sarus congregates in the remaining wetlands for night roosting. They show pre-roosting flocking behaviour, and many times individual pairs fly long distances to reach a wet area at dusk

PHOTO: BRIDESH KUMAR

CHAPTER V

Breeding

As in most wetland-dependent birds, breeding success of Sarus depends on the availability of water. In north India, monsoon is the breeding season of Sarus. Most nests are built in late July or early August when water fills up in the wetlands/depressions and paddy fields are flooded. In some suitable places, they also breed in February-March (e.g., seepage wetlands of Kota canal. Besides the quantity of monsoon water, pattern of rainfall is also important for successful breeding. Sarus Cranes need water in the wetlands/paddy for 3-4 months to make their large nests, lay and incubate eggs (about 30 days) and raise chick(s) largely hidden in vegetation for another 2-3 months before they are able to fly. Thus, their breeding is fine-tuned with the monsoon. In some drier areas, for example Kota in Rajasthan, seepage wetlands of large canals play an important role in the breeding success of Sarus (Kaur 2008).

In our study area, paddy and sugarcane are extensively cultivated. While paddy is a seasonal crop of 3-4 months duration, sugarcane takes 8-10 months to harvest. Sugarcane in any case is not suitable for either nesting or foraging of Sarus. Despite extensive canal network in the study area and easy availability of ground water, most paddy cultivation still depends on the annual monsoon. Although we have only two years data, we found very interesting results. In 2017, the monsoon was below normal in central Uttar Pradesh (average of 758 mm in seven studied districts), while in 2018, it was normal (1,013 mm). Due to insufficient rains in the study districts in the monsoon of 2017, we found very few breeding records. Out of 16 nests, eggs were stolen or destroyed in five nests, fate of six nests was unknown as we could not find chicks. Therefore, more than 50% of nests were failures. Even among eggs from which chicks hatched, we are not sure how many became juveniles.

However, in the monsoon of 2018, we monitored 26 nests and found that seven nests were in paddy fields, 18 in *jhabars* (wetlands) and one in paddy-wetland interface. When the chicks hatched, we monitored them as long as Sarus were in the area, sometimes for 50-70 days. We found that out of seven nests in paddy fields, five resulted in failure either due to removal of eggs or predation. Only two nests constructed in paddy fields were successful. Even in these two nests in the paddy field, chicks emerged but we could not monitor them for long as the parents took away the chicks due to human disturbances. Out of 18 nests in wetlands, 14 were successful in hatching chicks. One nest found in the interface of paddy-wetlands was a failure as the eggs disappeared due to unknown reasons (Table 10). Considering the overall success rate of hatching of chicks, it was very high (61%). However, we do not know how many chicks from these nests reached the juvenile stage. To assess the further developments, we did post-breeding monitoring from January to March.

Table 10. Nesting data of 2018

Nesting habitat	No. of Nests	Successful nests	Failed nests
Paddy	7	2	5
Wetland	18	14	4
Paddy-wetland	1	-	1

We found that in the study area, Sarus mainly breeds during monsoon and post-monsoon and early chicks are seen from August-September onwards. By winter, they reach the juvenile stage and move and fly with the parents. We consider breeding to be successful when a chick reaches juvenile stage and is able to fly and forage on its own. In Sarus, a juvenile will move with the parents for almost a year till the next breeding season. Therefore, we surveyed extensively from January to March to see how many Sarus pairs have juveniles. In the 2017 breeding season, we saw 202 pairs, both breeders and non-breeders (or whose chicks did not survive). In the 2018 breeding season, we saw 130 pairs (we were time-stretched taking data on other aspects which were not covered in 2017). From January to March 2018, we saw 17 pairs with 23 juveniles (some had two juveniles), while in 2019, we counted 41 pairs with 65 juveniles. We have only two years data, but it clearly indicates the importance of good rainfall on the breeding success of Sarus. To ensure that the same pair is not counted twice, we surveyed extensively in all the districts.

We have done test of proportion with correction for continuity in Program R (R core team 2013). There is a significant difference in pairs with juvenile (Chi-square=27.7, df=1, p=0.0001) and overall juveniles (Chi-square=58.6, df=1, p=0.0001) with breeding pairs in poor and good rainfall years. This further proves that normal (that is good) rainfall plays an important role in the breeding success of Sarus.

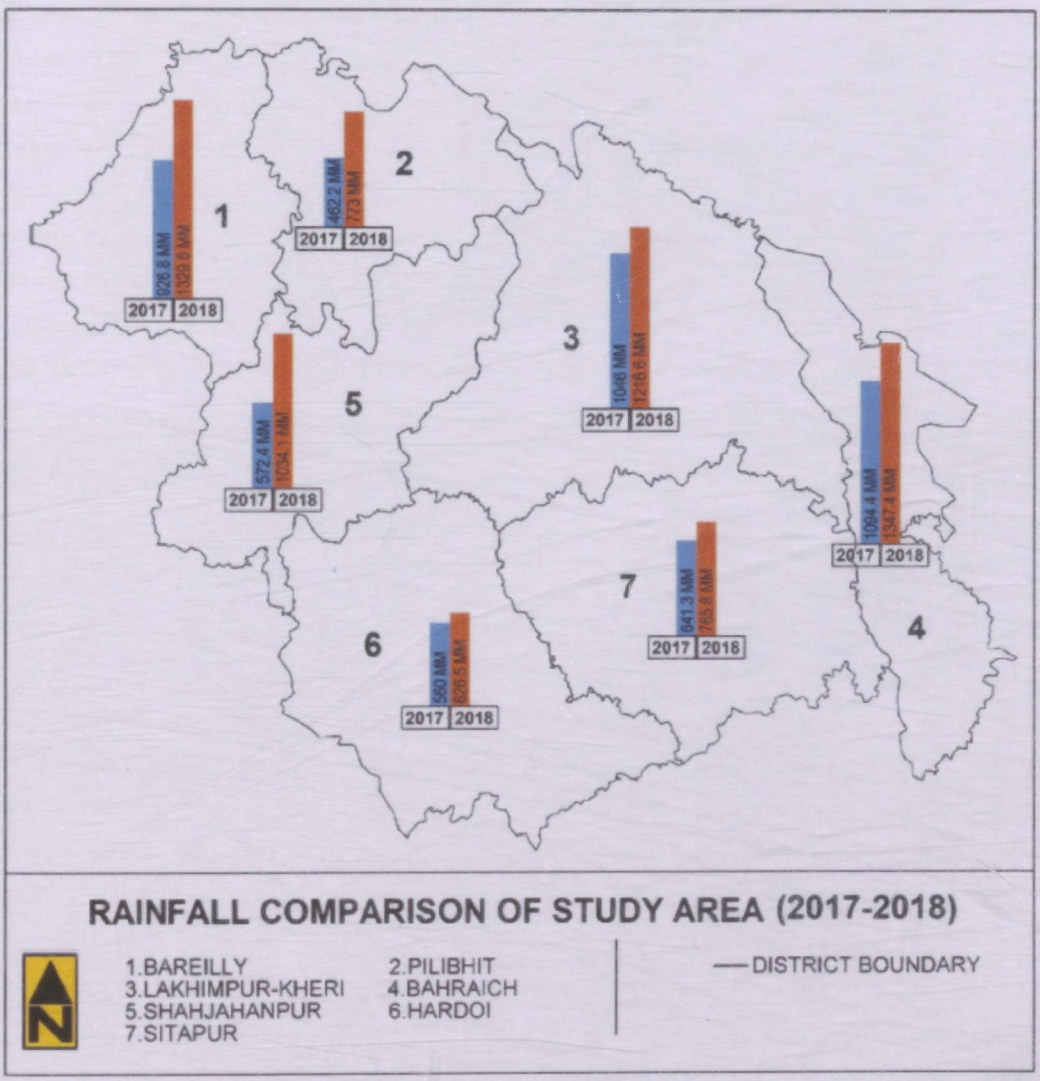


Fig. 15. Rainfall quantum in 2017 and 2018 in the study area

Table 11. Analysis of breeding success data of 2017 and 2018 through the presence of juveniles [Reference: R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria]

Year	Rainfall (mm)	Breeding season observations of pairs	Pairs with juveniles (January-March)	Total Juveniles	Test of proportion-Chi square, pair with juvenile	p	Test of proportion-Chi square, juvenile vs breeding pairs	p
2017	758	202	17 (2018)	23 (2018)	27.7	0.001	57.6	0.0001
2018	1013	130	41 (2019)	65 (2019)				

*Test of Proportion

In a low rainfall year (2017), the percentage of pairs that had juveniles was 8.41% (as seen after 6-8 months in 2018), while in normal rainfall year (2018), 31% pairs had at least one chick with them (as seen from January to March 2019).

In 2002, Borad *et al.* (2002) published the breeding performance of the Sarus Crane that they studied in agricultural landscape of Gujarat during 1996. They studied 22 nests and kept detailed records from egg-laying till fledging. They found that 11 clutches (50.0%) produced at least one chick. Ten clutches (45.45%) were destroyed due to various mortality factors, and one clutch (4.50%) failed to hatch. Interestingly, they found that of the 10 pairs whose clutches were destroyed, at least four re-nested. Egg destruction was mainly due to flooding (12.20%), predation (21.95%) and conflicts with farmers (14.64%). Predation accounted for 32% of chick mortality. Hatching success was higher in non-cultivable agricultural marshland (68.18%) compared to paddy cultivated marshland (38.48%), mainly due to human disturbance and higher predation risk. Overall breeding success was 19.51% (Borad *et al.* 2002). They also found that overall juveniles comprise only 9% of the total number of Sarus Cranes sighted during the post-breeding period.

One of the causes of poor breeding performance in the agricultural landscape was increasing conflict with the farmers, who suffer economic loss due to nesting in the crop field. If compensated, farmers may help in Sarus Crane conservation efforts (Borad *et al.* 2002).

In a slightly longer-period study by the same team from 1996 to 1998, the results were slightly different. Based on the study of 70 nests Mukherjee *et al.* (2002) found that at least one chick hatched from 50 clutches (71.43%), 19 clutches were destroyed due to various factors, but at least seven pairs re-nested. Egg mortality was mainly due to flooding (7.35%), predation (11.03%) and conflict with farmers (8.09%). Chick mortality due to predation was 8.24% and to other unknown factors was 30%. Number of chicks hatched and number fledged did not differ significantly in different microhabitats. Based on 70 nests, they found that the average breeding success was about 26%. In a one-year study, it was 19% (Borad *et al.* 2002). Mukherjee *et al.* (2002) also found that the breeding success was comparatively lower in paddy crop fields than in other microhabitats due to human disturbance and higher predation risk. The juveniles formed only 10.14% of the total Sarus sighted during the post-breeding period, which is not very different from one-year study of Borad *et al.* (2002) who noted 9%.

Non-seasonal breeding has been reported from some areas (e.g. Rajasthan by Jatinder Kaur 2008), but the renowned Sarus Crane expert, Dr. K.S. Gopi Sundar found that out of nearly 5,000 instances of breeding, less than 0.3% of such records were of unseasonal breeding. He also found that all of the unseasonal nestings were related to irregular water supply in the cranes habitat. This supply was either from rainfall that occurred outside of the regular monsoon season, or from irrigation canals that artificially kept the landscape wet. In the Terai area, particularly in Lakhimpur-Kheri, Pilibhit and Sitapur districts, we found that paddy is cultivated even during summer with pumped water (using generators) as the water table is quite high. However, we did not find any unseasonal nest of Sarus in such crop fields, which are mostly owned by rich farmers whose tolerance level to Sarus appears to be less benign than the traditional farmers.

PHOTO: ASAD R. RAHMANI

An abandoned nest where the eggs disappeared (above), and an active nest (below)

PHOTO: DHRITIMAN MUKHERJEE

PHOTO: ASAD R. RAHMANI

A nest close to forest area near Bhira was abandoned when one of the individuals died due to electrocution (above). A more successful pair with a chick (below)

PHOTO: DHRITIMAN MUKHERJEE

Chapter VI

Food of Sarus

Sarus Cranes omnivorous and forage in shallow wetlands, inundated crop fields, fallow fields and margins of small rivers. Their diet consists of fallen grains, tubers, roots, aquatic insects, grasshoppers, tadpoles, small fish, eggs of birds, as well as several species of aquatic plants. They have been seen to feed on larger vertebrates such as water snake, fish and baby turtles, but this is very rare. Many times, they catch a large fish or a frog, peck at it desultorily, and may eat a few pieces if the prey breaks up, leaving the rest. Among aquatic vegetation, they eat tubers, corn, and grass shoots. Tubers of aquatic and semi-aquatic plants appears to be their main diet, and Sarus can be seen probing in the soil for a long time till they extract the tuber. They probe into the depth as fas as their large beak can reach. Sometimes they even submerge their head for a brief period to reach a particular tuber. They eat seeds and grains, such as exposed groundnut, and fallen rice and wheat. Agricultural crops, however, do not constitute a major diet of the Sarus and hence they are tolerated by farmers in the agricultural landscape (Choudhury and Rahmani, 2014).

In the study area, rice, wheat and sugarcane are the main crops covering more than 80% of the total agricultural acreage. There is no danger to sugarcane plantation from Sarus, and similar is the case with rice seedlings are planted in the crop fields. Sarus is seen in newly planted rice and sugarcane fields mainly due to presence of water. Some farmers consider it useful as it eats insects, both aquatic and terrestrial. However, when wheat is planted by spreading seed the grains on the soil, Sarus can do some damage, eating exposed grains and sprouts. During this initial period, farmers take extra care of their crop fields and do not allow Sarus to come near.

Although Sarus is seen in standing crop, particularly when it is watered, we have never seen Sarus eating ripening crop of wheat and rice, perhaps due to the presence of hairy projections called awn on the spikelets that protect the developing grain. In botanical terms, an awn is a long hair or bristle-like appendage on any larger structure. It is found in wheat and rice and prevents predation by animals. Even herbivores avoid awns (of ripening grains) as they injure their tongues. Many cultivated varieties have short awns, while wild varieties of rice have long awns.

In India, rice is the second most important crop, and in our study area, it was the dominant crop along with sugarcane, sometimes cultivated throughout the year. Sundar and Subramanya (2010) have shown that rice fields are used by at least 351 species of birds in the Indian subcontinent, though only 2.7% of the birds breed in the rice fields. They find that the spread of rice cultivation could have benefited 64 common species, but is threatening many more species through changes in the natural habitat. Destruction of nests during harvest could be one of the reasons; this is particularly so when machine harvesters are used. This is a world-wide phenomenon and has resulted in the decline of many farmland species that nest in agricultural fields. A huge body of literature is available on this aspect (e.g. Fuller *et al.* 1995; Pain and Pienkowski 1997; Donald *et al.* 2001; Murphy 2003; Newton 2004; Green *et al.* 2005; Eaton *et* al. 2010; Kirk *et al.* 2011) but not much work has been done on this

PHOTO: ASAD R. RAHMANI

PHOTO: CHOTU KHAN

Sarus feeds on fallen grains (above, tubers, seeds, small fish, and sometimes on birds eggs below)

PHOTO: SARUS TEAM

Soon after harvesting of wheat, we counted the fallen grains and awn (above) and ground cover (below)

PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

We investigated the number of fallen wheat grains in the traditional harvest method (above) and mechanical harvest methods (below)

PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

Various types of machines used for harvesting wheat

aspect in India. Borad *et al.* (2000) estimated the fallen rice grains available to birds in Kheda district, Gujarat. They found that an average quantity of shattered grains was 106.26 kg/ha, ranging from 50.06 kg/ha to 198.19 kg/ha. Almost 90% of grains left on the ground disappeared within a four-week period after harvesting. Although this study is not confined to Sarus, it is interesting to know how fallen grains (if not picked up by villagers) has a high value for conservation of farmland birds. Sundar (2009) has shown that Sarus in Uttar Pradesh largely uses rice fields for nesting and foraging, although rice fields may be suboptimal habitat for them. The high density of Sarus in Uttar Pradesh could be due to the long history of cultivation of rice, tolerance of people, irrigation facilities developed from the British period (large network of canals), and cultural and societal acceptance of Sarus Crane as a part of the landscape.

After harvest, Sarus is seen in wheat and rice fields picking up the fallen grains. Wheat is harvested in two ways: manually or by machines called harvesters. Traditionally, wheat is harvested manually by cutting with a scythe or sickle and the cut crop is kept in bundles for a few days to dry. During the process, some grains and spike/ear/head fall on the ground (spike or ear or head is the part of cereal where grains are found).

We conducted a small study to find out which wheat harvesting system is beneficial to the Sarus crane. In the machine harvesting system, now employed by rich farmers, harvested wheat is gathered while hay is separated and either thrown back or collected by the machine. We also found another method where wheat is first harvested from the top of the plant, and the remaining plant (crop residue: stalks and stubble) is left standing for some time. After a few days or on the same day, another machine is used to remove the crop residue (hay). Lot of small pieces of crop residue remain on the ground, so the field is burnt (although illegal now) or ploughed back. This way, whatever little grain remains on the ground is also burnt.

We wanted to know which method is Sarus friendly (i.e. provides maximum fallen grains to the bird):

a) Manually harvested wheat ('Hand' in short)
b) Machine harvested with complete removal of crop residue and wheat at the same time ('Machine' in short)
c) Machine harvested top of wheat (*bali*) but crop residue is left and harvested (later) by another machine ('Bali harvest' or "Residue' in short)

We used 50 cm quadrats to count the number of fallen grains, number of ears/heads, and percentage area covered by hay or crop residue (more ground area covered means, a smaller number of grains visible to Sarus).

We randomly selected each type of harvested wheat fields and randomly placed the quadrat. In each type of harvested field, 100 quadrats were studied.

Table 12: The basic parameters of all variables i.e. wheat seed, awn (bali) and husk fallen in Manual and Machine harvested fields; Machine-Complete harvest, and Residue-Top harvest

		N	Number of grains (Mean)	Std. Deviation	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Wheat Seeds	a) Manual	100	6.39	28.150	0.80	11.98
	b) Machine	100	16.07	16.448	12.81	19.33
	c) Residue	100	18.58	30.839	12.46	24.70
Husk Cover %	a) Manual	100	0.88	2.095	0.46	1.30
	b) Machine	100	23.22	28.416	17.58	28.86
	c) Residue	100	34.70	34.647	27.83	41.57
Bali (ripe head with grains)	a) Manual	100	0.53	0.870	0.36	0.70
	b) Machine	100	2.23	2.677	1.70	2.76
	c) Residue	100	0.32	0.737	0.17	0.47

To compare the difference in fallen wheat, Awn (*Bali*) and husk in the field, Kruskal Wallis Nonparametric ANOVA and Dunn test (with Bonferonii option) was used for multiple comparison. Kruskal Wallis test was done as data was not normally distributed. 100 plots were laid in each harvest type, totalling 300 quadrats of 50 cm^2 size. The effect of harvesting was assessed by Test of Proportion.

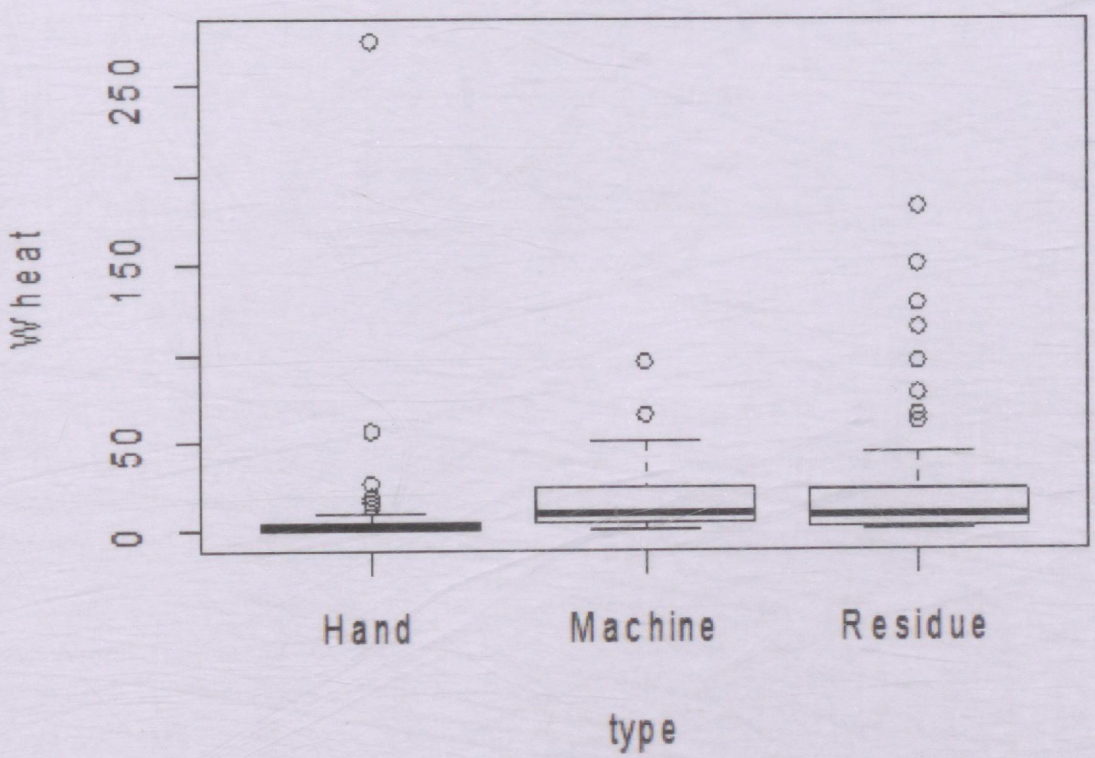


Fig. 16. Comparison (Box-whisker plot) of fallen wheat grains in different harvesting methods, Hand-Manual harvesting, Machine- Full removal by harvester, Residue-Top removal by harvester

Kruskal-Wallis chi-squared = 67.379, df = 2, p-value =2.338e-15

Multiple Comparison test

	Comparison	Z	P.unadj	P.adj
1	Hand - Machine	-7.634535	2.266362e-14	6.799087e-14
2	Hand - Residue	-6.428652	1.287406e-10	3.862218e-10
3	Machine - Residue	1.205884	2.278624e-01	6.835872e-01

There is a significant difference (KW= 67, p= 0.0001) in fallen wheat in the fields by three harvesting methods. All pairs of Hand (a), Machine (b), and Bali Harvest or Residue (c) methods found to be significantly different (P=0.0001). Fig. 16 indicates that least wheat is available in the fields harvested manually or harvested by hand method, contrary to the belief that there will be more wastage in this method of harvest.

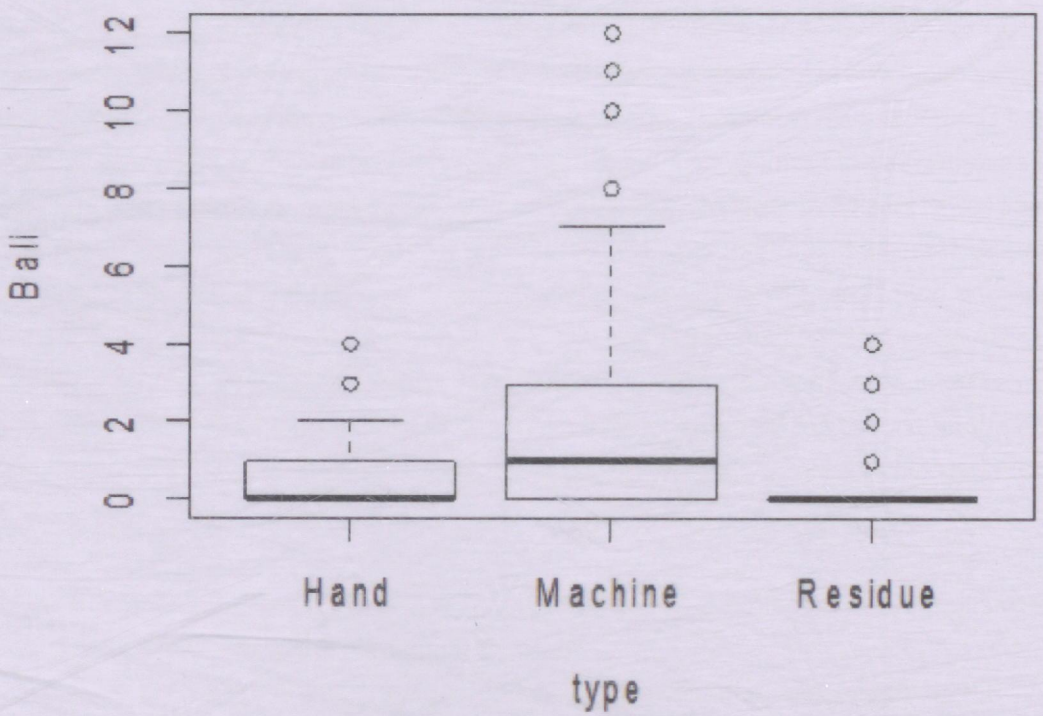


Fig. 17: Comparison (Box-whisker plot) of fallen awn (Bali) in different harvesting methods, Hand-Manual harvesting, Machine- Full removal by harvester, Residue-Top removal by harvester

Kruskal-Wallis chi-squared = 62.871, df = 2, p-value =2.228e-14

	Comparison	Z	P.unadj	P.adj
1	Hand - Machine	-5.790935	6.999557e-09	2.099867e-08
2	Hand - Residue	1.795135	7.263219e-02	2.178966e-01
3	Machine - Residue	7.586070	3.297538e-14	9.892613e-14

There is a significant difference (KW= 63, p= 0.0001) in fallen wheat awn (*bali*) in fields by three harvesting methods. All pairs of Hand, Machine and Residue type methods found to be significantly different (P=0.0001). Fig. 17 indicates that least wheat grains are available in the fields harvested manually or harvested by hand, contrary to the belief there will be more wastage in hand method of harvest. Maximum grains were available by mechanical method.

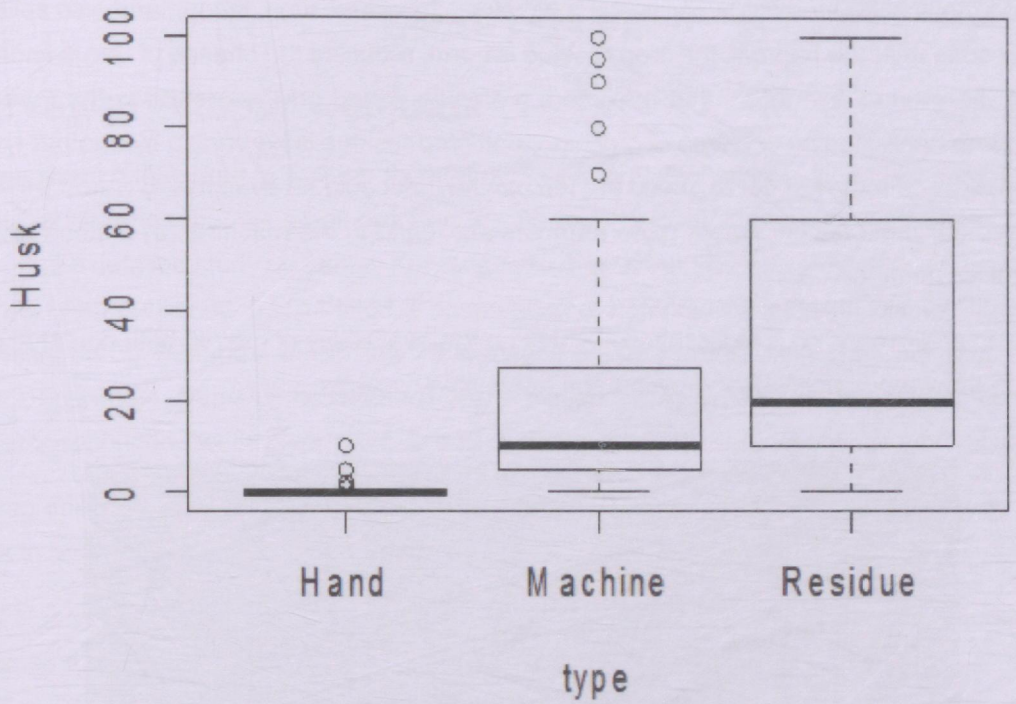


Fig. 18: Comparison (Box-whisker plot) of fallen husk in different harvesting methods, Hand-Manual harvesting, Machine- Full removal by harvester, Residue-Top removal by harvester

Kruskal-Wallis chi-squared = 132.72, df = 2, p-value <2.2e-16

	Comparison	Z	P.unadj	P.adj
1	Hand - Machine	-	8.833785	1.011924e-18 3.035773e-18
2	Hand - Residue	-	10.821197	2.731853e-27 8.195558e-27
3	Machine - Residue	-	1.987413	4.687669e-02 1.406301e-01

There is a significant difference (KW= 63, p= 0.0001) in fallen wheat husk in fields by three harvesting methods. All pairs of Hand, Machine and Residue-type methods found to be significantly different (P=0.0001). Fig. 18 indicates the least wheat is available in fields manually or harvested by hand contrary to belief that more wastage will be in hand method of harvest. Maximum wheat available was by Residue method (when awn is first harvested, followed by residue removal).

This is contrary to expectations. The normal view would be that the traditional method would provide more fallen grains and ear/head (*bali*) to the Sarus (and other birds). We found in the field that when traditional method is employed, a large number of people including children gather to cut the crop very systematically and collect any fallen ear/head (this is mostly done by children). The method is sometimes so efficient that hardly any grain is left behind. The second reason could be that in the traditional method, wheat is harvested just a few days before it is completely ripe and ready to fall out from the ear (called dehiscence or shattering). From an agriculture point of view, it is beneficial to reduce or prevent dehiscence, therefore agricultural scientists have developed wheat varieties (and other crops also) where dehiscence or shattering is delayed or/and reduced, so the crops now retain the seeds for a longer period, thus increasing the crop yield.

When the crop is harvested by machine, the main aim is to reduce time, labour, and also spillage. We found that soon after the harvest, the crop residue is burnt, reducing the chance of Sarus finding fallen grains on the ground. We found that maximum grain was found on the ground in the third method where grain is harvested by one type of machine, and crop residue is harvested by another type. After the crop residue is removed, lot of grains are left behind that could be available to Sarus. However as far as fallen ear (bali) is concerned, more numbers are found in the machine (b) method and lowest in Residue (c) method.

Our study is preliminary, so a more detailed study on the availability of grains, both rice and wheat, is required in the various rice/wheat growing and harvesting systems.

PHOTO: ASHOK CHAUDHARY

Sarus feeds on small fish, frogs and aquatic insects, but generally eats small pieces and leaves the the prey

CHAPTER VII

Resurvey of Sitapur wetlands

Two years is not a long time to monitor the status of wetlands. Therefore, we are not commenting on the status of wetlands that we studied during the Sarus project (July 2017 to June 2019). We were fortunate that a detailed study by Sanjay Kumar and Neeraj Srivastava on selected wetlands of Sitapur District had been published in 2011 titled "Conservation of Potential Wetlands in District Sitapur". This study described 30 wetlands, out of the 75 wetlands present in the district, as per records of the Irrigation Department. Name of the wetland, type of wetland, area in hectares, ownership, coordinates and general description were given (Kumar and Srivastava 2011). Sarus sightings were also given.

In order to find out the general status of the wetlands, we conducted a detailed resurvey of all 30 wetlands in May 2019. We give below the results of our survey of Sitapur wetlands.

Presence/absence of water: Eight wetlands were completely dry. This happens in summer in some wetlands, so this is not an alarming situation.

Encroachment: We found severe to moderate encroachment in 19 wetlands. This was in the form of building houses or other man-made structures.

Agricultural expansion: Only in three wetlands, we did not notice any agricultural expansion, rest of the wetlands had crop fields eating away major parts of the wetlands.

Fishing: Fishing was reported to us in 18 wetlands.

Over-grazing: While limited livestock grazing is good for tropical floodplain wetlands, over-grazing severely impacts the vegetation and breeding of ground-nesting bird such as larks, Red-wattled Lapwing, prinias, and even Sarus Crane. We found severe over-grazing in 13 wetlands during our visit. Moderate to little grazing was seen in remaining wetlands, particularly at the recently-exposed parts.

Earth digging: While some earth removal by villagers for their own consumption use is acceptable as this also helps in deepening of a wetland, large-scale removal of earth from a dried-up wetland changes the character of a wetland. This was seen only in Badataal near Tappa Khajuria, Sitapur tehsil, Thana Kheravat. It was a small wetland of about 47 ha (Kumar and Srivastava 2011) but we found that it has shrunk to about 7 ha.

Diversion of water: In two wetlands (Badalia and Sakrankhurd, both in Biswan tehsil) we noticed diversion of water.

Ownership of wetlands: Out of 30 wetlands surveyed, only two wetlands were owned by the Forest Department. They were Sakrankhurd, Biswan Tehsil, and Badhar wetland near Alipur in Maholi tehsil. The rest of the wetlands were owned either fully by the Gram Sabha (25 wetlands) or jointly with the Forest Department (3 wetlands).

Status of Sarus in Sitapur wetlands: Kumar and Srivastava (2011) have specifically mentioned Sarus as resident in all the wetlands, and also given range-wise numbers (e.g. Biswan range, 33;

Bajehra

Badaila

Lauki Nevada

Tendua

Dahawah

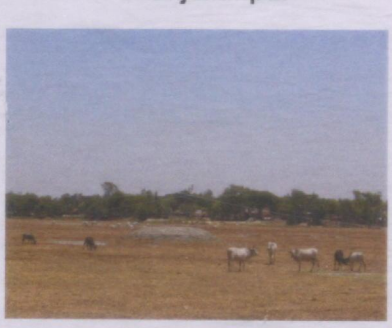
Jyotishah Alampur

Kathsaraiya

Shahjahanpur

Keshavpur

Shivra



Teppa-Khajuria

Bhaunri

Lodhasa

Sihanipara

Talgaon

Images of selected wetlands of Sitapur that were surveyed to compare their status with 2010-11 data. All images by Prakash Mehta

Hargoan range, 44; Laharpur range, 45, and so on) but wetland-wise Sarus numbers were not given by them. During our survey in May 2019, we counted the Sarus and also gathered information from the local people. We saw Sarus in 10 wetlands, generally a pair, but 11 were seen in Amitia wetland, Laherpur tehsil. In another ten wetlands, Sarus was reported to us by villagers. The number varied from 2 to 24 (Badataal, near Jyotishah Alampur village, Sidhauli tehsil), 30 (Benipur, Biswan tehsil), to 50 (Amitia, Laharpur tehsil).

The maximum number of Sarus reported to us was 50 individuals from Amitia wetland where we saw 11 birds. Other noteworthy records of summer numbers are 30 birds in Benipur in Biswan tehsil, and 24 birds in Badataal, JyotishahAlampur village, Sidhauli tehsil.

We also asked for winter congregation records. We found that in 11 wetlands, Sarus congregate in large numbers in winter. More than 100 were reported from Badhhar wetlands, Alipur, Maholi tehsil, and 65 from Badataal, Jyotishah Alampur, Sidhauli tehsil. Other noteworthy record is from Telgaon wetlands, Laharpur tehsil where 50 were recorded in winter.

Threat to Sarus: Electrocution or injury after collision with powerlines is becoming a major threat to Sarus, like for most birds. While conducting the survey of 30 wetlands, we gave special emphasis to find out the presence/absence of powerlines, and their distance from the wetlands. Out of 30 wetlands, we found high tension wires in eight wetlands. In three wetlands (Sarwahanpur in Biswan tehsil, Nauher in Sitapur tehsil, and Arsenijhabar, near Arseni village, Misrikh tehsil), high tension powerlines run over the wetlands, and in two they were within 10 m (Badkhapur talab, Shahjahanpur village, Sidhauli tehsil, and Keshwapur village, Sitapur tehsil). In three wetlands, powerlines were from 100 m (Rukundinpur, Maholi tehsil), 300 m (Benipur, Biswan tehsil) to 400 m (BaherJhabbar, Singhaura village, Maholi tehsil). In 22 wetlands, we did not find high tension wires. However, in 11 wetlands we found low tension wires. In all, we found powerlines in 17 wetlands, either low tension or high tension.

Status of Sitapur wetlands: It is very encouraging that the 30 wetlands that were studied and data recorded by Kumar and Srivastava in 2010-2011, are still surviving, albeit the threat of encroachment, siltation, eutrophication, Water Hyacinth, pollution, overfishing, and neglect is faced by all of them. In some wetlands, we found pillars demarcating the boundary of wetlands. Taking these wetlands as an example, we reiterate that proper site-specific Management Action Plans, catchment area treatment, desiltation, weed control, alternative fisheries options, and community participation should be initiated as had been suggested by Kumar and Srivastava (2011). These wetlands should be included by the State Wetland Authority, and some may be included in the National Wetland Conservation Programme of the MoEF&CC.

Table. 13. Wetland information available in the booklet Conservation of Potential Wetlands in District Sitapur (Sanjay Kumar and Neeraj Srivastava 2011). All the wetlands were surveyed by us in May-June 2019

S. No.	Name	Tehsil	N	E	Size (ha)*	Sarus (Breeds)	Maximum Sarus flock	Major threats as seen in 2010
1	Ajjaipur	Biswan	27.66495	81.24743	92	Yes	--	1,3,4
2	Bajehra	Biswan	27.44492	80.88942	22	2 pairs	10	1,4,6
3	Badaila	Biswan	27.49873	80.89387	18	Yes	--	1,6,7
4	Benipur	Biswan	27.48622	80.97972	19	2 pairs	6	1,6,7
5	Lauki Nevada	Biswan	27.64883	81.2296	8	Yes	4	3,5,
6	Sakrankhurd	Biswan	27.56803	81.04677	22	6 pairs	37	1,3,7
7	Sarwahanpur	Biswan	27.49958	80.8829	16	Yes	4	3
8	Tendua	Biswan	27.54072	80.89585	15	Yes	--	1,2
9	Dahawah	Sidhauli	27.35195	80.91998	14	Yes	--	2,3
10	Jyotishah Alampur	Sidhauli	27.382	80.8509	34	2 pairs	6	3,6
11	Kathsaraiya	Sidhauli	27.28812	80.8769	30	Yes	4-6	2,3, 5,6
12	Shahjahanpur	Sidhauli	27.25627	80.88075	28	Yes	--	3,4.6,7
13	Shivra	Sidhauli	27.38722	80.95512	10	Yes	--	2,3,4
14	Sita Rasoi	Sidhauli	27.33515	80.89307	29	Yes	--	6
15	Bhaunri	Sidhauli	27.31765	80.06672	22	Yes	--	2,3,6
16	Lodhasa	Mahmudabad	27.29717	81.07308	58	Yes	--	3,4,7
17	Sihanipara	Mahmudabad	27.66523	80.72093	1.2	6 pairs	40	2,3
18	Tappa Khajuria	Mahmudabad	27.57323	80.78615	47	Yes	--	3,6,7
19	Talgaon	Sitapur	27.61958	80.85725	45	I pair	8-10	1,2,3,5,6
20	AllipurBandia	Sitapur	27.7497	80.6139	37	2 pairss	6-8	1,2,3,
21	Amitia	Sitapur	27.74062	80.80367	48	1 pair	4-6	1,2,3,6
22	Keshavpur	Sitapur	27.71932	80.63313	10	1 pair	2-4	2,3,6,7
23	Nauner	Sitapur	27.70377	80.7535	38	4 pairs	10-20	1,2,3,4,5
24	Chawa-Begumpur	Sitapur	27.72127	80.48815	7	1 pair	4-6	1,2,3,6
25	Rukundinpur	Sitapur	27.61343	80.37637	29	2 pairs	4-6	2,6,7
26	SinghauraJhaber	Sitapur	27.6426	80.52647	10	2 pairs	4	1,2,3
27	Urdauli	Sitapur	27.63905	80.51357	4	4-6	10	1,3,5,7
28	Arsenijhabar II	Misrikh	27.5431	80.52293	9	1 pair	4-6	1,2,3,5,7
29	Shivthan	Misrikh	27.4887	80.52325	6	2 pairs	6-8	1,2,3
30	Arsenijhabar I	Misrikh	27.53898	80.52027	27	2 pairs	55	1,3,6

*Figures were rounded off

Major threats as seen in 2010: 1. Encroachment; 2. Drainage/Irrigation; 3. Water Hyacinth; 4. Poaching; 5 Pollution; 6 Fishing, 7. Trespassing

Table 14: Number of Sarus seen and data gathered during our survey in May 2019 of Sitapur wetlands

Sr. No.	Name of wetland	Number of Sarus seen	No. Of Sarus reported	Resident	Occasional	Winter visitor
1	Ajjaipur	-----	-----	-----	Yes	-----
2	Bajehra	2	2	Yes	-----	-----
3	Badhaila	2	12	Yes	-----	-----
4	Benipur	-----	30	Yes	-----	-----
5	Lauki	-----	4	Yes	-----	-----
6	Sakrankhurd	-----	-----	-----	-----	-----
7	Sarwahanpur	2	2	Yes	-----	Yes
8	Tendua	-----	-----	-----	-----	-----
9	Dahawah	-----	-----	-----	-----	-----
10	Badataal	-----	24	Yes	-----	65
11	Kathsaraiya	-----	20	Yes	-----	10
12	Badhka	-----	2	Yes	-----	10
13	Shivra	2	4	Yes	-----	-----
14	Sita	-----	4	Yes	-----	-----
15	Bhaunri	2	4	Yes	-----	-----
16	Lodhasa	2	4	Yes	-----	22
17	Sihanipara	-----	-----	-----	-----	-----
18	Talgaon	2	2	Yes	-----	-----
19	Amitia	-----	50	-----	-----	50
20	Badhhar	-----	8	Yes	-----	100
21	Badataal	11	4	Yes	-----	-----
22	Keshawpur	-----	-----	-----	-----	-----
23	Nauneri	-----	4	Yes	-----	16
24	Chawa-begumpur	2	8	Yes	-----	-----
25	Rukundinpur	-----	12	Yes	-----	-----
26	Baherjhabbar	2	4	Yes	-----	Yes
27	Pehna	-----	-----	-----	-----	Yes
28	Arsenijhabar	-----	4	Yes	-----	-----
29	Mansarovar	-----	2	Yes	-----	-----
30	Arsenijhabari	-----	2	Yes	-----	6

Table. 15. Threats to Sitapur wetlands as perceived/seen in May 2019

Sr. No.	Name of wetland	Encroachment	Agriculture	Fishing	Over grazing	Earth mining	Diversion of water	Mobile Tower	Electricity Wire (distance m)	High tension (distance m)	Absent
1	Ajjaipur	Yes	Yes	-----	Yes	-----	-----	-----	1	-----	-----
2	Bajehra	Yes	Yes	Yes	-----	-----	-----	-----	10	-----	-----
3	Badhaila	-----	-----	Yes	-----	-----	Yes	-----	20	-----	-----
4	Benipur	-----	Yes	Yes	-----	-----	-----	-----	-----	300	-----
5	Lauki	Yes	Yes	Yes	-----	-----	-----	-----	10	-----	-----
6	Sakrankhurd	Yes	Yes	-----	-----	-----	Yes	-----	-----	-----	Yes
7	Sarwahanpur	Yes	Yes	Yes	-----	-----	-----	-----	-----	1	-----
8	Tendua	-----	Yes	-----	-----	-----	-----	-----	10	-----	-----
9	Dahawah	Yes	Yes	-----	Yes	-----	-----	-----	-----	-----	Yes
10	Badataal	Yes	Yes	Yes	Yes	-----	-----	-----	-----	-----	Yes
11	Kathsaraiy	Yes	Yes	Yes	Yes	-----	-----	-----	10	-----	-----
12	Badhka	Yes	Yes	Yes	Yes	Yes	-----	Yes	10	10	-----
13	Shivra	-----	Yes	-----	-----	-----	-----	-----	-----	-----	Yes
14	Sita	Yes	Yes	-----	-----	-----	-----	-----	-----	-----	Yes
15	Bhaunri	-----	Yes	-----	-----	-----	-----	-----	-----	-----	Yes
16	Lodhasa	-----	Yes	Yes	Yes	-----	-----	-----	-----	-----	Yes
17	Sihanipara	-----	Yes	Yes	-----	-----	-----	-----	-----	-----	Yes
18	Talgaon	Yes	Yes	Yes	Yes	Yes	-----	-----	-----	-----	Yes
19	Amitia	-----	Yes	Yes	Yes	-----	-----	-----	20	-----	-----
20	Badhhar	-----	Yes	Yes	-----	-----	-----	-----	-----	-----	Yes
21	Badataal	Yes	Yes	Yes	Yes	-----	-----	-----	-----	-----	Yes
22	Keshawpur	-----	-----	Yes		-----	-----	-----	-----	10	-----
23	Nauneri	Yes	Yes	-----	Yes	-----	-----	-----	-----	1	-----
24	Chawa-begumpur	-----	Yes	Yes	-----	-----	-----	-----	-----	-----	Yes
25	Rukundinpur	Yes	Yes	-----	-----	-----	-----	-----	-----	100	-----
26	Baherjhabbar	Yes	Yes	Yes	Yes	-----	-----	-----	-----	400	-----
27	Pehna	Yes		Yes		-----	-----	-----	1	-----	-----
28	Arsenijhabar	Yes	Yes	-----	Yes	-----	-----	-----	1	1	-----
29	Mansarovar	Yes	Yes	-----	Yes	-----	-----	-----	1		-----
30	Arsenijhabari	Yes	Yes	Yes	-----	-----	-----	-----	-----	-----	Yes

Table 16: Ownership, size and water spread of Sitapur wetlands as seen in May 2019

Sr. No.	Name of wetland	Ownership Gramsabha	Forest	Mixed ownership	Maximum size of wetland (acre)	Minimum size of wetland (acre)	Current size of water spread (acre)	Water Presence
1	Ajjaipur	Yes	-------	-------	600	100	100	Y
2	Bajehra	Yes	-------	-------	65	20	20	Y
3	Badhaila	Yes	-------	-------	47	4	8	Y
4	Benipur	Yes	-------	-------	30	15	15	Y
5	Lauki	Yes	-------	-------	180	15	15	Y
6	Sakrankhurd	-------	Yes	-------	0	0	0	N
7	Sarwahanpur	Yes	-------	-------	100	1	2	Y
8	Tendua	Yes	-------	-------	40	0	0	N
9	Dahawah	Yes	-------	-------	40	0	0	N
10	Badataal	Yes	-------	-------	199	15	15	Y
11	Kathsaraiya	Yes	-------	-------	150	2.5	4	Y
12	Badhka	Yes	-------	-------	96	2	2	Y
13	Shivra	Yes	-------	-------	10	0	0	N
14	Sita	Yes	-------	-------	20	0	0	N
15	Bhaunri	Yes	-------	-------	120	10	10	Y
16	Lodhasa	Yes	Yes	Yes	140	3	3	Y
17	Sihanipara	Yes	Yes	Yes	5	0.5	0.5	Y
18	Talgaon	Yes	Yes	Yes	40	7	7	Y
19	Amitia	Yes	-------	-------	220	200	200	Y
20	Badhhar	-------	Yes	-------	123	0	0	N
21	Badataal	Yes	-------	-------	600	300	300	Y
22	Keshawpur	Yes	-------	-------	1	0.5	0.5	Y
23	Nauneri	Yes	-------	-------	300	0	0	N
24	Chawa-begumpur	Yes	-------	-------	17	9	9	Y
25	Rukundinpur	Yes	-------	-------	250	1	1	Y
26	Baherjhabbar	Yes	-------	-------	100	0	2	Y
27	Pehna	Yes	-------	-------	17	10	10	Y
28	Arsenijhabar	Yes	-------	-------	10	0	0	N
29	Mansarovar	Yes	-------	-------	15	5	5	Y
30	Arsenijhabari	Yes	-------	-------	140	2	2	Y

Chapter VIII

Threats to Sarus

Preamble

As this report confirms it is a well-known fact that Sarus Crane lives in human-dominated landscape and earlier may have even benefited from ruralization of the countryside. However, increasing human population, changes in the crop pattern, and rapid industrialization are putting subtle stresses on the Sarus populations that are sometimes not easy to understand and quantify. Another problem is we think that everything is fine "as we see lot of Sarus". Many people do not realize that in the rapidly changing landscape, many things can go wrong quite quickly, as far as Sarus is concerned. For example, new threats such as powerlines, free-ranging stray dogs and pesticides add to the existing problem of habitat destruction.

In this chapter we will discuss the existing and emerging threats, and based on the experiencesgained from this project and discussion with experts, will give recommendations for future studies that may help in Sarus conservation and bring about some policy changes.

8.1. Habitat destruction and modification: Wetlands

There are numerous studies in India regarding the status and number of wetlands in India (Gopal 2003, Gopal *et al*. 2008, Gopal and Chauhan 2001). Region-wise and state-wise papers are also available. We will not go in to the details of such studies. Wetlands are some of the most neglected ecosystems of the world despite the fact of their huge importance for human welfare. Based on the studies conducted by Space Application Centre, Ahmedabad, there are more than 745,000 natural wetlands in India. Wetlands of less than 5 ha are 630,869, constituting nearly 85% of total wetlands, and wetlands from 5-10 ha are 44,007, constituting 6%, and 10-50 ha wetlands are 53,710 constituting 7.21% (Table 1). In short, nearly 97% of natural wetlands are less than 50 ha. These are the wetlands that are suitable for the Sarus crane. We also have a large number of reservoirs (Table 2) but as we have shown earlier, reservoirs are generally deep and not suitable for Sarus. Similar is the case of "other" type of larger and small wetlands that are mostly found on the coast or in urban areas where Sarus is not found (Table 3). In this list we have Pulicat Lake, and other such wetlands.

In almost all the wetlands that we visited, we saw human presence in the form of rice or *singhara* cultivation and fishing. Out of the 380 natural wetlands that we visited, almost 100% had human intervention in some form or other. Drainage and cultivation were seen in nearly 80% of the wetlands. Almost 90% of the wetlands had the invasive weed Water Hyacinth, either fully covering the wetland or partially. Only very small wetlands of less than 5 acres, amongst crop fields, were free of this pernicious weed. Sometimes villagers had removed the weed for pisciculture – either way the wetland becomes unsuitable for Sarus.

We could not study the pollution level of the water of the wetland but it seems heavy pesticides and herbicides are used in the surrounding fields. Plastic was littered in all the 78 wetlands that we saw close to villages.

As Sarus needs small shallow wetlands to breed, raise chicks and forage, protection of small village wetlands is extremely important. Everywhere we found encroachment of wetlands, mostly with the connivance of the Gram Pradhan (village head). In some places, people told us that the Pradhan has given *patta* for cultivation. Encroachment is the biggest threat to all natural wetlands of Uttar Pradesh, except those which are protected in real terms under the Protected Area Network.

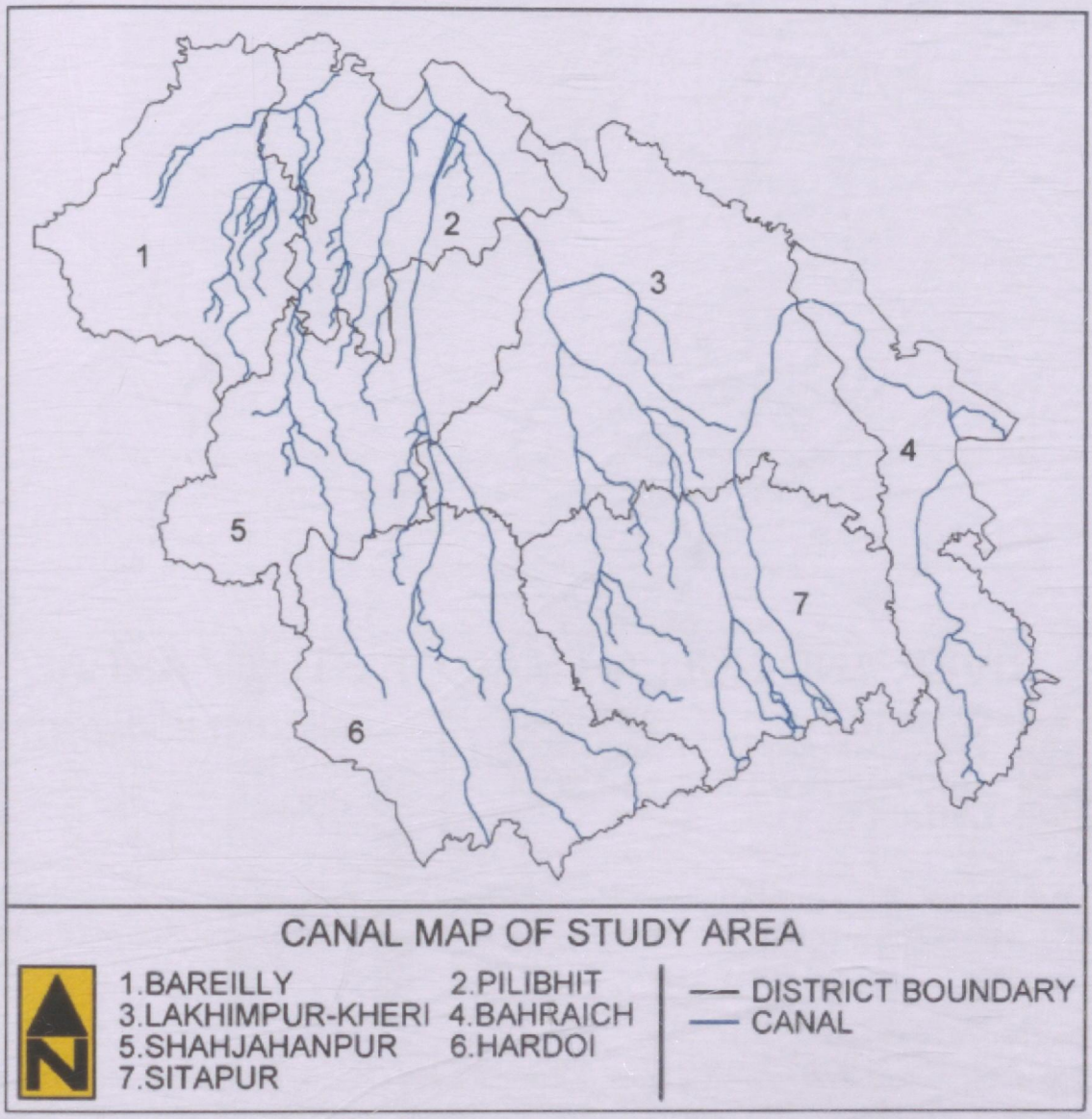


Fig. 19. Major canal network in the study area. Canals have both positive and negative impacts on the distribution of Sarus (see text)

We resurveyed 30 wetlands of Sitapur that were studied by Kumar and Srivastava (2011) and found that the threats mentioned by them (see Table 13) have not gone but new threats have come up (Table 15). A study and documentation like Kumar and Srivastava (2011) and WTI study on Important Sarus Wetland Sites (WTI 2015) should be conducted in more districts.

We recommend that a thorough resurvey should be done to find out the status of natural floodplain wetlands of Uttar Pradesh. These natural and also man-made wetlands should be mapped, demarcated and protected from encroachment under the State Wetland Authority.

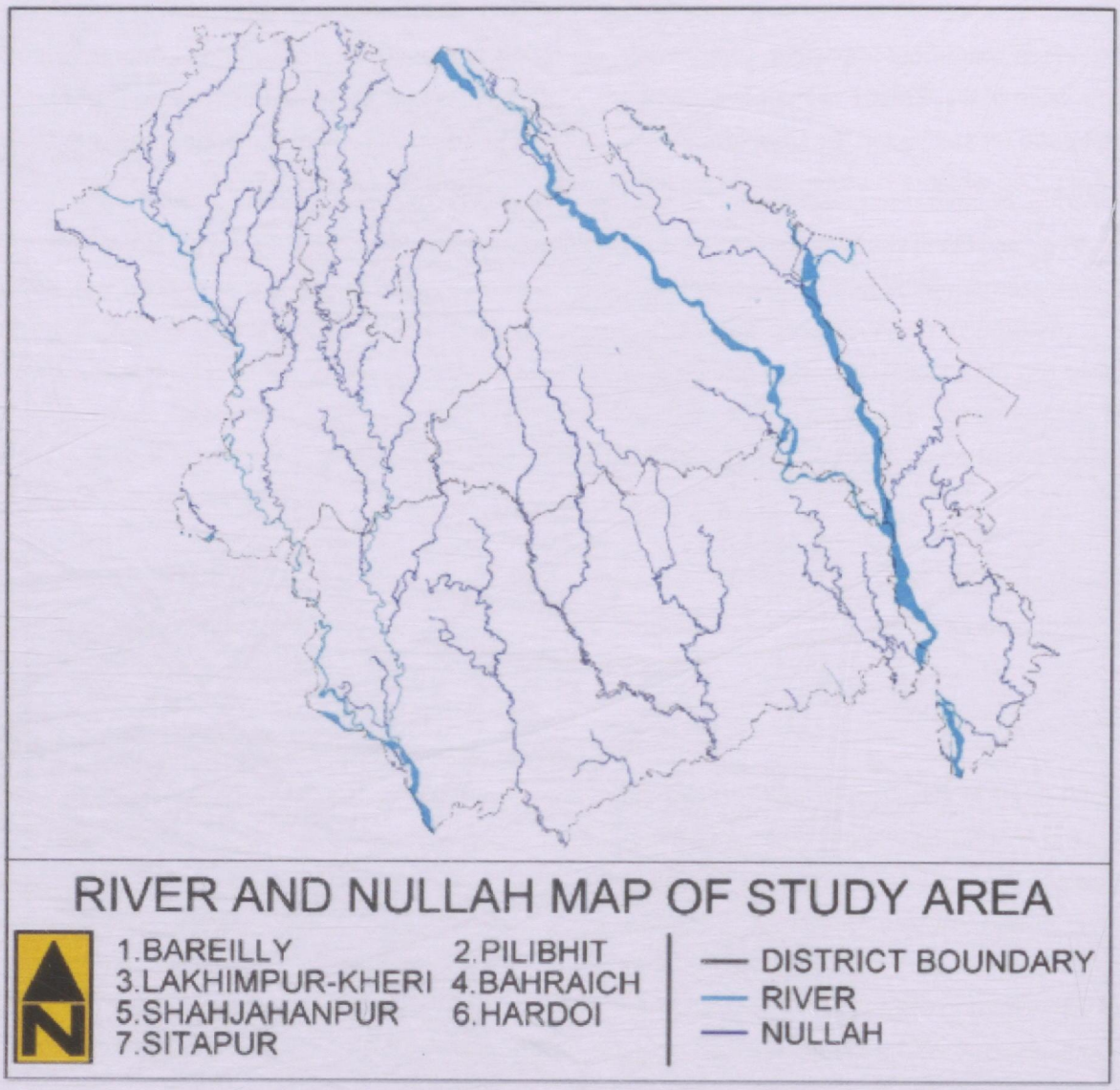


Fig. 20 . Rivers and streams (nullahs) in the study area. Not many Sarus are found near rivers, except during summer when ephemeral jheels/jhabbar dry up. They are found mainly on the edges of rivers and streams

8.2. Stealing of eggs

Stealing or destruction of nests is a big problem in some areas of Sarus distribution. While studying the breeding biology of Sarus crane in Kota district from February 2000 to October 2001, Kaur and Choudhury (2003) found a total of 49 nests, out of which eggs were stolen from 13 nests. We also found that stealing of eggs is a big problem in certain areas such as in parts of Shahjahanpur and Hardoi. In 2017, out of 16 nests monitored, eggs disappeared from five nests, and in another six the fate was not known – some may have been preyed upon. Kaur and Choudhury (2003) mention that most of the stealing of eggs was done by migrant labourers who had come to repair the canal or to work in the crop fields. They found that there was not much damage done by the local people. It was found that during paddy-sowing, eggs were removed for diet supplement. Egg shells were also used for curing seasonal fever, for eye treatment and childhood diseases. Some farmers removed the eggs to destroy the nest in the agricultural field (Kaur and Choudhury 2003).

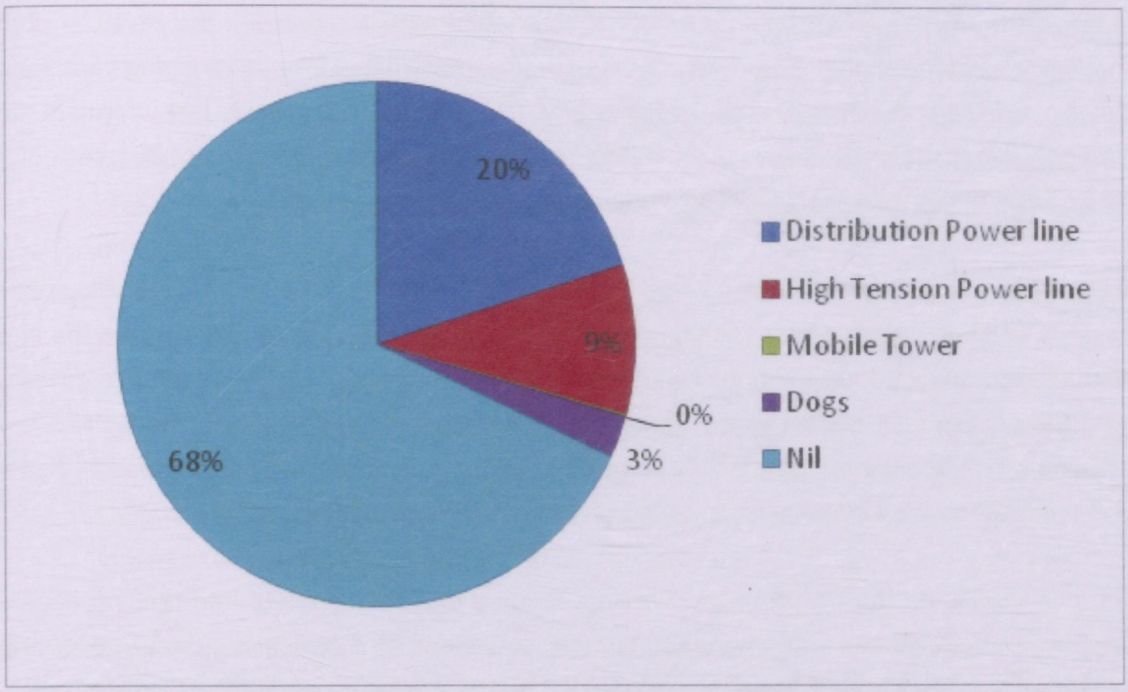


Fig. 21. Percentage of potential threats seen in the study area (n=1002). In 68% of the Sarus sightings, we did not see any powerlines, dogs or mobile tower within 500 m of Sarus

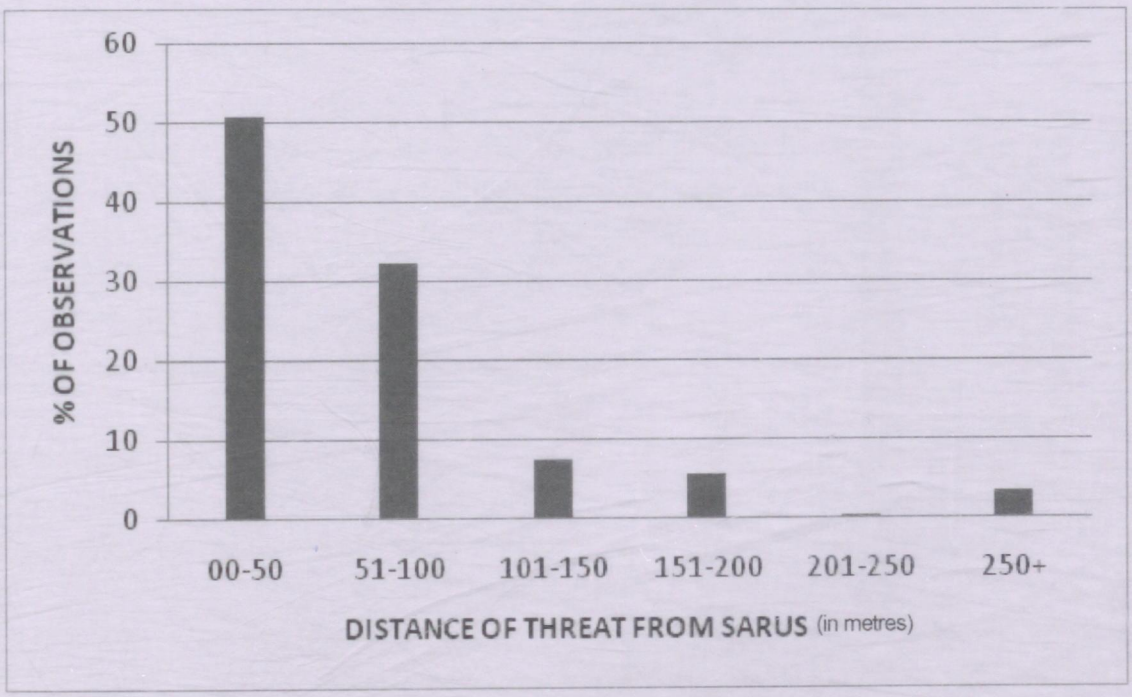


Fig. 22. Location of Sarus from threats (high tension power line, distribution power line, mobile tower and dogs) (n= 294)

8.3.1. Free-ranging Dogs: New apex predator of the countryside

Domestic dogs include feral and free-ranging stray animals and pet dogs. Pet dogs are not such a big problem for wildlife but free-ranging stray dogs have become a great menace to wildlife (Gomper 2014), particularly in the Indian countryside. Besides cats and rodents, dogs are the third most damaging mammalian invasive predators in the world. According to some estimates, there could be one billion dogs in the world today: about 75 percent are free breeding. World-wide, free-ranging domestic dogs

are reported to cause potential risk to nearly 200 vertebrate species listed in the Red List of IUCN (Doherty *et al.* 2017). In India, Bhardwaj *et al.* (2018) have shown that free-ranging dogs are the main predator of wildlife in the Thar Desert. Home *et al.* (2017) based on the online key informant survey and reports from national print media in India found that dogs attacked 80 wild species, including 31 IUCN Red List threatened species, of which four are Critically Endangered.

Abundance and distribution of free-ranging dogs is largely determined by anthropogenic subsidies in the form of direct feeding by humans, and access to garbage or livestock. India has the highest number of free-ranging domestic dogs in the world (Gompper, 2014). Domestic dogs are called free-ranging dogs when they are not under direct human supervision (leashed and listening to humans) and whose activities are not restricted by human activities (Cafazzo *et al.* 2010). These free-ranging dogs are also known to have access to both livestock and wild prey (Lenth *et al.* 2008).

During our studies on the Sarus Crane, we kept records of all sightings of free-ranging dogs near Sarus. While we found many such dogs during our surveys in all the districts, on 26 occasions we found dogs disturbing the Sarus or very close to Sarus with chicks/juveniles. Most sightings were of a single dog, but up to eight dogs disturbing Sarus were also noted (Fig. 23).

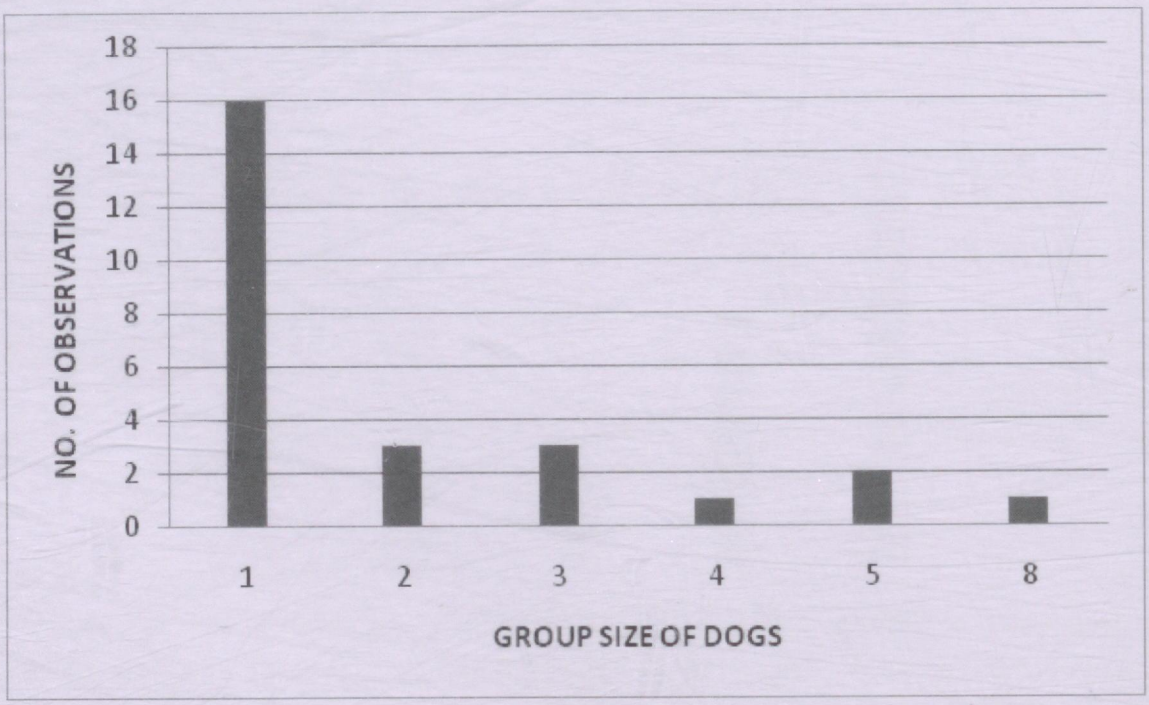


Fig. 23. Group size of dogs near Sarus (n=26)

Threats from dogs to Sarus can be of three types:

1) **Predation**: A dog may not be able to kill an adult Sarus but it is a grave threat to chicks and juveniles. An injured Sarus (e.g. after hitting the wire) or a sick Sarus (due to eating pesticide-laden grains) can easily fall prey to a pack of dogs.

2) **Disturbance**: It can be classified into two types:
   a) Direct disturbance: Harassment of Sarus by free-ranging domestic dogs is a big threat to Sarus. Many times, we have seen Sarus leaving the area when dogs appear. Sometimes

they chase the dogs but remain distressed for a long time, and leave the area. It is not only direct killing, which may not be common in the case of dog-Sarus interaction, but the effects of increased stress and energetically costly behaviour that also need to be considered, as shown by Lenth *et al.* (2008). Fear-mediated behavioural changes in the presence of predator can also decrease breeding success in some species (Zapata-Rios and Branch, 2016).

b) Indirect disturbance: Frequent presence of dogs in an area forces the Sarus to abandon the area either temporarily or permanently. When wild animals perceive dogs as a threat, they may change their behaviour and habitat use to avoid them. For example, a study near Sydney, Australia found that pet dogs, even when restrained by leash, walking in city parks and national parks reduces the abundance and species richness of birds (Banks and Bryant, (2007). They have shown that dog walking in woodland leads to a 35% reduction in bird diversity and 41% reduction in bird abundance.

3) **Multiplier impact**: When two threats join together, we can call it a multiplier impact. For example, after harassment by dogs, a Sarus is forced to fly away, and during flight it hits high tension wire and dies or get injured. The Sarus may not have been killed by the dog directly, but it may get electrocuted by powerlines as it escapes the ground predator. As dog numbers increases and powerline network spreads, there will be more and more chances of electrocution of Sarus.

Studies conducted by Mohandas (2017) in the Thar Desert of Rajasthan show that free-ranging dogs now act as the apex predator in the Thar landscape, and compared to other apex predators, they occur at much higher densities, to the tune of 1.79 ± 0.46 individuals per km^2, resulting in 1,804 dogs in 1,008 km^2. They were estimated to be killing about 30% of the Chinkara population every year which is predation pressure that no low-density animal can sustain. The study has recommended a sustained sterilization programme (Mohandas 2017).

8.3.2. Managing Dog problem

Managing free-ranging domestic dogs is an intricate social, religious, ecological and cultural problem. On top of this is the management issue of disposal of waste generated by human beings.

It is a misnomer to call free-ranging stray dogs as feral as a definition of a feral is a domestic animal gone totally wild over many generations. The dogs that we see all around in cities, villages and countryside are not feral dogs but domestic dogs living more or less a free life with or without a human owner (dog-lovers decorously call them "community dogs"). They roam the countryside killing wild animals, but most of them freely accept human presence, unlike a feral animal which runs away from a human being like any wild animal. These free-ranging dogs also partially depend on human-provided food or on garbage dumps. Their numbers and distribution, therefore, are more or less dependent on human beings. As urbanization and settlements expands, such dogs will also spread to newer and newer areas.

PHOTO: FAZLUR RAHMAN

PHOTO: SARUS TEAM

We noticed three cases of electrocution of Sarus in two years, and villagers told us about eight cases when Sarus died after hitting electric wires

PHOTO: ASAD R. RAHMANI

PHOTO: BRIDESH KUMAR

Electrocution or injury by wires is now a serious threat to Sarus. We found a dense network of wires in the study area

PHOTO: PRAKASH MEHTA

Owing to free-ranging abandoned cattle destroying crops, more villagers now keep dogs

PHOTO: CHOTU KHAN

Free-ranging stray dogs are now a major menace to wildlife, including Sarus. A dog with an egg of Sarus

PHOTO: B.C. CHOUDHARY

Sarus waiting at the edge of a wetland that has been taken over by singhara cultivation

PHOTO: ASAD R. RAHMANI

In numerous shallow jheels, Singhara or Water Chestnut is cultivated. Sarus generally abandons such wetlands during the singhara cultivation period (August to November) – its main breeding and chick-rearing period

PHOTO: SARUS TEAM

We collected data on the type of pesticides used in the crop fields in the study area

PHOTO: CHOTU KHAN

A Sarus that could not fly due to pesticide poisoning. There is an urgent need to start a comprehensive project on the impact of pesticides on the Sarus Crane.

PHOTO: VIKRAM TIWARI

We noted the presence/absence of high-tension wires whenever we recorded data on Sarus

PHOTO: BRIDESH KUMAR

Although Sarus is generally not killed or trapped, we saw small-scale trapping of waterbirds in a few wetlands where Sarus lives. Above, rescuing a Pheasant-tailed Jacana that was trapped. It was subsequently released and the nets destroyed by us

PHOTO: ASAD R. RAHMANI

Spread of Water Hyacinth and Ipomea has destroyed many Sarus suitable wetlands

PHOTO: ASAD R. RAHMANI

Powerlines, pesticides, dogs, Water Hyacinth, singhara cultivation, and drainage of wetlands for paddy cultivation are a deadly combination endangering the long-term survival of Sarus Crane in Uttar Pradesh

Another phenomenon that is increasing the number of dogs is the menace of free-ranging and abandoned old cows. More and more farmers are now spending their time in the crop fields to protect them from the abandoned cows. Farmers have started keeping more watch dogs to prevent crop damage by stray cows. Such dogs also alert the farmers in the night if a herd of cows descends on the crop field. Although we do not have statistical data, we found that wherever dogs were seen/kept in the crop fields, Sarus was not present.

8.3.3. Near absence of vultures

Near or total absence of vultures during the last 20 years due to large-scale killing by diclofenac (Oak *et al.* 2004; Shultz *et al.* 2004; Green *et al.* 2007) has led to an increase the number of stray dogs (Prakash *et al.* 2003) due to easy and abundant availability of animal carcasses. Earlier, before the catastrophic decline of vultures in India, there were so many vultures that a flock of 100-150 vultures would easily overwhelm dogs who would wait for vultures to gorge themselves before coming near a cattle carcass, but now the situation is reversed. Now there are so many dogs that even when they have eaten fully, they do not allow vultures to come to the carcass. They sit around the carcass, digesting food to eat more later. Near absence of vultures in the Indian countryside has also led to tremendous increase in the number of free-ranging stray dogs.

8.3.4. What is the solution?

Culling of free-ranging stray dogs is the best and most effective solution but it is socially unacceptable. Desexing or sterilization is a long-term solution but it has to be done on a massive scale. Sterilizing even 30-40 percent of the dogs of an area does not solve the problem – we have to reach 80-90% sterilization target before any results are seen. Moreover, sterilizing male dogs does not solve the problem as subordinate male dogs take over quickly. Sterilizing bitches is more important but it is time consuming and the animal has to be kept in care for 2-3 days.

Reducing access to food waste is a good solution, but it needs massive overhaul of administrative measures and most importantly, behavioural change in society. In a country where even cities are not kept clean, despite a huge army of cleaning staff, it will be too much to expect to keep the countryside clean!

8.3.5. Recommendation

As the menace of free-ranging dogs is a complex issue, we need an in-depth study to assess the impact of dogs on the survival of Sarus Crane, as was done in the Thar Desert by WII on the Great Indian Bustard. In future, both human and dog populations are likely to increase geographically and numerically, and it is imperative to understand the effects of free-ranging dogs on the Sarus Crane. We recommend sterilization of 80 to 90% of the free-ranging stray dogs in the countryside, particularly in Sarus areas and around PAs.

8.4. Powerlines: Threat of Powerlines to Sarus

The problems of wildlife conservation keep accumulating. The old problems do not go away while new problems come up. While habitat destruction and unsustainable harvests are the two major problems across the board for all wildlife species, for many species, powerlines (both transmission

220 kV and distribution 15 kV–45 kV lines), and other such infrastructures are now the major killers. This is particularly true for large flying birds such as bustards, storks, eagles, and cranes. Cranes and bustards have a visionary block in front of the head due to the placement of their eyes on the sides. These large birds are particularly prone to collision due to their low manoeuvrability during flight and/ or poor forward-facing visual vision. While flying fast, by the time they see a high-tension wire, it is too late. Either they are injured or electrocuted or both. Their large bodies touch two wires simultaneously, that results in electrocution.

There is an increasing scientific literature on the impact of powerlines on large flying birds. For example, in Spain it has been proved that collision from powerlines is the major problem for the Great Bustard *Otis tarda* (Alonso *et al.* 1994; Janss 2000; Martin & Shaw 2010; Martin 2011). A study on Whooping Cranes *Grus americana* found that when the juveniles migrate from Canada to Texas in the USA, many juveniles die after collision as they are unfamiliar with the landscape (Stehn and Wassenich 2008). They have mentioned 45 documented cases of mortality of Whooping Cranes from collision. Reduced visibility in foggy conditions also results in high collision of flying birds. In north India, during winter, there are many foggy days when the visibility is less than 50 m. We do not have comparative data on Sarus collision on foggy and non-foggy days.

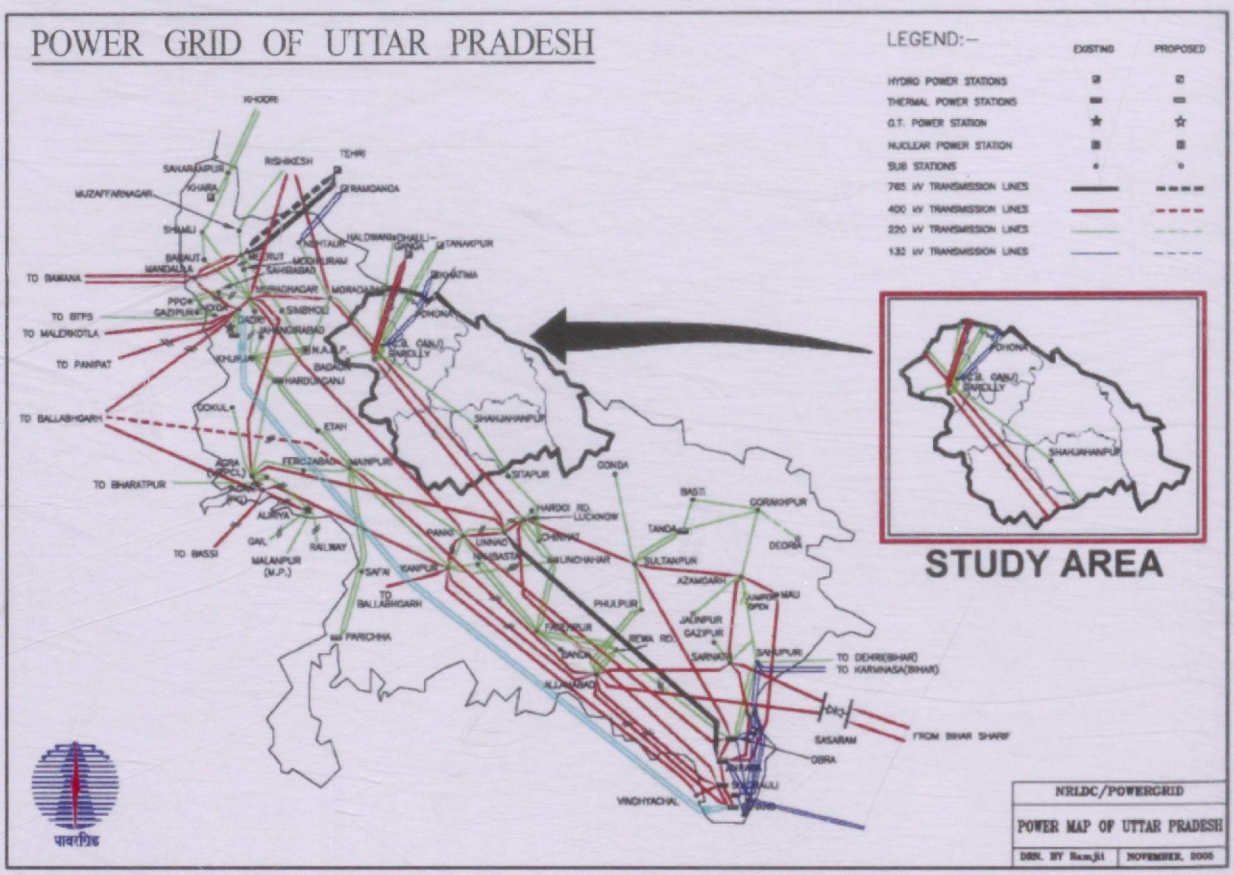


Fig. 24. Major power grid of Uttar Pradesh and the study area. We could not prepare a map of power lines going to villages, hamlets and generators, as the network was too dense.

In an infamous case of collision in Gujarat, nearly 150 flamingos (*Phoenicopterus roseus* and *Phoeniconaias minor*) died in one area (Tere and Parasharya 2011). Collision is most common with high voltage transmission lines. Collision occurs specifically with the earth wires that are less visible to birds (Fannes 1987). Most overhead transmission lines having voltages of 110 kV and above are provided with earth wires (or ground wires). The main purpose of the earth wires is the protection of the conductors against the direct incidence of lightning strokes that can cause line outages.

In a detailed study on the impact of powerlines on birds, especially Great Indian Bustard, Mohibuddin (2017) found that about 18,700 birds are dying per month in GIB habitats of Thar landscape in Jaisalmer. Collision per crossing was higher for high tension power lines with multiple wires. Mohibuddin (2017) shows that power lines are affecting a wide range of bird species, therefore, it is necessary to develop bird friendly infrastructures to fulfil human requirements without endangering birds, as well as implementing a regular powerline mortality monitoring programme to assess the effectiveness of these measures. Based on their studies of powerlines and Great Indian Bustard movement, the WII found four Great Indian Bustard carcasses under powerlines till date in the Thar desert. Extrapolation of their findings on total high-tension powerlines under prime GIB habitat of Thar indicates that about 18 Great Indian Bustards per year are dying due to powerline casualties.

Sundar and Choudhury (2005) were the first to highlight the threat of overhead wires to the Sarus Crane. In a study based in Mainpuri and Etawah districts, they found that 1% of the population of Sarus die every year after hitting the wires. They found that the non-breeding Sarus Cranes were most susceptible to wires and, within territories, mortalities were higher for pre-dispersed young. Similar proportions of non-breeding and breeding cranes were killed, together accounting for nearly 1% of the total Sarus Crane population annually. Supply wires accounted for the majority of Sarus deaths, and only non-breeding cranes were killed by both supply and high-tension power lines. Non-breeding crane deaths at roost sites were correlated with numbers of roosting birds and numbers of wires at each site. Over 40% of 251 known Sarus territories had at least one overhead wire posing a risk to breeding adults and pre-dispersed young. Most crane deaths in territories occurred as a result of wires at edges of territories. Wires around roosting sites, territoriality and age of Sarus Cranes appear to be the most important factors affecting their mortality due to wires. They suggested that mitigation measures will be most effective around roost sites and for wires that border territories of breeding pairs (Sundar and Choudhury 2005).

Uttar Pradesh has a huge and complex network of electric, telephone and high-tension wires in almost all the areas where we found Sarus. In many wetlands/crop fields, these wires go right across them. At every sighting of Sarus, we collected data on presence/absence of wires. We noted the two major types of wires: electricity and high-tension (called pylon for short). We found that 20% of sightings of the Sarus were within 100 m of powerlines, and 10% sightings near or under high-tension wires. We found dead Sarus in three incidents. We came to know another eight specific cases that had happened earlier but we could not find the carcasses as they had decomposed been eaten by predators. While speaking to local people, many of them told us that they have seen or know about cases of Sarus getting killed by powerline wires. When we asked local people about the major threats to Sarus, most of them told us that these were from pesticide poisoning and powerlines.

Turbines are another problem to large birds (Subramanian 2012) but fortunately, wind turbines are not present in the seven districts that we studied.

8.5. Sarus and danger of plastic pollution

Plastic has become a major threat to many birds, particularly seabirds which mistakenly feed on pieces of free-floating plastic, thinking it is a food item. Plastic pollution in the ocean is a global concern; concentrations reach 580,000 pieces per km^2 and production is increasing exponentially (Wilcox *et al.* 2015). Seabirds are particularly vulnerable to plastic pollution and are widely observed to ingest floating plastic. Wilcox *et al.* (2015) have shown that based on literature survey between 1962 and 2012, 80 of 135 (59%) species that were studied had ingested plastic, and within those studies, on average 29% of individuals had plastic in their gut. They also predict that plastics ingestion is increasing in seabirds, and it will reach 99% of all species by 2050. However, effective waste management can reduce this threat.

A recent review for the United Nations Convention on Biological Diversity documented over 600 species, ranging from microorganisms to whales, which are affected by marine plastic waste, largely through ingestion (Anonymous 2012).

Microplastic in the form of small pieces is ingested by many filter-feeding fish and marine mammals. Microplastic is now recognized as an increasing threat to freshwater lakes and ponds (Fisher *et al.* 2016). Large pieces of plastic that are now found in and around lakes are broken down to smaller pieces and finally into microplastic. This microplastic mixes up with organic contents of the water and also the soil. Quantity, quality and distribution of microplastic depends on the level of plastic pollution, wave action, soil grain size, temperature, and other chemicals found in a waterbody. Heavy winds influence microplastic abundance in the surface water layer (Fisher *et al.* 2016). As some studies have shown, the "average size of plastic particles in the environment seems to be decreasing, and the abundance and global distribution of microplastic fragments have increased over the last few decades. However, the environmental consequences of such microscopic debris are still poorly understood."

Microplastic also moves up in the food chain (Barnes *et al.* 2009). While we do not have any evidence of Sarus feeding on plastic, the danger is there as most of the wetlands that we surveyed were littered with discarded plastic. A recent study on the feeding habits of the Black-necked Crane *Grus nigricollis* reveals plastic for the first time in the faeces of this Vulnerable bird.

Researchers from the Ugyen Wangchuck Institute of Conservation and Environmental Research (UWICER), the Royal Society for Protection of Nature (RSPN), and the Bumdeling Wildlife Sanctuary (BWS) collected 1,000 samples of faeces in Bumdeling, one of the major wintering grounds for the Black-necked Crane in Bhutan. They found plastic pieces in 5 percent of faeces analysed so far. In one faeces, 6.5 gm of plastic pieces were found. This is a country that has officially banned one-time use plastic carry bags and where environment is still considered 'pristine'. Bumdeling is a small village of less than 3,000 people, so unlikely to have much plastic waste. Despite this, cranes are picking up plastic pieces thinking they are food items. Contrast this with rural Uttar Pradesh, where plastic is littered everywhere.

Although we could not conduct any research on the food habits of Sarus Crane (it was not our mandate under the Project), we recommend that a detailed study on the food habits of Sarus Crane and the impact of discarded plastic in the Sarus habitat should be studied.

8.6. Pesticides

We found heavy use of pesticides in all the districts, particularly at the start of the paddy growing season. We have made a list of pesticides used in the paddy fields at various stages of its growth. A recent hazard has emerged in the form of poisoning of Sarus (Muralidharan 1992; Kaur & Nair 2008), mainly unintentional but sometime intentional. A notorious case of Sarus poisoning occurred outside Keoladeo National Park, Bharatpur, Rajasthan on 23 November 2000, when 15 Sarus and three Common Cranes *Grus grus* were found dead in a field adjacent to the Park, where wheat seed had been sown the previous day (Muralidharan 2004). Chemical analyses of seed samples from the field and the cranes' alimentary tract contents identified residues of the organophosphate insecticide monocrotophos. Monocrotophos concentrations of 0.8 and 1.8 ppm were found in wheat samples, and 0.2-0.74 ppm (x=0.33) in the alimentary tract contents of five of the seven cranes examined. No other organophosphate or organochlorine pesticides were detected. It was concluded that the cranes died from monocrotophos poisoning after eating treated seed. Similar incidents of avian mortality and how to reduce such incidents were discussed by Muralidharan (2004). Although application of pesticides is meant for pests only, nontarget species, including domestic and wild species also get exposed to these pesticides and may even die. In several infamous cases in Haryana, nine adult peafowls (8 males and 1 female) died in Rewari district, and nine adult peafowls (4 males and 5 females) died in Sonepat district of Haryana during November 2014 and January 2015, respectively (Narang *et al*. 2016).

Monocrotophos, an organophosphorus insecticide and acaricide, is extremely toxic to birds. It is sometimes used as a bird poison (Smith, 1993). It is generally used in sugarcane, peanut, cotton and tobacco faems to control sucking, chewing and boring insects and spider mites (Meister, 1992).

During our surveys, in two years, we were thrice told by villagers that some Sarus died after foraging in crop fields where pesticides had been used. We did not come across any dead Sarus (it is not easy to find carcasses of dead wild animals as they are quickly eaten up by scavengers), but were told in Lakhimpur-Kheri district that a few years ago (the villager could not recall the year), eight Sarus had died and the Forest Department was informed. It was reported in the newspapers but we could not trace the news.

In our study area, we found that the following pesticides are popularly used in paddy (brand name in bold):

Super-D:, Chlorpyriphos, 50%+, Cypermethrin High percent. It is a liquid sprayed after dilution;

Cover: Chlorantrotraniliprole 0.4% w/w. Locally called 'cover';

Fax: Fipronil, 5% SC.

All three are very popularly used in paddy – almost 90% of all pesticide used in the study area, according to local farmers and shop owners.

For wheat, we were told that mainly herbicides are used to kill unwanted plants. The most popular is technically called Clodina-propargyl (Clodina)..

Fungicide is also used in both paddy and wheat. The most popular brand is Gillette, technically termed Propiconazole 25% EC (liquid).

S. No.	Brand Name	Chemical	Company	Introduced in India (year)	Nature
1	Super-D	Chlorpyriphos 50%+ and Cypermethrin 5% EC	Dhanuka Agritech Limited, Gurgaon, Haryana	1997	Insecticide
2	Cover	Chlorentrotraniliprale 0.4% W/W	Dumax Agro Industries, Ahmedabad, Gujarat	2015	Fungicide
3	Fax	Fipronil 5% SC	Dhanuka Agritech Limited, Gurgaon, Haryana	1997	Insecticide
4	Clodino-Super	Clodinafop Propargyl 15% WP	HPM Chemicals and Fertilizers Ltd.	1987	Herbicide
5	Cosmos	Propiconazole, 25% EC.	Canary Agro Chemicals Private Limited	1987	Fungicide
6	Prosulf-90	90% Sulphur fertilizer (Bentonite Sulphur – Pastille Granules)	Mahafeed Specialty Fertilizers (India) Pvt. Ltd., Pune, Maharashtra	1994	Sulphur Fertilizer

Table. 17. Pesticides and herbicides commonly used in the study area on crops

In India, manufacture of pesticides started soon after Independence, in 1952 to be exact. However, import of DDT started in 1948 as a miracle chemical for control of malaria. Benzene hexachloride (BHC) was also imported by India for control of locusts. By 1952, India started production of these chemicals. Boost for heavy use of pesticides was given during the Green Revolution in the 1960s. India is now the second largest consumer of pesticides in the Asia, after China and ranks 12th in the world. Persistent organophosphorus pesticides or POPs are now found in the general environment,

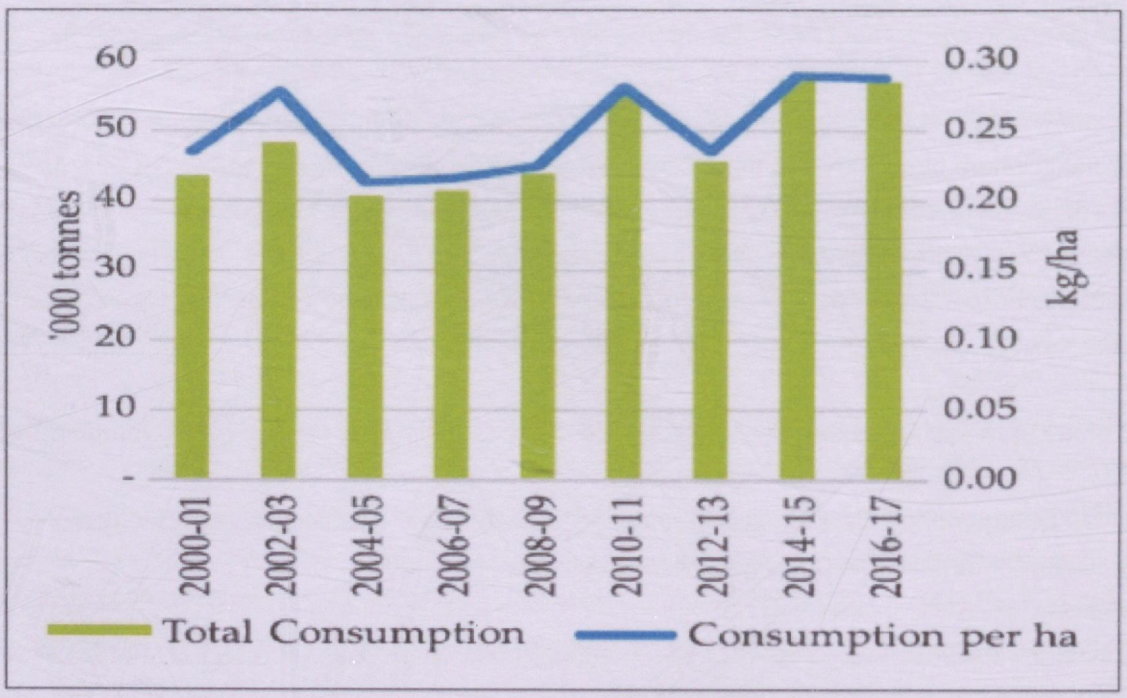


Fig. 25. Trend in consumption of pesticides (technical grade) in India (Source: https://www.researchgate.net/publication/323028689)

impacting both humans and wildlife. Nearly 70% of the pesticides used in India are on cotton (45%) and paddy (22%) (Vyas 1998). Mukherjee *et al.* (2006) conducted studies on the use of pesticides in Gujarat and found that economically sound farmers with large land holdings use more pesticides than the traditional small farmers. Economic characteristics of the farmers play an important role in selection and quantum of pesticides used. In the Terai, we have seen similar situation where heavy use of pesticides was seen in large farms, however, we do not have quantitative data.

Wetlands are very susceptible to chemical pollution (pesticides, weedicides, fertilizers, fungicides and industrial chemicals) (Varagiya *et al.* 2015; Muralidharan *et al.* 2014). Agriculture fields abut wetlands and chemical runoff is very common. Sarus frequently nests in paddy fields where heavy doses of pesticides are used. Hence, wetlands become a source of bioaccumulation and biomagnification of toxic chemicals and may reach birds through the food chain. The famous *jheels* of Keoladeo National Park, Bharatpur receive run-off water from a large catchment area which is under intensive agriculture. The water that comes to Keoladeo is contaminated with aldrin and BHC. Aldrin is suspected to be the main reason for the decline of Sarus population in Keoladeo National Park (Muralidharan, 1993; Muralidharan, 2000). From a population of 27-30 breeding pairs in the 1970s, now not more than 2-3 pairs breed in the Park, although there is no decrease the jheel area.

We want to alert the authorities that pesticides could be one the major threats to Sarus. We need a long-term study on this aspect in accredited government and non-government laboratories.

8.7. Cultivation of Water Chestnut (*singhara*)

Breeding of Sarus coincides with cultivation of *singhara*. We found that many *jhabars* have been converted to *singhara* cultivation and Sarus were either chased away or they abandoned the *jhabar*. Some *jhabars* were deepened and bunded, making them unsuitable for Sarus. *Singhara* is finally harvested by mid-November, after that the plant dies.

8.8. Bird Trapping

Although it is not a serious business, and Sarus is generally not targeted for trapping, small-scale bird trapping takes place in some areas. For example, in a flooded field near Bhira, we found a pair of Sarus foraging and in the same area a Pheasant-tailed Jacana was found trapped by noose trap. It is likely that the Sarus could have also been inadvertently trapped.

CHAPTER IX

Development of local network

As the Sarus lives in human-dominated landscapes in Uttar Pradesh and needs small wetlands and irrigated crop fields for nesting and raising chicks, community involvement is absolutely essential for its long-term protection. At present, most of the local people have a benign attitude towards Sarus ,but when it comes to the question of paddy field destruction by Sarus for nesting, or growing *singhara* in a Sarus wetland, the attitude changes. If the presence of Sarus becomes an economic threat and the choice between Sarus vis-à-vis wetland/paddy, the Sarus loses. As the pressure on land/wetland and aspirations of people increase, there will be more conflicts with Sarus. The new generation of people may not connect with Sarus as their ancestor did.

Community involvement, a buzzword these days, for the protection of Sarus is very important. Kaur *et al.* (2008, 2013) have shown that with the right approach, rural communities can be actively involved in Sarus nest protection. In their study in Kota district, Rajasthan, Kaur *et al.* (2008) in 2004-2005 provided protection to 22 nests by volunteer Rural Village Sarus Protection Groups. They demonstrated that it is possible to re-establish a bond between farmers and nature, and work on community involvement for the Sarus Crane. The Wildlife Trust of India (WTI) has done great work with local people in protecting nests and chicks, as a result of which nearly 500 Sarus were added to the population in eastern India (B.C. Choudhury, *pers. comm.* 2018). They used paid volunteers to guard the nests from disturbances. However, this approach though very successful is useful only as long as funds are available. As the Sarus lives in a large, multi-culture landscape, it cannot be applied everywhere because monetization of people's value system brings its own problems. It also encourages corruption and local conservation politics where none may exist now. Nonetheless, we recommend this approach in some areas where nests are actively destroyed by local people due to various reasons.

During our surveys, we made contacts with nearly 400 people in various villages where Sarus is found. We have trained six volunteers to take Sarus data on a standard proforma. Besides this, we recorded the names and mobile numbers of people who were willing to report to us regarding Sarus (Table 18).

People's attitude towards Sarus: We did not find any negative attitude of local people towards Sarus. Most of the people were worried that the Sarus population is not as much as it used to be. During survey in 2017, we noted that people were worried that Sarus had not bred due to insufficient rains. Sometimes, Sarus was seen as close as 30 m from a busy road or a human dwelling, clearly indicating that it is not molested by people.

Sarus signboards: We also found that the posters/signboards put up by the Sarus Protection Society on the roads have played a major role in highlighting the status of Sarus Crane as the State Bird. In many areas, local people said that they have read the poster/board and Sarus is UP's State Bird and needs protection. Most of the people were happy to help us in our census of Sarus. All these are positive signs.

Development of Sarus Mitres in Uttar Pradesh

As Sarus lives in human-dominated landscape, people's involvement for its protection is essential. It has been surviving all these years, mainly due to the traditional protection given by local communities. As many shallow wetlands have been converted into crop fields, Sarus sometimes nests in crop fields. It also feeds on newly-sown crops, resulting in some resentment by farmers. Despite some crop damage by Sarus, it is still not persecuted, at least in Uttar Pradesh, although sometimes its nest is destroyed/removed from the crop field, or it is not allowed to nest.

In order to strengthen the existing traditional tolerance of the Sarus Crane, and remove any misgivings about Sarus, there is a need to develop a network of volunteers or *Sarus Mitre* of local villagers and cropfield owners for further protection of the Sarus Crane. This can be done under *SarusSurakshan Samiti* (SSS). As this is still at the planning stage, here are some suggestions for the criteria for selection of Sarus Mitre:

1. The person should be interested in Sarus protection, or his interest can be developed
2. The person should own crop land, or co-own crop land in Sarus habitats
3. The candidates should be willing to help the Forest Department
4. The candidate should be from the local area, or live most of the cropping season in the area
5. Although age will not be a limiting factor, youngsters will be preferred

Role of Sarus Mitre

a) Information provided to the Forest Department if Sarus nests in his/her crop field

b) Protection of nest till the chick(s) hatch

c) Protection till the chicks fledge

d) Prevention of poaching/disturbance to nest/chicks

e) No use of lethal chemicals that kills Sarus

What will Sarus Mitre get in return

1) After a minimum of two years successful protection of Sarus nests and chicks/fledglings, a *pramanpatra* (certificate) will be given to the Sarus Mitre by the Forest Department

2) The person who protects Sarus in his/her area for five years or more, will be invited to the annual Bird Festival and will be facilitated by the Chief Guest.

3) The community that is providing good and continuous protection to Sarus cranes, including successful annual breeding, will be recognized and the village recommended for providing greater facilities.

Table 18. SARUS MITRE LIST

S. No.	Name	Contact Detail	Village	Tehsil	District
1	Mohd Afzal	9453154496	Charaga	Motipur	Bahraich
2	Ram	7753843926	Kadra	Hardoi	Hardoi
3	Kamlesh	8953794783	Rabha	Shahabad	Hardoi
4	Ritesh	8601145571	Akola hanspur	Puranpur	Lakhimpur Kheri
5	Ashok Kumar	8601388537	Baguli	Gola	Lakhimpur Kheri
6	Rajendra Kumar	7393834121	Bharampur	Nighasan	Lakhimpur Kheri
7	Lakhpati Ram	8382983650	Bhusoria	Gola	Lakhimpur Kheri
8	Shivam	7522896642	Chattipur Grant	Gola	Lakhimpur Kheri
9	Kamlesh Kumar	7380914837	Chhatipur-raja	Gola	Lakhimpur Kheri
10	Palaj	7084974181	Chhatipur-raja	Gola	Lakhimpur Kheri
11	Aman Gupta	9305012062	Kaimari	Gola	Lakhimpur Kheri
12	Munna Lal	9919835379	Kedari	Mohammadi	Lakhimpur Kheri
13	Shamshuddin	8874169516	Motipur	Gola	Lakhimpur Kheri
14	Arun Kumar Verma	8770078460	Nagriya	Gola	Lakhimpur Kheri
15	Amit Singh	7860625729	Sadibama	Nighasan	Lakhimpur Kheri
16	Madan Lal	9670350718	Semrai	Gola	Lakhimpur Kheri
17	Rohit Kumar	7080179531	Simrai	Lakhimpur	Lakhimpur Kheri
18	Nanelal	8052229560	Sisnaur	Gola	Lakhimpur Kheri
19	Sarvesh	9639411721	Songatalli	Gola	Lakhimpur Kheri
20	Kasiram	7081137264	Pipra	Mohammadi	Lakhimpur-Kheri
21	Sidhanth	7292080166	Aactgaon	Bisalpur	Pilibhit
22	Mahesh	7248601910	Diwalpur	Powayan	Pilibhit
23	Surendra	9012948572	Diwalpur	Puranpur	Pilibhit
24	Shyam Charan	9758240670	DundaKhanpur	Puranpur	Pilibhit
25	Ram Krishna	9690926126	Kakrahiya	Bisalpur	Pilibhit
26	Shivbans Kumar	9675394643	Mudigawan	Bisalpur	Pilibhit
27	Manoj	8933886713	Sardar Settlement	Powayan	Pilibhit
28	Ramlalla	6397233531	Shahjadpur	Bisalpur	Pilibhit
29	Sukdev Singh	7080403942	Syampur	Puranpur	Pilibhit
30	Basudev	7002095431	Laxmanpur	Puwayan	Shahjahanpur
31	Vive Singh	9719472589	NawdeyaBanki West	Powayan	Shahjahanpur
32	Bhagirath Singh	9919327323	Kalha	Sitapur	Sitapur
33	Ramnipas	9721020317	Sareli	Metauli	Sitapur
34	Vijay Kumar	8052736524	Uchipar-Mirzapur	Metauli	Sitapur

Besides the above list of villagers, we also contacted a large number of conservationists and animal lovers who agreed to become Sarus Mitre. They are all concerned about Sarus and willing to help the Forest Department in the protection of Sarus and its habitat. A few are mentioned in Table 19.

Table 19: Important conservationists of the study area who are willing to work as Sarus Mitre

Name	District	Mobile number	Email
Dr. V. P. Singh	Lahimpur-Kheri	9415148410	tarai_eco@yahoo.com
Mr. Suresh Choudhury	Katerniaghat Foundation	9415001079	wildcraft20@gmail.com
Mr. Neeraj Srivastava	Lucknow	8004921860	neervun@gmail.com
Mr. Akhtar Mia	Pilibhit	9997524542	twcs_uttarpradesh@yahoo.co.in
Mr. Aameen Shah	Pilibhit	9568777471	
Dr. Arshad Ali	Shahjahanpur	9897095205	drarshadali@yahoo.com
Mr. Sonu Leeladhar	Dudwa NP	9452042874	
Mr. Sachin Gaur	Bareilly	9456988145	Sachingaur449@gmail.com
Mr. Ravi Verma	Kannauj	9335382999	drverma.ravi@gmail.com
Dr. Mudit Gupta	Lakhimpur-Kheri	9839505303	
Mr. Dabeer Ahmad	Bahraich	9450257709	
Mr. Vikram Tiwari	Mohammadi	9793080980	wildtoday060@gmail.com

CHAPTER X

Sarus Workshops

One of our objectives was to conduct workshops on the Sarus Crane Project and to train the frontline staff in Sarus survey. To achieve this aim, we organized five workshops with the Forest Department, and one in Gandhi Faiz-e-Aam College, Shahjahanpur. Local conservationists were also invited to these workshops. In some workshops, lectures were delivered by experts such as Mr, Mohd. Ahsan, IFS (Retd.) CWLW; Dr. V.P. Singh (Retd), Lakhimpur-Kheri; Dr. Shailendra Singh, Director, Turtle Survival Alliance; Dr. Rajat Bhargava, Senior Ornithologist, BNHS; and Mr. Neeraj Srivastava, Lucknow.

Besides the main topic on the Sarus Project, the following lectures were delivered:

a) Sarus Crane Project Progress Report and Sarus census technique

b) Threatened Birds of Uttar Pradesh

c) Bird Tourism Potential in Uttar Pradesh

d) Travellers in Trouble

e) Amazing world of birds

f) Film on Sarus Crane, prepared by Wildlife Trust of India

PHOTO: SARUS TEAM

Six workshops were organized under the Sarus Project to sensitize people. Besides these workshops, numerous village-level meetings were held

PHOTO: SARUS TEAM

Inauguration of Sarus Workshop in Gandhi Faiz-e-Aam College, Shahjahanpur

In some workshops due to lack of time, all the lectures could not be delivered. The list of participants is given in Annexure I.

The details of these workshops are given below:

1. Gandhi Faiz-e-Aam College, Shahjahanpur: First workshop was organized on 13 August 2018 where more than 300 students and teachers participated.
2. Nawabganj Bird Sanctuary: Second workshop was conducted in Nawabganj Bird Sanctuary on 13 October 2018.
3. Lakh-Bahosi Bird Sanctuary: Third workshop was conducted on 19 February 2019 at Lakh Bahosi.
4. Dudhwa National Park: Fourth workshop was organized in Dudhwa NP on 11 April, 2019.
5. Katerniaghat Wildlife Sanctuary: Fifth workshop was organized on 24 April 2019.
6. Pilibhit Forest office: Sixth workshop was held on on 25 June 2019.

Very useful information on Sarus Cranes and wetlands was collected during interactions in these workshops. Besides these large workshops, many small meetings were held in the villages where issues of Sarus conservation were discussed.

PHOTO: SARUS TEAM

Workshops were conducted with the help of the Forest Department

PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

Workshop at Lakh-Bahosi Bird Sanctuary

PHOTO: SARUS TEAM

PHOTO: SARUS TEAM

Sarus workshop in Pilibhit

PHOTO: SARUS TEAM

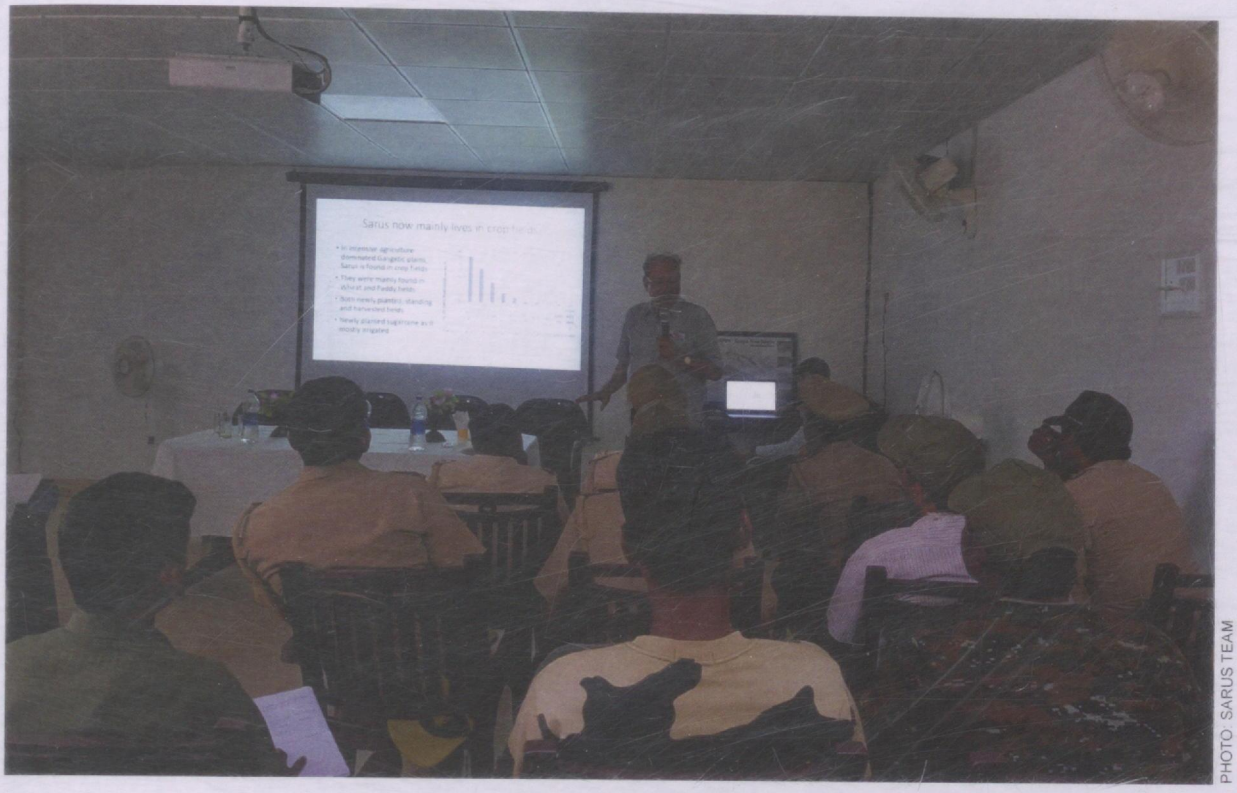


PHOTO: SARUS TEAM

During the workshops, interactive lectures were delivered on Sarus, threatened birds of UP, bird migration and other related topics

PHOTO: SARUS TEAM

The staff of the Forest Department participated enthusiastically in all the workshops. We also gained a lot of knowledge on distribution of wetlands and Sarus from the forest staff

CHAPTER XI

Recommendations

Preamble:

In Uttar Pradesh, Sarus lives in densely populated human-dominated landscapes. Sarus prefers small or large shallow jheels where the water level is from few centimetres to 1.5 m. Large wetlands, reservoirs or lakes are not preferred as they are either too deep for these birds or have high human disturbance in the form of fishing, boating, or abstraction of water, leading to sudden changes in water level. Sarus benefits from canal irrigation in some areas where seepage wetlands are developed, but at the same time, suffers if the cropping pattern is changed due to the consequent easy and assured availability of canal water.

Protected Area approaches, predominantly used for species protection and conservation, may have limited suitability for Sarus Crane for two major reasons: a) few Sarus have been observed inhabiting PAs, and b) many PAs, particularly forested ones, may be unsuitable for the species due to predation pressure, despite having wetlands within them. Dudhwa and Kishanpur are classical examples – both have wetlands but very few Sarus live there, mainly due to predation pressure of large cats.

As this report and earlier studies have shown, breeding success of Sarus is intricately linked with rainfall. But it is not only the quantum of rainfall that is important, the normal pattern of rainfall for 3-4 months is perhaps more important. Climate change may change the quantum and pattern of rainfall, impacting the breeding success of Sarus. At present, we do not have enough data on this issue.

As Sarus inhabits agrarian landscapes, three factors, namely cropping pattern, pesticide use and behavioural attitude towards farming as an occupation, have significant bearing on the suitability of the habitat for this species. The current cropping pattern appears suitable for Sarus in some regions of Uttar Pradesh. However, cropping pattern is subject to change due to various factors such as market forces, India's export/import policy, farmers distress, new agriculture research, and population pressures further subdividing already small holdings. Even genetic research can lead to change in the cropping pattern, indirectly impacting the Sarus crane. For example, new researches are showing that sugarcane can be genetically enhanced to increase the amount of oil content in its leaves and stems, which can be used for biofuel production. If growing sugarcane becomes much more lucrative in future (sugar, *jaggery*, bagasse and biofuel from one crop), many farmers presently growing paddy and wheat may change to sugarcane, hugely impacting Sarus Crane.

Pesticides are another issue that can change the Sarus status. Genetically modified crops and introduction of new chemicals may not appear to have any links with Sarus survival but we should be aware of such indirect links. For example, when the drug diclofenac sodium was introduced for veterinary use in the early 1990s in India, no one thought that it will have impact on vultures. It led to catastrophic decline in vulture numbers, from which they have still not recovered although veterinary use of diclofenac was officially banned in 2006 by the Government of India. Very little work on the impact of pesticides on Sarus Crane and other farmland birds has been done in India. Lack of data gives us a complacency that everything is fine.

At present, local people are positively inclined towards Sarus, but this attitude can change quickly as the new generation of farmers come up. They have a lesser connect to their landscape and the species therein. We are witnessing increasing farmers' distress and increasing aspirations of the new generation to make money. In such a situation any activity that even slightly decreases their crop productivity (e.g. Sarus breeding in paddy fields) will not be looked at positively. Sarus protection cannot be at the cost of loss of crop yield. These are changing attitudes in the fast-changing countryside of Uttar Pradesh.

Predation by free-ranging stray dogs is becoming a huge conservation problem for landscape species such as cranes. Old methods to eliminate the problem animals are now socially unacceptable and legally banned, so new solutions have to be found before this menace further aggravates, as far as Sarus is concerned. More disturbance by dogs to Sarus may lead to more electrocution deaths as the bird flies more. Devices are available that can minimize bird collision with powerlines. We also need research on the flight patterns of Sarus Cranes to find out which types of powerlines are less or more destructive to these large, low-flying birds. Presently not much is known about this in Uttar Pradesh.

Monitoring Sarus is not easy as it lives in a highly complex rural landscape, so standard line transect method may not be very suitable for field data. Randomly selected block count using ground staff/ researchers and drones may give better results. However, this has to be statistically robust to interpret the data for the whole area/region.

Recommendations

Considering all these aspects and links within interlinks, we suggest that the Sarus Surakshan Samiti encourages good research and conservation actions on the following issues:

a) **Management Actions by the Forest Department**

1) Awareness posters, panels and billboards to be placed in all Important Sarus supporting wetlands and other strategic locations for enhancing positive attitude of people towards the cranes.
2) Sarus population assessment by the frontline staff of the Forest Department at least twice a year (summer and winter congregation) monitoring and count with involvement of local and national NGOs and researchers.
3) Choose a day as Sarus Conservation Day, and organize events and celebrations in a wetland of repute in each forest and wildlife division of the State.
4) Allocate and outsource summer dusk sarus population monitoring exercises to professional wildlife NGOs and institutions on a long-term basis so that population trends of Sarus over the years are well-documented and understood.
5) Liaise with the state electricity transmission line agencies to use and convert open power lines to insulated power lines to prevent electrocution of Sarus. The spin-off benefit of such an exercise by the electricity department would also reduce power pilferage at the grassroot level.
6) Sterilization of stray dogs in and around important Sarus supporting wetland areas through the state animal husbandry department and/or NGOs to reduce major predation of Sarus chicks by stray dogs.

7) Formation of village level *Sarus Mitre* societies in each forest range with support from the Sarus Protection Society and organise their capacity building training programmes through organizations like the Wildlife Trust of India (WTI is already conducting such programmes in eastern Uttar Pradesh) and SACON, Coimbatore who are operating a sarus project in UP funded by the MoEFCC.
8) Set up Sarus Crane captive breeding programmes in Lucknow, Kanpur and Gorakhpur zoos for possible reintroduction into the wild. Such centres can also act as rescue centres for injured Sarus Cranes from electrocution and stray dog victimization.
9) Energize the Sarus Protection Society and its activities by appointing full-time staff and with approved annual work plans.
10) Organize a Sarus Crane conservation, management and research seminar through reputed NGOs such as BNHS, WTI, WISA, SACON, and ICF, where a stock checking of all activities that are taking place in Sarus conservation can be reviewed and new activities recommended for implementation through the Sarus Protection Society.

b) **Policy related recommendations to be implemented by the Forest Department**

1. Preventing adverse land use change by recording wetlands within revenue records, and notifying under Wetlands (Conservation and Management) Rules, 2017.
2. The Forest and Wildlife Department of Uttar Pradesh to work with the Fisheries and Irrigation departments to stop fishing and *singhadra* cultivation rights in all Sarus supporting wetlands. The Sarus Protection Society to prevent net loss of wetland habitats in the agricultural landscape of the State.
3. Provide incentives such as subsidy in seed supply, irrigation, etc for rice paddy cultivation in Sarus dominated agricultural landscape, as rice paddy cultivation areas are one of the major adapted habitats of Sarus Cranes in the State.
4. Liaise with the State Education Department to include Sarus Crane education module in the curriculum of secondary and high school syllabus.
5. Set up a Sarus Crane Sanctuary in wetland/grassland complex of the Terai region bordering Nepal to harness the support of the Buddhist sentiment of Sarus protection (as propagated through *Jatakas*) particularly on the lines of Lumbini Sarus Crane Sanctuary of Nepal.
6. Divide the state into three agro-climatic and/or physiographic regions and identify three or four national and/or reputed conservation organizations to plan and implement Sarus Conservation Actions. The suggested organizations are WII, BNHS, WTI, WWF-India, SACON, Katerniaghat Foundation, The Corbett Foundation, Wetland International South Asia (WISA), Lucknow University, AMU, Gorakhpur University and other universities and local conservation NGOs.
7. Engage Gram Panchayats in a community managed wetlands conservation programme which benefits Sarus, as well as provides diverse ecosystem services such as flood buffering, groundwater recharge, and nutrient cycling.
8. Implement a financial incentive scheme for farmers who secure Sarus habitats. In several countries, the rice from such habitats is branded and sold at a premium, thus compensating and even incentivizing the farmer for positive conservation action.

c) **Research related recommendations**

1) **Breeding success of Sarus in different crop types**: This project should be for at least five years because 2-3 years data will not give good results.
2) **Study on the movement and dispersal of Sarus** through satellite tracking, geolocators and colour bands. At least 15-20 adult Sarus and similar number of juveniles should be tracked. Only then we will get meaningful data.
3) **Impact of pesticides** and other chemicals on Sarus and its food.
4) **Monitoring** of the emerging cropping patterns, both at micro (village) and macro (region/ district) levels.
5) Taking Sarus as an iconic species, study the impact of **Climate Change** on the rainfall, small wetlands, crop pattern, shifting of human populations, and urbanization. Developing predictive models of the rural scenario for the next 10, 20, 30 years or more.
6) Study on the impact of **powerlines** and usefulness of deflectors on Sarus Cranes.
7) Selection of at least 100 sites for **summer dusk monitoring** of Sarus Crane every year. This will give a good idea of the population trend.
8) Assessment and evaluation of benefits to Sarus population due to implementation of conservation efforts in the State.

d) **Monitoring**

1) Twice a year monitoring by the Forest staff should continue as this gives a sense of engagement in Sarus protection, but we need to develop robust and doable Sarus monitoring protocol. Researchers with interest in field work and good knowledge of biostatistics should be used for such project. Such intensive monitoring should be done every three-four years and for more than 15-20 years. Only then we will be able to get good population trend data.
2) **Monitoring** of the emerging cropping patterns, both at micro (village) and macro (region/ district) levels.
3) **Summer dusk monitoring** of Sarus crane every year at at least 100 sites. This will give a good idea of the population trend.
4) **Monitoring land use and land cover change in small wetlands,** using satellite data of high resolution and ground truthing.

e) **Other Recommendation**:

Every two or three years, arrange a Sarus Photography Competition during the Wildlife Week in the state capital and other important circles of the state.

Note: *The recommendations were written in consultation with Prof. B.C. Choudhury, (Retd), Wildlife Institute of India, and Dr. Ritesh Kumar, Director, Wetlands International South Asia, Delhi.*

CHAPTER XII

Acknowledgements

We would like to thank the **Sarus Protection Society** for funding the project. Special thanks to various **Chief Wildlife Wardens** and Principal Chief Conservator of Forests (Wildlife) before and during the tenure of this project. Notable names are Dr. Rupak De, Mr. S.K. Upadhyaya, Mr Pawan Kumar, and Mr. Sunil Pandey. Our sincere thanks to Mr. Mukesh Kumar, Mr. V.K. Singh, Mr. Sanjay Srivastava, Mr R. K. Singh, Mr. Mohd Ahsan, Mr. Abu Arshad, Mr. R.K. Gupta, Mr. Raja Mohan, Mr. Aadarsh Kumar, Mr. Rajeev Kumar, Mr. Praveen Khare, and other officers of the Forest Department.

Our sincere gratitude to Dr. Ramesh Pandey, Field Director, and Dr. Mahavir Kaujlaji, Deputy Director, Dudhwa Tiger Reserve and all their staff.

My personal thanks to Dr. V.P. Singh, Mr. Neeraj Srivastava, Mr. Sanjay Kumar, Mr. Fazlur Rahman, Mr. Bridesh Kumar, Mr. Vinod Kumar, Mr. Suhail Ahmad, Mr. 'Sonu' Leeladhar for helping us in the field. Very special thanks to Mr. Qamar Qureshi of the Wildlife Institute of India, and Mr. Prakash Mehta of BNHS for preparing maps and diagrams.We also thank Mr. Qamar Qureshi for statistical analysis of data. Thanks Dr Mudit Gupta, Mr. Vikram Tiwari and Mr. Satpal Singh of Mohammadia.

Special thanks to Dr. Kamal Dalakoti of Wetlands International South Asia (WISA) for preparing maps of the wetlands of different districts. Our gratitude to Dr. Ritesh Kumar, Director, WISA and Dr. Siddharth Kaul, President of WISA.

Personal thanks to Mr. B.C. Choudhury, Dr. Samir Sinha and Dr. Arshad Ahmad of Wildlife Trust of India (WTI) for discussions from time to time.

We also had discussions with Dr. S. Muralidharan of SACON and his students working on the Sarus project.

We are grateful to Prof. Jamil Ahmad, Principal, Gandhi Faiz-e-Aam College, Shahjahanpur for organizing the first Sarus workshop. Thanks are due to Dr (Mrs) Arib Anjum Rahman, Chairperson, Zoology Department, Dr. Arshad Ali, Assistant Professor, Dr. Rajesh Kumar, Post Doctoral Fellow, and other staff and students.

In BNHS, we would like to thank Dr. Deepak Apte, Director and Mr. Debi Goenka, Hon. Secretary for their support. Other noteworthy names are Ms. Varsha Chalke, Mr. Sachin Kulkarni, Ms Siddhi Shelar, Ms Sushma Sakpal, Dr. Raju Kasambe, Mr. Rohan Bhagat, and Mrs. Nirmala Reddy Barure.

We also thank the photographers for providing their images of Sarus and related subjects. Their names are acknowledged beside the images.

We are grateful to Dr. Gayatri Ugra for editing the report.

Lastly, we thank Mr. Gopi Naidu for the layout and design of this report.

CHAPTER XIII

References

Alonso J.C., Alonso J.A. & Muñoz-Pulido, R. (1994) Mitigation of bird collisions with transmission lines through ground wire marking. *Biological Conservation* 67: 129-134.

Anonymous (2011) National Wetland Atlas, SAC/EPSA/ABHG/NWIA/ATLAS/34/2011, Space Applications Centre (ISRO), Ahmedabad, India, 310 p.

Anonymous (2012) Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel–GEF (2012) *Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions.* Secretariat of the Convention on Biological Diversity, Montreal, CBD Technical Series No. 67.

Banks, P. B. & Bryant, J. V. (2007) Four-legged friend or foe? Dog walking displaces native birds from natural areas. *Biology Letters* 3(6): 611–613.

Barnes, D.K.A., Galgani, F., Thompson, R.C. & Barlaz, M. (2009) Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transections of the Royal Society B.* 365 (1526): 1985-1988.

Bhardwaj, G.S., Dookia, S. and Dutta, S. (2018) Anthropogenic Mortality of Wildlife: A Case Study Demonstrating Free Ranging Dogs Emerging as the only Predator in Thar Desert. *Indian Forester* 144 (10): 947-957.

Bibby, C., Burgess, N., Hill, D. and Mustoe, S. (2000) *Bird Census Techniques* (2nd edn), Academic Press, London. Pp. 302.

BirdLife International (2019a) Species factsheet: *Emberiza aureola*. Downloaded from http://www.birdlife.org on 01/08/2019.

BirdLife International (2019b) Species factsheet: *Grus japonensis*. Downloaded from http://www.birdlife.org on 01/08/2019.

Borad, C. K., Mukherjee, A. and Parasharya, B. M. (2000) Conservation of the avian biodiversity in paddy (*Oryza sativa*) crop agroecosystem. *Indian Journal of Agricultural Sciences* 70 (6): 378-381.

Borad, C.K., Mukherjee, A., Patel, S. B. and Parasharya, B.M. (2002) Breeding performace of Indian Sarus Crane *Grus antigo neantigone* in the paddy crop agroecosystem. *Biodiversity and Conservation* 11 (5): 795–805.

Cafazzo, S., Valsecchi, P., Bonanni, R., & Natoli, E. (2010) Dominance in relation to age, sex, and competitive contexts in a group of free-ranging domestic dogs. *Behavioural Ecology* 21: 443-455.

Choudhury, B.C. and Rahmani, A.R. (2014) *Sarus Crane: A pictorial life history*. Bombay Natural History Society, U.P Forest Department and Sarus Protection Society, Mumbai and Lucknow. Pp 132.

Doherty, T.S., Dickman, C. R., Glen, A.S., Newsome, T.M., Nimmo, G., Ritchie, G. E., Vanak, A.T. and Wirsing, A. J. (2017) The global impacts of domestic dogs on threatened vertebrates. *Biological Conservation* 210 A: 56-59.

Donald, P. F., Green R.E. & Heath M.F. 2001. Agricultural intensification and the collapse of Europe's farmland bird populations. *Proceedings of the Royal Academy of Science B* 268: 25-29. http://dx.doi.org/10.1098/rspb.2000.1325.

Eaton, M.A., Appleton, G. F., Ausden, M.A., Balmer, D. E., Grantham, *et al.* (2010) *The State of UK's Birds (2010).* Royal Society for the Protection of Birds, British Trust for Ornithology, Wildfowl & Wetlands Trust,

Countryside Council for Wales, Joint Nature Conservation Committee, Natural England, Northern Ireland Environment Agency, and Scottish Natural Heritage, Sandy, Bedfordshire, UK.

Fannes, C.A. (1987) *Bird Behaviour and Mortality in Relation to Power Lines in Prairie Habitats*. U.S Fish & Wildlife Service. Fish & Wildlife Service Technical Report 7. 24 pp.

Fisher, E. K., Pagliolonga, L., Czech, E. & Taminga, M. (2016) Microplastic pollution in lakes and lake shoreline sediments – A case study on Lake Bolsena and Lake Chiusi (central Italy). *Environmental Pollution* 231: 648-657.

Fuller, R. J., Gregory, R. D.,Gibbons, D. W., Marchant, J. H., Wilson, J. D., Baillie, S. R. & Carter, N. (1995) Population declines and range contractions among lowland farmland birds in Britain. *Conservation Biology* 9: 1425-1441.

Gole, P. (1989) *The Status and Ecological Requirements of Sarus Crane*. Phase I. Ecological Society, Pune, India.

Gompper, M.E. (Ed.) (2014) *Free-ranging dogs and wildlife conservation*. Oxford University Press, UK. 336 pp.

Gopal, B. (2003) Perspectives on wetland science, application and policy. *Hydrobiologia* 490: 1–10.

Gopal B, Junk W. J., Finlayson C. M., Breen, C. M. (2008) Present state and future of tropical wetlands. In: Polunin N (ed) Aquatic ecosystems. Cambridge University Press, Cambridge, pp. 142–154. (U.K. Foundation for Environmental Conservation).

Gopal, B. and Chauhan, M. (2001) South Asian wetlands and their biodiversity: the role of monsoons. *In* Biodiversity in wetlands: assessment, function and conservation. Volume 2. Edited by B. Gopal, W.J. Junk and J.A. Davis: Backhuyas Publishers, Leiden, The Netherlands. pp. 257-275

Gopal B., Junk, W.J., and Davis, J.A. (2000, 2001) Biodiversity in wetlands: assessment, function and conservation. Part 1 and 2. Backhuys Publishers, Leiden: 353p and 310p

Green, R. E., Cornell, S. J., Scharlemann, J. P. W. & Balmford, A. (2005) Farming and the fate of wild nature. *Science* 307: 550-555.

Green, R.E., Taggart, M.A., Senacha, K.R., Raghavan, B., Pain, D.J., *et al.* (2007) Rate of Decline of the Oriental White-Backed Vulture Population in India Estimated from a Survey of Diclofenac Residues in Carcasses of Ungulates. *PloS ONE* 2: e686.

Hirji, R., Mandal, S. & Pangare, G. (Eds.) (2017) *South Asia Groundwater Forum: Regional Challenges and Opportunities for Building Drought and Climate Resilience for Farmers, Cities, and Villages*. Academic Foundation, New Delhi, India. 116 pp.

Home, C., Bhatnagar, Y.V., and Vanak, A.T. (2017) Canine Conundrum: domestic dogs as an invasive species and their impacts on wildlife in India. *Animal Conservation* 21: 275-282.

Janss, G.F.E. (2000) Avian mortality from power lines: a morphologic approach of a species-specific mortality. *Biological Conservation* 95: 353–359.

Kaur, J. (2008) Impact of Land Use Changes on the Habitat, Behaviour and Breeding Biology of the Indian Sarus Crane (*Grus antigone antigone*) in the Semi-arid Tract of Rajasthan, India. Ph.D. Thesis. Forest Research Institute University, Dehra Dun.

Kaur, J. and Choudhury, B.C. (2003) Stealing of Sarus crane eggs. *Current Science* 85 (11): 1515-1516.

Kaur, J. and Nair, A. (2008) Community involvement in conservation of Sarus crane breeding habitat in three districts of semi-arid tract of Rajasthan, India. Report submitted to Rufford Small Grants Foundation, U.K.

Kaur, J., Nair, A. and Choudhury, B.C. (2008) Conservation of the vulnerable sarus crane *Grus antigone antigone* in Kota, Rajasthan, India: a case study of community involvement. *Oryx*, 42: 452-455.

Kaur J., Nair, A.K., Choudhury, B.C. (2013) Distribution of Sarus Crane *Grus antigone antigone* in

Rajasthan and People's Participation in the Protection of its Breeding Sites. In: Sharma B., Kulshreshtha S., Rahmani, A. (eds) Faunal Heritage of Rajasthan, India. Springer.

Kirk, D. A., Lindsay, K. E. & Brook, R. W. (2011) Risk of agricultural practices and habitat change to farmland birds. *Avian Conservation and Ecology* 6 (1): 5. http://dx.doi.org/10.5751/ACE-00446-060105.

Kumar, S. and Srivastava, N. (2011) *Conservation of Potential Wetlands in District Sitapur: A first hand impression*. U.P. State Biodiversity Board, Lucknow. Pp. 143.

Lenth, B.E., Knight, R.L. & Brennan, M.E. (2008) The Effects of Dogs on Wildlife Communities. *J. Natural Areas* 28(3): 218-227.

Martin, G. R. (2011) Understanding bird collisions with man-made objects: a sensory ecology approach. *Ibis* 153: 239–254.

Martin G.R. and Shaw, J. M. (2010) Bird collisions with power lines: failing to see the way ahead? *Biological Conservation* 143: 2695–2702.

Meister, R.T. (1992). *Farm Chemicals Handbook*. Meister Publishing Company. Willoughby, USA.

Mohandas, M.S. (2017) *Has conservation gone to the dogs? Ecological aspects of free-ranging dogs in the Thar*. MSc Dissertation. Saurashtra University, Rajkot, and Wildlife Institute of India, Dehradun. Pp. 68.

Mohibuddin (2017) *Assessing threats to birds from power-lines in Thar with special emphasis on the Great Indian Bustard*. MSc dissertation. Department of Wildlife Sciences, University of Kota, Kota, Rajasthan. Pp. 45.

Mukerhee, A., Borad, C.K., & Asnani, M.V. (2006) Process documentation research on pattern of pesticides use in Western India. *Zoo's Print Journal* 21 (12): 2498-2494.

Mukherjee, A. (1999) Ecological study the Indian sarus crane *Grus antigone* in the central Gujarat. PhD thesis, Saurashtra University, Rajkot, Gujarat.

Mukherjee, A., Borad, C.K. and Parasharya, B.M. (2002) Breeding performance of the Indian sarus crane in the agricultural landscape of western India. *Biological Conservation* 105(2):263-269.

Muralidharan, S. (1992) Poisoning of Sarus. *Hornbill* 1992(1): 3-7.

Muralidharan, S. (1993) Aldrin poisoning of Sarus cranes (*Grus antigone*) and a few granivorous birds in Keoladeo National Park, Bharatpur, India. *Ecotoxicology* 2 (3), 196-202.

Muralidharan, S. (2000) Organochlorine residues in the waters of Keoladeo National Park, Bharatpur, Rajasthan. *Bull. Environ. Contam. Toxicol.* 65 (1), 35-41.

Murlidharan, S. (2004) Mortality of globally threatened Sarus cranes *Grus antigone* from monocrotophos poisoning in India. *Science of the Total Environment* 326 (1-3): 55-61.

Muralidharan, S., Ganesan, K., Nambirajan, K., Kirubhanandhini, V. & V. Dhanajayan (2014). Wetland birds indicator of pesticide contamination: Current and future prospects for research in India. *In* G. V. Gopi & S. A. Hussain (Eds) *Waterbirds & Protected Areas* (*ENVIS Bulletin*, 16: 314-323:, Wildlife Institute of India, Dehradun, India.

Murphy, M. T. (2003). Avian population trends within the evolving agricultural landscape of eastern and central United States. *Auk* 120: 20-34. http://dx.doi.org/10.1642/0004-8038(2003)120[0020:APTWTE]2.0.CO;2

Murray, J.A. (1888-1890) *The avifauna of British India and its dependencies*. Education Society Press, Bombay.

Newton, I. (2004) The recent declines of farmland bird populations in Britain: an appraisal of causal factors and conservation actions. *Ibis* 146: 579-600. http://dx.doi.org/10.1111/j.1474-919X.2004.00375.x

Oaks, J.L., Gilbert, M., Virani, M. Z, Watson, R.T., Meteyer, C.U., et al. (2004) Diclofenac residues as the cause of vulture population declines in Pakistan. *Nature* 427: 630–633.

Pain, D.J. & Pienkowski, M.W. (1997) (editors) *Farming and birds in Europe: the common agricultural policy and its implications for bird conservation*. Academic Press, California, USA.

Prakash, V., Pain, D. J., Cunningham, A. A., Donald, P. F., Prakash, N., Verma, A., Gargi, R., Sivakumar, S. & Rahmani, A. R. (2003). Catastrophic collapse of Indian white-backed *Gyps bengalensis* and long-billed *Gyps indicus* vulture populations. *Biol. Conservation* 109: 381–390.

Shultz, S., Baral. H.S., Charman, S., Cunningham, A.A., Das, D., et al. (2004) Diclofenac poisoning is widespread in declining vulture populations across the Indian subcontinent. *Proc Royal Soc Lond* B (Suppl) 271: S458–S460.

Smith, G.J. (1993). Toxicology and pesticide use in relation to wildlife: Organophosphorus and carbamate compounds. C. K. Smoley, Boca Raton, FL. USA.

Stehn, T.V., and T. Wassenich (2008). Whooping crane collisions with power lines: an issue paper. In: Folk, M.J. and S.A. Nesbitt (eds). 2008. *Proceedings of the Tenth North American Crane Workshop*, Feb. 7-10, 2006, Zacatecas City, Zacatecas, Mexico: North American Crane Working Group. pp. 25-36.

Subramanian, M. (2012) The troubles with turbines: An ill wind. *Nature* 486:310-311.

Sundar, K,S, Gopi (2009) Are Rice Paddies Suboptimal Breeding Habitat for Sarus Cranes in Uttar Pradesh, India?*The Condor* 111(4): 611-623.

Sundar, K.S.G., Kaur, J. & Choudhury, B.C. (2000) Distribution, demography and conservation status of the Indian sarus crane (Grus antigoneantigone) in India. Journal of the Bombay Natural History Society, 97, 319–339.

Sundar, K.S. Gopi and Choudhury, B.C. (2005) Mortality of Sarus Cranes (Grus *antigone*) due to electricity wires in Uttar Pradesh, India. *Environmental Conservation* 32(3): 260-269.

Sundar, K.S.G and S. Subramanya (2010) Bird use of Rice Fields in the Indian Subcontinent. *Waterbirds* 33 (sp1): 44-70.

Sundar, K.S.G. & Choudhury, B.C. (2003) The Indian sarus crane *Grus a. antigone*: a literature review. *Journal of Ecological Society*, 16, 16–41.

Tere, A. and Parasharya, B.M. (2011) Flamingo mortality due to collision with high tension electric wires in Gujarat, India. *Journal of Threatened Taxa* 3(11): 2192–2201.

Varagiya, D., Pandya, D., & Tatu, K. (2015) Pesticide Toxicity with Special Reference to Wetlands of India - A Review. *Jalaplavit* 6 (3) (Research Special): 51-59.

Vyas (1998) *Pesticides industries*: *Today and Tomorrow*. Pesticides Manufactures and Formulation Association of Gujarat, Ahmedabad, India.

Wilcox, C., Sebille, E.V. and Hardesty, B.D. (2015) Threat of plastic pollution to seabirds is global, pervasive, and increasing. *PNAS* 112 (38): 11899-11904.

WTI (2015) *Important Sarus Wetland Sites in the Agricultural Landscape of Eastern Uttar Pradesh*. Wildlife Trust of India, New Delhi. Pp. 61.

Zapata-Ríos, G. & Branch, L. C. (2016) Altered activity patterns and reduced abundance of native mammals in sites with feral dogs in the high Andes. *Biological Conservation* 193: 9-16.

Appendix I

Participants of Sarus Workshop at Nawabganj, 13 October 2018			
S. No.	**Name**	**Designation**	**Contact Info.**
1	R.K. Singh	Chief Conservator of Forests	
2	Mr.Mohd Ahsan	Former PCCF (Wildlife)	
3	Mr. Abu Arshad	Wildlife Warden	
4	Mr Neeraj Srivastava	Lucknow	
5	Dr. Rajat Bhargava	BNHS	
6	Dr. Shailendra Kumar	Turtle Survival Alliance, Lucknow	
7	Mr. Mohanraj Shukla	Nawabganj	9450377100
8	Mr. Mohd	Jaffer	9453946163
9	Mr. NankiBallav	Lakh Bahosi	9628237795
10	Mr. Gulak Singh	Lakh Bahosi	9651990223
11	Mr. Vivek Kumar Verma	Kukrail	8218394550
12	Mr. Sushil Kumar Awasthi	Lakh Bahosi	9415152817
13	Mr. Ashutosh Kumar	Forester, Sandi Bird Sanctuary	9415521363
14	Mr. Dhananjay Kumar Singh	Kukrail	9936427935
15	Mr. Aditya Singh Chauhan	Forester, Kukrail	9554161616
16	Mr. Arvind Kumar	Forest Guard, Samaspur	7880403102
17	Non readable name		9918022022
18	Mr. Gyanchandra Patel	Wildlife Guard, Lakh Bahosi	8874159498
19	Mr. Piyanshu Yadav	Sandi	9628066672
20	Mr. Alok Kumar	Sandi	7317783134
21	Mr. Manoj Kumar	Nawabganj Bird Sanctuary	9532334380
22	Mr. Dharmendra Kumar	Nawabganj	9473883609
23	Mr. Sushil Kumar	Samaspur	
24	Mr. Pradeep Kumar	Samaspur	9305481919
25	Rakesh Kumar	Samaspur	7351607481
26	Vijai Shankar Dule	Sapru Marg, Lucknow	9208080435

Participants of the Sarus Workshop at Lakh-Bahosi, 19 February 2019			
S. No.	**Name**	**Designation**	**Contact Info.**
1	Mr. R.K. Gupta	IFS, Endangered Species Project	9415130102
2	Dr. Ravi Verma	Doctor	9355382999, drverma.ravi@gmail.com
3	Amit Gupta	Businessman	8415124167, amit Shukla80@yahoo.com
4	Mordwaj Shukla	RFO, Nawabganj	7839434597
5	Mohd. Jayar	Gharial Centre, Kukrail	9453946163
6	Ashutosh Kumar	Forester, Sandi	9415521363
7	Avenesh Kumar Verma	Guard, Nawabganj	7376677601
8	Aditya Singh Chauhan	Forester, Kukrail	9554161616
9	Vivek Kumar Verma	Forester, Nawabganj	9358228390
10	Bahadur Singh	Kukrail	9919076956
11	Brij Mohan	Guard, Kukrail	8115553601
12	Gyanchandra Patel	Guard, Lakh-Bahosi	8874159498
13	Priyanshu Yadav	Guar, Sandi	9628066672
14	Sushil Kumar Srivastava	RFO, Lakh-Bahosi	9415152827
15	JankiBallav	Forester, Lakh-Bahosi	9628237795
16	Alok Kumar	Guard, Sandi	7317783134
17	Deshpal Singh	Guard, Nawabganj	7417175176
18	Manoj Kumar	Guard, Nawabganj	8178444313
19	Gulab Singh	Wildlife Guard, Lakh-Bahosi	9651990223
20	Karan Singh	Guard, Lakh Bahosi	8126831160
21	Rajesh Kumar	Nawik, Lakh Bahosi	8736604089
22	G. Gupta	Student	9415124167

Participants of the Sarus Workshop at Dudhwa, 11 April 2019			
Sr. No.	**Name**	**Designation**	**Contact Info.**
1	Mahavir Kaujalgi	Dy. Director, Dudhwa Tiger Reserve	7839435186
2	Toufik Mohammad	WLW-Kishanpur	9559791180
3	Lallan Swarup Dixit	Up Sanrakshak Vanyajiv	9450486894
4	Khadag Bahadur	Up Kshetriy Van Adhikari-Belroya Range	
5	Ram Kumar	R. O. Tourism	7839434393
6	Ram Naresh	R. O. Tourism	9628725191
7	Ghanshyamsinh	Van Daroga	9979926046
8	Ramdas Srivastav	Van Daroga	8052369506
9	Jagdish Prasad Rana	Van Daroga	9455207475
10	Rajkishor	Van Daroga	9670840152
11	Munish Kumar	Van Daroga	9415412572
12	Hansram	Van Daroga-Sonaripur Range	9792434533
13	Vinod Kumar Trivedi	Van Daroga-Belroya Range	7380332309
14	Pradip Kumar	Watcher	9532846750
15	Pradip Kumar sharma	Watcher	7068647322
16	Ajay Kumar	Watcher	9161295848
17	Gurarkali	Watcher	9451535552
18	Bhagirath	Watcher	9451535552
19	Arun Kumar	Watcher	9455676529
20	Parshuram	Watcher	9917646838
21	Rahul Kumar	Watcher	9918622485
22	Raamsevak	Watcher	9451121087
23	Manoj Kumar	Watcher	7376192889
24	Mahesh Kumar	Watcher	7839492216
25	Sujit Kumar Sinh	Vanyajiv Rakshak	9454860804
26	Sarvesh Kumar	Vanyajiv Rakshak	9454658180
27	Nandram	Van Rakshak	7983359942
28	Mohammad Nasim	Private Guide	9670251528
29	Ravi	Tourism	7518391510
30	Kamlesh Kumar	Tourism	972121297
31	Mangalram	T.C.	8004054992

Participants of the Sarus Workshop at Katerniya-Ghat, 24 April. 2019			
Sr. No.	**Name**	**Designation**	**Contact Info.**
1	Maheknath Yadav	Range Officer	9415974903
2	Ashok Kumar Tyagi	Range Officer	9412504229
3	Abhay Paratap Singh	Range Officer	9415332500
4	Malikram	Van Rakshak	7376123986
5	Hanumandas Shrivastav	Up Rakshak	9415722598
6	Ravindra Yadav	Up Rakshak	7376370619
7	Sanjiv Kumar	Watchman	9451657116
8	Pravesh Kumar	Vanyajiv Rakshak	9457773208
9	Mo. Irfan Ansari	Kshetriy Van Adhikari	9837017869
10	Anand Prasad Arya	Kshetriy Van Adhikari	9935830761
11	Yogendra Dhadve	STPF	9392154521
12	Suhaglal	Up Rakshak	9919248813
13	Vijay Pal	Vanyajiv Rakshak	9451515952

Participants of the Sarus Workshop at Katerniya-Ghat, 24 Apr. 2019 (contd.)			
Sr. No.	**Name**	**Designation**	**Contact Info.**
14	Dayanand Kushwaha	STPF	9415561356
15	Iftekhar Ahmed	STPF	7800907880
16	Anil Kumar Pandey	STPF	8005423914
17	Hiralal Yadav	Assistant Dog Handler	8004145820
18	Ram Kumar	Van Daroga	8400244884
19	Manoj Kumar Pathak	Van Daroga	9005354888
20	Satyendra Kumar	Platoon Commander STPF	9450605261
21	Anil Kumar	Forester	9415959229
22	Darpanrayan Shukla	Vanyajiv Rakshak	9452000541
23	Bhargav Prasad Yadav	Van Rakshak	7905577100
24	Deepak Kumar	Driver	9473690610
25	Ram Singh	Navik	9455579945
26	Kallu Singh	Navik	9450975066
27	Shiv Kumar Yadav	Navik	7851976722
28	Ramsukh Yadav	Vanyajiv Rakshak	9452224627
29	Kari lal Vasan	Forest Guard	9452066124
30	Yashvant	SDO	9950860608
31	Dayashankar Singh	Range Officer	7839434565
32	Piyush Mohan	Range Officer	9415177600
33	Yogesh Pratap Singh	Forest Guard	9956191500
34	Radheshyam	DFO	9453730100
35	Vinod	Guide	9621049003
36	Ashok kumar	Mali	_____
37	Lalla	Watcher	7275253150
38	Lakshman	Keeper	9450986320
39	BhimChandra Mourya	Up Kshetriy Vanadhikari	9453893505
40	Shaharyar Khan	Van Rakshak	9455975171
41	Shivam Kumar	Watchman	7839472174
42	Fazlur Rahman	Coordinator KGF	9454476565
43	G. P. Singh IFS	DFO	9415148607
44	Dabeer Hasan	SDO WWF	9450257709
45	Umesh Kumar	Keeper	9415585352
46	Kaden Rasool	Reporter	9452472572
47	Bridesh Kumar	Assistant Dog Handler	8874510014
48	Mo. Afzal	Guiede	9453154496
49	Mo. Irshad	Driver	8004001415
50	Adil Hussain	Driver	9451221090
51	Savli Prasad	Driver	7703058065
52	Surendar	Driver	
53	Mansoor Ali	Driver	9455451093
54	Vivina	Driver	8004184700
55	Fulsinh	Guide	9451683517
56	Nazakat Ali	Driver	9415230904
57	Shankar	Driver	9532858465
58	Amit Kumar Shrivastav	Watcher Operator	9455743901
59	Sharif Ahmed	Van Daroga	7991612324
60	Jitendra Kumar Mishra	STPF	9450795293
61	Arun Kumar	STPF	8005112978
62	Subhash Kumar Singh	STPF	8840845166
63	Ramesh Singh	STPF	8858712171

Participants of the Sarus Workshop at Department of Zoology, Gandhi Faiz-e-Aam College, Shahjahanpur, 13 August 2018			
Sr. No.	**Name**	**Designation**	**Contact Info.**
1	Prof. Jamil Ahmad	Principal	
2	Dr. (Mrs) Arib Anjum Rahman	Chairperson	
3	Dr. Arshad Ali	Assistant Professor	
4	Dr.Mohd Shoeb	Assistant Professor	
5	Dr. Rajesh Kumar	Post-Doctoral Fellow (UGC)	
6	Ms. Saba Saadat	Assistant Professor	
7	Mr. Sajid Khan	Lab Assistant	
8	Mr. Yusuf Ali	Lab Assistant	
9	Nearly 300 students		

Participants of workshop held in the office of Field Director, Pilibhit Tiger Reserve on 25 June 2019

S. No.	Name	Designation	Mobile number
1.	Mr. N. Raja Mohan	Field Director, Pilibhit TR	916191249
2.	Mr. Aadarsh Kumar	Dy. Director, Pilibhit TR	
3.	Mr. Rajeev Kumar	DFO, Pilibhit	
4.	Mr. Praveen Khare	ACF, Pilibhit	9453051318
5.	Mr. Giriraj Singh	RFO, Mahauf	8006712162
6.	Mr. Govind Ram Gangwar	Dy. RO	9412846884
7.	Mr. Radheyshyam	Forester	9639558562
8.	Mr. Rakesh Kumar	Dy. RO	9761468428
9.	Mr. Ram Bharat Yadav	Forester	9927442220
10.	Mr. Raghuveer Rawat	Forest Guard	9412846872
11.	Mr. Shankar Singh	Forest Guard	7917969580
12.	Mr. Avinesh Kumar	Forester	8006247387
13.	Mr. Surendra Gautam	Forest Guard	9758477287
14.	Mr. Chandra Sen Maurya	Forester	9411426076
15.	Mr. Shabbir Ahmad Khan	Dy. RO	9634160485
16.	Mr. Musavvir Khan	Operator	8923349802
17.	Mr. Rahul Kumar	Field Assistant, WWF	9568776796
18.	Mr. A. Shukla	Reporter, Hindustan	9411690479
19.	Mr. Ram Dhar	Forest Guard	6397113179
20.	Mr. Saurav Pandey	Journalist	9412360669
21.	Mr. Nand Ram	Forester	9761285470
22.	Mr. Sher Singh	Forester	9411282344
23.	Mr. Muktiar Baksh	FC	9661121141
24.	Mr. Sauvaran Singh	Forester	9759707796
25.	Mr. Gyani Singh	Forest Guard	9411284350
26.	Mr. Radhyeshyam	Forester	9412585383
27.	Mr. S. Rahman	Forester	8650224658
28.	Mr. Girish	Dy. RO	9690670724
29.	Mr. Mohammad Arif	Forester	7243854097
30.	Mr. Adnan Khan	Journalist	9917674176

Participants of workshop held in the office of Field Director, Pilibhit Tiger Reserve on 25 June 2019 (contd.)			
S. No.	**Name**	**Designation**	**Mobile number**
31.	Mr. Wazir Hassan	RFO	9456688783
32.	Mr. Ramji	RF, Mala	9626552072
33.	Mr. Pramod Kumar	Forester	9410896841
34.	Mr. Bilal	Photographer	9837141990
35.	Illegible name	Amar Ujala press reporter	8439355650
36.	Mr. Kali Charan	P.T.R.	740988756
37.	Mr. Prashant	Dainik Jagran reporter	8535080692
38.	Mr. Sher Singh	Orderly	7830061580
39.	Mr. Arjun Singh	Forester	9457873347
40.	Mr. Suresh Chandra	Forest Guard	9412870229