



Habitat Preference and Current Threats to The Sarus Cranes *Grus Antigone* (Aves: Gruiformes: Gruidae) In Important Bird Areas of Haryana, India: Implications for Determining Effective Conservation Actions

Harsh Gulati¹, Sarita Rana²

¹Research Scholar, Department of Zoology, Kurukshetra University Kurukshetra, Haryana, India.
harsh12@kuk.ac.in

²Assistant Professor, Institute of Integrated and Honors Studies, Kurukshetra University Kurukshetra, Haryana, India.

<i>Article History</i>	<i>Abstract</i>
Received: 13 Feb 2022 Revised: 15 May 2022 Accepted: 14 August 2022	Understanding the habitat preferences of Sarus Crane can assist ecologists in identifying high-priority habitats and improving conservation strategies. The habitat utilization and preference of Sarus Crane were studied in and around Important Bird areas of the Gurugram district from November 2019 to October 2020. In total, 171 flocks were observed in agricultural land followed by marshland (147) and grassland (11). Our analysis showed that the Sarus Crane strongly preferred agricultural areas ($s = +0.18$) and avoided grassland habitats ($s = -0.22$ and -0.53 respectively). There was a significant difference in the utilization of agriculture and marshland ($P < 0.05$) habitats in different seasons. However, the Sarus Crane utilized the grassland habitat randomly ($P > 0.05$). The Sarus Cranes experienced several serious threats, including predation, habitat destruction, and the agricultural use of pesticides. This study on habitat preference and current threats will provide a scientific baseline for future research to better understand the ecology of the Sarus Cranes and will be helpful in their conservation. These IBA's are the only suitable sites in Haryana because it is surrounded by a large area of agricultural land and exposed to the pressure of human activities. It is, therefore, necessary to protect such habitats, to provide a healthy ecosystem for Sarus Cranes.
CC License CC-BY-NC-SA 4.0	Keywords: <i>Basai wetland, Gurugram district, habitat use, Sarus Crane, threats, Sultanpur National Park</i>

1. Introduction

The Sarus Crane, *Grus Antigone* is the only resident Crane species that breeds in India^{2,4,11}. The word Sarus came from “**Sarasa**” which indicates “**bird of lake**” which is a well-known species of open marshlands³³. The Sarus Crane is classified as vulnerable species probably due to experiencing a rapid population decline

that is expected to continue as a result of widespread reductions quality of wetland habitats⁴. Due to the decline in the marshland habitat, it is increasingly being forced to migrate to agricultural areas^{26,27,30}. These Cranes require flat open wetlands, cultivations, fallows, and grasslands for nesting, foraging, and physical maintenance²⁹. The destruction of their eggs and juveniles as a result of poaching causes this species to become vulnerable¹⁶. Conservation is regarded as a significant novel method for biodiversity conservation¹; however, it has primarily been used to conserve the species in and around protected areas. There are certain community preserved areas for some species in India²², but the Sarus Crane, which is not limited to a narrow area, has not benefited from such programs. Due to the lack of efficient conservation methods for Cranes, the number of threats to their population is expanding at an alarming rate²³. However, there are limited studies focusing on habitat use and threats to Sarus Crane. In this study, we focused on habitat use and preference of Sarus Crane along with the information on current threats to Sarus Cranes were recorded. Taking into consideration of this ecologically important species our studies rely upon habitat preference and use by the Sarus Crane.

2. Material And Methods

2.1 Study Area

The study was undertaken in the Important Bird Areas of Gurugram district which is located in south-eastern Haryana. Fieldwork was carried out in Basai wetland (28°28' N – 76°38' E), Sultanpur National Park (28°28' N – 76°55' E), and associated areas from November 2019 to October 2020. The Sultanpur National Park of Gurugram district is such a wetland that is a perfect abode for Sarus Crane due to its hydrological and vegetative characteristics. The wetland of the Sultanpur National Park was added to the Ramsar list of wetlands in 2021. Basai wetland is located 2 km far from Najafgarh Jheel Bird Sanctuary which is named after the village Basai in Gurugram district. Basai wetland covers an area of 250 acres having shallow water that serves as an important bird area for a number of threatened species¹². A large area of agricultural land surrounds the Najafgarh Jheel bird sanctuary with paddy, wheat, and mustard is the most common cultivated crops. This Jheel is one of the most polluted, due to untreated sewage flowing into it, nevertheless, it is considered a favorable habitat for avian diversity.

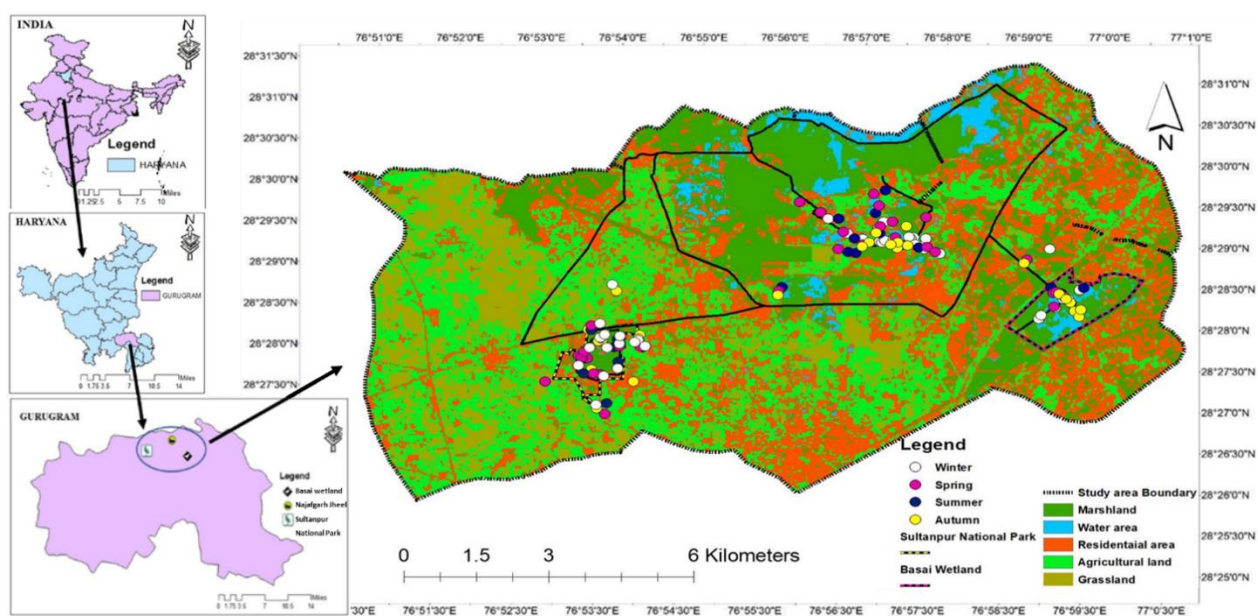


Figure 1. Habitat use was interpreted from a Landsat imagery along with a line transect route in and around Important Bird Areas of Gurugram district. The small filled circles (in different colors) indicate the flocks of Sarus Crane located in different seasons during the study period.

2.2 Field surveys

To know the habitat utilization, transect surveys were conducted during their feeding time between 8:00 and 18:00¹⁹. The transect was covered within 2 days during the field visits. A single complete survey was conducted continuously for 2 days with a total of 24 surveys (two each month) accomplished during the study. For the successive transect survey, the direction of the path was reversed. To make distance calculations easier, the positions of all flocks were plotted on a 1:50,000 multi-temporal Landsat image (acquired on 24 October 2020). Agricultural land, marshland, water area, grassland, and residential areas are among the five land-use types identified in the Landsat TM5 satellite image. Using ArcGIS 10.8.1 (ESRI, New York St., Redlands, California, USA), buffer analysis was conducted to obtain land use data along the transect. The area of the given habitat was computed using remotely sensed photographs (resolution 15 X 15, October 2020). To confirm the habitat composition for ground-truthing 65-point locations were recorded within 250 m along each side of the transect. A single GPS location was recorded for each flock sighted during the survey³⁰. According to previous studies, we only examined agricultural land, marshy areas, and grassland (Table 1) as suitable feeding habitats for the Sarus Crane¹⁹.

Table 1. General features of land cover classes within the Important bird areas and surrounding agricultural landscape were used for the analysis of the habitat preference of Sarus Crane¹⁷.

Habitat	Description	Dominant vegetation
Agricultural land	Land use for cultivation	Crops, e.g., <i>Oryza sativa</i> (Paddy), <i>Triticum aestivum</i> (Wheat), <i>Brassica nigra</i> (Mustard)
Marshland	Soil is generally waterlogged and the lake is covered with shallow water throughout the year	Submerged aquatic plants such as <i>Hydrilla</i> , <i>Vallisneria natans</i> , emerging plants like <i>Typha angustata</i> , <i>Saccharum munja</i> , <i>Cyperus rotandus</i> , <i>Eichornia crassipes</i> (Water hyacinth).
Grassland	Soil is not waterlogged during the study	<i>Cynodon dactylon</i> (Bermuda grass) and <i>Sporobolus diander</i>

2.3 Habitat use and Preference

The number of flocks of the Sarus Cranes observed in each habitat type was divided by the total flocks observed during the survey regarded as habitat usage. To find out the habitat preference the relative index known as Ivlev's electivity index (s) was used^{13,14,34}. The habitat electivity index was determined by using the formula $s = (a - b)/(a + b)$, here 'a' represents the fraction of the flock that uses a particular habitat and 'b' represents an area of the habitat as a proportion of total available habitat. The value of this electivity index ranged from -1 to +1¹³. The negative value of electivity index indicates habitat avoidance and the positive value represents exclusively used habitat by these birds. Whereas, the '0' value reflects the used habitat according to the availability of that habitat. The seasonal habitat preferences of the Sarus Crane were also considered during this study.

2.4 Current threats to Sarus Crane

A threat matrix has been developed for the species; it lists the principal threats and scores for the severity of threats given based on three categories²¹;

Scoring for the severity of threats to Sarus Crane: **3 = Lesser threat** – a factor that did not have any critical or significant impact on the species; **2 = Significant threat** - factors that were not solely responsible for the species' population reduction; **1 = Critical threat** - a major factor in the decline of the population size. Various threats to their nests and eggs were identified using a trapping camera (Cuddyback) which was placed 7-8 feet apart from the nest during the breeding season. Based on the findings, appropriate conservation measures and recommendations were proposed.

3. Results

3.1 Habitat use and preference

A total of 329 flocks of Sarus Crane were observed during the study. In total, 171 flocks were observed in agricultural land followed by marshland (147) and grassland (11). Sarus Crane showed a high proportion of agricultural land usage in the winter and autumn seasons, but varied habitat uses patterns for marshland and grassland (Table 2 and figure 2). A single flock of Sarus Crane was found in a village pond during the breeding season. As a result, the pond habitat was considered unavailable or unused, and it was excluded from the analysis.

Results suggested that these birds strongly preferred agricultural areas ($s = +0.18$; positive selection) and avoided grassland habitats ($s = -0.22$ and -0.53 respectively; negative selection) (Table 2). Sarus Crane, on the other hand, avoided marshland in the winter and autumn but had a seasonal preference for this habitat that changed with the seasons. Sarus Cranes avoided marshland but exhibited a strong preference during the spring and summer season, even higher than that of agricultural land (figure 2). There was a significant difference in the utilization of agriculture ($f = 5.094$, $P=0.009$) and marshland ($f = 5.857$, $P=0.005$) habitats in different seasons. However, the Sarus Crane utilized the grassland habitat randomly ($P>0.05$).

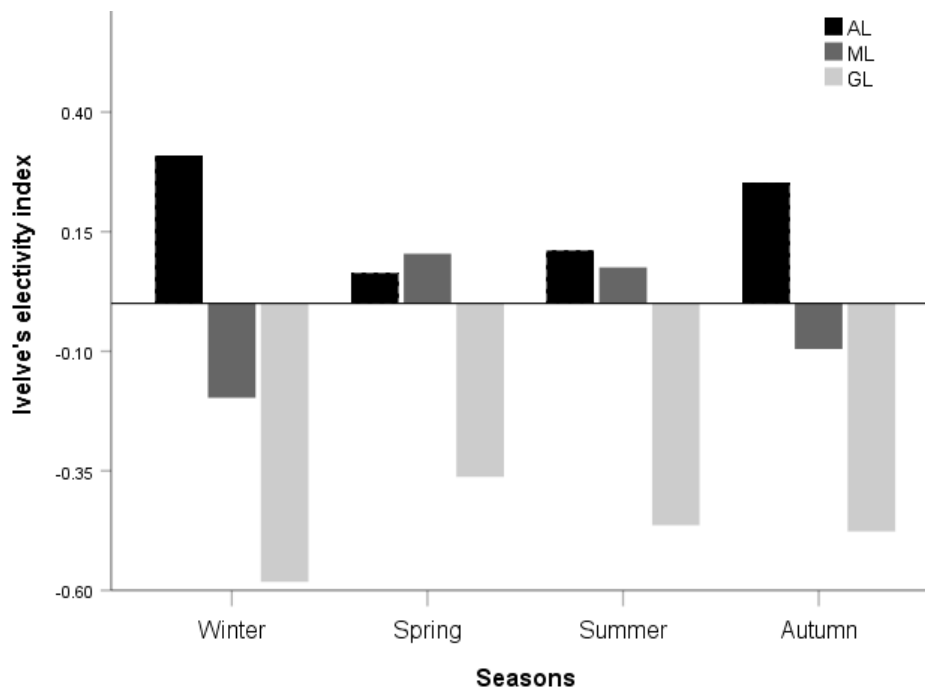


Figure 2. Seasonal habitat preferences of Sarus Crane in Gurugram, Haryana, India. The positive and negative value of electivity index (s) indicates habitat preference and avoidance, respectively.

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Table 2. The area of each habitat in which Sarus Crane was recorded in Important bird areas of Gurugram along with the percentage availability of each habitat, number of observed Sarus Crane flocks, and the percentage of each habitat used by the Sarus Crane (based on observations).

	Habitat type			
	Agricultural land	Marshland	Grassland	Total
Area (ha)	988.6	1247.3	252.6	2777.2
Habitat availability (%)	35.59	44.90	9.09	100.0
No. of Sarus Crane flocks	171	147	11	329
Habitat use (%)	51.97	44.68	2.73	100
Ivleve's electivity index (s)	0.18	-0.22	-0.53	-



Image 1. Pairs of Sarus Crane in agricultural land. © Harsh Gulati



Image 2. A flock of the Sarus Crane in the marshland of the study area. © Harsh Gulati

3.2 Current threats to Sarus Crane

In this study, the main challenges to the survival of Sarus Cranes included predation (especially by jackal and feral dogs; image 3a and 3b respectively), habitat destruction, cattle grazing, powerline collisions, and intense use of pesticides in farmlands. During the survey, wetlands were observed as a source of irrigation in the area of Basai wetland and Najafgarh Jheel. The destruction of Sarus Crane eggs by Jackal was reported in Sultanpur National Park during the data collection (Image 3a). The locals reported that 2 individuals of Sarus Cranes were killed by collision with high tension power lines in the study area (per comm). Running across their breeding territory, cattle were found to be a major threat to the eggs and nests of the Sarus Crane. Frequent flooding in the Najafgarh Jheel area posed a serious threat to their nests resulting in low nesting success. Among 18 eggs recorded, 7 eggs were found destroyed. Four eggs were found to drown due to a sudden increase in water level. The cause of the destruction of the two eggs in the study area was uncertain. One active nest with a clutch of 1 egg was found to be damaged by nilgai (*Boselaphus tragocamelus*). Farmers frequently used contaminated water directly for irrigation from the Najafgarh drain resulting in the reduction of food supply due to the intense use of pesticides on agricultural land. Results of this study suggested that the Sarus Crane along with other creatures facing high pressure of habitat destruction in Basai wetland, Gurugram. Conversion of agricultural land and marshland to deeper water bodies should be avoided because these birds never used ponds in the study area. The conversion of agricultural land to other habitats was also unfavorable for the Cranes because they strongly preferred agriculture and marshlands. However, during the study period, few activities have been implemented at the village level to raise awareness about the importance of habitat for the conservation of Sarus Cranes.

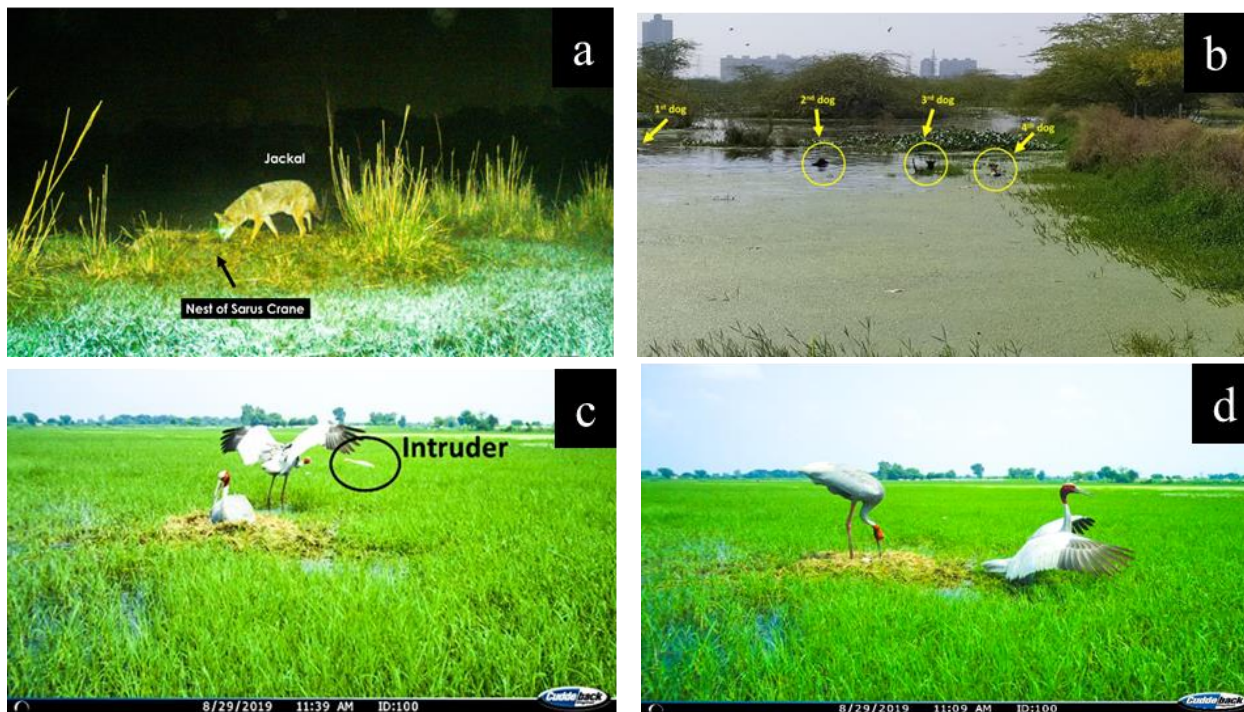


Image 3. Threats to Sarus Crane were recorded using cuddy back camera traps (a) Jackal searching eggs on the nest of Sarus Crane in Sultanpur National Park; (b) Feral dogs searching the eggs in the Basai wetland; (c) Intruder coming inside their territory; (d) Male protecting his nest from a predator.

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Table 3. Types and Severity of threats to Sarus Crane in the study area. Scoring for the severity of threats to Sarus Crane, *Grus antigone*; Capital letters (B, S, N) in superscript indicates threats in different sites; B=Basi wetland, S = Sultanpur National Park, N = Najafgarh Jheel Bird Sanctuary.

S. No.	Type of threat	Resulting stress on Sarus Crane	Level of threat
1	Conversion of wetlands	Habitats unsuitable for nesting, feeding, roosting	1 ^B
2	Overexploitation of wetland resources	Disturbance of Cranes, reduced habitat quality, or food resources	1 ^{BN}
3	Change in agricultural land use	Interference with feeding/breeding on agricultural lands, reduced food resources, increased exposure to agriculture poisons, or human disturbance	2 ^N
4	Increase in water level	Egg destroyed, poorly developed embryo	2 ^{BSN}
5	Drought & desertification, especially related to climate change	Reduced food supplies, increased vulnerability of nests & chicks to predation	2 ^N
6	Collision with Powerlines	Mortality	2 ^N
7	Urban expansion & land development	Reduced nesting and foraging habitat, increased human disturbance	2 ^B
8	Invasive species	Decreased quality (or loss) of important habitats due to reduced food resources, roost and nesting sites, increased risk of predation	2 ^{BN}
9	Predation	Often associated with habitat changes — reproductive failure, population impacts for rare species	3 ^{SN}
10	Pollution & environmental contamination	Impacts on habitat quality (food sources), reduced health or reproductive fitness, increases in mortality	3 ^{BN}

“3 = Lesser threat (has been, or has the potential to be, a detrimental factor in some localities or for some populations, but not with a significant or critical impact on the species as a whole)

2 = Significant threat (has been, or has the potential to be, an important though not leading factor in the decline of the population size and/or restriction of the species' range)

1= Critical threat (has been, or has the potential to be, a major factor in the decline of the population size and/or restriction of the species' range)”

4. Discussion

This study concluded that the Sarus Cranes utilize diverse habitats in different ways based on our findings and those of previous habitat studies^{9,19}. We found that these birds exhibit high dependency on marshland in Sultanpur National Park probably due to the healthy wetland ecosystem. The Sarus Cranes in this study, on the other hand, preferred agricultural land¹⁷ over marshland around the Basai wetland. This is most likely due to the sufficient availability of food in the agricultural area as compared to marshland and grassland²⁰. The very high proportion of agricultural land in the Najafgarh Jheel area provides suitable habitat and forced these birds to migrate there from the Basai wetland. However, the Sarus Crane also showed a high proportion of marshland use during the spring and summer seasons. This is most likely due to an increase in behaviors such as unison calling, displaying, and dancing during the breeding season¹⁸, which was accomplished to establish their breeding territories. Moreover, spring plowing (February and March) may cause these birds to migrate away from agricultural land resulting in intense use and preference for marshland. During the present study, the socialization of the Sarus Crane was also recorded in the marshland

habitat¹⁹ as shown in image 2. Marshland may be considered the most suitable feeding habitat for Sarus Cranes due to the soft surface for probing and sufficient food availability with minimal human access^{19,20}. Agricultural land has a sufficient amount of food and significant insect populations, yet it is considered an unsuitable habitat due to intense human activities^{19,20}. Meanwhile, Sarus Cranes make extensive use of agricultural land across the Najafgarh Jheel Bird Sanctuary in Gurugram, and it can be considered a diverse foraging habitat throughout the winter. Grassland is the least effective Crane habitat probable due to the limited food options and tough ground surfaces^{19,20}.

The primary habitat of these birds is threatened by various human activities, including pollution, overexploitation of biodiversity, and habitat destruction²⁵. Several challenges to the survival of Sarus Cranes were observed during the study. The Sarus Crane in the Basai wetland faced the greatest threat from the conversion and degradation of wetlands²⁵. The findings of a recent study by Sundar (2000) and Aryal and co-researchers (2009) revealed that collisions with electrical wires harmed 20% of the Sarus Cranes in India. Being a large-sized bird, their huge body encounters the wires which may lead to the death of these birds¹⁰. Questionnaires revealed that one Sarus Crane died at village Budhera as a result of a collision with high-tension electricity. Several studies reported that breeding failures can be attributed to human disturbance of nests or theft of eggs and chicks^{10,11}, however, incidents of egg or chick theft were not observed from any type of habitat in the study area. The nests of these birds were submerged and their eggs washed away when the area was suddenly flooded⁵. Similarly, a rapid rise in water levels was responsible for the flooding of the nests of these birds in Sultanpur National Park and Basai wetland during the breeding season of the study period. It was reported that feral dogs, black kites (*Milvus migrans*), jackals (*Canis aureus*) have been found to attack their eggs whereas, nilgai (*Boselaphus tragocamelus*), cattle are the major threats in the study area. Predation, especially by the Jackal (*Canis aureus*), was the primary cause of death of these birds⁵. Jackals were reported to attack the chicks during feeding in their nesting sites in Sultanpur National Park. These Important bird areas support a rich diversity of flora and fauna, including a variety of water birds. Our study indicates that Sarus Cranes mostly prefer agricultural land near Basai wetland and Najafgarh Jheel Bird Sanctuary wetland because it is the least disturbed habitat protecting their nests and progeny from predators. Due to the ever-increasing urbanization, some other water bodies, that Sarus Cranes may visit, have become unsuitable for nesting during the breeding season. This alarming situation is an eye-opener for the state administration and people in general. Conservation efforts, including educational, community, and government-aided programs, are critically needed for the species²⁴. These activities are crucial for the conservation of Sarus Crane since they take place mostly in private and communal areas^{26,27}. However, limited efforts have been carried out to spread awareness for the conservation of these birds³², and no initiative has been carried out to support local people to participate in the Sarus Crane conservation program in the past. However, during the study, few activities at the village level (named as SAVE SARUS mission) have been implemented to raise awareness for the conservation of Sarus Cranes³².

Some initiatives to consider are as follows:

1. Water hyacinth (*Eichhornia crassipes*) might be used as a biofuel as well as the bedding material for mushroom farming⁶, providing an effective commercial use for the weed. This would also increase the state's revenue in addition to creating local jobs.
2. Before releasing sewage water into the wetland habitat, it must be treated. It will help to enhance water quality which can be reused for irrigation. This will help to protect the water bodies from contamination.
3. For the habitat conservation of Sarus Crane in India, Meine and Archibald (1996) advised that wetland protection should be integrated into village-based awareness programs.
4. In view of this finding, it is proposed that regular monitoring of alterations should be carried out to maintain the natural vibrancy of the valuable natural resources of marshlands in Haryana.
5. The findings of this study indicated that it is feasible to re-build a relationship between the Sarus Cranes and farmers and work on community involvement for the conservation of the Sarus Crane with the participation of more districts of Haryana.

6. At the grass-root level, village-based education programs and other local developmental programs should be helpful in creating an ambiance for improving the situation.

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Conflict of interest

The authors declare that they do not have any conflict of interest.

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